Comparative bibliometric study of the scientific production in Maghreb countries (Algeria, Morocco and Tunisia) in 1996-2009 using Scopus

Belkheir HAMMOUTI *

LCAE-URAC18, Faculty of Science, Université Mohammed Premier, BP 717, 60000 Oujda – Morocco

**Corresponding Author: Email address: hammoutib@gmail.com ; Tel. +212 536500602; Fax +2125336500603.*
Received in 05 July 2010, Revised 22 Sept, Accepted 24 Sept 2010.

Abstract

This paper is a bibliometric study of the publication patterns of academic and research scientists of Maghreb countries: Algeria, Morocco and Tunisia. The comparative study of the scientific production in the countries of Maghreb is made using Scopus data during the period 1996-2009. Results show that the total scientific production of Tunisia is higher than that of both Morocco and Algeria, even though the population in Tunisia is only one third of that of Morocco and Algeria. Scientometric analysis is furthermore related to the population to each country. The study deals also to introduce the Hirsch index called h-index of the most published authors according to the Scopus database. Ten of the most published authors of each country are listed and their corresponding h-index values were given.

www.scopus.com

Keywords: Bibliometric, H-index, Citation, Maghreb, Scopus, Scientometric analysis.

1. Introduction

Bibliometric studies become more and more good tool to evaluate the scientific power of research institutions and countries. This quantitative analysis may be used as indicator of scientific productivity to judge the research horizontally for different disciplines and vertically between institutions or countries. Data may also indicate the researchers' preferences for publication. Results play a major role in decision in research development or reorientation of governments as well as attributing funds [1-8].

Several database such as the Thomson-Reuter Institute of Scientific Information/Web of Science database (ISI), Scholar Google, Publish or Perish and Scopus offer bibliometric parameters such as number of publications (e.g., productivity) to total citations (e.g., total impact) by each author as well as by affiliation or key words.

Scientific productivity depends on various factors, such as age and subject specialisation, laboratories history and economic indicators, such as government expenditure on civil research and development. Since 1976, Price proposed that there is a relationship between the importance of the scientists and the logarithm of the number of papers they have published during their life [9]. The result obtained in this study showed that there is no adequate relationship and a large difference was observed between the numbers of papers published by the scientists with doctorates as compared to those without PhDs. Prestige is a driving force that prompts authors to publish in foreign journals. Many of the bibliometric studies which have been conducted in other countries provide a theoretical context for this research. Lancaster argues that many scientists in developing countries prefer to publish in foreign journals rather than in their native journals for the sake of prestige and recognition and half of the papers of Indian scientists are published in the United States [10].

In her paper, Meyer [11] regrouped an overall on h-index proposed in 2005 by Hirsch, a physicist of the University of California at San Diego. H-index may be good tool to quantify an individual's scientific research output [12].

Although Hirsch's proposal was not the first attempt to rank scientists in an objective way, namely by a number, he obviously presented an idea that was both convincing and controversial [11]. The original definition of the h-index, proposed by Hirsch (2005), was: "A scientist has index h if h of his or her Np papers has at least h citations each and the other (Np − h) papers have ≤ h citations each". The most advantage and interesting property of this h-index is that it is easy to compute using the online resource. In other words, h characterizes both quantity of publications and their citations. Publication of the h-index has attracted the wide attention of the scientific community.

Actually, the h-index and some related bibliometric indices received a lot of attention from the scientific community in the last few years due to some of their good properties (easiness of computation, balance between quantity of publications and their citation [13-20].

Jacobs in 2001 published a bibliometric study of the publication patterns of scientists in South Africa 1992-96 [21]. This study endeavoured to establish the relationship between status of the scientists and their productivity. The findings obtained in this study showed that the productivity of a scientist is directly related to his status in the department. The results showed that those with a higher status like professors most of whom possessed a PhD and postdoctoral qualifications published and presented papers profusely compared to those who had lesser degrees of qualifications. Those academics with an Honours' degree or below hardly ever published a paper or presented at conferences.

In Morocco, Bouabid and Martin [22] in their paper, presented the results of an evaluation of the national research system in Morocco The exercise focuses on the period 1997–2006 and included a comparison with South Africa, Egypt, Nigeria, Tunisia, Algeria, Portugal and Greece. They examined the empirical model set by Glänzel [23] that related the h-index to the number of publications and the mean citation rate per paper for these 'upper-class' researchers. The use of this model confirmed that the h-index was likely to reflect the importance and the quality of the scientific output of a given researcher [22].

In the last few years, these bibliometric data contributed to rankings of universities [24]. Several ranking were proposed, but two rankings have attracted the wide attention of the scientific community and the public media: those published by the Jiao Tong University in Shanghai since 2003, and those published by the Times Higher Education Supplement (THES) since 2004 [25].

Bornmann et al. [26] examined a comprehensive set of papers (n = 1837) that were accepted for publication by the journal Angewandte Chemie International Edition (one of the prime chemistry journals in the world) or rejected by the journal but then published elsewhere. This study tested the extent to which the use of the freely available database Google Scholar (GS) can be expected to yield valid citation counts in the field of chemistry. Analyses of citations for the set of papers returned by three fee-based databases – Science Citation Index, Scopus, and Chemical Abstracts – were compared to the analysis of citations found using GS data. Whereas the analyses using citations returned by the three fee-based databases show very similar results, the results of the analysis using GS citation data differed greatly from the findings using citations from the fee-based databases. This study therefore supported, on the one hand, the convergent validity of citation analyses based on data from the fee-based databases and, on the other hand, the lack of convergent validity of the citation analysis based on the GS data.

The objective of the present study is to highlight the level of scientific productivity of three countries of Maghreb (Algeria, Morocco and Tunisia) in the period 1996-2009 based on Scopus. The productivity is then compared and linked to the population. The evolution of productivity and h-indices of ten most published authors in each country are presented. The three countries constitute the Arab Maghreb Union (AMU) near Libya and Mauritania. The five Maghreb states - Algeria, Libya, Mauritania, Morocco, and Tunisia - created the Maghreb union in 1989 in Marrakech. The main objectives of the AMU Treaty are to strengthen all forms of ties among Member States (in order to ensure regional stability and enhance policy coordination), as well as to gradually introduce free circulation of goods, services, and factors of production among them. The study is limited only to the three countries because on the Scopus, the scientific papers produced by Libya and Mauritania are 130 and 245, respectively.

Data collection

The data of the production of publication and Citation Index h is available directly from online data of Scopus. The data were collected by affiliation separately, Tunisia, Algeria and Morocco. The data on Scopus can be arranged by years, authors and key words, source title, article title, affiliation… Data obtained for example by key word, are presented in five columns: source title, author name, year, affiliation and subject area.

The collected data are drawn in comparative figure showing publication number at each year for the corresponding country. A survey literature gives information about each country of this Maghreb region. The plots obtained may be related to each million population. The discussion may be enriched by giving the most published authors in relation with their corresponding h-Index deduced from Scopus.

Tunisia, Algeria and Morocco situated in the North of Africa as indicated in the maps below. Table 1 gathered data on these countries concerning population, area, and other factors.

Map of Maghreb Arab (Morocco, Algeria and Tunisia)

Position of the Maghreb in North Africa

Table 1. Data on Maghreb countries : *Sources :* CIA World Factbook 2008 et *L'état du monde 2004* (éd. La Découverte, Paris, 2003),

Demography of Maghreb Countries			
Countries	**Algeria**	**Morocco**	**Tunisia**
Total Production 1996-2009 (Scopus)*	14436	18199	22094
Population (millions habitants)	33,7	34,3	10,4
Annual demographic increase (en %)	1,22	1,55	0,99
Life expectancy (years)	72,1	70,94	75,12
Density (habitants/ km²)	15	77	63
Analphabetic (% of total population)	26.5	34.2	19.1

* Data of Scopus at July, 5th, 2010.

Results and discussion

The productivity of the scientists was estimated by the total of papers collected from Scopus for a period of 14 years (1996-2009), all research fields included. Figure 1 shows the comparative data on Algeria, Tunisia and Morocco.

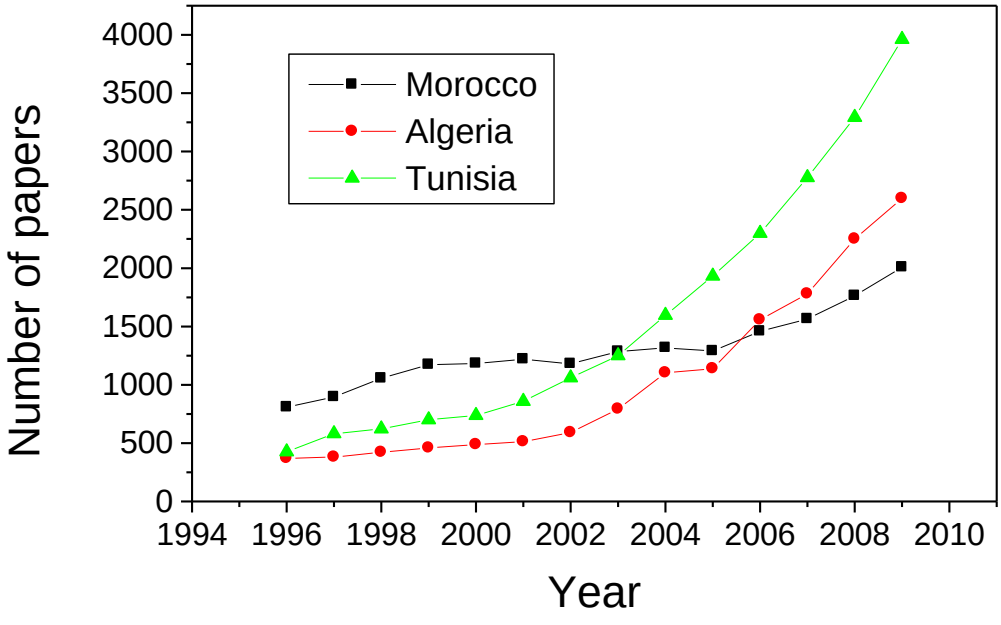

Figure 1: Scientific production of Maghreb countries between 1996 and 2009 actualised in July 5th, 2010.

The most popular field cited for Morocco and Tunisia are Medicine, Engineering, Physics and astronomy, Agricultural and biological sciences, Materials science, chemistry…Medicine in Algeria is classified at the rank 10. Analysis of the collected data indicates that Moroccan productivity was higher at first before 2003 and thereafter Tunisia productivity increased these last years. The number of publication of Algeria was the lowest and began to increase and exceed that of Morocco in 2006. This event can be explained by the retirement of a number of researchers in 2005 in Morocco following the policy of voluntary departure retiring, in addition to no public national funds allocated to the research centres, except the so-called PARS, PROTARS I, II and III for the period 1998-2005 marked by the unique research strategy of the Ministry of Higher Education and research which was stopped later on. It also complements the reform adopted by the Higher Education and the procedure for promotion from grade to grade for the university staff, in addition to less recruitment of assistants in the old universities where research is effectively performed. In general this deficit and imbalance is mainly due to the research policy followed by the government. For instance, in some universities such as in Rabat and Marrakech, the major staffs are old professors without assistants for replacement in very few years.

View the disproportion between the three countries in terms of population and other factors which are gathered in Table 1, it is interesting to link this scientific production relative to the population of each country (Figure 2). Tunisian scientific production is largely exceeding the Algerian and Moroccan one these last years. In 2009, a relative growth of more than twice in Tunisia is observed against in Morocco. This may indicate the imbalance in the educational system in the two countries Morocco and Algeria. How can state with a smaller area and number of population (the third) have been able to achieve such amount of knowledge productivity.

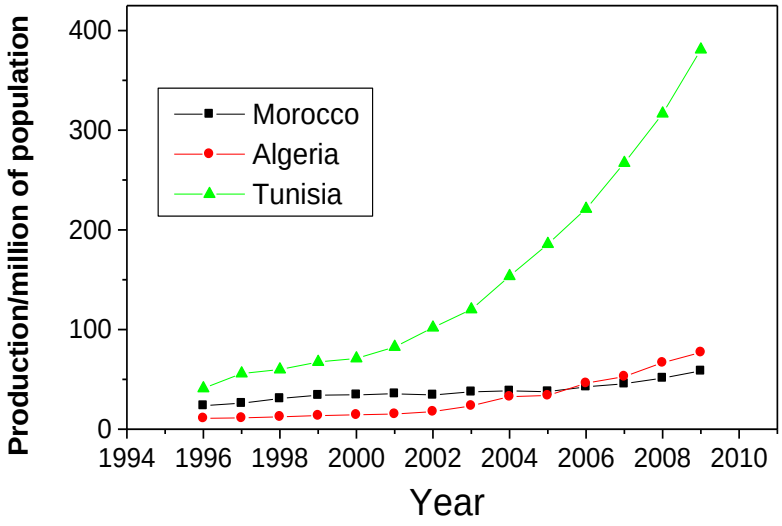

Figure 2: Scientific production per million populations of Maghreb countries between 1996 and 2009

Regarding the Maghreb productivity, some measure should be suggested in order to increase the research activity and publication. The promotion law with regard to lecturer's grades in Morocco should be reviewed so that lecturers are encouraged to deliver more interesting scientific research work, and not an automatic promotion only based on the number of years of service. It is encouraging in my view to maintain the old system containing the four grades of assistant, associate professor, lecturer to full professor.

It would be advisable to the Ministry of High Education to create a special Commission to be in charge for establishing research policies and giving grants, awards and attention to those researchers who are very active in their fields of research and who are deploying a lot of effort and energy for establishing well laboratories for giving correct scientific advice and producing young researchers of high qualifications. I would recommend to Maghreban universities to create post doctorate positions to be held by young researchers who have obtained their doctorate degree. The group of research formed by these post doctorate researchers and the team of research in the specific laboratory must be remunerated whenever there is scientific production established.

It is not correct to employ young scientist people with doctorate degree in field not relevant to their speciality (field where they are formed). There is a need in qualified doctors to work in Maghreban universities in order to develop new technologies and to occupy positions of those who will soon depart for their retirement.

Also, an increased co-operation between national and international bodies would open newer horizons for research and publication.

It is interesting to give some data on the population ranking of some countries of the world. The Central Intelligency agency (CIA) provides the ranking of countries by population; the three first ones are China, India and United State. Egypt, Algeria, Morocco and Tunisia are in rank 16, 35, 38 and 77, respectively [27]. Then, it is interesting to

compare the total scientific production of the Maghreban scientists in this period 1996-2009 with that of Egyptians. It is 54729 papers in Maghreb and 57503 papers in Egypt. The population of Maghreb and Egypt are 78.4 and 79 Millions respectively. Four Nobel Prizes were awarded in Egypt while none in Maghreb. Figure 3 illustrates the evolution per year of the scientific production in Maghreb, Egypt and France. The figure shows that the scientific production of Maghreb is closely the same as that of Egypt with a slight increase last years in Maghreb. This may a good indicator of political leaders to activate positively the Arab Maghreb Union. In other words, the united Maghreb possesses all chances of development. Figure 3 also shows clearly the huge difference between France and Maghreb. The productivity of France is 933242 papers in the studied period. This comparison is achieved by searching bibliographic databases of Israel always between 1996 and 2009. Scopus gives total papers of 195 995. The productivity by year started by 11 222 papers in 1996 to reach 17 142 papers in 2009.

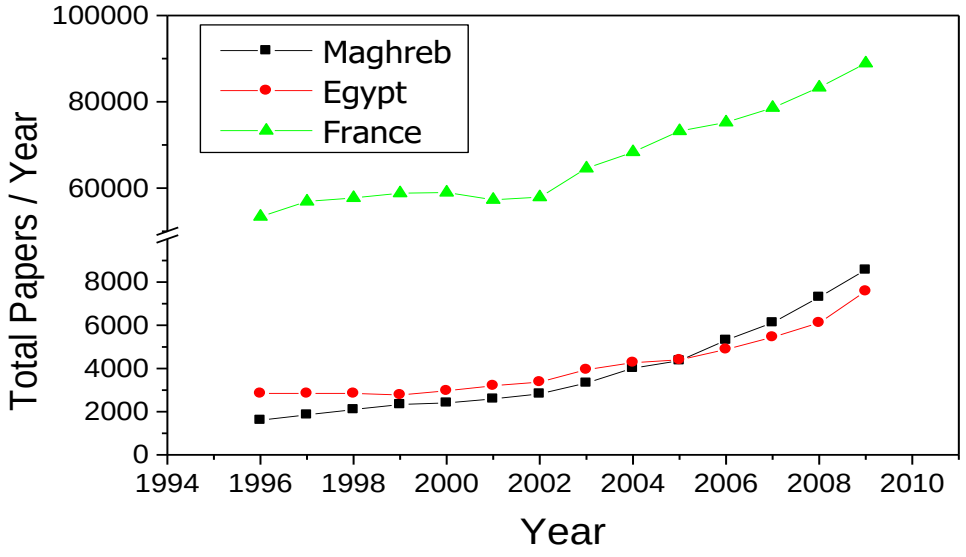

Figure 3: Production of Maghreb compared to Egypt and France between 1996 and 2009

In the other hand, it is interesting to give periodically some light on the persons who have published the highest number of articles in each Maghreban country during some period of time. Table 2 gives some data on scientific productivity per researcher within the three Maghreban countries during the period 1996-2009.

Table 2. The most published authors in Algeria, Morocco and Tunisia between 1996-2009 with the corresponding productivity (N) and h-index (N-h). Sept. 13th, 2010.

Algeria	**Morocco**	**Tunisia**
Aourag H. 128-17	Hammouti B. 131-21	Maaref H. 145-12
Bouarissa N. 105-13	Essassi E.M. 107-10	Haouet S. 125-7
Benchohra M. 91-9	Hajjaj-Hassouni N. 105-8	Ghorbel A. 117-11
Bouhafs B. 74-15	Aboutajdine D. 104-8	Boudriga N. 111-5
Maschke U. 74-14	Benyoussef A. 98-10	Rzaigui M. 108-8
Khenata R. 67-11	Lakhdar H. 92-9	Fazaa B. 100-
Chetouani L. 65-10	Hassam B. 81-4	Zahaf A. 99-11
Gabouze N. 62-8	Jiddane M. 78-8	Dellagi K. 99-10
Benmoussa M. 59-3	El Mrini M. 76-5	Marrakchi M. 99-10
Zaoui A. 59-4	Saber M. 77-1	Mokni M. 98-12

The Table illustrates the first ten authors together with the corresponding number of scientific articles. We notice that Aourag and Hammouti were awarded by Scopus title of the most publishing authors in their countries in March 2010 and March 2006, respectively. Figure 4 shows the histogram of the scientific productivity of the three most publishing authors in each country of Maghreb. We notice also that the Aourag scientific productivity has reduced with respect to that of the Moroccan and Tunisian scientists and this is probably due to its new administrative position as General Director of the Scientific Research and Technological Development.

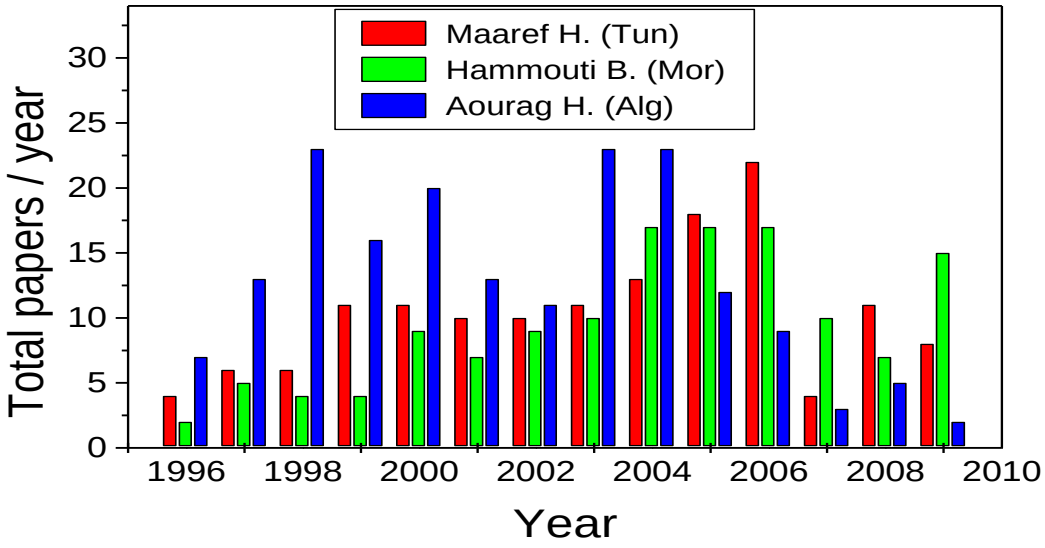

Figure 4. Evolution of the scientific production of the most published authors in Maghreb during 1996-2009

We would like to recall that not all researchers have a single profile within Scopus. Some of them have various profiles and thus it is difficult to give a real idea about the h-index of each researcher. Finally, I like to give an idea of the h-index of Dr. Fouad Bentiss, the University of Bouchaid Doukali, El Jadida, Morocco, who has the higher h-index (29) among the researchers in the Maghreb. His h-index was calculated in July, 19th 2010. Figure 5 shows the evolution of the citation of each paper of the mentioned author. In other words, his 29 papers have at least 29 citations each and the others have less than 29. You can't find one of his scientific publications which was not cited. There is a strong relationship between the scientific productivity and the citation.

Costas and Bordons concluded in their paper about the advantages and limitations of h-index that both quantity and impact of publications are taken into account when calculating the h-index, but the number of publications plays a very important role, since it is the maximum h-index an author can obtain. The h-index tends to underestimate the achievement of scientists with a "selective publication strategy", that is, those who do not publish a high number of documents but who achieve a very important international impact [28].

Throughout their paper, Bouyssou and Marchant assumed that the only relevant information for ranking scientists and journals is represented in a profile. The scientific content of the publications, the age of a scientist, his/her country, the reason why a paper is cited or not are all aspects that are not taken into account. Although there are perhaps some contexts where the profile is the only relevant or available information, there are also many circumstances where more information than the profile is available and pertinent [29]. Furthermore, Bornmann et al do not think it would be wise to develop further variants of the h index in future, but it is useful to complement the h index with additional information in order to obtain a more complete and more reliable picture of the research output of a single scientist [30].

Apart some researchers in the Maghreb, h-index measure is still small indicating that the scientific production and activity of the university professors in Maghreb is weak. The Maghreban universities need young human potential and sending a lot of professors to retirement because their bids in management have not demonstrated well-deserved services. Maghreban countries, I think, should opt for a community made of professors who are only committed to the research work and not other heavy charges of teaching or administration. The real development requires the selection of young potentials who are very efficient in scientific work and who will be the basis for taking their countries to a prosperous future.

The findings of this study point towards the role played by status, prestige and funding in the productivity of the scientists. The study therefore suggests some measure in order to increase the research activity and publication especially among the junior members who are still aspiring towards achieving their doctorate. It is incomprehensible that the state creates jobs for young doctoral students. Moroccan Laboratories become increasingly empty researchers.

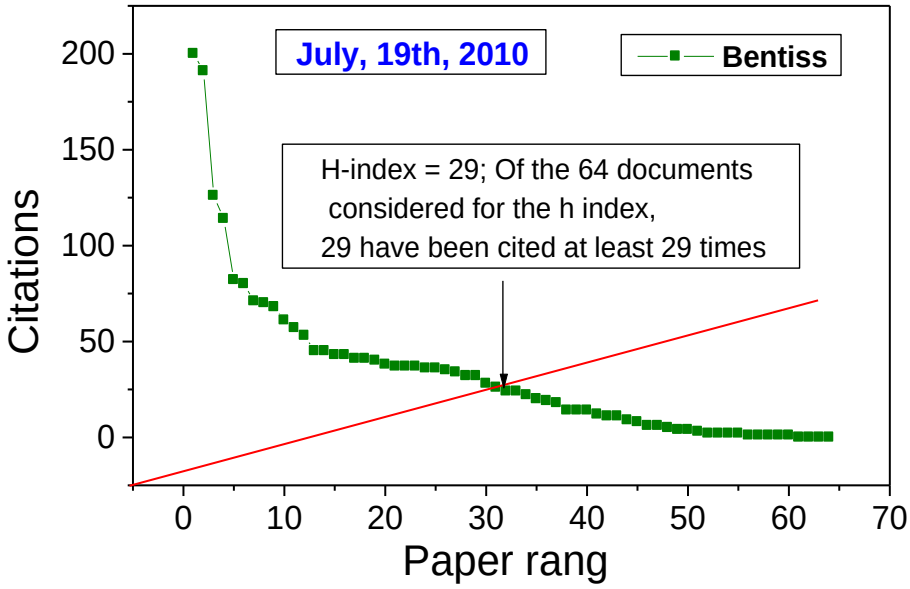

Figure 5. Graphical determination of h-index of Fouad Bentiss (Morocco).

Finally, enhancing cooperation in the field of higher education and scientific research in AMU will be a pillar of educational development. Effective AMU cooperation has become a pressing necessity to bring about an educational renaissance in these countries, especially in graduate studies, scientific research and publication. Actually, the budgets set by the governments for scientific research is less than one percent of public income, whereas in advanced countries governments spend more than two percent of their budgets on research. Then, this percentage must be displaced to significant values. The research policy in universities and academic institutions should have a clear objective serving the goals of the university or society, and the studies must be performed in the society service.

Conclusion

This study claims to compare the scientific productivity of the three countries of Maghreb (Algeria, Tunisia and morocco) during fourteen years 1996-2009.
Due to the different size of population of each country, we decided to compare the scientific production per million of population. This ratio is only giving a clear comparison between the three countries.
We gave a table for the ten best researchers of each country in the period studied. The table showed the number of publications and corresponding h-index associated to each author.
We have also presented a prominent young researcher who has the highest index in the three countries.

References

1. Aksnes, Dag W., Citation rates and perceptions of scientific contribution, *Journal of the American Society for Information Science and Technology* 57 (2006) 169.
2. Douglas, M.L., Atran, S. (Eds.), 1999. Folk Biology. MIT Press, Cambridge, MA. Garfield, E., Is citation analysis a legitimate evaluation tool? *Scientometrics*, 1 (1979) 359.
3. Rousseau, R., & Ye, F. A proposal for a dynamic h-type index, *Journal of the American Society for Information Science and Technology*, 59 (2008) 1853.
4. Peng, M.W., Zhou, J.Q., Most cited articles and authors in global strategy research, *Journal of International Management*, 12 (2006) 490.
5. Katz, J.S., Scale-independent indicators and research evaluation, *Science and Public Policy*, 27 (2000) 23.
6. Yangge Tian, Cheng Wen, Song Hong, Global scientific production on GIS research by bibliometric analysis from 1997 to 2006, *Journal of Informetrics*, 2 (2008) 65.
7. Zhang, L., Wang, M-H., Hu, J., Ho, Y-S., A review of published wetland research, 1991–2008: Ecological engineering and ecosystem restoration, *Ecological Engineering*, 36 (2010) 973.

8. Jiang Li, Mark Sanderson, Peter Willett, Michael Norris, Charles Oppenheim, Ranking of library and information science researchers: Comparison of data sources for correlating citation data, and expert judgments, *Journal of Informetrics*, 4 (2010) 554.
9. Price, D.D.S., A general theory of bibliometric and other cumulative advantage processes, *Journal of the American Society for Information Science* 27 (1976) 292.
10. Lancaster, F.W. (1982) "Publication patterns in Brazil." Science and Culture, 34, 627-634.
11. Meyer, V.R., The h Index – Help or Hype? *Chimia*, 63 (2009) 66.
12. Hirsch, J.E., An index to quantify an individual's scientific research output, *PNAS*, 102 (2005) 16569.
13. Alonso, S., Cabrerizo, F.J., Herrera-Viedma, E., Herrera, F., h-Index: A review focused in its variants, computation and standardization for different scientific fields, *Journal of Informetrics*, 3 (2009) 273.
14. Alexander, W.A. Kellineri, Luiza, Ponciano, C.M.O., H-index in the Brazilian Academy of Sciences – comments and concerns, *Annals of the Brazilian Academy of Sciences*, 80 (2008) 771.
15. Glanzel, W., On the h-index – A mathematical approach to a new measure of publication activity and citation impact, *Scientometrics*, 67 (2006) 315.
16. Bornmann, L., Daniel, H.-D., Does the h-index for ranking of scientists really work?, *Scientometrics*, 65 (2005) 391.
17. Harzing, A.W.K. & Wal, R. van der, Google Scholar as a new source for citation analysis?, *Ethics in Science and Environmental Politics*, 8 (2008) 62.
18. Marek Kosmulski, Hirsch-type index of international recognition, *Journal of Informetrics*, 4 (2010) 351.
19. Courtault, J-M., Hayek, N., Rimbaux, E., Zhu, T., Research in economics and management in France: A bibliometric study using the h-index, *Journal of Socio-Economics*, 39 (2010) 329.
20. Jie Hu, Yuwei Ma, Liang Zhang, Fuxing Gan, Yuh-Shan Ho, A historical review and bibliometric analysis of research on lead in drinking water field from 1991 to 2007, *Science of The Total Environment*, 408 (2010) 1738.
21. Jacobs, D. "A bibliometric study of the publication patterns of scientists in South Africa 1992-96, with particular reference to status and funding." *Information Research*, **6** (2001) Available at: http://InformationR.net/6-2/paper104.html
22. Bouabid, H., Martin, B.R., Evaluation of Moroccan research using a bibliometric-based approach: investigation of the validity of the h-index, *Scientometrics*, 78 (2009) 203.
23. Glänzel, W., On the h-index - A mathematical approach to a new measure of publication activity and citation impact. Scientometrics, 67 (2006) 315.
24. van Raan A.F.J., Comparison of the Hirsch-index with standard bibliometric indicators and with peer judgement for 147 chemistry research groups, *Scientometrics* 67 (2006) 491.
25. van Raan, A.F.J., Challenges in the ranking of universities. In: J. Sadlak and N.C. Liu (eds.). The World-Class University and Ranking: Aiming Beyond Status. Bucharest: UNESCO, (2007).
26. L. Bornmann, W. Marx, H. Schier, E. Rahm, A. Thor, H-D. Daniel, Convergent validity of bibliometric Google Scholar data in the field of chemistry—Citation counts for papers that were accepted by Angewandte Chemie International Edition or rejected but published elsewhere, using Google Scholar, Science Citation Index, Scopus, and Chemical Abstracts, *Journal of Informetrics*, 3 (2009) 27.
27. https://www.cia.gov/library/publications/the-world-factbook/rankorder/2119rank.html
28. Costas, R., Bordons, M., The h-index: Advantages, limitations and its relation with other bibliometric indicators at the micro level, *Journal of Informetrics*, 1 (2007) 193.
29. Bouyssou, D., Marchant, T., Consistent bibliometric rankings of authors and of journals, *Journal of Informetrics* 4 (2010) 365.
30. L. Bornmann, L., Mutza, R., Daniela H-D., The h index research output measurement: Two approaches to enhance its accuracy, *Journal of Informetrics*, 4 (2010) 407.