

Knowledge Management Model for Fruit-Horticultural Agroindustry Case: Córdoba - Colombia

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Abstract—This article describes the characteristics that the network of knowledge has in the productive chain of fruit-horticultural, during the stages of harvesting and post-harvesting, especially in a relevant Colombia zone, the Córdoba department. There, the following components are integrated: technicians, organizations and producers from the fruit-horticultural sector, lined up to a model of knowledge management that describes the main components of this network, schematized by nodes or resources of knowledge, that are based upon several internal and external agents that facilitate the process. Its effect is being evaluated according to indicators or conduct of a network of applied knowledge in the Fruit Agroindustry, as in the case of the Córdoba department and the Caribe region of Colombia.

Index Terms—Agroindustry, innovation, knowledge management, knowledge network.

I. INTRODUCTION

In the last two decades, a new economic discipline has developed, under the name of "The Economy of Knowledge". It follows the study of its production, transmission and utilization [1]. The fruit-horticultural production was based on two main factors that explain the conduct of the production; they are the area of harvesting and the physical performance, which is the product of the fertility degrees of the soils in the region of middle Sinú in Colombia [2]. The production organizations are more and more interested in generating an integration of its entire strategical applications, which requires initiatives of knowledge management, e-business, and logistical networking such as the Supply Change Management. The agroindustrial production in the fruit-horticultural sector, especially in the Cordoba department, was characterized by a low competitiveness level and disarticulation, in the internal level as well as in the level of policies of the State, the Academy and the market trends. In Colombia, there is a sector of Agriculture and Pecuniary, which also includes the fruit- horticultural sector, that is relatively well organized, has institutional visibility, and is consolidated in corporations and associations; furthermore, without embargo, the articulation of this sector is incomplete. As Porter asserts [3], the competitive advantages generation inside the company listens to the efficient articulation of the same surroundings of a "Valor

Chain" [4]. Therefore, the best way of achieving the integration of the components of a knowledge network in the fruit-horticultural agroindustry is through a model which allows a more integrated and complete vision of a knowledge network's components in the fruit-horticultural industry.

II. THE MODEL'S PHILOSOPHY

The competitive advantages of its generation and consolidation in an organization are based on the relations with all the factors, variables and conditions in the environment of that organization. These conditions influence the organization in such a manner that maintaining these variables as visible becomes very important, through a type model of research that guarantees the flexibility of this kind of representation, allowing the easy access to the information from any part, to the component of the established model, through an analysis of the variables that are comprised in the fruit-horticultural agroindustry, of the Cordoba department, in the harvest and post-harvest stages.

The work in networks is promoted in many spheres worldwide, among those of the Organization of the United Nations for Agriculture; which promotes in its Internet page the management of knowledge through the Knowledge Forum, to be a fundamental strategy in which all the actors of the alimentary system are connecting and exchanging information; even the Ministry of Agriculture and Rural Development; has developed the initiative of the *Agrocadenas (Agro Chains)* that was later on transformed into AGRONET, and that today maintains the existence of the Agropecuary information network of Columbia, RIDAC; this is why the tendency of working in a grouped manner, through the network technique, is new and constitutes a valuable mean in the search of the innovation generation.

Among the aspects of proposing a network structure, there is the facility of characterizing the knowledge network of the productive chain of fruits (harvest and post-harvest), especially in the department of Cordoba, where the following component can be found:

- Connectivity.
- Collaboration
- Economy based on knowledge.
- Network technology.
- The opportunity of learning from one another and becoming more specialized and productive.

Realizing the characterization of the knowledge network in the stages of harvest and post-harvest in the fruit horticulture agroindustry, through a network-type model, constitutes an important level in the generation's search for a

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strategy that shall encourage competitiveness in this sector of the country's agroindustrial production; aspect that, according to the protagonists of this sector, including the primary producers, the associations and the persons involved in the agroindustry, is one of the factors that is being mostly tolerated, because it is the sample of the little or null industrialization in this fruit-horticultural sector.

The administration, usage and management of the knowledge networks may constitute a powerful mean that shall encourage the innovation and increase the knowledge in an organization, the working product for the main components of the network, such as the individuals, the usage and the management of its tacit knowledge, sustaining a new type of organization, based upon the knowledge, encouraging the innovation through the means of decentralization and the globalization, that facilitates the access to information, like in the network model, and it should be the most suitable for acceding to the adequate information, even if it is for capture, transformation, distribution or it's realization.

III. ORGANIZATIONAL MODEL PROPOSED FOR THE FRUIT-HORTICULTURAL AGROINDUSTRY

The proposed network model is of a centralized type, which allows sharing and having access to knowledge. Through the means of this model it's made possible the representation of that components that generate knowledge, by mediating a graphical representation, where through a diagram there are being symbolized the inter-relationships of the nodes or knowledge resources, that are constituting the aesthetic part of the model and a dynamic part constituted for the inter- relationship of these components or nodes, in the internal as well as in the external level; in the Fig. 1, one can see the proposed structure, its components and the inter-relationships that exist, and it makes possible as well seeing that this type of models is not aesthetic and does not present any kind of restrictions regarding the type of either nodes number and arches, and that it disposes of the possibility of being amplified, according to the specific requirement.

A. Description Model

In the diagram of Fig. 1, it is possible to detail the three fundamental nodes according to this proposal, in order to characterize the knowledge network in the fruits productive chain in the department of Cordoba, as a strategy for the innovation generation in this sector; these nodes are connecting as following: node of primary producers; node of associations and the technological node, proving the relationship that exists between this type of components in the knowledge network of the productive chain of fruit-horticultural. In this scheme it is being presented like the central axis, product of this interaction of the mentioned nodes, the "Knowledge" and the "Innovation", which results as being the reason for such schematization and the benefice of this has repercussions in the development levels of the

Fruit-Horticultural Agroindustry in the department of Cordoba; this interaction does not seem to be the only product of the action of many other aspects, factors and variables, each one of those nodes continues in sub-nodes and these will form others, schematizing another form of seeing the knowledge network in the fruit-horticultural production chain in the department of Cordoba, by therefore proving the horizontality of the model, as it is represented in the Fig. 2.

The model described in the Fig. 2, it can be considered so that each of the components are shown as follows: the nodes illustrated in the figure represent the technological node, the associations node and the primary producers node, and act as the points of transfer or interconnection through which the knowledge flows. From a more operational viewpoint, the nodes can be described as information storage centers that are interconnected in a systemic way. Each of the major nodes is described as follows:

Node or core: Consisting of knowledge, in this case it also represents innovation as a result or end product of management of the knowledge network. This node is associated as a repository or central knowledge node where related experiences are located, for example through the problems and their corresponding solutions. The way that knowledge flows and spreads throughout all the components of the network can be established through this node or core, in order to facilitate its effective implementation in the different nodes or components that require its use.

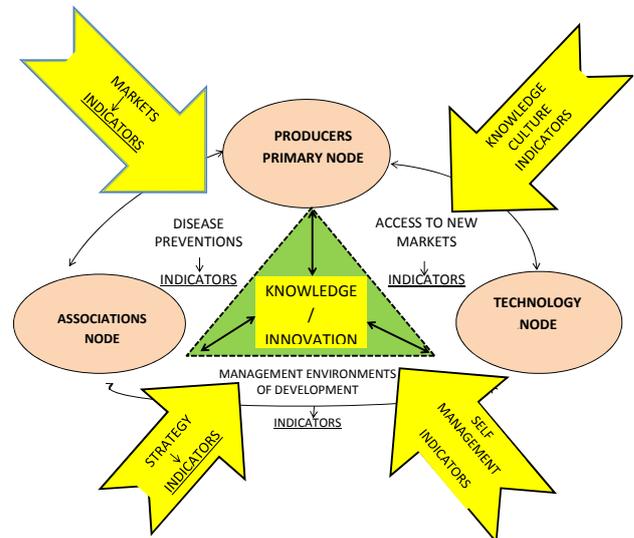


Fig. 1. The representative structure, proposed in order to characterize the knowledge network in the productive fruit chain production (Harvest and post-harvest) in the department of Córdoba. Source: Adaptation model SGC-U [5].

Primary Producers Node: The majority of the activity is concentrated in this node, which generates the primary product as a result of the in situ application of the knowledge acquired, thus demonstrating the degree of effectiveness of the proposed strategy. Furthermore, the evaluation of various events that have occurred becomes a source of valuable information that can be applied in future experiences.

Technological Node: This node serves as the pathway that facilitates and promotes the activity of intercommunication

among the various actors, turning the technological component into a tool that facilitates the implementation and development of multiple possibilities. This shows how any idea, whether a positive or negative experience, can be accessed or disseminated.

B. Facilitating Agents

At the organizational level, the tendency is to use facilitating agents that will encourage the performance of their personnel and expedite the operating processes [6]. Taking into account the direct impact on the organization, we can classify the facilitating agents into two types, according to their scope:

External or cross-sectorial facilitators: They are related to market conditions, cultural factors and sectoral elements, and provide the elements for the regulation or management of activities in the fruit and vegetable production sector. These components constitute the environment of this sector, and as such their dynamics have a direct influence on it. The external facilitating agents described in this proposed model are:

- Markets
- Culture of knowledge
- Strategy
- Self-management

Internal facilitators or facilitators of the supply chain's internal management: These agents are an inherent part of the production system and supply chain during the harvest and post-harvest stages, and are involved with the principal node or core. The internal facilitators are:

- Disease prevention program
- System of access to new markets
- Expansion into new environments of development management

In this proposed model, each of the nodes is associated with a facilitating agent, but there is no restriction on associating them with others based on the strategy you wish to put into motion. The internal facilitating agents of the nodes are:

Internal Facilitators of Primary Producers Node:

- Quality of the tools implemented
- Quality of knowledge
- Productivity
- Teaching
- Workshops and conferences

Internal Facilitators of Associations Node:

- Performance of associations
- Modernization and continuous improvement

Internal Facilitators of Technology Node:

- Implementation of technology
- Technical innovation

C. Indicators

An indicator is the quantitative, measurable, verifiable

expression of the behavior and performance of a process. According to Eswaran, Pushparajah and Ofori, indicators are defined as "Variables whose purpose is to measure a change in a determined phenomenon or process" [7].

Therefore, in order to be able to evaluate the development and effectiveness in the implementation of the facilitating agents, it is essential to assign them indicators that can be incorporated into the standard scorecard of the organization and will serve to verify and monitor the proper implementation of each of the facilitating agents. Having several indicators established throughout the network will enable each event in a specific area to be monitored and recorded, and in turn be able to make the necessary corrections or adjustments of a specific performance as required, based on concrete arguments and specific reasons, thereby facilitating the management and control of the entire network in all of its parts. Through the administration of these indicators, precise control can be had over the accomplishment of proposed goals or compliance with policies, with the intention of fulfilling the specific requirements of a market or regulation that governs exportation of the product.

It is important to define the nature of these indicators, ensuring that they work towards the improvement in the use and management of the network of knowledge, while maintaining its integrity. Beyond measuring the efficiency or effectiveness, they must also include the action of the various agents that may be associated with the performance of the facilitating agent. Thus, we have established that the use of these types of indicators should be comprehensive and not just limited to the generation of a value that does not manage to measure the integration of the diverse components of the knowledge network, through the proposed model for the fruit and vegetable agribusiness in the department of Cordoba.

IV. EVALUATION AND APPLICATION OF THE MODEL (PROTOTYPE SOFTWARE TO SUPPORT THE MODEL)

The proposed model allows us to demonstrate that efforts can be made during the harvesting and post-harvest stages of the fruit and vegetable agribusiness which can foster its development, by using interconnected components or nodes that assist in achieving their personalized goals and needs. This type of integration can be better facilitated by using software that supports this knowledge network, providing the layout and means for receiving and capturing the knowledge required for the effective development of the knowledge network, which is represented in a centralized model. This technology shows its usefulness in storing large amounts of information that can be eliminated after implementation, as part of the management of the knowledge network and the monitoring of each of its parts via the indicators, which permit control to be maintained over each area. Various software interfaces are shown in Fig. 3 and Fig. 4, which allow us to have a more comprehensive view of the entire network, as revealed by the structure of the nodes and their

respective facilitating agents.

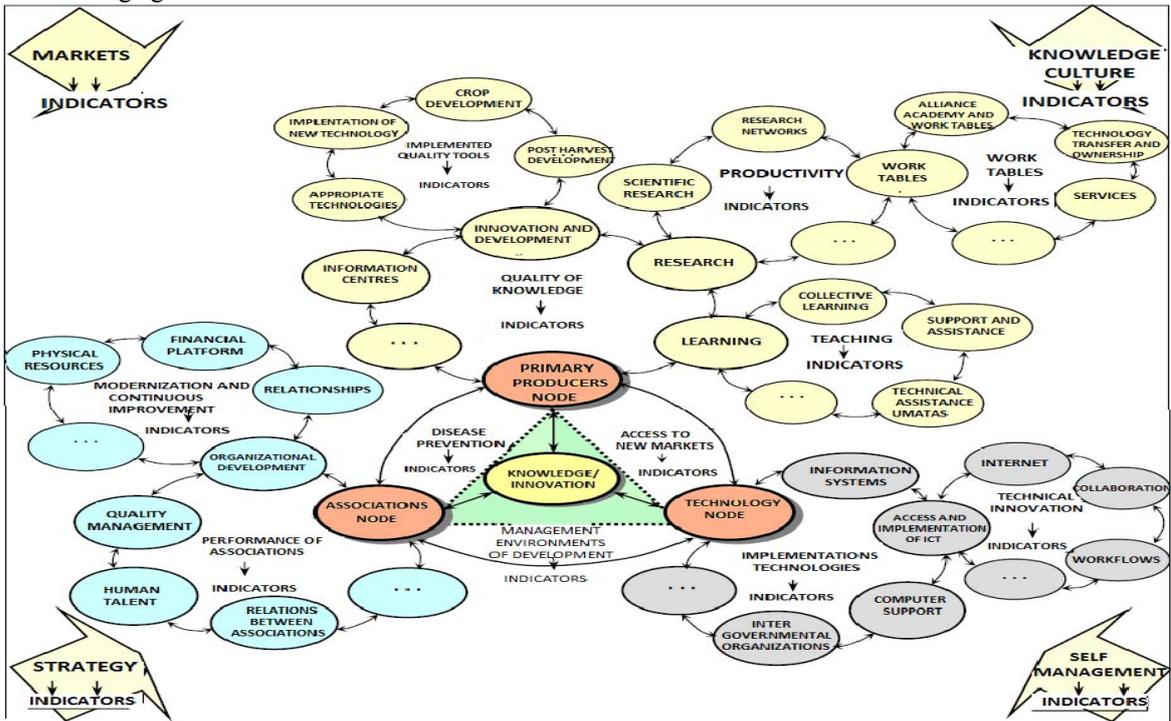


Fig. 2. This is a more detailed view of the representative structure proposed for the characterization of the knowledge network in the productive chain of fruits (Harvest and post-harvest) in the department of Cordoba. Adaptation model SGC-U [5].

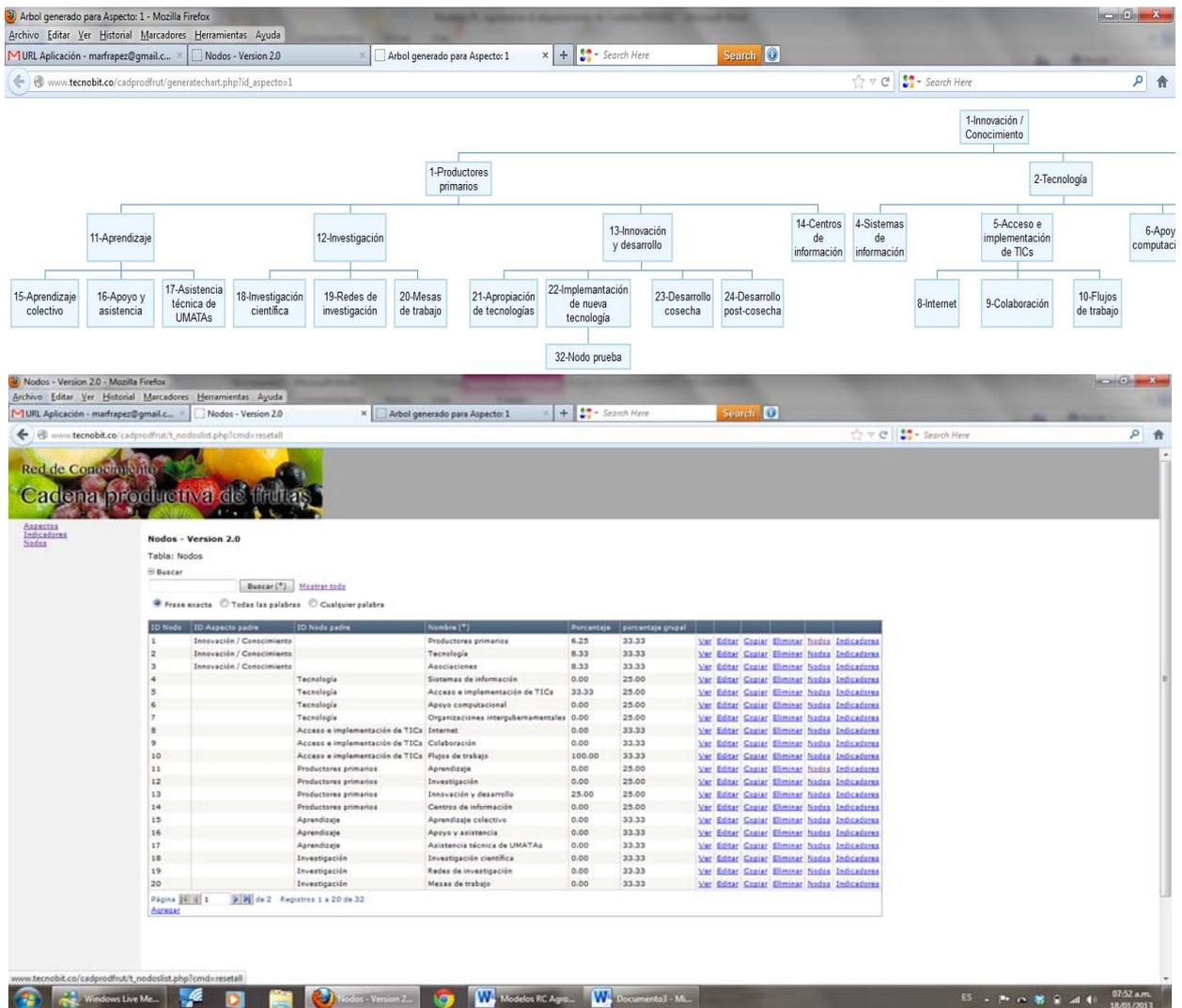


Fig. 3. Prototype software to support the model. Source: Authors.

An additional important component is the means by which information is acquired for its future use in the knowledge network. This type of software, along with those run by AGRONET, governmental portals and NGO sites, permit obtaining access to knowledge.



Fig. 4. Prototype software (eg. contents). Source: Authors.

A model that diagrams and describes the knowledge network enables the identification of the different components of the knowledge network within the fruit and vegetable agribusiness in the department of Córdoba. The interrelationship of the different components that participate in this fruit and vegetable agribusiness during the harvesting and post-harvest stages can be synthesized through this model, and it is made evident that the actions of facilitating agents make management of this knowledge network possible and turn it into a tool that can be wielded to foster competitiveness in the aforementioned agribusiness. Therefore, this model proves that a diagrammed relationship of each of the components in this network and their interconnection allows for the identification of the areas where facilitating agents need to be established, both on an internal and external level, in order to create a network that is sufficiently comprehensive to achieve the established goals, which, in the case of this agribusiness, are increasingly more rigorous.

V. CONCLUSIONS

The result of this research has been the analysis and characterization of the knowledge network of the fruit and vegetable agribusiness during harvest and post-harvest stages in the department of Córdoba. A model was used to demonstrate that the infrastructure of this agribusiness can be differentiated in its possession of knowledge, and which shows the need for the fruit and vegetable agribusiness to change its traditional production structures during the harvesting and post-harvest stages, in favor of more dynamic and flexible structures that meet the needs set by the market dynamics and the different aspects that are related to this agricultural industry. This type of change is defined as a network structure, which helps create a dynamic that facilitates the restructuring of this network in a way that brings it to act as a tool that generates components of competitiveness for the benefit of this agricultural industry.

Such a type of network structure promotes the acquisition, production, dissemination and transfer of knowledge, which is established as the principal input to be managed. During the harvest and post-harvest stages, the fruit and vegetable agribusiness in the department of Córdoba needs to instill a change in the aptitude and attitude of primary producers, so that significance is placed on the importance of acquiring and utilizing knowledge, and that knowledge is firmly established in the center of the knowledge network. As such, it is understood that the solution to the problems of agribusiness are not based only on infrastructure, which though deemed necessary and especially biased by the fact that large investments are always demanded, is not the only factor implicated in the development of the agribusiness. An additional component is the implementation of a knowledge network that would function to manage the shared knowledge through interdisciplinary work by diverse actors who strive to achieve benefits for this sector of the agricultural economy.

This type of network does not operate by itself, and so it is essential to integrate both internal and external agents that will give the network a degree of agility to respond to the needs or goals set by such agents as the market. Given the current case of the Free Trade Agreement that is now in force, it is necessary for production systems to operate via networks, in this case knowledge networks, which will allow them to reach their goals, which are every day more dynamic and demanding and best achieved through a network model. In conclusion, the construction of this model is a first step towards the possibility of creating a change in the production structures of the fruit and vegetable agribusiness in the department of Córdoba, wherein the input of knowledge is given the greatest importance as a means of generating competitive levels that allow the farmers to have access to markets and to stay in compliance with all the requirements that they demand.

REFERENCES

- [1] M. Arguelles and B. G. Carmen. (2008). Conocimiento y crecimiento económico: Una Estrategia Para Los Países En Vías De Desarrollo. [Online]. Available: <http://search.proquest.com/docview/1002600318>
- [2] B. Prieto, J. A. Peroza, and Grandet. (2009). Effect of Tillage and Management of Organic Materials on Some Physical and Chemical Properties of A Vertic Endoaquept at Sinu Valley. [Online]. Available: <http://revistas.unicordoba.edu.co/rta/documentos/15-2/Art%20Efecto%20de%20LAbRANZA.pdf>.
- [3] J. A. Caro. *Estrategia De Apoyo Al Desarrollo Tecnológico Y A La Innovación Agroindustrial En Colombia*, ISBN: 978-958- 99415-2-2. IICA, SENA. 2008.
- [4] J. G. Izasa. (2010). Cadenas productivas. Enfoques y precisiones Conceptuales. [Online]. Available: <http://revistas.uexternado.edu.com>.
- [5] V. H. Medina, "Modelo Organizacional y tecnológico de gestión del conocimiento en la Universidad," Tesis doctoral. Universidad Pontificia de Salamanca, Facultad de Informática, Madrid - Spain 2004.
- [6] V. H. Medina, J. N. Pérez y, and J. H. Torres, *La Investigación en Ingeniería: Ciencia y Tecnología de la Información y del Conocimiento*, libro Editorial Fondo de Publicaciones de la Universidad Distrital, Bogotá.
- [7] M. Glave and J. Escobar, Indicadores de sostenibilidad para la agricultura andina. [Online]. Available: <http://search.proquest.com/docview>



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