DiverBeans

SUMMARY OF THE SECOND WORKSHOP HELD IN NORTH MACEDONIA

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Background

Common bean (*Phaseolus vulgaris* L.) is a crop that is traditionally grown and widely consumed in North Macedonia. Despite its cultural and economic relevance, total bean production has reduced by about 30% in the last ten years. Many environmental, social, and economic factors hamper bean production in the country. The DiverBeans project aims to improve organic bean production in North Macedonia. This project is funded by Coop (through ETH Foundation), a retail and wholesale market company in Switzerland. Coop has been buying organically produced 'Borlotti type' beans from one of the project partners, Suzana Dimitrievska, in North Macedonia since 2016. They are interested in increasing the quantity of 'Borlotti type' beans that they can import for the Swiss market. Effective implementation of the project requires involvement of multiple stakeholders and therefore, the project has adapted a transdisciplinary approach from the outset.

In September 2019, we held our first stakeholder workshop in North Macedonia. The aim of this workshop was to understand the situation and challenges faced by bean farmers in the country. Through this workshop we found that water limitation, strong sunlight and weed pressure were the main environmental limiting factors of bean production. In addition, we found that farmers usually use sprinkler irrigation system to irrigate bean plants. One solution we proposed to counteract these challenges is intercropping, which is growing of two or more crops in the same piece of land at the same time. The second solution we proposed was to replace sprinkler irrigation with drip irrigation system as it results in more efficient water usage. After the first workshop we decided to choose those additional crop species that would potentially mitigate the effects of the determined environmental limiting factors on the yield of beans.

First, we conducted a greenhouse experiment at ETH Zürich to screen for drought resistant 'Borlotti type' bean varieties. Through this first experiment we selected three Italian varieties. In a second greenhouse experiment, the three chosen Italian varieties were mixed with three additional crop species (sunflower, chickpeas, and sorghum) in different crop and variety mixtures. The aim was to select bean variety and crop mixtures that are drought tolerant and that result in higher bean yield. Through this second experiment we have now selected variety and crop mixtures that we would like to trial in farmer fields in North Macedonia.

Workshop objective

The aim of the workshop was to disseminate the results of the previous greenhouse experiments to our project partners and to share the potential layout of the planned field trial. We further wanted to understand the challenges associated with our proposed solutions and the planned trial. Discussions on these challenges and solutions were finally used to collaboratively design the field trial.

Workshop participants

Due to limitations in North Macedonia on the number of people allowed to gather, we had a hybrid meeting where five participants joined personally, and the rest joined virtually. Due to this limitation we could only invite two farmers for the workshop who are our main partners. The workshop participants were:

- The principal investigators: Christian Schöb (Agricultural Ecology group, ETH Zürich), Pius Krütli (Transdisiciplinarity Lab, ETH Zürich) and Pietro Iannetta (Ecological Sciences, The James Hutton Institute).
- Akanksha Singh (Agricultural Ecology group, ETH Zürich, the project coordinator)
- Suzanna Dimitrievska (one of the main collaborator farmers of the project). Suzana is the owner of Eko-llinden farm and has been supplying beans to Coop since 2016. We will be conducting one of the field trials in Suzanas' farm.

- Mirjana Jankulovska (our local scientific collaborator from the Faculty of Agricultural Sciences and Food, Ss Cyril and Methodius University in Skopje). Mirjana is responsible for providing different accessions of local bean varieties.
- Fidanka Trajkova (local scientific collaborator from the Goce Decev University - Stip). Fidanka will be responsible for coordinating the field trial data collection in 2021.
- Ljupcho Vasilev (one of the main collaborative farmers of the project). We will be conducting one of the field trials on Ljupchos' field.
- Gabriela Micevska (representative of Palladium, an international development foundation supporting sustainable businesses in North Macedonia).
- Annina Böhlen (Representative of Coop in North Macedonia).
- Nadine Stähli (Transdisciplinary Lab, ETH Zürich). Nadine is conducting her master thesis as part of the project. She aims to understand the drivers and barriers of adoption to organic and diverse agricultural practices.
- Sasha Arsov (Bachelor student in Goce Decev University - Stip). Sasha is a student assistant who is helping Nadine with translations during her field work in North Macedonia.

Workshop Structure and Activities

The workshop was conducted on the 12th of January 2021. We first presented the results of our greenhouse experiments to all the attendees. We shared the list of crop combinations that we would like to trial in the fields in North Macedonia and we also shared the potential layout of the field trial. After this we conducted two brainstorming exercises for which participants were divided into three groups. The aim of the first exercise was to determine challenges and opportunities associated with the planned field trial at the farm production level. Aim of the second exercise was to determine solutions or potential alternatives to the challenges outlined through the first exercise. In both exercises we encouraged the participants to reflect on our proposed solutions as well. For both exercises, participants were told to first think individually about the questions before discussing them in their groups. Afterwards each group was asked to present a summary of their discussions.

Proposed field trial plan

The field trial will occur in two different regions in the fields of our main collaborative farmers. One trial will be held in Suzanas' farm in the Mustafino region and the other will be held in Ljupchos' farm in the Gevgelija region. The combinations that were the most productive in our greenhouse trials and the ones we will trial in the fields are: (a) Bean variety *Sassorosso*+Sorghum, (b) Bean variety *Sassorosso*+Chickpeas, (c) Bean variety *Sassorosso*+Bean variety *Taylors* and, (d) Bean variety *Sassorosso*+Chickpeas+Sorghum. In addition, we will also plant monocultures of each of the crops to test how each of the crops perform in crop mixtures compared to their respective monocultures. This will give us 8 crop combinations in total. We will further trial each of these combinations under three irrigation treatments: (a) Drip irrigation system with no water stress, (b) Drip irrigation system with drought stress and, (c) sprinkler irrigation system. By including both sprinkler and drip irrigation system, we will be able to demonstrate the effects of efficient water use on bean production. Overall, we will have 24 experimental treatments in the field trial (8 crop combinations*3 irrigation treatment). Figure 1 represents our field trial layout. Part of the field trial area was left unplanned. This was done to allow farmers to decide other combinations or treatments that they would like to try.

The sub-plots in the trial will have an area of 16m^2 (4*4 mts) and all sub-plots will be separated from others by 2 meters on all sides. Each sub-plot will have ten planting rows. Layout of the planting rows in crop mixture sub-plots can be seen in Figure 2.

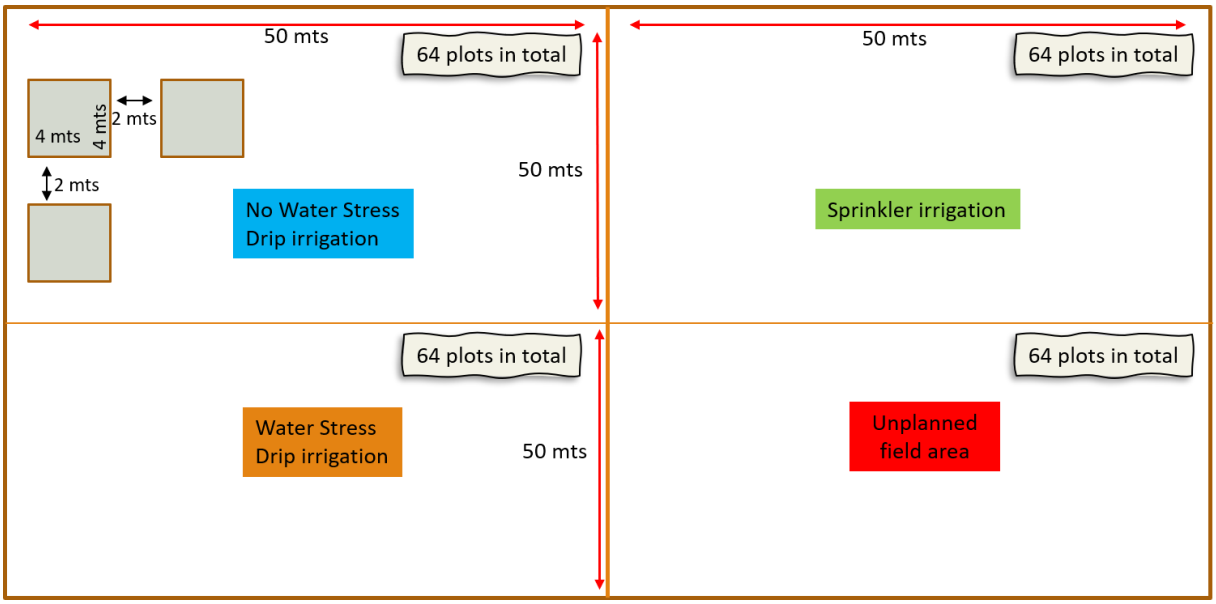

Figure 1: Potential layout of the field trial

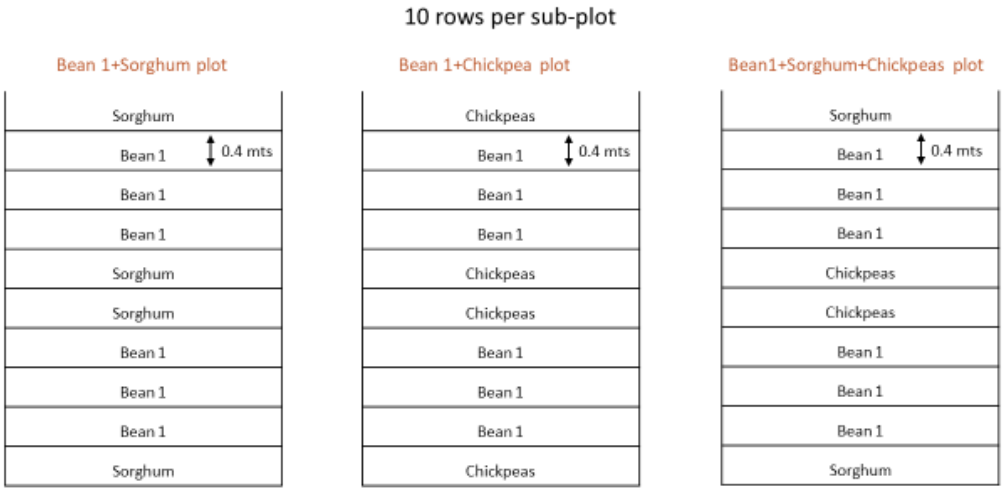

Figure 2: Layout of planting rows in crop mixture sub-plots

Summary of Workshop Discussions

Below we list the challenges that were determined in the workshop and the discussions or potential solutions associated with each of these challenges. The discussions were focused based on the bean farming regions of Mustafino and Gevgelija where the trials will be conducted.

1. *High cost of investment in drip irrigation*: For the trial, the project will provide financial assistance for installation of the drip irrigation system. However, if the solution is adapted, it is the farmers who would cover such costs in the long run. We discussed that as drip irrigation leads to higher water use efficiency and removes the cost of labor needed to move the sprinkler irrigation device in the field; this may compensate for the initial investment in such a system. We will be collecting data on economic parameters in our trial to test the profitability of this drip irrigation based solution.

2. *Chosen bean varieties may not be adapted to the climate in North Macedonia:* Our field trial should provide us more information regarding how our chosen varieties will perform. We could not select local Macedonian 'Borlotti type' bean varieties for our project. We were unable to acquire sufficient quantity of seeds for local 'Borlotti type' beans because it is not cultivated for commercial use and is only cultivated for self-consumption by the farmers. Instead, 'White type' bean varieties are more

widespread in North Macedonia and are cultivated for commercial use. For some local 'borlotti type' varieties, our local partners were only able to derive as low as 30-50 bean seeds per variety from the farmers. To counteract this challenge, we decided to run an additional small trial on our field sites using local 'borlotti type' varieties (only in monocultures). This will help us in estimating the performance of these local varieties and to further propagate their seed numbers.

3. *No market for Sorghum in North Macedonia and birds are known to eat Sorghum in the fields:* This was another main challenge associated with our proposed solutions. We had chosen Sorghum to be included as the additional crop because it is (a) drought tolerant, (b) has a low nutrient demand compared to cereals such as wheat or maize, (c) has the potential to reduce weed pressure; it is well-studied that including cereals in crop mixtures can reduce weed pressure and, (d) has the potential to reduce sunlight and wind pressure on bean plants as it is a tall plant. In our previous experiment bean yield was recorded to be the highest when beans were grown with Sorghum for all bean varieties. With all these potential benefits in mind, one of our collaborative farmer decided to trial sorghum associated mixtures in her field irrespective of no current market opportunities. She also suggested to use sorghum as animal feed. Our local partners further suggested that we should test mixtures of beans with local maize varieties in an additional small trial. Maize is widely consumed in the country and there are a few farmers who practice bean-maize intercropping. Maize is a nutrient and water demanding crop and several studies have found bean yield to decrease in the presence of maize. This was the reason why we had not included Maize in our previous experiments. However, effect of maize on bean yield may vary across different maize varieties. This will be an interesting aspect to test in a small field trial.

4. *Incorrect sowing time:* Traditionally beans have been sown in early April in the Mustafino region of North Macedonia. In the past few years with the changing climate, this period has become too cold for sowing of bean seeds. However, farmers have not adapted to this change because they fear that if they sow later, the bean flowers may get damaged due to strong sun and wind conditions that occur in the months of July and August. The farmers were interested in trialing two different sowing times (early and late). Hence, for the 'unplanned field area' of our trial we decided to trial late sowing of our chosen crop mixtures under the irrigation treatment 'Drip irrigation system with no water stress'.

5. *High labor cost:* Rising labor cost is a systemic issue in North Macedonia. Higher prices obtained by selling organically certified products, potentially lower prices of inputs associated with agroecological farming and, profit from selling additional crops, will potentially make up for the high labor cost. Deeper investigation of this issue is beyond the scope of the project, although we will be recording labor cost across our different treatments for the socio-economic analysis.

6. *Forming a farmer cooperative can be difficult:* Forming a farmer cooperative would be beneficial for several reasons: (a) for obtaining of an organic certificate, which is usually expensive for a single small-scale farmer, (b) several NGOs and farming institutes provide funding to cooperatives and not to individual farmers, (c) for procurement of harvesting and processing machinery and, (d) for better dissemination of results and knowledge exchange. From the experience of our local partners, it is usually difficult to convince farmers to form a cooperative, potentially due to lack of trust in institutions in general. We plan to hold a demonstration event during the field trial where we will invite local farmers to observe the results in real time. This could potentially motivate farmers to be involved in knowledge exchange for the project. In addition, during the event we will also invite the representatives of coop and other funding bodies to directly meet with the farmers and discuss with them funding options associated with cooperatives. Finally, our two main collaborative farmers are building their own farmer networks which may ultimately assist in development of cooperatives.

Future Outlook

Overall, the workshop was beneficial in addressing the concerns associated with our trial and our proposed solutions. We will now trial our chosen crop combinations with the respective irrigation treatments (as shown in figure 1 and 2) in only one field in the Mustafino region. In the unplanned area in this field (Figure 1) we will trial 'late sowing' of our chosen crop combinations as mentioned above. The early sowing will probably occur at the end of April and the late sowing will probably occur at the end of May.

We will also obtain some local 'Borlotti type' varieties and grow them in Mustafino in a small trial to test their performance in the region and to propagate the seed material. We will also trial mixtures of common beans with local maize varieties in the same field in a small trial.

In the other field in the Gevgelija region we have chosen the following additional crop mixtures that the farmers are interested in testing: (a) Borlotti variety *Taylors* monoculture, (2) Local white bean variety monoculture, (c) Local kidney bean variety monoculture, (d) Borlotti variety *Taylors*+Kidney bean, (e) Borlotti variety *Taylors*+White bean, (f) Borlotti variety *Taylors*+Sunflower, (g) Borlotti variety *Taylors*+Watermelon, (h) Borlotti variety *Taylors*+Soybean, (i) Soybean monoculture, (j) Watermelon monoculture and, (k) Sunflower monoculture. The farmers chose these additional crops and bean types mainly because these have a local market in the country. Each of these mixtures we will try with early sowing and late sowing. Similar to Mustafino, we will have plots that are 4*4 meters in size. There will be 2-meter distance between plots on all sides (Figure 3).

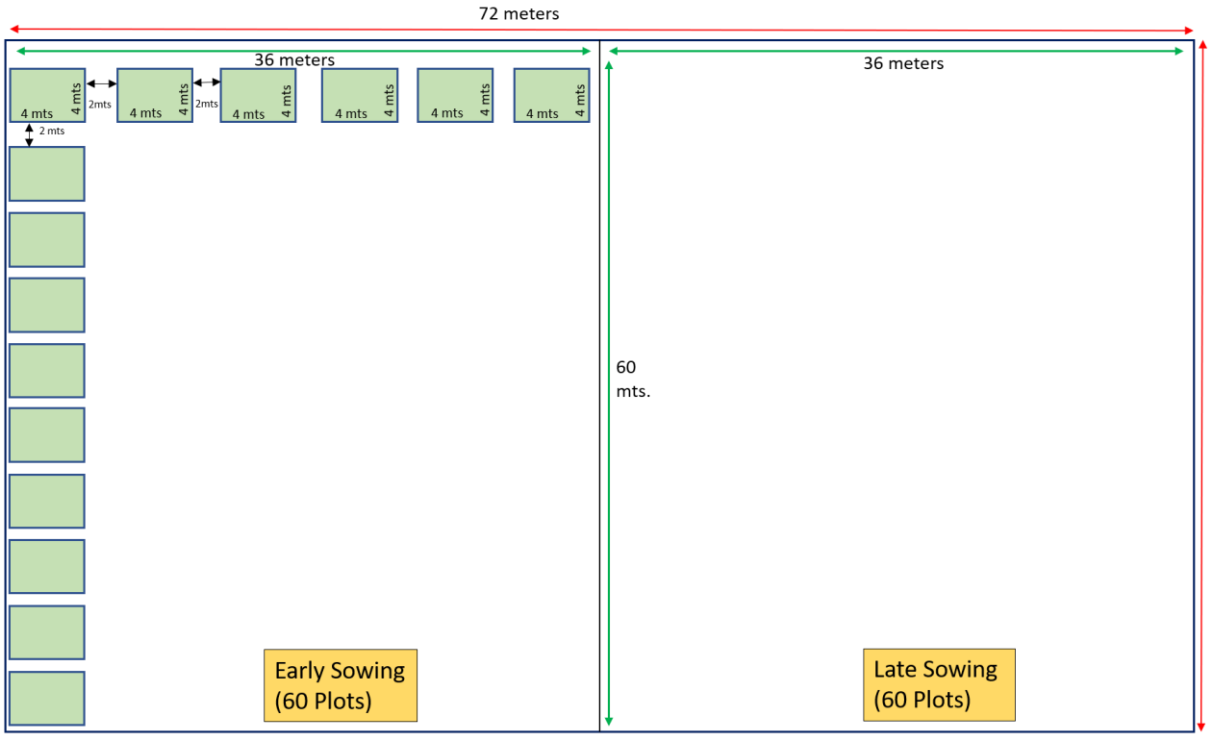

Figure 3: Layout of the field trial in Gevgelija

We will collect data on multiple ecological and economic parameters during the trial. Student from the local universities will be involved in data collection. When the bean plants start to yield fruits, we will also hold a demonstration event to show farmers results of the trial in real time.

Forming of cooperatives can be beneficial for the farmers and for dissemination of solutions of our project. Two of our main farmers have already started building farmer networks in their regions and this could potentially help in cooperative formation in the long run. If our trial results in high bean

yield, the demonstration event should also encourage farmers to be involved in information exchange. We have decided that development of such information exchange groups and cooperatives is one of the aspects that the project will focus on in 2021.