NATIONAL WORKSHOPS REPORT

IPMWORKS National Workshop *Denmark*

Date: 15/4/2024

Unfortunately it has not been possible to gather a group of people for a workshop, but the information to answer some of the questions is available from previous work in the project and in other activities.

National Focal Point for Denmark: Mette Sønderskov

Reporting person for this meeting: The following text was written by Mette Sønderskov and based on communication within the project and with advisory services and with policy makers in general.

IPMWORKS has been presented for the Danish environmental protection agency and the National Advisory services (SEGES) several times, furthermore the project was presented for the Danish agricultural agency at a previous occasion. Discussion with the hub coaches from Djursland Landboforening and Velas (the two local advisory services participating in IPMWORKS) has taken place throughout the project.

Validation of the concept promoted by the IPMWORKS project.

- **How can demo events and HUBs further drive the adoption of IPM practices?**

  The concept of groups of farmers meeting and exchanging experiences has been in practice for many years in Denmark, but not really connected in a network. I Denmark these groups are not necessarily on IPM but could be related to specific types of cropping systems or crops. The similarity to the IPMWORKS hubs is in the structure and the format of communication. The Danish hubs are connected to local independent advisory services and a local advisor is connected to the hubs. The farmers in the group pay the advisor to join the meeting, which takes place on the farms and the farmers take turns to host the meetings. The meetings usually include a field visit and discussion on relevant topics for the specific farm. The groups are usually located in geographical proximity and the groups often stay together over a long time, which also means that often the age of the farmers is similar. But the groups are also able to include young farmers starting in the area, either within the same geographical area or in a specific type of farming.
  This explanation is to state that in Denmark there is a general agreement that experience exchange among farmers is of high value and the potential in seeing how other farmers plan their pest control and cropping system in general is very useful. It is the impression from other meetings and discussion (also the events where IPMWORKS has been presented for the policy makers and funders of national projects) that they very much support such a structure to promote IPM implementation. A national project is running on innovation farms,

which are a kind of demonstration farms to promote IPM, which is funded through the Danish environmental protection agency. The demo events, or presentation of specific issues, on the farms enable practical discussions and give the visiting farmers an opportunity to bring new solutions to the table or come with input to the farmer hosting the meeting. When farmers stay together in a group for a long time, there is a high level of trust among them, and they know each other's cropping system well. Usually, it is the same advisor joining the meetings in a group unless the advisor leaves the advisory service or change job within the organization.

Hubs and demo events are very good opportunities to disseminate knowledge, and this is one of the primary ways IPM has been implemented in DK. The National advisory service provides the local advisory services with information. In addition to the experience exchange groups and direct communication with local advisors, farmers gain knowledge through advisors from companies related to their contracts on specific crops (like grass for seeds or other seed production). In a previous project, IWMPRAISE, a questionnaire was made to investigate what sources of information was most valuable to the farmers with regard to their weed management and the ranging was as follows: Independent advisors, experience exchange groups (similar to hubs), consultants from specialized companies (if the farmers has special crops e.g. seed production of grass or vegetables or high value crops, not chemical companies), farmers magazines, experience collected by practical management on the farm and family, colleagues (other farmers not in a experience exchange group), information and demonstration events, internet in general, through education, information from chemical companies, contract worker/machine providers, social media. (The report was google translated and attached at the end of this report to support the statement). The system of independent advisors in Denmark paid by the farmers themselves is considered a very strong system and ensures the information stream from research through advisory services (national and local) to farmers.

The concept of hubs in IPMWORKS is very similar to these experience exchange groups, and the local advisors have a lot of experience in facilitating discussion among the farmers. This means that the two Danish hubs in IPMWORKS were largely based on farmers already participating in groups, however, the farmers in the hubs were mixed from already existing groups, but familiar with the concept and comfortable with exchanging information and experiences. In Denmark, the national average of pesticide use is published every year per crop type and the farmers can always compare their practice of pesticide use with this national average. The national statistics are based on the spraying journals submitted by the farmers. One aim of the hubs was to make the farmers able to compare their practice to other farmers and this might not have been a major part of the hub work in DK within the hubs.

One of the major drivers of IPM in Denmark is resistance issues both for diseases and weeds. The hubs in DK have focused on herbicide resistant grass weeds and during the last years there has been a development among farmers that it is not something you try to hide from your fellow farmers. Previously, it was a bit shameful for farmers if they experienced resistance on their farm, but now the problem is widespread and there is an openness around the issues that benefit the use of IPM to fight the resistance problem. Resistance among insect pests is also an issue and the very limited number of available actives to control insect pests encourage farmers to turn to alternative management strategies (IPM).

The discussion in the hubs promotes the use of thresholds to determine the need to spray for insects and there is a tendency for farmers to be more tolerant to small numbers of certain insects. Farmers feel more comfortable with not spraying when they see other

farmers successfully limiting their insecticide use. The same might be true for fungicides, but here it is more about the number of fungicide applications than matter of not spraying at all.

- **What are the main barriers you identify to scale up the IPMWORKS methodology?**

  One aspect of the IPMWORKS concept which could further benefit IPM implementation in Denmark is more quantitative evaluation of on-farm experimentation. But the effort to collect the data is often too time consuming and difficult to manage. To scale up the IPMWORKS methodology, the information coming from the hubs should be counteracted by more information going from the network to the hub. It is difficult for the farmers and advisors to see what they gain by being part of the larger network. The effort to collect data in the hubs does not result in information making them more likely to succeed with their IPM implementation. If the IPMWORKS network is to be carried on more knowledge exchange on technical aspect must be in place. Maybe smaller groups of arable hubs with similar growing conditions would be an option. The two Danish hubs have had good outcomes of meeting and discussing among the farmers.

  It has been a barrier for the hub coaches that the information material required for them to make did not appear relevant for knowledge sharing among the hubs, mainly because the cropping conditions are very different throughout Europe. The requirement for data is a barrier. The way to collect data (surveys) must be less time-consuming to work with and maybe accommodate systems already in place in the countries participating.

  Another barrier is the funding for advisors to participate with their group of farmers. As described, there are potentially more groups of farmers that could be included in the IPMWORKS project as hubs, but the time of the advisor to participate in the network activities is not covered by funding. The farmers pay themselves to have the advisor join the group and they cannot pay for the time needed to fulfil the data collection for the network.

- **How should the HUBS be customized to address obstacles in your local context?**

Some of this was addressed in the previous considerations.

The following text is a report which was Google translated from Danish, slightly corrected and amended, on a questionnaire carried out in a previous EU project, IWMPRAISE, only on weed management in Denmark.

Interview study on weed control

By Mette Sønderskov, Agroecology, Aarhus University

In connection with the EU project, IWMPRAISE (Box 1), at the beginning of 2018, an interview study was conducted in two parts among farmers and experts on weed control and agriculture in a number of European countries. The method comes from the Netherlands, where it has been used for the study of organic farms. This concept was adjusted to shed light on barriers to further implementation of integrated weed control (IWM) (Box 2).

Box 1: IWMPRAISE
Integrated Weed Management: PRACTICAL IMPLEMENTATION AND SOLUTIONS FOR EUROPE
Integrated weed control (IWM) is the way to achieve more sustainable and robust cultivation. IWMPRAISE is a Horizon 2020 project that runs in the period 2017-2022. The project will support and promote the implementation of IWM in Europe. We work on strategies that reduce the dependence on herbicides in 4 types of crops.
EUR 6.6 million has been granted to IWMPRAISE, with the participation of 37 partners from 8 European countries. It includes 11 leading universities and research institutions in the weed field, 14 small / medium sized enterprises and 12 advisory organizations or farmers' organizations. The project is coordinated by Per Kudsk, Professor at Agroecology, Aarhus University.

The main purpose was to identify any barriers to IWM implementation and to find out whether there is a match between the experts' assessment of the practical weed control and what tools / strategies the farmers actually use.

The questions, in the interview survey, were based on an initial work on opportunities within integrated weed control, which divided the control into five groups (1) Combating associated with respectively. crop rotation (2) establishment (3) tillage / fertilizer (4) direct control and (5) monitoring / evaluation. These groups represent different times of the season and thus the weed life cycle. One of the purposes was to find out if the farmers use tools from all five groups in their strategies. The participants in the interview survey were asked what tools are used in weed control. Experts should describe what farmers think in their opinion and farmers should describe their common practice. All parts of the cultivation strategy were also asked about the measures that are not directly related to weed control, but which may have an influence.

The tools mentioned in the interviews were ranked according to how many of the interviewed persons mentioned them, and to what extent the individual focused on the topic.

This article only describes the results of the Danish part of the study on which tools are considered most influential in the weed control. The 18 interviewed farmers all run relatively large farms (103 - 1700 ha) and were all full-time farmers except one. The age ranged between 32 and 68 years with an average of approx. 49 years. Virtually all businesses are family businesses (except 2), but the largest

are not run directly by the family, but by an operator and some as operating communities. Four farms also had pig production. The crop rotations are typically 4-5 years and included both winter and spring seeds. Crop crops with sugar beet all contained both winter and spring seeds. Many also had seed grass in the crop rotation also the beet growers. Winter oilseed rape was often part of the crop rotation, but was usually kept in separate crop rotation from beets, but not always. Some had other crops such as potatoes, corn, spinach, peas, horse beans or cabbage. All farms were conventional, and there was a single farm that consistently practiced no-till ("conservation agriculture"), but in addition there were many different levels of tillage represented among the farmers. Some had completely laid the plow away and were running a reduced tillage.

The farmers stated that it was a wide variety of weed species that caused problems. In cereals, it was primarily thistles, willow trees, large-billed beetles and bird grasses (some with resistance) of the dicotyledonous species that caused problems. In sugar beet, it was Chenopodium album, Polygonum convolvulus, polygonum aviculare and thistle. The biggest challenges in cereals were clear grass weeds, both due to competition against the crop and potential resistance, but many also cultivated seed grasses, which have a high purity requirement. It is primarily Lolium sp, Alopecurus Myosuroides and Vulpia. Only a few had registered resistance in the fields (one case of Lolium multiflorum and Alopecurus Myosuroides, respectively). A total of 16 dicotyledonous species and 10 grass species were specifically mentioned.

Many related major weed problems with soils of inferior quality and where there were problems with excess water. The open crops in the crop rotation generally also had major weed problems. In

BOX 2: DESCRIPTION OF THE INTERVIEW EXAMINATION

The study is based on two groups of stakeholders for weed control; practitioners (farmers) and researchers / advisors / legislators etc. (here called experts). The group of experts consists of people who broadly cover all stakeholders who may be interested in how agriculture handles weed problems. Therefore, the project started to make stakeholder analyzes for the individual project countries. In general, stakeholders are divided into the following types; ministerial institutions, research institutions, consultative organizations, agricultural organizations, commercial enterprises and NGOs. A priority was made so that five of these were represented within each crop type that the study focused on.

The categories of crops are row crops in small row spacing (cereals and rapeseed), and actual row crops on large row spacing (sugar beet, corn etc.) and tree crops (olives, wine and apples). Not all project countries participated in all crop categories. In Denmark, focus is on narrow and actual row crops represented by winter wheat and sugar beet. The five experts broadly represented all stakeholder organizations. The representatives of ministerial institutions and NGOs were used for both crop types, as they are not expected to distinguish between the crop categories. In addition, the representative of the National Advisory Service has been asked about weed control in both winter wheat and sugar beet. The more specialized experts were different for the two crop types. Three experts were used for both crop types and two experts were selected specifically for each type. The farmers were selected based on regional differences and to represent different ages, sizes of agriculture and innovation interest. 11 farmers were interviewed for each crop category. Since sugar beet is always included in a crop rotation with e.g. cereals, beet growers will have experience from both crop types, therefore there were four farmers who were used for both crops. Specifically, weeds were asked for weed control in respectively. cereals and sugar beets. The farmers who were interviewed on weed control in cereals typically had other crops in the crop rotation, too. seed grass and winter oilseed rape.

addition, some species were associated with the field edge. The farmers were very aware of the spreading of grasses with machines (especially arable grass).

There were no farmers who gave the weeds a real positive value. However, we mentioned that the weed occurrence gives the opportunity to look more closely at the fields by walking around and recording the weed populations. Thus, other problems are also discovered. Two farmers mentioned that game and birds can enjoy the wild flora, but primarily outside the field surface (actual landscaped flower streaks or fences / hedges). The negative effect of competition on the crop overshadowed any positive side effects of weed populations in the fields of farmers.

Among the experts, several benefits of weeds were mentioned. Considering agricultural land as specific ecosystems, all species have their justification. Some species are specifically associated with the cultivated land and will have severe conditions if their habitat is restricted to non-cultivated land. The yield can be maintained in many crops on narrow row distances, although there are populations of different weed species. It will be a matter of limiting populations and fighting the most fatal. In actual row crops, the consequences of weeds will be greater as they are more sensitive to the weed stock and do not tolerate weed competition without compromising yield. In the case where the yield can be maintained, a weed flora which supports beneficial insects can be speculated. Yet this has not been exploited to any significant extent. There may be some benefits to some species that, like after-and-middle crops, improve soil structure due to root development and biomass supply.

Sugar beets

Herbicides were the main tool for weed control, but crop rotation and soil cultivation were assessed to have a major impact on the need to use herbicides and on resistance development. There was a high degree of coherence between the experts' perception of what farmers are practicing for weed control and what is actually used by farmers (Table 1). However, it was not the opinion of the experts that farmers use mechanical control in beet, whereas some of the farmers indicated that it was part of their strategy when conditions allow, and chemical control is inadequate. Eg. The summer of 2018 subsequently showed that some farmers used row cleaning, as the drought resulted in a reduced effect of herbicides. However, there are problems with the capacity of row cleaning and with the precision if it is old equipment used. Some farmers used a combination of broad spraying and row cleaning. The farmers set the quality of the seedbed very high, and it was often described as the good craftsmanship. The good craftsmanship is a combination of the right soil preparation and the timing for seedbed establishment. Emphasis was also placed on this by two experts. There were no farmers who made a false seedbed before sowing beets. It is too important to get the beets in the soil early, and the effect of a false seedbed is too small to delay the sowing. Fighting problem species in stubble from previous crop was mentioned by few farmers. The competitiveness of varieties against weeds did not play a role in the variety choice of farmers, but a single expert mentioned this as a factor in weed control. One single farmer mentioned that he was working to get the right plant number to germinate, which suppresses the weeds best. The tools that were most widely used represented all five groups identified in the initial work: crop rotation, establishment, tillage / fertilizer, direct control and monitoring / evaluation.

Table 1: The tools mentioned in the interviews on sugar beet. The experts' assessment of which measures farmers use most and what farmers actually use in their weed control strategies. The tools are listed on how many people have mentioned them and to what extent the individual tools influence the weed population.

Experts	Farmers

Herbicides in general	Herbicides in general
Crop rotation	Crop rotation
Soil cultivation strategy	Quality of seedbed + timing /"good craftmansship"
Quality of seedbed + timing /"good craftmansship"	Soil cultivation strategy
False seedbed and Pre-Em herbicides	Monitoring+ evaluation
Monitoring+ evaluation + DSS	Mechanical weeding/weed harrowing
Variety choice	Weed control in stubble from previous crop

In addition, it was asked what was needed to increase the degree of integrated control in sugar beet (Table 2). The experts and farmers agreed that further integration of mechanical control into sugar beet cultivation should be undertaken to reduce herbicide consumption and increase the implementation of IWM. Weed harrowing does not have a capacity that makes it competitive in comparison to broad spraying of herbicides at present. The realistic is a combination of band spraying and weed harrowing to hit both the weeds in the row and between the rows. In addition, according to the farmers, a higher degree of precision must be achieved to use mechanical control. However, there were some farmers who see opportunities to use the regular sprayer and shut off 50% of the nozzles and run with low boom height, as a kind of band spray. Some experts felt that farmers are using too much of a spray program at the expense of a species-specific herbicide choice.

Table 2: Answers to the question of what is needed to promote integrated weed control in sugar beet.

Experts	Landmænd
Development of robots and precision tools	Increased precision of mechanical weeding
Increased use of mechanical weeding, e.g. flaming	Technic to sow in patterns to enable weed harrowing in two directions
Increased use of targeted herbicide choice in each field	

In the study, the interviewed persons were asked to rank a number of factors that influence the weed control strategy chosen. The factors were: economy, legislation, technical factors, bio-physical, social / cultural and individual (Figure 1).

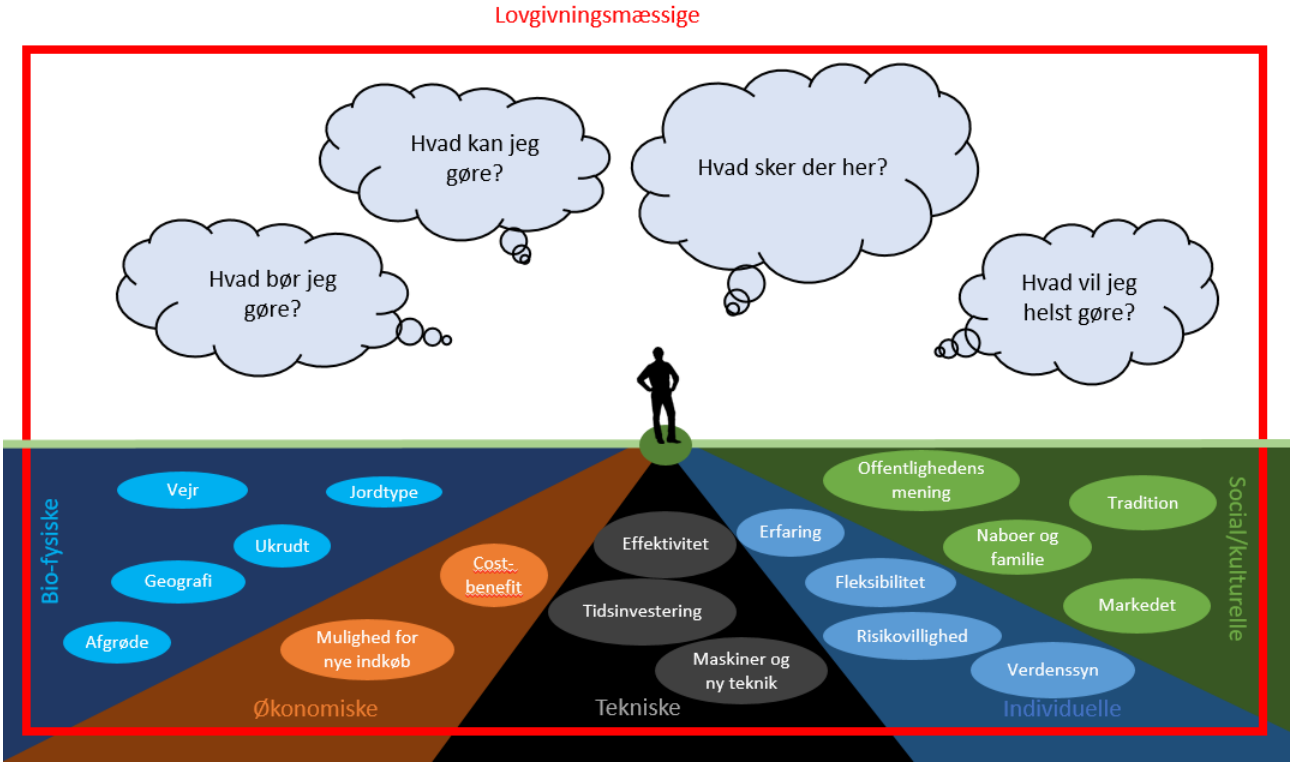

Figure 1: There are a number of factors that influence the choices the farmer takes regarding weed control. These factors can be divided into 6 groups; legislative, economic, bio-physical, technical, individual and social / cultural.

There was great agreement that legislation and economy are the factors that have the greatest influence on the choices (Fig. 2). On the other hand, the bio-physical factors were weighted higher by the farmers than the experts estimated. Eg. the farmers were very aware of their soil type and areas of soil conditions that were involved in weed control. The farmers generally did not see the technical factors as limiting the weed control they choose. They had, more or less, the machines and materials that are needed. However, there was a limitation on the capacity of mechanical weed control and a desire for increased accessibility for precision technology, as mentioned above. This gives some weight to the technical factors. The farmers themselves considered that they cannot be influenced to a great extent by the public view of the farm, whereas the experts put more importance to this. The farmer's individual attitude / outlook played a slightly greater role according to the farmers themselves than what the experts considered.

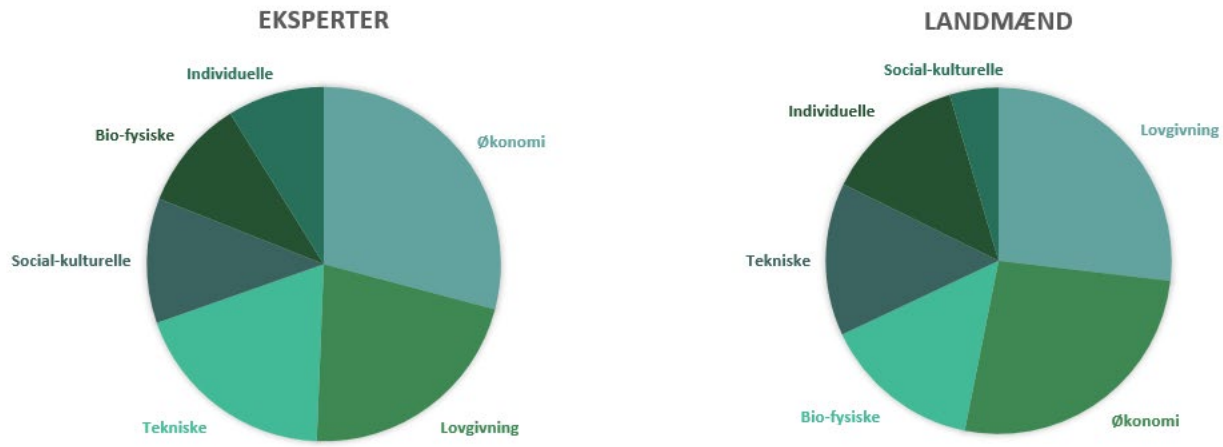

Figure 2: Weighting of the various factors suggested as important to the choices the farmer makes about weed control in sugar beets. See Figure 1 for explanations of factors.

Note: Most of these labels are similar to English, but ”lovgivning”=”legislation”, “Landmænd” = “farmers”

It is important to keep an eye on where farmers find new knowledge and seek advice when they have problems or seek inspiration (fig. 3). In Denmark, we have a large network of independent advisors, which was clearly the primary source of information. Next, almost all farmers were members of an ERFA group, which has high priority among farmers. There is typically an advisor to the meetings of these groups, so there is a connection between the various sources of information. The company advisors from seed companies and the like were also highly rated by the farmers, whereas the experts did not consider it to be a particularly important source of information. However, there may be an imbalance in this category, since it was only in the interviews with the farmers that the specific division between company advisers and information from the industry was established, as the farmers felt a need to be able to make a very specific division between the chemical companies and sellers of seed (box 3). The experts did not necessarily have the same division in mind during the interview. Two other sources of information that had higher priority among farmers than assessed by the experts are journals and the Internet in general. Many farmers are looking for inspiration in magazines, both online and in print. In addition, the Internet is generally more used than the experts assessed. Many farmers stated that they "google" a problem or a new idea to gain more knowledge. Information from chemical companies is perceived primarily as advertising, and it is with a lot of skepticism that the farmers receive this material. But it is read, and they also participate in meetings where the chemistry companies tell about their products. However, preferably meetings where several companies are represented. The social media had no professional value for the farmers, as there is no tradition of finding information via Facebook groups or other platforms. The contract workers who are hired for shorter periods were not considered to be a source of new information. However, there is a large variation in this group, as it covers both seasonal workers and machine station work.

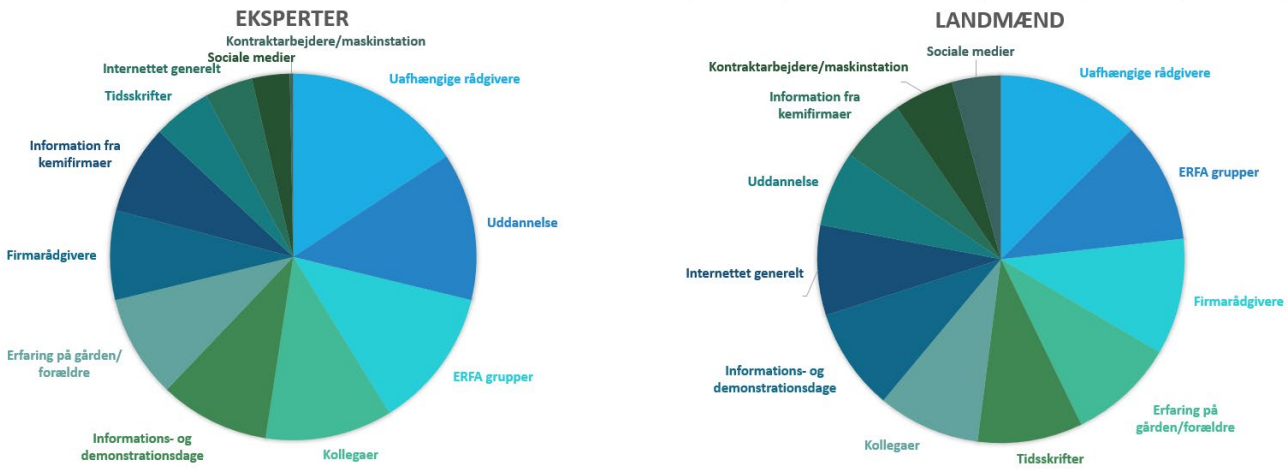

Figure 3: Weighting of the various sources of information proposed. Information sources cover the various sources that farmers can use to gain new knowledge

Uafhængige rådgivere = independent advisors

Uddannelse = education

ERFA grupper = study groups

Kollegaer = Peers

Informations- og demonstrationsdage = information and demonstration days

Erfaring på gården/forældre = experience on farm/parents

Firmarådgivere = company advisors (from farm supply business mainly)

Information fra kemifirmaer = Information from chemical companies

Tidsskrifter = magazines

Internettet generelt = Internet in general

Sociale medier = social media ☺

Kontraktarbejdere/maskinstation = constract workers

Cereals

Here too, there was a high degree of consistency between the experts' assessment and the actual weed control of the farmers (Table 3). However, no emphasis was placed on differentiated treatment of field edges by the experts, while half of the farmers saw this as an important tool for keeping specific species out of the field. In particular, farmers focused on grasses that migrate from the edges and become a problem. No great emphasis was placed on the competitive effect of the selected varieties against weeds on the part of the farmers. The variety choice is primarily a tool for diseases and renting sperm. The tools most commonly used also represented for cereals all five groups identified in the initial work; crop rotation, establishment, tillage / fertilizer, direct control and monitoring / evaluation.

The use of mechanical control in cereals was not considered practicable by farmers and experts and was not used by conventional farmers. There has been no interest and use of row cleaning in rapeseed, but it was a small part of the interviewed farmers who mention this. As for beets, it was the development of precision technology that was sought after by farmers with grain cultivation.

Table 3: The tools mentioned in the grain interviews. Experts' assessment of which measures farmers use most and what farmers actually use in their weed control strategies. The tools are listed according to how many people have mentioned them, and to what extent the individual tools were judged to have an influence on the weed population.

Experts	Farmers
Herbicides in general	Herbicides in general
Crop rotation	Crop rotation
Variety choice	Soil cultivation system
Seeding time	Differentiated treatment of field edges
Soil cultivation system	Sowing time
False seedbed	Monitoring+ evaluation

Quality of seedbed + timing /"good craftmansship"	Variety choice
Monitoring+ evaluation + DSS	Weed control in stubble from previous crop
	Increased seeding density to control grassweeds (Vulpia, VLPMY)

As for beet growers, both farmers and experts were asked to rank a number of factors according to the influence of weed control strategies (Fig. 4). Economy and legislation had the greatest influence on the choices farmers make. There was no correlation between the two interviewed groups' ranking of the other factors. The farmers attach much greater influence to the bio-physical factors than the experts, who considered it to be the least influential factor.

On the other hand, the farmers did not believe that it was the technical factors that put restrictions on their choice of weed strategy. It is by far the same picture for sugar beet and grain, where farmers attributed much less influence to the environment (social / cultural factors) than the experts considered.

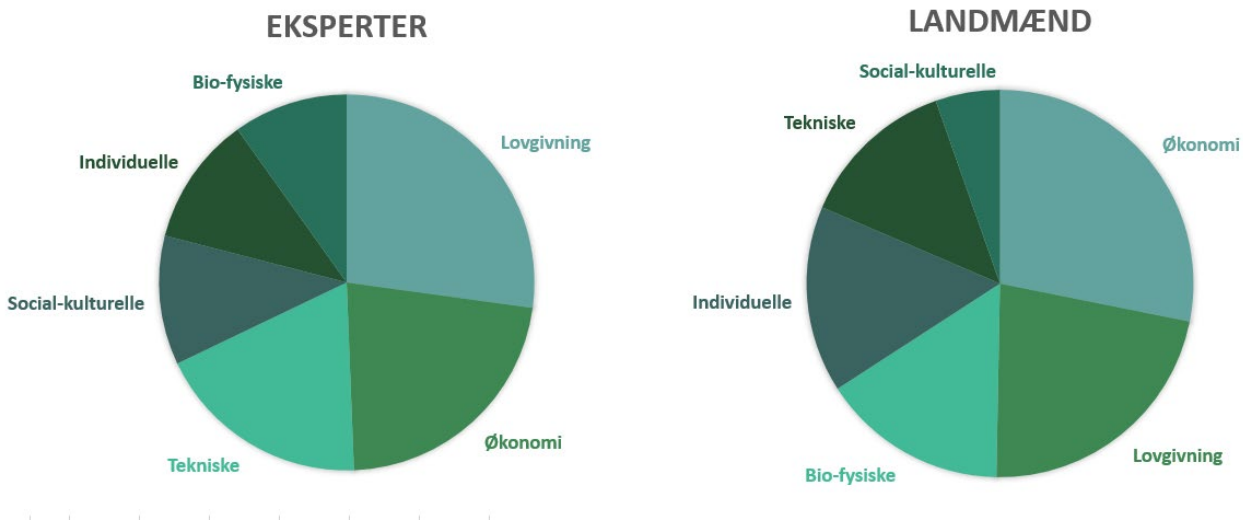

Figure 4: Weighting of the various factors suggested as important for the choices the farmer makes about weed control in sugar beets. See Figure 1 for explanations of factors.

Note: Most of these labels are similar to English, but "lovgivning"="legal", "Landmænd" = "farmers"

Again, there is no doubt that the independent advisers are most influential in the flow of information to farmers (Fig. 5). ERFA groups and colleagues also play a major role, which both experts and farmers acknowledge. Education is low for farmers, who attaches much more importance to the subsequent experience. One can argue that experience is not a source of information in the traditional sense, but here was asked how farmers find their information and how they get input to develop their strategies. Here, their own experience is an important source of information. A number of small trials are being carried out at farm level, where farmers experiment with the solution that is right for them. These experiences are shared with ERFA groups and other colleagues. There is generally the same picture for beet and cereals.

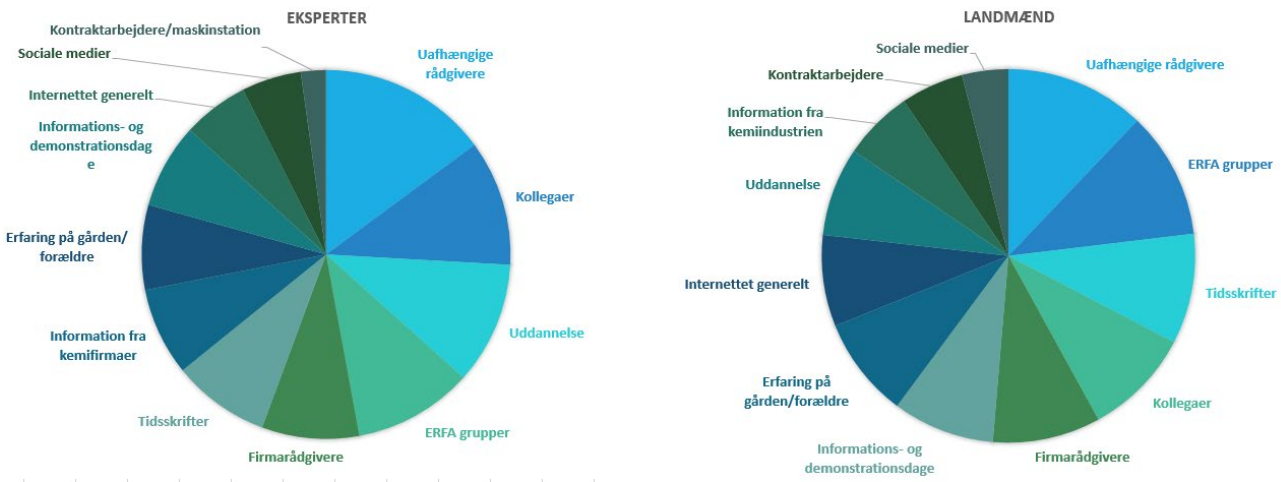

Figure 5: Weighting of the various sources of information proposed. Information sources cover the various sources that farmers can use to gain new knowledge

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Box 3: Reservations

There are minor differences between the way in which the interviews are performed for experts and farmers. The interviewer was very passive in the expert survey and let the interviewees decide which topics were discussed.

Experience showed that this strategy worked less well for the interviews with farmers. There were too many issues that were not affected at all in these interviews, unless specific tools were asked. Therefore, the interviewer specifically mentioned the tools that one could imagine, for example. mechanical control, differentiated treatment in field edges, catch crops, sowing points, etc. This can cause minor deviations and make the comparison less accurate. However, the way to rank factors influencing weed control and sources of information is identical.

The further analysis of these results will take place at the European level under the auspices of IWMPRAISE and will be conducted by researchers from Wageningen University and Research.