COOPERATE TO INNOVATE - THE CASE OF PEACH PRODUCTION IN BEIRA INTERIOR REGION FOCUSED ON TRIPLE HELIX MODEL

MARIA PAULA SIMÕES[1], DORA FERREIRA[1], CARMO MARTINS[2], PEDRO DINIS GASPAR[3]

[1] Escola Superior Agrária de Castelo Branco (ESACB), Q.ta Sr.ª de Mércules, 6000-909 Castelo Branco, mpaulasimoes@ipcb.pt

[1] Escola Superior Agrária de Castelo Branco (ESACB), Q.ta Sr.ª de Mércules, 6000-909 Castelo Branco, dorairferreira@gmail.com

[2] Centro Operativo e Tecnológico Hortofrutícola Nacional (COTHN), Estrada de Leiria S/N. 2460-059 Alcobaça, carmo@cothn.pt

[3] Universidade da Beira Interior (UBI), Rua Marquês d'Ávila e Bolama, 6201-001, Covilhã, dinis@ubi.pt

RESUMO

The Triple Helix model is a model of development that is based on the involvement of three spheres - Academia, Industry and State Organizations - that cooperate and interact to consolidate economic development based on knowledge and innovation. The application of the model to the agricultural sector is still little rooted. The main goal of the project "+peach - Innovation and development in the peach tree culture in the region of Beira Interior", is to contribute to increase the global value of the activity through the performance of various cultural techniques and enhancement of its product - the peach, This project develops in a structure and organization of the Triple Helix model, in which the sphere of industry is occupied by fruit growers and Producer Organizations. The most relevant aspects of this regional-based initiative is the contribution to the creation of a knowledge network, the complementarity of the tasks carried out by the actors and the planning of future actions in a bottom-up perspective. It is highlighted as a very positive feature, the dynamic work from space zone of intersection of the different spheres whose synergy enhanced innovation and pro-active and collaborative work. The maintenance or strength of it is now dependent on governmental Sphere and closely associated to time needed to make decisions.

KEYWORDS: regional development, knowledge network, rural, peach, *Prunus.*

1. INTRODUTION

Territorial innovation concepts involves adapting or creating new organizations or new concepts of organizational functioning that can fill gaps in the regional innovation environment. This perspective recognize that R&D is not the only driver of innovation (Kline & Rosenberg, 1986; Cohen et al., 1987).

In Madureira et al. (2014a; 2014b) it has been appointed the importance of collaborative approaches to innovation, which supposes the participation of a diversity of actors. For Ranga & Etzkowitz (2013), "innovation spaces" are promoted and occurred when the common feature of organizational formats increases the value of collaborative initiatives based on local / regional knowledge, covering all Triple Helix actors.

The Triple Helix Model (THM) is an analytical model that recognizes, analysis and promote the importance of the interaction between the University - Industry - State spheres for the innovation process (Etzkowitz & Leydesdorf, 2000). The creation and consolidation of regional innovation systems based on knowledge is presented as a main goal of the THM (Etzkowitz, 2008).

Ranga & Etzkowitz (2013) demonstrate that THM focused on innovation and economic development, finds a more prominent role of the University, fortifying the hybrid role of the spheres of Industry and State, as a foundation for new institutional and social formats, for production, to transfer and knowledge application.

This view validates the role of each of the institutional spheres, as well as their interactions, in the dynamics of innovation. Etzkowitz & Leydesdorf (2000) defend the active role of the University sphere and the collaborative work in solving problems related to the productive sector. In low-density territories, where institutional thickness is reduced, multi-actor networks are the competitiveness key, both in identifying problems and in defining and promoting common solutions. The reflection about the THM perspective, observed in the productive framework of the agricultural sector, is little rooted (Chaisalee et al., 2010). However, in low-density territories, these actors foster new leadership models of innovation networks based on intense collaborative action with other players, from municipalities, R & D, public bodies, sectoral and territorial associations, researchers, among others (Madureira et al., 2013).

In this context, the present work applies and discusses THM in the promotion and development of the peach production in the Beira Interior region. The THM was used to explain and highlight the interaction between the different actors and the roles they play in the +peach initiative, and,

how it has contributed to the main goal of adding value to peach production chain. In addition, and as a result of this interaction, the initiatives that have been built up together and how the different actors behaved are explained.

2. METODOLOGY

The methodology of this work applies and discuss the THM in the peach production chain in the Beira Interior region and the dynamic initiatives that have been built. Therefore we used a qualitative methodology can be divided into two main sections. Section 1, about +peach project that involves: a) brief presentation of the project; b) identification of actions and partners in the project; c) the Triple Helix spheres and d) the Triple Helix spaces. Sections 2, about new project initiatives that have been built, designated by Prunus.

Regional development should always contribute to increase population welfare. This welfare is directly related to per capita income increase. Therefore, regional development plans should draw up strategies to increase capital gains and income fixation within the region. The peach production in the Beira Interior region has a high growth potential, but the joint work synergy of all regional stakeholders is needed. Thus, the project +peach - Innovation and development in peach production in the Beira Interior region meets the needs of the region. This project develops the Triple Helix model, involving the Academy, Production and Government.

3. CASE STUDY: +PEACH

Climatic and soil conditions of the Beira Interior region, characterized by high sun hours, low rainfall in summer time and permeable sandy soils (Simões, 2009), are favorable to peach production, being currently the main production region of Portugal, with 1630 ha and 49% of the national peach production (Dias et al., 2016). At the same time, there has been a tradition of fruit production in this region since the 60's, during which time the fruit activity was greatly increased as a result of State actions both at the national level and at the regional level (IV Development Plan). This tradition empowers the region of technical knowledge, both at the level of producers, at the level of Production Support Organizations and at the level of associated companies, and at the same time, there are marketing channels installed, which are very important factors to consider, estimate and to value.

The project +peach - Innovation and development in peach production in the Beira Interior region, aims to contribute to the overall recovery of the sector through several activities at the production techniques level, and also through peach enhancement. The project includes both the development and evaluation of new production techniques. It also aims to contribute to the profitability of peach production, and environmental preservation.

The peach production activity presents itself as an agricultural activity with high potential for valorization of the region, but it is necessary to involve partnerships and enhance synergies of the regional actors. In order to achieve this goal, a large team of different actors, aware of the common objective, work together and build up the project "+peach - Innovation and development in the peach tree culture in the Beira Interior region", which develops in the THM, since it involves actors from the spheres of Academia, Production and State (Figure 1).

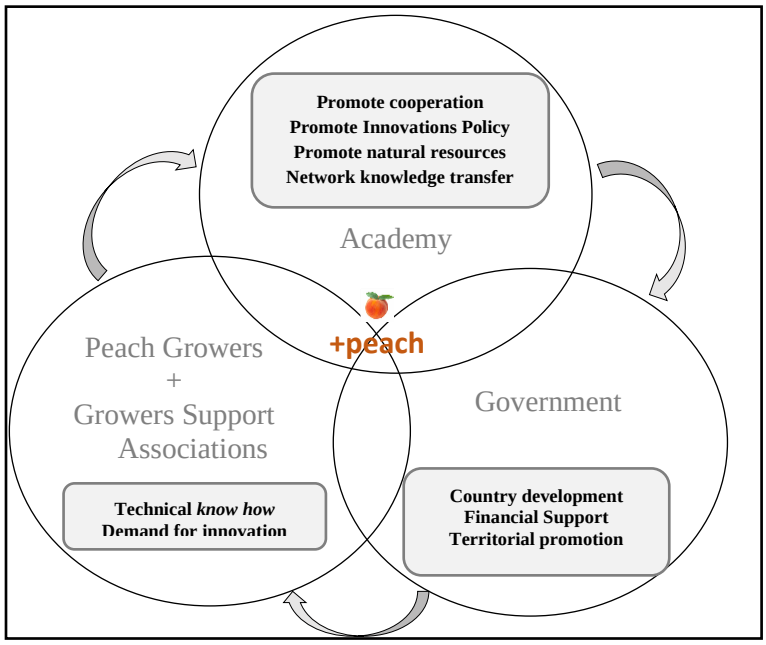

Figure 1 – Triple Helix model applied to +peach project.

The Academy Sphere includes the Escola Superior Agrária of Castelo Branco (ESACB – The School of Agriculture of the Polytechnic Institute of Castelo Branco), the Universidade of Beira Interior (the University of Beira Interior) and the Instituto Superior de Agronomia (ISA – The School of Agriculture of the Technical University of Lisbon). The Production Sphere includes both peach growers and their organizations, namely the Association Quinta de Lamaçais,

Associação de Agricultores de Produção Integrada de Montanha (AAPIM – Mountain Integrated Production Farmers Association) and Associação de Proteção e Produção Integrada do Zêzere (APPIZÊZERE – Association for Protection and Integrated Production of Zêzere). The Government Sphere includes the Gabinete de Planeamento de Projetos (GPP – Planning and Projects Office) (Figure 1). This project involves also three research and technical support institutes, that were included in the Academy Sphere, namely Instituto Nacional de Investigação Agrária e Veterinária (INIAV – National Agronomic and Veterinary Research Institute), Centro de Apoio Tecnológico Agro-alimentar (CATAA – Technology and Agrifood Support Center), and Centro Operativo e Tecnológico Hortofrutícola Nacional (COTHN – National Center for Horticultural Production). The last center that congregates all the sector. Fifty people participate in this project.

The +peach project consist of seven different activities that are distributed all over the production peach process and they include not only tests of innovative technology, but also knowledge creation and new technology creation. The different activities function as workpackages, as can be seen in Table 1, encompassing the following production techniques: soil maintenance, flowers thinning, fruits thinning, irrigation, fertilization, characterization of fruit quality throughout the production period, and an economic characterization of this sector. Table 1 identify the partners and the leadership.

Table 1 - Objectives and partners involved in the different activities of the project + peach

Activities	**Goals**	**Partners**
Soil maintenance	To assess the effect of the use of ground cover blanket Ecoblanket in fruit production in the first two years after orchard installation	AAPIM, APPIZÊZERE, ESACB, COTHN, ISA
Flower thinning	To assess the impact of Saflower equipment at flower thinning	AAPIM, APPIZÊZERE, ESACB, COTHN,
Fruit thinning	To design and build a prototype for a portable device that will allow the mechanization of fruit thinning operation	AAPIM, APPIZÊZERE, ESACB, COTHN, UBI
Deficit irrigation	To optimize irrigation water management	AAPIM, APPIZÊZERE, ESACB, COTHN,
Fertilization	To contribute to the determination of reference values to be used in assessing plant nutritional status	AAPIM, APPIZÊZERE, ESACB, COTHN, INIAV
Characterization of fruit quality throughout the production period	To assess fruit quality parameters to support an outreach plan as well as to contribute to fruit quality maintenance	AAPIM, APPIZÊZERE, ESACB, COTHN, CATAA
Economic characterization of the sector	To assess crop yield and contribute to provide information needed for planning projects	AAPIM, APPIZÊZERE, ESACB, COTHN.

Table 2 shows the different stakeholders in the Triple Helix related to the project divided into Academy sphere, Fruit Production sphere and Government sphere.

Table 2 – Players involved in +peach project.

Academy	Fruit Production	Government
ESACB	Sociedade Agrícola Quinta de Lamaçais (growers organization)	
UBI	AAPIM	
ISA	APPIZÊZERE	GPP
	8 Peach Growers	
CAATA		
INIAV	COTHN	

3.2 SPHERES

3.2.1 Academy

Although the traditional role of the Academy is lecturing and research, in recent years the Academy has assumed a third role – involvement in the socio-economic development of the regions where they are located and research is partially developed with productive sector (Godin & Gingras, 2000). As a result of a strong connection to the production sector and an integrated vision of regional potentialities, ESACB assumes this third role in the present project, promoting interaction of the large team involved. University of Beira Interior, due to its potential to develop technology, was invited to create a new equipment, a new technology e which may be used to solve regional problems. ISA provides laboratory technology and technical and research knowledge. Research organizations such as INIAV and CATAA are included in the Academy Sphere and provide laboratory facilities and laboratory techniques.

3.2.2 Fruit Production

The aim of the Production sphere is to create income through the production process. This income, in a simplistic way results from two major components: a) Productivity (tone/ha) and b) economic factors, strongly affected by commercial price per kilogram obtained by farmers. The productivity depends on soil, climate, plants and farmers knowledge and production capacity. The final economic result depends on factors' cost like plants, fertilizers, plant phytosanitary protection, water, labour and market price of the final product, mainly not so farmer dependent.

In a simplistic way, the rise of capital gains for growers can be obtained by increasing gains at the production process, which results from either increasing yields or decreasing production costs, or both. Moreover, capital gains can be achieved through direct increase of the final market price. Unfortunately, growers do not influence the final market price because it is increasingly imposed by large distribution chains. Aware of this situation, production demands successful innovation in the production process, enabling growers to increase their income. Growers are always looking for innovation, new cultivars, new pruning systems, new equipment, that allows new competitive capabilities. The Triple Helix model can lead a collaborative action among those who, on the one hand, have the role of creating and/or disseminating innovation and, on the other hand, those who need it.

In this sense, the participation of the sphere associated with the productive sector in the + peach project results, firstly, from the existence of previous links with the sphere of the Academy and Production (relational capital and social capital) and comes to assume itself as mobilizing sphere in the creation process of technical and scientific knowledge capable of solving practical problems (through the experimentation of new cultural techniques).

The fact that +peach project growers provided their orchards for new cultivation techniques experiments, highlights their need and demand for innovation. This contributes actively to accelerate the process of knowledge transfer.

3.2.3 Government

All government will attempt to boost regional development in its country. In order to achieve this goal it will create legislation and establish the legal control of its country economics. Nowadays, at the government sphere we can distinguish two main steps, the amounts of founds that are available and the subsequent legal control of its utilization. Traditionally, the role of any government is to establish the legislation and subsequent control (Leydesdorrf & Meyer, 2006), which aims to ensure an efficient resource use (Etzkowitz & Ranga, 2000).

Laws and rules should be established bearing in mind the goals of the methodology that will be adopted. In the present case study, PRODER funding, measure 4.1 innovation (2007-2013) and PDR - Operational Groups (2014-2020), has as a requirement that the project should be led by either farmers companies or farmers organizations. This will lead to a greater interaction and a

planning according to the Triple Helix model. In other words, the fact that these rules has to be complied has had the consequence that Triple Helix methodology had to be adopted.

3.3 SPACES

a) Spaces and relationships

In any interconnected spheres model there are overlap zones. Group dynamics as well as innovation dynamics takes place in these overlapping areas. They will contribute to contribute to generate, manage and monetize knowledge networks. They are the main entrance for innovation attitude within organizations (spheres). To understand the power of the connections of these space zones will be able to take full advantage of the individual actor performance as well as gain insights into and can enhance a team work that contributes for a global result rather than promote a self-centered and immediate result.

The players in these spaces zones are able and will generate bottom-up strategies that frequently are loved by the proponents and shows a greater capacity of resources profitability. This will result in a more cooperative attitude, where stakeholders may take each other roles whenever needed. These two aspects, individual substitution/replacement and group collaboration are highlighted as focal points of space zone relationship in the Triple Helix model.

If the dynamics of Triple Helix model are clearly understood, cooperation and replacement aspects can be enhanced especially in the case of a small project in a small region. Briefly, at the level of the peach chain, the sphere of production plays an important role in the co-creation of knowledge. We must emphasize that growers encouraged and carried out experiments at their farms, at their own risk, which traditionally were assigned to the Academy sphere. Simultaneously the Academy actively develops a role of identifying and testing innovations aimed at responding to the needs of the productive sector. So, in the +peach project, the Academy takes the role assigned by the productive sector as they adopt an active attitude identifying innovation needs in a collaborative relationship with the productive sphere, transferring these innovation needs to their research goals.

b) Knowledge network

A very positive result of the +peach project is the recognition of local technical skills for peach production including growers, farmers association and the Academy, at a regional level as well as

at national level. This recognition leverage the innovation attitude and it may attract more investment. At the same time, stakeholders become aware of their role, build and share knowledge networking, which definitely contributes to the enhancement of existing human resources. This attitude towards innovation contributes to the definition of new projects, to the development and increase the qualified human resources (improving brain gain) over the depletion of these resources (brain drain).

This research aims contributing the identification of constraints that may reduce the potential of a triadic relationship among the different spheres and how this project enhance a new dynamic of new project proposal from Jan-2016 to Nov-2016, increasing the team involved and extending to different knowledge needs of peach and cherry production sectors.

4. DYNAMICS RESULT

The +peach project took place since 2015 until June of 2017. The positive dynamics created among players drive to two main results: a) the publication of results toward peach growers and b) the creation of new projects proposals to get new solutions for identified problems.

In respect of results publication three +peach books were diffused: "+peach – Basic Peach Production Guide", "+peach – Innovation at Production Techniques" "+peach – Results for Management Support" (Figure 2), taking in account that they should be mainly for peach growers and technicians. So, they were written in Portuguese and at book format that allows simple consultation, wakening curiosity and facilitates the knowledge transference.

Figure 2 – +peach books front page

Beyond the referred aspects this three books promotes self-proud between peach growers, encourages technical discussion and opinions sharing. Simultaneously players of Fruit Production Sphere feel recognized not only by this activity, but also as a partnership in the process of knowledge creation because the published results have roots in their own work. Considering that Beira Interior Region is an impoverished and low density region, the book publication contributes definitely for national recognition of technical capacity of Growers Organization technicians and promoted their crucial role in regional development and subsequently in national development.

The high inter-institutional dynamics installed associated with the enhancement of the interaction spaces identified in the TH model resulted in a proactive attitude towards a participated identification of new knowledge needs and an interactive search for different solutions. Several formal and informal meetings took place between different players. This meetings can easily be located in the interconnection spaces identified in the THM.

The main problems identified and solutions proposed can be seen in Table 2.

Table 2 – Main problems identified by actors in the Triple Helix and solutions proposed under the Prunus network

Priority	Which problems are in the base of the action?	Which are the solutions proposed?

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Production	1. Identification of phytosanitary problems in potentiated orchards with fruits that are deposited on the ground; 2. Need to use food supplements in small ruminants during the summer	• Conception of an autonomous robotic equipment to withdraw the orchard fruit in the soil, reducing the pressure of the disease / pest; • Promote the use of a product without current value (fruit waste) for animal feed.
	3. Lack of real knowledge about the production potential of the orchards; 4. High costs in weed control.	• Design of an autonomous aerial robotic system devoted to: a) recognition and fruit classification and quantification of production; b) test an adjustable spray high to remove accuracy dominant weeds.
	5. Evaluation and monitoring of phytosanitary problems related to main pests and disease, some of them recently introduced in Portugal. 6. The need to mitigate their impact on crops.	• Monitor the pest cycle / disease in order to correctly position the intervention with greater effectiveness; • Evaluate different control methods minimizing the use of chemicals.
	7. Problems limiting the production, especially the nutrition of nitrogen and phosphorus in the case of cherry and magnesium in the case of peach trees as well as a transversal low content of organic matter in the orchards.	• Optimization of deficit irrigation and recovery of waste; recovery of waste for the conservation of soil organic matter.
Priority	**Which problems are in the base of the action?**	**Which are the solutions proposed?**
Testing	8. Absence of experimental fields that allow investment optimization in the activity, with the inherent risk reduction at the level of agricultural investment.	• Installation of an experimental field that allows: a) evaluating the potential and adaptability of new cultivars and rootstocks; b) testing innovative cultivation techniques; c) testing, demonstrating and disseminating new equipment's; d) performing operational demonstration activities.
Post-harvest and commercialization	9. Lack of knowledge about the effectiveness of processes for the conservation of peaches and cherries, as well as the use of packaging which preserve the fruit in its peak quality for the longest period.	• Optimize storage processes; • Develop active and / or intelligent packaging appropriate to extend the period of consumption of endogenous fruit in the Beira Interior region using new technologies and materials.
Promotion and dissemination	10. Absence of a territorial strategy planning and infrastructures to support agricultural activity, particularly peach.	• Promote actions that linking the regional fruit production sector and tourism; • Valuing the local biodiversity associated with the fruit sector in the region; • Create a territorial marketing strategy and enrich the image of the local products.

As a result of this interactive space a participated innovation attitude drive to the creation of nine new project proposals that were built during 2016 steered to production techniques, storage conditions, marketing perspectives, promotion, and dissemination of knowledge (Figure 3). These new proposals include not only the peach production activity, but also cherry production activity, valuing the two activities simultaneously and the stone fruit sector globally, taking into account that Beira Interior is the main Portuguese production region of either peach or cherry. Hence, all the new proposals were designated by Prunus, bearing in mind that the cherry tree (*Prunus avium*) and the peach tree (*Prunus persica*) belong to the same botanical genus.

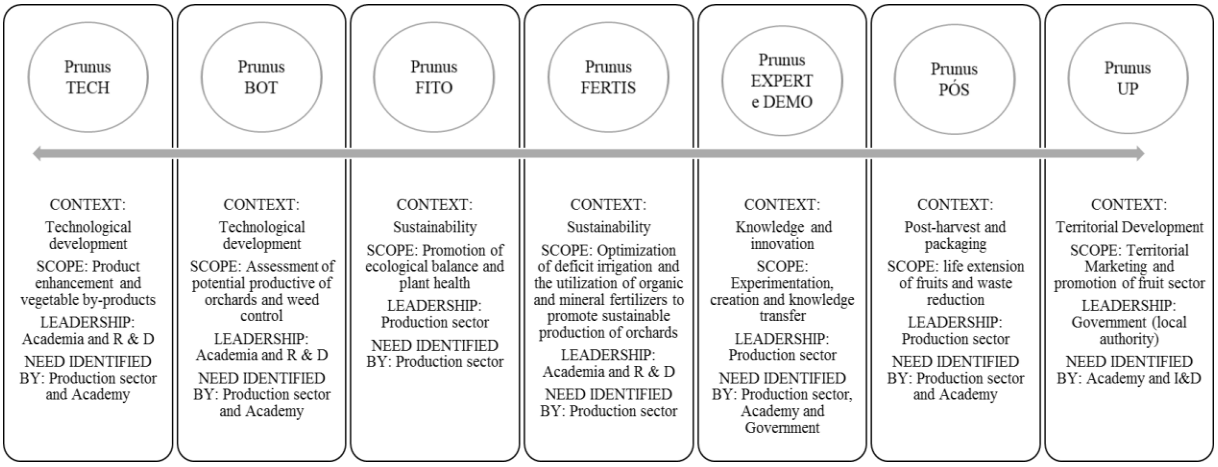

Figure 3 – Contextualization of Prunus network initiatives.

The needs identified resulted in the submission of nine initiatives to The European Agricultural Program "Measure 1.1 - Operating Groups", called: Prunus TECH, Prunus BOT, Prunus PHYTO, Prunus FERTIS, Prunus EXPERT, Prunus DEMO, Prunus POS, Prunus TRACE and Prunus UP. These project proposals aim helping to:

- Increase farmers income by the use of waste products like damaged fruits in the orchards;
- Monitoring and control weeds by economic and environmental sustainable methods;
- Promote of ecological balance and plant health with the anticipation of alternative responses to limiting the use of plant protection products with alternative control methods;
- The optimization of irrigation systems, particularly with deficit irrigation and organic and mineral fertilizers, to promote the sustainable production and the rational use of natural resources;
- Creation of field experimentation and enforce knowledge transfer network related to adaptation capacity of new varieties, rootstocks, training systems, fertilization, among others techniques related to the production, taking into account consumer trends;
- Promote conservation studies and shelf life extension experimentation for consequent decrease of fruits waste;
- Encourage the investment in promotion and marketing territorial, able to enhance innovation and develop new product based of the stone fruit.

Figure 3 illustrates the diversity in relation to the contexts and scope of each initiative, who proposed and who is a leader. Emphasizing that all of the proposal initiatives were designed by a bottom-up process, with a horizontal prevalence and a mix of formal and informal interactions between the different actors of the Triple Helix system.

According to Figure 3, it stands out the fact that most of the actions involves partners from all spheres of Triple Helix. This suggests that each initiative arises from the collective learning process and the need to strengthen farming systems, knowledge sharing and co-innovation in the agricultural production. This is crucial to promote the territorial and sectorial developments.

It is well known that work ties and gets people together, but this approach and interaction will further strength the team, if results are achieved, if the result reaches expectations, rewarding the effort that are associated. In this step comes the government sphere, that through their evaluation, will validate or not the work accomplished. This task should be done in a short period of time avoiding team dispersal.

In this case study, as can be seen in Figure 4, the Governmental Sphere are taking too much time for technical decision which are a negative factor for dynamic maintenance.

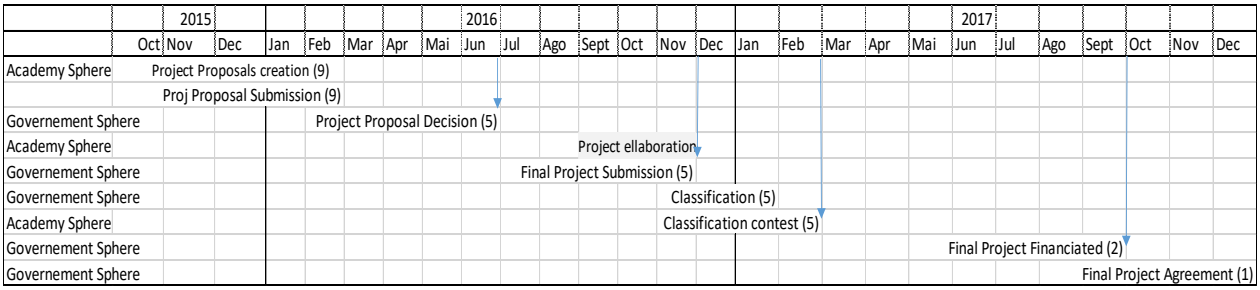

Figure 4 – Chronogram of different tasks of Prunus network initiatives. Inside parenthesis is the number of initiatives involved.

5. CONSTRAINTS

The +Peach project developed and strengthen the role of the consensus space (as identified in the Triple Helix system), which may be a physical or virtual space, such as a space of discussion and planning where information flow will be either bottom-up or top-down leading to leadership emergence in a collaborative process, rather than an authoritative and isolated one (Etzkowitz & Ranga, 2015). We have identified some constraints associated with the generation and consolidation of this consensus space. One of these constraints is devaluation of the time allotted

to reflection and creativity. Science and Academy are dominated by a culture of quantification, bibliometric and internationalization. Academy´s role in local dynamics is not easily compatible with this field of info metrics. A simple and complex question can be: Is it correct to evaluate the role of the Academy in the development of marginal regions with the same tools / indicators that are used for international research projects? In countries with impoverished areas will it not be necessary to value and promote the intervention of the Academy to try to reduce regional differences by promoting integration?

The answer and decision associated to these issues should always be seen in the long term perspective which is not valued in today's society.

Another relevant aspect are related to standards and rules that are always changing, which results in an enormous amount of bureaucracy and, therefore, a considerable waste of time and resources. If standards and rules are always changing, it is necessary quite a lot of time to adapt to these news one, time that should be used to plan, to interact, to discuss and analyze the obtained results. To overcome these constraints, The Government Sphere should adopt innovative attitude towards marginal regions and their particular needs. As referred by Etzkowitz & Ranga (2000) the consensus space should be promoted. Its consolidation, which can be reached by increasing the time allotted to it, will foster partnerships, develop human resources skills and an innovative attitude. This will lead to a collaborative and replacement attitude with resources mobilization.

6. CONCLUSIONS

The methodology used in the project + peach - Innovation and development in peach production in the Beira Interior region uses the Triple Helix model involving the Academy, the Production sector and the Government, triggering the promotion of partnerships. This network was mainly focused on incremental improvements in farming practices, fruit quality and organizational matters so as to obtain cumulative productivity gains and sustainability increases, alongside with market competitiveness gains. The main findings of this research indicate that in the Triple Helix system the networking collaboration among government, academy and farmers is the key for development. This networking collaboration is essential for new knowledge creation and promotion of innovation in the stone fruit production sector, taking advantage of the territorial endogenous potentialities. Technical capacity has been highlighted and promoted favoring the

sense of belonging of a team that can jointly play a decisive role in the elaboration of development proposals. In addition, it was possible to evidence a pro-active attitude that allowed deepening relations between the Academy and Governmental spheres with the Productive sector, especially fruit growers.

The developed dynamics between stakeholders boosted for new dynamics of research, new types of approach and collaboration towards the identify needs and search for new solutions to strategic sectors of the territory. As a main results a Prunus network was developed that has allowed developing several work proposals that definitively will promote and develop the fruit production activity in the Beira Interior region, going towards a constant demands for new knowledge by fruit growers. This network has the main objective of developing the ability to strengthen territorial activities related to the peach and cherry production and its sustainable development. The Prunus network presents itself as a cohesive structure where the proactive involvement of each partner is strong.

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