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Executive Summary – UMAIPUR (Revised version)

At the Unit for Monitoring and Analysis of Scientific Research Activity in Puerto Rico (UMAIPUR), our main objective is to study the scientific investigation on the island. We particularly focus on the results of the research and creative work carried out at the University of Puerto Rico (UPR), since it is the largest research-based public institution of higher education in the country. The UPR's results constitute a potential resource to help the island decisively, especially in times of deep economic uncertainty.

Our study uses a set of bibliometric indicators to describe and analyze research in four dimensions:

- I. Production
- II. Collaboration
- III. Visibility and Impact
- IV. Research Areas

A first approach has been made by using Web of Science™ (WoS) core indexes as sources. WoS also lets us focus on the pure, experimental, and technological scientific disciplines due to their dynamics and weight on the University's context, and the greater presence they have in these sources.

For these purposes, we have created a database based on records from WoS, subjected to rigorous and continuous normalization of data in order to better identify institutions, especially the UPR's and its 5 most productive units – these units being the ones that produce at least 1% of the UPR's total production. For the analysis of scientific areas and disciplines, we use the Journal Citation Reports® thematic classification guidelines. The results show a sustained growth of the University of Puerto Rico's scientific production throughout the period, with notable increases in international collaboration, size of research groups, and publication in high visibility and impact journals. We have identified and analyzed the ten disciplines with the highest publishing activity, taking into account elements such as productivity indicators, international collaboration, and impact.

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UMAIPUR constantly analyses the scientific policies at the University, and the development of new projects. The presentation of results and constant updating of these analyses are presented thanks to the financial support of the Office of the Vice-Provost for Research and Technology of the University of Puerto Rico. Since its inception in August 2013, we have enjoyed the generous collaboration of the IUNE-UC3M project (Carlos III University of Madrid).

Dimension I: Production

The scientific production of the UPR during the period 1999-2015 began with 446 documents and reached the end of the period with 927, reaching its highest point in 2012 with 1029 documents, and a cumulative total for said period of 13,460. In terms of total production in Puerto Rico, the UPR has contributed with a percentage that has fluctuated between 65 and 67% - in other databases such as Scopus, this percentage reaches 88%.

The distribution of UPR's production by units shows a clear presence of three groups:

- 1) The three units with graduate programs: Río Piedras, Mayagüez, and Medical Sciences.
- 2) The units in Humacao and Cayey.
- 3) The rest of the units, including Aguadilla, Arecibo, Bayamón, Carolina, Ponce and Utuado.

The accumulated totals during the period for Group 1 reflect the following order: Río Piedras has a total of 4,372 documents, or 32.48% of the UPR's total. Medical Sciences follows with 4,314 documents (32.05%), and finally Mayagüez with 3,785 contributions (28.12%). In Group 2, Humacao is presented with 492 documents (3.65%), followed by Cayey with 244 documents (1.18%). Group 3 is comprised of 6 units, in which Ponce stands out with 59 documents, or 0.43%, followed by Arecibo with 27 contributions (0.42), and Bayamón with 56 (0.41%). With minor productions, Aguadilla has generated 46 documents (0.34%), Utuado has 19 (0.14), and finally Carolina has 16 (0.12%).

While examining the documentary typology of UPR's scientific production for the period researched, the most prominent productions are articles published in scientific journals

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(65.68%), followed by abstracts of papers presented in congresses (meeting abstracts 23.43%), papers in congresses (3.92%) and reviews (2.47%). The documents published by the UPR are collected in 2,678 scientific journals on an international scale. Thirty percent of said publications are included in 24 journals, of which 3 are UPR journals - PR Health Sciences Journal, J. of Agriculture, and Caribbean Journal of Science, 50.08% of the papers are concentrated in 133 journals. 70% of the papers are concentrated in 467 journals.

Dimension II: Collaboration

We have noted a significant increase in the number of authors per document, from an average of 6.7 in the first four-year period, to 177.2 in the last four-year period. Collaborations between UPR authors and international colleagues has fluctuated between 44.17% in 1999, and 67% of production in 2015. Due to its high correlation, the indicator of international collaboration is considered to be related to the improvement in the visibility of scientific production, as well as attracting a high number of citations. However, collaboration with authors from Puerto Rican institutions, including among UPR units, started the four-year study period at 37.83% and ended at 32.34%. The international collaboration in the UPR units' production presents the following distribution:

Mayagüez = 64.22%

Río Piedras = 55.81%

Medical Sciences = 55.51%

Cayey = 37.7%

Humacao = 35.97

The total of the remaining units reaches 30.5% of its productions.

Dimension III: Visibility and Impact

The study measured the impact of the scientific production of the UPR. Using the impact factor of the journals, what is called the first quartile (grouping 25% of the journals with

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the highest impact factor) show a firm positioning, exceeding 40% of published articles. This percentage has gradually increased to 45.45%. As this production percentage is broken down by UPR units, the Medical Sciences Campus exhibits the highest values (42.81%), followed by Río Piedras (34.61%), Mayagüez (29.7%), Cayey (22.95%), and Humacao (22.36%). The remaining units have values below 20%.

Another measure of impact is the percentage of publications in the first three journals (Top 3), or those with the highest impact factor within a particular discipline. After calculating this indicator for UPR units show the following values: Medical Sciences with 15.32%, followed by Río Piedras (5.58%), and Mayagüez (4.23%). The remaining units have values lower than 3% of their publications.

Another impact factor is the citations received by the publications. The UPR show growing values ranging from 16.13 to 21.88 citations per publication, an average of 19.29 for the period. The application of this indicator (citations per documents) to the units show the following values:

Río Piedras = 16.46

Mayagüez = 14.85

Medical Sciences = 13.03

Humacao = 7.79

Arecibo = 5.35

Cayey = 4.61

Bayamón = 3.92

The rest of the units have values less than 3 cites per document. Citations to UPR's total publications for the period have shown an increase from 61% to 74%.

Dimension IV: Research Areas

The analysis of research areas, based on a group of indicators, allowed the identification of the following patterns. The 10 disciplines with the highest growth, based on document

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production, are: Multidisciplinary Chemistry (318), Particle Physics (284), Biochemistry and Molecular Biology (262), Materials Science (239), Public, Environmental and Occupational Health (239), Cellular Biology (205), Biology (193), Applied Physics (186), Physical Chemistry (158) and Astronomy and Astrophysics (150). From the perspective of international collaboration, the five disciplines that show percentages above 50 % of their productions are: Physics applied (74.73%), Physics of condensed matter (68.69%), Materials science (66.94%), Physical chemistry (66.45%) and Public, environmental and occupational health (52.71%).

Applying the citation indicator to the production of the five major units highlights the following five disciplines:

Medical Sciences: Neuroscience (11.23%), Psychiatry (10.42%), Public, environmental and occupational health (8.05%) Immunology (7.16%) and Biochemistry and Molecular Biology (5.88%).

Mayagüez: Physics of particles (26.03%), Multidisciplinary Physics (22.8%), Astronomy and Astrophysics (19.87%), Nuclear Physics (15.38%), Multidisciplinary Sciences (9.7%) and Materials Science (4.96%).

Río Piedras: Ecology (12.72%), Physical Chemistry (11.71%), Multidisciplinary Chemistry (10.59%), Material Science (10.48%) and Applied Physics (8.97%).

Humacao: Applied Physics (18.18%), Materials Science (14.47%), Physical Chemistry (12.65%), Physics of Condensed Matter (12.52%), and Evolutionary Biology (9.81%).

Cayey: Neuroscience (24.76%), Materials Science (9.32%), Multidisciplinary Chemistry (8.7%), Electrochemistry (7.72%) and Physical Chemistry (6.74%).

When considering the total production of UPR for the period, the three disciplines with the highest percentage of citations are: 1) Physics of particles (96.3%), 2) Ecology (96.27%) and 3) Astronomy and Astrophysics (96.15%).

The ten disciplines that show the highest number of articles in first quartile journals are: Biochemistry and Molecular Biology (505), Cell Biology (462), Biology (438), Materials

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Science (349) Applied Physics (297), Multidisciplinary Physics (277), Physical Chemistry (251), Neuroscience (238), Multidisciplinary Chemistry (213) and Ecology (188).

The Activity Index (percentage of UPR publications in a particular discipline / percentage of UPR publications in all disciplines) is a specialty indicator that shows the disciplines in which the UPR stands out. The ten disciplines with the highest IA (> 1) during the 2012-15 period are: Physics of particles (1.49), Multidisciplinary Physics (1.46), Atomic Physics (1.45), Applied Physics (1.45), Materials Science (1.44), Physical Chemistry (1.43), Physics of Condensed Matter (1.42), Multidisciplinary Chemistry (1.26), Biochemistry and Molecular Biology (1.24) and Zoology (1.24).