GUIDE BOOK

PARTICIPATORY ON-FARM RESEARCH FOR ORGANIC FARMERS

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1. Introduction

The Leonardo Da Vinci project of the European Union provided financing for professional training and re-skilling by international cooperations. The Leonardo project supports and extends the vocational training policy of the EU. It supports participants by coverring travel and lodging costs for participants, to allow participants to study methods used by the different partners and countries. The international project “On Farm Education towards Organic Farmers (OFEOF)” was run by four institutions from four European countries: Institute for Organic Agriculture Luxembourg (IBLA), Research Institute of Organic Agriculture (FiBL Austria), Bioinstitut Czech Republic and Hungarian Research Institute of Organic Agriculture (ÖMKi Hungary). The aim was to share knowledge and experience to improve organic production and strengthen collaboration between science and practice.

This guidebook was continuously prepared during the OFEOF project (2013-2015). We gathered knowledge and experience in various countries in order to compile best practices in the field of on-farm educational and research activities. During numerous visits to farms and also during all the discussions between farmers, researchers and advisors, we only affirmed our expectation: successful development of organic farming is based on participative approaches and needs to be directly connected to the place and people where production is happening - the farms. Many concrete examples of good practice from Luxembourg, Hungary, Austria or the Czech Republic show that successful research projects are those based on close cooperation between farmers and researchers under “real-life conditions”.

In a participative research approach farmers play an active role in the research design. Participatory research builds cooperation that creates strong connections between experts, scientists and the farmers. Even though the participative approach is often more or less included in the projects, it is often not a conscious and conceptual part of them. The organic sector was early to recognize the importance of this approach, and continues to explore its various dimensions.

This guidebook describes basic aspects of participatory on-farm research, presents literature on traditional research methods as well as on on-farm experimentation methods that combine science, education and networking. It also includes information on how to successfully plan and start participative activities on-farm and how to choose the right partners for a good project.

2. Participatory on-farm research: a definition

On-farm research is a type of research where the experiments are carried out on farms under real-life conditions with the original production goals set by the farmers. The relatively simple experiments are planned together with the farmers who play an active role in the project. The farmers who take part in the research get information directly about their own land cultivated with their own technology. More than one farm, often with very different circumstances, is involved for each research topic, so that the results can provide a broader view on organic production practices and on the applicable solutions for a specific practical problem.

The main advantage of participatory on-farm research is the cooperation between the different actors of the sector. Choosing the research topic, the execution, the analysis and the discussion of the results, all create a strong connection between the scientists, advisors and the farmers. Regular meetings, on-farm events, tastings and workshops provide opportunities for community development among farmers. Discussion between the participants helps to make the professional information become more available for all while sharing experiences multiplies the participants' competences.

In Western Europe and North America, on-farm research plays a significant role in supplying farmers with best practices and in the development and propagation of innovative methods. In the framework of the Sustainable Agriculture Research and Education ("SARE") programme by the US Department of Agriculture, an on-farm research network was already established in 1970. This research method has also spread to Europe long ago and has become a basic development tool for organic research institutes like the Dutch Louis Bolk Institute, British Elm Farm Research Centre, or the Norwegian NORSOK. The Swiss Research Institute of Organic Agriculture (FiBL Switzerland) has successfully shown the connection between research and practice by several on-farm research projects and by publishing many related practical guidelines

during the last 40 years. The method became so successful that other countries also adopted its principles. In Austria an on-farm research network, called Bionet-AT, has been initiated in the framework of the National Rural Development Programme with participation of FiBL Austria, the Austrian Agricultural Chamber, BIO AUSTRIA organic fellowship, agricultural universities, and of course the farmers. In Hungary, experiments conducted on farms have a long tradition. However participatory on-farm research was not applied on organic farms in the country before 2012, when ÖMKi was established and began with scientific experiments on organic farms in Hungary. In the Czech Republic on-farm research has been basically based on cooperation of individual farmers and research institutions or universities. For last couple of years new projects appear that include a participative approach. Also there is a new network for on-farm research and education inspired by Austrian model called BIONET CZ. In Luxembourg, agricultural research is only done on-farm, however, research for organic farming, and as such participatory on-farm research for organic farming, only began in 2009.

3. How to plan and execute participatory on-farm research?

Literature review on on-farm trials design.

The concept of conducting on-farm research is in itself not new; many farmers have routinely managed trials on their land for years. Traditionally on-farm experiments follow a scientifically-valid replicated research method (Veseth et al.1999). Results from such tests give contributions to improve (organic) production efficiency and farm profitability (Ketterings et al., 2012). However, in participatory on-farm research it is essential that farmers, researchers, and agricultural advisers cooperate from the very beginning of the trial design, as they can help each other in planning and realizing feasible and practical experiments (Sooby, 2001).

The project "Farming Systems Comparison in the Tropics", implemented by the Swiss Research Institute of Organic Agriculture (FiBL) addressed the participatory technology development (PTD) component of on-farm trials as “a specific problem of organic farmers, with the aim to develop innovative and adapted solutions in a participatory approach”. The PTD approach is presented also as a scheme in Figure 1, where one of the most important elements is farmer meetings and exchange visits. On such occasions farmers can discuss the success factors and the challenges of their experiments (FiBL, 2014). In contrast to research conducted on-station, under well-observed conditions, on-farm trials demonstrate influences of diversified environmental factors such as different plant populations, disease and pest effects, or soil types on a new agricultural practice, variety or system (Mason et al., 2002).

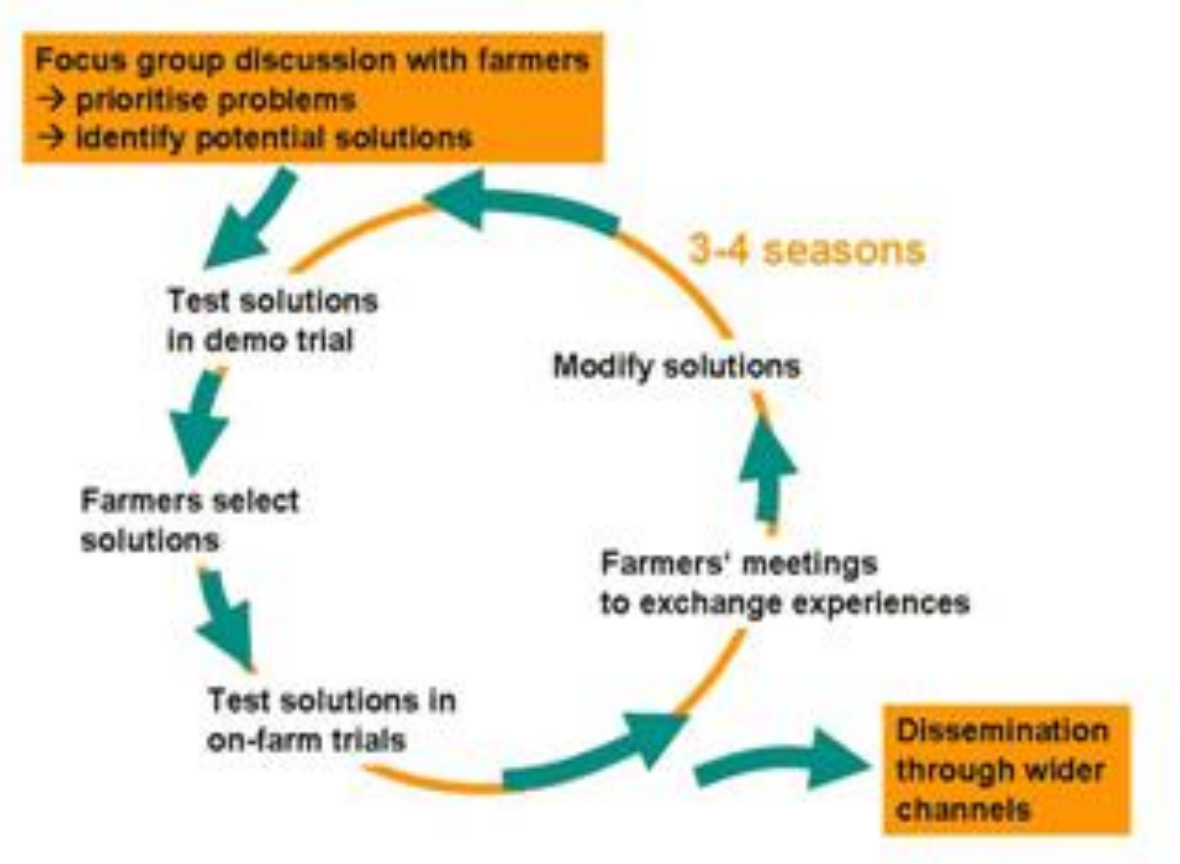

Figure 1: The participatory technology development (PTD) approach for on-farm trials, developed by the project "Farming Systems Comparison in the Tropics", FiBL 2014

3.1 DEFINING ON-FARM RESEARCH AIMS

As the first step, the relevant research questions need to be clarified and the hypothesis formulated. This has been exposed by Ketterings et al. (2012) and is visualized in Figure 2 (Murrell, 2013). Once it is clear which hypothesis should be tested, the trial goals need to be defined. These should include answering question on how the hypothesis will be tested, the optimum timing of planting, crop management, plot size, duration of the trial, and time needed for evaluation and interpretation of trial results (Colley and Myers, 2007). All this can be designed in collaboration with farmers, or established by researchers based on actual research questions and practical challenges of the participating producers.

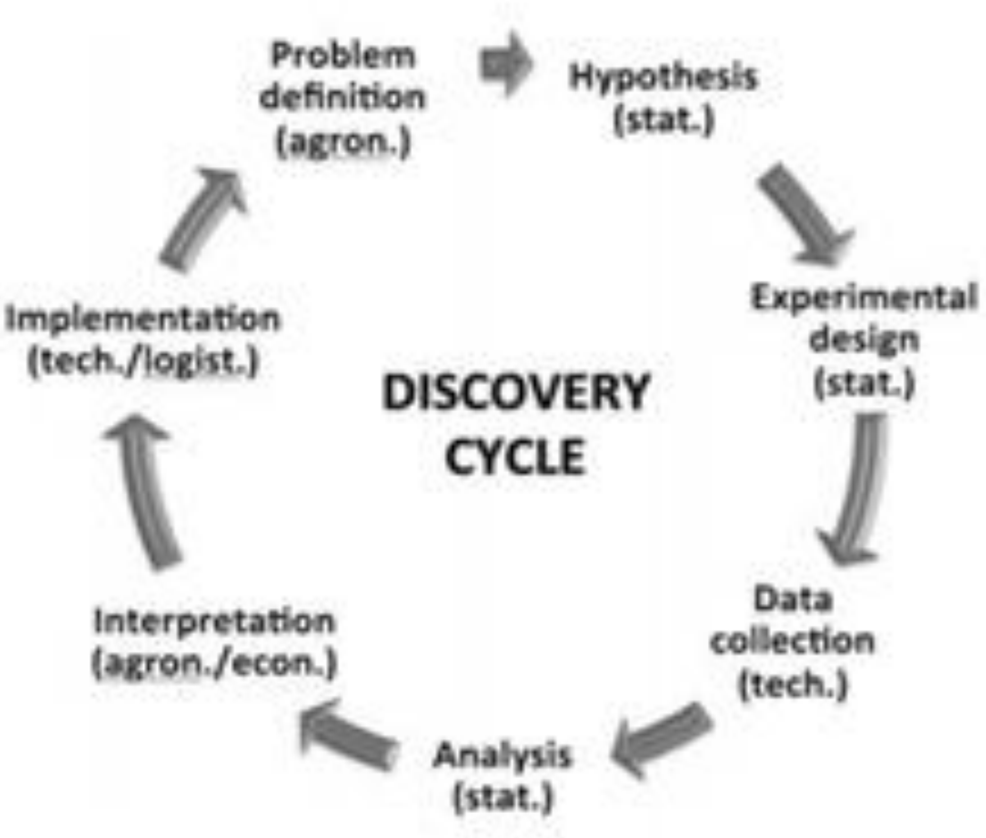

Figure 2: Elements of the discovery cycle with primary expertise (Murrell 2013).

Omer and Mahgoub (2014) as well as Meertens (2008) classified on-farm trial development into three types, based on the degree of the farmers' participation:

(1.) experimental design and management by researchers,

(2.) experimental design by researcher and management by farmers, and

(3.) experimental design and management by farmers.

The selected type of research approach is highly dependent on the farm's research capacity, the farmer's interest, the project participants' agreement, the research aims and the organization of the trial. However to make the project successful and scientifically valid, the researchers should assist farmers with the experimental design.

3.2 Planning participatory on-farm trials

Anderson (1993) mentions that the first and most important step in planning on-farm trials is to narrow down the idea or inquiry to its simplest form. The next step should be to define the trial implementation in detail: What will be measured and how? How will the data collection, evaluation and analysis proceed? And finally how will the trial results be utilized? The size and shape of trials depends on the topic being tested and the demand for machinery use. If results need to be published in a scientific journal, it is necessary to take statistical methods, replications and randomization into account.

When planning trials, it is important to keep a few basic principles in mind:

1) keep it realistic: address problems which are important to farmers,

2) keep it simple: test only one question with one experiment, limit the experiment to a comparison of two (or maximum three) treatments,

3) go step by step: try not to include too many new steps at once, and

4) remain objective: if results are not as expected, be prepared to accept and learn from the negative results (Meertens, 2008).

Replication and Randomization

Replication and randomization are important elements of on-farm experiments as they help to separate treatment effects from field effects (variation in the environment) through statistical data analysis (Colley and Myers, 2007). Therefore replication is a necessary tool to limit the external influences (weed population, fertility, soil, pests, diseases, field management, etc.). It also helps to explain if differences between plots (area of the trial with individual treatment/variety) are due to treatments/genetic differences between varieties or due to field variations (Colley and Myers, 2007). In statistics, field variation is called "error". Four replications are standard in scientific research and for on-farm research four to six replication are adequate for a Randomized Complete Block Design (Mason et al., 2002). Likewise Meertens (2008) and Ketterings et al. (2012) recommend replication of each treatment at least four times and each block (set of all tested treatments) should have also a plot without treatment included, called control. Anderson (1993) considers a minimum of six replications as adequate when treatments are compared in narrow stripes.

For so called ´observational stripe´ trials, designs with no replication within a farm are prescribed (Colley and Myers 2007). It is a simple system with larger stripes and no replication and no statistical evaluation. However this method is valuable for example for initial findings.

There are different ways how to do replications. One is that all plots are in the same location (multiple plots), or repetition of treatments is on different farms or in different years (multiple years). Usually it is preferable to involve more farms and have fewer replications of the same treatment-variety per farm, rather than have fewer farms and more replications on each individual farm (Meertens, 2008).

Randomization as the coincidental selection and order of varieties/treatments in the trial, means that every plot has the same chance to occupy any location (Anderson, 1993). The reason to perform a randomization of treatments is that the place of the treatment in the trial could have an influence on treatment effect (nutrients, shadow/sun, water, soil structure etc.) (Meertens, 2008).

It is not possible to completely isolate the trial from environmental variations on the farm but it is possible to eliminate their influence with replication, randomization and control treatments. This way, in statistical analysis, errors can be separated from actual treatment effects (Meertens, 2008). This chapter only gives some basic information, as detailed experimental design principles are handled in other publications.

3.3 Implementation of on-farm research

3.3.1 Choosing field and location

The ideal field and location for an experimental trial would be on a soil that is representative for the whole farm (texture, structure, fertility), with a uniform slope and drainage. Unfortunately, in practice, this is usually not possible and therefore there are therefore several things that need to be taken into consideration. If it is not possible to avoid a field with slope, rocky area or any other field disparities, the plots of the trial need to run in such a way that they are affected equally by the disparities (Anderson, 1993, Sooby, 2001). As an example, Figure 3 illustrates correct and incorrect orientation of plots on a slope. However, before laying out the trial, it is useful to create a map of the field, diagramming and marking any sources of variability (If available, use soil maps, e.g. maps of finance soil valuation), and to collect history information about the field use (fertilization, rotation, tilling, soil moisture, soil pH) (Mason et.al, 2002).

Any differences in soil type, irrigation type, disease or pest pressure that one is aware of, wind and sun direction and temperature gradients such as cold air drainages on a hill slope need to be marked on the map or an aerial photo. Blocks may be established on adjacent areas of the farm (replication by location), but, as was mentioned above, blocks should be placed in a manner that minimizes variability within them. Variability should also be minimized between the blocks as much as possible, but priority is given to providing uniform conditions within the blocks (Ketterings et al., 2012). Avoid placing trials in runoff areas, near fence lines or in field corners as these areas are often subject to multiple or irregular applications of fertilizers and other input materials (Meertens, 2008).

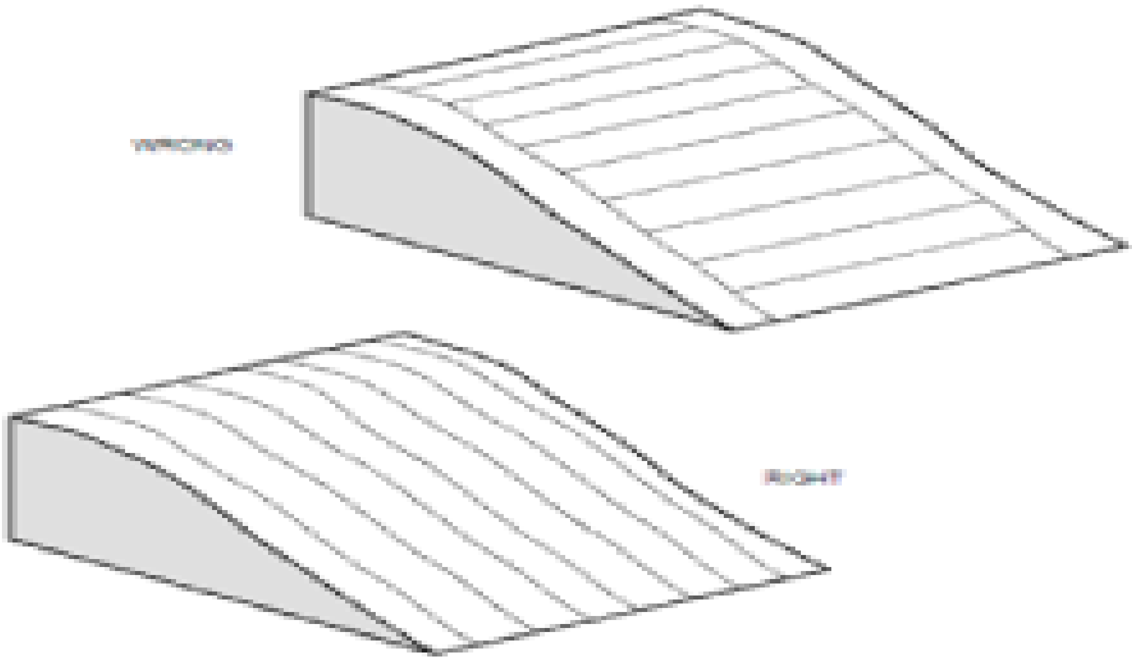

Figure 3: Slope with incorrectly (above) and correctly (below) orientated plots (Anderson, 1993).

If the field has two different soil types or conditions, arrange the plots at right angles to these conditions, as shown in Figure 4. Using the whole area for the experiment is only appropriate if the different soil conditions exist to the same extent across treatments and replications (Sooby, 2001).

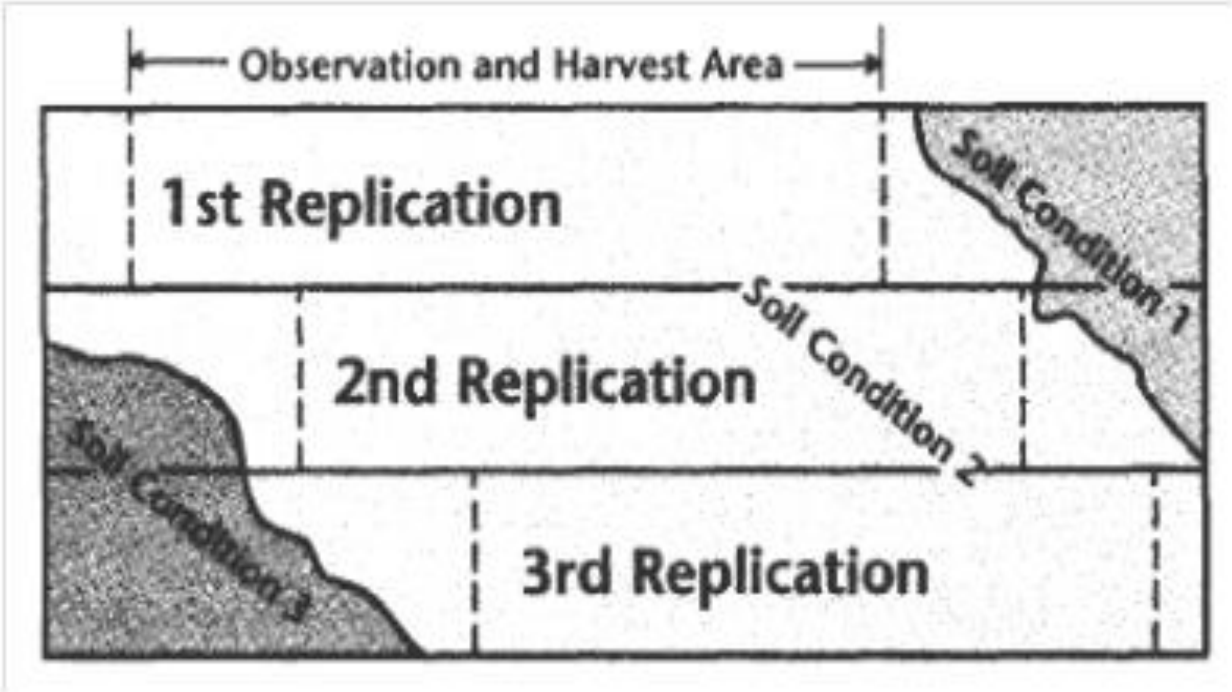

Figure 4: : Example of treatments located across three soil conditions. Observations and harvest samples should be taken from similar areas with the most uniform soil conditions. Harvest area is shown between the dotted lines in each replication (Havlin et al.,1990).

3.3.2 CHOICE OF EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS OF ON-FARM RESEARCH RESULTS

Design and analysis of a trial are dependent on each other. What kind of statistical analysis is suitable to interpret trial results depends on how treatments are investigated, what answers are demanded and, of course, on how many unwanted "noises" were present on the field.

In testing two treatments Soody (2001) mentions the *paired comparison* design, also called ´observational trial´, where easy statistical analysis, the Student's t-test, can be performed on the data to detect any significant differences. In the so-called single replicate on-farm test, four or more farmers establish a single replicate each to form, together one complete experiment with replications. A combined paired-comparison analysis over all farms may be conducted in this design. The limitation is that the field effects should be kept in mind as differences in performance of treatments could be rather due to variable field conditions than treatments (in variety trials: genetic or seed quality) (Colley and Myers 2007). The single replicate on-farm test can be used on a homogeneous field and is useful for developing recommendations about a variety or production practice for a broad production or climate area (Meertens 2008).

Most frequently a *randomized complete block* (RCB) design is used in on-farm trials for comparing several treatments. The plots can be applied in stripe form with a larger area or as small plots with few square meters (especially for variety trials). It is important that all known field variables are determined when implementing this design. Blocking does not help when variation in the field presents randomly, but can reduce error when variation runs along a gradient such as a slope, drainage, changing soil texture, or other factors (Figure 4). Though, the area within a block should be relatively uniform, there may be large differences between the blocks, but this is what makes blocking effective. The statistical test analysis of variance (ANOVA) is used to analyze the data from this design (Sooby, 2001).

Split plot model (Figure 5) is a more complex design and allows us to see how different treatments interact. The split-plot design looks at how different levels of a treatment interact with another set of treatments by applying sub-treatments over main treatments. Statistically speaking, sacrificing precise information on the main treatment for more precise measurements of the sub-treatments simply because the sub-treatments are replicated more times than the main treatments. Though fairly easy to set up in the field, analyzing the data can be somewhat complex because of the greater number of treatments. Adequately replicating a split-plot experiment takes much more space in the field. It is important to work together with someone knowledgeable in statistics before setting up a split plot experiment (Sooby, 2001).

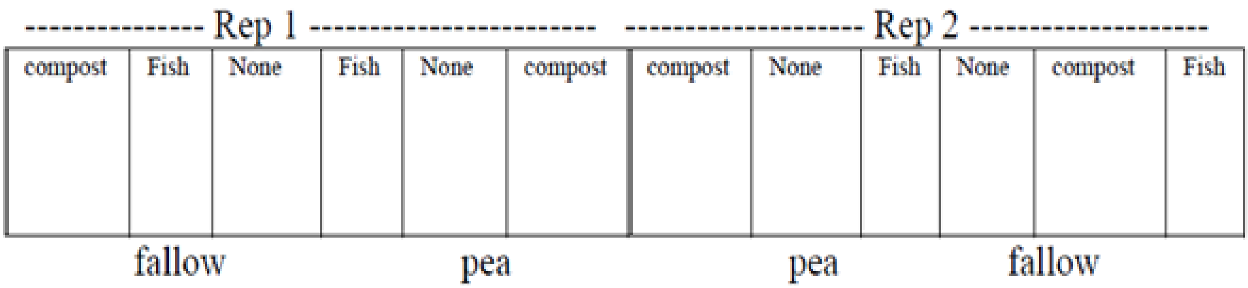

Figure 5: Split plot experiment with two main treatments (pea and fallow) and three split treatments (compost, fish and none) replicated twice. The fallow-none plots are controls (Sonny 2001).

Data analysis and interpretation can be challenging if the research project was not well designed and/or maintained (Nielsen, 2010). It is important to be objective when reviewing results. Much can be learned through discussion with the farm crew and interactive debate about what the results mean for an individual farmer and for farmers in the region (Ketterings et.al., 2012). Economic data can be included in the results and useful cost-benefit analyses of different farming practices may be generated (Sooby, 2001).

3.3.3 Plot size

Once areas and trial design are selected it is time to layout and mark the trial in a manner that will not be in the way for tractors and other equipment (Colley and Myers, 2007). On-farm trials should be 25-50% larger than normal research trials, and border rows are needed between the plots in order to reduce effects from neighbours (For example, in variety tests, a taller growing oat plant may overshadow a neighbouring barley plant, inducing an unusual growth spurt in the barley plant, as the plant is competing for sunlight. By including border rows between the different varieties that are being tested, such effects can be reduced) (Ketterings et al., 2012). Available machinery has important influence on plot size, as plot size needs to be adapted to the width of all the machines being used on the trial (plough, sowing machine, harvester etc.). Typically paired comparison trials are field length and one or two tractor passes wide (Sooby, 2001). In RCB, all plots from one block should be placed together with equal width and length.

However, Colley and Myers (2007) point out that the larger the plot, the more difficult it is to manage, especially if there are a large number of varieties and three or more replications. When varieties are being tested, it is important to consider the recommended minimal number of plants per plot to represent the population (Figure 6) (Colley and Myers, 2007). On-farm research targets "real world" fields that, by virtue of their larger size, are typically more variable than smaller fields used for small-plot research (Nielsen, 2010). Therefore, for preventing impact from potential environmental sources of variation, border rows should be planted not only on the sides of the trial, but also on the top and bottom of the field as well (Sooby, 2001). For better results, variety trials should be included within the production field so that all trial practices are the same as for the commercial arable production and plots should have at least three or four rows (Colley and Myers, 2007).

Crop	Min.# of plants
Corn	30
Brassicas	30
Carrots	50
Radishes	50
Tomatoes/Peppers	10
Squash/Cucumbers	10
Beans (bush varieties)	30
Beans (pole varieties)	10
Lettuce (heading varieties)	10
Lettuce (leaf varieties)	25
Spinach	25
Peas	30

Figure 6: Recommended minimum number of plants per plot in a replicated variety trial to evaluate population (Colley and Myers, 2007).

The common practices for the culture (e.g. wheat, carrots, faba bean) used in the experiment can influence the size and shape of the plot for ease of operation/management (Meertens, 2008). Mason et al. (2002) underline that drawing a map of the experimental field is one of the most useful things to do for visualization and orientation of the trial on the field. For better orientation during growing season (collecting data and observation) as well as at harvest, placing stable signs (wooden or plastic) at each treatment/variety is highly recommended.

3.3.4 MAINTENANCE OF EXPERIMENTAL FIELD

All management practices should be consistent and uniform across all trial plots including irrigation, soil fertilization, pest management, cultivation and weeding, or any other aspect of crop production, unless one of these management practices is also one of the studied treatments, e.g. weed management (Colley and Myers, 2007). It is necessary to regularly check on the experiment during the growing season, especially around flowering and just before harvest and to take notes if any unpredictable signs appear on plants, soil or surrounding areas (Ketterings et al., 2012).

3.3.5 DATA COLLECTION AND HARVESTING

What type of data should be collected and how it should be evaluated needs to be decided during the planning step. If varieties are tested, you might want to note selected traits during different growing stages and when various growth stages are reached (Colley and Myers, 2007). Figure 7 shows ideas of such key traits (Mason et. al., 2002). Data collection must be consistent for each individual plot, and grain yield from each treatment should not be lumped together (Ketterings et al., 2012). It is important to have a time schedule for data collection.

- seed germination (sample tested before planting), - seedling emergence, - canopy closure, - weed pressure, - plant height, - lodging, - disease, - heading plant biomass,	- yield, **Equipment Required to:** - test weight, - protein - percent moisture, - gluten strength, soil nitrogen, phosphorus, potassium & organic matter levels (soil tested before planting

Figure 7: Example of evaluation points for a variety trial during the growing season and at harvest (Mason et al.2002, 4).

To avoid border effects, select a central row for harvest from each plot to get the most accurate results (Anderson, 1993). Sooby (2001) recommends collecting data from each section of the plot in order to have a good representation from the entire plot area but also agrees that just the central rows should be selected for harvest. The Center for Tropical

Agriculture developed a scale with a 1-9 evaluation score which simplifies the comparison and evaluation of the expression of different plant quality or quantity traits (1=poor, 3=fair, 5=average, 7=good, and 9=excellent) (Colley and Myers, 2007). When evaluating on the field, find first the best individual or variety for the evaluated trait and give it a 9, then find the worst one and give it a 1. Find the middle one and rate it 5. Now rate the remaining varieties. This system can also be used for evaluating water/nutrition stress, pests and diseases on plants, plant height, lodging, yield etc. Grain samples need to be taken at harvest for further analysis in the laboratory (nutritional content, hectolitre mass, thousand kernel weight, moisture content etc.). If equipment is available, aerial images taken in middle to late season can provide information on variable crop stress (Nielsen, 2010). It is very important to keep logbook where every action taken on the field and the collection of measurements of concomitant variables is noted down (waterlogging, rainfall, soil type, dates of sowing and weeding), as it is easier to repeat the experiment or to look back to see what went wrong/right (Sooby, 2001).

3.4 On-farm vs. on-station experiments

The structure of an on-farm experiment (questions, hypotheses, experiment, observations, analyses, and conclusions) is often not much different from an on-station trial design. An on-station experiment is an ordered investigation that attempts to prove or disprove a hypothesis. A trial's primary purpose is to test whether someone's prediction is correct. Results from such experiments are generally not recognized / accepted unless scientific standards, set by other researchers around the world, were being followed. On-farm trials are established by researchers and farmers as an approved scientific research method in order to develop and improve local farming technology or to test new varieties. One of the main differences is that on-station research is usually established in a single thoroughly observed experimental environment whereas on-farm experiments are located in multiple sites, surrounded by different environmental noises. On-farm trials are thus more exposed to real world conditions (Maat, 2010). Moreover, Maat (2011) underlines that the main difference between on-station and on-farm research is not the capacity to experiment but the embedding of experiments in a specific ecological, material and institutional environment with equipment which is usually not affordable for farmers. However, the benefit of on-station experiments is that these experiments can be more complex and are generally more accurate (as environmental „noises“ are eliminated). The main benefits of on-farm research, on the other hand, are that it is usually more flexible and that the dissemination is more direct (peer to peer learning). Furthermore, as there is a strong cooperation between farmers, researchers and advisors the dissemination pathway for research results is shorter and results arrive and can be applied more quickly in practice.

Thus, the power of on-farm research comes from adopting a participatory approach, and thus combining the creativity, experience and resources from multiple sectors to address a common problem. The data that results from such participatory on-farm trials, conducted on several farms across several years, are more practice oriented, reliable and more trustworthy than a few replicated trials conducted ex-situ in a laboratory (Mason et. al., 2002). Even though the transfer of results of on-station trials into the real world, at a real farm can sometimes be challenging, the research questions and methods may be more complicated and precise. Nevertheless, both types of trials are important and should complete each other.

3.5 Conclusion

Ashby (1987) highlighted the importance of partnership for conducting on-farm research; where farmers and researcher are consulting and planning together through the whole experiment. Only then can research be beneficial to both. With participatory on-farm research trials, the involved farmers get feedback directly from their own farming area and they receive professional information and help from the project coordinators who also control and evaluate the results. Farmers have the possibility to gather experience with different farming methods/technology, plant treatments, varieties, that could make their production more successful and efficient. It is important that dissemination and objective reviewing of results is done at the end of the experimental period. In this way a report of trial outputs can be useful also for other farmers, who were not involved in the tests. Improvement of future on-farm trials may also be achieved through the presentation and discussion of the results.

4. On-farm methods in practice

Practical insight into on-farm activities of four European countries.

This chapter provides overall information on the history, structure, financial aspects and other experiences with participatory on-farm research in Austria, Luxembourg, Hungary and the Czech Republic. The chapter is closed by an insight to several projects of IBLA in Luxembourg.

FiBL Austria started in 2005 with on-farm arable crop experiments and in 2009 they extended the trials to also include vegetables. Their on-farm activities are financially supported by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. The Institute for Organic Farming in Luxemburg (IBLA) has been researching with on-farm methods since 2009 and in the last two years they have been working also on on-farm education programs. Their on-farm research is supported from national funds through the Ministry of Agriculture's action plan for organic agriculture, through European projects (e.g. Core Organic), and by the agriculture industry (organic and conventional). The Research Institute of Organic Agriculture in Hungary (ÖMKi) launched its on-farm research projects in 2012. These have been financed by private donations of the Pancivis Foundation, and partly by diverse national and international projects (Horizon, LEADER, Leonardo etc.). The Bioinstitut from the Czech Republic started on-farm trials in 2013. Their project activities are funded by the Czech Technology Platform for Organic Agriculture (CTPOA) and the Ministry of Agriculture. They hope that from 2015 onwards on-farm projects will fit into the Czech Rural Development Program (RDP) funds.

For better effectiveness of project work diverse collaborations are called for – producers, breeders, research institutes, universities, certifying agencies, consumers, traders, government and non government institutions, farmers associations etc.

In all four countries the subjects of on-farm trials are established together with the participating farmers, based on both current research questions and practical challenges. Recent research activities at IBLA cover topics connected with: "Reduced tillage methods" (TILMAN-ORG) which included 3 farmers, "Cultivation of grain legumes" pursued with 2 farmers in the frame of the COBRA project and with 3 farmers involved in the LegoLux project. The "Soybean Variety Test" was conducted with one single farmer, "Summer and Winter Cereal Variety Tests" are pursued with two farmers, and finally "Clover/Grass Mixture Variety Tests" with one farmer. All in all 10 farmers have been involved in different on-farm experiments over the last 5 years.

ÖMKi presently collaborates with 94 organic farmers throughout Hungary with different on-farm research topics. These include arable trials such as: "Cropping technologies, plant protection, and use of resistant varieties in organic potato production", "Comparison and evaluation of varieties of winter wheat respectively minor cereals such as emmer and einkorn – development of their production technologies" and "Determining stress factors affecting organic soybean yields with special attention to appropriate variety selection". Horticultural topics include: "Testing plant conditioners against apple scab on Idared variety", "Alternative plant protection methods against the cherry fruit fly (*Rhagoletis cerasi*)", "Cultivation and marketing opportunities for landrace tomato varieties", and "Development of new vineyard cover crop seed mixtures suitable for the environmental conditions of Hungary". Moreover, 20 beekeepers are taking part in the on-farm "Research program for varroa control in organic beekeeping".

The Czech Bioinstitut started their first on-farm pilot project in 2013 on testing winter wheat varieties. FiBL Austria currently involves around 20 farmers for arable crops (cereals, plants for green manure, oil and protein plants) and 15 farmers for vegetable and potato trials per year.

Farmers who wish to be involved in on-farm research need to be reliable, communicative, committed, curious and certified organic farmers who can – with professional help – actively take part in practical research and on-farm education. For participating in the on-farm network, IBLA is paying farmers lease for their fields, as well as for the work hours of planning, tilling, sowing, harvesting and machinery. ÖMKi farmers are volunteers and they are taking care of experimental trials as a part of their own cultivation fields. ÖMKi colleagues visit them regularly and make sure that documentation and sampling are pursued correctly. Likewise in Austria farmers are volunteering in tilling and harvesting, but the seeds are offered cost-free by the seed associations. Austrian advisers and Bionet coordinators control the trials 4-5 times during the season (emergence – youth stage – plant disease – harvest) and have discussion with farmers according to current needs. Czech colleagues have at the moment a pilot project running on standard experimentation fields, but for the next season they would like to involve at least one farm and they suppose it should be at least partly voluntary.

With participation in research trials, farmers get feedback right from their own land and receive professional information and help from the project coordinators who also control and evaluate trial results. Farmers have the possibility to closely encounter different farming methods/technologies, treatments, varieties that could make their production more successful in the future. Meetings between farmers and researchers generally happen more often during the season, when they go sampling, but this also depends on the trial arrangement and budget. Usually in June/July IBLA organizes several educational field days for every project. Farmers and all other interested parties are invited to visit. In Austria, FiBL prepares once a year on each topic a coordination meeting, plus different field excursions. For arable crops indoor seminars are in winter for each region (all in all approximately five). For vegetables one indoor seminar is organized for all Austria. Likewise, ÖMKi organizes educational events which consist of 1-2 workshops per year/topic, planning days in the winter season, and open farm visits for direct exchange on the field. Bioinstitut combines presentations of Bionet with field days.

Structure of the experimental trials is dependent on the research areas studied (viticulture, agriculture, horticulture, apiculture), and is different at each institution. For example, the winter wheat Pilot project structure of Bioinstitut CZ is as follows: 5 varieties, 4 repetitions, 10m^2 blocks and a trial scope of 3 years. IBLA implemented trials for the reduced tillage project in strip plot design as this was easier from the machinery point of view. When it is possible, they prefer the Complete Randomized Design with at least 3-4 repetitions as this provides greater assurance that the results are scientifically accurate. Typical trials at ÖMKi are strip plots without repetition, as farmers don't have the necessary equipment to conduct small plot experiments. Strip plots are sampled in 3-4 repetitions. In Austria for arable crops trials small plots with random blocks (12m x 1,5m) are applied with 4 repetitions, or stripes (3-6m x150m) with 3 repetitions. Vegetable crop trials are organized mostly as field trials with 3 repetitions and on the research stations in random blocks.

4.2 Challenges and improvements

Bioinstitut will have the first valid results from their trials in autumn 2015 (after 3 years of variety testing), so the best practice and specialty of their work could not yet be defined. However, they could point out that the lack of farmers motivated to do something above everyday routine and the difficult communication between involved institutions are surely posing challenges for the future, as well as finances. The key motto of IBLA project activities is "communication". They are presenting results from trials in interim reports (2-3 times/year/project), at conferences (2-3 times/year), field days (5-6 times/year) and at the end of each project as a final report. Their main target group is small due to the small number of organic farmers in Luxemburg. However, as the organic sector is still small, it is easy to get to know the different actors and the different farmers. Nevertheless, challenges arise when farmers don't follow instructions or the plan of the research project. This can be improved by increasing communication, frequent visits to the research field and the farmer, and choosing farmers that have some understanding about research.

ÖMKi presents on-farm results on professional events and in numerous practical publications (thus the experiences are accessible for many farmers), and also posts online reports (webpage: www.biokutatas.hu). Scientific results from the first 3 years of some trials will be available at the end of 2015. As the Luxembourgish partners, ÖMKi also pointed out that good communication as best practice. Specialty of ÖMKi on-farm methodology is that they include a wide range of research areas and a high number of organic farmers from different parts of Hungary. The main challenges of the on-farm network activities are the distances between experimental fields and the institute, mistakes made by the partners/breeders, or other issues that may disturb the experiments (weather anomalies/animal damage/theft). In Austria, FiBL focuses on these goals: to cross link farmers, researchers and advisers, to solve current problems and adaptation of (inter)national research results for Austrian conditions, validation and improvement of farming technologies. They actively work on organizing indoor and outdoor seminars and every once or twice a year they produce Bionet leaflets (available also on Homepage: www.bio-net.at). Their specialty is the well-developed collaboration chain between farmers, researchers and advisers which makes problem-solving more effective and enables a quicker improvement of farming strategies.

4.3 Conclusions

All international on-farm activities are mainly field trials that are implemented and set in life-like situations conforming to the goals of production defined by the farmers. Aim of the experiments is to investigate new ideas and methods and to improve farming practices.

All project partners mostly experienced the openness and interest of farmers for participation in projects. There are topics where the interest is especially high (in ÖMKi case: tomatoes, vine, apiculture are very popular topics); nevertheless, there are also many farmers who are not interested in providing their land and time. Also, not all farms are suitable for research. Criteria such as reliability, preciseness, enthusiasm need to be met. None of the countries target especially young farmers with on-farm trials. ÖMKi had in 2013 a special project dedicated to young farmers but otherwise their network does not focus especially on young farmers. From the yield of the trials, the researchers only take samples and the rest is part of the farmer's harvest.

All project partners are overall very satisfied with current project activities. IBLA manages to do quality research, share the results quickly with the farmers and thus achieve a rapid turnover of results into practice. ÖMKi plans to further develop its current projects by involving international network actors in framework of EIP or Horizon 2020 projects. Bioinstitut aims to involve active farmers in its future activities and create a more stable financial status for its network through project grants.

4.4 IBLA EXAMPLES

IBLA has all its research fields located on organic farms, thus there is automatically an involvement of these farmers in the research projects. In 2014, IBLA had 4 different field trials running: Cereal variety trials, clover-grass mixture trial, and two CORE ORGANIC projects (Tilman-org and COBRA).

Cereal variety trials

Aim: to evaluate different varieties of cereal species in order to find the variety for each species best suited for the regional growing conditions.

Experimental Design: randomized block design with 3 replications (two sites)

Assessments: Emergence, winter survival rate, begin flowering, health and weed cover at flowering, HEB-Index (= height of crop at harvest / height of crop at flowering), lodging, yield, humidity, thousand kernel weight (TKW), hectolitre weight (HLW), protein content, falling number and sedimentation (the latter two assessments only for wheat)

Level of involvement: the level of involvement is relatively low. The farmers prepare the fields for sowing and help with weed control. Sowing and harvesting is done by the Agricultural School in Luxembourg as they have the machinery necessary for establishing small plot trials.

Dissemination: the trials and their results are being presented to the farmers on several field days, on variety information conferences organized by the national variety commission, on the internet, by e-mailing the results to interested parties, and through brochures, as well as through our agricultural extension services.

Clover-grass mixture trial

Aim: to evaluate different clover-grass mixtures in order to find the mixture best suited for the regional growing conditions (in regards to yield, fodder quality, winter survival rates and previous crop value).

Experimental Design: non-replicated strip trial (one site)

Assessments: Dry matter yield, protein content, energy content for each of the different cuts, and species composition and weed cover assessed once per year.

Level of involvement: the level of involvement is relatively high. The idea for this trial came directly from the farmer himself and a good level of communication is needed to organize the sampling by the researchers in time with the different cuts done by the farmer. Here a strip plot design was chosen as the machinery for sowing small plots was not available and no replications were done due to spatial restraints.

Dissemination: the trials and their results are being presented to the farmers on several field days, by active participation at seminars, on the internet and through articles in the trade press.

Tilman-org project

Aim: to evaluate different tilling methods and green manures in order to find the combination best suited in regards to yield, weed control, soil organic carbon and carbon dioxide emissions.

Experimental Design: non-randomized strip plot design with 4 replications (1 site) in combination with non-replicated (ON-FARM) strip trial (3 sites)

Assessments: Weed species present, number of plants present / species, weed cover, weed dry matter, yield (crop and green manure), protein content (crop), C_{org}, CO_2 emissions.

Level of involvement: the level of involvement is relatively high. The strip plot design was chosen as it was easier from a machinery point of view: the trial was sown and harvested using the farmer's standard machinery. This was our first big project and it taught us a lot about the importance of working with farmers that understand the importance of sticking to the planned methodology and contacting the researchers BEFORE doing anything on the research field. It taught us to be more critical in choosing which farmers we are working with.

Dissemination: the trials and their results are being presented to the farmers on several field days, by active participation at seminars, on the internet. The results are being shared with peers through active participation at conferences and the publications of papers in international journals. A summary leaflet of the whole project has been published, where the main results from all the partners are being presented.

COBRA project

Aim: to evaluate different grain legume cropping systems in order to find the grain legume species best suited for the regional growing conditions (in regards to yield, fodder quality and previous crop value).

Experimental Design: randomized block design with 4 replication (two sites) in combination with non-replicated (ON-FARM) strip trial (two sites)

Assessments: Emergence, winter survival rate, begin flowering, health and weed cover at flowering, HEB-Index (= height of crop at harvest / height of crop at flowering), lodging, yield, humidity, thousand kernel weight (TKW), hectolitre weight (HLW), crude protein content, crude fibre content, crude ash content, crude fat content, starch content, sugar content, amino acid profile and content as well as several antinutritive components. The structure of yield (number of plants / m^2, number of pods or ears / plant, number of grains / pod or ear, dry matter weed / m^2 and dry matter straw / m^2) was also assessed on 1 x 0.5 m^2 per plot in the small plot trial and on 3 x 0.5 m^2 per plot in the ON-FARM trial.

Level of involvement: For the small plot trial the level of involvement is relatively low: For the site in Luxembourg, the farmer prepares the field for sowing and helps with weed control. Sowing and harvesting is done by the Agricultural School in Luxembourg as they have the machinery necessary for establishing small plot trials. For the site, on the research farm of the University of Kassel, in Frankenhausen, Germany, everything is done by the research staff.

For the ON-FARM strip plot trial the level of involvement is high: field preparation, sowing weed control and harvesting was all done using the farmers' standard machinery. Especially during the growing season of the grain legume cropping systems, the farmers needed to spend a lot of their time helping on this trial as mechanical weed control in grain legumes time consuming.

Here the idea of combining the exact trial with the ON-FARM trial was born from farmers' comments on field days of the exact trial (which was established two years earlier). Farmers commented that grain legume cultivation might be practicable in small plots but not under real size farming conditions. Thus, to demonstrate to them, that grain legume cultivation is also possible on a bigger scale, these ON-FARM trials were established in a second step.

Dissemination: the trials and their results are being presented to the farmers on several field days, by active participation at seminars, on the internet. The results are being shared with peers through active participation at conferences and the publications of papers in international journals.

5. On-farm research checklist

Bionet is a practice-oriented knowledge transfer project which was founded in August 2005. It has various objectives in the field of knowledge transfer between science and farmers in both directions and is looking for practice-oriented solutions to urgent deficits in organic production. Bionet is probably the most sophisticated and broadest network with above mentioned goal in the organic agriculture sector in Europe. The following chapter text is an abstract from the "Checklist for transfer-farms" (Lindenthal, Kranzler, Fischl 2007).

The checklist of criteria is a collection of basic conditions and demands on farms. It might be used by research institutions as an interview guide when basic information about farms has to be identified. The collected data might also be a basis for the selection of an appropriate farm to be a partner in research issues.

Farming conditions are separated in three main themes:

- ✓ What are the requirements on the location of a farm to achieve results with high representativeness and validity? (local conditions)
- ✓ What are the operational criteria of a farm to enable efficient and effective testing facility, test realisation and evaluation as well as providing a framework for communication between scientists and farmers? (operational conditions)
- ✓ Which personal and professional prerequisites must be fulfilled by the farm manager in order to ensure an efficient and effective testing facility, test realisation and evaluation as well as good communication? (special conditions of the farm manager)

The most important criteria are listed always at the beginning of a chapter. At the end of it there is always the small topic “Further mentioned criteria”, which are criteria of small importance, but they may newertheless be of interest in some special cases .

5.1 LOCATION

The criterion **„Representativeness“** has the largest weighting overall and it is the most important aspect of the location. It refers to soil, climate and to the crops that are scheduled for trial. The particular significance of this criterion depends on the transferability of the expected results to other farms.

An important question with regard to the representativeness is the delimitation of the region. Within the framework of this project it is a so-called (and officially defined) small production area.

Representativeness can be defined with following data as long as they are easily available:

- Climate of the region (annual rainfall, annual average temperature): climate conditions at the farm compared with the regional average (definition of the region is given above)
- Geologic parent material: recorded by maps
- Soil character: character of soil of the farm and the region, recorded by maps
- Type of soil: type of soil of the farm and the region, recorded by maps
- Productivity index [1]: productivity index of the farm and the average productivity index of the region; recorded by maps
- Potential additional criteria for representativeness: humus content, pH-value, nutrient supply (P and K), exposition of the area, crop rotation and the requirement that the crops that are scheduled for trial are typical for the location of the farm.

[1] The productivity index is a term for the quality of soil in combination with climate conditions.

Further mentioned criteria

- Accessibility: geographical proximity of the farm and the trial consultation (researcher) to enable efficient test realisation and support, easy communication, less time resources and spontaneous visits/inspections in the short term. For visitors: easy accessibility of field days or excursions
- Presence of extreme locations to point out differences caused by trials
- Presence of farms in every important production area
- Landscape features: for questions in the field of nature conservation (for example the amount of hedges, litter meadow, specimen trees and bordering permanent meadows as well as forests in the neighbourhood of the fields
- Involvement of the bordering fields next to the testing areas

Specific criteria for animal husbandry

- Existing relationship between the farm and animal health as well as veterinarian (transparency of the state of health)
- Existence of basic equipment for trials
- Farms with free-range production

5.2 Farm

The type of the farm is the most important criterion in the theme “farm” and may be gathered by:

a) Type of farm:

- Labour status: not a hobby undertaking
- Amount of animal husbandry
- Size of agricultural land (compared with regional average)
- Crops
- Amount of employees (compared with regional average)

- Level of fertilisation and nutrition: records of the farm regarding most important crops; compared with experiences of other farms (experiences of advisors)
- Nutrition level (should be representative): nitrogen and phosphor balance, nitrogen balance of experimental grounds

b) Cultivated crops:

- The habitat requirements of the crops that are scheduled for trial in accordance with local conditions of the farm
- Records of the crop rotation of the fields owned by the farm
- Comparison of these records with well-known crop rotations used by other organic farms in the region / experiences of the regional crop rotations of the advisors
- Experiences of the farmer with crops that are scheduled for trial (Did the farmer cultivated them already? If yes - for how long?)

c) Documentation

Aspects of that criterion are the quality of the recordings of purchases and sales (cash accounting), crop rotations (transparency of the crop rotations on the fields), significant management measures of each field (nutrition, pest control); - Do the operators keep a crop-cutting record?

d) Technical equipment

Collected data are about the facilities of drawing vehicles, soil tillage machines, weed management and pest control as well as additional possibilities of transportation.

e) Homogeneity of the trial areas

If available these data may be collected in maps of finance soil valuation. A scientific evaluation based on pedological/geological mapping of soils is too expensive.

f) Communication tools on the farm

E-mail or fax address, mobile phone.

g) Building equipment / Infrastructure

Storage capacity for test equipment, crops being harvested and test materials.

h) Future-oriented farm

A “future-oriented farm” is an innovative farm which will most likely continue to exist economically over the long term. Parameters: Level of awareness with regard to successful products and innovations (awareness among advisors and other farmers), reputation of the farm in terms of its economic situation (among advisors and other farmers), full-time farm, professional and social standing of the farmer.

Further mentioned criteria:

- ✓ Well-organised and effective internal operations
- ✓ Appropriate cultivation areas: necessary size of the fields and required land consolidation
- ✓ Trial areas should correlate with the main growing area of the crop
- ✓ Actual pest and diseases (farm/region)? One year forerun
- ✓ Project/Topic of the trial is the focus of the farm
- ✓ Integration of the trials in the existing fields: important for cultivation measures
- ✓ Homogeneous crop: same species, same age and same cultivation
- ✓ Uniform areas – “healthy” and “contaminated” fields
- ✓ Basic equipment for analysis: equipment for drying and cooling, field scale
- ✓ Difference of requirements for “model farms” and “research farms”, both types and mixed forms are necessary
- ✓ Vegetable production: irrigation system and not a farm with a mixture of arable and vegetable production
- ✓ Conversion date: in the past four years (recommended)
- ✓ Nutrition supply: results of soil analysis compared with other organic farms in the region
- ✓ Motivated staff: experiences of the advisors with the farm staff
- ✓ Good relationship with the control authority

Specific criteria for animal husbandry

- ✓ Adequate size of stock (separation of groups in feeding trials)
- ✓ Requirements for trials:
    - o Several boxes with same conditions

  - Boxes for 10-40 animals (fattening) with +/- simultaneous entry
  - Possibility of different feeding for each box
- ✓ Possibility of weighting
- ✓ Feedback of slaughterhouse (classification services)

  - Minimum level of hygiene measures - for example overalls, disinfection mats, hygiene lock in piglet production (to enable visits)
  - Data of slaughter analysis are available, screening results of eggs available (also in direct marketing in a farm shop)
  - No special permissions, compliance with existing guidelines
  - Animal scale is available
  - Minimum standard depending on the issues (feeding, breeding, piglets, hygiene, animal health) - detailed planning is necessary
- ✓ Separation of water and food allocation should be possible
- ✓ Group size depending on the issue

5.3 Farm Manager

a) Innovativeness

Willingness to carry out field trials

Is the farm manager interested in field trials, issues and scientific questions (from the point of view of the farm manager and the advisors)? Did he already visit or even carry out field trials? Is he flexible and does he have improvisation skills?

Experimentation

Is the farm manager interested in trying new things? Is this interest well-known among other farmers and advisors? Did the farm manager already try out any innovations/new ideas on his own - on small fields or in larger scale? Did he motivate other farmers to try out new things?

(Dosed) Willingness to take on risks

Is there willingness to take risk? Did he take risks in the past (for example by making investments or by time- consuming work effort)?

Education

Agriculture education, advanced training, additional skills

b) Communication skills, cooperation, Readiness to engage in dialogue

Is there an interest in communication with science and advice? Is the farm manager talkative and is he already in a lively discussion (constructive, uncomplicated) with farmers, advisors and scientists? Did the farm manager already share his own experiences with them?

c) Power of observation

Does the farm manager take much pleasure in observing his fields? Did he share his pleasure with other farmers or advisors by telling them?

d) Records

Does the farm manager like keeping records? Are the records accurate and in detail? Does he keep records that are not required by a control authority?

e) Buffer time

Does the farm manager have buffer time for the arrangement, realization and assistance of the evaluation of the field trials? Was/Is there enough manpower to handle additional work?

f) Reliability

Is the farm manager a reliable partner from the point of view of other farmers and advisors? Does he keep appointments? Is the farm manager working professional to fulfil the required performance in field trials?

Further mentioned criteria

- ✓ Recognized farm manager: professional competence and social status
- ✓ Convinced organic farmer

- ✓ Experiences with the crops that are scheduled for trial
- ✓ Marketing and response to latest developments
- ✓ Open for personal growth
- ✓ Precision: exact work, consultation of measures, target oriented way of finding solutions
- ✓ Marketing management, business management knowledge
- ✓ No newcomers
- ✓ Willingness to “untreated control fields” in trials with plant diseases

6. SIX RULES FOR SUCCESSFUL ON-FARM RESEARCH

In the following chapter the six most important rules for on-farm research are being presented. These rules are based on the checklist presented in the previous chapter and ten years of experience in realizing the project “Bionet Austria.. They are recommended for a successful cooperation between researchers, advisors and farmers.

An essential success factor, that should be mentioned at first is the involvement of the advisor of a farm at the very beginning of the selection procedure of a farm. By communicating with the advisor a kind of pre-selection is possible. Due to his experiences he is able to estimate the overall situation and to characterize the farm manager.

1) Representativeness of the location

The goal of on-farm research is to generate practical and useful solutions for many agriculture businesses. The transferability of the expected results, ensured by the representativeness of the location, takes on the greatest significance. Various location-related data have to be collected, including the climate of the region, geologic parent material, soil character, type of soil and productivity index. These data have to be compared with the regional average, to ensure representativeness of the farm location. A necessary prerequisite is the delimitation of the region, in Austria it is a so-called (and officially defined) "small production area".

2) Type of farm

For the selection of the farm the "type of farm" is also very important. That includes aspects of production and economy of the farm. Important parameters are the labour status, the number of animals, the cultivated crops, the size of agricultural land, the amount of employees and the level of fertilisation and nutrition. The last three parameters have to be compared with regional averages.

Especially the cultivated crops have to be considered exactly. The accordance of the habitat requirements of the crops that are scheduled for trial with the local conditions of the farm is very important. Records of the crop rotation of the fields owned by the farm and experiences of the farmer with the crops that are scheduled for trial are also very useful.

Farm managers know their land so their help is important in the selection of suitable areas. They know about the history and special impacts on the soil, as well as the treatment. All of that is very useful and needed to make the right choice. Altogether the selection of the testing area is based on hard data concerning soil and climate as well as soft data which include all knowledge and experiences of the farm managers.

3) Business equipment

Business equipment includes technical equipment, building equipment and communication tools on the farm. All the information about pulling vehicles, soil tillage machines, machines for weed management and pest control, additional possibilities of transportation and storage capacity should be collected. The machines constitute the framework of the test procedure. Furthermore modern media is very useful in planning, realisation and evaluation of the trials.

4) Documentation

Recordings are essential to guarantee transparency of the trails for all involved persons. Recordings of purchases and sales, crop rotations and significant management measures of each field (nutrition, pest control) should be common.

5) Innovativeness and communication skills of the farm manager

Innovativeness and communication skills of the farm manager are necessary for farms. That means the farm manager should be interested in field trials, issues and scientific questions as well as innovations and experimentation. He has to be motivated to try out new things and be ready to take dosed risks.

Equally important is the dialog between all involved partners. The farm manager should have a committed, critical and constructive approach, the communication should be straightforward.

6) Appreciation

On the other side a respectful attitude of the researcher is necessary. The researcher has to be ready to work on equal footing with the farm manager, otherwise long-term cooperation won`t work. For the researcher the farm has to be a partner in finding a solution for research questions and not only a research site.

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8. APPENDIX

COMPARISON OF PARTICIPATION LEVEL OF ON-FARM RESEARCH

According to the degree of the farmers' participation we can differentiate between high and low level of participation. International examples in the table below show that the level of involvement and area of involvement depend on the actual research field and topic. Some research projects are more technical ones, such as cereal varieties, in which case participation is rather low. Although the level depends on several factors, researchers can motivate higher participation with supporting farmers in many ways i.e.: explaining the research process in the details, helping them to apply for grants, providing them solutions for cost saving, offering innovative research topics, research with new varieties to satisfy their curiosity. Farmers show low participation level when research seems to be complicated or frightening with a lot of administration, tight deadlines and „left behind" feelings. Researchers should be proactive in these cases to avoid any negative effects.

Name of the project	Duration	Organisation	Country	Participative approach: 1 (low) 5 (high)	Description	Participative activity of farmers	More info
inter cereals variety trials for organic crop production	since 2010	IBLA	Luxembourg	2	Testing of varieties in OF conditions in small plot trial, two different sites	Preparation of fields before sowing, weed control, checking on the trials in between our visits, observations and assessments were done by IBLA, harvest and sowing was done by agricultural school LTA.	www.ibla.lu
Spring cereals variety trials for organic crop production	since 2014	IBLA	Luxembourg	2	Testing of varieties in OF conditions in small plot trial, two different sites	Preparation of fields before sowing, weed control, checking on the trials in between our visits, observations and assessments were done by IBLA, harvest and sowing was done by agricultural school LTA.	www.ibla.lu
LegoLux Project: Suitability of grain legumes as regional animal food for organic agriculture in Luxembourg	2011-2015	IBLA, Universität Kassel (FöL), BIOG, LTA, SER	Luxembourg	3	Comparison of grain legume cropping systems as regional protein fodder and their previous crop value under OF conditions in small plot trial on 1 site over two seasons	Preparation of fields before sowing, weed control, checking on the trials in between our visits, observations and assessments were done by IBLA, harvest and sowing was done by LTA.	www.ibla.lu
Network demonstration farms	since 2009	IBLA. ASTA	Luxembourg	5		Complete responsibility of the activities by the farmers; coordination by IBLA.	www.ibla.lu ; www.demonstrations

							betriebe.lu
Cultivation of tomato variaties open land	2012	IBLA	Luxembourg	5	Test of new pest tolerant varieties at x different sites	Tomato tasting; planting and follow up was done by the growers.	
COBRA - Coordinating Organic Plant Breeding Activities for Diversity	2013-2016	IBLA, LIST and 40 different partners from 14 different countries	Luxembourg	4	Comparison of grain legume cropping systems as regional protein fodder and their previous crop value under OF conditions in small plot trial on 1 site and in strip trial on 2 sites, also comparison of different pea and faba bean varieties and breeding strains in pure stand and in mixture with a cereal partner under OF conditions in small plot trial and in small line trial	Tillage, sowing, weed control, harvests was all done by farmers for the strip trial, observations and assessments were done by IBLA , tillage was done by farmers, sowing and harvest was done by LTA or University of Kassel for the plot and line trials, weed control, observations and assessments were done by IBLA or University of Kassel.	http://www.cobra-div.eu/
TILMAN - ORG - Reduced tillage and green manures for sustainable organic cropping systems	2011-2014	IBLA, LIST and 14 different partners	Luxembourg	4	Comparison of 3 different tillage methods and 3 different green manure methods in OF conditions in small plot trial on 1 site, comparison of 2 different tillage methods under OF conditions in strip trial on 3 sites	Tillage, sowing, weed control, harvests was all done by farmers for the strip trial, for the plot trial harvest was done by LTA, observations and assessments were done by IBLA.	http://www.tilman-org.net/tilman-org-home-news.html
Gras-clover mixture trial in organic agriculture	2013-2015	IBLA	Luxembourg	5	Comparison of different grass-clover mixtures under OF conditions in strip trial on 1 site	Tillage, sowing, harvests was all done by farmers, observations and assessments were done by IBLA.	www.ibla.lu
Soybean variety trial for organic crop production	2014	IBLA	Luxembourg	1	Testing of varieties in OF conditions in small plot trial, 1 site	Preparation of fields before sowing, weed control, checking on the trials in between our visits by agricultural school, observations and assessments were done by IBLA, harvest and sowing was done by LTA.	www.ibla.lu

Winter wheat varieties suitable for organic farming	from 2013	CTPOA/Bioinstitut	Czech Republic	2	Testing of varieties in OF conditions on five different sites	Farmer evaluates some parameters of varieties he grows, which will be compared to the results on research standardized sites.	http://bit.ly/1JJo7uw http://bit.ly/1JJo6H6
Study of methods and crop management practices for seed yield of selected grass, legume and intercrop species and its quality increasing in organic farming.	2010-2014	VÚPT	Czech Republic	4	Testing of different seed rates, 2 types of management for rye and phacelia	Providing of trials on his farm.	
Potato on-farm trials for organic production	since 2012	ÖMKi	HU	5	Comparative examinations of short-term and main crop potato varieties, on 23 sites. Good cooperation net is built among farmers, breeders, retailers, universities, chefs	Planting and cultivation are done by the farmers. Common evaluation of results, active brainstorming in the subject of further cooperation and other research subjects.	http://omki.org/
Comparison of different cover crop mixtures in Hungarian vineyards	since 2012	ÖMKi	HU	4	Testing and developing of seed mixtures under On Farm conditions, especially native species from local provenance, as it is possible. The open-field trial is on seven wine regions of Hungary, not just in certified organic vineyards.	Buying the seeds and compiling the seed mixtures recommended by us; preparation of the inter-rows before sowing; tillage (rolling, cutting). They are open and active to develop the topic, they share their experiences and ideas.	http://omki.org/
Hungarian on-farm research program for varroa control in organic beekeeping	since 2013	ÖMKi	Hungary	5	Comparative trials on organic varroa control methods under on-farm conditions. Twenty market operations participating throughout Hungary .	The annual protocols for treatment is based on a common design. The treatment and the mite count monitoring are done by the beekeepers. The result are jointly assessed.	
Soybean variety and cultivation trial for the development of soybean production	since 2013	ÖMKi	Hungary	5	Testing of varieties in OF conditions on 4-5 different sites with 4-8 varieties, Testing of the seed-inoculation and others cultivation	We carried out the buying the seeds and monitoring few times on the field . The farmer is responsible for the preparation of fields, sowing, weed control, checking on the trials in between our visits, harvest.	

					methods on 2-3 sites		
Winter wheat varieties suitable for organic farming	since 2011	ÖMKi	Hungary	5	Testing of varieties in OF conditions on 7-10 different sites with 6-10 varieties	We carried out the buying the seeds and monitoring few times on the field . The farmer is responsible for the preparation of fields, sowing, weed control, checking on the trials in between our visits, harvest.	
Hulled cereal trials	since 2012	ÖMKi	Hungary	5	Testing of emmer, einkorn, spelt varieties under OF conditions on 3-5 sites with 3-4 varieties	We carried out the buying the seeds and monitoring few times on the field . The farmer is responsible for the preparation of fields, sowing, weed control, checking on the trials in between our visits, harvest.	
Testing Beauveria bassiana against cherry fruit fly	since 2013	ÖMKi	Hungary	5	Testing the efficacy of biocontrol agent product on farm with 4 sites	We carry out the sourcing of materials (product, traps) and set up the trials, the farmers check the traps and apply the spraying. We take cherry samples and evaluate results.	
Utilisation of participatory breeding system in the research and breeding of wheat cultivars suitable for organic cultivation	2013-2017	CRI, CULS, USB, PRO-BIO LtD.	Czech Republic	3	The evaluation of participatory plant breeding concept at the level of first phases of breeding procedure involving of organic farmers into the process	The farmers choose the best breeding lines (F3 generations) of common wheat and spelt for their own conditions received from the research team.	www.vurv.cz
Bionet Austria - Part arable farming	2005 - 2017	FiBL AT	Austria	4	Testing of various cultivars under field conditions, Farmers exchange experience through field days.	Farmers bring experience to the management of the culture, make assessments, care of the experimental plots together with consultants and researchers.	www.bio-net.at
Bionet Austria - Part vegetable farming	2008 - 2017	FiBL AT	Austria	5	Testing varieties, treatment of current problems in the cultivation	Farmers give the subjects of the experiments before, share the experience in focus groups, some experiments operate on their own	www.bio-net.at

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