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Looking for the missing link: The multiple meanings of sustainability in agricultural knowledge and information systems

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Abstract

Purpose: The challenge of sustainability generates the need for multi-actor collaboration schemes, which set and pursue mutual goals. In this work, we aim at depicting the different meanings attributed to the concept of sustainability by Greek farmers, advisors, and agronomy students. We also attempt to explore the ways through which sustainability-related knowledge is constructed by these three groups and to identify the major obstacles in the knowledge construction process.

Design/Methodology/Approach: To answer our research questions we followed an iterative qualitative approach. Data collected through focus groups, semi-structured interviews, and observational research, were combined into a common thematic analysis.

Findings: The analysis uncovered that participants seem unable to fully understand the intercorrelations among the three dimensions of sustainability, thus losing the opportunity of drawing the big picture of sustainable agriculture. Farmers and advisors emphasize the economic dimension of agricultural sustainability, whereas students prioritize the need to

embrace environmental strategies in farm practice. The low levels of trust between farmers and advisors, the different types of skills and knowledge they possess, and the lack of knowledge networks in which scientific and practical knowledge can be combined reduce their opportunities to reach a common understanding of sustainability. Moreover, the limited attention paid by the Greek system of agronomic education to the development of sustainability-related knowledge and skills restricts advisors' ability to develop key competencies needed to guide the transition towards sustainable agriculture.

Practical/Theoretical implications: Findings reveal that key actions are needed to rebuild trust between farmers and advisors, create webs for knowledge co-production, and provide students with opportunities to develop facilitation skills.

Originality/value: This work, aiming at understanding the multiple meanings of sustainability for farmers, advisors, and agronomy students, uncovers barriers to the transition towards sustainable agriculture.

Keywords: sustainability, AKIS, farmers, advisors, agronomy students, sustainability-related knowledge

Introduction

Worldwide, agricultural knowledge and information systems (AKIS) focus on the promotion of sustainable farm production models which can secure farmers' economic well-being while in parallel conserving natural resources and maintaining social balance (Adolwa et al., 2017; Gava et al., 2017; Zecca and Rastorgueva, 2017). Today, there is a general agreement that to achieve agricultural sustainability all the actors and the sub-systems of AKIS should develop a mutual understanding of sustainability, set and pursue common goals, and adopt a uniform vision of the future. Nevertheless, despite the fact that all the actors involved in the production and supply of agrifood products advocate sustainable development (Francis, 1990), the meaning attributed to the concept of sustainability heavily depends on the priorities set by each actor (Sydorovych and Wossink, 2008; Kamali et al., 2014).

In the case of AKIS, it is well known that participating organizations and individuals have multiple and often conflicting foci (Lioutas et al., 2019), as well as diverge perceptions of what should be designated as important (Agbontale and Issa, 2017; Ortolani et al., 2017). In this vein, it is not surprising that sustainability is differently conceived by the involved actors (Curry et al., 2012), leading to varying aims and objectives. So, a critical question is whether the key actors who participate in knowledge and information systems attribute the same meanings to the concept of sustainable agriculture.

Of course, the term "sustainability" – as Paehlke (2005) argues – is quite amorphous, thus generating conflicting or even competing views over it (Krueger and Agyeman, 2005). These different considerations, built upon distinct interests and varying experiences (Šūmane et al., 2018), lead to different knowledge stocks which, when combined, can create new knowledge bases (DeCarolis and Deeds, 1999; Tzabbar et al., 2008). However, despite the high volume of research on the relationships between farmers and other participants in the knowledge and innovation systems (e.g., Sutherland et al., 2013; Hilkens et al., 2018), only a small share of attention has been directed to the ways sustainability is approached by AKIS's actors.

This study aims at depicting the perspectives of farmers, advisors and agronomy students on agricultural sustainability in Greece. A second objective is to investigate the ways sustainability-related knowledge is built by these three groups. By focusing on two central nodes of AKIS (farmers and advisors) we can gain insights on what facilitates or impedes transition towards sustainable agriculture, whereas by adding the students' point of view we can outline the ways agronomic education can contribute to the development of a holistic understanding of sustainability.

From empty banks to multi-stakeholder learning loops

The theoretical framework in the article is based on a critical, constructivist approach to learning. Critical pedagogy builds upon the groundbreaking work of

Paolo Freire (1970). In "Pedagogy of the oppressed," Freire argues that successful learning must be built on empowerment, and not on an imitation of the language of the ruling class. Students and other learners should not be seen as empty vessels to be filled with knowledge, but as co-creators of knowledge. Freire further stressed the importance of dialogue between theory and practice.

Many years have passed since Freire worked with education for illiterate people in Latin America, but the basic features of the power dimensions of learning still remain. The relation between farmers and advisors is not equal. Advisors, in general, have more skills in theory, while farmers have practical skills (Ingram, 2008). Sustainability is sometimes perceived as an elite concept, with little relevance for people in the manual labor sectors. The theory of critical pedagogy implies that if agriculture should become sustainable, it must be learnt by farmers on their own terms, and not as something imposed from above. The relation between advisors and farmers will thus be examined from a critical perspective. The farmers' definition and experiences of sustainability issues will be compared with the advisors' perspective and practices.

To escape the pitfalls of traditional pedagogy, alternative concepts have been launched, of which "action learning" is of specific relevance for this article. In order to meet the challenges of sustainability, a combination of practical and theoretical skills is needed (Heiskanen et al., 2016). This calls for an "action learning" approach, that links the world of learning with the world of action through a reflective process within learning groups (McGill and Beaty, 1992). There is a growing recognition that an effective understanding of how learning happens must encompass a variety of pedagogical approaches to support the learning process (Freeman et al., 2014). Action learning happens in the complex real world – on farms, and in the entire agrifood system, where many actors and stakeholders are involved. Successful learning is thus often based on learning loops where skills and knowledge are transferred, developed and re-transferred between actors (Lieblein et al., 2012, Francis et al., 2013). With an action learning approach, we aim to discuss if there are

potentials for learning loops, with farmers and advisors as key actors, which can lead the way towards more sustainable agrifood practices.

Methods

To answer our research questions we followed a qualitative approach. Focus groups, semi-structured interviews, and observational research were used to ensure triangulation. This combination of different data collection methods permits the complementarity of conclusions and enhances the trustworthiness of the results (Morgan and Spanish, 1984; Morse, 2003). At the first stage, a series of three focus groups was conducted during fall 2018. Participants in the first focus group were four table-grape producers, the second focus group consisted of 18 agronomists who offer advisory work to farmers, and in the last focus group participated five agronomy students. A focus group guide was used as an agenda for data collection. Since one of our aims was to compare the groups, we used some common questions in all three cases (Morrison-Beedy et al., 2001). The collected data were analyzed thematically (Braun and Clarke, 2006). Data extracted from focus groups' discussions were collated into codes, and then these codes were combined to produce meaningful themes.

Moreover, the methodology of action learning was employed to create groups of heterogeneous actors (learning sets) who engage in collective, discovery-based learning activities, so as to collaboratively construct new knowledge. In total, two different learning sets were formed: one focused on livestock farming, and a second centered on viticulture. Each one of these groups consisted of a farmer, a student of agronomy, an academic, an agronomist/advisor with work experience in the field, and an observer with expertise in knowledge co-production processes.

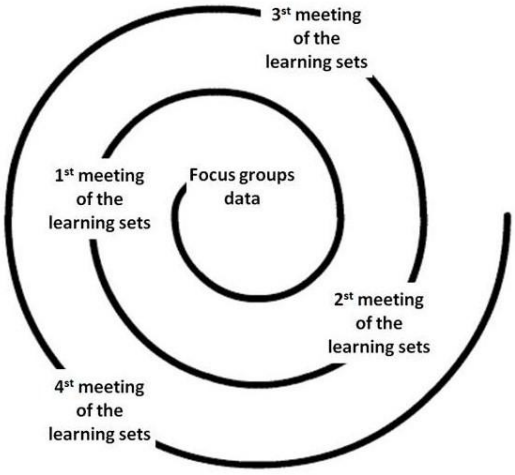
Through a process of discovering problems, proposing and implementing solutions, and reflecting on the procedure of identifying-solving problems, each learning set intended to develop a common understanding of the ways farming is practiced as well as to discover different meanings of farming and agricultural

sustainability. This way, within the framework of the learning set, each participant helps others to make sense of their experience (Revans, 1982; Mumford, 1996) while the dialogue and the reflection process leads to a redefinition of the concept of farming. In parallel, the identification of a problem can lead to the questioning of some old perceptions, to the redefinition of aims, and, finally to the reconstruction of agricultural knowledge (Revans, 2017).

After the formation of the learning sets, a series of meetings were organized. During these meetings the members of each team discussed on problems associated with farm practice, attempted to contextualize these problems, proposed and applied solutions in real settings, observed the outcomes of these solutions, and, finally, reflected on the process so as to clarify what the set has done and how members contributed to the knowledge co-production process. The observer collected data on the process, ensuring in parallel the democratic functioning of the set. After each meeting, all the participants completed a semi-structured questionnaire.

Both, observational data and qualitative data collected through these questionnaires were analyzed using the principles of thematic analysis. An iterative process was used during data analysis, to ensure that themes and explanations are valid. Hence, after each meeting, a preliminary analysis of the data was performed, and the results were used to inform the data collection process in the subsequent meetings of the learning set. Such a procedure of reflexive iteration (Srivastava and Hopwood, 2009), which is also common in other methods like interpretative phenomenological analysis (Smith et al., 1999) or autobiographical memories analysis (Charatsari, 2014), leads to the generation of new questions aimed at the clarification of some concepts and the search for identical themes (Lasch et al., 2010), thus permitting the comprehensive description of the issues under study (Polkinghorne, 2005). This way, the data analysis process followed a spiral path (Fig. 1), since each step of the analysis was used to inform subsequent steps.

Figure 1. The spiral path of data analysis process



Results

Farmers

Pursuing sustainability

Participants in the focus group noted that they face considerable problems due to climate change. The frequency of extreme weather events, along with the altered weather patterns which heavily affect yield potential and grapes quality, increased farmers' awareness of the issue of environmental sustainability. However, all the participants seem to emphasize the economic dimension of sustainability. This finding was also evident in the data collected the learning sets. The analysis indicated that the lack of appropriate knowledge supply schemes limits farmers' opportunities to better understand the complex relation between ecological and economic systems.

To cope with climate change, farmers are trying to adapt their strategies, without however having a clear orientation. Most of the times, they rely on their own intuition and experimentation, while they learn and infer from successful or unsuccessful decisions. Both, the high cost and the limited efficacy of agrochemicals used, along with the fact that Greek legislation forbids the use of some pesticides, have led farmers to reconsider agrochemicals use. One of the table-grape producers noted that some years ago he began to apply biological treatment systems to control

grape insects and fungi. As he explained, after four years of application, the control system was proven to be quite effective. Nevertheless, he continues to use standard phytosanitary treatments in combination with biocontrol strategies.

Other participants expressed mixed opinions about the potential of biological control of vineyards. For some of them, a major barrier in the implementation of such alternative strategies is the extremely high cost of biological control, whereas for others lack of know-how is the major constraint. In general, table-grape producers use a wide range of agrochemicals. Our data revealed that farmers' reliance on pesticides has a binary nature. On the one hand, it is an outcome of the vulnerability of vineyards to climate variability. On the other hand, this over-reliance on chemicals has some psychological precursors: using pesticides seems to be a "safer" decision, reducing the level of farmers' perceived production risk. The overall picture is that farmers feel trapped when it comes to coping with sustainability. They are well aware of the need to reduce pesticides, for both economic and environmental reasons, but most of them feel that they do not have much choice, due to the impact of the changing weather conditions. Climate change generates the need for more intensive use of agrochemicals, thus leading to climate-unfriendly behaviors.

In addition, an interesting finding – emerged from both the focus group data and the learning sets – was that farmers' willingness to reduce pesticide use is mainly guided by economic motives. Hence, although they understand that pesticides have serious effects on biodiversity and increase resistance in target pests, they believe that agrochemicals can secure the production levels of their farms. Environmental sustainability is placed on an equal footing only when it is associated with the economic performance of farms.

Knowledge networks and sustainability

An interesting finding is that farmers have a rather negative attitude towards education and training. Some of them mentioned that farming is learned in the field and not in the classroom. However, all the farmers stated that they participate in several informal networks through which they can access information and share

knowledge with other farmers and agronomists. Social media communities – in which farmers and agronomists exchange experiences and information about product prices, plant diseases, subsidies, new policies, technologies, and other issues – serve as informal knowledge networks. Focus group participants stressed that the production of table grapes is a dynamic business, which generates the need for quick and flexible access to knowledge when new situations occur. Indeed, all farmers emphasized the importance of collaboration networks for both innovation and market access. Some of the participants have installed humidity and temperature sensors or systems predicting insect attacks, hence they see these networks as spaces facilitating innovation adoption. In addition, networking offers farmers opportunities for gaining market information and developing new marketing channels, so as to reduce their dependence on wholesalers who dominate the distribution chain, thus reducing profit margins for table grape producers.

Apart from their participation in digital networks, farmers noted that they collaborate with agronomists, with whom they have also developed social relationships. Nevertheless, they express a mixed attitude towards agronomic knowledge. The analysis revealed that farmers distinguish between empirical and scientific knowledge. The first type of knowledge refers to the levels of their practical understanding of farming. According to focus groups' participants, through their daily work as farmers, they have developed skills and competencies that have transformed them into experts on farming systems. As one of the participants commented: "We don't really need continuous assistance from agronomists. After all, nobody knows my farm as I do."

The second category of knowledge is related to the theoretical understanding scientists' have on the complex interrelations among farming systems components. Although some farmers noted that empirical knowledge is more important because it is by default adapted to the special context of each farm when a new problem emerges the need for scientific knowledge inputs is evident. Nonetheless, farmers are concerned about how difficult it is for them to get access to research results. To their

opinion, scientific knowledge stays within the boundaries of academia, since there is a lack of knowledge bridges between academia and farmers.

Agronomists are used as advisors on issues related to new pests, fungi, and technological equipment. Nevertheless, the lack of public organizations in the Greek AKIS urges farmers to collaborate exclusively with private agronomists, who also sell agrochemicals or agricultural machinery. This dependence on private sector advisors often leads farmers to question the neutrality and the reliability of scientific knowledge. Some of the participants noted that during summer 2018 when the climate conditions led to an increase in pest attacks, agronomists consulted them to spray higher quantities of pesticides. The limited efficacy of this practice, along with the unwillingness of advisors to propose alternative pest control solutions, was interpreted by farmers as an attempt on the part of agronomists to sell more agrochemicals. The first learning sets also uncovered a feeling of mistrust between farmers and agronomists, which poses obstacles to the development of mutual and agreed goals and objectives. It seems a paradox, but the analysis suggested that although farmers prioritize their economic goals over environmental concerns, they believe that agronomists' overemphasis on economic gains is what impedes the transition towards sustainability.

Advisors/agronomists

Sustainability: Is it really important?

For most of the advisors who participated in the focus group, the issue of sustainability was found to be associated with the overuse of agrochemicals. The new legislation, which forbids the use of certain pesticides, urged Greek agronomists to reconsider the feasibility of some well-established farm management practices. Nevertheless, their focus is on the economic aspect of agricultural sustainability, whereas the environmental and social dimensions of sustainable farming systems attract limited attention. According to the analysis, the main concern of agronomists is the economic viability of farm enterprises. Consequently, they care more about the

maintenance of agricultural production at a high level than on the conservation of natural resources.

However, advisors seem to attribute a different meaning to the concept of sustainability. Observational data further supported this argument, indicating that each agronomist emphasizes on different aspects of sustainable farm production. Terms like animal welfare, water conservation, soil fertility or gas emissions were mentioned during the learning sets by agronomists, but without being combined into a common concept. As the analysis indicated, this is an outcome of their different educational backgrounds. Even agronomists who graduated from the same university have different specializations, depending on the discipline they chose to study. Agricultural universities in Greece offer two years of introductory education in which students take general courses (such as mathematics, physics, and chemistry) and three years of specialized education, in which students are offered courses in only one of the following disciplines: horticulture and viticulture, plant protection, arable crops, hydraulics and soil science, animal production, food science and technology, and agricultural economics. Hence, graduates have the opportunity to reach a high specialization level in their discipline, but they lack general knowledge about farming systems. This can explain why agronomists look at the issue of sustainability through different lenses, as well as why they lack a holistic understanding of the issue.

Moreover, it is remarkable that some advisors seem to perceive sustainable agriculture as a collection of "alternative" farm production practices, which, oftentimes, are viewed as opposed to scientific developments and as outdated in a world where technology progresses rapidly. In general, most of the agronomists believe that new, smart farming technologies can lead to a more sustainable agriculture, although – again – the prominence is given to the maintenance of production and not to the potential environmental benefits of smart farming.

Sustainability and agronomic knowledge

Although all the surveyed agronomists noted that advisory work is one of their everyday tasks, information and knowledge supply is an extra service offered to

farmers free of charge. Since there is a lack of public extension services and the Greek state does not financially supports private advisors, consultants also sell chemical pesticides and/or technology in order to make a living. Farmers do not pay for the advisory work offered by agronomists, but only for the products that they buy. This has led to a situation where farmers think that advisors have a hidden agenda, to sell products.

Under such circumstances, the development of trust between farmers and advisors seems to be a high priority. One advisor highlighted the importance of building strong relations with farmers and making them understand that agronomists are trying to help and support them. This issue should also be addressed when an advisor collaborates with a farmer. As data from the learning sets indicated, mutual understanding is crucial for the development of trust between farmers and advisors. However, what impedes the development of such a mutual understanding is the different "knowledges" farmers and advisors possess. Both groups seem to perceive their "own" knowledge as superior. This feature is illustrated in the following comment, made by a focus group participant: "Farmers don't ever admit that they can be wrong. In order to challenge this, we should develop a higher degree of trust."

However, to effectively supply farmers with sustainability-related knowledge, agronomists should also develop some new, interpersonal skills. Nevertheless, as some advisors explained, the only way to build these new skills is through their experience. As they noted, agronomic education in Greece focuses almost exclusively on natural science issues, whereas the economic and social aspects of farming systems receive a limited share of attention. A participant noted that the course of "agricultural extension and education" is provided only to the students of the branch "Agricultural economy" of Aristotle University of Thessaloniki and Agricultural University of Athens, whereas other universities in the country do not include such courses into their curricula. In this course, students have the opportunity to learn the basic principles of effective communication, whereas they are also exposed to a way of thinking that endorses the need to develop strong bonds with the agricultural population. Nevertheless, even in institutions offering extension/education courses,

the focus continues to be on linear models of knowledge and innovation diffusion, thus revealing a dominance of a traditional, largely outdated way of thinking.

Students

Sustainability: An idealized concept or a necessity?

Contrary to the other two groups, agronomy students are more aware of the sustainability issue. The analysis of focus groups data revealed that participants had a more uniform view of sustainability than professional agronomists. According to their responses, the main goal of sustainability is the optimization of production, the reduction of resource depletion, and the cyclical management of the production process. Moreover, an important finding is that they attribute higher importance to the environmental dimension of sustainability. During the learning sets, sometimes it was observed that students proposed solutions having in mind the environmental impacts of agriculture. However, these solutions were not always judged as economically viable by the other members of the learning set. This observation indicates that students often perceive the economic dimensions of sustainability as contradictory to the aim of environmental conservation.

Our results also indicated that students believe that, while – as future agronomists – they have to play a crucial role in a shift from conventional to sustainable agriculture, the achievement of sustainability is a difficult task for the farmers, mainly because of their mindset and their low educational level. A key prerequisite for the implementation of sustainability in agriculture is the change in farmers' mindset concerning the reduction of inputs in their farm enterprises. To their opinion, a critical skill for any agronomist is to cultivate her/his ability to help farmers adopt a more holistic view of their enterprise, so as to change their mindsets.

Moreover, the transition to sustainable agriculture is viewed by students as a collective process. Some participants suggested the need to develop new, multi-actor collaboration schemes that operate beyond the agronomist-farmer dyad, so as to effectively promote sustainable agriculture. To their view, agricultural cooperatives,

independent agronomists, farmers and the Greek Ministry of Rural Development and Food should collaborate closely to facilitate the transition to sustainable agriculture.

Building sustainability knowledge: Are books enough?

All the students were found to agree that they need to build knowledge on how to guide the transition process. The shift from conventional to sustainable agriculture is viewed as quite demanding and – as some focus groups participants noted – the support from more experienced actors (organizations and individuals as well) from other countries can help Greek farmers and agronomists overcome some of the major barriers they face during transition.

As, gradually, the higher education in Greece began to integrate active learning with traditional teaching techniques; students have the ability to participate in research projects conducted by their institute. Three out of five students that participated in the focus group were working in research projects: Argyris participated in a project concerning a new pest (insect) that attacks the crops of kiwi in the area of Katerini, Orestis worked in the laboratory investigating the population of a specific pest, and Thodoris was studying the development of resistance of *Tetranychus urticae* to pesticides. According to their responses, their active engagement in research projects helped them to improve their comprehensive skills, although no mention of the issue of sustainability was made.

Argyris, working in the project, found a new enemy of kiwi that destroys the crops and his main concern was to inform farmers and farm communities in the region of Katerini and all over Greece about this insect. Nevertheless, universities are poorly connected with farming communities, thus reducing students' opportunities to interact with farmers and, consequently, to know their real needs. A major question for students was: "how can anyone convince a farmer to adopt sustainable farm management practices without knowing her/his real needs?" Data from the semi-structured interviews also revealed that learning through interacting with farmers is considered as more important when compared to traditional teaching methods. One of the students who participated in a learning set stated that this interaction offers the

opportunity not only to test the veracity of scientific knowledge but also to develop interpersonal skills, necessary for facilitating the transition towards sustainability.

Students argue that the contribution of the Greek educational system to the development of sustainability-related skills is limited. The curricula offered by the higher education institutes – although knowledge-intensive – are not aimed at providing students with the skills necessary to effectively carry out the duties of an agronomist-advisor. So, they express the need for more specialized courses which will give them the knowledge and the skills to identify and solve farmers' real problems, as well as to effectively communicate with farmers. One of the students who spent a semester in The Netherlands within the framework of a European students' exchange project (Erasmus+) noted that action-based learning could help future agronomists cultivate a different mindset and develop a new variety of skills.

Discussion and conclusions

In this study, we pursued to understand the different meanings attributed to sustainability by Greek farmers, agronomists/advisors, and agronomy students. By combining different data, we also aimed at uncovering the processes through which these three groups construct sustainability-related knowledge. Our work indicated that, for Greek farmers and agronomists/advisors, the interest on sustainability emerged as a result of the observation that conventional farm practices cannot ensure the viability of farm enterprises. The analysis revealed that farmers express serious concerns about the future of farm production in Greece. The climate change has serious implications for the productive capacity of farms and generates the need to effectively manage new plant diseases. Although the findings showed that there is a consensus among farmers on the need to reduce agrochemicals use, conventional styles of plant protection continue to be the common practice. The lack of effective alternatives, the high vulnerability of some crops, and producers' psychological reliance on chemical pesticides contribute to the maintenance of a conventional logic of farm management.

Interestingly, most farmers agree that transition to sustainability is heavily dependent on agronomic science, but there is a considerable speculation about both the competencies and the intentions of agronomists and advisors. Such a lack of trust was also evident in the results from the advisors focus group. This shortage of confidence is the outcome of the different "knowledges" farmers and advisors possess and the different viewpoints they adopt. Ingram et al. (2010) argue that the work contexts of farmers and scientists shape their understandings on and meanings they attribute to different components of farming systems. However, as observational data from the learning sets revealed, when these knowledges are combined new meanings can emerge. This integration of different types of knowledge can facilitate the understanding of both the complex issues that characterize sustainability (Folke et al., 2005; Kelman et al., 2012) and the roles occupied by different actors in sustainability transition (Pahl-Wostl et al., 2008).

According to critical theories of learning, different "languages" and lack of trust between actors are a major threat to the development of new knowledge and skills. It is interesting to note that while farmers have a critical attitude towards formal education, they are very active in exchanging knowledge with other actors by using digital media. In these online social communities, the interaction between farmers and advisors is more open, providing opportunities for knowledge cross-fertilization. Therefore, online communities serve as mechanisms for single- and double-loop learning (Argyris, 1976), helping farmers to question whether they can improve their practices or whether they should change practices and ways of thinking, respectively (Hayes and Allinson, 1988).

Nevertheless, differences in "languages" and "knowledges" still remain, as could be seen in actors' understanding of sustainability. As the findings revealed, agronomists and farmers associate sustainable agriculture mainly with the issue of economic viability, underemphasizing the environmental dimension of sustainability and paying limited attention to the social aspects of sustainable agrifood systems. On the contrary, students underline the link between sustainability and the environment, without however paying special attention to the overlap between the three dimensions

of sustainability. Data derived from both students and advisors suggest that a possible source of this stance is the prominence given by agronomic education to technical issues and the lack of focus on interpersonal, communication, and guidance skills. Indeed, some recent studies suggest that agronomic education in Greece is not oriented towards supplying students with such skills, whereas it puts limited emphasis on sustainability issues (Charatsari et al., 2018; Charatsari and Lioutas, 2019).

In sum, our findings indicate that in the Greek AKIS sustainability has diverged meanings for different actors. To come out of this Babel-like situation, more efforts are needed in the direction of cultivating trust among stakeholders, by creating effective learning loops between scientists, farmers, and students, and by supplying current and future agronomists with soft skills to facilitate the transition towards sustainable agriculture.

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References

Adolwa, I. S., Schwarze, S., Bellwood-Howard, I., Schareika, N., and Buerkert, A. (2017). A Comparative Analysis of Agricultural Knowledge and Innovation Systems in Kenya and Ghana: Sustainable Agricultural Intensification in the Rural–Urban Interface. *Agriculture and Human Values*, 34 (2): 453-472.

Agbontale, A., and Issa, F. (2017). Agricultural Knowledge Information System (AKIS) in Nigeria: Practice, Challenges and Solutions. *Journal of Sustainable Development*, 8 (1): 66-74.

Argyris, C. (1976). Single-Loop and Double-Loop Models in Research on Decision Making. *Administrative Science Quarterly*, 21 (3): 363-375.

Braun, V., and V. Clarke (2006). Using Thematic Analysis in Psychology. *Qualitative Research in Psychology*, 3 (2): 77-101.

Charatsari, C. (2014). Collecting and Using Autobiographical Memories in Rural Social Research: A Step-by-Step Guide. *Journal of Agricultural & Food Information*, 15 (1): 19-41.

Charatsari, C., and Lioutas, E. D. (2019). Is Current Agronomy Ready to Promote Sustainable Agriculture? Identifying Key Skills and Competencies Needed. *International Journal of Sustainable Development & World Ecology*, 26 (3): 232-241.

Charatsari, C., Papadaki-Klavdianou, A., Koutsouris, A., and Lioutas, E. D. (2018). *Agronomic education and the quest for sustainability: Is there a link?* 13th European International Farming Systems Association (IFSA) Symposium, Farming systems: facing uncertainties and enhancing opportunities, 1-5 July 2018, Chania, Crete, Greece http://ifsa.boku.ac.at/cms/fileadmin/Proceeding2018/1_Charatsari.pdf

Curry, N., Ingram, J., Kirwan, J., and Maye, D. (2012). Knowledge Networks for Sustainable Agriculture in England. *Outlook on Agriculture*, 41 (4): 243-248.

DeCarolis, D. M., and Deeds, D. L. (1999). The Impact of Stocks and Flows of Organizational Knowledge on Firm Performance: An Empirical Investigation of the Biotechnology Industry. *Strategic Management Journal*, 20 (10): 953-968.

Folke, C., Hahn, T., Olsson, P., and Norberg, J. (2005). Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources*, 30*:* 441-473.

Francis, C. A. (1990). Sustainable Agriculture: Myths and Realities. *Journal of Sustainable Agriculture*, 1 (1): 97-106.

Francis, C., Breland, T. A., Østergaard, E., Lieblein, G. and Morse, S. (2013) Phenomenon-Based Learning in Agroecology: A Prerequisite for Transdisciplinarity and Responsible Action, *Agroecology and Sustainable Food Systems*, 37 (1): 60-75.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., and Wenderoth, M. P. (2014). Active Learning Increases Student Performance in Science, Engineering, and Mathematics. *Proceedings of the National Academy of Sciences*, 10 (23): 8410- 8415.

Freire, P. (1970). *Pedagogy of the oppressed* (M. B. Ramos, Trans.). New York, NY: Seabury Press.

Gava, O., Favilli, E., Bartolini, F., and Brunori, G. (2017). Knowledge Networks and their Role in Shaping the Relations within the Agricultural Knowledge and Innovation System in the Agroenergy Sector. The Case of Biogas in Tuscany (Italy). *Journal of Rural Studies*, 56: 100-113.

Hayes, J., and Allinson, C. W. (1998). Cognitive Style and the Theory and Practice of Individual and Collective Learning in Organizations. *Human Relations*, 51 (7): 847-871.

Heiskanen, E., Thidell, Å., and Rodhe, H. (2016). Educating Sustainability Change Agents: The Importance of Practical Skills and Experience. *Journal of Cleaner Production*, 123: 218-226.

Hilkens, A., Reid, J. I., Klerkx, L., and Gray, D. I. (2018). Money Talk: How Relations between Farmers and Advisors around Financial Management are Shaped. *Journal of Rural Studies*, 63: 83-95.

Ingram, J. (2008). Are Farmers in England Equipped to Meet the Knowledge Challenge of Sustainable Soil Management? An Analysis of Farmer and Advisor Views. *Journal of Environmental Management*, 86 (1): 214-228.

Ingram, J., Fry, P., and Mathieu, A. (2010). Revealing Different Understandings of Soil Held by Scientists and Farmers in the Context of Soil Protection and Management. *Land Use Policy*, 27(1): 51-60.

Kamali, F. P., Meuwissen, M. P., De Boer, I. J., Stolz, H., Jahrl, I., Garibay, S. V., ... and Lansink, A. G. O. (2014). Identifying Sustainability Issues for Soymeal and

Beef Production Chains. *Journal of Agricultural and Environmental Ethics*, 27 (6): 949-965.

Kelman, I., Mercer, J., and Gaillard, J. C. (2012). Indigenous Knowledge and Disaster Risk Reduction. *Geography*, 97: 12-21.

Krueger, R., and Agyeman, J. (2005). Sustainability Schizophrenia or "Actually Existing Sustainabilities?" Toward a Broader Understanding of the Politics and Promise of Local Sustainability in the US. *Geoforum*, 36 (4): 410-417.

Lasch, K. E., Marquis, P., Vigneux, M., Abetz, L., Arnould, B., Bayliss, M., ... and Rosa, K. (2010). PRO Development: Rigorous Qualitative Research as the Crucial Foundation. *Quality of Life Research*, 19 (8): 1087-1096.

Lieblein, G., Breland, T. A. Francis, C. and Østergaard E. (2012). Agroecology Education: Action-oriented Learning and Research. *Journal of Agricultural Education and Extension*. 18 (1): 27-40.

Lioutas, E. D., Charatsari, C., Černič Istenič, M., La Rocca, G., and De Rosa, M. (2019). The Challenges of Setting up the Evaluation of Extension Systems by Using a Systems Approach: The Case of Greece, Italy and Slovenia. *The Journal of Agricultural Education and Extension*, 25 (2): 139-160.

McGill, I. and Beaty, L. (1992). *Action learning: A practitioner's guide.* London: Kogan Page.

Morgan, D. L., and Spanish, M. T. (1984). Focus Groups: A New Tool for Qualitative Research. *Qualitative Sociology*, 7 (3): 253-270.

Morrison-Beedy, D., Côté-Arsenault, D., and Feinstein, N. F. (2001). Maximizing Results with Focus Groups: Moderator and Analysis Issues. *Applied Nursing Research*, 14 (1): 48-53.

Morse, J. M. (2003). Principles of Mixed Methods and Multimethod Research Design. In Tashakorri, A., and Teddlie, C. (Eds.). *Handbook of mixed methods in social and behavioral research* (189-208). London: Sage Publications.

Mumford, A. (1996). Effective Learners in Action Learning Sets. *Employee Councelling Today*, 8 (6): 3-10.

Ortolani, L., Bocci, R., Bàrberi, P., Howlett, S., and Chable, V. (2017). Changes in Knowledge Management Strategies can Support Emerging Innovative Actors in Organic Agriculture: The Case of Participatory Plant Breeding in Europe. *Organic Farming*, 3 (1): 20-33.

Paehlke, R. (2005). Sustainability as a Bridging Concept. *Conservation Biology*, 19 (1): 36-38.

Pahl-Wostl, C., Mostert, E., and Tàbara, D. (2008). The Growing Importance of Social Learning in Water Resources Management and Sustainability Science. *Ecology and Society*, 13 (1): 24.

Peterson, H. (2009). Transformational Supply Chains and the "Wicked Problem" of Sustainability: Aligning Knowledge, Innovation, Entrepreneurship, and Leadership. *Journal on Chain and Network Science*, 9 (2): 71-82.

Polkinghorne, D. E. (2005). Language and Meaning: Data Collection in Qualitative Research. *Journal of Counseling Psychology*, 52 (2): 137-145.

Revans, R. (2017). *ABC of action learning*. Abingdon: Routledge.

Revans, R. W. (1980). *Action learning: New techniques for management*. London: Blond and Briggs Ltd.

Revans, R. W. (1982). What is Action Learning? *Journal of Management Development*, 1 (3): 64-75.

Smith, J. A., Jarman, M., and Osborn, M. (1999). Doing Interpretative Phenomenological Analysis. In Murray, M., and Chamberlain, K. (Eds.). *Qualitative health psychology: Theories and methods* (218-240). London: Sage Publications.

Srivastava, P., and N. Hopwood (2009). A Practical Iterative Framework for Qualitative Data Analysis. *International Journal of Qualitative Methods*, 8 (1): 76-84.

Šūmane, S., Kunda, I., Knickel, K., Strauss, A., Tisenkopfs, T., des Ios Rios, I., ... and Ashkenazy, A. (2018). Local and Farmers' Knowledge Matters! How Integrating Informal and Formal Knowledge Enhances Sustainable and Resilient Agriculture. *Journal of Rural Studies*, 59: 232-241.

Sutherland, L. A., Mills, J., Ingram, J., Burton, R. J., Dwyer, J., and Blackstock, K. (2013). Considering the Source: Commercialisation and Trust in Agri-environmental Information and Advisory Services in England. *Journal of Environmental Management*, 118: 96-105.

Sydorovych, O., and Wossink, A. (2008). The Meaning of Agricultural Sustainability: Evidence from a Conjoint Choice Survey. *Agricultural Systems*, 98 (1): 10-20.

Tzabbar, D., Aharonson, B. S., Amburgey, T. L., and Al-Laham, A. (2008). When is the Whole Bigger than the Sum of its Parts? Bundling Knowledge Stocks for Innovative Success. *Strategic Organization*, 6 (4): 375-406.

Zecca, F., and Rastorgueva, N. (2017). Knowledge Management as a Key Stone of Sustainable Welfare in the Italian Rural Areas. *Rivista di Studi Sulla Sostenibilita*, 1: 183-201.