Agroknowledge: co-creation of a repository of agricultural best practices, to improve knowledge disemination and interoperability

Diego Torres[1,2], Mariana del Pino[3], Susana Gamboa[3], Leandro Antonelli[1], Jonathan Martin[1], Julieta Lombardelli[1], and Alejandro Fernandez[1]

[1]LIFIA, CICPBA-Fac. de Informática, Universidad Nacional de La Plata, Argentina
diego.torres@lifia.info.unlp.edu.ar
jonathan.martin@lifia.info.unlp.edu.ar
julieta.lombardelli@lifia.info.unlp.edu.ar
alejandro.fernandez@lifia.info.unlp.edu.ar

[2]Departamento de Ciencia y Tecnología, Universidad Nacional de Quilmes, Argentina

[3] Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata, Argentina
mdelpino@agro.unlp.edu.ar; susanagamboa;
susana.gamboa@agro.unlp.edu.ar

Abstract. Good Agricultural Practices (GAP), as defined by FAO, are a "collection of principles for on-farm production and post-production processes, resulting in safe and healthy food and non-food agriculture products, while considering economic, social and environmental sustainability." GAP are about understanding, planning and measurement, record, and management to achieve specific social, environmental, and productive objectives. GAPs goals are: to ensure food safety, to produce in a way that protects the environment and avoids its degradation, to ensure job well-being, and to obtain quality products according to consumer demand. For example, FAO enumerates general categories such as GAP for food safety, to improve market access or ensure water quality. GAP can be achieved by different actions depending on the crop, geography, available tools, and a diversity of variables. A federated catalog of GAPs that could be accessed by different stakeholders using different aspects is desirable. Also, as there are a diversity of GAPs experiences in the world, a catalog about those experiences is a helpful tool to help farmers exchange and adoption of knowledge. This chapter presents a semantic wiki repository that focuses on GAPs related to intensive horticultural activity in aspects that may be subject to improvement. The repository is framed in what is currently considered a collaborative repository. The wiki includes a description, goals, and methodologies of each good practice

defined in GAP. Also, the wiki contains links to tutorials, external sites about the agricultural field, and legal documentation.

1. Introduction

La Plata horticultural belt (LPHB), in Argentina, is the most important horticultural belt in Argentina. Over the last few decades, LPHB has grown exponentially. Thus, in recent decades, environmental, health, social, and labor factors demand a responsible and timely intervention to improve production conditions. Several problems arise as a consequence, such as contamination of drinking water, inappropriate use of pesticides, improper management of toxics, and precarious housing conditions.

Good agricultural practices have gained relevance to provide solutions for most of the formerly described problems. The GAPs are a broad set of recommendations and practices to be developed in several aspects to make sustainable use of resources in agricultural activities and production. They involve several objectives such as soil management, human welfare, crop and animal production, and wildlife conservation[18].

In Argentina, GAPs are proposed by SENASA (in Spanish, National Service of Agrifood Health and Quality), a national agency that defines policies for plant health and food safety. Actions includes a newsletter about GAPs in general and several publications about the trend lines in GAPs. However, the multiplicity of actors and several issues to information providers are a current issue in the horticultural community.

This chapter proposes and discusses the infrastructure and development of a collaborative catalog of horticultural GAPs. Catalogs are well-known alternatives to store pieces of information in specific domains. A catalog is a complete collection of elements that could be read from the first element to the last one, or the reader can navigate from element to element. A collaborative live catalog of horticultural practices is a web application where it is possible to store GAPs in a well-organized manner, and to use technologies to be integrated with knowledge-process systems in the Web of data. In this direction, this chapter proposes a collaborative repository called BPAi (Good Agriculture Practices for intensive horticulture crops in Spanish), a live catalog that includes both a semantic wiki and a semantic ontology that describes GAPs and their related concepts.

The BPAi data is described in a structured manner using specific semantic web languages. One of the benefits of the semantic Web is support for automatization and interoperability. Automatic agents consume and process semantic data. Also, as BPAi is a wiki, any person could access and collaboratively build its content.

This chapter is organized as follows; the following section introduces GAPs and their presence in Argentina, then Section 3 describes the main concepts behind a catalog in good practices in Argentina. The Agroknowledge ontology is introduced in Section 4. Then, Section 5 describes the BPAi wiki and its main features. To

make the BPAi more friendly, we propose a gamification strategy that promotes content generation without losing quality in Section 6. A discussion about the use of BPAi in the La Plata horticultural belt is described in Section 7. In the end, the Conclusions and future work are detailed.

2. Good Practices in Agriculture

In recent decades, the La Plata Horticultural Belt has shown constant growth in productive, technological, and commercial activities. These activities have led to qualitative differentiation of production, a significant increase in cultivated area, the number of producers, and technology innovations. This has given it great competitiveness compared to other producing regions, currently constituting the country's most important horticultural belt[11]. At present, the area covered with greenhouses in the region reaches 6000 ha, with more than 5700 producers[9]. This exponential growth in recent decades has led to environmental, health, social, and labor challenges that demand a responsible and timely intervention to improve production conditions.

Among various problems that arise, the most important are the lack of drinking water, inappropriate use of pesticides , non-use of protective elements for chemical treatments, lack of management and household waste production and precarious and unsafe housing conditions. In this context, dissemination and implementation of Good Agricultural Practices (GAP) have gained particular relevance in recent decades to advance the problem's comprehensive approach.

Worldwide, the agri-food industry's growth, the growing globalization of markets, and changes in consumption patterns make it necessary for countries to incorporate practices that work on food safety and quality in their production systems. GAPs are thus considered in the regulatory framework of globalized trade[10].

The concept of GAP consists of applying available knowledge to the sustainable use of basic natural resources for the benevolent production of safe and healthy food and non-food agricultural products while ensuring economic viability and social stability. It is about knowledge, understanding, planning and measurement, recording, and management to achieve specific social, environmental, and productive objectives[18].

In a broader sense, GAP are simply a set of technical practices, standards, and recommendations applicable to the production, processing, and transportation of food, aimed at caring for human health, ensuring product safety, protecting the environment, and improving conditions of workers and their families (FAO, 2012).

The concept is not new; we can cite the formation of the EUREP (European Retailer Group) in Germany in 1997, at the request of supermarkets and food retailers, and convening all production representatives' chain of fruits and vegetables. All of them jointly worked on the documentation of "Good Agricultural Practices" at that time.

EUREPGAP GAP is a means of incorporating Integrated Pest Management (IPM) and Integrated Crop Management (MIC) within the framework of commercial agricultural production[18].

The most developed and implemented protocol at the international level is GLOBALGAP, which establishes voluntary standards to certify agricultural products in many countries. The most important aspects that these regulations comprise are: Sustainable production techniques; Environmental Protection; Food safety; Social and labor aspects; and Traceability [25].

In Argentina and the La Plata Horticultural Belt, GAP's implementation is of interest to provide an adequate legal framework for the production process, the final product, and the working people while guaranteeing the safety of food care environment, according to region requirements.

Consequently, with this diagnosis, since 1999, various actions have been carried out to try to improve intensive horticultural production through some of these practices.

In Argentina, the SENASA (National Service for Agrifood Health and Quality) defines GAP as "those actions aimed at reducing the risks of physical, chemical and biological contamination in primary production from sowing to harvest, as well as field conditioning, postharvest, transportation and storage of food"[20].

Within this framework, GAP aims to: Ensure the safety and other aspects of food quality according to consumer demand; Produce while protecting the environment and avoid its degradation; and Guarantee agricultural and labor welfare

Nowadays, in the conditions of the COVID19 pandemic, it is essential to promote practices based on ecological, economic, and social sustainability since it is a consumer and society demand.

2.1 Advances in Good Practices in Horticulture in Argentina

Currently, in Argentina, voluntary adoption standards have been presented since 1999[20]. In December 2017, there was agreement on the need to incorporate the specifications for mandatory compliance with GAP into the Argentine Food Code through Res. 1-0047-2110-4246 - 17 -4 Ref.: Good practices in the production of Vegetables, Fruits and aromatic products. The resolution issued considers the treatment of 7 issues concerning horticultural production that make up the guidelines for this to be carried out considering GAP.

These points are about:

1. Mandatory documentation/traceability
2. Correct use of phytosanitary products
3. Control of water pollution
4. Harvesting and handling of products safely
5. Avoid the presence and contact of domestic animals between harvested products

6. Correct use of organic fertilizers and amendments
7. Implementation of GAP under technical assistance

The Argentine standard (Res. 1-0047-2110-4246-17-4, 2018 Ref.: Good Practices in the production of Vegetables, Fruits and aromatic products) establishes the deadline to comply with the requirement as of January 2, 2020, for the fruit sector and on January 4, 2021, for the horticultural sector [26].

In order that all entities related to the zonal horticultural activity could disseminate actions to improve agricultural practices in the area, BPAi was designed among all the parties involved.

Finally, different concepts were developed by different categories and contexts of "Good Horticultural Practices," such as "Common goods," "Tools," "Inputs," "Products," and "Waste" to be used and developed in future works.

3. A catalog of good agricultural practices

A catalog is a complete collection of elements that could be read from the first element to the last one, or the reader can navigate from element to element. Catalogs are also subdivided into categories. Each category relates elements according to specific characteristics. Thus, different categories can coexist in the same space, and thus, a good practice can belong to more than one category.

A GAPs catalog is introduced here to generate a complete collection of good agriculture practices. This catalog focuses on two main concerns: the infrastructure to store the good practices description and the tools to provide easy access to the good practices. The former includes humans and also computer systems access. Through an API, different systems could obtain information stored in the catalog and then use it in another context, for example, in smart or decision support systems.

The catalog of good practices should allow agriculture's stakeholders to access a diversity of good practices. In the agricultural value chain, there are a multiplicity of profiles: from farmers to policymakers. Each profile could be interested in several specific aspects of the definition and implantation of a good practice. For example, farmers need to understand which good practice fits their farm. Additionally, the development of a good practice requires a specific methodology or tool according to the ecosystem's characteristics a farm is set. In conclusion, the catalog should include a description of the good practices with a granularity level that allows users to access tailored information.

On the other hand, the catalog acts as a semantic web source to be part of the semantic agricultural ecosystem data cloud. The Semantic Web is a part of the Web with artifacts and tools to allow algorithms to understand and process data[2]. Domains are modeled with ontologies or linked data repositories. The data is described in a structured manner using specific languages like RDF and OWL[1]. One of the benefits of the semantic Web is supporting automatization and interoperability. Automatic agents consume and process semantic data. They are allowed to interpret

the data automatically and to combine it with other sources of semantic information. In the end, agents made a complex knowledge base as the combination of several resources[21]. Indeed, the resulting knowledge base includes combining the information from several distributed sources, making it a more valuable piece of knowledge than all the isolated resources. In conclusion, the semantic catalog of GAPs is a piece that will be enabled to be connected to the global semantic repository of agricultural information. Thus, existing agents could be used and allow agri-semantic research teams to generate new and more specific agents to improve the understanding of semantic data in agriculture[7, 8].

4. An Ontology for good practices

AgroknowledgeOntology is an OWL ontology of the good agricultural practices domain. It provides a vocabulary to describe the main concepts in best agriculture practices, focusing on intensive farming crops. The ontology was developed according to the method proposed by Noy and McGuinness guide[17]. This guide defines a procedure that consists of seven steps:

· Determine the domain and scope
· Consider reusing existing ontologies,
· Enumerate important terms,
· Define the classes and the class hierarchy,
· Define the properties,
· Define the properties domain and range, and
· Create instances.

In the next subsections, the procedure is presented in detail.

4.1. Domain and scope in a Learning and Design process

A multidisciplinary group of researchers from different disciplines developed the Agroknowledge ontology. The ontology design team included three agricultural engineers, one student in agriculture, two computer science researchers, one gamification designer, and two computer science students. Although the Agroknowledge ontology was developed in Spanish, we provide classes and properties in English and Spanish in this article.

The semantic vocabulary defined as a reference is AGROVOC, the giant thesaurus of agricultural terms[4]. It is a controlled vocabulary for agriculture, forestry, fisheries, nutrition, and forestry. AGROVOC uses a semantic definition, and it is based on SKOS, a vocabulary to define taxonomies. AGROVOC terms are organized in 25 hierarchies of main concepts[24]. However, it does not include specific

terms to describe the whole conceptualization of a GAP. Agroknowledge defines new terms that are connected to AGROVOC existing terms.

4.2 Classes and properties

The main goal of Agroknowledge is to build a collaborative and semantic repository of good practices in horticulture. Furthermore, it aims to apply gamification strategies to improve collaborative knowledge building and to achieve sustainable participation. Agroknowledge is focused on the horticultural belt of La Plata, Argentina. **Fig. 1** describes the ontology as representing the main classes and the relationships between them to develop the Agroknowledge repository. For each class, a list of attributes is specified. The nature of the relationships is labeled on the respective linking lines. For example, good practice uses tools, and tools require appropriate resources, uses supply, and produces waste. In the meantime, good practice can be applied for certification and solves problems. The definitions of each of the classes in ontology are detailed in **Table 1** and the object properties in **Table 2** for clarity.

Table 1 Agroknowledge class ontology description

Class	**Description**
Good Practice	A principle, regulation or technique to production addressing human health care, environment protection and improvement or worker conditions (FAO).
Method	A strategy to accomplish the good practice.
Supply	Elements uses in a tool or method
Waste	Unwanted materials produced by the performance of a tools
Resource	Natural elements involved (Water, Sol, Air)
Product	Wanted element produced in a production (tomato, spinach, etc)
Production	Type of production. How is organized the production activity
Zone Type	Characterize the geographic and spatial area
Cropping System	Refers to the crops and particular techniques in the agricultural field
Problem	The problem a farmer could have in the horticultural labour.
Certification	External set of rules to attesting a certain level of horticultural achievement

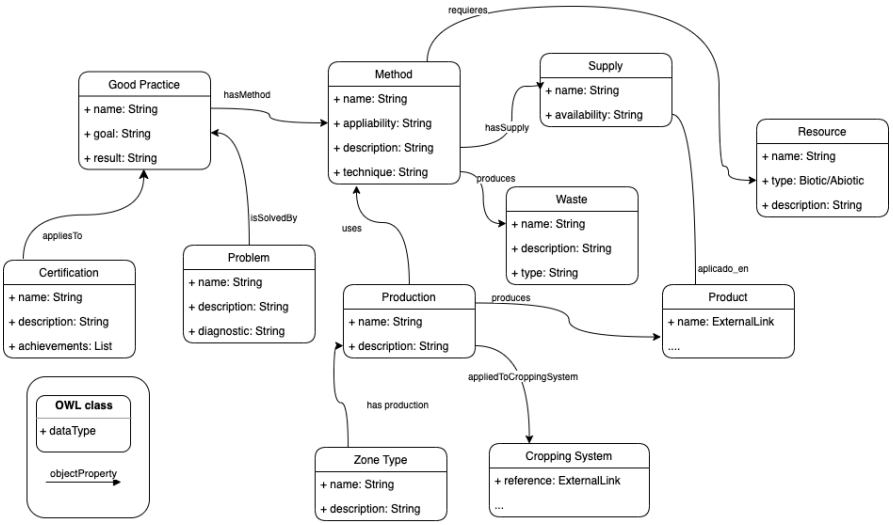

Fig. 1 Agroknowledge ontology

Table 2 Agroknowledge object property ontology description. D is the domain and R the range.

Object Property	**Description**
hasMethod	D: Best Practice R: Method
produces	D: Method R:Waste
applies_to	D: Certification R: Best Practice
isSolvedBy	D: Problem R: Best Practice
requires	D: Method R: Resource
hasProduction	D: ZoneType R: Production
appliedToCroppingSystem	D: Production R: CroppingSystem
produces	D: Production R: Product

5. BPAi: a Semantic Mediawiki tool

The ontology of best practices is deployed as a customization of Semantic Mediawiki (SMW)[14, 15], the extension of MediaWiki engine. SMW enhances Mediawiki with a semantic model layer. This semantic model is defined on top of the Semantic Web standards, and it is compatible with RDF. Thus, a traditional wiki with an editable hypertext now may contain semantic queries about their knowledge

base and export its information to another agent in the Linked Open Data cloud. For example, when labeling an article (e.g., Spain) with a category (e.g., European country), the engine generates an RDF triplet that relates Spain with the European Country (Spain rdf: type EuropeanCountry).

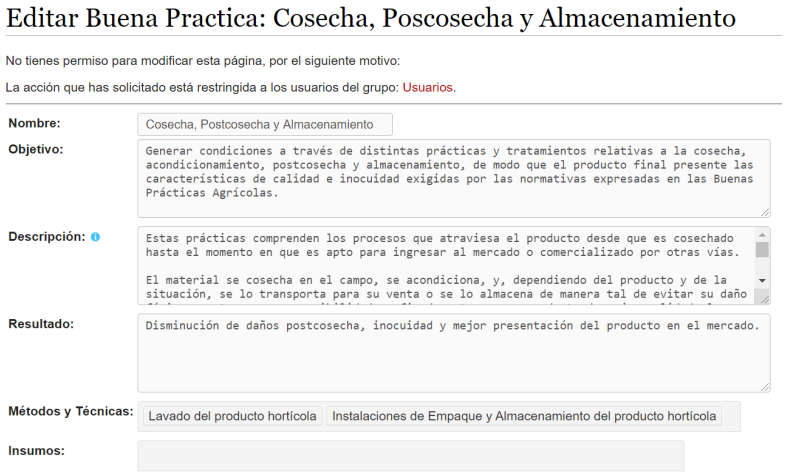

Fig. 2 Edit form of a Good Practice in BPAi

In SMW, categories are defined as RDF classes. With SMW, the articles also may be related to semantic properties (e.g., Madrid isCapitalOf Spain). The most significant difference this wiki has with a traditional wiki is the ontology of best practices. In this wiki, Good Practices, Methods, and other ontology classes are represented as SMW categories. The individuals of these classes are articles labeled with [Category::] to their type (e.g., the page of "Integrated Pest Management" belongs to the category Good Practices, and it includes the label [Category:: Good Practice]). To help users complete the properties, each concept has a form created by the Page Forms[4] and Semantic Forms extensions. Semantic Forms is a Mediawiki extension that provides simple semantic forms to create and edit items with a user-friendly interface. Our wiki offers semantic forms to create Good Practices, Methods, Supplies, Products, Resources, and Wastes. Figure 1 shows the semantic form to create and edit a Good Practice. In the picture, fields are in Spanish: Label "Nombre" for name property and it includes an input text for an identifier, "Objetivo" for the objective of this practice and it includes an expandable text field, "Descripción" for a description of this practice and it includes an expandable text field, "Resultado" for the outcome of this practice and it includes an expandable text field, "Métodos y Técnicas" for the Methods used in this practice and it is completed by a tokenized input that represents Methods concepts, and "Insumos" for the Supplies with a similar tokenized input for Supplies concepts. Once the user saves the page, it is displayed in a user-friendly aspect. **Fig. 3** shows part of the resulting page of the edition in **Fig. 2**.

Fig. 3 Good practice page in BPAi

5.2 Gamification strategies

As a concept, gamification refers to the implementation of elements from games and video games in spaces or environments designed for different purposes, which exceeds the idea of the playful experience. The main objective for which this strategy is applied is to motivate users to fulfill an objective such as performing a task, staying longer in an environment, participating more actively in a task[6, 22]. Gamification is found in the most diverse areas.

In this way, gamification, with its formal characteristics and adaptive particularities, becomes a powerful motivational tool that requires an analysis of its scope and limits to be correctly implemented. As a persuasive architecture, the success of its design is determined by the extent of knowledge about the particular characteristics of the circumstances in which it is implemented[5]

The first step to choose the elements of a gamification is to know the needs of the users, either in an individual context, in a small group of people, or a large open and collaborative community[23].

In BPAi, considering it a community of practice and collaborative knowledge construction, the gamification strategies are focused on increasing motivation and commitment, both in the short and long term[19].

Being a Wiki, cooperation appears as an emerging value of the community. Each editor in the wiki improves the encyclopedia by adding small pieces of quality contributions[12]. Therefore, it is appropriate to consider a model of cooperative play. This type of gamification has the characteristic that several users share a common goal. The fulfillment of that goal is promoted through individual actions, and others' actions are encouraged.

Fig. 4. First state: seed

The next step is to evaluate the community scenario proposed to address the GAPs, which focuses on the La Plata green belt area. Thus, a preliminary evaluation analyzed the models of interaction among the community members was executed. The evaluation concluded that the agricultural community of the region is not a frequent user of knowledge construction platforms on the web, although it does use mobile phones and the web. This analysis was performed qualitatively, as a first approach to potentially identify the profile of the BPAi community. Based on identifying certain traits in the community, it is analyzed that it is necessary to promote cooperative and collaborative work on it, rather than build little individualities.

Fig 5. Second state: first flowering

Therefore, the following game experience design is proposed: The collaborator makes contributions to the wiki (action) to generate knowledge about this field (state), which returns a series of indications that the wiki is growing (responses).

These indications show that the collaborators' contributions in the wiki directly affect the community's growth. For this reason, progress is the main element of gamification that is implemented. Nevertheless, progress is applied to the wiki's general health and not to each user's progress. Progress is generally shown in gamification actions and video games as a progress bar, a numerical or visual representation of the progress in the action/game to achieve the completion of a mission [3].

Another element of gamification that is implemented to establish feedback with a direct analogy to the community setting was a tomato plant, which contributes to a narrative and personalization. The tomato plant is one of the most important agricultural productions in the area.

Consequently, the wiki's progress is related to the page's health, responding to a maturation sequence depicted in the growth of a tomato plant: each new page in the wiki starts with the seed state (see Fig. 4). Then, this state passes to the next one first flowering state (Fig. 5)while the content and information on the wiki is proportionally increasing, for the different contributions of community collaborators. Finally, the gamification design also develops a voting system so that users can evaluate and validate together, if indeed that page corresponds to a BPAi domain, and thus move on to the next and last stage (ripening of the tomato), which shows that the page is correct, complete and is a validated BPAi.

Fig. 6 Final state: ripening of the tomato

6. Discussion

Characterization of the obstacles to the adoption of GAPs. The Good Agricultural Practices have as objective an improvement intervention on various or all aspects of the supply chain of intensive crops, from the selection of inputs and cultivation to the commercialization of the product, with a guarantee of safety, assurance of traceability, sustainable management of resources and protection of producers and workers.

In general, there is a large gap between the practices that producers do and those that they propose to implement GAP. Producers do not yet see the need to offer a

safe product or be more careful with natural resources because horticultural productivity still includes incompatible factors with GAP. Although a great effort has been made to raise awareness about these issues, there is still much work from the institutions.

The search for solutions to phytosanitary problems related to certain pests and diseases has been installed for decades to be solved. Precisely the chemical control was synonymous with efficiency and has been a benchmark for managing certain crops. This raises the difficulty of incorporating technologies focused and applied to processes, such as integrated pest management and biological control, GAP tools, compatible with more sustainable agriculture.

Another problem well identified by horticultural producers has also been for many years, the lack of good prices in the commercialization of the products and the lack of transparency in some commercial chain links.

Problems related to food safety, such as safety or lack of traceability or those that impact the environment and natural resources, are only now beginning to be considered. This is part of the interests and demands of a society currently more committed to health and well-being, personal and planetary. While this can positively influence production that is more friendly to human health and the environment, no short-term changes should be expected until the requirements implement control mechanisms. On the path of compliance with current and future regulations, BPAi will collaborate with the awareness and adaptation of the necessary conditions to meet the requirements of those regulations.

Evaluation of the experience. From an horticultural, and agronomic point of view, cataloging GAP was not an easy job. To begin to categorize and describe the vast amount of "Good Agricultural Practices" in intensive crops, it was necessary to order the ideas and concepts precisely as we had not done before.

We began by describing the area and the type of agriculture we work with and then the theoretical framework, contextualized mainly by FAO in various manuals and websites and then, a journey through the history of GAP, for more than two decades. The complexity of the categories led us to group them into "Tools", "Inputs", "Objectives" and "Waste" of Good Agricultural Practices.

In this way, we interpret as "Tools" those complex practices that are carried out with different objectives, and that involve different methodological processes, and that can be carried out with different process alternatives and / or use of inputs. With the category "Inputs", it was tried to cover all the substances or materials used to elaborate each process involved in "Tools" and in the category "Waste", it was proposed to cover the residue or final product without profit, which needs to be in somewhere that does not cause pollution.

It is not easy for a discipline linked to natural sciences such as agronomy to consider some practices that are often carried out empirically and strongly based on intuition or ancestral knowledge. The site offers content and information on concepts that producers and technicians in the area are still unaware of and consider them in the international context, such as water footprint, climate change, or carbon footprint.

The proposal was made to provide information to technicians, organizations and producers who transit the path of Good Agricultural Practices, from an integrative and broad perspective, since it includes various tools to improve all the practices of intensive agriculture

Languages diversities. The language is critical in the modelization and conceptualization of culture. The language coins words and expressions to express the most valuable elements. This happens in cultures and civilizations around different regions of the world, but this also happens in every discipline. Lawyers, mathematicians, and psychologists give specific meaning to words: "solve" a contract if different from "solve" an equation from "solve" a trauma. Agriculture and Computers are different domains. They have their language, but they also have a different and potentially opposing ways of understanding reality. Agriculture deals with biological and living beings, where rules are not rigid or strict. Whereas, Computers deal with strict formulations. For example, good computer science practice is a precise technique that should be done in one exact way. Nevertheless, in agriculture, a good practice is a topic that the farmer must have in mind and pay attention to it to manage in the best way. This was one of the first issues that both teams needed to understand to cope with the approach's objective.

Adoption. The adoption of BPAi by the community is one of the challenges to get success. BPAi is a collaborative tool to collect GAPs that could be usefully adopted by the La Plata horticultural belt community. The community is made of several people with different cultural backgrounds. Most of them, such as doing manual labor most of the day, have time to spend in the catalog edition. However, different academic and governmental organizations could articulate different activities by registering GAPs in the wiki.

Regarding visual aspects, BPAi is a semantic wiki that uses the same engine that the world's best-known wiki: Wikipedia. That means that when users access BPAi, they will not notice too much difference from any Wikipedia article. The similarity is an advantage in terms of understanding and familiarity with the BPAi catalog. Another advantage of BPAi is that it is easy to add new content, either creating a new page or editing an existing one. To create a new page, the user needs to fill a form that defines the structure and the main characteristics of a GAP, simplifying a news article's structure. Also, the semantic characteristics of the site are transparent for regular users. Users in BPAi generate content that is automatically connected with the semantic Web. Finally, the most challenging aspect is to ensure quality assessment in the generated content in the wiki. As any person could include new GAPs in the wiki, several checks are needed to avoid fake GAPs. The general idea of wikis is that the community continuously improve and check the content of wiki articles. The community is the regulator who defines when an article is wrong or right. We are also working on more tools to improve these workflows, such as badges in any article that indicates if the GAP is well defined, checked by academic members, and needs more description.

Interoperability. Finally, as we have already mentioned, the catalog acts as a semantic web source to be part of the semantic agricultural ecosystem data cloud.

The BPAi semantic information could be used as a source of structured information used by agents in smart systems. Several lines automatically extract the semantic knowledge base from heterogeneous resources such as semi-structured documents, databases, or social networks. Also, BPAi semantic information could be included in a model for detection and characterization of contradictory and incoherent use of GAPs combined with other practices or regulations. The semantic information of BPAi also could enrich a visualization system based on knowledge discovery. To conclude, a more complex agriculture module with the use of IT to facilitate agricultural knowledge exchange.

7. Conclusions and further work

This chapter introduced a semantic wiki catalog that focuses on GAPs related to intensive horticultural activity. The repository is a collaborative repository which includes for each GAP the description, goals, and methodologies.
The semantic web characterisitcs allows BPAi to share the collected information into the Linked Open Data cloud. Moreover, semantic agents could consume the information stored in the catalog to be combinend with other agricultural semantic repositories.

The experiences showed several challenges related to the complexity of a cultural exchange such as the diversity in the languages among the different stakeholders that are part of the La Plata horticultural belt. We characterize a set of barriers in the adaptation of GAPs in the region: sanitary control, producer's activities, consumers awareness.

The proposed tool is an initial point to enumerate GAPs and detect other types of agricultural practices related to GAPs. There many challenges to have a good aptoptin and participation of the community of farmers, producer, customers and academics.

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