

Chapter 2

A Knowledge Approach to Sustainable Agriculture

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Abstract The Dutch agricultural sector is facing major challenges, which can affect the entrepreneurial farming activities. One of the major challenges is the adoption of practices leading to sustainable agriculture. Therefore, it is relevant to investigate the knowledge of the main actors in agriculture: the farmers. In this project, the way farmers structure their knowledge is studied. The study was completed through filling questionnaires by interviewing them. It was revealed that farmers possess knowledge of their own about their enterprise, but they also receive knowledge from external sources. Through this organized survey, we identified the concepts that farmers associate with sustainable agriculture. However, it is not clear whether the farmers' knowledge is sufficient and suitable to adopt sustainable practices.

Keywords Agriculture • Cognition • Knowledge • Netherlands • Sustainable

1 Introduction

In the Netherlands, there is an increasing social demand for making agriculture more sustainable (Poppe et al. 2009). There have been many definitions about sustainability; however, none of these definitions clearly defines the concept of

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sustainability (Jorna 2006). It is a matter of serious debates (Robinson 2004). Sustainable agriculture was not a major issue in the 1960s and 1970s. The goal in those years was to grow enough food thanks to the green industrial revolution (Brady 1990). After being highly productive for more than half-century, agriculture now aims at being sustainable. There is a consensus that the different definitions of sustainable agriculture discussed in literature include (to a different extent) three basic elements: the natural environment, economic profit and the welfare of society. These concepts are included in the term “Triple Bottom Line or 3P’s (People, Planet and Profit or Prosperity)” coined by Elkington in 1994. It should be noted that the three basic elements that are specified are only for clarifying and analyzing human thinking about sustainability, since these issues seldom fall in one specific category. Sustainability issues are a complex combination of the 3P’s.

From a “Planet” perspective, agriculture is based on plant growth and on how different conditions as soil fertility, climate and pests affect it. The focus is on how various management practices and environmental conditions affect yield and how these conditions can be improved. Focusing on this aspect of sustainable agriculture leads to maintaining or improving current levels of biophysical productivity. From a “profit” perspective, agriculture is an enterprise at the farm level and an important economic sector at the international, regional, national and local levels. The focus on massive production was the main driver of the so-called green revolution, also known as the industrialized or conventional model of agriculture. The downside of conventional agriculture is that massive application of modern agricultural techniques has resulted in numerous ecological disadvantages, such as mismanagement of resources leading to land degradation, impoverishment of the rural masses and the fact that farmers increasingly depend on a few agricultural multinationals.

From a “people” perspective, agriculture is viewed as a producer with focus on its ability to satisfy requirements for food and fiber. Here, sustainable agriculture is associated with the prospects of meeting national and global food needs, quality and security of food supply, labor conditions, learning, well-being of people and human development on a general sense. Human development comprises the process of enlarging people’s choices at three essential capabilities: to lead a long and healthy life, to be knowledgeable and to have a decent standard of living (McKinney and Schoch 2003; Szirmai 2005). Table 2.1 shows the positive aspects of sustainable agriculture and the challenges it faces.

As Viederman (1990) points out, sometimes we are self-satisfied with our wisdom in moving ahead with sustainable agriculture. However, sometimes that wisdom is difficult to transfer and it requires not only speaking about sustainable agriculture, but also understanding its meaning for different stakeholders to satisfy their needs. In agricultural sector, the main stakeholders are those directly linked with agricultural practice and activities: the farmers. Thus, a key issue is not to establish just a conclusive list of sustainability indicators, but to investigate and understand the concepts that farmers associate with sustainable agriculture and find ways as how to achieve it. In trying to understand sustainable agriculture, it is important to focus not only on the state of affairs in the physical world, but also on how humans process knowledge about sustainability. It can be argued that in order to explore the meaning of sustainable development for different actors, a framework based on knowledge theory and

Table 2.1 Characteristics of sustainable agriculture

Positive aspects	Challenges
Aims at equilibrium among the basic ecological cycles and natural balances diminishing pollution	Lack of a concise definition
Ensures that the basic nutritional requirements of present and future generations, qualitatively and quantitatively, are met while providing a number of other agricultural products	Operationalization is sometimes difficult, especially concerning the social aspect
Provides long-lasting employment, sufficient income, and decent living and working conditions for all those engaged in agricultural production	Time consuming in reaching consensus among the different actors
Maintains and enhances the productive capacity of the natural resource base as a whole, and the regenerative capacity of renewable resources	Requires a new approach in thinking
Strengthens self-reliance of the farmers	To be independent

knowledge management can be used. Such a knowledge approach focusing on farmers is hardly found in the literature on sustainable agriculture. Only Laukkanen (2000) explores the notion of sustainability of the structure and dynamics of different agrarian municipalities in Finland as social entities and micro economies, and Boone et al. (2007) reported about the knowledge that extension educators have concerning the dimensions of sustainable agriculture.

2 Knowledge Approach

McElroy (2008) identifies knowledge as the key factor regarding sustainability. Farmers can be considered as human information processing systems. Human decision-making involves two components (Newell and Simon 1972). First, we have the farmer personal characteristics. In this respect, there have been studies regarding the personal characteristics (or traits) that influence farmers in order to adopt (or not) specific farming practices (de Lauwere et al. 2004). In the second place, there are person’s knowledge processes regarding farming practices. With knowledge processes, we mean the processes that individual farmers undertake to understand the information they received. These processes are divided in two domains: the static domain (which deals with the way an individual structures knowledge), and the dynamic domain (which deals with the reasoning processes of an individual). According to Gardner and Stern (2002), in spite of agreement on the fact that human activity is the cause of several environmental threats, there are just a few studies that study the human (cognitive or mental) dimension in detail, let alone in an operational way. We think that by studying the two domains of knowledge (static and dynamic), we get insights into the alignments farmers have with sustainable agriculture. The study of the static domain allows identifying the associated concepts with sustainable agriculture. The dynamic domain allows distinguishing mindset orientations as well as reasoning patterns. We state that agriculture is sustainability oriented, when it is ecologically sound, economically viable

and socially appropriate. Since the study of sustainable agriculture is not about optimizing one of these single factors, but about having equilibrium among them, we claim that a sustainable-oriented mindset looks for an overall and integrated view among these aspects. In Table 2.2, we present concepts that can be used to distinguish a sustainable oriented mindset from the mindset of classical farming.

From a knowledge perspective, we can distinguish in the European Union (Fig. 2.1) a transition in the knowledge approaches for every model of agriculture going from a conventional model of agriculture towards a sustainable model. Before 1945, there was a traditional model of agriculture. After the war period, the agricultural policy was based on maximizing the production yields in order to avoid food shortages. This goal developed into a situation that fosters a maximization of possible profits. In this period, the knowledge approach was oriented towards increasing production. The focus was on private companies and universities that helped the farmer and relied on public and private investments (Van der Ploeg and Roep 2003). The concept of sustainable agriculture appeared along with the concept of sustainable development, during the 1980s. The importance of the concept was recognized and confirmed at the Rio Earth Summit in 1992 (United Nations Division for Sustainable Development 2010). After 20 years, it is now recognized that the one-way top-down approach – where the farmer is told what to do – is insufficient to allow bottom-up interactions and feedbacks necessary for ‘natural’ diversification and system adaptation (Morgan and Murdoch 2000).

Table 2.2 Focus of sustainable oriented mindset on an agricultural system

Less sustainable oriented mindset	More sustainable oriented mindset
Focus only in specific units of the system	Focus on interrelations among units
Focus on “straight” chains in the system	Focus on networks within the system
(Lack of) focus on different interactions	Focus on feedback loops among units
Short time perspective (here and now)	Long time perspective (there and then)

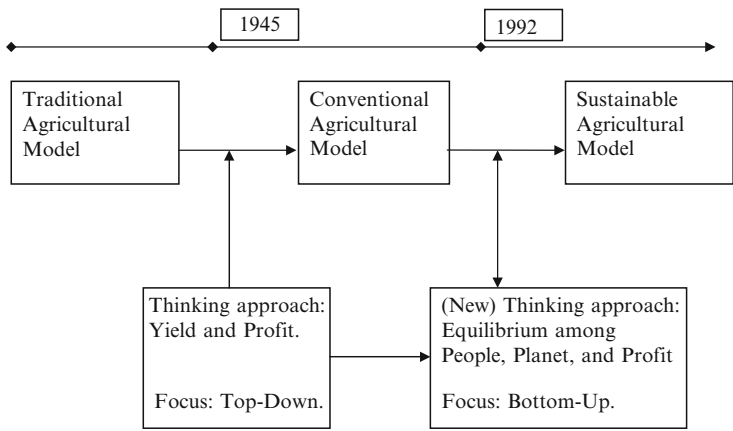


Fig. 2.1 Knowledge transition in agriculture

The top-down approach still dominates current visions of sustainable development of the agro-sector. Consequently, scientists and policy makers have typically defined indicators of sustainable development only. We argue that the “top-down” focus in the “old thinking” approach has to be adapted such that practice is embodied in the farmer’s knowledge structures as part of the farmer’s models of the world. We argue in favor of bottom-up models. These models provide a basis for planning, deciding and acting or reacting upon in specific circumstances. Farmers should possess agricultural-related knowledge structures that are used to interpret events or to initiate, formulate or recommend plans, projects or decisions.

The complexity of sustainable agriculture requires individuals to possess much knowledge regarding agricultural systems in order to make them behave in a sustainable way. Additionally, individuals require the acquisition of new insights and forgetting old customs that stand in the way of sustainability. Hence, local knowledge constitutes an extensive realm of accumulated practical knowledge and knowledge-generating capacities that is needed if sustainability and development goals have to be reached. This asks for a bottom-up approach, meaning an approach starting from the individual interpretation of that context. Therefore, it seems to be relevant to understand what knowledge farmers have about sustainable agriculture. It is also relevant to identify mind-settings and reasoning patterns used by farmers to interpret this knowledge.

The lack of a standard definition of knowledge is reflected in the different classifications of knowledge in literature. Jorna (2007) offers a model for knowledge types. The model can be used to assess the types of knowledge an agent has in performing certain kinds of tasks. The model refers to the three dimensions involved in knowledge representation. The first dimension is *sensory* knowledge. It starts from a perception of difference, interpreted in terms of an analogy, which is imitated in behavior. The second dimension is *coded* knowledge (texts and manuals). Codes can be categorized by taking into account the kinds of elements and combination rules a code consists of. The third dimension concerns *theoretical* knowledge. This dimension is about the structural relationships among events and categories of events. It looks into chains of reasoning, operationalized in “questions-why”. In the case of agriculture, we are interested not only in the mental models that farmers possess, but in the types of knowledge they might favor. The types of knowledge give an insight regarding the way farmers prefer to reason and to learn. Their understanding is relevant to support the bottom-up approach towards sustainable agriculture.

3 Exploratory Study

In order to understand the knowledge that farmers have regarding sustainable agriculture, we decided to carry out a pilot study to test communication and gather information prior to a more detailed investigation. Soil conservation practices should be a prime target in sustainable agricultural systems (Sojka et al. 2003;

Janvier et al. 2007). Hence, we work in combination with a leading laboratory in the agricultural sector in the Netherlands (BLGG, Oosterbeek, The Netherlands). Its core business is to analyze soil samples to determine its physical and chemical characteristics. The laboratory staff collect around 500,000 samples every year and provide technical advice when the customer asks for it. The laboratory aims at helping their customers to improve production and reduce costs through using improved farming practices. The process starts when a farmer calls them in order to collect a soil sample to determine its chemical and physical composition. The laboratory collects the sample for its analysis. The results are sent back to the customers. However, it is not known how much of these results are understood and used by farmers. Furthermore, we do not know if this knowledge is suitable and sufficient to cope with the challenges the Dutch agricultural sector faces, namely being more sustainable.

The aim of this exploratory study is to understand what knowledge farmers have and what farmers do, in cognitive terms, with the information they receive. The knowledge of sustainability in agricultural activities was evaluated using a semi-standardized interview. This is a method for reconstructing subjective theories (Flick 2006). The term “subject theory” refers to the fact that interviewees have a complex stock of knowledge about the topic under study: sustainable agriculture in our case. This knowledge includes assumptions that are explicit and immediate, and that interviewed farmers are more likely to express spontaneously in an openly designed interview situation than in a standardized interview or questionnaire. Additionally, more directed questions were asked to make the interviewee’s implicit knowledge more explicit.

The interview consists of three parts. The first one is devoted to gather demographic data. In the second one, interviewees were asked a series of questions to assess their knowledge about sustainable agriculture. The third one consisted of specific questions regarding their farming practices and the sources of information they used (regarding sustainability). In some of the questions, a 5-point Likert scale was used. In order to guarantee the validity of the interviews, we follow the directives from Wolcott (1990) during the interview process. A total of 11 participants were asked for the interviews. The participants are farmers that work in the Municipality of the Noordoostpolder in the Netherlands. The participants were interviewed at their offices for 1 h. The interview was held in Dutch. This interview guide was pre-tested with a group of experts on the topic of sustainability working at the University of Groningen. In order to reproduce the interviews as exactly as possible, each one of the meetings was voice recorded.

4 Results

The interviewees were asked to provide basic demographic information, including age, years worked, educational level, the extension of their farm and the products they grow. The average age was 43 years, the oldest farmer was 62 years and the

Table 2.3 Knowledge about sustainable agriculture

Concepts		Content	No. of mentions
P's	People	Working conditions	1
		Social issues	1
		None	9
	Planet	Environmental protection	5
		Soil protection	6
		None	0
	Profit	Market	4
		Price	3
		Earnings	1
		None	3

youngest farmer was 22 years. The average years worked in the farm was 23 years. The 11 respondents had a technical vocational degree.

The results concerning the static domain of knowledge are summarized in Table 2.3. We asked open questions to gain an insight in the concepts the interviewees associated with sustainable agriculture. The 11 participants were familiar with the term “sustainable agriculture”. Most of the interviewees mentioned that sustainability is related to environmental protection, especially to the protection of the soil. Most of them mentioned that it has also some economical implications.

Six participants expressed that sustainability has mainly to do with balancing their market with environmental protection. Just one of them mentioned it has to do with social issues, such as improving the working conditions of the farmers. Two persons mentioned that sustainability has to do with the way one looks at the future. One of these persons mentioned that there are many factors to be taken into account to be sustainable, but he thinks that one should start with soil quality. Five participants mentioned that even though they had some knowledge about sustainable agriculture, they did not know how it would look like in practice.

We wanted to get insight into the opinions of the participants relative to their main sources of information when it comes to sustainable agriculture. Participants were presented with 16 possible sources of information. Participants were asked: “when you want to know about sustainable farming practices you ask to.” They were asked to rank the sources of information using a 5 point Likert scale (1: strongly disagree, 5: strongly agree).

Media communications such as internet and newspapers were mentioned as the main indirect sources of information. Direct sources of information appear to be favored by the participants. Colleagues (other farmers) and fertilizer suppliers were mentioned as the main sources of information. In this point, it is important to state that nine interviewees mentioned that they had as a main source of information agricultural organizations, such as “Land en Tuinbouw Organisatie” (Federation of Agriculture and Horticulture) or “Agrarische Unie” (Agricultural Union). These organizations were their communication link with the Dutch Government (or even with the European Union). Also, fertilizer suppliers were considered as an important source of information regarding environmental regulations in the agricultural

sector. Participants valued the sensory (tacit) type of knowledge higher and clearly the theoretical (determine and analyze relations of concepts) type of knowledge lower. This is an indication that they favor knowledge acquisition through searching for perceptual analogies rather than by inductive and deductive reasoning.

Concerning the dynamic domain of knowledge, we used a 5 point Likert scale (1: strongly disagree, 5: strongly agree). The 11 interviewees were asked a series of questions about their mindset towards sustainable agriculture in their farming practices. For this, the questions reflected the time perspective that farmers have when thinking about their agricultural practices, their focus on new knowledge acquisition and simply not interacting with new knowledge. We argue that thinking about (impacts in) the future is an important element of a sustainable-oriented mindset. The results suggest that the group of farmers denied that they practice the same techniques as 10 years ago. This is an indication of the acceptance of new techniques in work. However, they also agree in the fact that they use a new practice only if they see that it makes a major difference. In the case of sustainable practices, this implies that farmers adopt these practices if they see that their colleagues are also adopting sustainable practices. The results also show that the group of interviewees prefers to discuss problems with other farmers. This supports the finding of interviewees favoring direct sources of information.

We found that farmers are used to receive information from experts. This is an indicator that the conventional model towards agriculture discussed in Fig. 2.1 is present among them. However, it gives an opening to another issue: how do the experts think? If the experts favor sustainable practices, then it is likely that farmers eventually will know (and adopt) these practices. We also asked some questions to see whether “Triple Bottom Line” concepts were included in their way of thinking. Seven farmers agree in the fact that they try to minimize the environmental damage they may cause. This supports the findings of Table 2.3 where it is shown that the 11 interviewees mentioned concepts related to “Planet” in the Triple Bottom Line Approach.

5 Conclusions

We presented a knowledge approach towards sustainable agriculture. Through this approach, we identified which concepts are linked with sustainable agriculture (static knowledge domain). The term “sustainable agriculture” was familiar for all the interviewees even if it was not a priority for them. Participants of the study concur with the notion that sustainable agriculture has mainly to do with the environment. We got insights in the sources that provide information regarding sustainable agriculture. Direct sources are valued higher. The interviewees also favored favor knowledge acquisition through searching for perceptual analogies (sensory knowledge) rather than by inductive and deductive reasoning (theoretical knowledge).

There were some signs of both conventional and sustainable-oriented mindsets, but there was not a clear indication regarding the participant's mindsets (dynamic knowledge domain). With such a divergence of findings, across even this small sample of Dutch farmers, we point to the possibilities and the barriers of the adaptation of "sustainable agriculture" used in the sources of information that farmers have. One favorable sign on the mindset of farmers is that most of them discuss problem with others to solve the problems. The goal of developing sustainable agriculture is the responsibility of all participants in the system, including farmers, workers, policy makers, researchers, retailers and consumers. Each group has its own part to play and its own unique contribution to strengthen the sustainable agriculture community. We believe that considering the concepts that farmers include in each model of farming practice will help the transition from a conventional to a sustainable agriculture. Hence, we will continue our research efforts studying and evaluating farmers' world-views and reasoning patterns regarding sustainable agriculture.

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