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Title

Resistance to Traditional Agroecological Knowledge erosion in industrialized contexts: A study in La Plana de Vic (Catalonia).

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Abstract

This work explores the actors and reasons behind Traditional Agroecological Knowledge (TAeK) conservation initiatives in industrialized contexts. Results come from interviews to key informants and social network analyses of TAeK conservation projects conducted in central Catalonia. Actors used contrasting discourses to refer to TAeK conservation, but with a strong potential to generate alliances between different types of projects. The existing parallelisms between resistances to TAeK erosion and resistances to industrialized agri-food systems could become the seed for common collective action to counterweight the loss of TAeK.

Key words

Agroecology, lexicometry, discourse, social network analysis, traditional knowledge conservation

Introduction

Traditional Agroecological Knowledge (TAeK or TAK)[1] is a term used to define the cumulative body of knowledge, practices, and beliefs about an agroecosystem that has evolved and adapted to the local environmental and cultural contexts after generations of farmer-nature interactions. (Reyes-García et al. 2013; Toledo and Barrera-Bassols 2008; Rocha 2005; Reyes-García, Benyei, and Calvet-Mir 2018). Examples of TAeK include farmers' knowledge of landraces (i.e., plants of a certain botanical taxon selected by farmers and resulting in local environmentally and culturally adapted crops), practices related to the preparation/transformation of cultivated plants, or beliefs and institutions related to agricultural resource management such as local rules around water management (Calvet-Mir et al. 2018).

TAeK is essential not only for agrobiodiversity conservation and management, but also for providing resilient and locally adapted food systems that contribute to food sovereignty (Altieri and Merrick 1987; Altieri and Toledo 2011; Armitage 2003). Research has shown that traditional agricultural practices contribute to biodiversity maintenance (Altieri and Nicholls 2000), including the maintenance of wild diversity (Blanckaert et al. 2007). For example, traditionally managed agroecosystems, such as *dehesa* grasslands (an agrosilvopastoral system found in southern and central Spain and Portugal), support a wide diversity of plant and animal species (Peco, Oñate, and Requena 2000; Plieninger and Wilbrand 2001). Similarly, traditional animal husbandry practices, such as shepherding, provide dispersal opportunities for multiple plant species and are thus considered useful approaches to plant diversity restoration in fragmented grasslands (Babai and Molnár 2014; Rico, Boehmer, and Wagner 2014). In the same line, traditional home gardens contribute to the *in-situ* conservation of crop genetic diversity (Calvet-Mir et al. 2011; Perrault-Archambault and Coomes, 2008) and to the provision of other ecosystem

[1] Many terms have been used to describe this concept. In this article, the term "Traditional Agroecological Knowledge" is used mirroring the term "Traditional Ecological Knowledge", a term widely used in the research and policy arena. The use of the word 'traditional' (rather than 'local' or 'folk') emphasizes the long-term historical continuity of these bodies of knowledge and the importance of social processes in their transmission and maintenance. The word 'traditional' does not imply knowledge being archaic or pre-modern, as traditional knowledge systems are highly dynamic and adaptive and co-exist and interact with other forms of agricultural knowledge (Reyes-Garcia et al. 2014).

54 services, especially cultural services such as the maintenance of cultural identity and social
55 networks (Calvet-Mir, Gómez-Baggethun, and Reyes-García 2012). Furthermore, TAeK is
56 considered critical for agroecological transitions since it offers the potential to contribute to the
57 reduction of farm inputs and to the intensification of farm biodiversity, providing answers to some
58 of the environmental, political and economic challenges that agroecological transitions face
59 (Koohafkan and Altieri 2011; Altieri, Funes-Monzote, and Petersen 2012; Guzmán et al. 2013;
60 Gliessman and Rosemeyer 2010; Calvet-Mir et al. 2018).

61 Although TAeK has some level of resilience that might allow its co-existence with industrial
62 farming knowledge and practices (Reyes-García et al. 2014), there is a great concern regarding
63 TAeK's rapid erosion (e.g., loss of traditional farm management practices or landrace names) and
64 enclosure (i.e., the establishment of restrictive property rights over agrobiodiversity and
65 associated knowledge). For instance, several authors have noticed the rapid loss of traditional
66 agroecological practices in Europe, a phenomena that has been often linked to two main factors.
67 First, the industrialization of the agricultural systems (understood as the process by which the
68 logics of industrial production are applied to agricultural production, including processes of
69 intensification and mechanization, Rotz and Fraser 2015). Second, the strict regulations in
70 protected areas (Gómez-Baggethun et al. 2010; Hernández-Morcillo et al. 2014). Other authors
71 have highlighted the problems related to the private and public management of TAeK (especially
72 landrace knowledge), calling for its protection under a "commons" framework (Brush 2007;
73 Srinivas 2012; Reyes-García et al. 2018; Reyes-García, Benyei, and Calvet-Mir 2018).

74 In the light of these threats, several initiatives aiming to promote TAeK conservation have
75 emerged around the world, including initiatives engaged in the static documentation or storing of
76 TAeK (an *ex-situ* or de-contextualized approach) and also efforts to gather, reproduce, transmit
77 and revitalize TAeK's use among knowledge holders and their communities (an *in-situ* or
78 contextualized approach; Benyei et al. 2019). For instance, after the signature of the Convention
79 on Biological Diversity (1992) that had articles referring to the inclusion of traditional knowledge
80 in biological conservation efforts (Alexander et al. 2004), there has been an emergence of policy

and legislative initiatives to protect traditional knowledge (including TAeK) through databases and inventories (Lakshmi Poorna et al. 2014; Pardo-de-Santayana et al. 2014). In parallel, a diversity of community-based programs have been initiated to encourage *in-situ* traditional knowledge maintenance (McCarter et al. 2014; Tang and Gavin 2016). These initiatives include projects aiming at putting TAeK into practice through workshops, the cultivation and exchange of landraces, the use of traditional tools, or the recovery of traditional gastronomy, among others. Some initiatives have also started to focus on traditional knowledge gathering and sharing among an extended online community, as a way both to protect and to revitalize these knowledge systems (Calver-Mir et al. 2018). Moreover, civil society organizations have also been promoting TAeK conservation and protection. For instance, in Spain, the different local seed networks (coordinated under the non-governmental organization "*Red de Semillas. Resembrando e Intercambiando*") have played a crucial role in inventorying and sharing traditional landraces knowledge (Reyes-García et al. 2018).

Recent research shows that initiatives targeting TAeK conservation seem to be more inclusive than initiatives targeting other domains of traditional knowledge (Benyei et al. 2019). This could be due to the specificities of some TAeK conservation actions that rely on community networks, public participation, and collective action (e.g., community seed banks, lifeway museums, or inter-generational TAeK exchange activities). Moreover, being TAeK loss the result of certain sociopolitical and economic conditions (namely the industrialization of food systems), some TAeK conservation initiatives could be understood as resistance actions since they represent individual or collective efforts that oppose, confront, and try to prevent or reverse those conditions (Hollander and Einwohner 2004; Lee 2017). Indeed, some of the main issues affecting TAeK loss (e.g., agricultural industrialization, privatization of agricultural knowledge) are structural factors that the agroecology movement also contests (Gómez-Baggethun et al. 2013). In that sense, the interests of TAeK conservation initiatives could potentially overlap with the interest of movements resisting industrialized food systems in general and with the agroecology movement

in particular (Koohafkan and Altieri 2011; Gliessman 2013; Bonanno and Wolf 2017; Calvet-Mir et al. 2018; Mier y Terán Giménez Cacho et al. 2018).

While the resistance movements against industrialized agri-food systems have received some scholarly attention (McMichael 2005), it is still not clear how the different approaches to TAeK conservation align with these movements in industrialized contexts, where the connection between agricultural production and TAeK has been weakened. Moreover, although TAeK conservation has been studied before, previous work has mainly explored conservation efforts related to one physical element in the TAeK systems (e.g., landrace knowledge conservation through seed networks, see for instance Calvet-Mir et al. 2012; Calvet-Mir and Salpeteur 2016). Thus, we lack a more holistic understandings of how TAeK conservation efforts are conceptually and relationally articulated (i.e., which are the motivations behind TAeK conservation and how do the different TAeK conservation efforts relate to one another; Benyei et al. 2019).

In this work, we shed light on these research gaps by exploring 1) local actors' perceived opportunities and threats to TAeK conservation; 2) local actors' discourses around TAeK conservation; and 3) the local network of TAeK conservation projects in a study area in central Catalonia where an industrialized agri-food system is rapidly replacing traditional agri-food systems. By inductively exploring these issues, we produce general categories that help understand the complexity of TAeK conservation realities, including the motivations behind and the relationships among TAeK conservation initiatives. Finally, we conclude by exploring the potential relations between TAeK conservation initiatives and agroecology as a resistance movement.

Study area

This study took place in the region of Osona, central Catalonia (north-east Iberian Peninsula). More specifically, we focused on the area called *La Plana de Vic* (Figure 1), the main flatland of the region where industrialized agriculture has taken over drastically, especially since the mid-20th century (Torrents i Buxó 2009; del Val i Torra 2016).

133 *Insert Figure 1 here*

134 La Plana de Vic is an erosion basin, about 30 km long and 10 km wide that includes 31
135 municipalities, with a population of 142.465 people and a surface of 620km^2 (IDESCAT 2017;
136 Vilamala 2018). Despite the relatively high average population density of the area (230 inh/km^2)
137 8 out of 31 municipalities are considered rural and predominantly agricultural, according to
138 municipal indicators of population density and economic activity (Domínguez i Amorós, Monllor
139 i Rico, and Simó i Solsona 2010). Despite being categorized as rural according to their population
140 density, most municipalities (20/31) are predominantly oriented towards services and industry
141 (including the food processing industry). Three municipalities (i.e., Manlleu, Torelló and Vic) are
142 categorized as urban. Moreover, despite the relative importance of the services sector compared
143 to the agricultural sector (74.6% of Osona's GDP and 60% of employment versus 1.8% and 3.3%
144 respectively), the food sector (including the food processing industry) still has a relatively
145 important weight in the economy of the area (IDESCAT 2017). Considering the whole food chain,
146 from production of raw materials (e.g., seed, fertilizers etc.) to elaboration of food products and
147 food retailing, the food sector in Osona employs 22% of the active population and produces 58%
148 of the region's income (CREACCIÓ 2014; del Val i Torra 2016).

149 Indeed, these data reflect an important industrialization of the agricultural sector, a process that
150 started in the mid-19th century, with the emergence of the textile and cold meat (sausage)
151 processing industries in the area (Castell i Castells 2001). Although until the mid-20th century,
152 industrial activities coexisted with traditional family farming, this socio-ecological configuration
153 changed drastically from the 1960's onwards, when there was an increasing industrialization of
154 agriculture, oriented towards intensive pig and cattle production (Torrents i Buxó 2009). Overall,
155 agriculture industrialization lead to the abandonment of traditional farming systems, as it
156 happened in other areas of Spain, (Naredo 1971). According to the latest agrarian census, fodder
157 plants are the predominant crop in La Plana de Vic (13% of UAA), which also produces 2% of
158 all the Spanish pork (being Spain the 2nd pork producer in Europe according to EUROSTATS
159 2016 and INE 2009).

160 Agricultural industrialization had and still has important socio-ecological consequences in the
161 area. For instance, the area has experienced an important rise in land prices driven both by
162 growing urbanization but also by increasing land concentration and the high land demand of the
163 pork industry (which requires land to deposit pig manure). The rise in land prices makes it very
164 hard for small producers to acquire land (Torrents i Buxó 2009). Also, nitrification of soils and
165 aquifers due to integrated pork farming and intensive manure fertilization is one of the biggest
166 ecological concerns in the area (Menció, Boy, and Mas-Pla 2011; Torrents i Buxó 2009; Vitòria
167 et al. 2008).

168 Despite this general situation, several sustainable agriculture experiences have emerged in the
169 area, including both organic and agroecological productive projects. Moreover, some of these
170 projects are starting to organize collectively around the APA-Osona (Osona's Agroecological
171 Farmer's Assembly, for its Catalan acronym). According to the latest agrarian census (INE 2009),
172 5.5% of the agricultural area in La Plana de Vic is under organic production, being Taradell and
173 Torelló the municipalities leading this tendency. Furthermore, a strong rural cultural identity still
174 exists in the area, and multiple local and regional historical societies have emerged since the
175 1980's. These societies include cultural associations recording elders' life histories with an
176 emphasis in documenting TAeK related information. Some lifeway museums have also been
177 created, including an Ecomuseum (open-air participatory museums, Riva 2017) in which several
178 municipal councils, the region's university, and several associations and historical site owners
179 have organized exhibition centers that hold inter-generational activities with a TAeK conservation
180 vision and mission (Hernández Fernández 2016).

181 ## Methods

182 Our work followed an inductive methodological approach, by which we explored the universe
183 of TAeK conservation actors and projects in La Plana de Vic and grouped them according to
184 their main goals. We used this information to explore the motivations behind and relationships
185 among TAeK conservation actors and projects.

186 **Data collection**

187 We collected data in several municipalities of La Plana de Vic during 2016 and 2017 using in-
188 depth interviews and a survey.

189 *In-depth interviews*

190 To explore the perceived opportunities and threats that TAeK conservation projects face and the
191 discourses around TAeK conservation, in December 2016 we performed 11 semi-structured in-
192 depth interviews with key informants tightly connected to TAeK conservation in the area.

193 To select informants, we used snowball sampling (Bernard, Wutich, and Ryan 2017). We started
194 by interviewing individuals contacted in an activity organized by the Ecomuseum in which
195 traditional cereal harvesting tools and practices were exhibited and taught by local elders. These
196 individuals gave us the contact details of other people participating in TAeK initiatives in the
197 area, who were also contacted and interviewed and who, in turn, gave us further contacts. This
198 process was repeated until no new actors were cited. People interviewed were mainly adult men
199 (only 2 of the11 persons interviewed were women) directly engaged in one or several of the
200 studied TAeK conservation projects (only two did not participate in any of the projects). One of
201 the interviews was a group interview to 4 members of the local seed bank (see Table 1).

202 *Insert Table 1 here*

203 Before starting the interview, we presented our definition of TAeK to the informants, also
204 providing some examples. This allowed us to have a common basis for discussion. The interview
205 followed a guideline that included questions addressing 1) TAeK loss in the area, 2) threats to
206 TAeK conservation, 3) opportunities for TAeK conservation, and 4) TAeK conservation projects
207 in the area. These interviews were recorded with the interviewees' consent and later transcribed.

208 *Survey*

In order to explore the network of TAeK conservation projects in La Plana de Vic, in May 2017 we conducted a survey designed to capture the existence of relations among ongoing TAeK conservation projects in the area.

The sample for the survey was selected through name generation techniques following a respondent-driven sampling design (Bernard, Wutich, and Ryan 2017). Specifically, we first obtained a list of TAeK conservation projects in the area from our in-depth interviews. The list was then reviewed and completed by participants in a workshop on "The value of TAeK" organized by the research team in the region's university. We also included in the survey those projects that were mentioned during the first surveying round. Our final sample was 28 TAeK conservation projects, which, to the best of our knowledge, are all the ones that exist in La Plana de Vic. From the 28 projects approached, 25 responded to the survey (a response rate of 89%). The projects missing were an organic farming project, an educational foundation, and a wood products workshop.

The survey was based on a closed-ended questionnaire in which we asked the respondent to grade the relation between his/her project and each of the other projects in the list in a scale from 0 (non-existing collaboration) to 3 (tight collaboration). We emphasized that the respondent did not have to provide a personal answer, but an answer that reflected the projects' relations.

Data Analysis

We started by classifying both actors and projects according to their main approach to TAeK conservation. These approaches were defined through and inductive process as accumulative, exhibitive, productive, processing, or educative based on what type of activities they conducted and what was their mission and vision regarding TAeK conservation. The accumulative approach focused on collecting TAeK and storing it in archives; the exhibitive approach focused on exhibiting TAeK-related artifacts, documents or practices; the productive approach focused on using TAeK to produce agricultural products; the processing approach focused on using TAeK to transform or process agricultural products; and the educative approach focused on including

TAeK in curricula. We then analyzed the data differentiating between the data from the in-depth interviews and the data from the survey.

In depth interviews

To explore local actor's perceived opportunities and threats to TAeK conservation, we transformed the in-depth interviews transcriptions into plain text with UTF-8 encoding using LibreOffice. This text was analyzed using RQDA (an R package for qualitative data analysis, Huang 2018) and following a grounded theory approach by which segments of text were coded and extracted (Corbin and Strauss 1990). The codes were generated following an inductive process by which we looked for patterns in the text and established codes for opportunities and threats to TAeK conservation that were not previously defined (Newing 2011).

To analyze the local actors' discourses around TAeK conservation, we used IRaMuTeQ (Ratinaud and Déjean 2009), an R based interface that uses the ALCESTE algorithm to produce word count based statistics that allow lexicometric analyses (Gavard-Perret et al. 2012; Reinert 1983, 1986). The plain texts from each interview were compiled in a single file that included coded headings expressing each interviewee's attributes. The attributes used were the ID of the interviewee and the TAeK conservation approach to which the interviewee was most strongly associated (i.e., accumulative, exhibitive, productive, processing or educative, see Table 1). Then, the software divided the text into Text Segments (TS) and calculated the frequency of word co-occurrences. Furthermore, the software identified clusters with a Descending Hierarchical classification Analysis (DHA). These TS clusters gathered pieces of text containing similar vocabulary. Thus, each cluster can be considered as a relatively stable cognitive-perceptual framework (Reinert 1983). Finally, using Chi^2 tests, the software calculated if certain words, actors, or TAeK conservation approaches were significantly associated to a certain cluster. These analyses allowed establishing the link between actors' profile and the words they used, which we interpreted in terms of types of discourses.

Survey

To analyze the network of TAeK conservation projects in the study area, we transformed the survey answers (i.e., degree of relationship among projects) into an adjacency matrix (a square data matrix showing the relation/distance between every two projects/nodes). We then coded the nodes according to the municipality where the project took place (color code) and the type of project (shape code). To code the type of project, we followed the classification of TAeK conservation approaches (i.e., accumulative projects - e.g., the historical societies; exhibitive projects - e.g., the museums; productive projects - e.g., farms; processing projects - e.g., basketry enterprise; and educative projects - e.g., technical school, see Table 5 in the results section).

The adjacency matrix was imported to Social Network Visualizer (SocNetV) 2.3 (Kalamaras 2017), an open software used to perform network visualization and social network statistical analyses (SNA). We calculated two network-level measures: (1) size, or number of nodes (projects) in the network, and (2) density, or the ratio of existing edges (connections) to all possible edges (n*(n-1)) between nodes. We also calculated two node-level centrality measures: (1) degree centrality (DC), or the number of weighted edges (connections) a node has to other nodes in the network, and (2) betweenness centrality (BC), or the ratio of edges between pairs of nodes which run through another node. Degree centrality is a measure of node activity (i.e., how active is the project in the network) that takes into account the number of projects a given project relates to and the weight of that connection. Betweenness centrality is a measure of brokering capacity that quantifies how much a specific project acts as an intermediary between other projects. To better interpret these measures, we calculated standardized indexes (DC' and BC') ranging from 0 to 1, being 1 the maximum possible DC and BC (i.e., DC'=1 when the node has the maximum possible connections and BC'=1 when the node falls on all edges). These centrality measures are widely acknowledged by the literature as reliable indicators assessing the structural relations of a social network (Knoke and Burt 1983; Wasserman and Faust 1994).

Results

Opportunities and threats to TAeK conservation

Actors engaged in TAeK conservation in La Plana de Vic reported economic, institutional, and sociocultural opportunities to TAeK conservation (Table 2). The most frequently mentioned opportunities for TAeK conservation were sociocultural opportunities (mentioned 34 times and in ten of the 11 interviews). These opportunities included both strong networks and TAeK cultural and social revalorization (each mentioned in six interviews). For example, A6 reported that "*there are many associations, since the late 70's, and this facilitates the initiation and maintenance of TAeK conservation projects*", thus emphasizing the opportunity that networks offer to the maintenance of TAeK. Regarding the revalorization of TAeK, A2 reported that "*now people are eating products and landraces that were not previously valued because they were considered animal feed*" and A1 added that "*we are starting to re-value the knowledge of these men*[2]*, which use to be considered old and ignorant*". Some other sociocultural opportunities for TAeK conservation mentioned by the actors include knowledge transmission activities (mentioned in five interviews) and individual or collective will to maintain TAeK (mentioned in three interviews). For example, A3 mentioned that "*to revert this process* (TAeK erosion)*, there is a need for social activities that, from the youngest to the eldest, favor knowledge transmission*".

Economic factors were also often mentioned as opportunities for TAeK conservation (mentioned 17 times and in six of the 11 interviews). The most commonly mentioned economic opportunity was the appraisal of new markets for landraces and products derived from the use of TAeK (mentioned in six interviews). For example, A4 mentioned that "*now we* (consumers) *are looking for artisanal bread. We want to recover what existed before*" and A8 reported that "*we are now living a small boom of artisanal cheese making*". Some other interesting economic opportunities mentioned were failures in the industrial agricultural system and the potential that alternative responses to these failures have, such as organic agriculture and neo-rural settlers (each mentioned in two interviews). For instance, A1 said "*There are still some small farmers, some of these neo-*

[2] Note that the actor referred to men when talking about the TAeK holders while several studies have proven that large amounts of TAeK are held by women (Díaz-Reviriego et al. 2016).

311 *rural people, new generations of organic farmers that are trying to change things… I think that*
312 *they are the last stronghold, the traditional knowledge "guerilla"".*

313 Finally, institutional factors were also mentioned as opportunities for TAeK conservation
314 (mentioned 15 times in eight of the 11 interviews). The most mentioned institutional opportunities
315 for TAeK conservation were the potential inclusion of TAeK in schools and the institutional
316 support of TAeK conservation activities (each mentioned in five interviews). For example,
317 regarding the inclusion of TAeK in schools, A4 mentioned as an opportunity that "*there is a youth*
318 *summer camp and we get funding so that the students come to help inventorying the traditional*
319 *farm tools and learn about traditional agricultural practices*". As for the institutional support of
320 TAeK conservation, A11 mentioned the fact that "*several municipality councils are supporting*
321 *these initiatives*" as an institutional opportunity.

322 *Insert Table 2 here*

323 In relation to the perceived threats to TAeK conservation in La Plana de Vic, the actors reported
324 economic, institutional, sociocultural, and resource access threats (Table 3). The most frequently
325 identified threats for TAeK conservation were economic (mentioned 46 times and in all
326 interviews). Economic threats to TAeK conservation included global issues such as
327 industrialization (mentioned in seven interviews), globalization, modernization, and agricultural
328 standardization processes (mentioned in four interviews each); but also, local issues such as the
329 high investments needed by TAeK conservation initiatives and the lack of funding (mentioned in
330 five interviews). For example, in relation to industrialization, A8 mentioned that "*the region's*
331 *economy is oriented to global models. Industry has invaded the agricultural fields and that is*
332 *surely facilitating TAeK erosion*". Regarding globalization, A2 said "*my children communicate*
333 *more easily with someone from Ireland or China than with their grandmother*". Finally, regarding
334 local economic issues, A9 reported that "*my first priority is economic viability, and if on top of*
335 *that I can recover some landrace, then that's something I gain*".

Sociocultural threats were also frequently mentioned in relation to TAeK conservation (mentioned a total of 42 times and in all the interviews). These included aspects such as changes in lifestyle (mentioned in seven interviews), loss of perceived sociocultural TAeK value (six interviews), and inter-generational gaps (four interviews). For example, regarding changes in lifestyle, A10 reported that "*farmers nowadays have no idea* (about TAeK practices) *because they are far away from the plant and the soil, from their vital processes*". Regarding loss of TAeK's perceived value, A7 said that "*the students only see tractors, big machines, big production and money; they don't see the value of TAeK*". Finally, regarding inter-generational gaps, A1 explained that "*there was a time when the grandfather drove a wagon and the son drove a tractor and didn't want anything to do with the wagon*". Another interesting sociocultural threat was personal conflicts between local actors engaged in TAeK conservation (mentioned in three interviews). For instance, A5 and A10 mentioned that personal and ideological conflicts were blocking the functioning of Osona's Agroecological Farmer's Assembly and preventing TAeK productive projects from further collaborating.

The actors also perceived institutional threats to TAeK conservation (mentioned 23 times and in eight of the 11 interviews). These threats included strict food production regulations to small scale farmers (mentioned in five interviews), lack of TAeK integration in school curricula or lack of farmer's training (four interviews), lack of institutional support to initiate TAeK conservation initiatives (three interviews), and institutional conflicts that prevent the materialization of TAeK conservation initiatives (two interviews). For example, regarding the strict regulations that are imposed on small or traditional farmers, A8 said that "*our parents still remember watching the cheesemaker come down from the mountains or buying milk directly from the farm, but nowadays these practices are hindered by European regulations*", and A10 added that "*they* (regulators) *are controlling the amount of manure you can put in the soil, but if you fertilize with chemical fertilizers, then there is no problem*". Regarding the lack of integration of TAeK in school curricula, A2 mentioned that "*students know about machinery and how to maintain it, but don't know anything about the ancient cereals and how to grow them*". In relation to the lack of

institutional support, A8 and A9 perceived as a threat the fact that there was little institutional financial support, especially when compared to other countries such as France or even other areas in Spain such as Andalusia. Lastly, in relation to the institutional conflicts, A1, A4 and A6 mentioned some frictions between TAeK conservation projects and local institutions or other administrative units that hindered their activity.

Finally, the actors also mentioned threats to TAeK conservation related to access to resources (mentioned 21 times and in eight of the 11 interviews). The threats related to access most frequently mentioned were access to land (mentioned in five interviews) and access to landrace seeds and seedlings (three interviews). For example, A5 mentioned that "*land ownership is a threat; a lot of people who want to do these projects* (agroecological production, including landrace cultivation) *do not own the land, and land owners prefer leasing to someone with intensive pork production that will pay more money*". Regarding access to seeds, A10 said that "*what we generally see is that although farmers keep one or two landraces, they mostly go and buy seedlings, which are normally hybrid varieties*".

Insert Table 3 here

Discourses around TAeK conservation

From our lexicometric analysis, we found 383 text segments (TS) and five clusters (ordered by clustering moment, from those that first emerged as differentiated to those that were split later by the software) with significantly associated words and attributes that retained 74.41% of the information (see Table 4). We interpret these clusters in terms of different discourses.

Insert Table 4 here

The first cluster, capturing 26.32% of the information, was associated to the technical agrarian school teacher (A7) and, to lower extent, to the members of the local seed bank (A11). The cluster was also associated to the educative approach to TAeK conservation, and to the words "big", "hybrid", "family" and "organic". This cluster represents a discourse that highlights the

388 substitution of family farms by big farms and the replacement of landraces by hybrid varieties as
389 threats to TAeK and organic farming.

390 The second cluster (which captured 20.70% of the information) was strongly associated to the
391 librarian from the local historical society in Taradell (A6) and to the president of the cart recovery
392 association and co-founder of the Ecomuseum (A4). This cluster was also strongly associated to
393 the accumulative approach and to a lower extent to the exhibitive approach. The words
394 significantly associated to this cluster were "to document", "school", "fair (i.e., exhibition)",
395 "network," and "mill". Thus, this cluster represents a discourse that highlights the importance of
396 documentation, fairs, school activities, and networks for TAeK conservation.

397 The third cluster, capturing 13.33% of the information, was strongly associated to the initiator of
398 the regional historical society (A3) and to a lower extent to the president of the cart recovery
399 association (A4). It was also associated (although not very strongly) to both the accumulative and
400 exhibitive approaches. A very diverse group of words including "work", "serve" (i.e., to be
401 useful), "bread", "song", "horse", "legend", "economic", "mills", "potato", "remedy", "historic"
402 and "lose" were associated to this cluster. This cluster represents a discourse that highlights the
403 idea that TAeK can be better preserved by its use. It also highlights the diversity of elements
404 within TAeK, as it includes varied elements such as horse carts, legends, bread making, songs,
405 medicinal remedies or cultivated plants.

406 The fourth cluster (which captured 15.44% of the information) was strongly associated to the
407 agroecological shepherd and cheese maker (A8), but also to the veterinarian (linked to the APA-
408 Osona, A5), the members of the local seed bank (A11), and the local chef that is revitalizing
409 landrace-based cuisine (A2). It was also associated, although not very strongly, to the processing
410 approach. The words "producer", "France", "tradition", "to worry", "industrialize", "region",
411 "Catalonia", and "market" were associated to this cluster. This cluster represents a discourse that
412 highlights the differences between countries and regions regarding industrialization and market
413 regulations for traditional producers, which are threatening the revitalization of TAeK.

414 Finally, the fifth cluster (which captured 24.21% of the information) was strongly associated to
415 the historical agroecological farmer (A10) and the productive approach. The words associated to
416 this cluster included “manure”, “humidity”, “sheep”, “throw”, and “organic matter”. This cluster
417 represents a discourse highlighting TAeK’s productive dimension, focusing on issues of manure
418 regulations (very relevant in the area due to the pork industry manure legislation) and how they
419 can threaten traditional soil maintenance practices.

420 **The TAeK conservation network**

421 Results from the social network analysis suggest that in La Plana de Vic there is a network of
422 TAeK conservation projects composed by 28 nodes (projects) and 152 edges (connections).

423 The TAeK conservation projects identified were evenly distributed throughout the study area (see
424 Table 5 and Figure 2). Some projects had overlapping objectives and approaches (e.g., most
425 museums that had primarily an exhibitive approach to TAeK conservation had also some
426 educative goals). However, when examining their main approach, we found that many projects
427 (10/28) were primarily exhibitive, as they collected TAeK-related artifacts, documents or
428 practices to exhibit them. These projects were mainly museums (including several exhibition
429 centers associated by means of the Ecomuseum consortium). One fourth of the projects (7/28)
430 were productive projects, as they cultivated landraces and/or used some type of TAeK in their
431 farm. These projects were mainly agroecological farms connected through the APA-Osona. Some
432 projects (5/28) were accumulative, as they collected TAeK-related documents (including oral,
433 photographic and written documents) and stored them in archives. These projects were mainly
434 local historical societies or associations led or co-led by local volunteers. Few projects (3/28)
435 were processing projects which used TAeK in the transformation of food (e.g., cheese) or other
436 agricultural products (e.g., basketry). Finally, we also found few educative projects (3/28), or
437 projects that included some aspects of TAeK in their courses and curricula.

438 *Insert Table 5 and Figure 2 here*

The network of TAeK conservation projects in La Plana de Vic has a relatively high density (Density = 0.40212), which means that there are many connections between the different projects. The visual analysis suggests that exhibitive and educative projects are at the center of the network, accumulating more and stronger connections, while productive, processing and accumulative projects are at the periphery, having less and weaker connections in the network (see Figure 3).

Insert Figure 3 here

The degree centrality measure does not vary much among projects and is relatively low (maximum DC' of any node is 0.075, in a 0-1 scale, see Table 6), meaning that no single project has substantially more or stronger connections than the other projects. The projects with higher degree centrality, or higher and stronger direct contact with other projects, were the basketry museum (DC'= 0.075), the archaeological museum in Tona (DC'= 0.065), and the region's university (DC'= 0.062). Differently, the betweeness centrality measure varies greatly between projects (from 0.000 to 0.846 in a 0-1 scale), meaning that there are projects with substantially higher brokering capacity than others. The project with highest betweenness centrality was the basketry museum (BC'=0.846). Other projects with relatively high betweenness centrality were the natural history museum (BC'=0.284) and the cart/wagon museum (BC'=0.274).

Exhibitive and accumulative projects were among those with higher degree and higher betweeness centrality. For example, the regional historical society in Folgueroles had relatively high degree centrality (DC'=0.058, BC'=0.173) and the local historical society in Taradell had relatively high betweenness centrality (DC'=0.032, BC'=0.253). Differently, the productive and processing projects had generally very low degree and betweenness centrality, except for the agroecological farm in Taradell (DC'= 0.048, BC'=0.129).

Insert Table 6 here

Discussion

The diversity of discourses local actors' had around TAeK conservation and the connectedness of TAeK conservation projects in the study area can contribute to understand 1) who engages in TAeK conservation and what motivates/hinders this engagement and 2) how the different approaches to TAeK conservation align with resistance movements against industrialized agri-food systems.

What is in it for you? Who and why participates in TAeK conservation

From our lexicometric and social network analyses, we found that there are differentiated discourses around TAeK conservation, which reflect diverse motivations to participate in these efforts. However, we also found that these differences do not prevent the existence of a relatively tight network of TAeK conservation projects in La Plana de Vic.

Actors and projects following exhibitive and accumulative approaches to TAeK conservation were linked to a discourse that emphasized the importance of documenting and exhibiting TAeK through school activities and fairs. These type of projects were also central in the network and had high brokering capacity (with information mainly flowing through them). Differently, actors and projects following productive and processing approaches to TAeK conservation, were less central in the network and linked to a discourse centered on the economic and institutional threats to TAeK. These actors and projects emphasized the importance of increasing market opportunities for TAeK-based products, re-thinking food and environmental regulations, and increasing institutional support.

Our results highlight the existence of two main overarching categories or approaches to TAeK conservation. On the one hand, there are projects and actors that have a more passive approach to TAeK conservation since they consider TAeK an object of study or collection, an element of the past productive systems rather than an active element for transformation. *Ex-situ* TAeK conservation projects (i.e., exhibitive and accumulative projects) seem to align more with this approach. On the other hand, there are projects and actors with a more active approach to TAeK conservation that view TAeK as a key element to the future transformation of farming systems.

In-situ TAeK conservation projects (i.e., productive and processing projects) seem to align more with this approach.

Despite these different approaches and discourses, most projects seem to have collaborated one with another, although with a varying degree of frequency. Also, there seems to be a consensus among local actors about the importance of local networks as an opportunity for TAeK conservation. The level of connection between projects suggests that, overall, the TAeK conservation network of the area is strong. Moreover, the many connections between the projects guarantee access to information and the establishment of trust relations between projects, with potential positive implications for TAeK conservation (Calvet-Mir et al. 2015). Our results contrast with results from studies focusing on networks of individuals exchanging seed and TAeK, that have shown a more fragmented and less dense network (Calvet-Mir et al. 2012; Reyes-García et al. 2013), arguably because the establishment of trust relations and the collaboration between projects is easier than the collaboration between individual actors and because having a common final goal (protect, maintain and revitalize TAeK), enhances inter-project relationships (Calvet-Mir et al. 2015).

Our results also highlight three main issues in relation to TAeK conservation. First, they bring into attention that TAeK conservation is approached in many different ways, with initiatives that can range from documenting and exhibiting TAeK (often out of its original context), to those that aim at the reproduction of TAeK based practices in the field. The range of actions for TAeK conservation found in our study site are in line with the diversity of actions described by other authors in the field of indigenous and local knowledge conservation (McCarter et al. 2014; Tang and Gavin 2016). For example, these authors have reported many examples of community-based programs that focus on reproducing traditional medicinal knowledge by building community medicinal plant gardens. These programs resemble efforts by the seed bank in La Plana de Vic, which aim to reproduce TAeK by building community gardens and selecting some gardeners as "seed guardians". In the same line, other authors such as Lakshmi Poorna, Mymoon, and Hariharan (2014) have reported documentation initiatives comparable to the ones initiated by the

516 museums and historical societies in La Plana de Vic. Indeed, we argue that the diversity of
517 projects probably responds to the diversity of factors challenging traditional knowledge
518 maintenance, which require diversified responses suitable for each context and moment (Benyei
519 et al. 2019).

520 Second, given that *ex-situ* or passive projects (and especially the basketry museum in Tona) have
521 a higher brokering capacity in the studied network than other types of projects, and considering
522 that previous research has demonstrated that these types of initiatives tend to be less inclusive
523 than *in-situ* initiatives (Benyei et al. 2019), the results presented here raise concerns regarding the
524 possible exclusion of the active or transformative views of the *in-situ* approaches when planning
525 TAeK conservation actions in the area. Thus, even though the density of the TAeK conservation
526 network is high, the differences in betweenness centrality among projects highlight the need for
527 actions that encourage the inclusion of all actors' views as a previous and necessary step for the
528 development of collective actions. One possible line of work would be to try to address the
529 personal and institutional conflicts that were mentioned by the actors as threats to TAeK
530 conservation. This is especially relevant considering that the productive projects are normally
531 unipersonal projects with little or no institutional support, and thus depend on the capacity of an
532 individual to stay connected with the rest of projects. Another line of work would be to promote
533 online communities of TAeK conservation agents, in which actors can interact and support each
534 other while contributing to preserving TAeK as a digital commons (for instance projects similar
535 to the CONECT-e project, Calvet-Mir et al. 2018).

536 Finally, our results highlight that some actors and projects have a vision of TAeK as an element
537 with strong political and economic dimensions and with an impact in their livelihoods, whereas
538 other actors confine it to the anecdotic or folkloric-cultural domains. In this line, we also found
539 that, while most actors mentioned economic threats to TAeK conservation (such as agricultural
540 industrialization), not so many actors mentioned economic opportunities. Indeed, most actors
541 focused on how sociocultural changes could enhance TAeK conservation rather than on how
542 transforming the mainstream economic and political model could enhance TAeK conservation.

Thus, even if agroecological transition movements consider TAeK as a key transformative element that can be mobilized in response to mainstream farming models (Méndez et al. 2013; Bonanno and Wolf 2017), our findings suggest that some TAeK conservation projects and actors might not consider agroecological transitions as key to the conservation and revitalization of TAeK. In other words, TAeK conservation actors and projects are not necessarily politicized around TAeK conservation since engaging in TAeK conservation is not necessarily motivated by the idea of resistance (i.e., to prevent or reverse social, cultural, or economic structural conditions through collective action).

Resistances to TAeK erosion for an agroecological transition

Results from the grounded theory analysis suggest that many actors in La Plana de Vic referred to the agricultural industrialization and globalization processes as key threats to TAeK conservation. Most actors holding this position were related to processing or productive agroecological projects (aligned with the active/transformative vision of TAeK conservation), but some of them were also linked to accumulative, educative, or exhibitive projects. This result suggests that many of the actors engaging with TAeK conservation in our study area have become aware of the threats that the agro-industrial system in general and the pork farming industry in particular represent, not only to traditional farming systems but also to the overall maintenance of environmentally and socioeconomically sustainable territories. Thus, even TAeK conservation initiatives that do not politicize around TAeK conservation, that are not working in the direction of an agroecological transition, and that are not linked to the agroecology movement can potentially become aligned with the resistance movement confronting industrialized food systems. Although our results should be taken with caution in regards to the extent to which TAeK conservation projects can actually join in such resistances, as being aware of the threats of agro-industrial farming does not necessarily imply taking action against it, they are in line with trends observed in the context of urban farming in Barcelona (Calvet-Mir and March 2017) and seem to be a result of the actors' increasing awareness regarding the multidimensional threats the industrialized food system poses to their activity (Bonanno and Wolf 2017). In that sense, since

revitalizing TAeK can secure a knowledge base that gives answers to the environmental, economic, and sociocultural challenges that the agroecological transition faces (Mier y Terán Giménez Cacho et al. 2018), and since the threats that TAeK conservation faces are tightly connected to those challenging an agroecological food system (Altieri, Funes-Monzote, and Petersen 2012; Altieri and Toledo 2011; Gliessman 2013; Guzmán et al. 2013; Koohafkan and Altieri 2011; Wezel et al. 2009), the agroecology movement could possibly find an ally in the resistance movement to TAeK erosion in La Plana de Vic, which could potentially lead to the generation of synergies and to common collective action. However, these potential alliances are hindered by the previously mentioned marginality of the TAeK conservation projects more closely linked to the resistance movement against industrialized food systems in the study area.

Conclusion

In this work we have explored the social network and discourses around TAeK conservation in an area in which TAeK has suffered a process of rapid erosion, partially due to the increasing predominance of an industrialized food system. We withdraw two main conclusions from our results. Fist, despite the diversity of TAeK conservation projects, representing two contrasting approaches to TAeK conservation (one more active that sees TAeK as an element for transformation, and one more passive that sees TAeK as a folkloric element of the past), TAeK conservation projects are tightly connected and different actors' discourses are intertwined. This highlights their complementarity, which altogether suggests a potential to generate alliances between TAeK conservation efforts. Second, independently of their approach, most actors engaging in TAeK conservation are aware of the multiple threats that industrialized farming poses on both the conservation of TAeK and the sustainability of their territory. This suggests potential parallelisms between resistances to TAeK erosion and resistances to industrial agri-food systems, which leads us to conclude that there might be a ground for common resistance and collective action that could be mobilized to counterweight the loss of TAeK, a key element in agroecological transitions that resist and oppose the predominant industrial food system.

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Figure captions

Figure 1. Geographical location of the study area.

Figure 2. Detailed map of the study area. The colored dots are the TAeK conservation projects and interviewed stakeholders according to their approach (blue for accumulative, purple for exhibitive, green for productive, orange for processing, and red for educative).

Figure 3. Network of TAeK conservation projects in the study area. Node size represents degree centrality.

Table headings

Table 1. Local actors interviewed in the study area

Table 2. Opportunities to TAeK conservation that emerged from the analysis of the in-depth interviews (n=11)

Table 3. Threats to TAeK conservation that emerged from the analysis of the in-depth interviews (n=11)

817 Table 4. Results from the lexicometric cluster analysis of our interviews. For each cluster, the
818 total word count (n) and the Chi^2 value

819 Table 5. TAeK conservation projects in the study area

820 Table 6. Results from the social network analysis. Degree and betweenness centrality of the
821 projects in the study areas' TAeK conservation network

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