KNOWLEDGE MANAGEMENT IN WESTSIK'S CROP ROTATION EXPERIMENT

Lazányi János

University of Debrecen Centre for Agricultural Sciences

Abstract

Knowledge management is an approach for addressing the information. It includes the practice of capturing, storing and sharing knowledge and is vital to improve the quality. The best known and most remarkable example of continuous production in Hungary is the Westsik's crop rotation experiment established in 1929, which is still in use to study the effects of organic manure treatment, develop models and predict the likely effects of different cropping systems on soil properties and crop yields. Such experiments are costly to maintain, but their cost can easily be justified if they serve a number of different objectives and provide data to improve agricultural practice. In this respect, Westsik's crop rotation experiment provides data of immediate value to farmers concerning the applications of green, straw and farmyard manure.

The experiment also provides a resource of yield, plant and soil data sets for scientific research, into plant and soil processes which control soil fertility, or into the sustainability of production. Moreover, maintenance of Westsik's crop rotation experiment can also be used to illustrate the value of knowledge management for the farmers of Nyírség region. Westsik crop rotation experiment is an important example for standardized approach in improving the competitiveness of the agricultural production and environmental consideration. It should be considered as a reference to sustainable agricultural production for improving the economy, environment and the countryside as the application of knowledge is vital in diversification of the rural economy and to improve the quality of life in rural areas.

There are different models of knowledge. The way of Vilmos Westsik is to "Go to the field, look at the thing, and understand the processes." He also thinks that theories is important and says to colleagues „Go to the field," and repeat five times "why" in order to look beyond for the essence. The knowledge management does not stop there as the farmers have collective discipline of "not yet". This means constant development of practices beyond compromises. Field day is an important factor of knowledge management, where context is shared. In field day farmers are coming together with ideas, thoughts, they share their context, and they engage themselves in real dialogue. It is not a formal meeting and everyone is committed to create knowledge.

Key words: knowledge management, crop rotation experiment, Vilmos Westsik, field days

INTRODUCTION

Sustainable farming is more than putting an ecological system together. Sustainable agriculture, being a living system, always behaves differently under different circumstances, since it has to adapt to the environment. Even the best sustainable system can fail if it is not adapted properly (Lazányi 2008, Lazányi and Henzsel 2009). The function of knowledge management is to develop a model, which can be used in farming operation by taking the local natural resources into account. Long-term experiments are also essential to investigate the effects of crop rotations and organic fertilization on soils, as a number of cultivation methods, such as diversified crop rotations and the application of organic manure, have a long-term effect on the physical, biological and microbial parameters of soils. It often takes decades for the quantity and quality of soil organic matter and to reach a new dynamic equilibrium (Smith et al. 1997, Barth 2000).

Although, there is a difference between information and knowledge management farmers usually do not have the time to make and think about the unique experiences and knowledge gained. However, by taking part in field days organised in the Westsik's crop rotation experiment, they contribute to knowledge management and are able to use the information in their work for the improvement of specific areas. Information management focuses on the collection, structuring and processing of data (Lazányi 2003, Rasmussen et al. 1998). Reliable and timely data are important for effective knowledge management, but it is only one part of the picture. Knowledge management may be derived from information, but it also implies an analysis of the data and information by farmers and researchers. There are many reasons why an effective system of knowledge management is important, but the analysis is critical to apply knowledge and bring better results (Bukowitz and Williams 1999, Eisenhart 2001).

By analysing data, information and experiences, farmers can capture valuable insights into scientific ideas and practical processes to improve their own performance (Denning 1998). Essence of knowledge management is sharing these experiences and farmers collectively can (i) avoid repeating past mistakes; (ii) highlight good practice to be replicated elsewhere; (iii) make their work more relevant, effective and accessible; (iv) compare experiences and draw out common issues and challenges; (v) influence policy and strategic thinking by rooting them in experience; (vi) make lesson-learning, and thereafter capacity-building, a conscious and habitual process within the organization of farmers; and (vii) help develop strong networks among farmers.

Knowledge management means different things to different people. In this paper the creation, organization, sharing, and use of knowledge are defined for farmers developing sustainable agriculture in Nyírség region. Farmers have personal knowledge and experiences in production, experts have experience with extension and research work. Knowledge management in Westsik's crop rotation experiment is the process, where farmers, mangers and/or research workers share their experiences, and then collectively build on them to improve the way they work as well as the results of their work.

MATERIAL AND METHODS

There are many ways in which farmers can practise knowledge management. Often they are already doing so without realizing it. By participating in a workshop and sharing personal experiences of what is worked and what did not in a particular region or within a specific research area, participant are passing their knowledge to others. By responding to a query on the production data, farmers are also sharing knowledge that may be applied by others. There are more informal ways of contributing to knowledge management, such as participating in a field days connected to Westsik's crop rotation experiment. Place, tradition and social environment created by Vilmos Westsik are very excellent for knowledge management (Westsik 1951, 1965).

The Experimental Farm was established in 1927, after the First World War, when Hungary lost two-thirds of its territory and growing attention was paid to the production on the low quality sandy soil occupying 20 per cent of the total arable land in Hungary. Many attempts were made to improve soil fertility, but the availability of farmyard manure was a serious limiting factor in this region. Fermented straw manure and mulch were among the available possibilities to increase soil fertility in region, where rye was cultivated on more than 50-70 % of the growing territory. Crop rotations, which included forage crops and/or leguminous green manure crops, were also introduced to improve the fertility. Field days are organised from the very beginning creating an environment where internal processes are structured to support people in creating, sharing and using their knowledge.

RESULTS

1./ Sustainable agriculture: Sustainable agriculture avoids or minimises the use of non-renewable production inputs. To achieve these objectives, farmers employ a variety of alternative production and management practices and try to maximise the use of (i) on-farm resources such as legumes and manure to provide plants with nutrients, (ii) crop residues, covering crops and conservation tillage to control soil erosion and nutrient leaching, (iii) crop rotation to control weeds, insects and diseases, (iv) energy conserving tillage system to save energy and reduce operation costs. In this way, farmers seek to minimise their dependence on costly off-farm resources. Traditional farming is based on reading the signs provided by nature, as well as those of individual fields and animals, and, on farmer intervention, to affect ecological systems. The return to such principles is an attractive task for farmers and also for research scientists.

Sustainable agriculture is a holistic approach and it is important to be prepared and know in advance what to do, how to do it, and where to get additional information from. Extensive planning in such circumstances is possible and necessary, but it needs to be wide and well established. Vilmos Westsik applies his experiment to strengthen knowledge management and contributes to a continuous knowledge base both in fast economic development, in crisis and recovery. It is even more important that farmers have processes and tools, which allow developing, sharing and applying experiences and scientific bases from agricultural production to environmental consideration. In this way, mistakes can be avoided and good practice can be replicated to improve the quality of life. Developing an appropriate crop rotation scheme is one of the most challenging tasks for ecological agriculture. Farmers should develop a rotation plan with both the needs of the farm and the needs of the sustainable system in mind. Farm requirements include such considerations as a market for the crops in the rotation, suitability to the soil, ecological conditions, equipment requirements, as well as those for farm feed and cash flow. Sustainability requires a crop rotation that can accomplish as many of these objectives as possible.

Crop rotation should also provide effective weed control by (i) alternating between cold and hot weather plants, (ii) including plants adapted to mechanical weed control, or with (iii) allelopathic properties, including (iv) legumes, and (v) crop with fibrous root systems to improve soil structure. Crop rotation should also provide effective insect and disease control.

Green manure crops play an important role in regenerative soil conservation strategy. Green manure adds organic matter to the soil, assists in dissolving nutrients, brings up nutrients from the subsoil and improves the water holding capacity of the soil. The crop rotation system should improve soil condition by including deep rooted plants and plants with a fibrous root system, to improve the stability of soil aggregates. Studies have shown that cultivated fallow and monoculture destroy soil structure, increase evaporability and soil compacting. In turn, by increasing the stability of aggregates, farmers increase water infiltration and retention. This, in turn, not only improves the ability of soil to sustain a plant in drought conditions, but also helps to reduce both wind and water erosion.

There is also evidence suggesting that an improved soil structure increases biological activity in the soil and enables plants to utilise soil moisture and nutrients more effectively. Crop rotation can also contribute to soil conservation strategy by including a leguminous crop in the rotation. Nutrients and trace elements may also be assured or enhanced by including certain other crops into the rotation.

2./ Westsik's crop rotation experiment and knowledge management: in 1929, when the long-term experiment was established, knowledge management was not a separated discipline. However, Vilmos Westsik was practising knowledge management without

realizing it and with a little extra effort we can capitalize on these effective knowledge management techniques even in our time. Field days are excellent way of exchanging information and knowledge with colleagues. It should not be introduced simply for the sake of having more meetings, but rather to allow more face-to-face contact with farmers and opportunities to share experiences and views on substantive issues. Meetings are focus on specific issues of agricultural production or environmental issues. For many years, Vilmos Westsik facilitated the meeting and focused on drawing out the main points or a few key lessons. As a note speaker, he was brief in sharing information with farmers on soil fertility management an general and very detailed in explaining treatment of field experiment. The treatments of the Westsik's crop rotation experiment were intended to increase soil fertility using different organic matter amendments, as the original purpose was to evaluate the cumulative effects of organic matters on light sandy soil with a long history of arable cropping.

The F-1 block received no fertilisers and organic material treatment except the rye and potato roots and straw incorporated into the soil. The fallow in this block was green, and the plant material produced was ploughed into the soil. The F-2 block represents green manure treatment, where lupine was grown as a main crop and incorporated into the soil 4-5 weeks after flowering. The phosphorus and potassium fertilisers in this treatment were applied the previous autumn, before the lupine was sown. The F-3 represents lupine root manure treatment, where lupine was grown for grain and the total organic material, except for the grain, was incorporated into the soil. Blocks F-4 - F-7 represent straw manure treatments. In the F-4 block, rye straw was applied as mulch. In blocks F-6 and F-7, straw manure was fermented without nitrogen, and in block F-6, with nitrogen addition. The straw manure was incorporated into the soil 4-6 weeks before the sowing of rye.

F-8 is the only block with 4 main crops, where lupine grew twice in 4 years; once as a main crop produced for grain and once as a second crop produced after rye and before potato, for green manure. In the F-9 block, lupine was grown as a forage crop and harvested 2-3 weeks after flowering. Blocks F-10 and F-11 represent farmyard manure treatments without and with supplementary fertilisers, respectively. In block F-12, lupine is grown after a green forage crop and sown in May. This block is also evaluated with farmyard manure treatments to measure the comparative effects of the two treatments. Blocks F-13, F-14, F-15 represent green manure treatments, where lupine is grown as a second crop after rye and before potato. The F-15 block received no supplementary fertilisers. The difference between blocks F-13 and F-14 can be found in the time of the incorporation of green manure.

3./ Rules of knowledge management in sustainable agriculture: Although there is no right or wrong way to practise knowledge management, but there are some key issues in the knowledge management of sustainable agriculture worth remembering.

1. Meeting demand: When developing a knowledge product, it is important to consider carefully who will be the audience, what is the demand for advice on a particular subject area and in what format will the knowledge product be shared and acted upon most efficiently.
2. Strategic: Ensure that the knowledge and expertise that you are providing links with strategic objectives of farmers, not only for the production practice, but more widely in environmental management.
3. Relevant: Your knowledge should be up to date and current. Focus ideally on new initiatives of Common Agricultural Politics (CAP).
4. Practical: Remember that farms are practice-based, profit oriented companies. The knowledge that you share will potentially be translated into future production procedure or management practices. The emphasis should therefore be on sharing

practical experience. Try to back up recommendations and advice with concrete experience projects and processes.

5. Replicable: Examples of good practice are often environmental-dependent. Explaining all contexts (political, environmental, socio-economic, etc.) helps farmers to judge whether realising proposed activity or process in different environment is likely to yield similar results.
6. Accessible: Use a format and style that gives the best chance of reaching and being understood by the target audience. Write reports and presentations as simply as possible. Avoid jargon, and think about using charts, checklists and short case studies to make the document more accessible. Consider the practical as well as the scientific audience.
7. Personal: The knowledge shared in connection with Westsik's crop rotation is based on field experienced and farmers can visit and scrutinise the plots and witnesses the development of different crops.
8. Critical: On field days farmers can profit from outside experts to discuss both the negative and the positive impacts of the experimental work. For example, it is difficult for manager of experimental farm to consider many aspects of production and environmental consideration.
9. Followed up: It is important to follow up to ensure that recommendations have been received, understood and acted by farmers. Good practice changes quickly in agriculture.

In Westsik's crop rotation experiment, fallow (F-1) is considered as a control treatment, for neither the organic manure nor the fertilisers were applied. Only the two test crops potato and rye are grown and in the third years follow is practiced to improve soil fertility. All the other treatments of the crop rotation experiment can be grouped according to the method of organic matter amendment. Crop rotations F-2 and F-3 represent the treatments with lupine grown as a main crop for green and root manure. Growing a leguminous crop, i.e. lupine, as a main crop ensures the organic matter supply in these cases. F-8, the only four-course crop rotation, can also be classified in this category, although, in addition to root manure with lupine as a main crop, it includes green manure with lupine as a second crop.

The second category includes the treatments with straw manure when rye straw is used as the basis for organic matter supply; therefore, rye is grown in the first and the third courses of the rotations. In the F-4 treatment straw mulch is applied; while in F-5, F-6 and F-7, with fermented straw manure used. In the F-5 treatment, straw manure is fermented with nitrogen, while in the F-6 and F-7, only water is added, without fertiliser. In this category, F-7 represents the control plot, because it does not receive any other nutrient except for the straw manure fermented with water.

Crop rotations based on the production of green fodder can be grouped in the third category. In the F-9 treatment, the fact that lupine green fodder is grown offers an opportunity for comparing its effects to those plots producing both green and root manure as main crops. The effects of farmyard manure can be investigated in crop rotations F-10 and F-11. The difference between these two is that the latter treatment also involves fertiliser supplement.
F-12 models the production of mixed winter fodder crops. After harvesting, the land is utilised with lupine green manure as a second crop. Crop rotations F-13, F-14 and F-15 were installed to allow the study of the effects of lupine green manure grown as a second crop. They differ in fertilisation characteristics and in the timing of ploughing under the lupine green manure. In F-13, the lupine green manure is already ploughed under in fall; in F-15, no fertiliser is applied.

Yield data from the treatments of Westsik's crop rotation experiment provide information on the following points: (i) comparison of farmyard manure with other organic

manure available in the region: rye, straw, and lupine green manure; study effects of different organic manure with or without NPK fertilisers; (iii) comparison of mulch and rye straw manure fermented with or without nitrogen supplement; (iv) comparison of lupine green manure as a main and as a second crop; (v) comparison of the effect of lupine grown for grain, forages and green manure on soil fertility; (vi) study effects of lupine green manure and (vii) study residual effects of different organic manure.

4./ Knowledge management strategy in Westsik's crop rotation experiment: Knowledge management strategy is a plan for sharing and applying knowledge and expertise. The development of a knowledge management strategy is recommended in all management activities. In Westsik's crop rotation experiment the strategy is a way of consolidating, improving and systematizing existing information. Strategy helps to: (i) increase awareness and understanding of good knowledge management practice; (ii) give a clear plan about where you are now, where you want to go, and how pilot farm manager plans to get there. The most important factors in guiding a knowledge management strategy are connected to CAP and the New Hungary Rural Development Programmes. A knowledge management strategy should also be consistent with human resource and local information technology available. A knowledge audit can reveal the management needs, strengths, weaknesses, opportunities, threats and risks. It provides an assessment of where you need to focus your efforts. Knowledge management strategy in Westsik's crop rotation experiment is based on (i) farmers to motivate and to realign them with central aims of sustainable agriculture; (ii) specific knowledge management tools and processes and (iii) supporting technological infrastructure. Knowledge management strategy in Westsik's crop rotation experiment is focused on connecting farmers with farmers.

Data and information management is compiled by the staff members of the experimental farm, so the strategy is focused on both collecting information and connecting peoples. Field days are the most important activities that are easy to plan and implement and they contribute to a positive knowledge-sharing environment. This gives farmers to meet yearly and discuss environmental programmes or best management practices. Westsik's crop rotation experiment allows farmer keep rural development strategy alive with real examples of knowledge management from agricultural practice.

Knowledge management activities include a product as well as a process component as Westsik's crop rotation experiment is effectively integrated into the programme of field days. Knowledge management products in Westsik's crop rotation experiment can be grouped as concepts, practical guide and management tools. Processes of these products are developed and maintained continuously by the staff members of experimental farm. Issues to be addressed in defining programme for the field days are includes (i) finding comparative experiences to draw upon and (ii) seeking out state-of-the-art thinking and approaches in the particular thematic area of production and environmental practices.

In general, farmers can be grouped into two broad categories: (i) the general group that needs introductory and broad guidance, and (ii) the expert group that demands detailed, in-depth and technical expertise. Knowledge management processes of Westsik's crop rotation experiment define how to develop a specific product, or how you mainstream knowledge management into the way we do business. For certain products, such as *Best practice* or *Lessons Learned* papers, the development, validation and dissemination processes are as important as the product itself. Such processes take time, resources and technical capacity. Technology development is based on the New Hungary Rural Development Plan and Common Agricultural Politics.

DISCUSSION

Knowledge is quite different than money. It can be created inside a community through research and collaboration and often results in new knowledge, when distributed, shared, or used. Critical reasons to adopt a knowledge management approach within Westsik's crop rotation experiment have been to capture knowledge needed to develop agriculture, to manage existing information more effectively, and to enable farmers in Nyírség region to work collaboratively. The building blocks of knowledge management include data, information, and knowledge. Knowledge is commonly divided into two categories: explicit (written, spoken) and tacit (held by individuals, insight). Knowledge management in Westsik's crop rotation experiment is an approach planned by the staff members of the experimental farm and community of farmers. It is focused on collecting, evaluating, integrating, sharing, improving, and generating value from long-term crop rotation experiment and the field days connected to it. The transition of information to knowledge can significantly enhance the ability of local peoples to carry out actions to address their goals. Effectiveness is dependent on the management of pilot farm to access accurate information, perform appropriate analyses, and react to ecological, social, political and economical changes as quickly as the situation demands.

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