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"Local Innovation System: Interactions and Innovation Efforts in the olive sector in La Rioja - Argentina"

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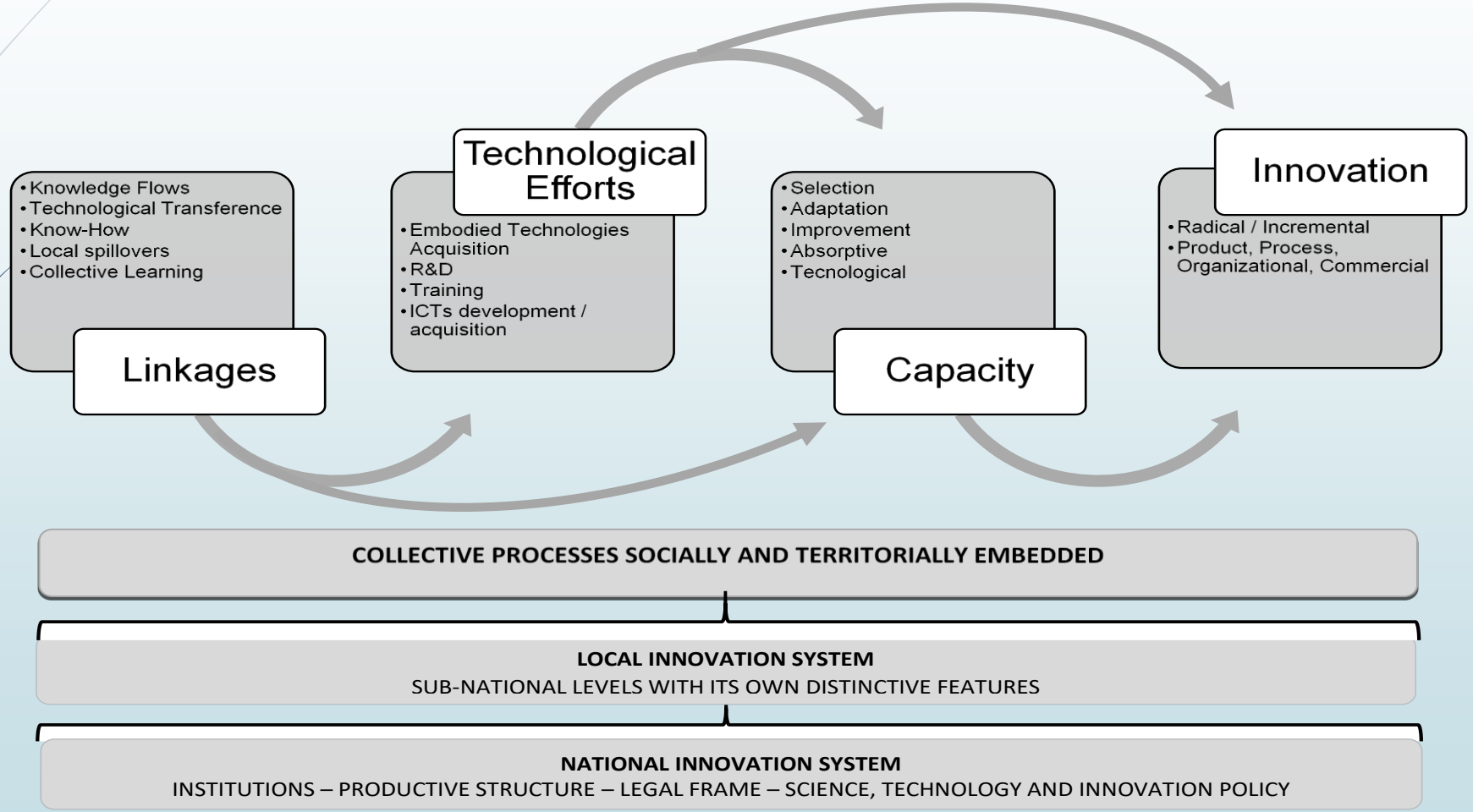
Contents

Introduction / Research Problem

- Under the new techno-economic paradigm called the "Knowledge Economy**", levels of productivity and competitiveness** reached by firms, regions and countries, are strongly related to the **technological capacities and efforts** needed to achieve **innovations**.
- The construction of **dynamic advantages** depends on the **adoption and diffusion of technological developments** and **local innovative capacity** (David y Foray 2002).
- **Evolutionary economics: systemic, interactive,** accumulative, and territorial approach. Innovation is not the result of isolated firms' actions and efforts, but of a **complex scheme of social interactions**. Relevance of **interactions between Firms, Science and Technology Organizations, Universities, Consumers and Suppliers** (Edquist 2005; Lundvall 2007).
- Research Problem: **the role of firms' interactions with other actors in relation to their innovation efforts in less developed regions.**
- Case Study: **Olive sector in La Rioja, Argentina**.

Theoretical Framework

Diagram N°1 Conceptual Framework: Interactions, Technological Efforts and Capabilities



Source: prepared by the author.

Background: Empirical Evidence

- Local Systems where **cooperative relations and synergies** emerge between firms and other actors favour **local economic and innovative development** (Italian Districts, Nordic clusters, Sillicon Valley, amongst others).
- More **complex linkages** with **science and technology organizations** and **universities** improve the **probability to innovate** (Camagni and Capello 1997; Asheim and Coenen 2005; Intarakumnerd and Vang 2006; Hassink 2002; Lavía et al. 2011; Fritsch and Franke 2004; Tödtling et al. 2008).
- In Latin America there are **weak interactions** between actors orientated to services provision and information exchange, technological **linkages and capacity concentration in larger firms**, and centralization of innovative results in more developed regions
- Study cases from **Chile and Colombia** show that **intermediary organizations** and **regional oriented S&T policies** have a central role in stimulating cooperation along with **technology and innovation promotion** (Jiménez et al. 2011, ALIAS 2011, De Fuentes y Ampudia 2009).

Background: Empirical Evidence

- For Argentina investigations highlight the presence of **heterogeneous conditions** between regions and within them (Boscherini et al. 1998, Gennero de Rearte et al. 2006, Yoguel y Boscherini 2000, Yoguel et al. 2006, Robert 2012, Robert and Yoguel 2013, Yoguel y Erbes 2007, Motta et al. 2010 y Sanchez y Bisang 2011).
- Argentine LISs present diverse levels of development; for **example Rafaela and Mar del Plata** constitute **synergic environments** where interactions and cooperation allow for **technological progress**, **competitiveness increases**, **capacity consolidation**, and **SMEs integration**.
- **Localities with less articulation amongst actors** concentrate firms with lower capabilities, technological efforts and innovative performance, and present a **correlation between firm size, technological capacity, number of interactions and innovative results**.
- **Smaller firms** establish a fewer number of interactions and face more limitations in order to **build technological capacity.**
- Main problematics can be outlined, such as **insufficient interactions**, **lack of translation mechanisms** between the productive sector and S&T organizations, **limited capabilities** amongst SMEs, difficulties in getting **financial assistance**, and **scarce knowledge exchange and technological transfer** (Yoguel et al. 2009).

Working Hypotheses

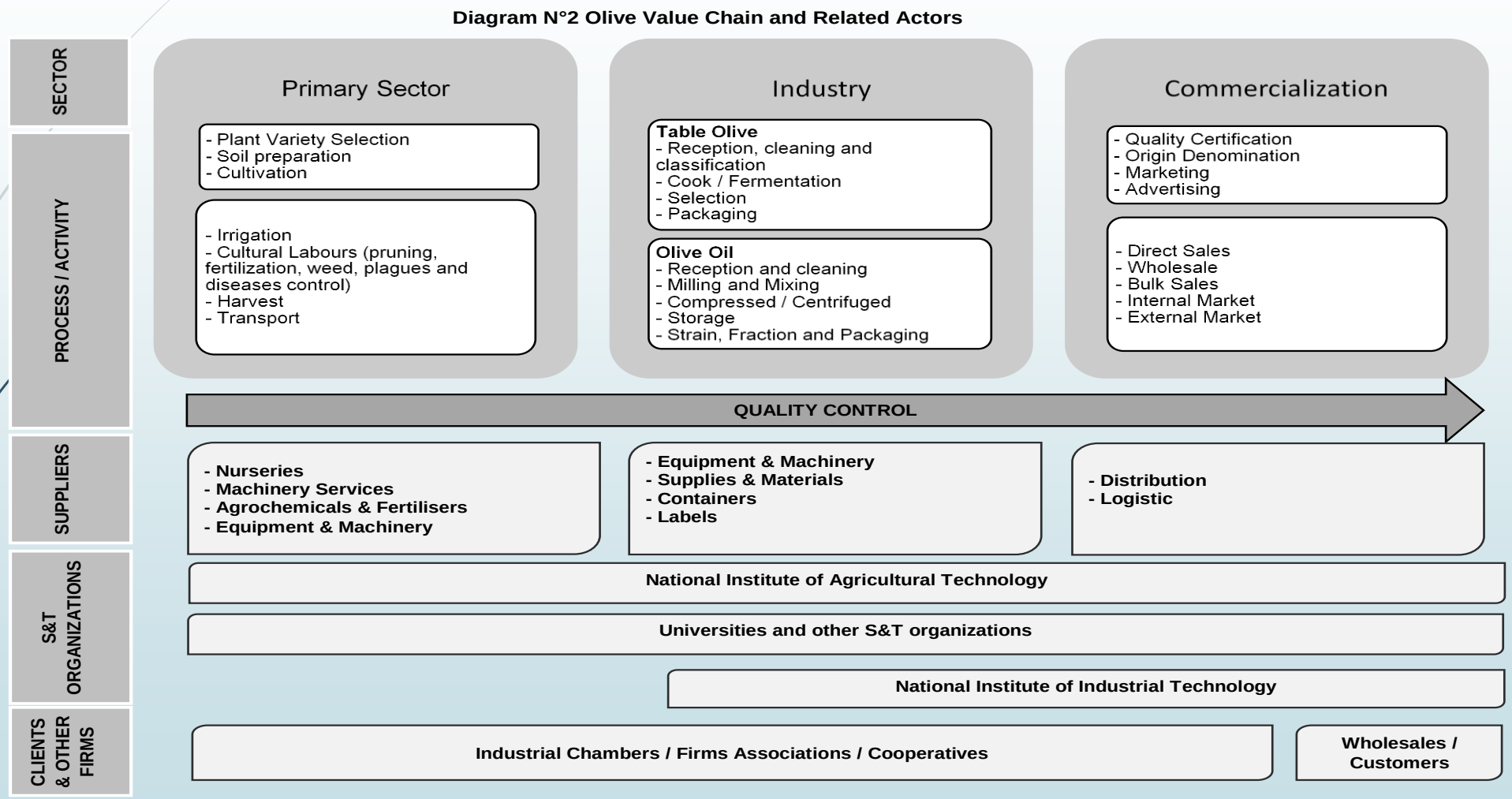
- **H1 -** ***Firms' interactions within the Local Innovation System motivate them to perform innovative efforts.***

- **H2 -** ***Firms' interactions within the LIS also increase the probabilities to carry out internal R&D.***

Olive Sector in La Rioja

- **Argentina** has a **major position** in the **olive by-products global market**, such as table olives and olive oil. **La Rioja** is **the most important olive producer provinces** in Argentina.
- It is ranked first with 33% of total raw material production, and second in planted hectares, and it is the first exporter of olive oil (27% of Argentine olive oil exports) (Day 2013; PROSAP 2014).
- Agricultural activity and the production of manufactured by-products concentrate 30% of the gross geographic product (GGP). **Olive growing is the main agricultural activity**. **Olive complex represent 20.2%** of total provincial **exports** (14.4% table olives and 5.8% olive oil) (DNRP 2015).
- The olive sector is characterized by the existence of different productive units that operate in **heterogeneous conditions**, like scale production, technological practices, and yields (UIA 2004).
- The implementation of **modern techniques** is fundamental to reach **international competitiveness** given the increasing demands for quality, innocuousness and tradability from global food markets.

Olive Sector in La Rioja



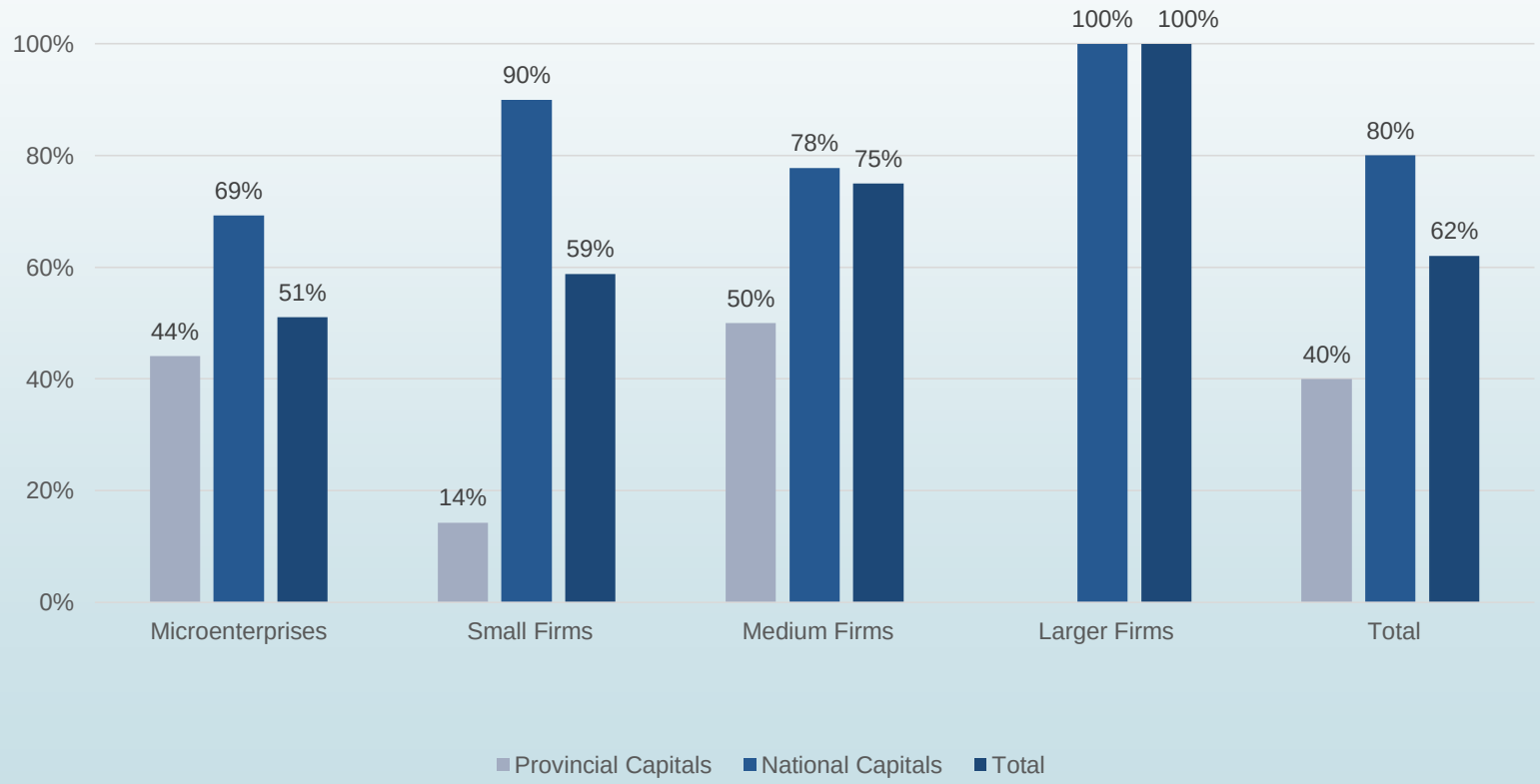
Source: prepared by the author based on Sánches (2013) and UIA (2004).

Methodology: Database

- **Database**: statistical information was collected through an extensive survey conducted to **91 olive local producers** by the National University of Chilecito in 2012.
- The survey contains information about **productive and innovative firms' characteristics** and about their **relationships with other LIS actors**. The selection of observations is based on a **probabilistic and stratified sample classified by department** including 91 producers of different sizes.
- The survey comprises 91 olive producers distributed in three local departments: Capital (20%), Arauco (37%), and Chilecito (43%), main areas of La Rioja dedicated to olive exploitation.
- 66% of them only produce raw material (olives), 31% are involved in secondary activity (eight firms elaborate table olives, six produce olive oil, and fourteen operate in both segments), and the remaining 3% work only in table olive production.

Methodology: Descriptive statistics

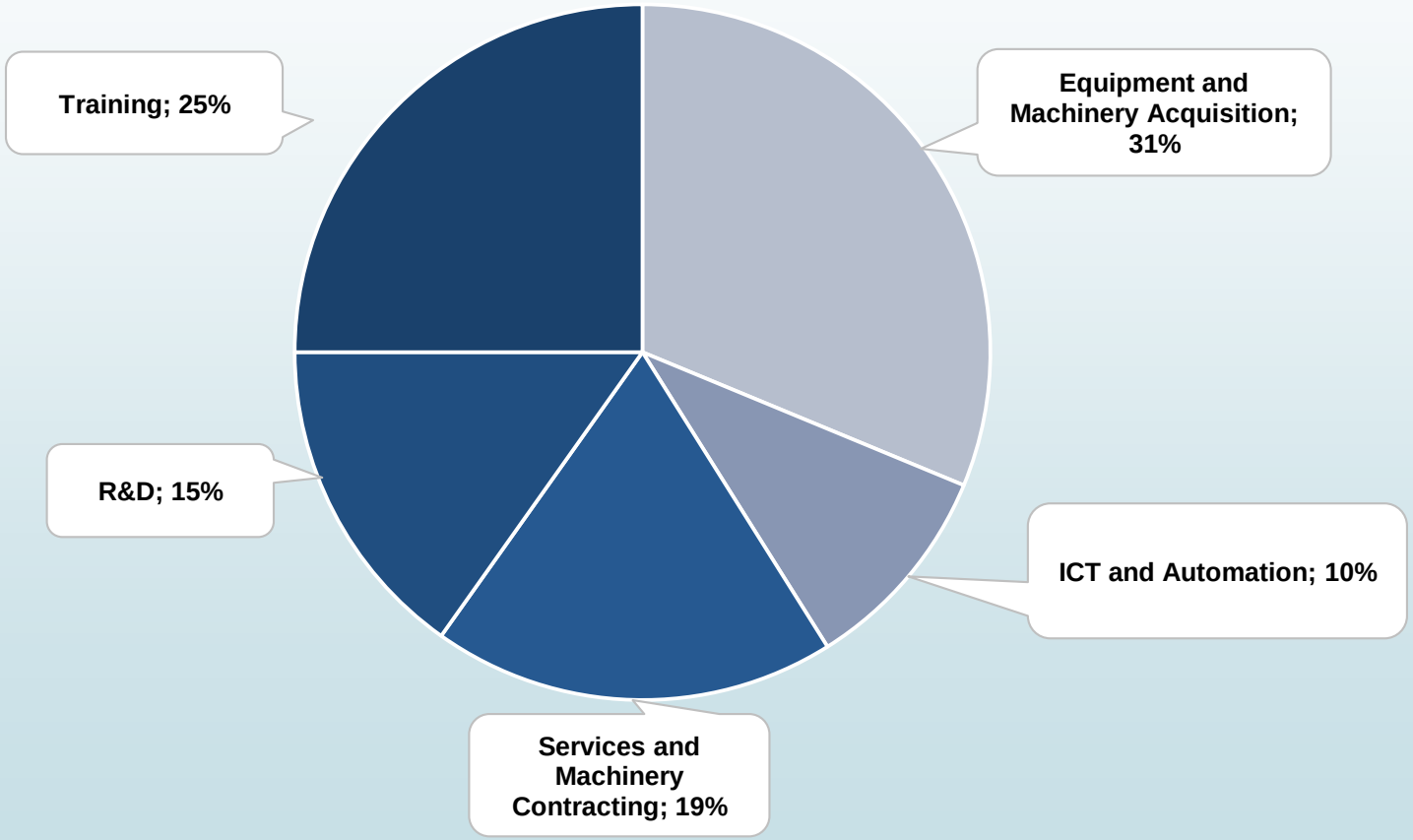
Graph N°1 Firms which perform Innovative Activities by Size and Investment Origin
-Percentage-



Source: own elaboration based on "Technological Demand for Olive Sector from La Rioja Province" Survey.

Methodology: Descriptive statistics

Graph N°2 Total Innovative Actitivities Composition by Type

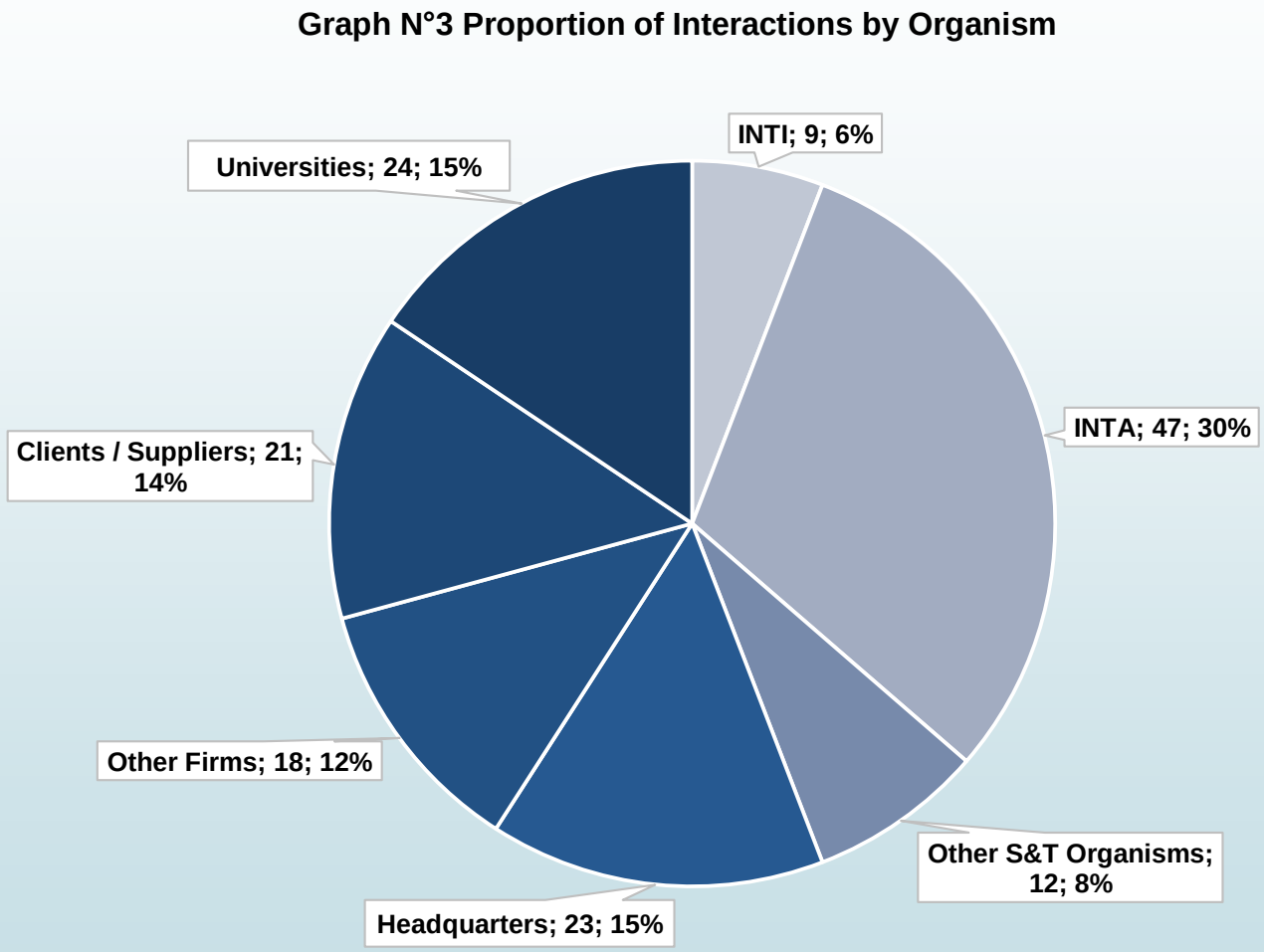


Source: own elaboration based on "Technological Demand for Olive Sector from La Rioja Province" Survey.

Methodology: Descriptive statistics

- Out of those firms which make technological efforts, **66% (37 observations) establish connections with other LIS actors** (S&T organizations, Universities, Customers, and Suppliers).
- They are distributed as follows: **46% in Chilecito**, 38% in Arauco, and only 16% in the Capital.
- The survey gathers information about firms' interaction, only in the case of those claiming to have done Innovative Activities.
- **Larger and Medium extra-local firms gather 50% of total sectors' interactions**.

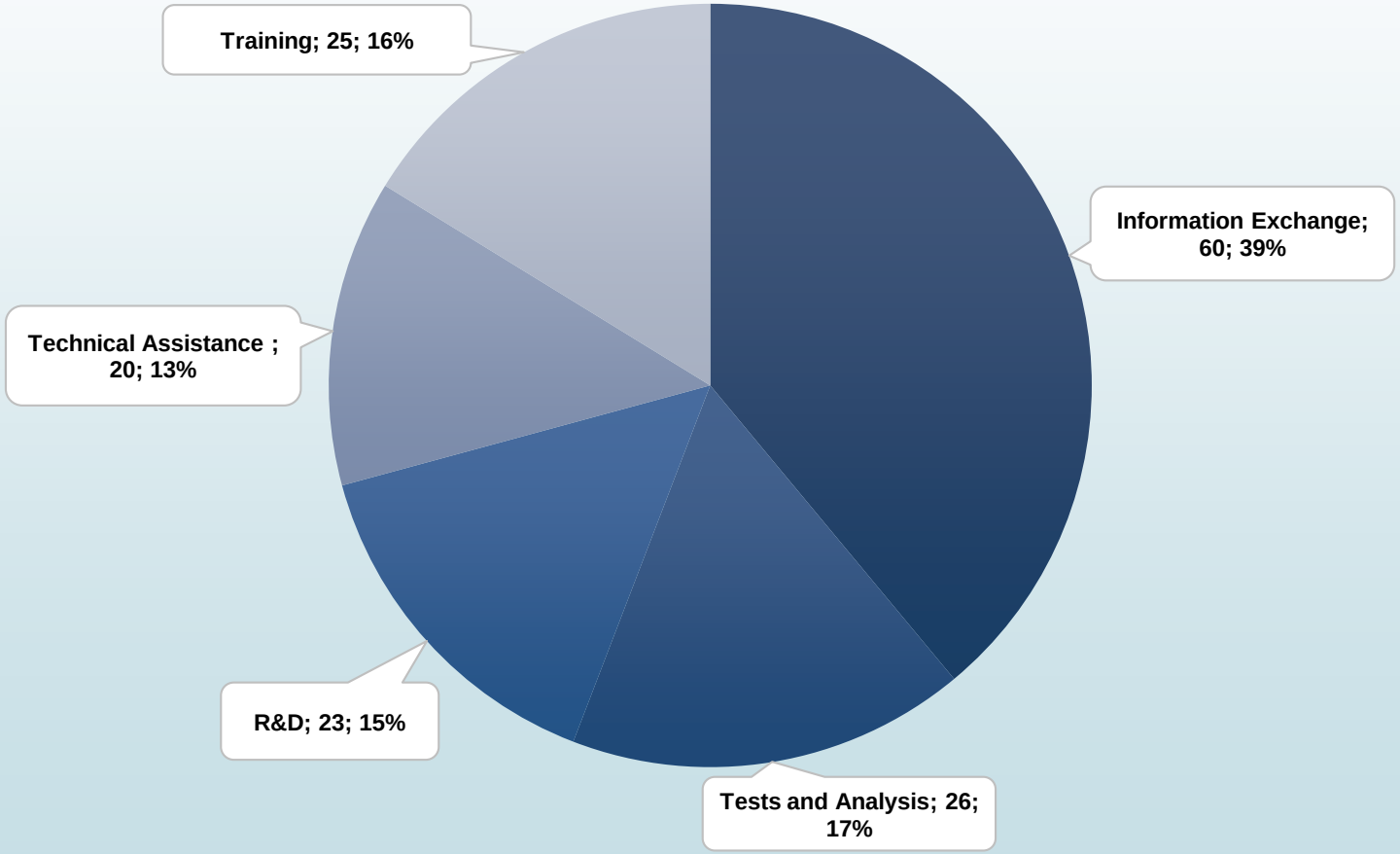
Methodology: Descriptive statistics



Source: own elaboration based on "Technological Demand for Olive Sector from La Rioja Province" Survey.

Methodology: Descriptive statistics

Graph N°4 Distribution of Interactions by Type



Source: own elaboration based on "Technological Demand for Olive Sector from La Rioja Province" Survey.

Methodology: Econometric Models

- Qualitative Response Models like **Binomial Logistic** and **Quasi-Poisson regression**, allow to study the relation between dependent binary variables and count data respectively, with a set of independent regressors which can be both qualitative or quantitative (Greene 1999).

Prob (event j occurrence) = Prob (Y = j)

Prob (event j occurrence) = F [relevant effects: parameters]

- For **parameter estimation the maximum likelihood method** is applied. The null hypothesis that the estimated coefficient is different from zero, is contrasted by using the **Wald test**.
- **Goodness of fit evaluation** is calculated with measures named pseudo R^2, they contrast the model's global utility comparing the likelihood function logarithm of the complete model against the one that only contains the constant intercept (**McFadden's Pseudo $\mathbf{R^2}$ or Likelihood Ratio, Cox y Snell's Pseudo $\mathbf{R^2}$, Nagelkerke's Pseudo $\mathbf{R^2}$**)

Methodology: Econometric Models

- **Model I Quasi-Poisson => total_ia ~ dep + inv + firm_size + prof_share + sector + interact**
- **Model II Binomial Logistic => R&D ~ dep + inv + firm_size + prof_share + sector + interact**
- **Model III Quasi-Poisson => total_ia ~ dep + inv + firm_size + prof_share + sector + total_interactions**
- **Model IV Binomial Logistic => R&D ~ dep + inv + firm_size + prof_share + sector + total_interactions**
- **Model V Quasi-Poisson => total_ia ~ dep + inv + firm_size + prof_share + sector + total_organizations**
- **Model VI Binomial Logistic => R&D ~ dep + inv + firm_size + prof_share + sector + total_organizations**
- **Model VII Quasi-Poisson => total_ia ~ dep + inv + firm_size + prof_share + sector + INTA + INTI + univers + other_s&t_org**
- **Model VIII Binomial Logistic => R&D ~ dep + inv + firm_size + prof_share + sector + INTA + INTI + univers + other_s&t_org**
- **Model IX Quasi-Poisson => total_ia ~ dep + inv + firm_size + prof_share + sector + R&D_interaction + TA_interaction**
- **Model X Binomial Logistic => R&D ~ dep + inv + firm_size + prof_share + sector + R&D_interaction + TA_interaction**

Econometric Results

Table I	Model I	Model II
	Probability of performing a greater number of IA	Probability of performing R&D
(Intercept)	-0.176 (0.244)	-2.979° (1.538)
Chilecito	0.533** (0.186)	-0.940 (1.043)
Arauco	0.288 (0.187)	-0.069 (0.978)
Investment	0.130 (0.167)	-0.709 (0.933)
Large	0.778*** (0.218)	1.414 (1.215)
Medium-sized	0.546** (0.184)	1.260 (1.040)
Small	0.239 (0.198)	0.708 (1.126)
Professionals_share	0.013 (0.009)	0.122* (0.056)
Sector	-0.028 (0.151)	1.393° (0.815)
Interact	0.015 (0.144)	0.664 (0.844)
Observations	56	56
Pseudo R^2	0.40	0.20
Pseudo R^2_{CN}	0.19	0.22
Pseudo R^2_N	0.46	0.31

Significance Levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '°' 0.1 ' ' 1

Econometric Results

Table II	Model III	Model IV
	Probability of performing a greater number of IA	Probability of performing R&D
(Intercept)	-0.115 (0.236)	-2.836° (1.546)
Chilecito	0.365° (0.185)	-1.611 (1.154)
Arauco	0.176 (0.181)	-0.440 (0.995)
Investment	0.100 (0.161)	-0.848 (0.952)
Large	0.709** (0.212)	1.390 (1.230)
Medium-sized	0.487** (0.176)	1.129 (1.069)
Small	0.261 (0.189)	0.960 (1.157)
Professionals_share	0.016° (0.009)	0.146* (0.061)
Sector	-0.125 (0.148)	1.117 (0.853)
Total_Interactions	0.041* (0.018)	0.225° (0.134)
Observations	56	56
Pseudo R^2	0.46	0.24
Pseudo R^2_{CN}	0.22	0.26
Pseudo R^2_N	0.52	0.36

Significance Levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '°' 0.1 ' ' 1

Econometric Results

Table III	Model V	Model VI
	Probability of performing a greater number of IA	Probability of performing R&D
(Intercept)	-0.144 (0.242)	-2.971° (1.584)
Chilecito	0.422* (0.193)	-1.609 (1.158)
Arauco	0.217 (0.187)	-0.407 (1.001)
Investment	0.107 (0.165)	-0.912 (0.972)
Large	0.753** (0.215)	1.488 (1.243)
Medium-sized	0.479* (0.187)	1.019 (1.068)
Small	0.243 (0.195)	0.941 (1.160)
Professionals_share	0.015 (0.009)	0.147* (0.062)
Sector	-0.080 (0.151)	1.251 (0.835)
Total_Organizations	0.066 (0.047)	0.514° (0.304)
Observations	56	56
Pseudo R^2	0.42	0.24
Pseudo R^2_{CN}	0.20	0.25
Pseudo R^2_N	0.49	0.36

Significance Levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '°' 0.1 ' ' 1

Econometric Results

Table IV	Model VII	Model VIII
	Probability of performing a greater number of IAs	Probability of performing R&D
(Intercept)	-0.258 (0.252)	-5.524* (2.489)
Chilecito	0.624** (0.189)	-1.089 (1.390)
Arauco	0.379° (0.192)	1.912 (1.487)
Investment	0.139 (0.174)	-2.865° (1.713)
Large	0.791*** (0.220)	3.651* (1.856)
Medium-sized	0.595** (0.184)	3.625° (1.924)
Small	0.287 (0.195)	1.556 (1.642)
Professionals_share	0.013 (0.010)	0.296** (0.109)
Sector	-0.057 (0.148)	2.383* (1.122)
INTA	-0.164 (0.147)	-2.099 (1.300)
INTI	0.088 (0.282)	4.357* (2.059)
Universities	0.062 (0.169)	2.861* (1.454)
Other_S&T_org	0.454° (0.242)	-2.401 (1.650)
Observations	56	56
Pseudo R^2	0.46	0.44
Pseudo R^2_{CN}	0.22	0.42
Pseudo R^2_N	0.53	0.59

Significance Levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '°' 0.1 ' ' 1

Econometric Results

Table V	Model IX	Model X
	Probability of performing a greater number of IAs	Probability of performing R&D
(Intercept)	-0.175 (0.236)	-4.170* (2.085)
Chilecito	0.432* (0.174)	-0.564 (1.258)
Arauco	0.188 (0.179)	-0.135 (1.261)
Investment	0.131 (0.159)	-1.070 (1.316)
Large	0.770*** (0.208)	1.620 (1.589)
Medium-sized	0.466* (0.177)	1.998 (1.422)
Small	0.209 (0.188)	0.592 (1.549)
Professionals_share	0.016° (0.009)	0.154* (0.078)
Sector	-0.112 (0.146)	1.858° (1.065)
R&D_interaction	0.142 (0.130)	3.599*** (1.074)
TA_interaction	0.258° (0.137)	-0.970 (1.288)
Observations	56	56
Pseudo R^2	0.47	0.44
Pseudo R^2_{CN}	0.22	0.42
Pseudo R^2_N	0.53	0.60

Significance Levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '°' 0.1 ' ' 1

Conclusions

- Empirical results corroborate the main hypotheses, **interactions within LIS motivate firms to encourage more innovative activities and R&D projects**.
- Local Innovation System approach shows that a **greater number of interactions and complex articulations with S&T organisms** have a relevant impact on **technological efforts** carried out by olive firms.
- It is not the mere fact of articulating with at least one actor but **establishing a greater number of interactions** which influence the probability to carry out more innovative activities and to perform R&D efforts.
- Particular connections promote more activities, for example **linkages with other S&T organizations and for Technical Assistance**. Opportunities to perform internal R&D are related to relations with **different actors**, connections with the **INTI and universities**.
- **Larger and medium-sized firms** have better probabilities of performing a higher number of innovative activities as well as those having a bigger **share of qualified human resources** and located in **Chilecito**. This fact confirms that in the local olive sector firm, the **size does influence technological efforts**, and learning and capacity building processes.

Conclusions

- Therefore, **a larger quantity of interactions implies that knowledge flows, technology and know-how transference, and collective learnings are generated, which favour innovative activities and reduce obstacles**.
- In local olive sector, the size of firms is related to their technological behaviour. These results indicate that even though interactions within LIS have a positive influence, **its development is not enough to make smaller firms overcome their own limitations**.
- Policy strategy must be focused on two areas, in the one hand, to **consolidate firms and organizations technological capacity**, in the other hand to **promote cooperative relationships** between firms and S&T organisms, particularly more complex activities.
- Thus, a greater number of interactions, which stimulate knowledge and technology exchange, generate local spillovers, and reduce uncertainty, along with capacity building, may **set off accumulative learning processes that allow to reduce technological gap and to achieve endogenous innovations improving local productivity and competitiveness**.

Bibliographic References

- ALIAS (2011). *Diseño y Establecimiento de la Estrategia Regional de Innovación y Acciones Afines en Biobío*. Technology Innovation Fund for the Biobío Region. Allied to Grow S.L.
- Asheim, B. T. and L. Coenen (2005). "Knowledge bases and regional innovation systems: Comparing Nordic clusters." Research Policy (34): 1173-1190.
- Boscherini, F., M. López, et al. (1998). Sistemas locales de innovación y el desarrollo de la capacidad innovativa de las firmas: un instrumento de captación aplicado al caso de Rafaela. Globalización e Innovación Localizada: Experiencias de Sistema Locales en el ámbito del Mercosur y Proposiciones de Política de CyT. Institute of Economics of Federal University of Rio de Janeiro. **17/98**.
- Camagni, R. and R. Capello (1997). "Innovation and Performance of SMEs in Italy: The relevance of Spatial Aspects." Centre for Business Research, University of Cambridge.
- David, P. and D. Foray (2002). "Una introducción a la economía y a la sociedad del saber." International Social Science Journal **171**.
- Day, J. (2013). *Actualidades y desafíos en la cadena olivícola de Argentina*. Working Document, Year 19, Edition N°128. Instituto de Estudios sobre la Realidad Argentina y Latinoamericana (IERAL). Fundación Mediterránea.
- De Fuentes, C. and L. Ampudia (2009). Los sistemas regionales de innovación de Querétaro y Ciudad Juárez. In Dutrénit, De Fuentes et al. (Eds.). Sistemas Regionales de Innovación: un espacio para el desarrollo de las PyMes. El caso de la industria de maquinados industriales. Metropolitan Autonomous University. Mexico DF.
- DNPR (2015). *Fichas Provinciales Octubre 2015, La Rioja*. Economic Policy and Development Planning Secretariat. National Direction of Regional Planning.
- Edquist, C. (2005). Systems of innovation: perspectives and challenges. En J. Fagerberg, D.C. Mowery, et al. (Eds.). The Oxford Handbook of Innovation. Oxford University Press.
- Fritsch, M. (2001). "Co-operation in Regional Innovation Systems." Regional Studies **35**(4): 297-307.
- Fritsch, M. and V. Slavtchev (2011). "Determinants of the efficiency of regional innovation systems." Regional Studies **45**(7): 905-918.
- Fritsch, M. and G. Franke (2004). "Innovation, regional knowledge spillovers and R&D cooperation." Research Policy **33**: 245-255.
- Gennero de Rearte, A., M. Lanari, et al. (2006). Capacidad innovativa de núcleos impulsores de firmas en entornos territoriales dinámicos. El caso de Mar del Plata, Argentina. In J. Cassiolato and H. Lastres (Eds.). Experiencias de sistemas locales en el Mercosur. IBICT, Brasilia.
- Greene, W. (1999). Análisis Econométrico. Third Edition. Prentice Hall Iberia, Madrid.

Bibliographic References

- Hassink, R. (2002). "Regional innovation support systems: recent trends in Germany and East Asia." European Planning Studies **10**(2): 153-164.
- INTA (2012). *Plan Tecnológico Regional.* Regional Centre Catamarca – La Rioja. National Institute of Agricultural Technology.
- Intarakumnerd, P. and J. Vang (2006). "Clusters and Innovation Systems in Asia." Science Technology & Society **11**(1): 1-7.
- Jiménez F., I. Fernández de Lucio, et al. (2011). Los Sistemas Regionales de Innovación: experiencias concretas en América. In J. Llisterri and C. Pietrobelli (Eds.). Los Sistemas Regionales de Innovación en América Latina. Inter-American Development Bank.
- Kaufman, A. and F. Tödtling (2000). *Science-Industry Interaction in the Process of Innovation: The Importance of Boundary-Crossing between Systems*. 40th Congress of the European Regional Science Association. Barcelona.
- Koschatzky, K. and A. Zenker (1999). "The Regional Embeddedness of Small Manufacturing and Service Firms: Regional Networking as Knowledge Source for Innovation?." Fraunhofer Institute for Systems and Innovation Research. Working Papers Firms and Region N°R2/1999.
- Lavía, C., B. Otero, et al. (2011). "Innovación y Territorio. Una encuesta a pequeñas y medianas empresas industriales." International Journal of Sociology **69**(2).
- Lundvall, B.-Å. (2007). "National innovation systems—analytical concept and development tool." Industry and innovation **14**(1): 95-119.
- Matías A., S. Molina, et al. (2012). *Olivicultura Argentina y Regional*. Working Document. National Institute of Agricultural Technology. Catamarca.
- McDermott, G., R. Corredoira, et al. (2006). *Public-private networks as sources of knowledge and upgrading capabilities: Lessons from the transformation of the argentine wine industry*. IBMEC. Research Workshop on Institutions and Organization. San Pablo, Brazil.
- Motta, J., H. Morero, et al. (2010). "Procesos de aprendizaje y de acumulación de conocimiento en las empresas autopartistas argentinas." Munich Personal RePEc Archive (26965).
- PROSAP (2014). Documento de Actualización de la Estrategia Provincial para el Sector Agroalimentario (EPSA). Ministry of Agriculture Livestock and Fisheries.
- Robert, V. (2012). *Interacciones, feedbacks y externalidades: la micro complejidad de los sistemas productivos y de innovación locales. Una aproximación en PyMes argentinas.* Doctoral Thesis. University of Buenos Aires.
- Robert, V. and G. Yoguel (2013). *Heterogeneity in local systems of innovation: evidence from Argentinean manufacturing SMEs*. Internacional Conference LALICS 2013 "Sistemas Nacionales de Innovación y Políticas de CTI para un Desarrollo Inclusivo y Sustentable". Rio de Janeiro, Brazil.
- Sánches, P. (2013). *Análisis de Diagnóstico Tecnológico Sectorial – Olivarero.* Estudios de Análisis de Diagnóstico Tecnológico Sectorial. Secretary of Planning and Policy on Science. Ministry of Science, Technology and Productive Innovation.
- Sanchez, G. and R. Bisang (2011). "Learning Networks in Innovation Systems at Sector / Regional Level in Argentina: Winery and Dairy Industries." Journal of Technology Management & Innovation **6**(4).