Paper to be presented at the DRUID Academy Conference 2017 at University of Southern Denmark, Odense, Denmark on January 18-20, 2017

Bridging the gap between knowledge creation and value chain needs in a peripheral sector

Camille Aouinait Camille Aouinait
EPFL
College of Management of Technology
camille.aouinait@epfl.ch

Abstract

Framework Small agricultural firms have to cope with increasing social, economic, legal and environmental difficulties. The firms have to find out solutions by implementing innovations. The inherent knowledge transfer implies gathering a good understanding of the market situation (e.g. needs and issues of practical side) and what the scientific community can provides as tools to remain competitive. Efficient knowledge transfer can support innovation adoption by rising awareness of stakeholders regarding which innovative solutions fit best the faced issues. The goal of the paper is to answer the following research questions: Is there coherence between the research supply and the needs of downstream firms of the traditional fruit sector in Switzerland? If not, what measures could efficiently fill in the gaps? Though the sector has received little attention in terms of adequacy in structural issues. The paper brings useful insights for the whole value chain. From the research side, impact of research activities would be oriented towards sectors' priorities. From the practical side, stakeholders receive and share knowledge and establish their importance in the network. Finally, identifying where the knowledge is produced can allow designing either a process to better match the supply and the demand or fulfilling the gaps of research activities at the right place. Method and Data Data was collected in the frame of a European project of the Seventh Framework program (TRAFOON). The first step was to identify the needs thanks to semi-structured surveys addressed in face-to-face interviews of stakeholders of apricot production. The sample included 22 producers, 3 retailers, 6 processors and 4 inter-professional organizations. Then, a focus group brought together five Swiss fruit stakeholders to validate and prioritized the needs collected thanks to a Likert scale. It was used to rate the innovation needs from 1 (not important) to 5 (very important). The second step aimed at identifying the research output realized in the last decades about the topics rated as "very important". It was performed with the databases Scopus and Web of Science (WoS). They were used to identify the firms, universities, research labs and other entities working on the specific themes, document types, publication year, language, research areas and sources' titles. Furthermore, the renewal of the Swiss apricot orchard was launched in the mid 1990's, so that new varieties were added to the traditional and unique one harvested. Therefore, the period selected is 1996-2015. Results Thirty needs were rated as "very important" over the 369 needs expressed in the interviews. The focus was put on the category of variety: increasing disease resistance, increasing the trade-off between productivity and quality, reducing the cracking effect of apricot and reducing the speed of post-harvest ripening. Those four needs were translated into

keywords to be used in Scopus and WoS. The first results collected showed a substantial difference in the publications results between the databases. Refining search levels was necessary. Concerning the sub-category of pests and diseases' resistance of apricot varieties, several search levels were performed. The producers interviewed regularly mentioned three diseases to be major sources of issues. For one of them, WoS found 227 results and Scopus found 185 ones. Published research increased since 1995 with peaks in 2010, 2012 and 2014 in the two datasets. The research has been conducted mainly in the USA, followed by Spain and Italy. 74.6% are articles for Scopus and 80.6% for WoS. The latter counted proceedings that the former did not have. Finally, there are some differences in the research areas. These results indicate two essential facts; the databases are complementary and the public research in this topic is rather new. There is a real need to solve the practical issues in order to increase the sustainability of the sector. Fundamental and applied research conducted in public research organization and universities can solve the needs identified in the study. The knowledge has to be transferred and shared in the network by extending interactions for instance.

Jelcodes:L39,Q19

Bridging the gap between knowledge creation and value chain needs in a peripheral sector

Aouinaït, C. [1,2]**; Kosinska, A.** [3]**; Christen, D.** [2]**; Carlen, C.** [2]
[1] College of Management of Technology, Swiss Federal Institute of Technology Lausanne (EPFL), Odyssea, 1015 Lausanne, Switzerland
[2] Research group in fruits crops in alpine region, Agroscope, Route des Eterpys 18, 1964 Conthey, Switzerland
[3] University of Applied Sciences and Arts Western Switzerland Valais (HES-SO Valais-Wallis), Institute of Life Technologies, Route du Rawyl 47, CH-1950 Sion, Switzerland,

Keywords: Bibliometric analyses, Innovation, Knowledge transfer, Traditional fruit production, Participatory prioritization

1. Introduction

Small agricultural firms have to cope with increasing social, economic, legal and environmental difficulties. The firms have to find out solutions in a short period. However, the most common problem asserted in literature is the time delay with which research can bring solutions to firms' issues. Progressing globalization results in increasing number of challenges faced by firms on different levels (e.g. political, economic, social, ethical, institutional and environmental). Firm size becomes important due to dissimilarities and asymmetries in adaptation to the new context. Adaptations are easier in bigger firms due to higher availability of financial or human resources (Acs & Audretsch, 1988). However, both small and big companies use innovation as a way of boosting their performance.
The goal of the paper is to investigate the coherence of the supply of research with the needs expressed by firms in societal, environmental and economic areas. Those firms are upstream of the supply chain of a peripheral sector in a protectionist country. The study focuses on the Swiss apricot production sector. Traditional fruit production is important at regional level in Switzerland. However, the sector has received little attention in terms of adequacy in structural issues. The paper brings useful insights for the whole value chain. From the research side, impact of research activities would be oriented towards sectors' needs and priorities. From the practical side, stakeholders receive and share knowledge and establish their importance in the network. Finally, identifying where the knowledge is produced can allow designing either a process to better match the supply and the demand or filling the gaps of the research activities at the right place.
The article is constructed as follows; a literature review targets definitions of the setting and important patterns in agricultural sector are described in the first section. The second section presents the method and data used to identify the needs for innovation of Swiss SMEs in traditional fruit sector. The third section gives a description of the results. The last part draw the discussion followed by the conclusions and perspectives of the case study.

2. Literature review

Innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". It can be divided in four types:

product or service, method, marketing and organization (OECD and Eurostat, 2005)[1]. Innovating is an iterative process from discovery and invention to commercialization and diffusion with many feedback loops, as illustrated by the chain-link model of technological change of Kline and Rosenberg (Arbo & Benneworth, 2007; Evangelista, Perani, Rapiti, & Archibugi, 1997; Kline & Rosenberg, 1986). Besides, innovations induce disruptive or smooth changes. Disruptive and incremental innovations are commonly opposed (Afuah & Bahram, 1995). Therefore, the innovation adoption is conditional on firms' capacity to adapt to the changes. As Pavitt (1984) demonstrated, diffusion of innovation is important for its success.

Traditional food definition

The study focuses on the agricultural value chain of a traditional product. Contrary to the common believes, tradition and innovation can be complementary (Cannarella & Piccioni, 2011; Vanhonacker et al., 2013). According to Gellynck and Kühne (2010) traditional food products are products "for which (1) the key production steps are performed in a certain area at national, regional or local level, (2) which are authentic in their recipe (mix of ingredients), origin of raw material, and/or production process, (3) which are commercially available for about 50 years and (4) which are part of the gastronomic heritage". Ingredients, composition and process are the three important criteria to respect in order to keep the traditional aspect of food products (Trichopoulou, Soukara, & Vasilopoulou, 2007). Raw materials and production process must not be substantially changed through innovation to maintain the traditional character of a product.

Importance of knowledge transfer and innovation for competitive advantage

Knowledge transfer may contribute to solve the value chain issues. It is increasingly studied as it is recognized to enable innovation introduction (Braun & Hadwiger, 2011). Competitiveness of Small and Medium-sized Enterprises (SMEs) strongly depends on effective implementation of innovations emerging from national and European research projects. Transferring the outcomes of those works is fundamental to enhance innovation. Besides in order to add value to regions and business sectors smart specialization could be followed using comparative advantages (Foray, David, & Hall, 2011). For Switzerland, one example is the high quality of goods and services. Hence, implementing innovation would enhance this benefit. The innovation intensity depends on the topic concerned (e.g. technology, marketing, agricultural sciences, management). Factors such as financial resources and knowledge required to use technological materials might slow down adoption and implementation of innovations.

Existing gaps between innovation supply and demand

Length and time with which solutions and innovative outputs have to be created is one of the corner stone in private versus public sector interactions. Indeed, private firms need to innovate and/or adopt innovations, improvements or new solutions to their issues in a short-term period. For instance, famers are more likely to adopt innovations by imitation, to be later entrants on the market (Klepper, 1996). When SMEs cannot have access to the private solutions, public outcomes are needed. However, public research takes longer to provide

[1] The Oslo manual was edited after studies driven by OECD countries about innovations and its measurement. It is the international source of guiding principles of collecting and using of information about innovation activities in industry.

society with research outputs. The time delay can affect firms' behaviour towards innovation, especially on adoption.

Agricultural sector patterns

Agricultural sector is characterized by a majority of SMEs, both in developed and developing countries. The European industry is composed by 99.1% of small firms (Food Drink Europe, 2013). They highly contribute to employment and economic health of countries. In the European framework, small and medium firms with 250 employees or fewer contribute to 58% of gross added value and 67% of employment, according to the European Commission (2014). These features are of importance regarding the resources available and the extent to which firms are active in the economic fabric.

In this frame, competitiveness represents a daily economic and venturesome task for agricultural SMEs. Porter's diamond model highlights the intertwined factors of efficiency and quality that are really important for firms, regions or countries that want to be competitive (Porter, 1990). The ability of companies to adapt to sudden changes in a global market and the ability to furnish diverse products with qualitative advantages at a faster pace than its competitors are fundamental.

The Swiss industrial sector benefits from a good image, based on a high quality. Norms and regulations applied in agriculture allow this important differentiation. The Swiss standard of good practices related to integrated production of food products is more restrictive than the European equivalent. This high quality represents added value on the export markets, which allows higher prices. Examples of methods to reach higher quality are varietal innovation and innovations in cultivation techniques.

Traceability and food safety denote challenging topics since the beginning of food scandals in the 1990's. Besides, with the increasing use of social networks and communication tools, information is transferred faster and can affect public opinion quickly. Hence, tracing products and ensuring safety become substantial goals to reach in order to satisfy the consumers and chain sustainability (Codron, Siriex, & Reardon, 2006).

Furthermore, the Swiss frame displays border protection with barriers regulating trade. Switzerland is one of the most protectionist countries in the world, impacting competitiveness of SMEs. Imports of fruits and vegetables follow two phases. When production of certain fruits is not possible in the country, especially due to climatic conditions (e.g. bananas, mangoes, pineapples), importation is free (Roher, 2012). For other fruits such as apricots when indigenous production becomes available, it will partially cover the population consumption. Thus, there are tariff barriers for imports, giving priority to Swiss products.

Taking into account the characteristics mentioned above, the traditional food SMEs in Switzerland are facing important issues. Companies perform innovation at different stages of the production chain and scales (e.g. organization, product implementation). Nonetheless, needs in innovation evolve with technology and research outcomes diffused in the last decades. Therefore, making an inventory of needs to match innovations (potentially solutions) is mandatory. Knowing the needs enables efficient and tailor-made transfer of knowledge to value chain stakeholders.

3. Materials and methods

The next sections describe the succession of steps of the methodology used in the study, as seen in figure 1.

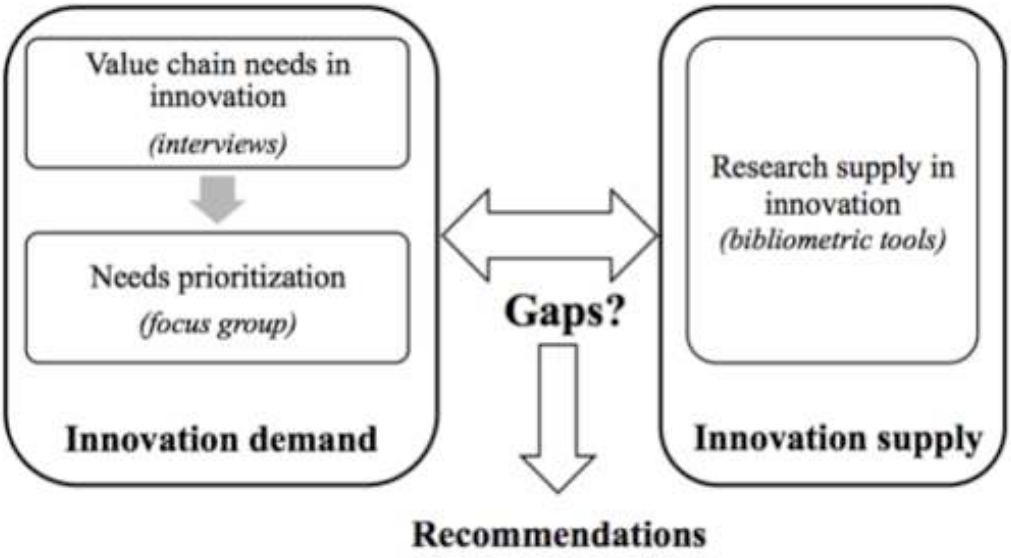

Figure 1. Method used in the study

3.1. Interviews

The first step was to identify the needs thanks to semi-structured surveys addressed in face-to-face interviews of stakeholders of the apricot production (e.g. producers, transformers, retailers, wholesalers).

3.1.1. Survey structure

Data was collected in the frame of a European project of the Seventh Framework program (FP7) named TRAFOON. The survey was similar for each European partner in order to be easily comparable and was used for several food groups including apricots and berries. The general structure was kept in order to fit the best possible way the idiosyncratic characteristics of the Swiss fruit sector. Some reformulations were made to obtain as much information as possible. The questionnaire was divided in four parts. The first two parts aimed to identify interviewees and their economic activity (i.e. type of fruits and surface harvested). The third part focused on the type of production like organic, conventional or integrated, as well as technological equipment used. Finally, the last part comprised questions about the value chain, from breeding to distribution. Consequently, each step of the production chain was highlighted and addressed regarding the potential issues and solutions needed. It included fruit varieties, orchard management (i.e. irrigation, fertilization, pest and disease resistance and phytosanitary aspects), environmental management (i.e. climate events such as hail, frost), homogeneity in production, traceability of raw materials, safety conditions, quality standards (e.g. Hazard Analysis Critical Control Points), water and energy saving, storage, packaging, transport and transformation of products. Then, non-technical aspects were discussed, as nutritional and quality aspect of the fruits (i.e. internal and external quality like colour, firmness, sugar rate and acidity), certification (i.e. organic or regional production), voluntary labelling, marketing and advertising, competitiveness on domestic and international markets.

In the aim of avoiding answer bias, all the questions were uniformly framed;
- What are the important challenges you faced within the last fifteen years in the topic of […]?
- For the already solved problems, which solution did you choose?
- For the unsolved problems, which solution may help?

- If you have not faced any challenges, what type of techniques do you use for this topic?

The structure of the questionnaire facilitated discussion between individuals interviewed and the researcher, allowing useful insights for further understanding of the needs identified.

3.1.2. Sample selection

The questionnaires were distributed among stakeholders involved in the apricot and strawberry production chain. However, for the remaining part of the study, only apricot production is concerned. Apricot production is concentrated in one Swiss region, the canton of Valais. Thus, it enabled the procedure of data collection. The traditional nature of Swiss apricot production induces specific structural characteristics. There are around 15 professional producers, 70 worker-peasants for which apricot is a small activity compared to other crops, 300 small producers performing traditional agriculture and 75 diversified producers which cultivate different crops for income diversification (Roher, 2012).
In order to have significant impact, selection of individuals for interviews was straightforward. Producers for whom apricot production represents a significant part of income were of interest. The others value chain actors were selected based on their availability and willingness to participate in the study. The respondents were contacted by email and phone. Then, between April and September 2014, 37 stakeholders were interviewed. Either the owner or the senior level manager represented the companies. The semi-structured interviews were realized in face-to-face and lasted 1h30 in average. The semi-structured form of the questionnaire allowed open discussion if needed. For instance, explanation of specific issue faced by the producer and the solution implemented at that time enrich the data. The sample included 22 producers, 3 retailers, 6 processors and 4 inter-professional organizations. Some stakeholders are working in several functions like producers that process their goods. Apart from retailers and inter-professional organizations, the firms included in the survey were SMEs. All were well established on the market. They were created between 1889 and 2009.

3.2. Focus group

The focus group is widely used in qualitative research method. It gathers small group of participants, usually from eight to twelve, who discuss the subject of interest in the appropriate environment. The discussion is guided by skilled moderator, which enables smooth expression of opinions and expectations (Gellynck & Kühne, 2010). The focus group carried out within this study brought together different Swiss fruit stakeholders to validate the needs collected. A second important goal was to prioritize the needs thanks to their expertise. Five representatives of the SME associations involved in fruit chain in Switzerland were present. A participatory approach was applied at this stage. A moderator animated the discussion and presented the needs identified during the interviews performed in the first stage of the survey. A Likert scale was used to rate the innovation needs from 1 (not important), 2 (slightly important), 3 (moderately important), 4 (important) to 5 (very important). The table listing the identified needs was distributed among the partners. The needs were grouped in categories used in the survey (e.g. breeding material, cultivation type, environmental effects, preservation, food safety, storage, transport). The frequency of citation by interviewees was reported in front of each need. It was followed by blank spaces for prioritization and relevant comments.

3.3. Bibliometric analyses tools

After needs' collection and needs' prioritization, the goal was to identify the research output realized in the last decades about the topics rated as "very important". As in the work of Leiser et al. (2009) about the bibliometric study of scientific production in fruits and vegetables sciences in the French National Institute for Agricultural Research, a portal to search bibliography was used (Leiser, Aventurier, Fournier, Dosba, & Jeannequin, 2009). It was performed with Scopus and Web of Science (WoS) databases. Archambault et al. (2009) found that using both Scopus and WoS as bibliometric tools to compare research outputs between countries is consistent. Besides, the correlation is strong for specific fields that support the method used in this paper.

Scopus is a database of peer-reviewed literature managed by the editor Elsevier. It contains books, conference proceedings and articles in topics like health sciences (32%), physical sciences (29%), social sciences (24%) and life sciences (15%). The search engine displays different levels: document, author, affiliation and advanced search. Within each level, several categories can be informed like in the document search there are article title, abstract, source, language, DOI and abstract among others. In this category that keywords are interesting for the study (Lokman & Yang, 2007). Web of Science was created before Scopus in 2004 (Mongeon & Paul-Hus, 2016). It groups Art and Humanities Index, Social Sciences Citation Index and Science Citation Index. Scopus covers the period from 1965 onwards, with 63% of records from 1995 until today. WoS is wider, going to 1945 Jacso (2005). However the two databases are quantitatively different (60 million of records for Scopus and 90 million for WoS) (Scopus, 2016). There is overlap of several disciplines but also specificities possibly fundable in just one of the two databases. Besides, the type of records differ in the databases, with more articles in WoS (95.85% in 2006) and 59.97% for Scopus (Bosman, van Mourik, Rasch, Sieverts, & Verhoeff, 2006) .

Web of Science Core Collection was used to perform the search. Then for both databases, the analysis tools proposed were used to gather quantitative and qualitative data of the results, when applicable. In this step of the study, the focus is put on the category of apricot variety, which is the category containing the most cited needs by stakeholders. The data collected are the universities, research labs or institutes' names, territories, document types, publication year, research areas and sources' titles. These data help to precisely identify where is located the pool of knowledge on diverse topics currently important for SMEs in apricot production.

4. Results

The Swiss apricot production is concentrated in the canton of Valais, where 96% of the total production was done (Valais-Wallis Promotion, 2015). Therefore, domestic competition is limited between regions (e.g. French speaking and German speaking areas). During the free phases, an important quantity of apricots was imported from neighbour countries, mostly from Spain, France and Italy. The national surface of apricot production was 676 hectares with a national production of 7,700 tons in 2014 (Office Fédéral de l'Agriculture, 2015; Roher, 2012).

4.1. Needs' identification

The inventory of needs in Switzerland was carried out face to face in the companies' premises between April and September 2014. 37 stakeholders involved in strawberries and apricot sectors were interviewed including producers (21), processors (6), branch organizations (4), and retailers (10). In total, 369 needs were identified, which were grouped into 98 needs and assigned to 22 categories, as presented in figure 2.

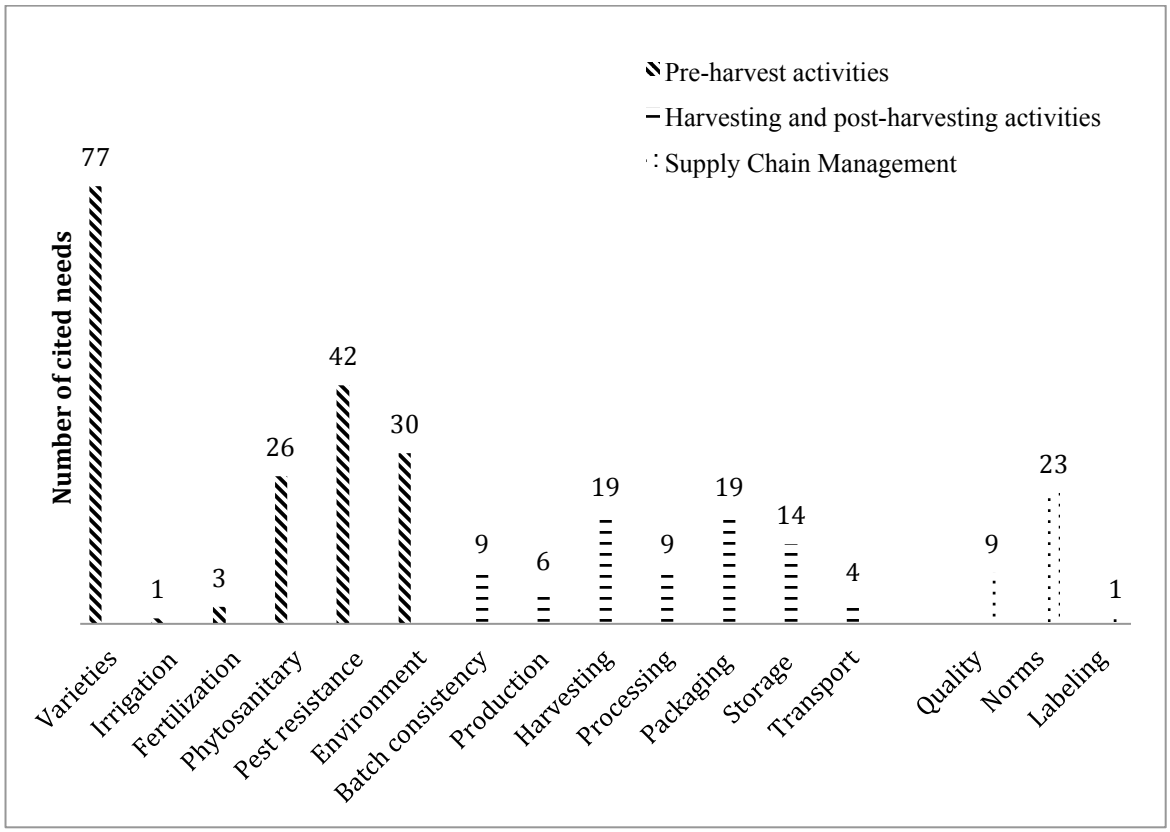

Figure 2. Needs claimed by Swiss apricot and berries stakeholders relating to innovation

The needs were grouped in topics like varieties, phytosanitary, quality, storage or labelling related to the questions asked in the survey. Most needs belonged to the pre-harvest category. The different categories of needs and their frequency of appearance are presented in Table 1.

Table 1. Major categories of needs in fruit sector Switzerland

Categories of needs (frequency)	
01. Varieties (77)	12. Storage (14)
02. Irrigation (1)	13. Quality (9)
03. Fertilization (3)	14. Transport (4)
04. Phytosanitary (26)	15. Norms (23)
05. Pest resistance (42)	16. Labelling (1)
06. Environment (30)	17. Marketing (9)
07. Batch consistency (9)	18. Communication (7)
08. Production (6)	19. IPR (1)
09. Harvesting (19)	20. Competition (38)
10. Processing (9)	21. Consumption (8)
11. Packaging (19)	22. Supply chain (14)

The stakeholders claimed 77 needs in this the varieties category. Improving the trade-off between productivity and quality was highly reported by the stakeholders interviewed. Increasing difficulties in terms of pests and diseases have been highlighted. Homogenization of rules about use of phytosanitary products was another important topic. Moreover, storage and quality areas are important for basic and applied research. Current trend in food sectors

have to evolve along with consumers' expectations and way of living. Food products have to remain stable for several days (i.e. coping with rapid progression of maturity), delivering good balance of taste and appearance. Process and organizational innovation are in line with the sustainability tendency like reducing waste and the use of chemical products. Organic production could also be established in the near future. Some producers interviewed mentioned this type of agriculture. Nevertheless, there are several constraints like higher costs of production (specific equipment and alternative non-chemical preparations), losses due to diseases, insects, weeds and soil fertility. Besides, there is a period of conversion from conventional to organic agriculture. Soils need time of adaptation to new crop management and restructuring; producers have to change their agricultural inputs, techniques and finding new markets. However, this increasing spending is not compensated by higher prices. Small farmers cannot afford these costs (Veldstra, Alexander, & Marshall, 2014). Then, in the category of supply chain management, there was also an important aspect of traditional fruit production chain. Competition was often cited (38). In the marketing innovation category, segmentation and use of labels could help producers to add value to the production. Factors that might impede their use are SMEs-dependent as the costly procedure. The principal commercialization channel used for fresh Swiss apricots is retailing. Nonetheless, closer contacts between upstream and downstream chain are sought. Finally, lack of resources, knowledge access and application were the barriers of SMEs for the implementation of innovation.

4.2. Validation and prioritization of identified needs

Thanks to the participation of five representatives of SME associations from Switzerland the needs identified in inventory of needs was prioritised through a focus group. The paper version of the needs table was distributed among the partners.

The Swiss stakeholders were asked to rate the importance of the needs from 1 (not important) to 5 (very important). When differences were important, it was noted in the column "comments by stakeholders". Some of the needs descriptions were ambiguous to stakeholders like six needs in the category of environment. Therefore, the descriptions were clarified and sent by e-mail to the five stakeholders after the meeting. The answers were collected and the table was completed. The categories with the highest number ($\geq$10) were kept. Thirty needs were evaluated as very important by the stakeholders, whereas only six as not important. Needs concerning competition, environment, harvesting, norms, packaging, pest resistance, phytosanitary, quality, storage, stakeholders rated supply chain and varieties as "important".

A discrepancy was found in the packaging category. Retailers and producers were opposed in terms of packaging diversity. Despite disagreement in some other topics, consensus was found. Still, there is an exception concerning the topic of norms. Flexibility of norms' application was a sticking point. It was not important for stakeholders representing SMEs.

In order to conduct the bibliometric analysis, a focus was put on the category of variety because of its importance for the stakeholders. The next section presents the results of this analysis.

4.3. Matching the very important needs with public research activities

Four important aspect of the fruit varieties were tackled during the first part of the data collection: increasing disease resistance, increasing the trade-off between productivity and quality, reducing the cracking effect of apricot and reducing the speed of post-harvest ripening. Thus, the four needs were translated into keywords to be used in Scopus and WoS. The first results collected showed a substantial difference in the publications results between the databases.

4.3.1. Need 1: reduction of apricot cracking

Skin cracking is one of the most important issues faced by producers. This is partly due to rainfall (Sekse, 1995). The production losses could be high. Research equations used in Web of Science and Scopus are presented in table 2.

Table 2. Research equation respectively used in Scopus and Web of Science on the topic of apricot cracking

Keywords' equation (WoS)	Number of results	Keywords' equation (Scopus)	Number of results
TS=("fruit cracking") AND TS=(reduc* OR dimin* OR decreas* OR elimin* OR cut* OR shorten* OR lower* OR sensitiv* OR dwindle* OR curtail* OR resist* OR protect* OR fight* OR hinder* OR opposition OR struggle OR tolera* OR strength OR resilien*) AND TS=(explo* OR crack* OR burst OR chop OR skin damage* OR break* OR cleave OR crackle OR fractur* OR split*)	226	TITLE-ABS-KEY(("fruit cracking") AND (reduc* OR dimin* OR decreas* OR elimin* OR cut* OR shorten* OR lower* OR sensitiv* OR dwindle* OR curtail* OR resist* OR protect* OR fight* OR hinder* OR opposition OR struggle OR tolera* OR strength OR resilien*) AND explo* OR crack* OR burst OR chop OR skin damage* OR break* OR cleave OR crackle OR fractur* OR split*))	224 (+115 patents)

The results in Scopus and WoS were similar in number (224 and 226 respectively). However, data cleaning ended up with 261 publications. Moreover, Scopus found 115 patents relating to this topic. However, the aims of the patents are wider like method to improve fruit production and fruit quality, method for fruit thinning at late growth stages of fruit plants, fruit sugar content increaser or new varieties of tomatoes, watermelons and other fruits, amongst others. Therefore, these patents were not included in the all analysis in this category.
More than a third of book series (33.18%) came from Acta Horticulturae. The source titles revealed diversity in the product (e.g. litchi, persimmon, cherry) and fields (e.g. botany, agricultural sciences, horticulture). Since 2008, there were increasing publications on this topic, with a peak in 2014. South China Agricultural University, University of Hannover Leipzig and Norwegian Research Institute of Crop were the first three affiliated organizations. USA, China and Germany came as the first countries publishing in this area. The publications concerned mainly cherries, and partially cherry tomato, grape, red fruits, watermelon, litchi, apple, mangosteen and mango. For the types of documents, 35.8% were proceeding papers and 60% are articles.

4.3.2. Need 2: increasing the trade-off between productivity and quality

Balancing gustative and aesthetic quality with productivity to ensure production sustainability was one need expressed by all producers interviewed. Results are displayed in table 3.

Table 3. Research equation respectively used in Scopus and Web of Science on the topic of trade-off productivity and quality

Keywords' equation (WoS)	Number of results	Keywords' equation (Scopus)	Number of results
TS=(trade-off OR trade off OR balanc* OR compromis* OR	56	TITLE-ABS-KEY ((trade-off OR	0

equilibrium OR match* OR equal* OR adjust* OR stabili* OR pois*) AND TS=(stone fruit* OR apricot) AND TS=(producti* OR yield) AND TS=(qualit*)	trade off OR balanc* OR compromis* OR equilibrium OR match* OR equal* OR adjust* OR stabili* OR pois*) AND (stone fruit* OR apricot) AND (producti* OR yield) AND (qualit*))

A few results have been found. Moreover, apricot, olive oil, grape, plum, peach and cherry were the products concerned. Serbia (University of Kragujevac and Fruit Research Institute of Cacak), Italy (universities of Perugia, Foggia, Bari, Bologna) and Spain (University of Seville) were the first affiliated organizations providing results. Among those results, 64.8% were articles. Around thirty percent of the publications came from Italy.

4.3.3. Need 3: increasing the resistance to diseases and pests

Climate change impacts, meteorological conditions' evolution and other environmental factors have direct and indirect effects on the crops management. Diseases and pests are increasing in quantity and strength. Crops have to be more resistant.
Concerning the sub-category of pests and diseases' resistance of apricot varieties, several search levels were performed. Three diseases were regularly expressed by the producers interviewed to be major sources of issues for their production. Monilia, apricot chlorotic leafroll and bacterial canker were including in separated searches.

Apricot Chlorotic Leafroll

Apricot Chlorotic Leafroll (ACLR) is a disease with symptoms like leaves' rolling, yellow coloration, fruits' withering (Desvignes & Cornaggia, 1982). It is also called European Stone Fruit Yellow (ESFY). Its impact has economically substantial losses for the producers (Carraro, Ferrini, & Ermacora, 2002). Table 4 depicts the results.

Table 4. Research equation respectively used in Scopus and Web of Science on the topic of Apricot Chlorotic Leafroll (ACLR) or European Stone Fruit Yellow (ESFY)

Keywords' equation (WoS)	Number of results	Keywords' equation (Scopus)	Number of results
TS=("ESFY" OR "ACLR" OR apricot cholorotic leafroll phytoplasma OR Phytoplasma prunorum OR European stone fruit yellow* phytoplasma) AND TS=(stone fruit*)	122	TITLE-ABS-KEY (("ESFY" OR "ACLR" OR "european stone fruit yellow" OR "apricot chlorotic leafroll" OR phytoplasma prunorum) AND "stone fruit*")	74

When adding an aspect of resistance or tolerance, the results fall down to 29 for WoS, with the query: TS=("ESFY" OR "ACLR" OR apricot chlorotic leafroll phytoplasma OR phytoplasma prunorum OR European stone fruit yellow phytoplasma) AND TS=("stone fruit*") AND TS=(resist* OR eradicate* OR eliminate* OR sensitivity OR decreas* OR reduc* protect* OR fight* OR hinder* OR opposition OR immunity OR struggle OR tolera* OR strength OR resilien*). Nevertheless, it appears that the 122 results of WoS were more relevant. It concerned mainly the detection, transmission and identification of the phytoplasma in different fruits (e.g. prunus, pear, peach, apricot, apple).

The research on this topic is concentrated around a few institutions and the same authors are frequently found in the database. Scopus also found one patent with the broader research. It pertained to RNA-GUIDED GENE DRIVES and it was published in July 2015 at the WIPO.
Only three authors wrote 34.5% of the publications, coming from Germany and Italy. Those countries summed 51.15% of the research results. France came at the third place with 17.4%. INRA, University of Bologna, University of Udine and the Institute Pflanzenschutz Obstau. The repartition of the types of documents was similar to the other searches performed (i.e. 60.6% of articles, 40.9% of proceedings and the remaining part were reviews). 65% of the papers presented to conferences concern the international symposium on virus and virus like diseases of temperate fruit crops. For the journals, 34% of the papers are published through Acta Horticulturae. The first research output published was done in 1996. Then, since 2001, 11.3% of the total outputs were published. This category depicts a saw-tooth profile.

Bacterial blight

Two main pathovars attack the stone fruit species. It causes "leaf spotting, bud necrosis and blast, twig die-back, cankers on branch and trunk, fruit scab". After a few years the trees are dying (Scartichini, 2010). Results for this category are presented in table 5.

Table 5. Research equation respectively used in Scopus and Web of Science on the topic of bacterial blight

Keywords' equation (WoS)	**Number of results**	**Keywords' equation (Scopus)**	**Number of results**
TS=(bacterial blight OR bacterial canker) AND TS=(stone fruit*)	103	TITLE-ABS-KEY(bacterial blight OR bacterial canker) AND TITLE-ABS-KEY(stone fruit*)	40

WoS found more results, but without a total overlap with Scopus. The latter provided a few interesting results. Like for the apricot chlorotic leafroll, reducing the window of results by adding the sensitivity and resistance aspect in the search was not that relevant.
More than forty percent of the publications are coming from the US, followed by Iran (11.6%). The research was mostly performed by INRA Montpellier, universities of California Davis, Georgia and Alberta. In the middle of the 90's, the publications appeared, followed by a slight increase in the last five years. Phytopathology and Journal of Plant Pathology were the three first journals to publish about this topic.

Monilia

Blossom blight and brown rot are due by pathogens, mostly *Monilinia fructicola* and *Monilinia laxa*. Their consequences are considerable because "brown rot has long been accepted as the major cause of postharvest fungal disease loss" (Walter et al., 2004).
By focusing on apricot and specifying this term in the query, the results should be more relevant for the study. There was a substantial difference between the two databases, as seen in table 6.

Table 6. Research equation respectively used in Scopus and Web of Science on the topic of monilia

Keywords' equation (WoS)	Number of results	Keywords' equation (Scopus)	Number of results
TS=(moniliose OR monilinia OR monilinia laxa OR monilinia fructicola OR monilia mumecola OR moniliasis OR candidiasis OR yeast infection OR brown rot) AND TS=(apricot)	106	TITLE-ABS-KEY ((moniliose OR monilinia OR monilinia laxa OR monilinia fructicola OR moniliasis OR candidiasis OR yeast infection OR brown rot) AND (apricot))	13

When mixing the two databases, the total of results was 106. There were various authors, there was no one stepping out of the line. Acta Horticulturae was again the main book series titles (36.2%). More than a half were articles (50.7%) and 40.9% were proceeding papers. 20.9% of the conferences concerned directly the apricot culture and/or breeding. 22% of the results published came from the US, Italy and Romania. Eleven percent of the results are affiliated to the University of California Davis. In 1999 and 2006, eleven and fifteen publications appeared respectively. Since 2010, the trend was going down.

4.3.4. Need 4: reducing the speed of post-harvest ripening

After the harvesting stage, fruit maturity continues to progress. However, in order to provide consumers with an optimal fruit maturity (i.e. ready for consumption), the evolution should be slowed down during storage in retailers' cold chambers.
In this category, on the 100 results, Scopus provided 61 results that were partially in WoS. Besides, five results were only fundable in Scopus. The research equations are the presented in table 7.

Table 7. Research equation respectively used in Scopus and Web of Science on the topic of post-harvest ripening

Keywords' equation (WoS)	Number of results	Keywords' equation (Scopus)	Number of results
TS=(accelerat* OR hurry* OR quick* OR speed* OR spur* OR stimulat* OR precipit* OR velocity OR quick* OR rapidity OR celerity OR hasten* OR fast* OR intens* OR pace OR momentum OR dynami*) AND TS=(fruit) AND TS=("postharvest* ripe*" OR "post-harvest* ripe*" OR "postharvest matur*" OR "post-harvest matur*")	62	TITLE-ABS-KEY((accelerat* OR hurry* OR quick* OR speed* OR spur* OR stimulat* OR precipit* OR velocity OR quick* OR rapidity OR celerity OR hasten* OR fast* OR intens* OR pace OR momentum OR dynami*) AND fruit AND ("postharvest* ripe*" OR "post-harvest* ripe*" OR "postharvest matur*" OR "post-harvest matur*"))	61

Only two publications concerned apricot fruit. Therefore, these results depict the landscape of research on a set of different fruits (e.g. kiwifruit, banana). 87.1% of the results were articles in the main fields of agricultural and biological sciences (61%), biochemistry, genetics and molecular biology (14%), chemistry (8%) and others. The research came from China (14%), the United States (12%), Germany (9%) followed by Italy and France. The main sources (39.3%) were Postharvest Biology and Technology Journal, Acta Horticulturae, the Journal of Agricultural and Food Chemistry and Scientia Horticulturae. The first scientific publication

was available in 1962, but it was only around the 90's that general scientific interest had grown up, with a peak of twelve publications in 2014.
The products concerned in the results are wide, including several tropical fruits like banana, mango, kiwifruit, papaya and passion fruit. Only two results implied directly apricots. One focused on the agronomical characteristics of a specific variety. The other publication was dedicated to the effect of molecules and enzymes during the post-harvest ripening of apricots.

4.4. Implications for research and knowledge transfer in the value chain

Through the analyses presented in the previous sections, the first result to highlight concern the databases used. Depending on the topic consulted, some overlap was found. However, in general, WoS provided more results than Scopus. Another striking result is the scarcity of publications related to the four research topics in the field of apricot variety. Nonetheless, this result was partially expected, as this is a peripheral sector. Even in countries with bigger production than Switzerland, pome fruits are more spotlighted than apricot in the international projects and scientific activities. Moreover, research activities are recent, particularly in the field of diseases. There is a clear trend of increasing concern relating to this topic due to the substantial economic losses. There is still a need to solve the practical issues in order to increase the sustainability of the sector.
Furthermore, the research activities are spread in the occidental part of the world (e.g. the US, Italy, France, Spain, Norway and Germany) and the oriental part (e.g. Serbia, Romania, Iran, China). These findings were partially expected because of the world apricot production concentration. France, Spain, Italy are one of the main producers. Nevertheless, all the results did not concern only apricot. That provides evidence on the lacks existing in this sector.
In the frame of the TRAFOON project, a procedural scheme has been created to shed light on several gaps occurring in the value chain. These gaps have been identified thanks to the interviews conducted with the value chain stakeholders and by searching for a matching with existing innovative solutions in the scientific community. Therefore, four gaps levels were identified; (i) gap in general knowledge, (ii) gap in specific knowledge related to a specific sector, (iii) gap in adaptation of the solutions to the SMEs needs and (iv) gap in the support for operational implementation of the solutions found to answer the needs expressed by the stakeholders. The gap in general knowledge relates to a lack of scientific evidence and empirical findings about a substantial issue, like reaching the trade-off between a satisfying productivity for stakeholders to rely on the economic activities and a satisfying quality of products for consumers downstream the supply chain. The second gap focuses on a lack for a specific sector or product. A lot of research projects and empirics have been done on pome fruits (e.g. apples, pears). The resulted findings could be generalized and applied to other fruits but this is not the case for every topic, particularly in the topic of diseases and pests. The third and fourth gaps identified are practice-oriented. The possible innovations and solutions found by researchers and other actors have to be adopted by firms. This stage constitutes a first barrier for some innovations, resulting in the third gap. The last one related directly to the implementation and its support in terms of funding and practical issues.

In this study, the low results found can be characterized mainly in the first two gaps, as presented in table 8.

Table 8. Existing gaps between research and practice in the sector of apricot traditional production in Switzerland

Topics	(i) Gap in general knowledge	(ii) Gap in specific knowledge related to apricot production	(iii) Gap in adaptation of the solutions to the SMEs	(iv) Gap in the support for operational implementation
Cracking		X	X	
Trade-off	X	X		
Diseases and pests resistance				
ACLR-ESFY	X			
Monilia		X	X	
Bacterial canker		X		
Postharvest ripening		X		

It appeared that scientific knowledge has to be deepened, particularly for the stone fruit sector as presented through the gap in column (ii). These results may be explained by the high specific quality of the topic investigated. Moreover, climate changes induce changes of environmental conditions, in turn impacting evolution of critical factors. The last column (iv) is empty. It can be explained by the fact that research is still at its premises in the topics studied in this paper. Nonetheless, these findings cannot be generalized to other countries or similar sectors and have to be taken in their specific contexts.

Many research teams are working in this area all around the world. Besides, many scientific activities allow knowledge transfer from researcher to researcher or from researcher to practitioner for instance. These activities permit experiences sharing from both sides. Nevertheless, there is still little room for innovations' creation like partnerships to initiate research activities. These findings suggest a better coordination of demand of the stakeholders of the professional chain and supply of research solutions. Several elements are discussed in the next section.

5. Discussion

Methodological issues are one of the main points to discuss. The needs collected are claimed by value chain actors thanks to interviews. However, there might be a gap between the needs reported and the real needs necessary for the sector. This divergence is not studied in the article but should be the focus of further research.

Besides, during a focus group, all stakeholders should have a common understanding of key words. Researchers should not influence the chosen definitions. For instance, innovation can be understood differently from a stakeholder to another one according to his/her position in the value chain. The main concern for the focus group is the potential bias arising from the researcher influence on stakeholders. Special care should be taken to avoid it. In this study, during the focus group, a consensus was found on rating innovation needs of Swiss fruit SMEs. It was the case for a few needs. In that specific case, stakeholder weight became important. However, the weight of participants in a focus group is difficult to investigate because of different behaviour between individuals and groups. Cohesiveness, spontaneity and participants' view arise within focus group discussion (Sim, 1998).

Moreover, two tools were used to perform the analysis. A substantial overlap was found. Nevertheless, for specific areas of research the use of both tools was useful. These results are

in agreement with those of Archambault et al. (2009). Furthermore, using other languages than English to conduct the bibliometric analyse would have been useful. The over-representation of English may bias the results, especially when not taking the national databases in the analysis (Mongeon & Paul-Hus, 2016). This should be added for further research and apply to other areas or fields of research.

In a study on the territorial impact of food initiatives, Paus and Réviron (2010) used subjective methods, opposed to the objective methods commonly used. The goal was to entail the society and key players in analysing the real effect of the initiatives conducted at regional and national scales in order to be sustainable. This emphasized the innovation scheme underpinned and whether involvement of stakeholders in the innovation process was flexible. Buur and Matthews (2008) and Kemmis and McTaggart (2007) demonstrated that involving stakeholders at different steps of the innovation process can enhance positive impacts on efficiency and relevance of innovations developed(Buur & Matthews, 2008; Kemmis & McTaggart, 2007)(Buur & Matthews, 2008; Kemmis & McTaggart, 2007). In our study, selected participants have been implicated in the focus group. Therefore, it had the advantage to take into account their interests. Participation early on the research does not induce the same impacts than later participation in the innovation process. The participatory action research focuses on permanent improvement of the research thanks to iterative loops in which stakeholders and researchers interact to rectify and improve the steps of the projects. In this setting, the ownership of the research project is shared between all involved bodies (Kemmis & McTaggart, 2007). Buur and Matthews (2008) explained the lead-user approach in the user-driven innovation goal. Implicating the end users right at the beginning of the research project may improve the success of the projects. The win-win framework is possible thanks to combination of scientific knowledge and methodologies of researchers and knowledge of end users on local framework. Additionally, in their paper, Esterhuizen et al. (2011) referred to knowledge creation term. It was initially developed by Samaddar and Kadiyala (2006) with two distinct definitions. In this study, the process aspect of the knowledge creation is considered. The authors defined it as a "process view defines knowledge creation as "dynamic, interactive and process-oriented, as well as being focused on the relationships that are involved in creating new knowledge". Therefore, the actors with which the knowledge has been created matters for its value in terms of enabling innovation. This concept should be applied for the sector focused on in this study. It appears that serious gap exist between knowledge producers and practitioners. Hence, involving adopters of innovation may reduce the gaps.
Finally, efficient knowledge transfer can support innovation adoption by rising awareness of value chain stakeholders regarding which innovative solutions best fit the faced issues. Acquisition of knowledge represents a key driver for innovation, though internal or external to firms' boundaries (Klewitz et al., 2012). In the current European projects, different actions are used to support this knowledge and innovation transfer. Nonetheless, an action for continuous knowledge flow might be missing in the actions available in the FP7 and H2020 projects. Integration of research type within a single project could allow better internalization of the needs of the value chain as well as providing the targeted solutions.

6. Conclusions

The study highlighted the current innovation needs of Swiss apricot sector. Needs have been identified thanks to interviews and prioritized with stakeholders involved in the value chain. The importance of improving varietal innovations was homogeneously expressed. Despite the good quality of products and production techniques, consumers and producers expect more taste of fruits. Trade-off between productivity and taste has to be increased in order to satisfy

both criteria. Knowledge on varieties for one-side and consumers' preferences on the other side have to be reached to add fundamental value to these fruits sectors and to induce higher competitiveness. On nutritional level, fruits have to be exploited for their healthy components. Promoting its consumption is thus an opportunity. Valorisation of by-products like apricot kernels, or new markets like organic production or premium products should be developed in this direction. Besides, pests and diseases management, phytosanitary products and competition are other major areas to put effort on. Stakeholders mentioned threats relating to homogenization of European rules (e.g. pesticides use). Diversity of phytosanitary products should be increased to give more alternatives to producers. These results go along with consumers' expectations and society in general. Fruit is part of healthy diet. The high level of Swiss agriculture could further be improved by reaching high quality of fruits and environmental preservation. This would be a success factor for small producers in the globalization and harsh economic times.

Moreover, fundamental and applied research conducted in public research organization and universities partially solved the needs identified in the study. Therefore, stakeholders should be included in future research projects to efficiently transform weaknesses into strengths for the value chain.

Finally, lack of resources, knowledge access and application are SMEs barriers to innovation implementation. The importance of networking becomes higher in such setting (Gellynck & Kühne, 2010). As a matter of fact, the study demonstrated a need of better coordination between stakeholders in agricultural production and researchers. The knowledge has to be transferred and shared in the network. Extending interactions and transmission of knowledge, either tacit or codified, might be part of future studies.

Acknowledgements

This study was conducted in the frame of the European project named Traditional Food Network to improve the transfer of knowledge for innovation (TRAFOON) within the seventh framework program (FP7), running from November 2013 to October 2016.

We are grateful for the financial support of TRAFOON and for the valuable discussion with project partners. The authors acknowledge funding from the following source TRAFOON (FP7-KBBE project number 110874).

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