Thinking about the future of farming through different facets of "work in agriculture". Textual analysis of papers from the first Symposium on Work in Agriculture

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Abstract: *Thinking about the future of farming systems requires connecting multiple facets of changes in work in agriculture. The first International Symposium on Work in Agriculture was held in 2016 to discuss a variety of themes, from employment and health to gender and work organization. Textual analysis of the symposium's proceedings was performed, identifying four research domains: the influences of 1) demographic and rural dynamics and changes on family involvement, 2) technical aspects of work on farm and work organization, 3) changes on work and new skills of agricultural advisors and 4) socio-technical changes on work in agriculture and agricultural models. Among these main domains, agroecological transition emerged as a key entry to study overall changes in farming and food systems. These elements will help to consolidate a vision of current hotspots of changes in work in agriculture and of major figures in research communities.*

Keywords: *work, agriculture, farming systems, agricultural changes*

Introduction

According to the World Bank, agriculture is the largest employer in the world, employing 30% of the working population in 2010. Although decreasing in relative terms (38% in 2000), the number of farm workers is increasing because of population growth and now exceeds 1 billion people. Relations between capital and labor, family and paid workers, and, more widely, forms of work organization are crystallized around models of "farming systems" that are diverse and subject to changes. Agroecology (Altieri, 1999), ecological intensification (Doré et al., 2011) and precision agriculture (Bongiovanni and Lowenberg-DeBoer, 2004), among others, may focus attention when debating the dynamics of farming system models. However, they also include changes in the degrees of mechanization/automation, in working conditions and skills and in forms of labor organization (e.g. Taylorism, delegation, mutual aid, co-operation). Work in agriculture has also maintained a strong social and territorial dimension, providing a place and a status to every worker. It nurtures, safeguards and stabilizes a rural population. It strengthens either 1) solidarities founded largely on a local cultural relationship with nature, agriculture and livestock management or 2) conflicts between notably urban and rural visions of what farming systems and farmer occupations should be now (Boogard et al., 2011). Moreover, the economic, social and environmental functions of work in agriculture coexist. In territories, they may sometimes be complementary, but they can also be quite strained.

We posit that thinking about the future of farming systems requires connecting multiple facets of changes in work in agriculture:

- employment (statuses of "workers" in agriculture, gender issues, development of contractors)
- work conditions (organization, rhythms and pressures, health at work, professional career paths (education and life-long training, evolution of skills, etc.)
- accessibility of farming (settlement and other policies for smallholders, etc.)
- professional identities under debate in the farming world and the image of farming occupations outside of it (in the city, wider society, the local area and one's own family)
- impacts of innovations (technological, social, market) and dynamics of work in agriculture in global chains.

An international Symposium on Work in Agriculture (SWA) was organized in November 2016 to discuss the many facets of changes in work in agriculture and to build an international community interested in combining viewpoints on work in agriculture (http://sites.uem.br/symposiumwa2016). Since it was the first symposium of this type, we decided to identify and analyze the dominant research domains beyond the papers published in its proceedings. This study presents results of the analysis.

Material and methods

To provide insights into the study of work in agriculture that was collected, we followed the general framework of Barbier et al. (2012) to analyze the scientific domains of the IFSA community and their dynamics. We adopted framework's first phase: textual analysis of all papers from the SWA.

Analysis method

The corpus was built with the conference papers of 2016 SWA proceedings. The main scientific domains were identified by analyzing the lexical composition of the corpus using the Reinert method (Reinert, 1990). It statistically classifies frequent associations of terms in a sentence or a paragraph based on descending hierarchical classification. The sentence or paragraphe is the elementary context unit composed by 40 words. Results were displayed on a graph composed of classes of the most significant words. The words in each class were selected according to their frequency (words displayed on the graph) and the strength of their association with a given class (size of words). To provide meaningful connections between words, paragraphs were extracted from conference papers to illustrate the context in which words were used. Analysis was performed using IRaMuTeQ software (v. 0.7), an interface of R software.

The research community most related to each domain was also described according to the main variables that corresponded to the classes. Two variables, each of which represented a category, were identified for each paper: 1) country (where the study was performed) and 2) co-authors' institutions. Each co-author institution was counted only once for each paper.

Description of SWA papers

The 2016 SWA proceedings contained 49 papers from eight workshops. The workshops on technical and organizational changes in work (2, 4, 5, 7 and 8) contained most of the papers, while workshops about social aspects of work (1, 3 and 6) had few contributions (Table 1).

Table 1. Papers in the 2016 Symposium on Work in Agriculture by workshop.

Workshop	Number of articles	Titles

1. Employment policies and income policies in farming	5	Value perspectives of producers and consumers regarding the sustainability of the dairy chain in Southern Brazil
		Land Reform and Solidarity Economy: COPAVI Case in Paranacity (PR, BR)
		Institutional incentives and new forms of accessory work on family farms
		Family farming development and the support of Unitrabalho/UEM: a Case studio of Cooperatvama in Poema/Nova Tebas (Paraná – BR)
		Coping strategies with food insecurity in two Egyptian villages
2. Dynamics of work in farming, in territories in a situation of global change	9	Changes and continuities in farming work. The case of small and medium grape producers in Mendoza, Argentina
		Characteristics and trends of wage labor in tree monocultures in Latin America
		Youth engagement in agriculture: challenges and opportunities
		Rural employment in Brazil: Farm work decline between 2001 and 2009
		Temporary workers in globalized agriculture. A case study in the province of Tucumán, Argentine
		Employment contracts and performance of agroforestry systems with cocoa in the Mbam and Kim area (Cameroon Center)
		The 'blind spot' of agricultural research: the composition and availability of labour, and the 'new worker profile' of farm workers in the South West of England
		Demography and development paths: what impact on family agriculture sustainability and rural development in Latin America?
		Securing Sahelian pastoral activities through the use of remunerated labor: ambivalence of monetization
3. Gender and work in agriculture	2	Rural women's work in conventional agriculture and agribusiness firms in Egypt: a comparative study
		Female labour in rural settlements in the northwest of Parana state-Brazil: Case studies supported by UNITRABALHO/UEM
4. Transformations in work organizations in farms	12	Labor conditions and family succession in dairy productions systems in Paraná State, Brazil
		Family work in oil palm cultivation in Santa Maria, Tomé-Açu/Pará
		Work organization in livestock farms: experiences from the use of the work assessment method
		Changes in work and its organization: the example of livestock farming
		What are the differences in quality of work between vegetable growers in agroecological and in conventional systems?
		Family farming work organization of agro-extractivist communities in the region of Mambaí, Goiás State, Brazil
		Persistence and renewal of cooperation in farm work in French agriculture
		What evolutions for wage earners' work in farms after hiring? A case study in dairy farms in Auvergne, France
		Family labour and land use in the Pará rural space
		Transformations in farm work organisation in Australia: the inter-relationship between climate variability, technology and farmers' workforce strategies
		Work and productive aspects due to smallholders' family characteristics by a MFA approach
		Coping with agronomic constraints in crop/livestock systems through the management of work within the farms: a case study from two regions in Morocco

5. Health and work in farming	4	Health in rural environment: an evaluation of postural workers in milking
		Gender analysis of cassava processors' knowledge level of precautionary measures on hazards associated with cassava processing in Ekiti State, Nigeria
		Implementation of integrated instrumentation in the evaluation of occupational hazards in shellfish farming
		Ergonomic analysis of work in poultry
6. Transformations in professional identities and the image of farming occupations	2	Social representation of work from the perspective of sugar cane cut workers
		Family farming in Senegal: the situation of unpaid rural young workers
7. Advice and training about the work	5	Taking into account the meaning, the organization and the productivity of work to better advise farmers
		Individual and collective advice to livestock farmers. A focus on advice about working condition
		Building the capacity of advisers to support farmers in their people management and workforce decisions: findings from an Australian dairy industry program
		Do work simulation tools help farmers to change crop practices?
		Research and development organizations get organised to consider the work component of livestock farming in Wallonia
8. Innovations (technological, social, market) and farming work	9	Management and work in crop-livestock-tree integration system in Roraima, Brazilian Amazonia
		Supporting farmers' management of change towards agroecological practices by focusing on the work dimension: the contribution of ergonomics
		Agroecological transition: the work of farmers, advisers, teachers and researchers in question
		The impact of precision livestock farming on work, skills and human-animal interactions
		Improved plant genetic biodiversity through the organization and promotion of agricultural shows and seed fairs
		Analysing the impact of use of mobile phones in enhancing demand and access to market information and services for pastoralist communities: Preliminary Insights from Isiolo County, Kenya
		Farm machinery cooperatives: a new arena for agroecological innovation?
		Agroecological transition and reconfiguration of horticultural work among family farmers in Buenos Aires, Argentina
		Impact of scientific and technological innovation in the Brazilian agribusiness sector

All continents were represented, with co-authors from 18 countries. Despite this diversity, contribution to the SWA proceedings was unequal among continents and countries. Most paper co-authors came from the Americas (25), Europe (21) and Africa (16), with few from Oceania (2) and Asia (2). Co-authors from Brazil and France contributed nearly half of the papers.

Results

Four main research domains of work in agriculture in the SWA proceedings

The corpus had 86% of its elementary context classified in four main classes (i.e. research domains) (Fig. 1). Two factors explained 75% of the differences between them: 1) context of analysis (rural development and people (Fig. 1, right) vs. farm-level changes linked to work

changes (left)) and 2) technical aspects (task, duration) (top) vs. more social aspects (bottom) of work organization in agriculture. The main research domains on work identified were the influences of 1) demographic and rural dynamics on family members' involvement, 2) technical aspects of work on farm and work organization, 3) changes on work and new skills of agricultural advisors and 4) socio-technical changes on work in agriculture and agricultural models (Fig. 1).

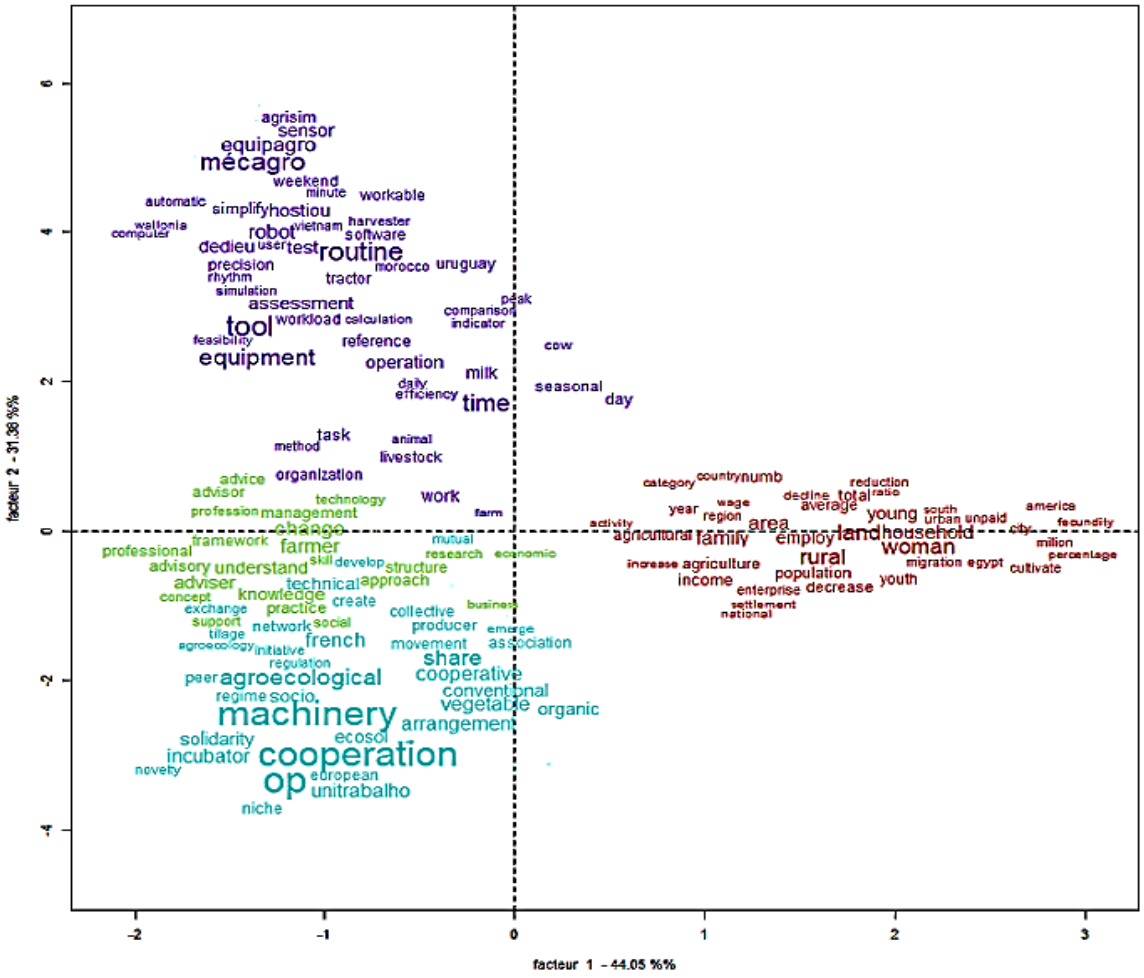

Figure 1. Four classes of words (distinguished by color) based on their association in the corpus extracted from the proceedings of the 2016 Symposium on Work in Agriculture. The classes represent research domains on work in agriculture: the influences of 1) demographic and rural dynamics on family members' involvement (brown), 2) technical aspects of work on farm and work organization (purple), 3) changes on work and new skills of agricultural advisors (green) and 4) socio-technical changes on work in agriculture and agricultural models (blue). Non-English terms correspond to cited authors (Dedieu, Hostiou), tools (mécagro, équipagro, agrisim) and cooperatives and organizations (Unitrabalho, Ecosol).

Influence of demographic and rural dynamics on family members' involvement

Demographic dynamics in rural zones change family members' contributions to work in agriculture. Rural populations have decreased due to a decline in fecundity rates and high migration to urban zones (key terms: *rural, population, decrease, decline, average, increase, fecundity, age, migration, urban*). Gender and generation are the key factors for understanding these changes (Buttel et al., 1984; Desai and Jain, 1994; Beegle et al., 2006). Gender analysis is strongly related to women's access to land and their activities in households and agriculture (key terms: *woman, household, land, settlement*). Generation analysis is related to young workers as an unpaid workforce on family farms or as employees of off-farm activities, including in urban zones (key terms: *young, youth, unpaid, urban, city*). Examples from SWA papers:

"Finally reproduction and fecundity decisions are taken within the family but impact the evolution of family workforce in relation with other dimensions of household strategy. […] This fecundity behavior can be related to the development of women school attendance in rural areas as shown by graph 6. Furthermore, there is a trend towards a masculinization of rural population. Age structure is also changing with a growth of population over 65 (graph 7), and an important fall of population under 17 (as confirmed by Neves Anderson and Schneider (2015) for Rio Grande do Sul), which reflects both rural migration and the fall of fecundity. Despite this last move, rural dependency ratio is high as working age population is also hit by rural migration. This is combined by the diminution of the persons/household ratio which is catching up with urban areas (table 3)." Demography and development paths: what impact on family agriculture sustainability and rural development in Latin America? (Requier-Desjardins, 2016).

"Women also play an important role in decision-making in production process; hence they decide the allocation of land use, the kind of crops that should be cultivated, the allocation for household and for marketing, according to their priorities for the household. This along with some other activities such as the care of the family and children and various activities and household chores". Rural women's work in conventional agriculture and agribusiness firms in Egypt: a comparative study (Solyman, 2016).

"…men work all day in oil palm cultivation and women care for the home and the children, and help in manioc harvesting after their domestic activities; and some young people, members of integrated families, migrate to work as wage earners in oil palm agribusinesses". Family labour and land use in the Pará rural space (Mota and Alves, 2016).

Studies examining the influence of these social aspects on changes in work are performed mainly in South America (Brazil, Chile) and Africa (Egypt, Senegal, Cameroon, Nigeria). The researchers involved work in research institutes and R&D institutions such as the Agricultural Research Center – Agricultural Extension and Rural Development Research Institute (Egypt) and CIRAD (France). International cooperation between researchers and institutions is observed within African countries such as Egypt, Senegal, Cameroon, Kenya and Burkina Faso.

Influence of technical aspects of work on farm and work organization

Studies assessed work to develop references and indicators (duration, efficiency) based on technical aspects of on-farm work, which are represented by the equipment used (robot, sensor, tractor, equipment, etc.) and the tasks. The organizational approach is based mainly on describing work rhythms (key terms: *routine, day, daily, weekend, seasonal, peak*) required by livestock and land management (Madelrieux and Dedieu, 2008; Hostiou and Dedieu, 2012). Examples from SWA papers:

"The routine work load (RW) on seven farms with automatic milking systems was analysed separately. Milking (including cleaning the machinery) accounted for half the farmers' daily RW, or 2 h 30 m per milking session on average. That corresponds to 5 minutes per cow per day on average, varying from 2 to 8 minutes. Lack of equipment leads to a considerable waste of time, as the routine is carried out twice a day, 365 days a year. The RW on the farms in the survey amounted to 3,468 h per year on average for 73 dairy cows". Research and development organizations get organised to consider the work component of livestock farming in Wallonia (Turlot et al., 2016).

"At the conclusion of this study, it appears that work simulation tools are not easy to use, in an individual service provision, to help farmers when changing their agroecological practices, in field crops. The method of use in individual advice is inadequate. Moreover, information on work provided to farmers is only a partial answer to their questions. The tools do not provide any qualitative information, at field level or for farmer networks (e.g.: CUMA).But these tools are learning materials for advisors, who can then mobilize their methodological framework to analyse work in a context of change". Do work simulation tools help farmers to change crop practices? (Petit et al., 2016).

The French livestock community has a strong influence in this domain. The main (French) institutions that address technical issues of work are the Livestock Institute (IDELE), INRA and VetAgro Sup (a university). The studies were performed in French-speaking countries (France and Belgium). Studies in other countries (Uruguay, Morocco and Vietnam) were performed in cooperation with French researchers.

Influence of changes on work and new skills of agricultural advisors

Analyzing work is not usually part of the portfolio of agricultural advisors' methods. Advisors have to change their practices, knowledge and skills to help farmers better manage work changes on farms (Cerf et al., 2011; Cristovao et al., 2012). Researchers develop approaches and frameworks to better understand the influence of changes on advisors' professional identities and accompanying methods. Examples from SWA papers:

"This study of advisory practice change related to human resource management and workforce issues on-farm has found that the process of linking professional development to the personal and career aspirations of advisers was crucial. Building advisory capacity can be considered as an effective change management strategy for particular contexts including non-traditional topics for advisers, an area of increasing demand from farmers, an area where there are compliance risks/information rich, and where advisers see an opportunity to progress their careers or standing in the industry through formal training. The research provides additional findings to the literature by revealing how particular aspects of the advisory context both mediate and regulate the extent of advisory practice change. That is, the advisers years of experience, the strength of interest from the advisor in developing a new professional identity in a different area of practice, and the level of support needed to develop new practices from within and outside an advisory organization." Building the capacity of advisers to support farmers in their people management and workforce decisions: findings from an Australian dairy industry program (Nettle et al., 2016).

"Existing research on changes in both farmers' and AKIS actors' work, associated with the agroecological transition, examines these transformations primarily from the perspective of the professional transitions experienced by these different actors. The term agroecological transition implies that they experience change in their ways both of doing things and of relating to their professional identity. This professional transition is not simple: all of these actors have to contend with a lack of relevant knowledge and experience, and with the diversity of claims about how best to achieve such a transition. What are the difficulties that they all face when engaging in such professional transitions? What resources do they draw on to support these transitions? To what extent can such transitions support more sustainable work in agriculture?" Agroecological transition: the work of farmers, advisers, teachers and researchers in question (Coquil et al., 2016).

Both French and Australian research communities are strongly implicated in discussions about professional identity. In France, co-authors are affiliated with a research center (CNAM) and a university (AgroSup Dijon), working in strong collaboration with INRA co-authors on changes in advisory services. In Australia, co-authors are affiliated with the University of Melbourne.

Influence of socio-technical changes on work in agriculture and agricultural models

Transition between agricultural models (key terms: *agroecological, agroecology conventional, organic*) is related to the influence of socio-technical changes on work in agriculture by connecting work arrangements at the farm and collective levels (key terms: *share, solidarity, cooperative, cooperation, collective, association, network, machinery co-op, Unitrabalho, Ecosol*) (Yang et al., 2014; Dawson et al., 2016). Examples from SWA papers:

"The socio-technical network associated with the machinery co-op often functions as a network of technical dialogues between farmers. These allow for learning processes and local knowledge production between peers. […]. Labour-sharing arrangements tend to strengthen technical dialogues, because they allow each farmer to improve their knowledge

of the on-farm conditions and practices of his peers. […] Do these experiences contribute to a reversal of the prevailing socio-technical regime or to the emergence of a new regime? Facing the lack of appropriate resources provided by the prevailing regime, the national network of machinery co-ops seeks to network the existing niches to support their efforts. In the long term, if research institutions and agricultural suppliers evolve to provide appropriate resources for agroecological practices, we think that the niches shaped by the machinery co-ops would remain important tools for farmers […]." Farm Machinery Cooperatives: A New Arena for Agroecological Innovation? (Lucas and Gasselin, 2016).

"The reconfiguration of horticultural work, through the introduction of the agroecological transition process by family farmers traditionally involved in the conventional market for the supply of fresh vegetables to the city of Buenos Aires, requires not only efforts for relearning or readopting tasks and work pace for disrupting or slowing down the productivist logic that has guided their production practices for decades, but it also requires considering to what extent it proves feasible and sustainable in the long term. In this reconfiguration, the adoption of the agroecological transition process unfolds a double movement, which we mean to summarise in terms of scope for socio-productive and commercial innovation that this process can bring to the family farming devoted to horticultural production." Agroecological Transition and Reconfiguration of Horticultural Work among Family Farmers in Buenos Aires, Argentina (Parodi, 2016).

The studies were peformed in diverse countries (Argentina, Belgium, Democratic Republic of the Congo and France). Co-authors were affiliated with 1) universities, such as the University of Lanús – Argentina and University of Louvain – Belgium; 2) cooperatives, such as the French National Federation of Farm Machinery Cooperative; and 3) associations, such as Humana People to People – Congo.

Linkages between agroecological transition and labor organization are emerging hotspots

Agroecological transition emerged as a theme discussed in the SWA, even though it was not a central concern of the eight workshops. Agroecology is a key entry point for studying overall changes in both farming and food systems. This is a new way to think about agroecology to analyze agricultural changes. In agricultural sciences, agroecology is usually associated with agricultural production that has a strong territorial identity (e.g. community resources, local knowledge) (Altieri, 1999).

The contribution of agroecological transition to analysis of work in agriculture is not limited to changes in farmers' agricultural practices (Parodi, 2016), but encompasses work arrangements in collective organizations to produce, transform and commercialize food (e.g. cooperatives and associations). These work arrangements are important for maintaining farming sustainability by enhancing working conditions on farms while improving the collective capacity for governance of food systems, as shown by the Brazilian cooperative case study:

"COOPERATVAMA is a classic way of giving solidarity to an economic enterprise, where rules of cooperatives and scope of self-management are applied. Incubation by Unitrabalho/UEM is support and guidance for the establishment, with systemic monitoring, aimed at legal formalization of supported groups, being constituted as a cooperative or association. […] So, after a lot of research about markets and also about management, this group acquired the seedlings of organic passion fruit and the community help system, guided by incubator acquired the seed and planted the seedlings. This group of cooperative producers received all appropriate guidelines, took courses and was qualified by Unitrabalho, which also provided necessary support and technical assistance. At the same time, they were investing in the diversification of organic fruit production, starting to produce and to sell pineapple, strawberry. […] After 2011, the COOPERATVAMA was responsible for its self-management, so the Nucleo / Incubator Unitrabalho gave only ad hoc aid in technical assistance to producers and marketing forms, because it already had concrete conditions to

be 'un-incubated'". Family farming development and the support of Unitrabalho/UEM: a Case studie of Cooperatvama in Peoma/Nova Tebas (Paraná – BR) (Culti et al., 2016).

Discussion and conclusion

The textual analysis is a first step to mastering the main scientific domains related to work in agriculture. While the four domains identified are the initial research domains of the SWA (i.e. rural dynamics, work organization, development of skills, socio-technical changes), agroecological transition emerges as a hotspot providing insights about overall changes in farming and food systems, including trade-offs with work in agriculture.

In the SWA papers, agricultural activity is the convergence point for the main research domains of the SWA. It covers mostly socio-economic aspects of agriculture and rural development, including socio-technical division of work (who does what and rhythms of work) according to gender (Dufour et al., 2010) and family membership (family workers/non-family workers) (Lips et al., 2013), as well as agricultural dynamics according to farming models (conventional/agroecological) and the workforce (employment, migrations) (Finley et al., 2017).

On the other hand, these themes are discussed by different research communities worldwide. Countries in the Southern Hemisphere give more attention to socio-economic aspects of agricultural activity (e.g. gender, decent employment, income, land access), while those in the Northern Hemisphere give more attention to technical-economic aspects of agricultural activity (e.g. work productivity, equipment facilities) and agricultural services, especially advice. Global trends may be explored in future research to better understand the diverse viewpoints about work in agriculture. Indeed, agroecological transition is increasingly discussed countries in both the Southern (Altieri, 1999) and Northern (Cayre et al., 2018) Hemisphere.

To highlight the position of the SWA in the worldwide research community dealing with work in agriculture, three steps will be performed 1) characterize the initial scientific base of the SWA (e.g. dominant disciplines and linkages between them), 2) a bibliometric analysis of international scientific publications about work in agriculture covering different themes and disciplines; and 3) identify guidelines for a future research agenda. For instance, agroecological transition appears as a potential research theme for discussing farmers' work organization and agricultural dynamics.

All of these elements will help to consolidate a vision of current hotspots of changes in work in agriculture and of major figures in research communities. It will also help to validate the perspective of the International Association on Work in Agriculture (https://www.workinagriculture.com), created in 2018 to combine viewpoints on work in agriculture and aiming to develop an original interdisciplinary framework relating multiple facets of work and major drivers of changes.

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