

ANALYSIS OF INTERNATIONAL PUBLICATIONS IN AGRICULTURAL BIOLOGY ON THE WEB OF SCIENCE DATABASE: CURRENT SITUATION AND SOLUTIONS.

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Abstract:

This paper is a Web of Science (WoS) based study for papers of Vietnam authors in agricultural biology sector. The metric methods used for scientific bibliography demonstrates the credibility of qualitative and quantitative analysis made for international publications of Vietnam authors during 2000-2019 period. It is the first time, an analysis is made for the complete data set of WoS based international publications in agricultural biology sector; the analysis being made in detail on basis of their funding sources. Initial analysis outcomes show a drastic growth of international publications in agricultural biology sector from 78 works by 2000 to 6,895 works by 2019. During this time period, the international publication of research works passed a change in practice of indicated funding sources. The published works which did not indicate the funding sources made 84% in quantity before 2009 then reduced to 30% since 2010. The analysis of research works shows well the necessity of international research cooperation for higher quality of scientific research in Vietnam. The analysis shows a big change in science-technology (S&T) human resources and also the important role of the National Foundation for Science and Technology Development through active funding supports for higher positions of Vietnam affiliated authors in international research publications and also the higher average authors per publication. This study, with the made outcomes, provides an useful information basis for preparation of solutions to increase the quality of support measures for basic research works in agricultural biology sector in particular and in management of support activity for basic researches in general in Vietnam.

Keywords: *Basis research; NAFOSTED; International publication; International cooperation; Agricultural Science; Agricultural biology.*

Code: 20072301

1. Introduction

International publications in well reputed scientific magazines have been used from long years in practice by many countries as metric tool for evaluation of development level of science and technology (S&T) which becomes the competitive target in development of knowledge economy (Garfield E, 2002). The higher quantity and quality of scientific researches and international

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publications has become the important indicator deciding the formation and development of research teams as well as success level of scientists (*Bui Minh Duc et al., 2019*). The number of international publications in education and training sector is found as an important indicator for rating universities and evaluating quality of their teaching staffs. From vision by management works, this indicator serves as important basis for forecasting the development trends of the sector and adjusting management policies for scientific research activities in future (*K. Frenken et al., 2009; Adler et al., 2009; OECD, 1996*).

Vietnam, in its practice of international integration, experiences the same trend. With the regulations as stipulated in Article 39, Law on Science-Technology, 2000 year, the Government had signed officially Resolution No. 122/2003/ND-CP on 22nd October 2003 to establish and regulate the rules for organization and operation of the National Foundation for Science and Technology Development (called shortly as “the Fund” afterwards). One of the crucial tasks of the Fund is funding activities where the ones for basic research works are set as the first priority. By February 2008, the Fund, however, only starts operations and realizes the supports for basic researches in natural science sectors and the funding works were the first activity implemented by the Fund in 2009 (*Ministry of Science and Technology, 2000*).

At this stage, the ISI indicator has become, for the first time, the obligatory term for the Fund supports in any research work. This indicator is one of the deciding factors for evaluation of basic research works. By 2015, with the targets to enhance quality of support measures, the Fund had made a preliminary evaluation of funding works for basic research works during 2009-2015 period and, at the same time, used the WoS based data of international publications as basis to set up the list of reputed international magazines for better management works of funding supports by the Fund. The Fund uses the classification list of sectors and sub-sectors according to Decision No. 12/2008/QĐ-BKHCHN on 04th September 2008 on basis of the Fields of S&T by OECD issued by 26th February 2007. Before 2012, in practice by the Fund, the *Agricultural Biology* was named as sub-sector in the sector of *Life Sciences*. After 2012, the sector of *Life Science* had been split into two sectors: *Agricultural Biology* and *Biological Medicine-Pharmacy*. From this time, *Agricultural Biology* has become one of the 8 natural science and technics sectors under funding supports by the Fund. The implementation of funding activities produces certain contributions to support basic researches in S&T organizations and the measures lead to considerable increase of the number of research teams; the fact being seen clearly through the qualitative and quantitative growth of international publications (*Tran Duc Cuong et al., 2018*).

Up to now, many studies were conducted on basis of WoS data for evaluation of Vietnam international publications such as *Nguyen Van Tuan, Pham Thy Ly (2013); Ho Manh Dung (2015); Pham Duy Hien (2018); Nguyen Van Tuan*

(2016) and etc. However, no studies were made for analysis on international publications in Agricultural Biology sector for 2000-2019 period in general and for evaluation of impacts of funding works by the Fund to them in particular. Therefore, this paper, with the WoS based data from international publications in *Biology and Agricultural Science* sector for 2000-2019 period, describes the status of international publications in Agricultural Biology sector through the analysis made for funding sources recorded as Vietnam originated and, at the same time, the analysis made for impacts from the NAFOSTED Fund to Agricultural Biology during 2010-2019 period. On basis of that, a recommendation is proposed to enhance the quality of supports for basic researches in Agricultural Biology sector for the next time period.

2. Collection and treatment of data

- Collection of data

The whole set of data we use for the study of Agricultural Biology sector is taken from the database of international publications by Thomson Reuter at the affiliation www.webofknowledge.com (*Web of Science, 2019*). By using the descriptive statistic method the paper authors first collected secondary data and the necessary data were downloaded with the key words Country = Vietnam (in this study, we make an assumption to call them Vietnam's publications), the Time Year = from 2000 to 2019 (the time the data were downloaded was September 2019). This study had chosen the time of collected data from 2000 to 2019. (*Please note the 2000 year is the time of promulgation of Law on Science and Technology where Article 39 stipulates the set-up of the National Foundation for Science and Technology Development*). The data were downloaded from WoS website in files of format (*.xls) with the total of 7,250 records (in form of data lines). The key words used for searching data for Agricultural Biology sector include 29 sub-sectors as classified according to OECD standards. The key words for searching funding sources included "NAFOSTED" = "Vietnam National Foundation for Science and Technology Development" for data related to the publications sponsored by the Fund. Also, we noted that certain publications do not have the key word "Vietnam" but contain "Hanoi" = "Hanoi City" or "TPHCM" = "Tp. Hochiminh" = "HoChiMinh City" and then the paper, authors take them as being sponsored by Vietnam. The publications with the key words other than "Vietnam" are taken as not-sponsored by Vietnam. The label "No funding source indicated" is made for the publications which do not indicate any funding source.

+ Treatment of data

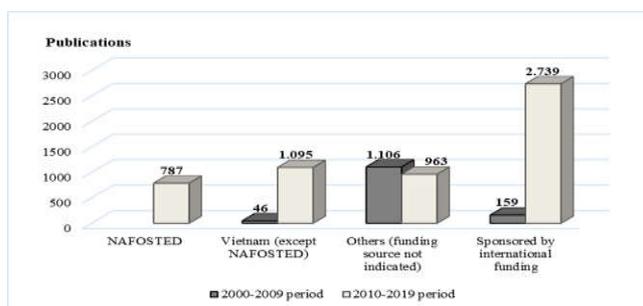
The whole set of data was processed by using Microsoft Excel tools of Microsoft Office 2010. We conducted analysis of the collected data in two parts. The first part contains 6,895 works (making 95.1%) classified as scientific publications (articles, books, chapters, data papers, early accesses,

proceedings, retreated publications, letters and reviews. The remaining part containing 355 works (making 4.9%) includes brief scientific informations (book reviews, editorial materials and meeting abstracts). After screening the collected materials we, as advised by experts, conducted analysis of the data collected for the first part (95.1%). The data are divided into 4 funding sources, namely: (i) Foreign funded works; (ii) NAFOSTED funded works; (iii) Vietnam funded works (except NAFOSTED) which get supports from the Vietnamese Government scholarship programs, KC programs (Ministry of Science and Technology) and projects of ministries; and (iv) No funding source indicated.

For evaluation of these publications, we used the information recorded in the publications such as the affiliation of authors, affiliation of first authors, affiliation of corresponding authors, funding sources, citation indexes, codes of sub-sectors and publication time. We used Journal Citation Reports 2018 (*JCR 2018*) as reference for values Q1, Q2, Q3 and Q4 (*King DA, 2004*), (*Eugene Garfield, 2007*) at the time for all the publications in Agricultural Biology sector. All the publication related factors such as productivity, quality, first authors and corresponding authors of research works funded by NAFOSTED were taken into consideration for evaluation of impacts of supports for research publications in Agricultural Biology sector.

3. Findings and discussions

3.1. Number of publications in Agricultural Biology sector and classification of funding sources



Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 1: Funding sources as noted in international publications in Agricultural Biology sector of Vietnam, 2000-2019 period.

As shown by statistic analysis, the funding sources for international publications during 2000-2009 period have 3 groups: (i) Purely sponsored by foreign sources; (ii) Funded by Vietnam sources; and (iii) No funding source

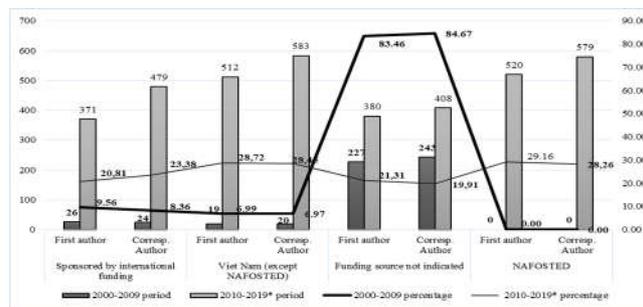
indicated. During 2010-2019, the fourth group of funding sources appeared - NAFOSTED. As to avoid confusion, the terms “Vietnam source” or “Vietnam funded” are used to indicate the funding sources from Vietnam but other than NAFOSTED.

The collected data also show that during 2000-2019 period the publications with the pure supports from foreign sources have the top position: 2,739 works (making 42.03% of the total number of international publications in Agricultural Biology sector). The number of international publications funded by NAFOSTED is 787 works (making 11.41%). The number of Vietnam funded international publications is 1,141 works (making 16.55%). Before that, during 2000-2009 period, the top position was the group of international publications not indicating funding sources.

3.2. Quality of international publications

The evaluation of quality of international publications remains a topic with multiple disputes. In this study, however, the authors use certain well known indicators such as the role and contribution of Vietnam affiliated authors (first authors, corresponding authors), average citation, Q classification of funding sources and the number of contribution by Vietnam scientists in international publications.

3.2.1. Main role in publications



Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

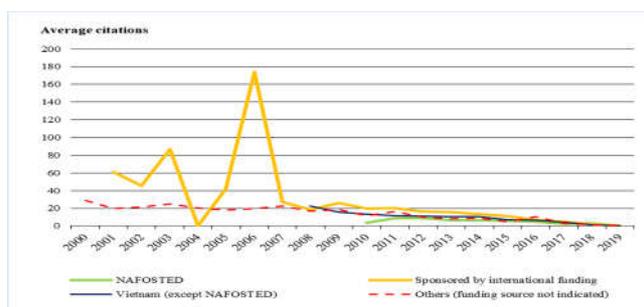
Figure 2: Number of first authors and corresponding authors with Vietnam affiliation in international publications in Agricultural Biology sector, 2000-2019 period.

As shown by data, during 2000-2019 period the number of authors with main role in international publications (first authors, corresponding authors) with Vietnam affiliation has an increasing trend in term of funding sources. Typically, the number of international publications which are Vietnam funded (except NAFOSTED) have a radically increasing growth during 2000-2019

period. It is interesting to remark that during 2000-2009 period, the publications which did not indicate funding sources prevail and then during 2010-2019 period the publications with Vietnam funding sources do. The apparition of the NAFOSTED marked a shift in policies to promote ISI classified international publications up to the same position as international publications with Vietnam sources do. This situation explains the trend of formation and development of research teams during 2010-2019 period. In addition, research teams gradually exhibit their independence in scientific researches in a research environment purely of Vietnam. As shown by the record of Vietnamese Government funding sources, during the last 10 years, Vietnam scientists have established their research reputation not only locally but gained success in catching up with international standards (Fig. 2).

3.2.2. Average citation in international publications in Vietnam

For a fair evaluation of quality of scientific publications the indicator of citations by other researchers (citation index) (*Eugene Garfield, 1955*) is used. It is possible to say the citation index is the “echo” of a research work. A quality research work is capable of propagating its echo followed by colleagues in the field of research (*Nguyen Dinh Nguyen et al., 2008*). The citation index, however, depends on the “culture” in the sector, scientific reputation of authors and the publication time (the longer time of publication produces more citations).



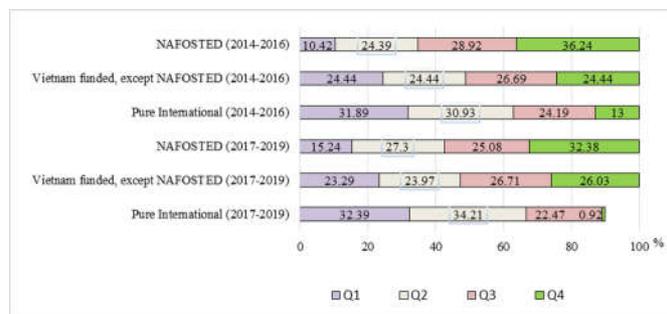
Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 3: Average citations of international publications in Agricultural Biology sector

As shown by statistic data, averagely the number of citations of foreign funded international publications has a dominating position during 2006-2007 time period with the number of average citations up to 180. Since 2010 on, the number of these citations remains the highest one in comparison to the average range of 10-20 citations of Vietnam funded scientific publications (Figure 3).

3.2.3. *Quality of international publications according to magazine classification indexes Q1, Q2, Q3 and Q4*

The quality of ISI classified magazines mainly is evaluated on basis of selection procedure and statistic evaluation of citations for publication of research works (Impact Factor = IF). The US Institute for Scientific Information (ISI) examines the quality of magazines in the world very toughly and carefully before entering them into their database. Despite of controversial views, ISI remains one of the highly rare tools of classification which are largely recognized and used for evaluation of scientific quality of research works. Actually, the UN, national governments and international organizations have a large practice to use ISI statistic figures for management works and planning of science-technical policies. The indexes Q1, Q2, Q3 and Q4 are the familiar ranks reflecting the quality of magazines where Q1 is the magazines with the highest quality with the lower quality from Q2 to Q4 (*Scopus, 2019; Web of Science, 2019*).



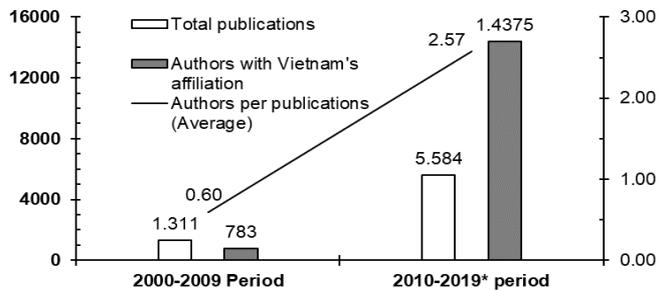
Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 4: Number of scientific publications as classified by quality index during 2014-2019 period.

By 2015, with objectives to enhance the quality of scientific publications through evaluation of the quality of magazines, the NAFOSTED issued the list of scientifically reputed magazines and ISI classified magazines (Circular No. 37/2014/TT-BKHCN on 12th December 2014 by MOST governing the management of basic research works to be funded by NAFOSTED). The list is applied for research topics which had signed the contracts since 2015 and recorded the acceptance formality of research results since 2017. This paper does not take the list of reputed and ISI magazines into consideration while examines scientific publications 3 years before and after the application in 2016 of the list by NAFOSTED for basic researches. The outcomes show the positive impacts from the issuance of the list toward the Q indexes of Vietnam. As shown by analysis, the quality of scientific publications passed changes during the pre- and post- 2016 times. Namely, the Q1 rate increased for international publications purely funded by foreign sources (10.45% before 2016 and 15.24% after 2016) while the Q1 rate reduced for Vietnam funded international

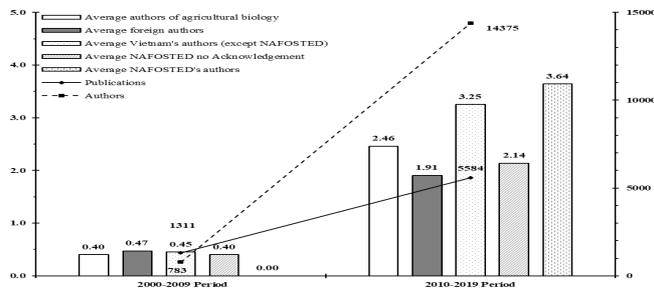
publications (24.44% before 2016 and 23.29% after 2016). The same trend was observed for the Q2 rate where the share of 30.93% had increased to 34.21% for international publications purely funded by foreign sources and from 24.39% to 27.30% for NAFOSTED funded international publications. The reducing trend was observed for non-NAFOSTED funded international publications from 24.44% to 23.97%. The Q3 and Q4 rates for international publications purely funded by foreign sources and NAFOSTED funded ones passed the trend different to the one of Vietnam funded international publications. The Q3 rate for foreign funded international publications reduced from 24.19% to 25.08% while the Q3 rate for Vietnam funded international publications slightly increased from 26.69% to 26.71%. The Q4 rate for foreign funded international publications reduced from 13% to 10.92% and the one for NAFOSTED funded international publications reduced from 36.24% to 32.38% while the Q4 rate for Vietnam funded international publications increased from 24.44% to 26.03% (Figure 4).

3.3. “Local” human resources in international publications in Agricultural Biology sector



Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Hình 5a. Average number of authors per publication with Vietnam affiliated research works in scientific publications in Agricultural Biology sector



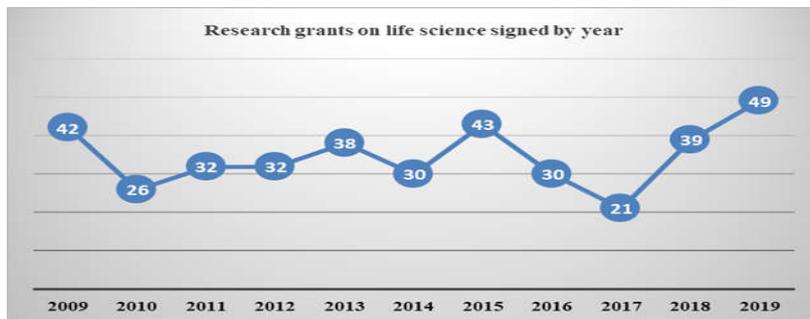
Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 5b. Average number of authors per publication with Vietnam affiliated research works in scientific publications according classification by funding sources

Statistical data in Figure 5a show that during 2000-2009 period the number of authors having Vietnam affiliation (“local” human resources) were only 783 (making 37.39%) while during 2010-2019 period the number increased to 14,375 (making 72.02%). The average rate of Vietnam affiliated authors per research work was 0.6 for 2000-2009 period then increased to 2.57 for 2010-2019 period. However, when considering the average number of Vietnam affiliated authors of international publications per research work according to classification by funding sources (Figure 5b), the data show a global increasing trend but different in terms of funding sources. The average rate of Vietnam affiliated authors has the highest value in the group of NAFOSTED funded research works for 2010-2019 period with 3 Vietnam affiliated authors per scientific publication. The lowest value is of the group of foreign funded scientific publications (Figure 5b). The data can be used as basis for managers to mobilize the “local” human resources in support activities and to adjust policies for promotion of scientific human resources in future time.

4. International publications in Agricultural Biology sector funded by NAFOSTED, 2009-2019 period

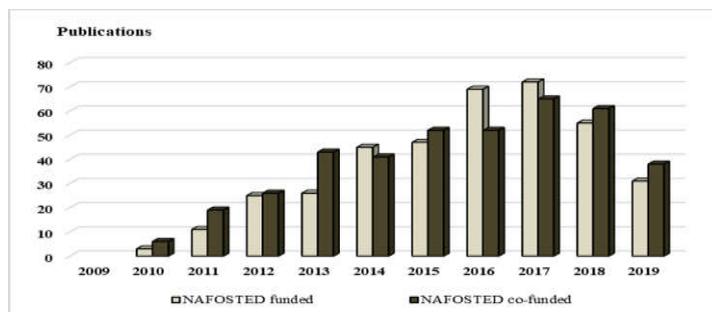
4.1. Number of NAFOSTED funded international publications



Source: NAFOSTED

Figure 6a: Number of research works in Agricultural Biology sector funded by NAFOSTED during 2009-2019 period

As shown by data, during 2009-2019 period the NAFOSTED provided funds for 382 research works in Agricultural Biology sector with condition for acceptance of 2 international publications, as at least, in reputed magazines per research work. So, with 100% of results of research works accepted, they bring in 764 international publications as at least (Figure 6a). As shown by data of international publications of 2010-2019 period, 787 international publications were made with NAFOSTED funds which are higher that expected (since the international publications funded during 2017-2019 time do not pass yet acceptance procedure).



Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 6b: NAFOSTED Funding sources for international publications

This is a good sign for efficiency of supports form the Fund in this sector. With a deeper analysis made for the NAFOSTED funded international publications, the paper authors indicate that only 383 international publications have NAFOSTED as single funding source while 403 other international publications have at least 1 co-funding source in addition to NAFOSTED one, the trend experiencing a permanent growth rate during 2009-2019 period (Figure 6b).

4.2. Quality of international publications in Agricultural Biology sector

4.2.1. Main role in international publications

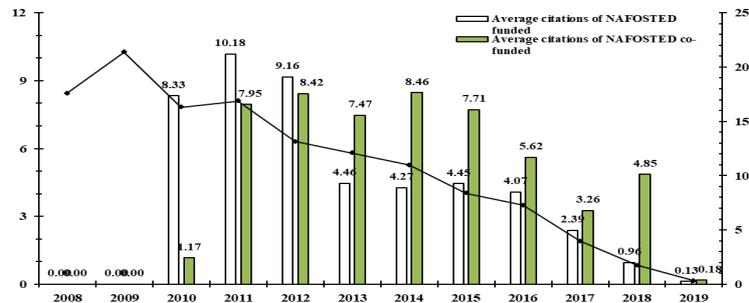
Table 1: Number of first authors and corresponding authors in NAFOSTED funded international publications

NAFOSTED Funded	Total international publications	Number of first authors	Number of corresponding authors
Number of international publications with single funding source from NAFOSTED	384	337	324
Number of international publications co-funded by NAFOSTED and another sources	403	242	296

Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

As shown by analysis of funding sources, the international publications with single funding source from NAFOSTED record a higher number of first authors and corresponding authors than the ones co-funded by NAFOSTED and another sources. In terms of corresponding authors, the number of international publications with single funding source from NAFOSTED is double of the ones with multiple funding sources (Table 1).

4.2.2. Average citation in NAFOSTED funded international publications

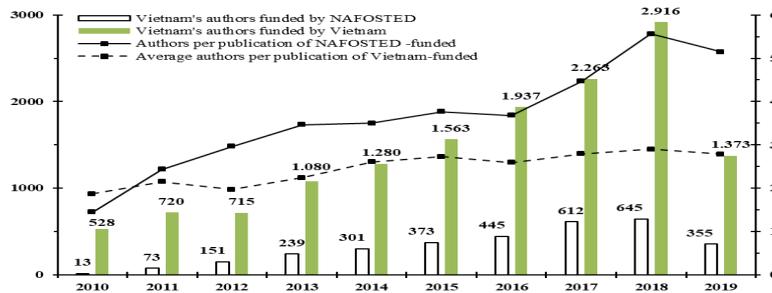


Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 7: Average number of citations in NAFOSTED funded international publications

International publications with multiple funding sources have a trend with more citations in comparison to the ones with single funding source from NAFOSTED (Figure 7). As shown by data, the situation fits well with the one of 4 funding sources in the same Agricultural Biology sector (Figure 3).

4.3. Vietnam affiliated authors in NAFOSTED funded international publications in Agricultural Biology sector



Source: Summarized and analyzed by the authors from data of WoS based international publications of Vietnam, 2000-2019 period as downloaded by September 2019.

Figure 8: Number of Vietnam affiliated authors in NAFOSTED funded international publications

As shown in Figure 8, during 2010-2019 period, even the number of NAFOSTED funded international publications made only about 20% of the total international publications funded by Vietnam but they have higher number of Vietnam affiliated authors (3-5 Vietnam affiliated authors per NAFOSTED funded publication against 3 Vietnam affiliated authors per Vietnam funded publication). This reality reflects well the objective of NAFOSTED “to develop research capabilities of local scientists, to form strong research teams at

international level” in basic researches. So, this objective of NAFOSTED to support research works in science-technical sectors confirms the initial success of the Fund (Figure 8).

5. Conclusion and recommendation

5.1. Conclusion

As answering to the title of this study, the outcomes of analysis of international publications in Agricultural Biology sector as recorded with funding sources from Vietnam show:

Quantitative aspects:

International publications in Agricultural Biology sector recorded as of Vietnam have a continuous increasing trend from 2000 to 2019. This period was split into the pre-NAFOSTED time (2000-2009) and the post-NAFOSTED time (2010-2019). An in-depth analysis shows:

- NAFOSTED Fund is the first unit to introduce a compulsory requirement to indicate NAFOSTED as funding source for research works. It is seen as one of the main reasons to complete “the research culture” in publication of research results in basic research activities in Vietnam (Note that before the establishment of NAFOSTED, 84% of scientific publications did not indicate funding sources while after that only 30% of scientific publications did not do it);
- The number of international publications in Agricultural Biology sector of Vietnam during 2010-2019 period (post-NAFOSTED time) increases 4 times in comparison to the one of 2000-2009 period. This shows the Fund model exhibits effectiveness and efficiency in supporting activities for basic research in Vietnam (787 NAFOSTED funded international publications in Agricultural Biology sector contribute a big share (41%) in the total international publications (1,928 international publications) with funding sources from Vietnam in general);
- The number of purely foreign funded international publications in Agricultural Biology sector is 1.5 time higher than the total number of international publications with funding sources from Vietnam. This shows well the Agricultural Biology sector is highly capable of attracting foreign supports.

Qualitative aspects:

- The use of some largely applied indicators such as main role in publications, average citation index, Q1, Q2, Q3 and Q4 in international publications shows increasing trends of quality of international publications of Vietnam. Namely, the main role in international publications noted as of Vietnam is

recorded as increasing through the number of first authors and corresponding authors in international publications with funding sources from Vietnam (for 2000-2009 period, 9% of the pure foreign funded international publications had Vietnam scientists as first authors which came up to 26.8% during 2010-2019 period). The international publications with Vietnam funding sources (except NAFOSTED) made a modest figure of 7% for 2000-2009 period which came to 31% for 2010-2019 period. Particularly for 2010-2019, with funding supports from NAFOSTED, the rate of first authors made 33% and the one of corresponding authors made 29%. Also, in term of international publications not indicating funding sources, the role of first authors made 83% for 2000-2009 period reduced to 23% for 2010-2019 period. The one of corresponding authors reduced from 89% for 2000-2009 period to 21 % for 2010-2019 period.

Human resource aspects and trends

The change in the status of main role in scientific researches is the evidence for higher independent research capabilities of local research teams. This also demonstrates the higher value of the “local” human resources and proactive initiatives in scientific research activities. The rate of involvement of Vietnam affiliated authors in research activities in Agricultural Biology sector has an increasing trend from 0.6 scientist per scientific publication for 2000-2009 period to 2.57 scientists per scientific publication for 2010-2019 period. The lowest number of Vietnam affiliated authors is recorded for international publications with pure foreign funding sources (less than 2 authors per international publication). The highest number of Vietnam affiliated authors is recorded for international publications with single funding source from NAFOSTED (4-5 authors per international publication) and from non-NAFOSTED funding sources (including also the international publications not indicating funding sources) (2-3 authors per international publication). The data reflects well the nature of the roles and positions of funding sources in scientific publications where the foreign funding sources require higher research capabilities of researchers, higher quality and larger scope of research works, all together reflecting the higher citation index. The scientific publications funded by NAFOSTED exhibit the priorities in policies to support scientists working in Vietnam for 2010-2019 period.

5.2. Recommendations

All the scientific research activities depend on the human factors. Scientific researches exhibit improvements of research results (quantitatively and qualitatively) then require managing organizations as well as S&T agencies to carry out the following activities:

- Organizations providing supports for basic researches in general and in Agricultural Biology sector in particular should require international publications to indicate clearly funding sources and full affiliation of authors (because in some studied cases we record the name of Vietnam based research units without indicating “Vietnam” as the host country. This shortage may lead to difficulties in statistic studies);
- For promotion of quantitative and qualitative aspects of international publications in Agricultural Biology sector, the State agencies should enhance linkage in scientific research activities. As shown by statistic data, particularly for Agricultural Biology sector, international cooperation in scientific publications becomes a natural trend in international integration process to enhance quantity and quality of scientific publications as well as values of training quality and human resources. Efforts to maximize use of funding sources for a research project bring in not only financial benefits but Vietnam researchers would have access to leading and reputed scientists, high quality research teams and sophistic research equipment of quality laboratories in the world. This remark is clearly seen through analysis of international publications funded by foreign funding sources or co-funded with NAFOSTED. As result, these international publications have a higher average citation index than the ones with single funding sources (e.g. NAFOSTED) or other options. Then, in future time, if we want to promote quality of scientific publications, we should extend research activities though cooperation links;
- For offering modern and convenient research environment, State agencies should allocate budgets to upgrade research facilities, particularly now Vietnam has research teams with international standards. The independence in research activities is necessary to promote specific Vietnam research topics. For that Vietnam needs to identify roadmaps to upgrade research facilities and infrastructure. The research teams of Vietnam would be able to extend research topics specifically of Vietnam./.

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