

# **UNIVERSITY OF PADUA**

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Scienze Forestali ed Ambientali

## **Technical publications of Italian scientists: synergy or conflict with scientific publications?**

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## Abstract

Knowledge and technology transfer is a crucial step in the processes related to Research and Development (R&D) and is strongly related to the Third Mission activities of universities and research bodies. Aim of this study is to detect if there is a synergy or a conflict between technical and scientific publications by Italian scientists. Data about technical and scientific publications with reference to the period 2011-2013 have been collected in two steps. In the first part of the study, papers related to forest topics have been recorded from 9 Italian technical magazines specialised in forest sciences in a broad sense. A total of 239 papers and 259 authors has been found. An absolute and a weighted value has been assigned to each authors of each paper. Later, based on the annual weighted value of publications of each authors, has been selected a sample of the 51 most productive authors. In the second part of the study, for each of the 51 authors has been checked the amount of scientific papers published in the same period on the online database "Web of Science". To expand the investigation, data have been also collected from the *Società Italiana di Selvicoltura ed Ecologia Forestale* (SISEF) web site, as concern the absolute number of SISEF members and their distribution among the main Italian research organizations. Data have been also grouped by institutional categories. Both parametric and non-parametric analysis have been carried out on the data. A confidence level of 95% and of 90% has been set. For the data collected from the SISEF members' list has also been investigated the chi-quadro test. As regard to the comparison between technical and scientific publications, findings have been found statistically more significant when using the total absolute values that using the total weighted values of the authors. Differences among the institutional categories have been found too. Indeed, with reference to the total absolute values, "University" and "CNR" have been found to be statistically significant, while "CRA" presents a non straightforward behaviour. Instead, with reference to the total weighted values, only "CNR" has been found statistically significant, while "Universities" presents a trade-off and "CRA" shows again a non straightforward behaviour.

Looking at the absolute data on technical publications, findings of this study underline a leading role of the University system in publishing both technical and scientific papers. Instead, the ratio between the number of technical publications and the number of researchers (SISEF members) highlights the higher attention to technical publications of the Council for the Research and Experimentation in Agriculture (CRA) against Universities and the National Research Council (CNR). As regard the ratio between the number of scientific publications and the number of researchers (SISEF members), CNR is the institution playing the main role. Nonetheless, no one of the institutional categories have been found to publish more than half paper per year. To conclude, a general synergy between technical and scientific publications has been found, even if with differences among institutional categories. However, considering the absolute data, the study shows a tendency of Italian scientists to publish little both of technical and scientific papers. Thus reasons of such low general productivity need to be further investigated.



## **1 Introduction**

In this chapter we discuss the general problem of technology transfer to frame our research objectives. More specifically, in section 1.1 information about the "knowledge based society" concept and the Third Mission of universities and research bodies in the Italian system are provided. In section 1.2 the problem that is at the focus of this study is stated. Section 1.3 introduces the objectives and the research question of the study, while section 1.4 presents the overall structure of the thesis.

### **1.1 Background**

Nowadays we are living in a "knowledge based society", defined by the GESCI (2016) as *"societies based on the creation, dissemination and utilization of information and knowledge. It is a society with an economy in which knowledge is acquired, created, disseminated and applied to enhance economic and social development"*.

The concept of "knowledge based society" has been introduced in the USA by the engineer and technocrat Vannevar Bush, that in 1945 in his report "Science-The endless frontier" to the USA President F. D. Roosevelt, underlines the need to innovate the public research system, giving importance to universities and the basic research (ROARS, 2016). Thus it is clear how the role of the education system is becoming more and more important in its relationship between science and society.

It is with this concept in mind that the European Union, since 2007, promotes projects to support the research activities, like the "Horizon 2014-2020" program. Aim of the projects of the "Horizon 2014-2020" is to find new and innovative tools to increase the connection between science and society (Scienza in rete, 2015). This changes in the relation between science and society imply a new approach and consideration of the role of research, that thus aim to connect people from different fields of knowledge in order to respond better to the needs of the European citizen (Scienza in rete, 2015).

In the Italian public research system, universities and non-academic bodies whose institutional task is the scientific and technological research (Rocchi and Scarda, 2003) are the main institutions carrying out research activities. Indeed, as reported by Montanaro and Torrini (2014), two-thirds of the public expenditure in the research sector (that counts for the 0.6% of the public system) are attributable to the University system. The main research bodies carrying out research in agriculture and forestry are the National Research Council (CNR), that is funded and supervised by the Italian Ministry of Education, Universities and Research (MIUR), the Council for the Research and Experimentation in Agriculture (CRA) and the National Institute of Agricultural Economics (INEA), both funded by the Ministry of Agriculture, Food and Forestry Policies (MIPAAF). With the State Budget Law of 2015, INEA and CRA have been jointed in the new institution CREA-*Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria* ([www.politicheagricole.it](http://www.politicheagricole.it)).

As regard to universities, that respond to the MIUR (Materia, 2012), traditionally their main functions have been teaching and making research (ANVUR, 2014). However, a third function is becoming more and more important, that is the spreading to the society of the knowledge acquired by universities with the research activities.

This function is better known as "Third mission" to *"engage with society in meaningful and mutually beneficial dialogues and processes. These naturally centre on education and research, but they also exploit the potential each university represents by virtue of the extraordinary concentration in one place of so many vigorous and intelligent people, so much knowledge, and such impressive resources"* (DiSSGeA, 2016).

In May 2011 the National Agency for the Evaluation of Universities and Research Institutes (ANVUR) has been established. The Agency gives the following definition of Third Mission (ANVUR; 2014): *"per Terza Missione si intende l'insieme delle attività con le quali le università entrano in interazione diretta con la società, affiancando le missioni tradizionali di insegnamento (prima missione, che si basa sulla interazione con gli studenti) e di ricerca (seconda missione, in interazione prevalentemente con le comunità scientifiche o dei pari)"*.

The Third Mission focuses on two different aspects (ANVUR, 2014):

- industrial-economic development of the society,
- the socio-cultural development of the society.

In order to evaluate the quality of the research of the universities, a first evaluation exercise has been performed in 2004–06 by ANVUR, with reference to the period 2001–03, using a peer review method (Ancaiani *et al.*, 2015). Then a second evaluation exercise has been performed in 2011 with reference to the period 2004–10. This second evaluation exercise, that evaluates also the activities related to the Third Mission of universities (ANVUR, 2014), is known as VQR (*Valutazione della Qualità della Ricerca*) and has been officially started in July 2011 by the Ministerial Decree 17/2011 (Ancaiani *et al.*, 2015). For the VQR exercise, information about scientific publications had to be provided by all Italian universities as well as by the research bodies supervised by MIUR (Ancaiani *et al.*, 2015). A total of 95 universities, 12 MIUR-supervised research bodies and 26 inter-University consortia and other research bodies have participated to the assessment, for a total of almost 185,000 research outcomes that have been submitted (Ancaiani *et al.*, 2015). Among these, 12.636 outcomes are related to Third Mission activities ([www.bollettinoadapt.it](http://www.bollettinoadapt.it), 2016). The evaluation of the scientific publications has been carried out using both peer review and bibliometric methods; specifically, the bibliometric indicators used were the number of citation and the measure of the impact of the journal (Impact Factor-IF) (Ancaiani *et al.*, 2015).

The indicators and parameters adopted to evaluate the research and the Third Mission are listed in the "Enclosed E" of the Ministerial Decree 47/2013 and reported as follow (MIUR, 2016):

- "1. Percentuale dei docenti che non hanno pubblicato negli ultimi 5 anni (inattivi);*
- 2. Produzione scientifica per area degli ultimi 10 anni/docenti di ateneo;*
- 3. Numero di premi nazionali e internazionali;*
- 4. Attività di divulgazione scientifica e culturale;*
- 5. Fellow (o equivalenti) di società scientifiche;*
- 6. Rapporto numero di progetti in bandi competitivi/docenti dell'ateneo negli ultimi 10 anni;*
- 7. Percentuale di prodotti negli ultimi 5 anni con coautori internazionali;*
- 8. Numero medio di tesi di dottorato per docente;*
- 9. Numero medio di brevetti per docente negli ultimi 10 anni;*
- 10. Rapporto fatturato conto terzi e progetti di ricerca vinti in bandi competitivi/numero docenti negli ultimi 10 anni;*
- 11. Numero di spin off degli ultimi 10 anni;*
- 12. Numero di attività extra moenia collegate alle aree di ricerca (es. organizzazione di attività culturali o formative, gestione di musei e siti archeologici, organizzazione di convegni...);*
- 13. Numero di mesi/uomo di docenti/ricercatori stranieri trascorsi in ateneo;*
- 14. Risultati VQR."*

Thus, the outcomes coming out from the VQR exercise allows to have a standardized and comparable database of the 95 Italian universities for what concerns the research and the Third Mission activities (ANVUR, 2016). The results obtained with the evaluation can be used by policy makers to take decisions for the governance of the R&D (research and development) sector, like planning the distribution of funds and the recruitment of young scientists, according to the purposes of the knowledge based society concept.

## 1.2 Problem statement

Although the importance of VQR to assess the quality research to enhance social and economic development, some criticisms have been raised up about the evaluation criteria and indicators adopted in the evaluation exercise. This thesis takes into consideration the issues raised in a specific field of applied research: the forestry sector. In this forestry sector two leading Italian technical magazines, namely "Sherwood-Foreste ed Alberi Oggi" specialized on forest management topics and "Acer-Il Verde Editoriale" in urban green spaces development, have claimed that the bibliometric indicators (especially the Impact Factor-IF) used to evaluate the research quality encourage the researchers to produce more scientific publications on international journals (usually written in English) rather than spreading knowledge through Italian technical magazines. Hence, the two magazines have promoted a petition "*Cambiamo la valutazione della ricerca per foreste, alberi e territorio!*" ([www.change.org](http://www.change.org), 2016) that on the 15<sup>th</sup> of September 2014 has been sent to the MIUR, the MIPAAF, the CRA, the CNR and the ANVUR ([www.foreste.info](http://www.foreste.info), 2016). In the petition the two magazines have asked for a redefinition of the current evaluation criteria, in order to give the proper importance also to more applied and technical knowledge transfer and the operational outcomes of the activities carried out by researchers, such as conferences, workshops, books and manuals ([www.foreste.info](http://www.foreste.info), 2016). Indeed, although the increasing number of online means of divulgation, such as webinars, hard-copy technical magazines are still a cornerstone in technological transfer. Moreover, redefining the evaluation criteria will also reduce the gap between the research and the forest resources management, actually very far from optimal conditions, at least in Italy.

### **1.3 Objectives and research questions**

On the basis of the petition promoted by the Italian technical magazines "Sherwood-Foreste ed Alberi Oggi" and "Acer-Il Verde Editoriale", the aim of the thesis is to assess the relation between scientific and technical publications and the role of technical publications in technology transfer in the forestry sector. Specifically, the thesis is aimed to detect if there is a conflict or a synergy between technical and scientific publications by Italian scientists.

### **1.4 Structure of the thesis**

The thesis is organized as follows.

After presenting in this introduction the background information and the research objectives and questions, Chapter 2 describes the research methodology. In this session the sources, the sample used in the study, as well as the statistical analysis that have been carried out are described. Chapter 3 presents the results obtained, while in Chapter 4 the empirical findings are discussed, as well as the limitations of this study and the suggestions for future research. Chapter 5 presents the conclusions that have been drawn from the results of the survey.

## **2 Research methodology**

In this chapter the research approach is presented in section 1.2. The procedure used for the data collection is provided in section 2.2, while section 2.3 describes the data analysis carried out in the study.

### **2.1 Research approach**

In order to assess the synergy or the conflict between technical and scientific publications of Italian scientists, data about both technical and scientific publications have been collected, relative to the period 2011-2013. For the survey, only publications in the form of paper have been considered; no interviews, comments, boxes or notes published in the magazines have been taken into account. Statistical analysis have been then conducted on the obtained quantitative data.

### **2.2 Data collection**

Data collection took place in two steps. In the first part, from November to the end of December 2015, we have collected information about technical papers. We have been considered the papers published in the triennium 2011-2013. Thus, papers related to forest topics have been recorded from 9 Italian technical magazines specialised in forest sciences in a broad sense, including the use of woody bioenergy and urban green spaces. The magazines considered in the survey are:

- Sherwood-Foreste ed Alberi Oggi and its associate journal
- Tecniko&Pratiko.
- Acer-II Verde Editoriale;
- AgriforEnergy;
- Dendronatura;
- Informatore Agrario with its monthly supplement on bioenergy;
- Rivista dei Dottori Agronomi e Forestali;

- Terra e Vita with its supplements;
- Il Legno.

The magazines have been found in different academic libraries and institutions in Legnaro (PD), Verona and Trento. Data were organized and elaborated in an Excel file recording the following information:

- the name of the magazine in which the paper has been published;
- the serial number of the magazine and the year of publication;
- the week/month/semester in which the paper has been published according with the frequency of publication of each magazine;
- the name of the author(-s);
- the title of the paper;
- the name of the institution to which belong each author.

In this way a complete set of data for each magazine and for each year of the triennium 2011-2013 has been obtained. A total amount of 239 papers by 259 authors have been collected from the 9 magazines in the triennium.

A ranking of the authors has been made with 2 approaches:

- for each paper a value of 1 has been given to each author, also in the case of co-authorship;
- for each paper a weighted value (1, 0.5, 0.33, ...) has been given to each author in relation to the number of authors that have published the paper (1, 2, 3, ...).

Both the absolute and the weighted values have been summed for each author, obtaining the total absolute and the total weighted values of publications in the triennium per author. The total weighted values have been then divided by three, obtaining the annual average weighted value of the number of publications for each author.



On the basis of the annual average weighted value, a set of more “productive” 51 authors, within a range from 6 (top value in the ranking of the annual average weight values) to 0.34, has been selected. In the 51 authors dataset foreign authors have been excluded; 3 outlier authors have been found: Alessio Fini, Raffaele Spinelli and Natascia Magagnotti.

In January 2016 the second part of data collection, regarding the scientific publications, have been carried out. For each of the 51 authors we have been checked the amount of scientific papers published in the same period (2011-2013) on the online database "Web of Science". A total amount of 132 papers by 262 authors (counting also the co-authors for each paper) have been collected in the triennium. Again, for each of the 262 authors the total absolute values and the total weighted values have been elaborated. From the total weighted values the annual average weighted values has been obtained. The comparison between the technical and scientific publications has been conducted first considering all the 51 authors, then progressively taking out each one of the 3 outliers and finally taking out all of them.

For ranking both technical and scientific publications by institution, a weight has been given also to each institution in relation to the number of authors of the institution that have wrote the paper; the obtained weighted values have been summed to have a total weighted value of the number of publications of each institution. The total weighted values of publications for each institution has been assumed as the numbers of publications of the institution in the elaboration later conducted.

Data related to the 51-authors' list have been also grouped by institutions (without using a weighing system but just identifying to which institution belongs each author). Grouping in institutional categories have been done with reference both to the total absolute value and to the total weighted value of the authors. Focus has been given to the most numerous institutional categories: "Universities" (UNIV), "National Research Council" (CNR) and "Council for the Research and Experimentation in Agriculture" (CRA). The category "CRA" has been further investigated using the polynomial trendline. Thus a comparable dataset for both technical and scientific publications has been created.

In order to expand the investigation, data have been also collected from the *Società Italiana di Selvicoltura ed Ecologia Forestale* (SISEF) web site. The Society, founded in 1995, focuses its work mainly on silviculture and forest ecology. Main aim of the Society is the promotion of researches and studies about forest ecosystems and their management, dendrology, tree plantations for wood production and reforestation (<http://sisef.org/society>).

The absolute number of SISEF member and their distribution among the main Italian research organizations have been considered a good *proxy* of the universe of the Italian scientists working on forestry science topics and, in this way, potential authors of technical papers. This assumption has some elements of weakness: while scientists working in the fields of forest management, forest planning, forest ecology, forest modelling, agroforestry, wood technology and harvesting, soil ecology, landscape history, arboriculture have a good level of representativeness in the Society<sup>1</sup>, scientists working in other fields of forest science like forest economics and policy, forest entomology and pathology have a lower representativeness. Indeed, SISEF gathers a huge amount of researchers (258 in 2015) from universities and research bodies. Elaboration of the data have been conducted in relation to both the technical and scientific publications. The institutional categories took into account for the elaboration are: "Universities" (UNIV), "National Research Council" (CNR), "Council for the Research and Experimentation in Agriculture" (CRA), "National Institute of Agricultural Economics" (INEA), "*Istituto per le Piante da Legno e l'Ambiente*" (IPLA), "Foreign authors" and "Others". The "Others" category includes consultants as well as state, regional and provincial officers.

Using the list of members enrolled in the SISEF, it has been possible to elaborate for each institutional category the number of members. In this way the ratio between the number of publications (the total weighted value previously explained) and the number of researchers for each institutional category (in the triennium and per year) has been obtained.

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<sup>1</sup> See the SISEF Working Groups are listed in <http://sisef.org/gdl/>.

Due to the low number of researchers in the categories "INEA", "IPLA", "Foreign authors" and to the peculiarity of the category "Others", all these categories have been jointed in one single category, named "Others".

Later, confronting the SISEF members' list with the list of the authors of the 259 technical papers, the amount of researchers of each institutional category that are also authors of the technical papers has been investigated. A total of 47 the technical authors have been found to be also members of the SISEF.

From these data the percentage ratio of the number of researchers against the total number of technical authors (259) as well as against the total of SISEF members' (258) and against the total number of technical authors that are also members of SISEF (47) have been obtained.

### **2.3 Data analysis**

Data have been analyzed using Microsoft Office Excel. Several statistical procedures were involved in the data analysis, using both parametric and non parametric analysis. Statistical significance of the correlation ( $r$ ) and of the regression line ( $\beta$ ) have been conducted on the data, considering a confidence level of 95% and of 90%. For the data collected from the SISEF members' list has also been investigated the chi-square test.

### 3 Results

In this chapter the outcomes of the data analysis are presented.

In section 3.1 findings relative to the amount of technical publications of each magazine per year in the period 2011-2013 are presented. Section 3.2 reports the distribution of technical publications among the different institutional categories, while section 3.3 focuses on the technical publications among the universities involved in the survey. In section 3.4 the relation between the amount of technical publications and the amount of SISEF researchers for each institutional category is showed, first including and then excluding the category "Others". Moreover, the numbers of publications per researcher for each institutional category in the triennium and per year is presented as well as the percentage ratio, for each institutional category, of technical authors that are also member of SISEF.

Results relative to the distribution of scientific publications among the different institutional categories are reported in section 3.5. Section 3.6 presents the relation between the amount of scientific publications and the amount of SISEF researchers for each institutional category. Finally, sections 3.7 and 3.8 compare the technical and scientific publications, making reference to the total absolute values and on the total weighted values of authors respectively. Results of statistical significance relative to the 51 authors, the 48 authors (i.e. excluding the 3 outliers) and to most numerous institutional categories ("Universities", "CNR" and "CRA"), with special focus on the "CRA" category, are showed in the two sections.

### 3.1 Publications in the technical magazines

The amount of publications in the 9 technical magazines for each year of the triennium 2011-2013 is reported in Tab. 1.

Table 1: Amount of publications in the 9 technical magazines in the triennium 2011-2013.

Magazine	No. papers 2011	No. papers 2012	No. papers 2013	Tot per magazine	Average per year per magazine	% papers 2011-13
Acer	10	12	11	33	11	13.81%
Agriforenergy	4	1	3	8	2.66	3.35%
Dendronatura	4	8	7	19	6.33	7.95%
Dottori Agronomi e Forestali (AF)	3	0	3	6	2	2.51%
Il Legno	0	1	0	1	0.33	0.42%
Informatore Agrario (IA)	6	5	1	12	4	5.02%
Sherwood	38	30	28	96	32	40.17%
Tecniko&Pratiko (T&P)	4	10	11	25	8.33	10.46%
Terra e Vita (TeV)	13	13	13	39	13	16.32%
<b>Total</b>	<b>82</b>	<b>80</b>	<b>77</b>	<b>239</b>	<b>79.67</b>	<b>100.00%</b>

The magazines "Sherwood", "Terra e Vita" and "Acer" have been found to be the more relevant in terms of publications, with a total of 96, 39 and 33 publications respectively in the triennium and an average number of publications of 32, 13 and 11. Percentage value is of 40.17%, 16.32% and 13.81% respectively (Fig. 1). The total number publications per year is 82, 80 and 77, to which corresponds an average of publications of 79.67 per year.

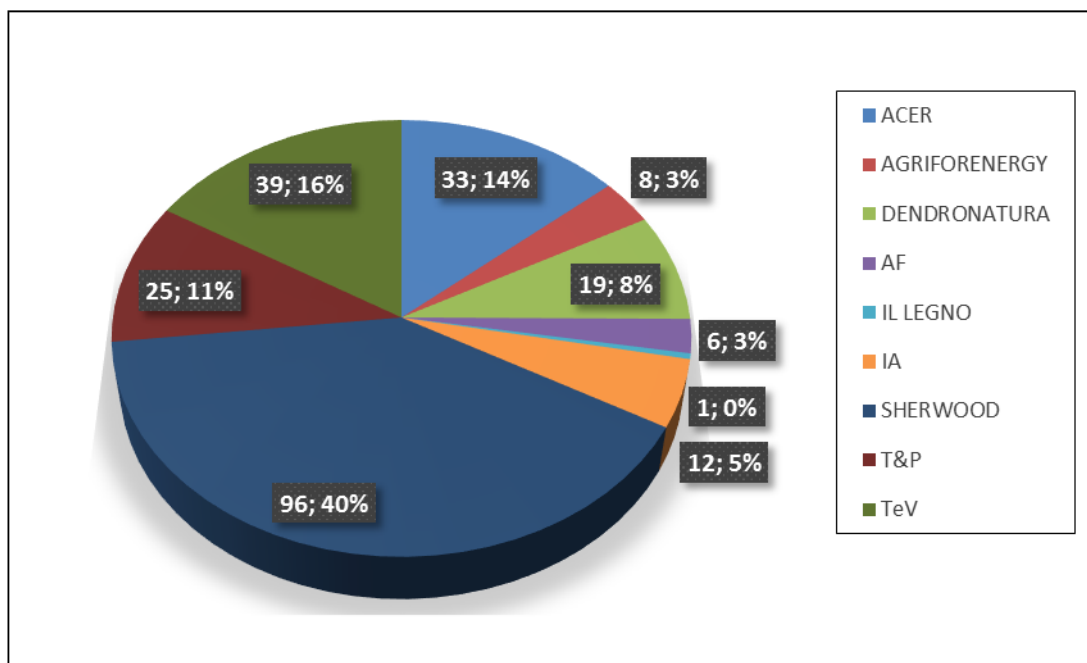


Figure 1: Absolute and percentage values of technical publications per magazine in the triennium 2011-2013.

### 3.2 Technical publications by institutional categories

The distribution of the technical publications among the different institutional categories considered in the survey is presented in Tab. 2.

Table 2: Amount and percentage of technical publications of each institutional category in the triennium 2011-2013.

<b>Institution</b>	<b>No. publications 2011-13</b>	<b>% publications 2011-13</b>
Universities	129.83	54.32%
CRA	43.73	18.30%
CNR	32.60	13.64%
INEA	7.30	3.05%
IPLA	5.12	2.14%
Others	4.92	2.06%
Foreign authors	15.50	6.49%
<b>Total</b>	<b>239.00</b>	<b>100.00%</b>

In absolute terms the most productive institutions are "Universities", "CRA" and "CNR" with an amount of publications of 129.83, 43.73 and 32.60 to which correspond a percentage value of 54.32%, 18.30% and 13.64% respectively (Fig. 2).

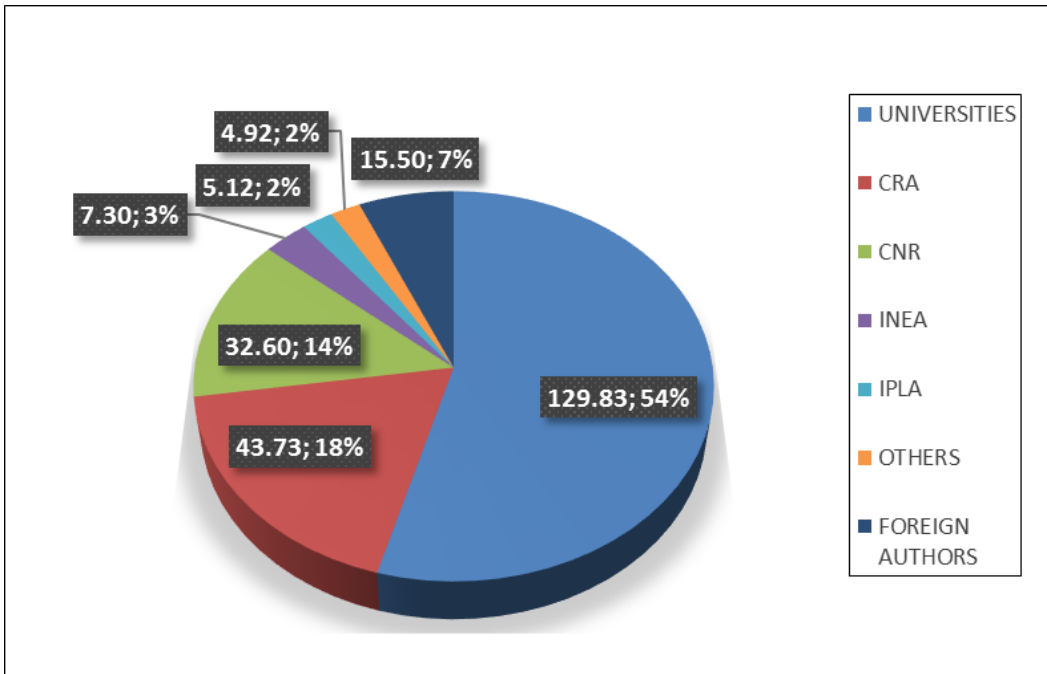


Figure 2: Absolute and percentage values of technical publications per institutions in the triennium 2011-2013.

The University system can be considered therefore by far the leading institution in producing technical papers, even if university research is, by definition, free and without any specific obligation to publish in technical journals.



### 3.3 Technical publications by Universities

Special attention to the University category has been paid. Table 3 reports the technical publications among the universities involved in the survey.

Table 3: Amount and percentage value of technical publications for the different universities in the triennium 2011-2013.

<b>University</b>	<b>No. publications</b>	<b>% publications</b>
UNI Firenze (UNIFI)	41.67	32.09%
UNI Padova (UNIPD)	27.98	21.55%
UNI Torino (UNITO)	20.07	15.46%
UNI Toscana (UNITUS)	15.65	12.05%
UNI Trento (UNITN)	5.17	3.98%
UNI Milano (UNIMI)	4.67	3.59%
UNI Politecnico Marche (UNI POL MARCHE)	4.00	3.08%
UNI Reggio Calabria (UNIRC)	3.00	2.31%
UNI Udine (UNIUD)	2.47	1.90%
UNI Molise (UNIMOLISE)	1.50	1.16%
UNI Catania (UNICT)	1.00	0.77%
UNI Ferrara (UNIFE)	1.00	0.77%
UNI Trieste (UNITS)	1.00	0.77%
UNI Pisa (UNIFI)	0.67	0.51%
<b>Total</b>	<b>129.83</b>	<b>100.00%</b>

The most productive universities have been University of Firenze, Padova and Torino with an amount of publications of 41.67, 27.98 and 20.07 respectively, to which correspond a percentage value of 32.09%, 21.55% and 15.46% respectively (Fig. 3).

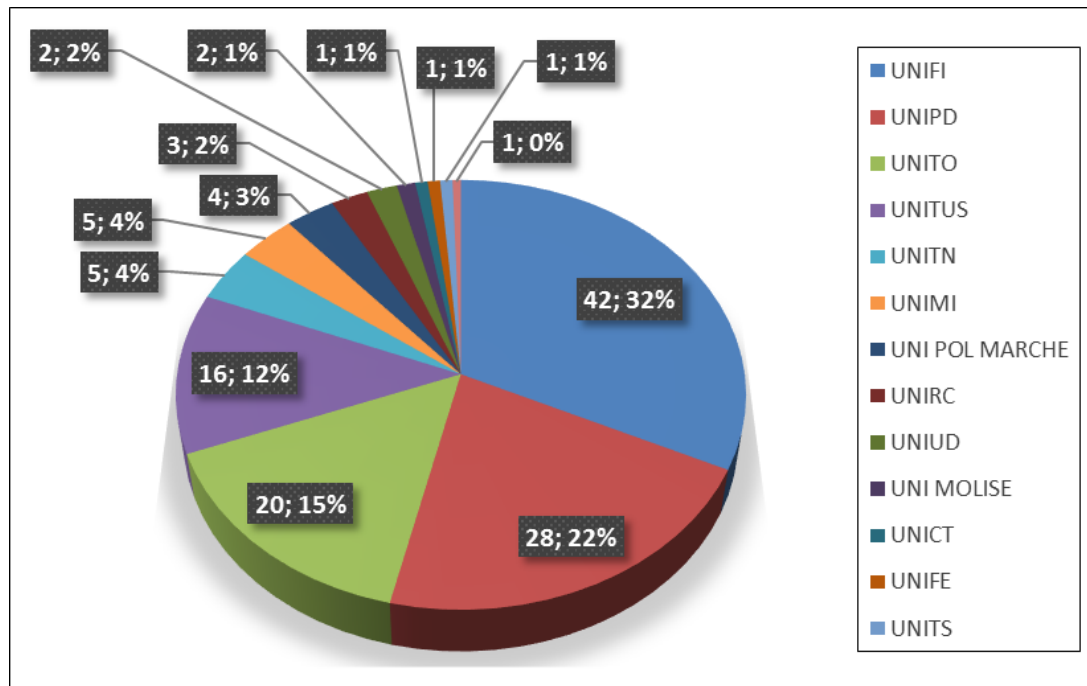


Figure 3: Absolute and percentage values of technical publications for different universities in the triennium 2011-2013.

Looking at these data we can see that the interest in technical publication by the Universities is extremely variable. In general terms the commitment towards technical publications seems not related to the numbers of scientists working in each university. In the following pages this relation will be explored more in detail in quantitative terms.

### 3.4 Technical publications and SISEF researchers

Based on the list of members' of the SISEF, data have been grouped by institutional categories. As for section 3.2, Table 4 represents for each institutional category the amount and percentage value of the technical publications. However, in this case also the amount and percentage of researchers of each institutional category as derived from the members' list have been considered.

Table 4: Amount and percentage value of researchers (SISEF members) and technical publications per institution in the triennium 2011-2013.

<b>Institution</b>	<b>No. researchers</b>	<b>% researchers</b>	<b>No. publications</b>	<b>% publications</b>
UNIV	129	50.00%	129.83	54.32%
CNR	35	13.57%	32.60	13.64%
CRA	30	11.63%	43.73	18.30%
INEA	2	0.78%	7.30	3.05%
IPLA	1	0.39%	5.12	2.14%
Foreign authors	8	3.10%	15.50	6.49%
Others	53	20.54%	4.92	2.06%
<b>Total</b>	<b>258</b>	<b>100.00%</b>	<b>239.00</b>	<b>100.0%</b>

Again, "Universities", "CNR" and "CRA" have resulted to be the most productive, publishing 129.83, 32.60 and 43.73 respectively, to which correspond the percentage value of 54.32%, 13.64% and 18.30%. The amount of researchers involved in technical publications is of 129 for "Universities", while for "CNR" and "CRA" it is of 35 and 30 respectively; the corresponding percentage values are 50.00%, 13.57% and 11.63% respectively. Figure 4 presents the distribution of researchers and publications among the institutional categories.

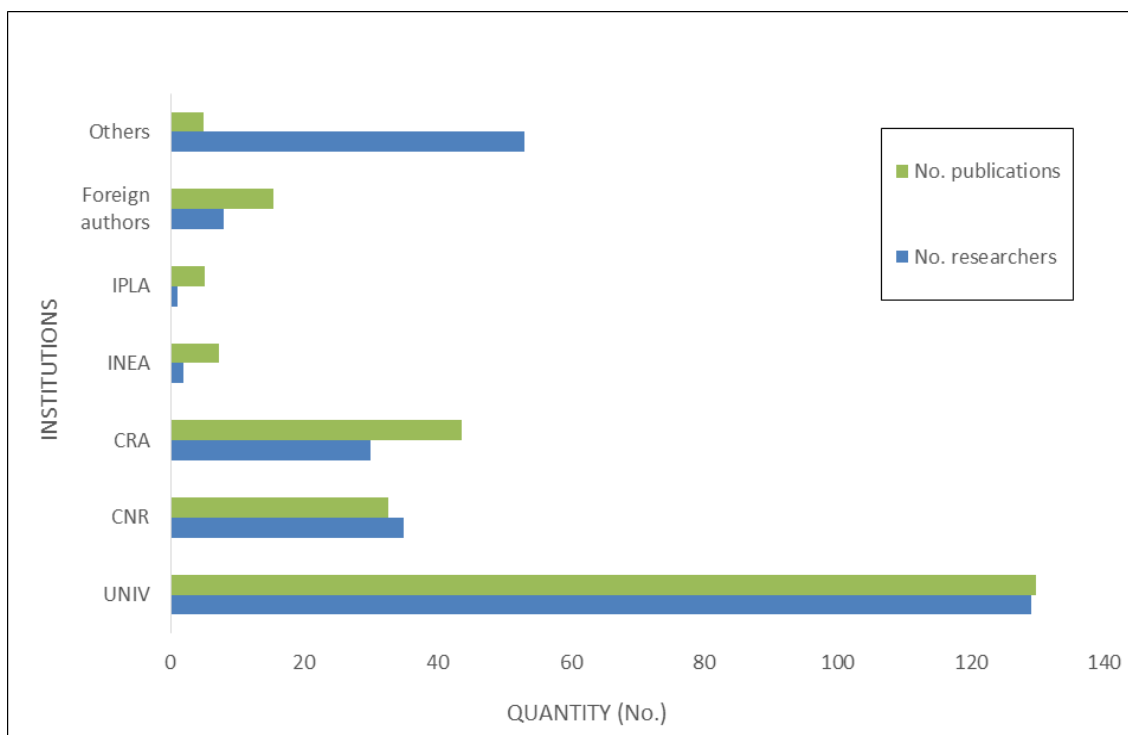


Figure 4: Distribution of researchers (SISEF members) and technical publications among the institutional categories in the triennium 2011-2013.

In order to be able to make a more homogeneous comparison, a parallel elaboration has been conducted without considering the category "Others", due to its peculiarity. Results are presented in Table 5.

Table 5: Amount and percentage value of researchers (SISEF members) and technical publications per institution excluding the "Others" category in the triennium 2011-2013.

<b>Institution</b>	<b>No. researchers</b>	<b>% researchers</b>	<b>No. publications</b>	<b>% publications</b>
UNIV	129	62.93%	129.83	55.47%
CNR	35	17.07%	32.60	13.93%
CRA	30	14.63%	43.73	18.68%
INEA	2	0.98%	7.30	3.12%
IPLA	1	0.49%	5.12	2.19%
Foreign authors	8	3.90%	15.50	6.62%
<b>Total</b>	<b>205</b>	<b>100.0%</b>	<b>234.08</b>	<b>100.0%</b>

Figure 5 presents the number of researchers and publications among the institutional categories.

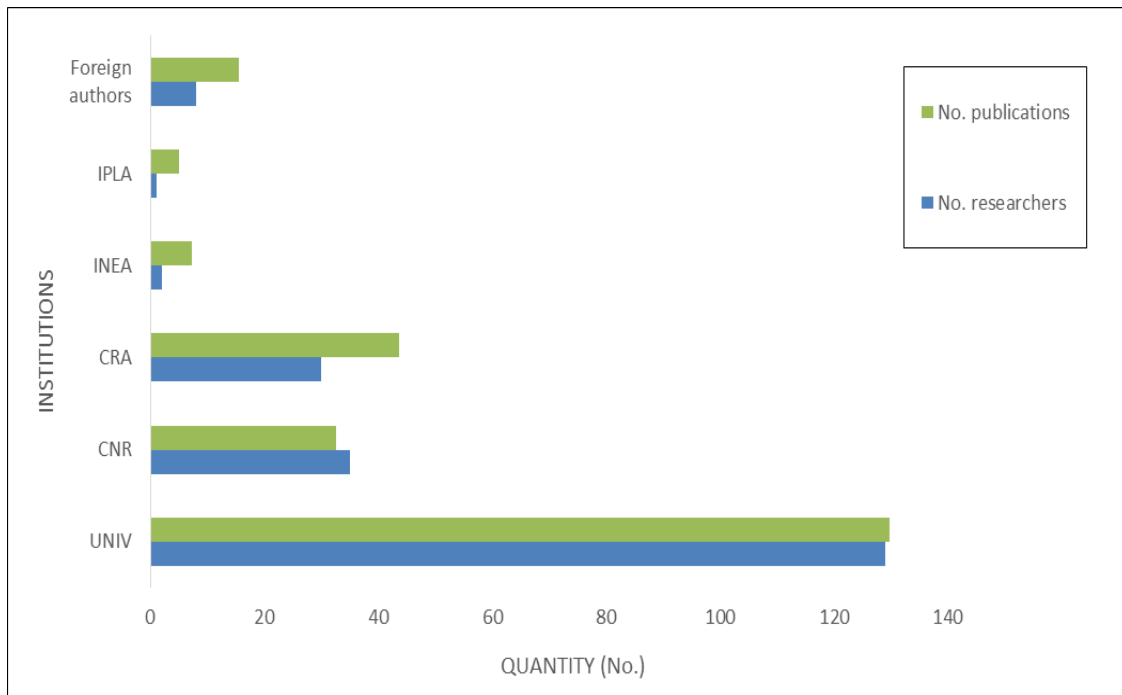


Figure 5: Distribution of researchers and technical publications among the institutions, excluding "Others", in the triennium 2011-2013.

The ratio between the number of publications and the number of researchers (SISEF members) for the institutional categories for the triennium and per year has been calculated too; results are reported in Table 6. As explained in section 2.2, in this case the categories "INEA", "IPLA", "Foreign authors" and "Others" have been joined in one single category named "Others".

Table 6: Ratio of the number of technical publications on the number of researchers (SISEF members) for the institutional categories for the triennium and per year.

<b>Institution</b>	<b>No. publications per researcher</b>	<b>Publications per researcher/year</b>
UNIV	1.01	0.34
CNR	0.93	0.31
CRA	1.46	0.49
Others	0.51	0.17
<b>Total</b>	<b>0.93</b>	<b>0.31</b>

"CRA" has been resulted to have the highest value (1.46), followed by the "Universities", "CNR" and "Others" with values of 1.01, 0.93 and 0.51 respectively. The standard deviation on the total is 0.38.

Furthermore, the amount of researchers of each institutional category (except "Others") that are also authors of the technical papers (see section 2.2) has been investigated.

A total of 47 technical authors have been found to be also member of SISEF. Percentage ratio of the numbers of researchers against the 259 technical authors, the 258 members of SISEF and the 47 authors in common has been calculated.

Results against the 259 technical authors and the 47 authors in common are showed in Table 7 a and b; percentage ratio against the 258 members of SISEF are similar for those of Table 7a and are not reported.

Table 7: Percentage ratio of the numbers of researchers for the institutional categories "Universities", "CRA", "CNR", "IPLA" and "INEA".

- a. Percentage ratio of the numbers of researchers against the total amount of technical authors (259).

<b>Institution</b>	<b>No. researchers</b>	<b>Percentage ratio</b>
CNR	5	1.93%
CRA	12	4.63%
INEA	1	0.39%
IPLA	1	0.39%
UNIV	28	10.81%

- b. Percentage ratio of the numbers of researchers against the 47 technical authors members of SISEF.

<b>Institution</b>	<b>No. researchers</b>	<b>Percentage ratio</b>
CNR	5	10.64%
CRA	12	25.53%
INEA	1	2.13%
IPLA	1	2.13%
UNIV	28	59.57%

In both cases, "Universities" presents the highest ratio, followed by "CRA" and "CNR". In the first case the values are 10.81%, 4.63% and 1.93% respectively, while in the second case, the values are 59.67%, 25.53% and 10.64%.

Finally, to investigate the relation of each institutional categories respect to the number of researchers and the numbers of publications, the chi-square test has been conducted. The test has been done first including the category "Others" and then excluding that category, due to its peculiarity. The obtained chi-square values have been 4.49545E-09 and 0.1113 respectively, resulting to be significant in the first case but not in the latter. Thus the category "Others" influence the ratio between the number of researchers and the number of publications of the others institutional categories.

These data underline the main role, in absolute terms, of Universities in producing technical publications, both including and excluding the category "Others". Moreover, University is the leading institution also regarding the amount of researchers (SISEF members), both with reference the 259 authors of technical papers and the 47 authors that are also members of SISEF. Anyway, when considering the number of publications per researchers (SISEF members), the highest ratio is presented by "CRA" (1.46), while "Universities" has 1.01 and "CNR" 0.93. This seems quite consistent with the "CRA" mission, an institution depending form the Ministry of Agriculture, Forest and Food Policies, and therefore more connected with the concrete and operational problems of the primary sector.

### 3.5 Scientific publications by institutional categories

In this section the number of the scientific publications among the different institutional categories considered for the survey (Table 8) is presented.

Table 8: Amount and percentage of scientific publications of each institutional category in the triennium 2011-2013.

Institution	No. publications 2011-13	% publications 2011-13
Universities	56.05	42.46%
CNR	41.72	31.61%
CRA	16.32	12.37%
Others	4.93	3.74%
IPLA	0.33	0.25%
Foreign authors	12.64	9.58%
<b>Total</b>	<b>132.00</b>	<b>100.00%</b>

The most productive institutions are "Universities", "CNR" and "CRA" with an amount of publications of 56.05, 41.72 and 16.32 respectively to which correspond a percentage value of 42.46%, 31.61% and 12.37% respectively (Fig. 8).

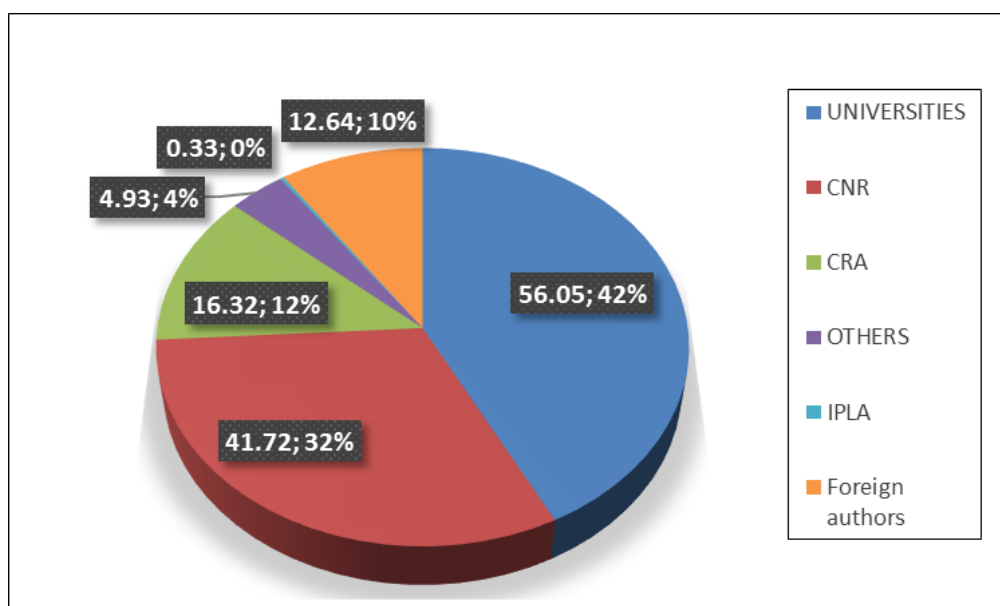


Figure 6: Absolute and percentage values of scientific publications per institutions in the triennium 2011-2013.



As for technical publications by institutional categories, also with reference to scientific publications the Universities system is the leading institution. This highlights the important role of Universities in research activities.

### 3.6 Scientific publications and SISEF researchers

Based on the list of members of SISEF, data have been grouped by institutional categories. As for section 3.5, Table 9 presents for each institutional category the amount and percentage values of the scientific publications. However, in this case also the amount of researchers of each institutional category as derived from the members' list has been considered.

Table 9: Amount and percentage value of researchers and scientific publications per institution in the triennium 2011-2013.

<b>Institution</b>	<b>No. researchers</b>	<b>% researchers</b>	<b>No. publications</b>	<b>% publications</b>
UNIV	129	50.00%	56.05	42.46%
CNR	35	13.57%	41.72	31.61%
CRA	30	11.63%	16.32	12.37%
IPLA	1	0.39%	0.33	0.25%
Foreign authors	8	3.10%	12.64	9.58%
Others	53	20.54%	4.93	3.74%
<b>Total</b>	<b>258</b>	<b>100.00%</b>	<b>132.00</b>	<b>100.00%</b>

"Universities", "CNR" and "CRA" have been resulted to be the most productive, publishing 56.05, 41.72 and 16.32 respectively, to which correspond the percentage value of 42.46%, 31.61% and 12.37%. The amount of researchers is of 129 for "Universities", while for "CNR" and "CRA" it is of 35 and 30 respectively; the corresponding percentage values are 50.0%, 13.57% and 11.63% respectively.

The ratio between the number of publications and the number of researchers (SISEF members) for the institutional categories for the triennium and per year has been also calculated. Results are reported in Table 10. As explained in section 2.2, in this case the categories "INEA", "IPLA", "Foreign authors" and "Others" have been jointed in one single category named "Others".

Table 10: Ratio of the number of scientific publications on the number of researchers (SISEF members) for the institutional categories for the triennium and per year.

<b>Institution</b>	<b>No. publications/researcher</b>	<b>Publications per researcher/year</b>
UNIV	0.43	0.14
CNR	1.19	0.40
CRA	0.54	0.18
Others	0.29	0.10
<b>Total</b>	<b>0.51</b>	<b>0.17</b>

"CNR" has been resulted to have the highest value (1.19), followed by the "CRA", "Universities" and "Others" with values of 0.54, 0.43 and 0.29 respectively.

These data underlines the main role, in absolute terms, of Universities in producing scientific publications. Moreover, University is the leading institution also regarding the amount of researchers (SISEF members). Anyway, when considering the number of publications per researchers (SISEF members), the highest ratio is presented by "CNR" (1.19), while "CRA" has 0.54 and "Universities" only 0.43. This seems a reasonable result, consistent with the fact that "CNR" scientists are normally not involved in teaching and are working full time in basic and applied research.

### 3.7 Comparison of technical and scientific publications using total absolute values

Figure 7 presents the relation between the technical and scientific publications in the triennium 2011-2013, considering the 51 authors.

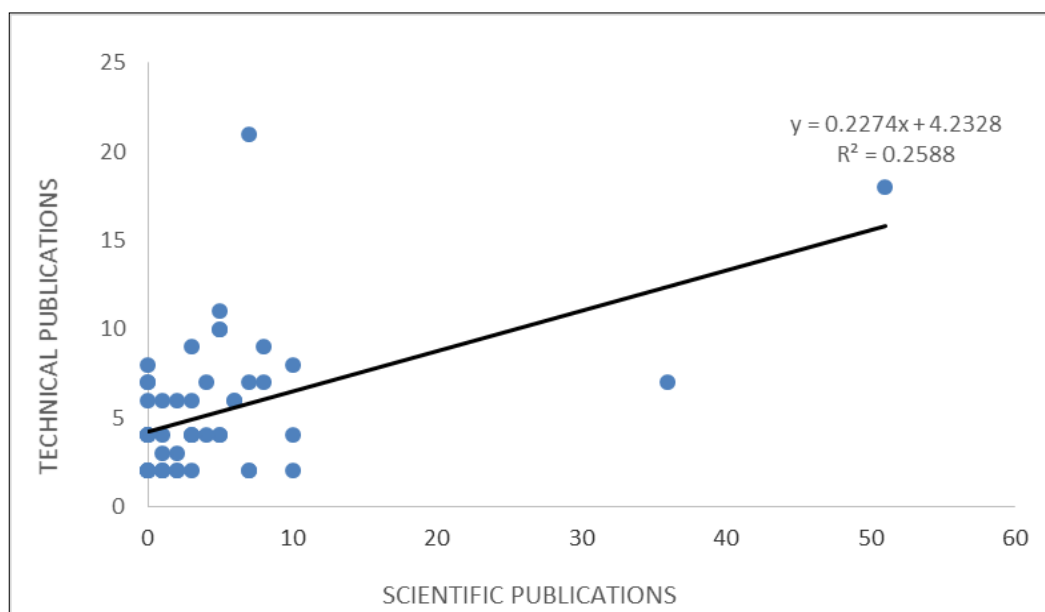


Figure 7: Relation between technical and scientific publications for the 51 authors in the triennium 2011-2013, using the total absolute values.

Statistical significance of the correlation and the regression line have been considered; results are reported in Table 11 a and b.

Table 11: Statistical significance between technical and scientific publications for the 51 authors, using total absolute values.

- a. Statistical significance of the correlation between technical and scientific publications.

No.	r	t	p	statistical significance
51	0.508726	4.1363042	0.00013798	*

b. Statistical significance of the regression line between technical and scientific publications.

No.	r <sup>2</sup>	a	b	statistical significance
51	0.2588	4.2328	0.23	*

In both cases, r and beta values ( $r = 0.5087$  and  $b = 0.23$ ) have been found to be statistically significant with a confidence level of 95%.

Then attention to the outliers has been paid, assuming three scientists as such. Taking out Alessio Fini, r and beta values have been found to be again statistically significant with a confidence level of 95%, with  $r = 0.5984$  and  $b = 0.2177$ . Excluding Raffaele Spinelli, again r and beta values have been found to be again statistically significant but with a confidence level of 90%, with  $r = 0.2603$  and  $b = 0.1602$ . Instead, excluding Natascia Magagnotti r and beta values have been found to be again statistically significant with a confidence level of 95%, with  $r = 0.5579$  and  $b = 0.2912$ .

Finally, all the three outliers have been not considered. Figure 8 presents the new relation between technical and scientific publications of the remaining 48 authors.

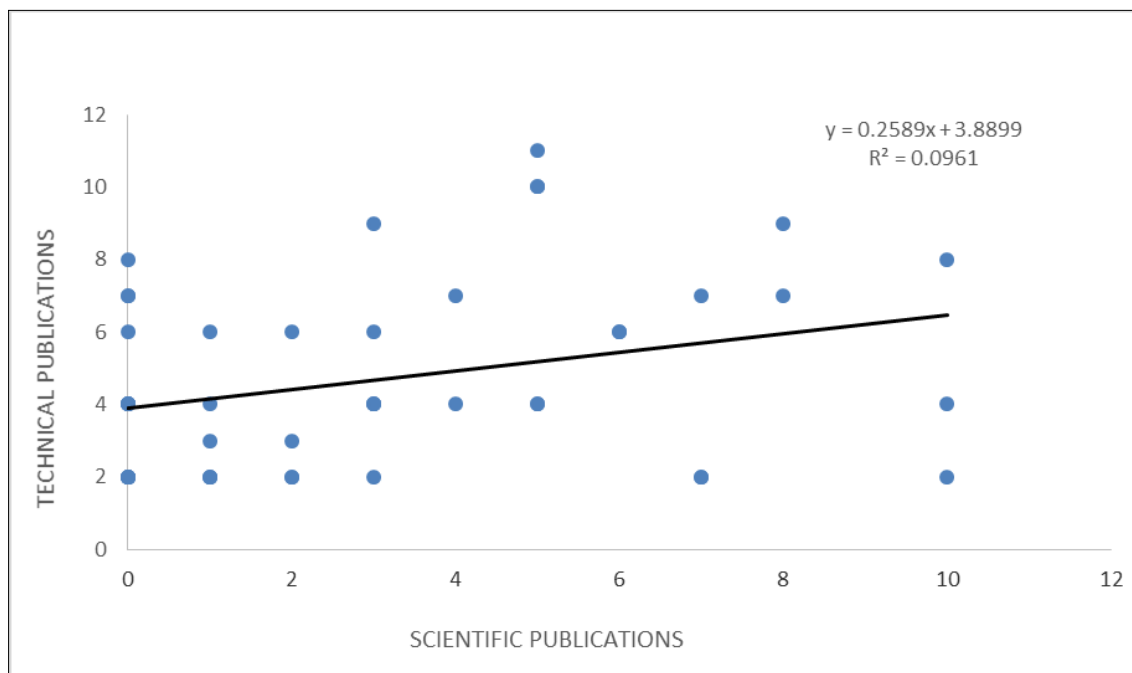


Figure 8: Relation between technical and scientific publications of the 48 authors in the triennium 2011-2013, using total absolute values.

Table 12 a and b presents the statistical significance of the correlation and the regression line.

Table 12: Statistical significance between technical and scientific publications for the 48 authors, using total absolute values.

a. Statistical significance of the correlation between technical and scientific publications.

No.	r	T	p	statistical significance
48	0.31	2.21146676	0.03201179	*

b. Statistical significance of the regression line between technical and scientific publications.

No.	r <sup>2</sup>	A	b	statistical significance
48	0.0961	3.8899	0.258929	*

As well, in both cases, r and beta values have been found to be statistically significant with a confidence level of 95%., with  $r = 0.31$  and  $\beta = 0.2589$ .

Later, authors have been grouped in the institutional categories "University", "CNR" and "CRA". Figure 9 presents the relation among technical and scientific publications of the institutional categories.

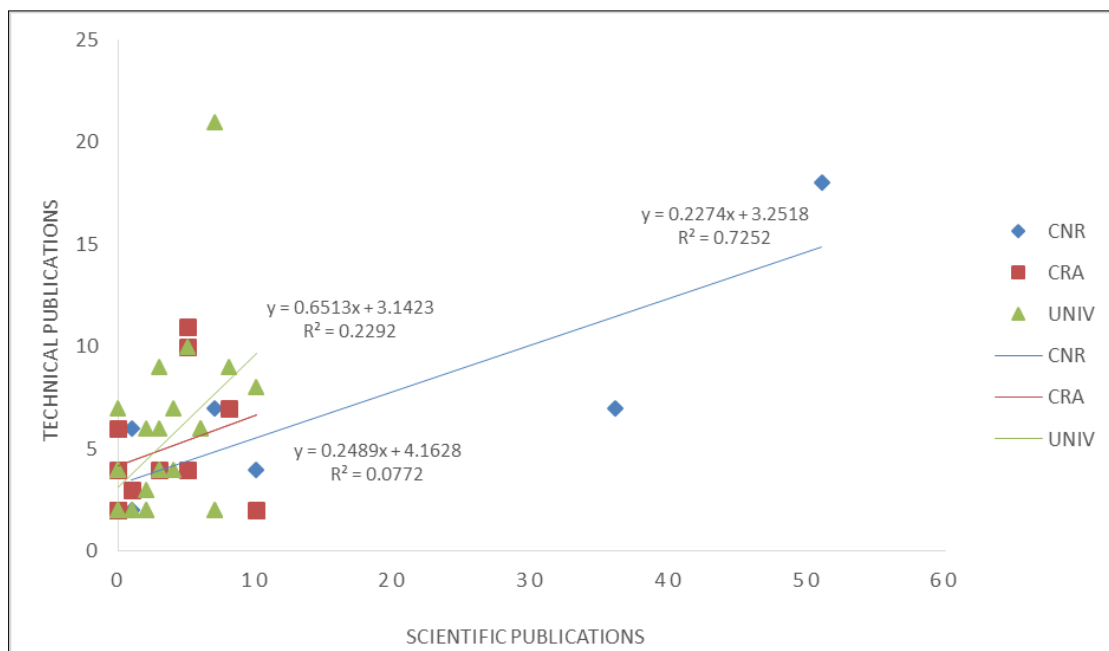


Figure 9: Relation among technical and scientific publications of the institutional categories in the triennium 2011-2013, using total absolute values.

Results of the statistical significance of the correlation and the regression line are showed in Table 13 a and b.

Table 13: Statistical significance between technical and scientific publications for "CRA", "CNR" and "Universities" in the triennium 2011-2013, using total absolute values.

a. Statistical significance of the correlation between technical and scientific publications.

Institution	No.	r	t	P	Statistical significance
CNR	7	0.851608	3.632499	0.015021	*
CRA	11	0.277778	0.867713	0.408092	NS
UNIV	28	0.478763	2.780501	0.009958	*

b. Statistical significance of the regression line between technical and scientific publications.

Institution	No.	r <sup>2</sup>	a	B	Statistical significance
CNR	7	0.7252	3.2518	0.227363	*
CRA	11	0.0772	4.1628	0.248905	NS
UNIV	28	0.2292	3.1423	0.651336	*

In both cases,  $r$  and beta values of "CNR" and "Universities" have been found to be statistically significant with a confidence level of 95%, with  $r = 0.8516$  and  $r = 0.4787$  respectively and with  $b = 0.2273$  and  $b = 0.6513$  respectively. "CRA" instead has been found not statistically significant in both cases.

Thus, a deeper investigation on the category "CRA" using a polynomial trendline has been conducted. Figure 10 presents the comparison of the linear regression line and the polynomial trendline.

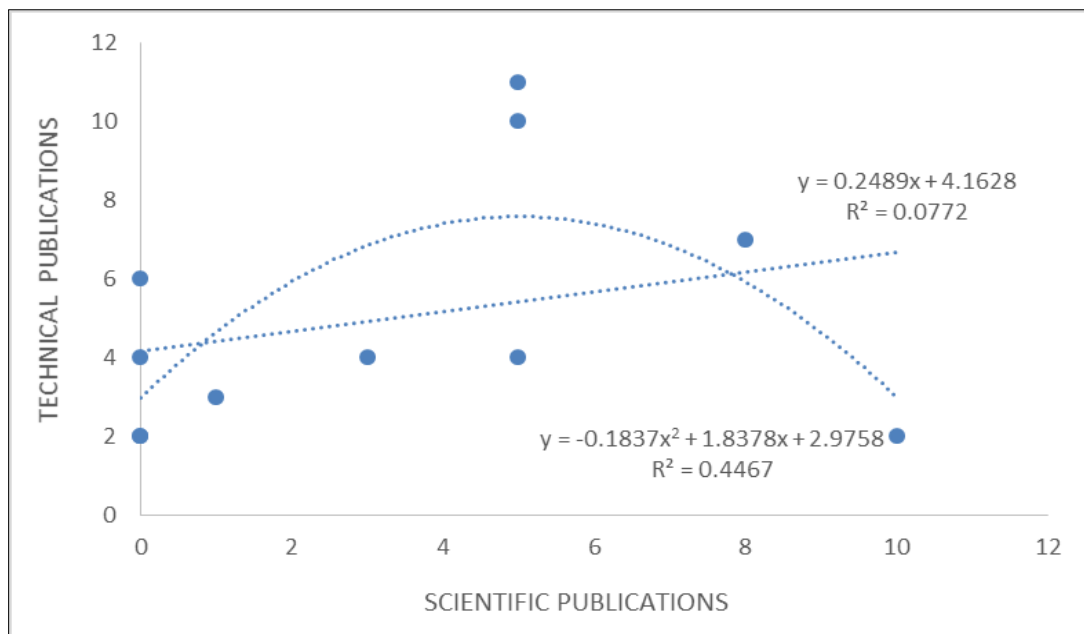


Figure 10: Polynomial trendline of the "CRA" category, using total absolute values.

The polynomial trendline responds better to the set of data, indeed the value of  $r^2$  increases, from 0.0772 to 0.4467.

The findings show a general synergy between technical and scientific publications, both for the 51 and the 48 set of authors (i.e. excluding the three outliers). As regard the institutional categories, only "CRA" has been found not to have a straightforward relation between the two publication typologies. Indeed, looking at the polynomial line, it presents both a direct and inverse relation between technical and scientific publications, in relation to the low vs. high number of publications by authors.



### 3.8 Comparison of technical and scientific publications using total weighted values

The same elaboration presented in section 3.7 has been carried out using the total weighted value for the authors' publications. Figure 11 presents the relation between technical and scientific publications in the triennium 2011-2013, considering the 51 authors.

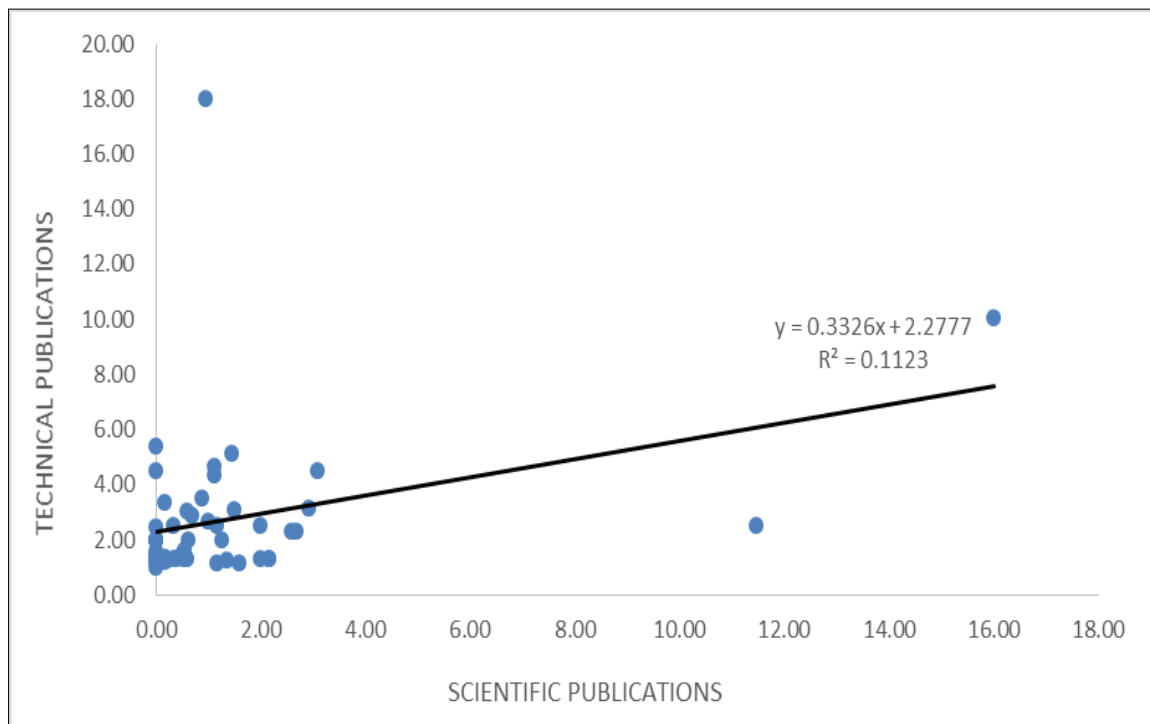


Figure 11: Relation between technical and scientific publications for the 51 authors in the triennium 2011-2013, using the total weighted values.

Statistical significance of the correlation and the regression line have been elaborated; results are reported in Table 14 a and b.

Table 14: Statistical significance between technical and scientific publications for the 51 authors, using total weighted values.

- a. Statistical significance of the correlation between technical and scientific publications.

No.	r	t	p	statistical significance
51	0.335058	2.489343	0.016242	*

- b. Statistical significance of the regression line between technical and scientific publications.

No.	r <sup>2</sup>	a	b	statistical significance
51	0.1123	2.2777	0.332613	*

In both cases, r and beta values ( $r = 0.3350$  and  $b = 0.3326$ ) have been found to be statistically significant with a confidence level of 95%.

Again, attention has been paid to the outliers. Taking out Alessio Fini, r and beta values have been found to be again statistically significant with a confidence level of 95%, with  $r = 0.5981$  and  $b = 0.3481$ .

Excluding Raffaele Spinelli, again r and beta values have been found to be not statistically significant, with  $r = 0.0571$  and  $b = 0.0822$ . Instead, excluding Natascia Magagnotti r and beta values have been found to be again statistically significant with a confidence level of 95%, with  $r = 0.4034$  and  $b = 0.4735$ .

Finally, all the outliers have been not considered. Figure 12 presents the new relation between technical and scientific publications of the remaining 48 authors.

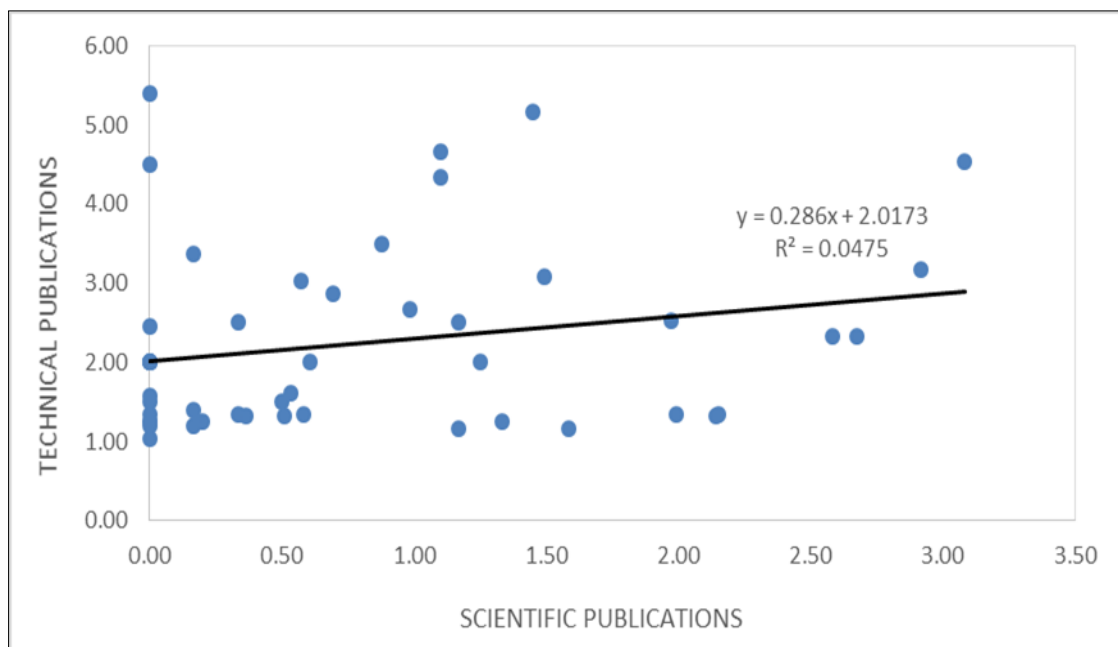


Figure 12: Relation between technical and scientific publications of the 48 authors in the triennium 2011-2013, using total weighted values.

Table 15 a and b shows the statistical significance of the correlation and the regression line.

Table 15: Statistical significance between technical and scientific publications for the 48 authors, using total weighted values.

- a. Statistical significance of the correlation between technical and scientific publications.

No.	r	t	p	statistical significance
48	0.217834	1.51381	0.136915	NS

- b. Statistical significance of the regression line between technical and scientific publications.

No.	r <sup>2</sup>	a	b	statistical significance
48	0.0475	2.0173	0.285995	NS

In this case both values ( $r = 0.2178$ ;  $\beta = 0.2859$ ) have been found to be not statistically significant.

Later, authors have been grouped in the institutional categories "University", "CNR" and "CRA". Figure 13 presents the relation among technical and scientific publications of the institutional categories.

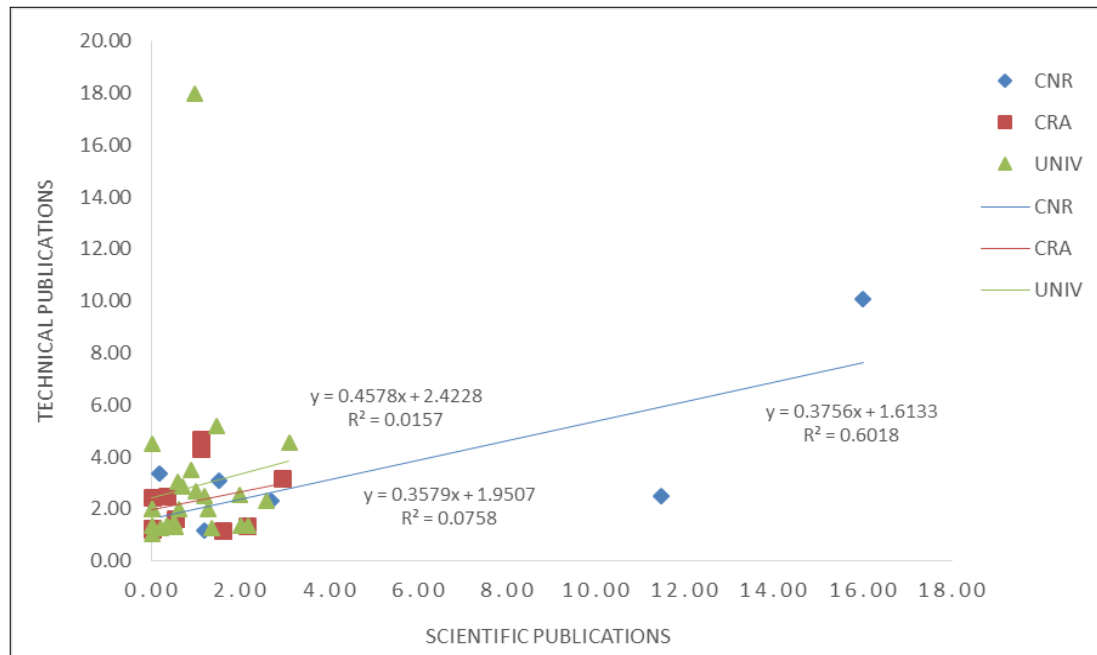


Figure 13: Relation among technical and scientific publications of the institutional categories in the triennium 2011-2013, using total weighted values.

Results of the statistical significance of the correlation and the regression line are showed in Table 16 a and b.

Table 16: Statistical significance between technical and scientific publications for "CRA", "CNR" and "Universities" in the triennium 2011-2013, using total weighted values.

a. Statistical significance of the correlation between technical and scientific publications.

Institution	No.	r	t	p	statistical significance
CNR	7	0.775728	2.748806	0.040367	*
CRA	11	0.275394	0.859394	0.412428	NS
UNIV	28	0.12519	0.643417	0.525588	NS

b. Statistical significance of the regression line between technical and scientific publications.

Institution	No.	r <sup>2</sup>	a	b	statistical significance
CNR	7	0.6018	1.6133	0.375561	*
CRA	11	0.0758	1.9507	0.357855	NS
UNIV	28	0.0157	0.0157	0.457792	NS

In both cases, only "CNR" has been found to be statistically significant, with  $r = 0.7757$  and  $b = 0.3755$ , while "CRA" and "Universities" have been found to be not statistically significant for both the values.

Again, a deeper investigation has been conducted on the category "CRA" using a polynomial trendline. Figure 14 presents the comparison the linear regression line and the polynomial trendline.

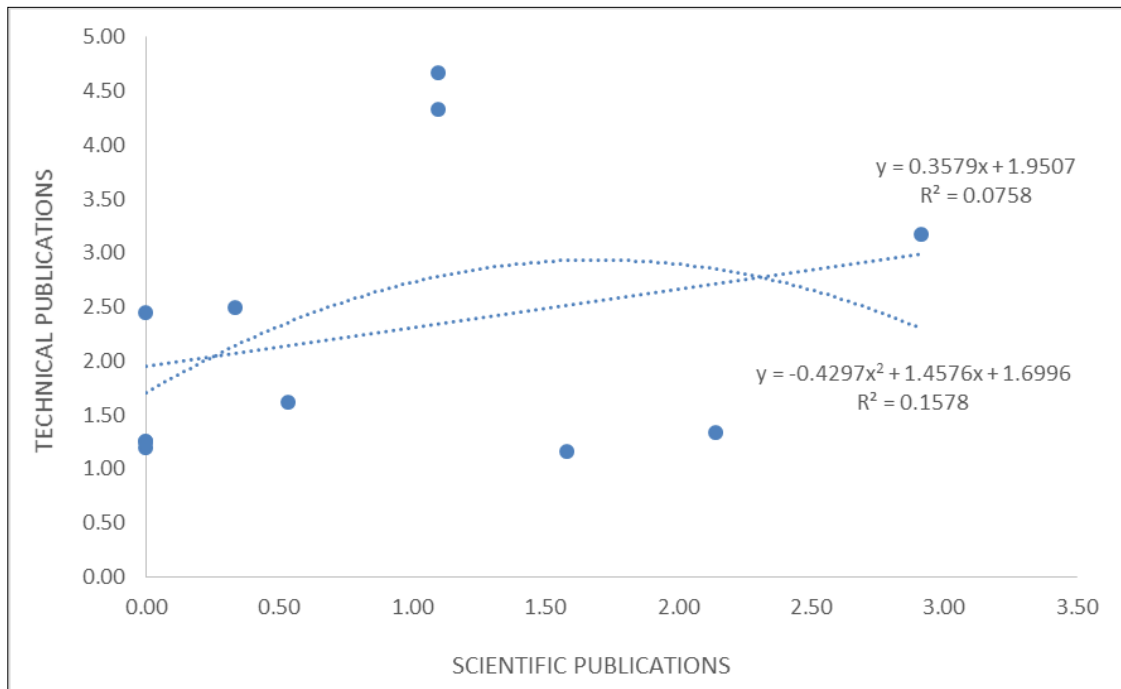


Figure 14: Polynomial trendline of the "CRA" category, using total weighted values.

The polynomial trendline responds better to the set of data, indeed the value of  $r^2$  increases, from 0.0758 to 0.1578.

Similarly to what has been presented in section 3.7, the findings show a general synergy between technical and scientific publications. Anyway in this case, synergy has been found with reference to the 51 author set but not to the 48 author set (i.e. excluding the three outliers). As regard the institutional categories, "CNR" is the only category where a synergy with statistical significance has been found, while "Universities" presents a conflict and "CRA" presents again a non straightforward relation. Indeed, looking at the polynomial line, it presents both a direct and inverse relation between technical and scientific publications.

## 4 Discussion

In this chapter the findings of the survey will be discussed. Firstly attention will be paid to the technical publications, then to the scientific publications and finally to the comparison between the two set of publications. In section 4.1 limitations of the study and suggestions for future research are presented.

As concern the distribution of the publications among the 9 technical magazines involved in the survey, the magazines "Sherwood-Foreste ed Alberi Oggi", "Terra e Vita" and "Acer-Il Verde Editoriale" have been found to be the most relevant, with 96, 39 and 33 publications respectively in the triennium 2011-2013. Nevertheless, the magazines "Sherwood-Foreste ed Alberi Oggi" and "Informatore Agrario" present a decrease in the number of publications in the triennium, while the others magazines present a number of publications more or less constant, or that even increases throughout the period. In any event, even if the magazine "Sherwood-Foreste ed Alberi Oggi" presents a decrease of the amount of technical publications, it is the magazine with the highest amount of publications.

As regards the distribution of technical publications by institutional categories, "Universities" plays an important role, counting for the 54.32% of publications in the triennium. When the category "Others" is not considered, the percentage of "Universities" increases (55.47%). The most productive universities are the University of Firenze, Padova and Torino: the results are underlining a possible difference in the publication activity among universities in the North/Centre and universities in the South of the country, where a relatively large number of forest courses are organized, even if the university staff for each forest school is comparatively smaller.

CRA and CNR follow, counting for the 18.30% and the 13.64% of the amount of publications respectively, values much lower than those of the "Universities" category. Of course, when the category "Others" is not considered, the values increase slightly (18.68% and 13.93% respectively).

With regard to the numbers of members of SISEF (258), emerges that the "Universities" category counts for the 50% of the amount of researchers (when including the category "Others" in the total numbers of members) and for the 62.93% when the category "Others" is not considered. As well, "CNR" and "CRA" count for 13.57% and 11.63% when including the category "Others" and for 17.07% and 14.63% when excluding that category. In the investigation of the amount of researchers of each institutional category (except "Others") that are also authors of the technical papers, again "Universities" has the highest values. Indeed, against the 259 authors of technical publications and against the 47 authors that are also members of SISEF, "Universities" counts for 10.81% and 59.57% respectively. "CNR" and "CRA" count just for the 4.63% and 1.93% against the 259 authors respectively, and for the 25.53% and 10.64% against the 47 authors also members of SISEF, respectively. As regard to the number of publications, the average number of technical publications per researchers in the triennium is 0.93 that corresponds to 0.31 publications per researcher per year. The total standard deviation is 0.38. Looking to each institutional category, "Universities" has a ratio of 1.01 publications in the triennium (0.34 publications/year). "CRA" presents an average number of publications of 1.46 in the triennium (0.49 publications/year) while "CNR" presents an average number of publications of 0.93 in the triennium (0.31 publications/years). Thus, although "Universities" category has the higher numbers of researchers (129), "CRA" presents the highest ratio value in the triennium (1.46) against the 1.01 of "Universities" and the 0.93 of "CNR". The higher ratio value of "CRA" could underline a higher attention of this research bodies to the technical publication than the "CNR".

As regards the distribution by institutional categories of the scientific publications, "Universities" category still presents the highest value, counting for the 42.46%. Anyway, in this case the "CNR" category plays an important role against the "CRA". Indeed, "CNR" counts for the 31.61% of the scientific publications, while "CRA" contributes just for the 12.37%. Also the ratio between the numbers of publications and the number of researchers enrolled in SISEF in the triennium highlights the higher production of "CNR" (1.19), against "Universities" (0.43) and "CRA" (0.54). These values could confirm the highest attitude of "CNR" to write scientific papers against "Universities" and "CRA".



Anyway, with reference to both the technical and the scientific publications by institutional categories, the values of the ratio of the numbers of publications on the number of researchers in the triennium is generally low. Indeed, no one of the categories' member is publishing on the average more than half paper per year.

As concerns the comparison between technical and scientific publications with reference to total absolute and total weighted values, the findings based on the total absolute values have been found to be statistically more significant than the findings based on the total weighted values. Focusing on the comparison based on the total absolute value, the comparison has been found to be statistically significant considering both the 51 and 48 (i.e. without the 3 outliers) authors' set. Instead, with the total weighted values, the comparison has been found statistically significant with the 51 authors but not with the 48 authors' set. Regarding the grouping by institutional categories, when using the total absolute values "Universities" and "CNR" have been found statistically significant while "CRA" has been found not statistically significant. Considering the total weighted values, only "CNR" has been found to be statistically significant. Using the polynomial trendline, with reference to both the total absolute and total weighted values, has emerged the different trend of publications for the "CRA" category against "Universities" and "CNR" categories.

#### **4.1 Limitations and suggestions for future research**

One preliminary limitation of our survey relies on the basic assumption of the analysis: the number of technical publications as an adequate indicator of the role played by the Third Mission among forest scientists. Probably in the past this indicator has been more significant and appropriate; nowadays there are other media that can be used by scientists to support technology and innovation transfer: technical reports, working papers, DBs, and other information made available on Internet, with pdf files or in other formats. Also publication of books and manuals (made available open access on the web as pdf files), poster and paper presentations, organization of workshops and training schools are probably now more used than in the past for implementing the Third Mission. Still the traditional paper publications are able to reach those operators, the large majority in the forest sector in Italy, that are no much familiar with internet facilities, so we assume that the paper technical publications remain the main vehicle for the technology transfer in the sector.

Although this study has been well set up, some limitations should be taken into consideration. The main one consists on having focused the elaboration just on the set of 51 authors that have been found to be active in writing technical publications. The findings obtained are hence partial and the study has to be considered as a preliminary work. Thus for future studies, we suggest to expand the sample, using the whole database of the 259 authors of technical publications. Moreover, others aspects are worthy to be taken into account. In theory it could be interesting to compare the triennium considered in the survey (2011-2013) with previous periods, in order to have an overall picture of the trend in technical and scientific publications through time.

While this could be possible as far as the scientific publications are concerned, it would be an almost impossible task for the technical publications: the magazines context has been changing with time, with new journals entering in the market, other closing down. The set of technical journal is so radically changed in the last 10-15 years that an intertemporal comparison is hardly feasible.

Finally, it should be considered that, making reference to the Web of Science as a database for scientific publications, we have implicitly introduced a rather strict definition of “scientific publications”, identifying them with those publications in peer review international journals, mostly in English. It should be acknowledged that papers, manuals and books of high scientific quality can be published also in Italian scientific journal not included in the WoS DB, even if there is a clear tendency towards an identification of high scientific papers with those recorded by WoS and Scopus.

## 5 Conclusions

According to the results, the study shows a general synergy between technical and scientific publications, more than a trade-off. So it is not proved the hypothesis that a focus on scientific paper publication by Italian researchers is inducing a reduced attention to technical ones. Scientists that have a good record in scientific publications tend to have good performances also in technology transfer activities, assuming technical papers as a good *proxy* of this activity. This tendency relation presents however some differences.

Indeed, as concerns the sample of 51 authors with reference to the total absolute values, synergy between technical and scientific publications has been found both against the 51 authors and the 48 authors (without considering the 3 outliers). Regarding the institutional categories, synergy has been found to exist for the "Universities" and "CNR" categories, while for "CRA" has been found to have a non straightforward behaviour. Indeed, as showed by the polynomial trendline, authors that focus mainly on technical publications do not publish scientific publications. Vice versa, authors focusing mainly on scientific papers publish little of technical papers. Anyway, authors that publish an average number of scientific publications (4-6 papers in the triennium) publish quite a lot of technical publications (6-8 papers in the triennium). Thus, for the "CRA" authors both a direct and an inverse relation between technical and scientific publications has been found.

With reference to total weighted values, synergy between technical and scientific publications has been found against the 51 authors but not against the 48 (without considering the 3 outliers), for which have been observed a trade-off. As regards the institutional categories, in this case only for the "CNR" a synergy between technical and scientific publications has been observed, while for "Universities" has been observed a trade-off and "CRA" presents a non straightforward behaviour. Thus, for "CRA" category can be derived the same assumptions previously explained about its peculiar trend.

Looking at the absolute data on technical publications, the study shows a tendency of scientists to publish little both of technical and scientific papers. Indeed, considering the number of publications per researcher (SISEF members) with reference to the institutional categories "Universities", "CNR", "CRA" and "Others", no one of the categories publish more than half paper per year, both in the technical and the scientific journals. Regarding the technical publications, the highest average value of the ratio is represented by "CRA" (1.46 papers in the triennium, 0.49 papers/year), while regarding the scientific publications the highest value is represented by "CNR", with 1.19 papers in the triennium (0.40 papers/year). Anyway, in both technical and scientific publications, the University system is, due to the high number of scientists working in Forest Schools, that one publishing by far more papers (in absolute terms) and the Third Mission activities are in Italy mostly based on these institutions.

Thus, the study does not support the complains reported in the petition promoted by "Sherwood-Foreste ed Alberi Oggi" and "Acer-Il Verde Editoriale" where it is stated that the current criteria adopted for evaluating the research and Third Mission activities by universities and research bodies encourage researchers to write more scientific publications than technical publications. The results of this preliminary work give evidence instead of a general low productivity of Italian scientists in both technical and scientific publications. These results seem not very consistent with the ageing of Italian scientists, due to the reduced turnover in most of the research institutions, all in all a negative trend, but that should favour an increased attention to technical publications, *coeteris paribus*. This as well others driving forces should be better investigated to explain the low general productivity of Italian forest scientists.

Finally, it is noteworthy to remind that, while most of the scientific publications tend to be open access (also because Italian scientists are being evaluated in relation to the number of their citations in scientific journals), all the Italian technical journals are made available under subscription. This is a limiting factor to the spreading of technical information. No public support is given to these relevant means of technological transfer. This fundamental step in the modernization of the forestry sector seems to be in Italy the Cinderella of the process of innovation. The state of the forestry sector in our country is giving us evidence of this perception.

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