Scientific Development in African Countries: a scientometric approach 1996–2009

Project report

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Research

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TABLE OF CONTENTS

Executive summary

Objectives

This report, a collaboration between the Cuban Ministry of Higher Education, the National Center for Scientific Research and INASP, presents findings from a bibliometric analysis of the 26 most productive African countries in Scopus between 1996-2009. Data is presented examining changes in the scientific research output of these countries, and comparison made with world patterns across 27 scientific knowledge domains. In addition to the regional context, these findings allow consideration of international trends and identification of strengths and weakness to inform future decision-making processes. Similar to an earlier study on Latin American countries, this report focuses on the INASP:PERii partner countries and addresses the same six key questions:

- How have research publication patterns changed over the last ten years in the selected countries?
- What is the number of research publications produced per country per year?
- What are the top research institutions in Africa, as ranked by publication output?
- What is the breakdown of research publications by subject area?
- How has this research been cited by others in their research publications?
- What are the changing patterns of international research collaboration, as indicated by multi-author publications with different country affiliation per author?

Methodology

Quantitative indicators used to assess scientific production included:

- total publication output, cited documents, growth rate and the activity index.

The qualitative dimension was studied through a set of impact indicators:

- total of cited documents, percentage of cited documents, total of citations, average of citations by document and attractivity index.

Scopus, the Elsevier database for bibliometric research, provided the key source of data. Further data was extracted using the scientometric tool SCImago Journal & Country Rank and the SCImago Institutions Ranking. Data was retrieved in May 2011 with updates made in November 2011.

Africa in an international context

In keeping with the traditional negative vision of Africa as the poorest and most disadvantaged continent, studies on African scientific activity are predominantly negatively focused. The lack of research capabilities and the structural weaknesses of the internal research collaboration are key factors hindering African R+D activity. However, this report focusing on the quantification of the scientific output of the African countries, and their individual thematic specialization, presents a positive view of the continent's scientific behaviour. The regional advances are closely correlated with the growth of Southern Africa and in particular the emergence of South Africa, the lead country in the region. However in general and in common with worldwide trends, Scopus data indicates African scientific production has been growing during the past 15 years with an overall increase (497 % in Northern Africa, 258 % in Central Africa, and 158 % in Southern Africa). During the same period, scientific production increased internationally by 67.8 per cent with Latin American having a regional growth of 190.5 per cent.

Findings

Sections 4 and 5 set out the study's findings. Summarised below are the key findings for the 10 PERii partner countries included among the 26 most productive African countries.

Cote d´Ivoire

- *Medicine* is the most important subject area in the scientific production of Cote d´Ivoire.
- The most active and visible areas of research are *Immunology and microbiology*, *Agriculture and biological sciences*, *Veterinary*, *Medicine* and *Environmental sciences.*
- The higher relative impact is in the fields of Art and Humanities (with a low output) and Veterinary.
- The proportion of international collaboration does not show an evolution during the whole period (66,4% in the period 1996-2002, 67,2% in the period 2003-2009).

Ethiopia

- Ethiopian scientific production is mainly concentrated on *Agriculture and biological sciences,* although *Medicine, Immunology and microbiology* and *Biochemistry, genetics and molecular biology* are also highly productive.
- The most active and visible areas of research are *Veterinary*, *Agriculture and biological sciences*, *Immunology and microbiology*, *Environmental sciences*, *Earth*

and planetary sciences, Economy, econometrics and finances, and *Social sciences.*

- The higher relative impact is in the fields of *Energy* and *Materials Science.*
- The proportion of international collaboration evolved from 56,2% in the period 1996-2002 to 70% in the period 2003-2009.

Ghana

- The output in Ghana increased during the period 2002-2009. During the last studied period 68% of the scientific production was published.
- *Medicine*, and *Agriculture and biological sciences* are the main subject areas in scientific production.
- The most active and visible areas of research are *Immunology and microbiology*, *Agriculture and biological sciences*, *Social sciences*, *Veterinary*, *Environmental sciences*, *Economy, econometrics and finances*, and *Energy.*
- The higher relative impact is in *Dentistry*, *Veterinary* and *Energy.*
- The proportion of international collaboration shows a low evolution, from 58,6% in the period 1996-2002 to 66,1% in the period 2003-2009. However, more than a half of citations were received during the last period.

Kenya

- *Agriculture and biological sciences* and *Medicine* are the two main subject areas in Kenyan scientific production.
- The most active and visible areas of research are *Veterinary*, *Immunology and microbiology*, *Agriculture and biological sciences*, *Environmental sciences*, *Multidisciplinary sciences*, *Social sciences* and *Economy, econometrics and finances.*
- There is a high relative impact in the field of *Energy*, *Medicine* and *Veterinary.*
- The proportion of international collaboration evolved from 60,8% in the period 1996-2002 to75,1% in the period 2003-2009.

Madagascar

- Madagascar also doubled its scientific production during the period 2002-2009 (67,5% of the total output), with a clear biomedical profile.
- *Agriculture and biological sciences* the most important subject area, covering the 40,5% of the whole scientific production.

- The most active and visible areas of research are *Agriculture and biological sciences*, *Immunology and microbiology*, *Environmental science*, *Earth and planetary science,* and *Veterinary.*
- The higher relative impact is in *Arts and Humanities* and *Social sciences* (areas with a low output).
- The proportion of international collaboration evolved from 76,5% in the period 1996-2002 to 86,9% in the period 2003-2009.

Malawi

- Malawi doubled its scientific production during the period 2002-2009 (67,3% of the total output), with a clear biomedical profile.
- *Medicine* is the most important subject area, covering 50,7% of the whole scientific production and reaching the highest relative impact.
- The most active and visible areas of research are *Immunology and microbiology*, *Medicine*, *Agriculture and biological sciences*, and *Nursing.*
- The proportion of international collaboration evolved from 65,1% in the period 1996-2002 to 80,3% in the period 2003-2009.

Tanzania

- *Medicine*, *Agriculture and biological sciences* and *Immunology and microbiology* are the main subject areas in Tanzanian scientific production.
- The most active and visible areas of research are *Veterinary*, *Immunology and microbiology*, *Agriculture and biological sciences*, *Environmental sciences*, *Dentistry, Social sciences*, *Economy, econometrics and finances*, *Medicine*, *Energy*, and *Health Professions.*
- The higher relative impact is in the fields of *Computer science* and *Engineering.*
- The proportion of international collaboration evolved from 69,2% in the period 1996-2002 to 79,8% in the period 2003-2009. The citation activity was highest during the period 2002-2009 (more than 50% of citations received).

Uganda

- *Medicine*, *Immunology and microbiology* and *Agriculture and biological sciences* are the main subject areas in the Ugandan scientific production.
- The most active and visible areas of research are *Immunology and microbiology*, *Agriculture and biological sciences*, *Veterinary*, *Environmental sciences*, *Social*

sciences, Medicine, *Economy, econometrics and finances*, and *Health Professions.*

- The higher relative impact is in the fields of *Economy, econometrics and finances* and *Medicine.*
- The proportion of international collaboration evolved from 65,6% in the period 1996-2002 to 81% in the period 2003-2009. The citation activity was higher during the period 2002-2009 (more than 50% of citations received).

Zambia

- *Medicine* is also the main subject areas in the scientific production from Zambia, followed by *Immunology and microbiology* and *Agriculture and biological sciences*.
- The most active and visible areas of research are *Immunology and microbiology*, *Veterinary*, *Agriculture and biological sciences*, *Environmental sciences*, *Earth and planetary sciences*, *Medicine*, *Social sciences,* and *Economy, econometrics and finances.*
- The higher relative impact is in the low productive areas of *Arts and Humanities* and *Economy, econometrics and finances*. However, *Medicine* also shows a high relative impact, with a citation per document higher than the world mean.
- The proportion of international collaboration evolved from 70% in the period 1996-2002 to 84,4% in the period 2003-2009. The citation activity was higher during the period 2002-2009 (more than 50% of citations received).

Zimbabwe

- The output in Zimbabwe decreased during the period 2002-2009.
- The 53,4% of the scientific production was published in the period 1996-2002, and the 64,6% of cites were received during the same period.
- *Medicine*, and *Agriculture and biological sciences* are the main subject areas in the scientific production.
- The most active and visible areas of research are Veterinary, *Agriculture and biological sciences*, *Immunology and microbiology*, *Environmental sciences*, *Earth and planetary sciences, Social sciences, Economy, econometrics and finances*, and *Medicine.*
- The higher relative impact is in the less productive areas of *Dentistry* and *Economy, econometrics and finances.*
- The proportion of international collaboration evolved from 57,1% in the period 1996-2002 to 74,9% in the period 2003-2009.

Conclusions

This study provides the evidence to assist policy and decision makers at an institutional, national, regional and international level. It is hoped that the findings will contribute to broader research into the changes in scientific output of African countries:

- to provide data to inform future policy-making;
- to create firmer links between trends in scientific output and policy decisions; and
- to gauge the impact of specific policy decisions on scientific output.

Possible next steps include widening this research to incorporate the Asian PERii partner countries. Alternatively extending the study of the African and Latin American countries already analyzed, focusing on areas of particular importance or working with individual countries could potentially help guide future development.

1. Introduction

This study provides a scientometric picture of the most productive African countries, especially the countries (Kenya, Tanzania, Ethiopia, Uganda, Zimbabwe, Ghana, Cote d´Ivoire, Malawi, Zambia and Madagascar) participating in one of the INASP programmes - PERii. The report considers scientific papers published in high visibility journals, and uses Scopus-based quantitative data to analyze the activity and visibility of the above countries during the period 1996–2009. Activity and visibility comprise:

- the entire scientific production of the countries; and
- the relative quality or impact of research, measured by citation-based indicators.

The study focuses on how research patterns in the selected areas have changed over the last 15 years. Aiming to enhance the use of bibliometric indicators in research evaluation policy across the globe, the study demonstrates how bibliometric indicators can be applied in:

- measuring the scientific output of countries and organizations;
- identifying the level of specialization of each country by knowledge areas; and identifying the leader scientific institutions.

The study considers the following six questions:

- How have research publication patterns changed over the last ten years in the selected countries?
- What is the number of research publications produced per country per year?
- What are the top research institutions in each country, as ranked by publication output?
- What is the breakdown of research publications by subject area?
- How has this research been cited by others in their research publications?
- What are the changing patterns of international research collaboration, as indicated by multi-author publications with different country affiliation per author?

The preliminary findings presented in this report were revealed during the National Training of Bibliometric Methods for Research Evaluation (Havanametrics 2010), developed in Havana, Cuba, from February 6 to 9, 2012, and organized by the National Centre for Scientific Research (CNIC) and the Cuban Ministry of Education with support from INASP.

2. Methodological aspects

2.1. Data sources

Scopus, the main Elsevier database for bibliometric research purposes, was used as the primary data source. Scopus has a total of 19 million documents with bibliographic references, belonging to more than 18,000 serial publications from across all knowledge domains, published since 1996.

Data from the period 1996–2009 (and sub-periods 1996–2002 and 2003–2009) were extracted from the scientometric tool SCImago Journal & Country Rank (SJCR, available at http://www.scimagojr.com), created by the SCImago Research Group, a Spanish research team belonging to the Institute of Goods and Public Policies (IPP-CSIC). SJCR offer a wide range of scientometric indicators, very useful for scientific and technological researchers and decision-makers. Data related to the most productive institutions were extracted from the SCImago Institutions Ranking (SIR, available at http://www.scimagoir.com), the most recent scientometric tool developed by the SCImago Research Group.

Data was retrieved in May 2011with updates made in November 2011.

2.2. Indicators

Quantitative indicators used to assess scientific production included: total publication output, cited documents, growth rate and the activity index. The qualitative dimension was studied through a set of impact indicators: total of cited documents, percentage of cited documents, total of citations, average of citations by document and attractivity index.

These indicators were used to assess data for each of the 26 African countries with more than 1,000 articles published during the period 1996-2009 (45,6% of all the African countries covered by the SJCR). Activity and visibility (Attractivity) indexes were especially used to indicate the characterization of the ten PERii partner countries included in the group of studied African countries.

Other social and economic indicators obtained from the OECD reports (OECD, 2010) were used as complementary information of countries.

2.3. Countries studied

A total of 26 African countries were studied, which were structured in three geographic regions, according to the SJCR.

Northern Africa: Tunisia, Morocco, Algeria, and Lybia. Egypt (covered by the SJCR among the Middle East countries) was excluded of the studied sample.

Central Africa: Nigeria, Cameroon, Ghana, Senegal, Cote d'Ivoire, Burkina Faso, Benin, Congo, Gambia, Mali, and Gabon.

Southern Africa: South Africa, Kenya, Tanzania, Ethiopia, Uganda, Zimbabwe, Botswana, Sudan, Malawi, Zambia, and Madagascar.

The African PERii partner countries were especially identified in the study: Kenya, Tanzania, Ethiopia, Uganda, Zimbabwe, Ghana, Cote d'Ivoire, Malawi, Zambia, and Madagascar. Lesotho, Mozambique and Rwanda were excluded because of their low output (less than 1,000 research articles published during the period 1996-2009).

2.4. Limitations

The main limitations of this report concern the primary data source (Scopus). Some authors report inconsistent coverage of journals and problems with the identification of the countries in the affiliation field of the database registers (Jacsó, 2009).

Scopus only covers a core of approximately 18,000 journals from the total amount of peer reviewed journals published in the world. This evidently implies that findings are not based on the total scientific output of these countries. The report is therefore to be taken as a study of the more internationally visible scientific literature produced by the studied countries.

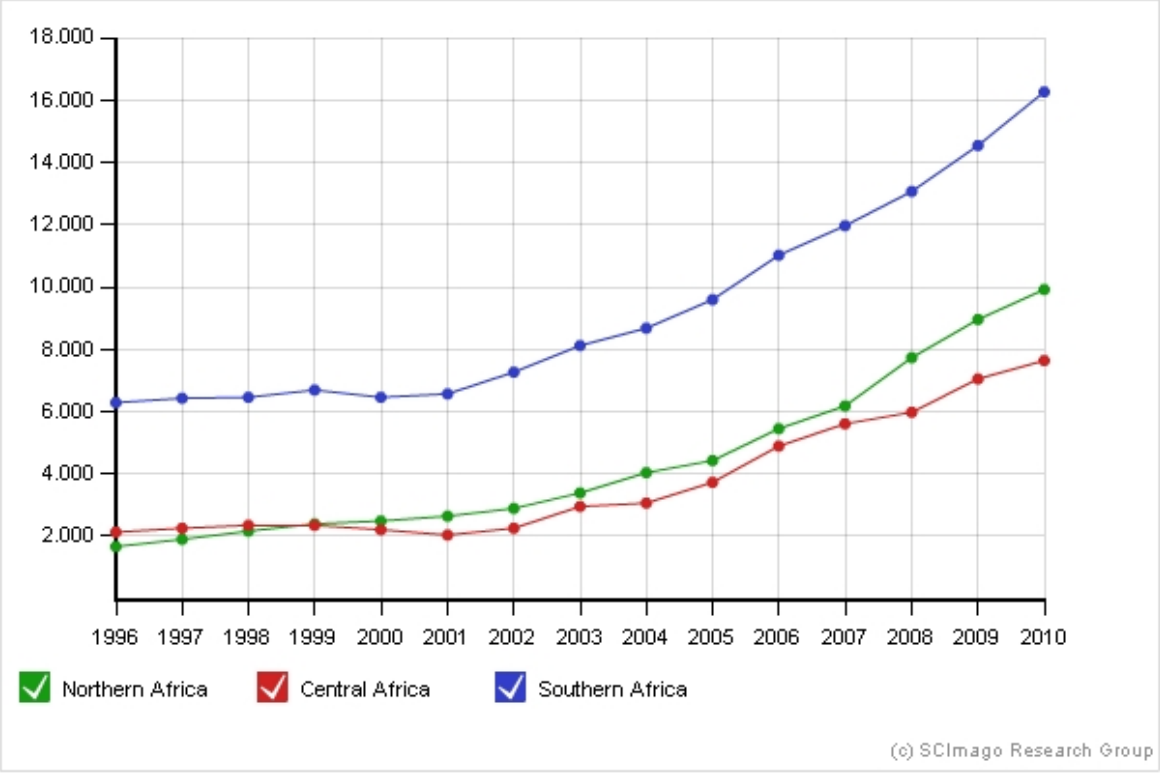
3. General overview

3.1. The scientific production of Africa

African scientific development has been studied using bibliometric indicators during the last ten years (O. B. Onyancha, 2009; Omwoyo Bosire Onyancha & Maluleka, 2011; Pouris & Pouris, 2009; Toivanen & Ponomariov, 2011). Some of these studies reveal a particularly intensive activity in the field of Biomedicine (Hofman, Kanyengo, Rapp, & Kotzin, 2009; Owolabi, Bower, & Ogunniyi, 2007; Schoonbaert, 2009; Siegfried, Busgeeth, & Certain, 2006; Swingler, Pillay, Pienaar, & Ioannidis, 2005; Uthman & Uthman, 2007). However, a negative picture of the scientific activity is evident in the papers, closely related to the traditional vision of Africa as the poorest continent with an disadvantageous situation relative to the World (Pouris & Pouris, 2009; Toivanen & Ponomariov, 2011).

Despite a global effort to harness science, technology and innovation in order to support regional development (Bugaje, 2006), it is clear that the continent advances depend on the growth of Southern Africa in general (Figure 1), and in particularl on the emergence of South Africa, the lead country of the region.

Figure 1. Annual patterns of scientific production in Northern, Central and Southern Africa (SJCR 1996–2008).



The continent's dependence on industrialized nations for the development of their national innovation systems is also easy to demonstrate by analyzing patterns of international collaboration (Omwoyo Bosire Onyancha & Maluleka, 2011), an interesting factor included in this study. Documented evidence illustrates not only the lack of research capabilities as a key factor arresting the development of African R+D activity, but also the structural weaknesses of the internal research collaboration (Toivanen & Ponomariov, 2011). High values of international collaboration on a research paper is therefore not the most important aspect for the studied countries. It is more likely that a key to future regional advancement lies in development of strong networks among the most productive institutions and sectors. INASP and other initatives supporting research in the region, are fostering such networks.

3.2. Regional distribution of the African scientific output indexed by Scopus

Data extracted from Scopus indicates that the African scientific production has been growing during the last 15 years (Table 1, Figure 1).

Table 1. Annual distribution of the world scientific output in Scopus by region (SJCR 1996–2008).

Years	Northern Africa	Central Africa	Southern Africa
1996	1660	2130	6292
1997	1900	2257	6420
1998	2154	2340	6455
1999	2384	2344	6697
2000	2483	2208	6459
2001	2643	2037	6558
2002	2895	2257	7260
2003	3380	2950	8121
2004	4029	3060	8671
2005	4430	3729	9595
2006	5448	4886	11023
2007	6180	5605	11968
2008	7735	5981	13065
2009	8961	7047	14537
2010	9914	7643	16268
Growth Rate	497%	258%	158%

Despite the clear protagonist role of the Southern Region, which is more than two times more productive in 2010 than in 1996, significant achievements can be observed in Central and especially in Northern Africa.

The scientific production of Northern Africa increased almost five fold during the studied period. In all regions, the most important growth commenced in 2002.

3.3. The most productive African institutions

This growth is closely related to the efforts of leading institutions in each country, which can be identified in Tables 2, 3 and 4. Universities from Tunisia, Algeria and Morocco led the output of Northern Africa. The universities of Sfax and Monastier, both from Tunisia, produced more than two thousand articles during the period 2003-2010 (Table 2).

Table 2. Top ten of the most productive institutions from Northern Africa (SIR 2003–2010).

Institution	2003	2004	2005	2006	2007	2008	2009	2010	Total
Universite de Sfax, Tunisia	158	216	241	330	382	491	493	228	2539
Universite de Monastir, Tunisia	124	157	224	299	333	399	374	193	2103
Universite des Sciences et de la Technologie Houari Boumediene, Algeria	144	186	185	246	287	412	315	94	1869
Universite de Tunis El Manar, Tunisia	157	172	190	181	297	239	367	161	1764
Universite Cadi Ayyad, Morocco	155	197	198	207	219	240	192	64	1472
Universite Mentouri-Constantine, Algeria	95	139	132	174	210	212	210	74	1246
Centre Hospitalier Ibn Sina Rabat, Morocco	138	93	117	155	144	151	211	131	1140
Universite Mohammed V-Agdal, Morocco	104	113	118	141	142	151	168	149	1086
Universite Badji Mokhtar – Annaba, Algeria	55	75	101	120	125	168	213	119	976
Hopital La Rabta, Tunisia	72	83	97	114	121	167	121	118	893

Table 3. Top ten of the most productive institutions from Central Africa (SIR 2003–2010).

Institution	2003	2004	2005	2006	2007	2008	2009	2010	Total
University of Ibadan, Nigeria	228	273	302	452	473	605	610	556	3499
Obafemi Awolowo University, Nigeria	179	193	222	352	327	286	289	202	2050
Universite de Yaounde I, Cameroon	141	155	181	219	296	292	277	184	1745
University of Lagos, Nigeria	77	111	118	177	256	276	226	143	1384
University of Benin, Nigeria	79	61	109	163	223	155	259	161	1210
University of Nigeria, Nigeria	73	88	90	106	143	176	230	293	1199
University of Ghana, Ghana	88	116	111	116	176	160	210	211	1188
Ahmadu Bello University, Nigeria	88	71	72	130	163	185	164	173	1046
University College Hospital, Nigeria	122	107	121	127	135	144	143	124	1023
Universite Cheikh Anta Diop de Dakar, Senegal	111	85	128	115	157	162	148	60	966

Nigeria is the most productive country in the central region. Two universities of this country produced more than two thousand articles during the period studied: University of Ibadan and Obafemi Awolowo University (Table 3). However, the University of Ibadan is clearly the region's leading institution, with significant growth during the last years.

Leadership of South Africa is evident in the southern region. Nine of the top ten institutions are from this country, most producing more than two thousand articles during the period (Table 4). The Makerere University, from Uganda, is the only non-South African institution included in the top ten. The five most productive South African universities were also the most productive institutions of the whole continent.

Table 4. Top ten of the most productive institutions from Southern Africa (SIR 2003–2010).

Institution	2003	2004	2005	2006	2007	2008	2009	2010	Total
University of Cape Town, South Africa	891	1065	1277	1450	1596	1668	1813	1747	11507
University of Pretoria, South Africa	741	908	977	1106	1067	1222	1297	1133	8451
University of the Witwatersrand, Johannesburg, South Africa	760	844	915	1028	1166	1159	1278	1189	8339
Stellenbosch University, South Africa	682	755	835	952	995	1151	1257	1159	7786
University of KwaZulu-Natal, South Africa	696	781	831	874	888	1046	1055	922	7093
University of the Free State, South Africa	201	249	243	303	316	297	334	309	2252
Rhodes University, South Africa	190	213	211	270	299	320	306	296	2105
Makerere University, Uganda	140	194	191	218	288	324	384	320	2059
South African Medical Research Council, South Africa	144	148	229	241	289	293	304	302	1950
University of Johannesburg, South Africa	152	194	191	215	248	247	336	275	1858

3.3. The most productive institutions from African PERii partner countries

A total of 458 institutions from PERii partner countries produced at least one article during the period 2003-2010. From these institutions, 191 (42%) belong to the Health Sector, 102 (22%) are government institutions, and 20% (90 universities) belong to the Higher Education Sector. However, if we takes into account the 25 most productive institutions, it is clear that Higher Education has a protagonist role in the scientific output of PERii partner countries (Table 5).

The Makerere University (Uganda), is not only the most productive institution belonging to African PERii partner countries, but also the only institution with more than two thousands articles covered by Scopus during the period 2003-2010 (Table 5).

Table 5. Top 25 of the most productive institutions from PERii Partner African countries (SIR 2003–2010).

Organization	2003	2004	2005	2006	2007	2008	2009	2010	Total
Makerere University, Uganda	140	194	191	218	288	324	384	320	2059
University of Nairobi, Kenya	168	195	195	203	252	259	255	203	1730
Addis Ababa University, Ethiopia	122	141	145	191	248	216	214	233	1510
Kenya Medical Research Institute	145	177	153	193	179	242	238	160	1487
University of Zimbabwe	190	158	152	173	176	157	117	164	1287
University of Ghana	88	116	111	116	176	160	210	211	1188
University of Dar es Salaam, Tanzania	74	86	89	97	111	125	107	100	789
Muhimbili University of Health and Allied Sciences, Tanzania	48	67	77	100	111	114	130	101	748
Kwame Nkrumah University of Science and Technology, Ghana	48	45	45	82	107	130	145	133	735
International Livestock Research Institute Kenya, Kenya	114	81	74	64	82	75	92	81	663
Universite de Cocody, Cote d'Ivoire	49	58	48	62	96	122	136	89	660
Sokoine University of Agriculture, Tanzania	64	60	69	91	90	70	87	75	606
University of Zambia	51	40	55	68	93	104	97	93	601
Uganda Ministry of Health	49	74	67	71	67	70	61	54	513
International Centre of Insect Physiology and Ecology, Kenya	61	43	60	87	74	85	53	45	508
Kenyatta University, Kenya	51	49	48	81	70	71	51	44	465
National Institute for Medical Research, Tanzania	22	39	40	58	74	72	62	64	431
Moi University, Kenya	38	44	45	47	65	37	40	51	367
Universite d'Antananarivo, Madagascar	25	27	42	41	64	64	62	26	351
Ethiopian Institute of Agricultural Research	23	18	50	56	53	63	46	29	338
Council for Scientific and Industrial Research Ghana	38	26	43	39	61	50	35	35	327
World Agroforestry Centre Kenya	32	45	44	67	46	35	26	16	311
Egerton University, Kenya	25	31	35	61	58	39	20	22	291
Universidade Eduardo Mondlane, Mozambique	27	30	41	41	33	49	50	19	290
Kenya Agricultural Research Institute	23	17	37	59	54	28	25	25	268

Nine of the 25 most productive institutions are from Kenya, clearly the leader of the 13 PERii partner nations.

The bibliometric study of the 26 most productive African countries is presented in the next section.

4. Bibliometric study of African countries, 1996–2009

In this section, the statistical data for each of the studied countries is presented. Specialists, analysts and decision-makers can compare the bibliometric information of each country with the information from the previous section.

For each country the information was structured according to two topics:

1. General data (output, impact and international collaboration; plus social and economic indicators)
2. Research areas

The topic ‘General data’ presents information extracted from SJCR in three tables related to the scientific production of the country in Scopus. It has used a battery of output and impact indicators, calculated for the whole period and for the two periods established for comparative purposes:

total number of documents **Doc**,
primary documents (articles, reviews, letter, short communications and conference proceedings) **P.Doc**,
total number of citations **Cit**,
self-citations **S-Cit**,
average of citations per document **CxD**,
average of self-citations per document **SCxD**,
cited documents **CD**,
uncited documents **UD**,
percentage of international collaboration **IC(%)**,
proportion of the world scientific production% **World**,
and the Hirsch Index of the country **H index** (Hirsch, 2005).

The topic ‘Research areas’ shows output, impact, and relative indicators in each of the 27 Scopus subject areas*:

Activity Index **AI** (Frame, 1977),

Visibility (Attractivity) Index **VI** (Braun & Schubert, 1997)’

And Relative Impact **RI**.

*** Abbreviations of the subject areas:** Agricultural and Biological Sciences **abs**; Arts and Humanities **ah**; Biochemistry, Genetics and Molecular Biology **bgmb**; Business, Management and Accounting **bma**; Chemical Engineering **ce**; Chemistry **che**; Computer Science **cs**; Decision Sciences **ds**; Dentistry **de**; Earth and Planetary Sciences **eps**; Economics, Econometrics and Finance **eef**; Energy **ene**; Engineering **eng**; Environmental Science **es**; Health Professions **hp**; Immunology and Microbiology **im**; Materials Science **ms**; Mathematics **mat**; Medicine **med**; Multidisciplinary **mul**; Neuroscience **neu**; Nursing **nur**; Pharmacology, Toxicology and Pharmaceutics **ptp**; Physics and Astronomy **pa**; Psychology **psy**; Social Sciences **ss**; Veterinary **vet**.

4.1. South Africa

Population (thousands): **50 110**
Land area (thousands of Km^2): **1 221**
Population density (pop/Km^2): **41**
GDP based on PPP valuation (US $ million): **487 107**
GDP per Capita (PPP valuation, $): **9 721**
Annual real GDP growth (average over 2001-2009): **3.6**

4.1.1. General data (output and impact)

Table 6. Total output and impact of the South African scientific activity (SJCR 1996–2009).

South Africa 1996–2009	Total
Documents	82.043
Citable documents	77.865
Citations	706.261
Self citations	159.576
Citations per document	8,61
H index	179

Table 7. Annual output and impact of the South African scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	4.168	4.214	4.368	4.525	4.363	4.446	5.043	5.420	5.879	6.524	7.332	7.734	8.655	9.372	82.043
P. Doc	4.076	4.083	4.194	4.371	4.161	4.202	4.763	5.116	5.544	6.144	6.953	7.313	8.140	8.805	77.865
Cit	51.317	52.937	57.092	62.668	59.149	54.310	50.919	58.715	62.366	58.705	52.697	41.218	30.332	13.836	706.261
S-Cit	11.501	11.740	11.335	12.697	12.613	12.179	12.530	13.296	13.569	13.073	12.929	10.637	7.715	3.762	159.576
CxD	12,31	12,56	13,07	13,85	13,56	12,22	10,10	10,83	10,61	9,00	7,19	5,33	3,50	1,48	8,61
SCxD	2,76	2,79	2,6	2,81	2,89	2,74	2,48	2,45	2,31	2,00	1,76	1,38	0,89	0,40	1,95
CD	3.409	3.511	3.605	3.734	3.657	3.754	4.085	4.372	4.669	5.005	5.441	5.459	5.301	3.994	59.996
UD	759	703	763	791	706	692	958	1.048	1.210	1.519	1.891	2.275	3.354	5.378	22.047
IC(%)	31,14	31,23	32,12	31,73	30,83	28,12	27,86	41,64	45,16	46,54	46,17	48,58	47,12	48,1	*38,31*
% World	0,37	0,36	0,38	0,39	0,36	0,34	0,37	0,38	0,37	0,37	0,40	0,40	0,44	0,46	0,39

Table 8. Output and impact of the South African scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	31.127	37,94	50.916	62,06
Citable documents	29.850	38,34	48.015	61,66
Cites	388.392	54,99	317.869	45,01
Self cites	84.595	53,01	74.981	46,99
Cites per doc.	12,48		6,24	
Self cites per doc.	2,72		1,47	
Cited docs.	25.755	42,93	34.241	57,07
Uncited docs.	5.372	24,37	16.675	75,63
% International collaboration	*30,43*		*46,19*	
% world	0,365		0,41	

4.1.2. Research areas

Table 9. Bibliometric indicators by subject areas (South Africa-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**SAF**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	17.367	21,17	143.896	8,29	3,02	2,71	0,81
Arts and humanities	1.583	1,93	3.313	2,09	1,35	1,99	1,32
Biochemistry, genetics and molecular biology	7.175	8,75	93.673	13,06	0,78	0,58	0,68
Business, management and accounting	820	1,00	3.181	3,88	0,53	0,46	0,78
Chemical engineering	1.997	2,43	17.255	8,64	0,61	0,98	1,43
Chemistry	4.223	5,15	41.622	9,86	0,76	0,66	0,77
Computer science	1.868	2,28	10.247	5,49	0,51	0,51	0,89
Decision sciences	338	0,41	1.794	5,31	0,95	0,73	0,69
Dentistry	213	0,26	2.113	9,92	0,61	0,80	1,17
Earth and planetary sciences	8.261	10,07	79.204	9,59	2,53	2,66	0,95
Economics, econometrics and finance	917	1,12	5.663	6,18	1,11	0,89	0,73
Energy	812	0,99	3.277	4,04	0,71	0,83	1,06
Engineering	5.050	6,16	19.147	3,79	0,50	0,49	0,88
Environmental science	7.178	8,75	69.905	9,74	2,50	2,44	0,88
Health professions	447	0,54	3.110	6,96	0,84	0,59	0,63
Immunology and microbiology	4.612	5,62	69.919	15,16	1,80	1,64	0,82
Materials science	2.850	3,47	17.618	6,18	0,59	0,58	0,89
Mathematics	3.165	3,86	14.267	4,51	1,02	0,90	0,80
Medicine	18.090	22,05	192.089	10,62	0,80	0,94	1,07
Multidisciplinary	535	0,65	20.441	38,21	0,63	0,69	0,99
Neuroscience	703	0,86	11.154	15,87	0,47	0,37	0,72
Nursing	453	0,55	2.804	6,19	0,52	0,56	0,96
Pharmacology, toxicology and pharmaceutics	1.347	1,64	14.643	10,87	0,63	0,76	1,08
Physics and astronomy	4.231	5,16	33.840	8,00	0,70	0,64	0,83
Psychology	1.516	1,85	7.272	4,80	1,38	0,68	0,44
Social sciences	5.230	6,37	19.410	3,71	1,72	1,67	0,88
Veterinary	1.630	1,99	9.742	5,98	2,42	3,22	1,20
Total	**82.043**	**100**	**706.261**	**8,61**			**0.90**

Figure 2. Activity and visibility of the South African scientific output by subject areas (SJCR 1996–2009).

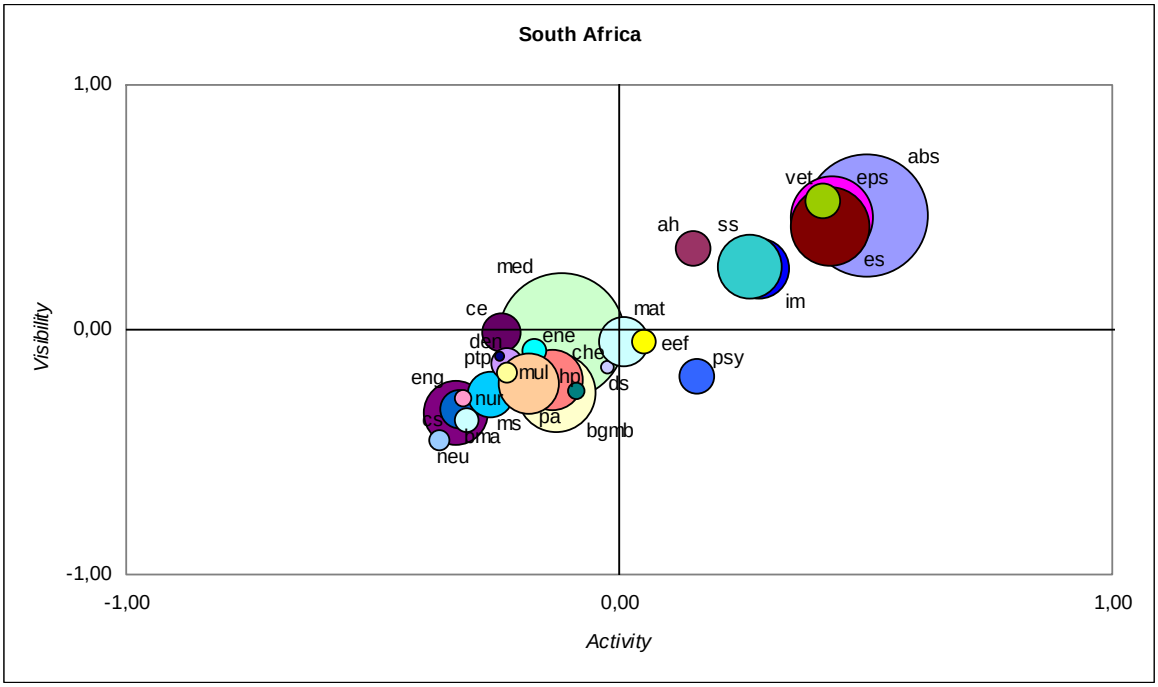
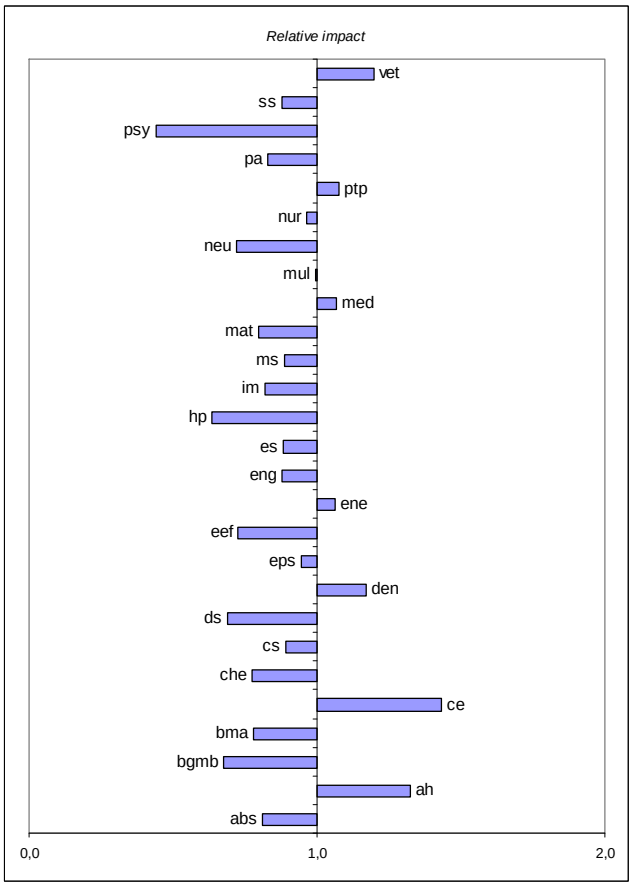


Figure 3. Relative impact of the South African scientific output by subject areas (SJCR 1996–2009).



4.2. Nigeria

Population (thousands): **154 729**
Land area (thousands of Km^2): **924**
Population density (pop/Km^2): **167**
GDP based on PPP valuation (US $ million): **327 822**
GDP per Capita (PPP valuation, $): **2 119**
Annual real GDP growth (average over 2001-2009): **8.2**

4.2.1. General data (output and impact)

Table 10. Total output and impact of the Nigerian scientific activity (SJCR 1996–2009).

Nigeria 1996–2009	Total
Documents	24.805
Citable documents	24.325
Citations	90.760
Self citations	23.500
Citations per document	3,66
H index	67

Table 11. Annual output and impact of the Nigerian scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	1.036	1.037	1.015	1.020	1.055	961	1.092	1.320	1.392	1.786	2.623	3.138	3.279	4.051	24.805
P. Doc	1.031	1.030	1.002	1.007	1.034	944	1.067	1.280	1.360	1.736	2.568	3.095	3.219	3.952	24.325
Cit	6.247	7.324	7.080	7.349	7.113	6.375	6.028	7.273	6.994	7.717	7.478	7.438	4.386	1.958	90.760
S-Cit	1.624	1.853	1.630	1.900	1.568	1.515	1.571	1.893	1.802	2.235	2.139	1.918	1.250	602	23.500
CxD	6,03	7,06	6,98	7,2	6,74	6,63	5,52	5,51	5,02	4,32	2,85	2,37	1,34	0,48	3,66
SCxD	1,57	1,79	1,61	1,86	1,49	1,58	1,44	1,43	1,29	1,25	0,82	0,61	0,38	0,15	0,95
CD	823	831	779	824	798	727	815	1.001	1.021	1.261	1.547	1.651	1.460	925	14.463
UD	213	206	236	196	257	234	277	319	371	525	1.076	1.487	1.819	3.126	10.342
IC(%)	39,38	34,14	35,76	30,00	28,25	22,79	23,81	28,33	27,87	25,42	21,5	20,01	22,60	22,32	*27,30*
% World	0,09	0,09	0,09	0,09	0,09	0,07	0,08	0,09	0,09	0,10	0,14	0,16	0,17	0,20	0,12

Table 12. Output and impact of the Nigerian scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	7.216	29,09	17.589	70,91
Citable documents	7.115	29,25	17.210	70,75
Cites	47.516	52,35	43.244	47,65
Self cites	11.661	49,62	11.839	50,38
Cites per doc.	6,58		2,46	
Self cites per doc.	1,62		0,67	
Cited docs.	5.597	38,70	8.866	61,30
Uncited docs.	1.619	15,65	8.723	84,35
% International collaboration	*30,59*		*24,01*	
% world	0,08		0,14	

4.2.2. Research areas

Table 13. Bibliometric indicators by subject areas (Nigeria-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**NIG**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	6.449	26,00	23.600	3,66	3,70	3,46	0,36
Arts and humanities	227	0,92	150	0,66	0,64	0,70	0,42
Biochemistry, genetics and molecular biology	3.075	12,40	11.595	3,77	1,10	0,56	0,20
Business, management and accounting	288	1,16	497	1,73	0,61	0,56	0,35
Chemical engineering	678	2,73	2.892	4,27	0,69	1,27	0,71
Chemistry	948	3,82	5.020	5,30	0,57	0,62	0,42
Computer science	329	1,33	429	1,30	0,30	0,16	0,21
Decision sciences	37	0,15	130	3,51	0,35	0,41	0,45
Dentistry	108	0,44	583	5,40	1,03	1,71	0,64
Earth and planetary sciences	1.039	4,19	4.137	3,98	1,05	1,08	0,39
Economics, econometrics and finance	164	0,66	801	4,88	0,66	0,98	0,57
Energy	433	1,75	1.881	4,34	1,25	3,72	1,14
Engineering	899	3,62	1.835	2,04	0,30	0,37	0,47
Environmental science	1.879	7,58	6.357	3,38	2,16	1,73	0,31
Health professions	87	0,35	267	3,07	0,54	0,40	0,28
Immunology and microbiology	1.541	6,21	9.653	6,26	1,99	1,76	0,34
Materials science	748	3,02	2.955	3,95	0,51	0,76	0,57
Mathematics	360	1,45	1.154	3,21	0,38	0,57	0,57
Medicine	6.806	27,44	29.189	4,29	0,99	1,12	0,43
Multidisciplinary	924	3,73	2.308	2,50	3,59	0,61	0,06
Neuroscience	134	0,54	969	7,23	0,29	0,25	0,33
Nursing	522	2,10	985	1,89	1,99	1,53	0,29
Pharmacology, toxicology and pharmaceutics	1.348	5,43	4.634	3,44	2,10	1,86	0,34
Physics and astronomy	371	1,50	1.162	3,13	0,20	0,17	0,32
Psychology	103	0,42	277	2,69	0,31	0,20	0,25
Social sciences	1.602	6,46	2.534	1,58	1,74	1,70	0,37
Veterinary	730	2,94	1.849	2,53	3,59	4,76	0,51
Total	**24.805**	**100**	**90.760**	**3,66**			**0.38**

Figure 4. Activity and visibility of the Nigerian scientific output by subject areas (SJCR 1996–2009).

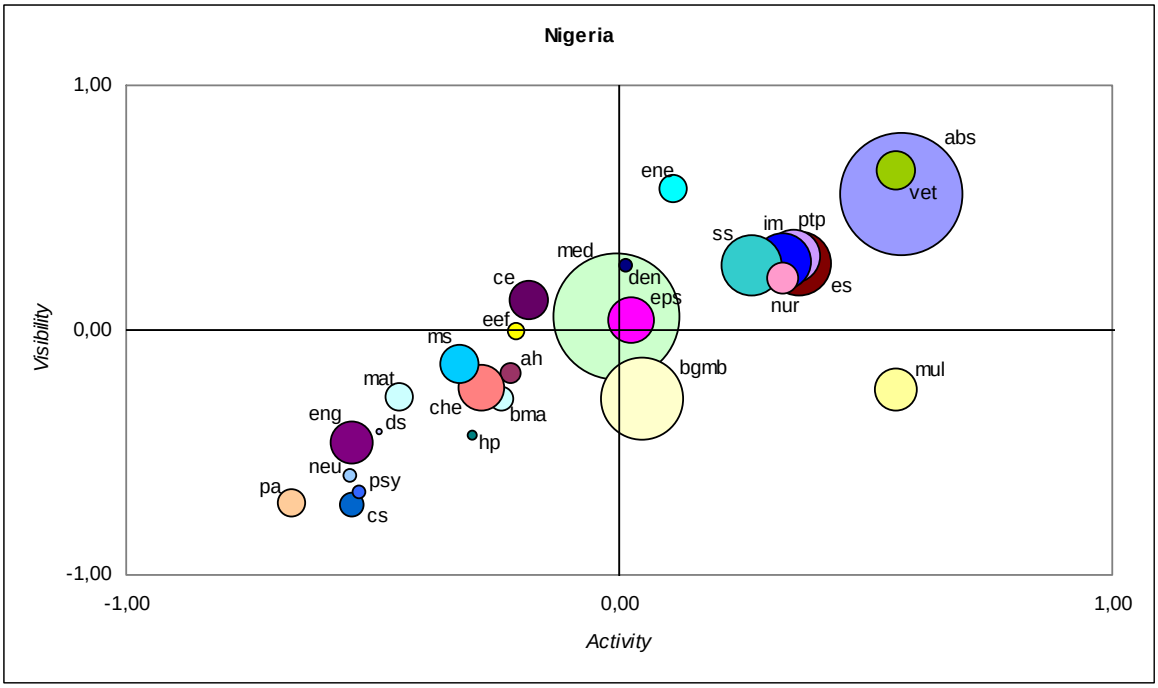
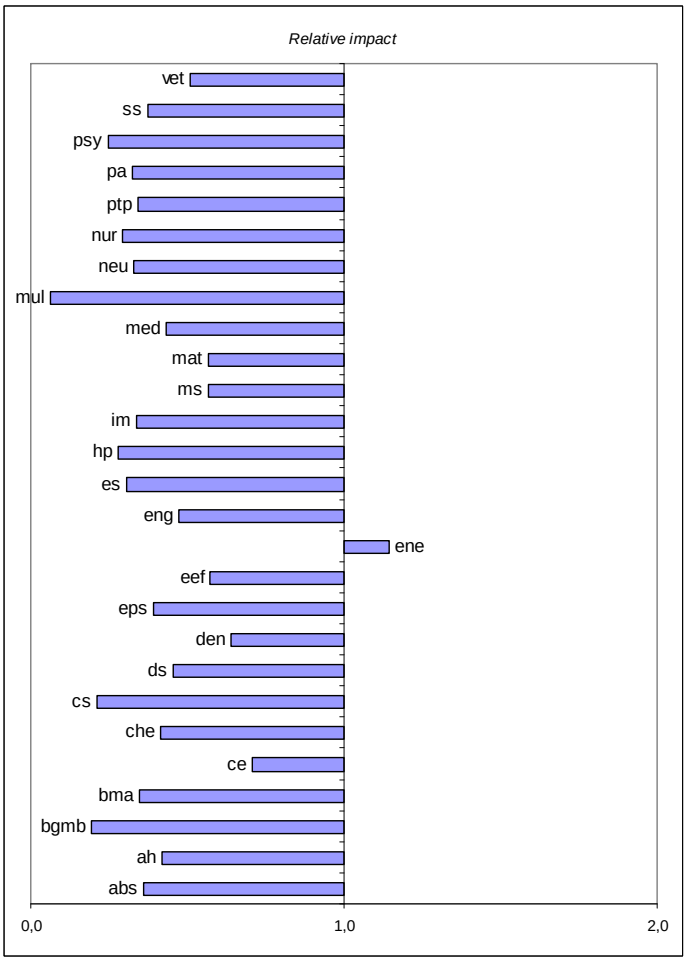


Figure 5. Relative impact of the Nigerian scientific output by subject areas (SJCR 1996–2009).



4.3. Tunisia

Population (thousands): **10 272**
Land area (thousands of Km^2): **164**
Population density (pop/Km^2): **63**
GDP based on PPP valuation (US $ million): **89 010**
GDP per Capita (PPP valuation, $): **8 666**
Annual real GDP growth (average over 2001-2009): **4.6**

4.3.1. General data (output and impact)

Table 14. Total output and impact of the Tunisian scientific activity (SJCR 1996–2009).

Tunisia 1996–2009	Total
Documents	22.216
Citable documents	21.436
Citations	87.487
Self citations	21.173
Citations per document	3,94
H index	68

Table 15. Annual output and impact of the Tunisian scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	427	578	619	700	741	858	1.061	1.244	1.562	1.912	2.294	2.744	3.549	3.927	22.216
P. Doc	422	570	605	683	729	833	1.042	1.217	1.531	1.871	2.211	2.675	3.274	3.773	21.436
Cit	2.657	6.315	4.346	4.588	5.960	6.803	6.764	7.363	7.553	9.271	8.617	8.085	6.480	2.685	87.487
S-Cit	676	942	925	1.163	1.437	1.562	1.685	1.803	1.953	2.189	2.181	2.144	1.636	877	21.173
CxD	6,22	10,93	7,02	6,55	8,04	7,93	6,38	5,92	4,84	4,85	3,76	2,95	1,83	0,68	3,94
SCxD	1,58	1,63	1,49	1,66	1,94	1,82	1,59	1,45	1,25	1,14	0,95	0,78	0,46	0,22	0,95
CD	299	407	427	511	576	669	764	928	1.054	1.300	1.587	1.655	1.612	1.211	13.000
UD	128	171	192	189	165	189	297	316	508	612	707	1.089	1.937	2.716	9.216
IC(%)	41,92	44,46	41,36	38,29	38,87	36,95	38,36	41,96	45,07	45,14	43,16	44,79	41,73	44,46	*41,89*
% World	0,04	0,05	0,05	0,06	0,06	0,06	0,08	0,09	0,1	0,11	0,13	0,14	0,18	0,19	0,11

Table 16. Output and impact of the Tunisian scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	4.984	22,43	17.232	77,57
Citable documents	4.884	22,78	16.552	77,22
Cites	37.433	42,79	50.054	57,21
Self cites	8.390	39,63	12.783	60,37
Cites per doc.	7,51		2,90	
Self cites per doc.	1,68		0,74	
Cited docs.	3.653	28,10	9.347	71,90
Uncited docs.	1.331	14,44	7.885	85,56
% International collaboration	*40,03*		*43,76*	
% world	0,06		0,14	

4.3.2. Research areas

Table 17. Bibliometric indicators by subject areas (Tunisia-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**TUN**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	2.494	11,23	12.895	5,17	1,60	1,96	0,51
Arts and humanities	37	0,17	20	0,54	0,12	0,10	0,34
Biochemistry, genetics and molecular biology	2.090	9,41	16.833	8,05	0,84	0,85	0,42
Business, management and accounting	89	0,40	218	2,45	0,21	0,25	0,49
Chemical engineering	1.137	5,12	7.834	6,89	1,29	3,58	1,14
Chemistry	1.779	8,01	10.189	5,73	1,19	1,30	0,45
Computer science	1.188	5,35	2.371	2,00	1,20	0,94	0,32
Decision sciences	202	0,91	1.022	5,06	2,11	3,34	0,65
Dentistry	40	0,18	24	0,60	0,42	0,07	0,07
Earth and planetary sciences	653	2,94	3.263	5,00	0,74	0,88	0,49
Economics, econometrics and finance	139	0,63	346	2,49	0,62	0,44	0,29
Energy	197	0,89	834	4,23	0,63	1,71	1,11
Engineering	2.319	10,44	7.338	3,16	0,86	1,52	0,73
Environmental science	1.053	4,74	6.355	6,04	1,35	1,79	0,55
Health professions	76	0,34	170	2,24	0,53	0,26	0,20
Immunology and microbiology	887	3,99	6.961	7,85	1,28	1,32	0,42
Materials science	2.077	9,35	9.481	4,56	1,58	2,52	0,66
Mathematics	1.556	7,00	4.165	2,68	1,86	2,13	0,47
Medicine	6.507	29,29	21.296	3,27	1,06	0,84	0,33
Multidisciplinary	91	0,41	275	3,02	0,40	0,08	0,08
Neuroscience	100	0,45	1.181	11,81	0,24	0,32	0,54
Nursing	33	0,15	73	2,21	0,14	0,12	0,34
Pharmacology, toxicology and pharmaceutics	268	1,21	1.947	7,26	0,47	0,81	0,72
Physics and astronomy	1.694	7,63	6.511	3,84	1,03	0,99	0,40
Psychology	37	0,17	123	3,32	0,12	0,09	0,31
Social sciences	230	1,04	608	2,64	0,28	0,42	0,62
Veterinary	175	0,79	899	5,14	0,96	2,40	1,03
Total	**22.216**	**100**	**87.487**	**3,94**			**0.41**

Figure 6. Activity and visibility of the Tunisian scientific output by subject areas (SJCR 1996–2009).

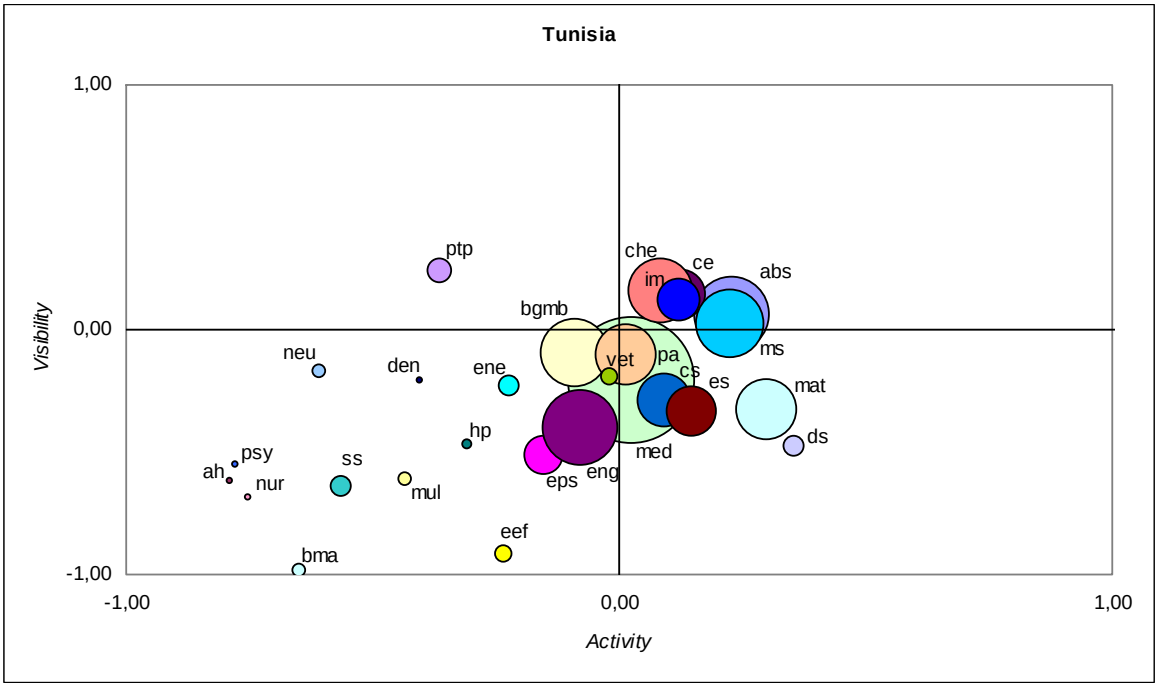
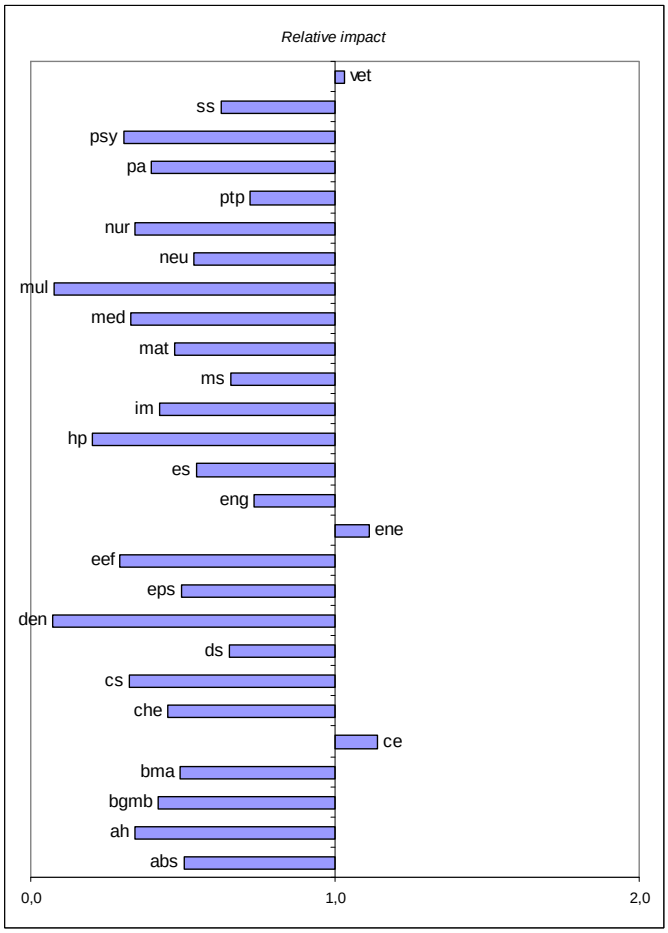


Figure 7. Relative impact of the Tunisian scientific output by subject areas (SJCR 1996–2009).



4.4. Morocco

Population (thousands): **31 993**
Land area (thousands of Km^2): **711**
Population density (pop/Km^2): **45**
GDP based on PPP valuation (US $ million): **151 855**
GDP per Capita (PPP valuation, $): **4 747**
Annual real GDP growth (average over 2001-2009): **5.1**

4.4.1. General data (output and impact)

Table 18. Total output and impact of the scientific activity in Morocco (SJCR 1996–2009).

Morocco 1996–2009	Total
Documents	18.090
Citable documents	17.550
Citations	96.798
Self citations	18.783
Citations per document	5,35
H index	76

Table 19. Annual output and impact of the scientific activity in Morocco (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	807	894	1.052	1.171	1.178	1.210	1.178	1.275	1.291	1.281	1.448	1.552	1.754	1.999	18.090
P. Doc	804	888	1.041	1.160	1.163	1.182	1.145	1.237	1.267	1.250	1.382	1.486	1.660	1.885	17.550
Cit	7.908	7.294	9.803	8.818	9.102	7.975	8.077	8.299	7.612	6.538	6.280	4.812	3.002	1.278	96.798
S-Cit	1.260	1.422	1.533	1.809	1.727	1.760	1.672	1.548	1.522	1.389	1.262	940	618	321	18.783
CxD	9,8	8,16	9,32	7,53	7,73	6,59	6,86	6,51	5,9	5,1	4,34	3,1	1,71	0,64	5,35
SCxD	1,56	1,59	1,46	1,54	1,47	1,45	1,42	1,21	1,18	1,08	0,87	0,61	0,35	0,16	1,04
CD	640	655	854	904	932	916	927	963	909	904	965	905	837	556	11.867
UD	167	239	198	267	246	294	251	312	382	377	483	647	917	1.443	6.223
IC(%)	63,07	56,71	59,79	55,08	51,27	42,98	43,38	52,31	57,09	56,83	52,56	54,38	54,79	47,72	*53,43*
% World	0,07	0,08	0,09	0,10	0,10	0,09	0,09	0,09	0,08	0,07	0,08	0,08	0,09	0,10	0,09

Table 20. Output and impact of the scientific activity by periods in Morocco (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	7.490	41,40	10.600	58,60
Citable documents	7.383	42,07	10.167	57,93
Cites	58.977	60,93	37.821	39,07
Self cites	11.183	59,54	7.600	40,46
Cites per doc.	7,87		3,57	
Self cites per doc.	1,49		0,72	
Cited docs.	5.828	49,11	6.039	50,89
Uncited docs.	1.662	26,71	4.561	73,29
% International collaboration	*53,18*		*53,67*	
% world	0,09		0,08	

4.4.2. Research areas

Table 21. Bibliometric indicators by subject areas (Morocco-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**MOR**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	1.845	10,20	13.753	7,45	3,02	2,71	0,81
Arts and humanities	69	0,38	86	1,25	1,35	1,99	1,32
Biochemistry, genetics and molecular biology	1.412	7,81	13.972	9,90	0,78	0,58	0,68
Business, management and accounting	30	0,17	125	4,17	0,53	0,46	0,78
Chemical engineering	753	4,16	6.498	8,63	0,61	0,98	1,43
Chemistry	2.207	12,20	17.200	7,79	0,76	0,66	0,77
Computer science	589	3,26	1.873	3,18	0,51	0,51	0,89
Decision sciences	159	0,88	590	3,71	0,95	0,73	0,69
Dentistry	54	0,30	87	1,61	0,61	0,80	1,17
Earth and planetary sciences	1.081	5,98	8.010	7,41	2,53	2,66	0,95
Economics, econometrics and finance	43	0,24	164	3,81	1,11	0,89	0,73
Energy	201	1,11	1.124	5,59	0,71	0,83	1,06
Engineering	1.321	7,30	5.979	4,53	0,50	0,49	0,88
Environmental science	999	5,52	7.125	7,13	2,50	2,44	0,88
Health professions	84	0,46	215	2,56	0,84	0,59	0,63
Immunology and microbiology	452	2,50	4.492	9,94	1,80	1,64	0,82
Materials science	1.655	9,15	10.518	6,36	0,59	0,58	0,89
Mathematics	1.886	10,43	5.890	3,12	1,02	0,90	0,80
Medicine	4.545	25,12	13.988	3,08	0,80	0,94	1,07
Multidisciplinary	80	0,44	780	9,75	0,63	0,69	0,99
Neuroscience	139	0,77	1.550	11,15	0,47	0,37	0,72
Nursing	25	0,14	57	2,28	0,52	0,56	0,96
Pharmacology, toxicology and pharmaceutics	330	1,82	3.044	9,22	0,63	0,76	1,08
Physics and astronomy	2.195	12,13	12.199	5,56	0,70	0,64	0,83
Psychology	29	0,16	112	3,86	1,38	0,68	0,44
Social sciences	189	1,04	365	1,93	1,72	1,67	0,88
Veterinary	122	0,67	775	6,35	2,42	3,22	1,20
Total	**18.090**	**100**	**96.798**	**5,35**			**0.56**

Figure 8. Activity and visibility of the scientific output by subject areas in Morocco (SJCR 1996–2009).

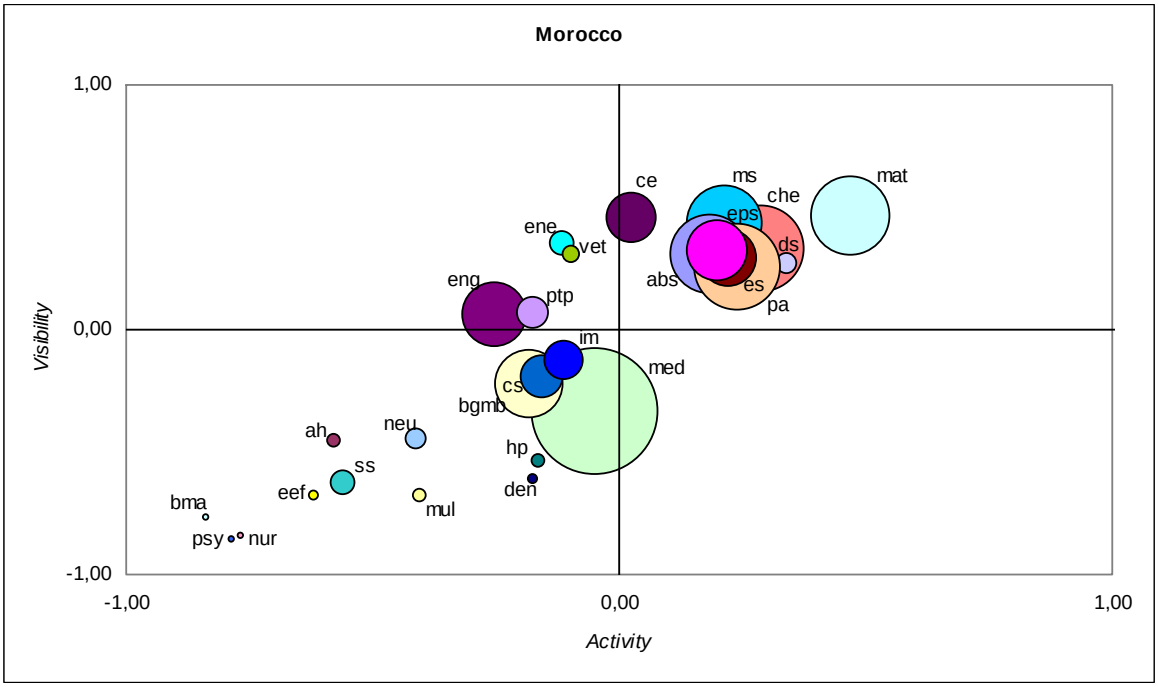
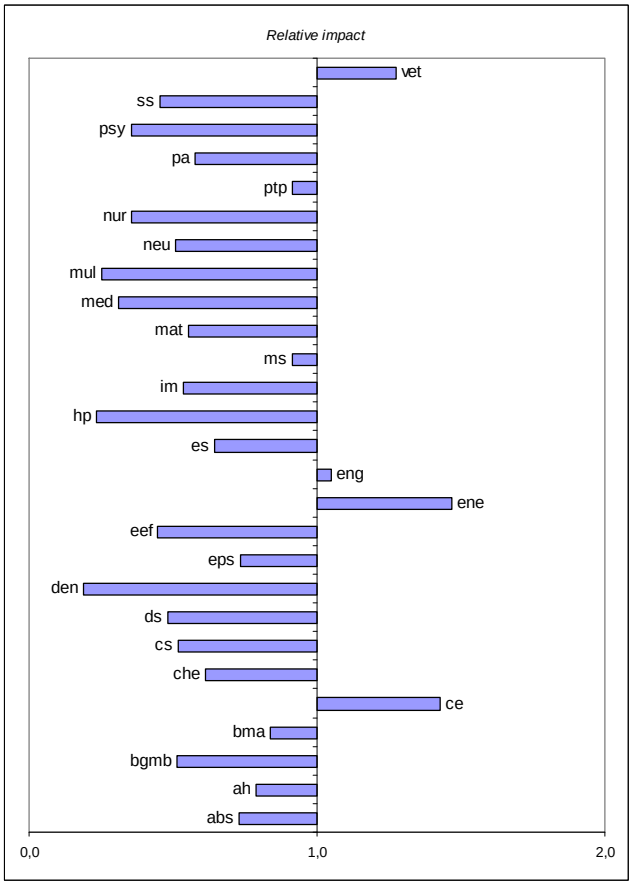


Figure 9. Relative impact of the scientific output by subject areas in Morocco (SJCR 1996–2009).



4.5. Algeria

Population (thousands): **34 895**
Land area (thousands of Km^2): **2 382**
Population density (pop/Km^2): **15**
GDP based on PPP valuation (US $ million): **256 542**
GDP per Capita (PPP valuation, $): **7 352**
Annual real GDP growth (average over 2001-2009): **3.7**

4.5.1. General data (output and impact)

Table 22. Total output and impact of the Algerian scientific activity (SJCR 1996–2009).

Algeria 1996–2009	Total
Documents	14.430
Citable documents	14.307
Citations	55.037
Self citations	11.211
Citations per document	3,81
H index	62

Table 23. Annual output and impact of the Algerian scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	369	376	419	455	492	511	589	799	1.086	1.129	1.553	1.771	2.258	2.623	14.430
P. Doc	369	376	415	454	490	506	581	791	1.073	1.121	1.542	1.764	2.240	2.585	14.307
Cit	3.296	2.652	3.624	3.029	3.911	4.330	3.644	4.332	5.712	4.493	5.892	4.560	3.814	1.748	55.037
S-Cit	453	445	615	595	707	762	756	1.013	1.132	1.122	1.309	1.071	830	401	11.211
CxD	8,93	7,05	8,65	6,66	7,95	8,47	6,19	5,42	5,26	3,98	3,79	2,57	1,69	0,67	3,81
SCxD	1,23	1,18	1,47	1,31	1,44	1,49	1,28	1,27	1,04	0,99	0,84	0,6	0,37	0,15	0,78
CD	295	278	320	362	355	382	404	573	713	736	969	995	983	733	8.098
UD	74	98	99	93	137	129	185	226	373	393	584	776	1.275	1.890	6.332
IC(%)	66,12	64,89	63,48	62,2	51,22	47,55	43,46	55,07	53,22	55,45	54,09	56,01	51,77	54,10	*55,62*
% World	0,03	0,03	0,04	0,04	0,04	0,04	0,04	0,06	0,07	0,06	0,09	0,09	0,11	0,13	0,07

Table 24. Output and impact of the Algerian scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	3.211	22,25	11.219	77,75
Citable documents	3.191	22,30	11.116	77,70
Cites	24.486	44,49	30.551	55,51
Self cites	4.333	38,65	6.878	61,35
Cites per doc.	7,63		2,72	
Self cites per doc.	1,35		0,61	
Cited docs.	2.396	29,59	5.702	70,41
Uncited docs.	815	12,87	5.517	87,13
% International collaboration	*56,99*		*54,24*	
% world	0,04		0,09	

4.5.2. Research areas

Table 25. Bibliometric indicators by subject areas (Algeria-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**ALG**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	930	6,44	3.727	4,01	0,92	0,90	0,39
Arts and humanities	21	0,15	39	1,86	0,10	0,30	1,17
Biochemistry, genetics and molecular biology	685	4,75	6.230	9,09	0,42	0,50	0,47
Business, management and accounting	32	0,22	33	1,03	0,12	0,06	0,21
Chemical engineering	1.037	7,19	6.029	5,81	1,82	4,38	0,96
Chemistry	1.622	11,24	8.878	5,47	1,67	1,80	0,43
Computer science	1.141	7,91	2.435	2,13	1,78	1,54	0,35
Decision sciences	109	0,76	386	3,54	1,75	2,01	0,46
Dentistry	2	0,01	1	0,50	0,03	0,00	0,06
Earth and planetary sciences	546	3,78	3.258	5,97	0,95	1,40	0,59
Economics, econometrics and finance	10	0,07	30	3,00	0,07	0,06	0,35
Energy	368	2,55	1.750	4,76	1,82	5,71	1,25
Engineering	2.737	18,97	7.545	2,76	1,56	2,49	0,64
Environmental science	802	5,56	4.448	5,55	1,59	1,99	0,50
Health professions	22	0,15	41	1,86	0,24	0,10	0,17
Immunology and microbiology	172	1,19	1.680	9,77	0,38	0,51	0,53
Materials science	2.484	17,21	10.465	4,21	2,92	4,42	0,61
Mathematics	1.316	9,12	3.261	2,48	2,42	2,65	0,44
Medicine	665	4,61	5.289	7,95	0,17	0,33	0,80
Multidisciplinary	274	1,90	224	0,82	1,83	0,10	0,02
Neuroscience	30	0,21	763	25,43	0,11	0,33	1,16
Nursing	15	0,10	9	0,60	0,10	0,02	0,09
Pharmacology, toxicology and pharmaceutics	115	0,80	683	5,94	0,31	0,45	0,59
Physics and astronomy	2.513	17,42	9.439	3,76	2,35	2,28	0,39
Psychology	16	0,11	22	1,38	0,08	0,03	0,13
Social sciences	137	0,95	191	1,39	0,26	0,21	0,33
Veterinary	48	0,33	93	1,94	0,41	0,39	0,39
Total	**14.430**	**100**	**55.037**	**3,81**			**0.40**

Figure 10. Activity and visibility of the Algerian scientific output by subject areas (SJCR 1996–2009).

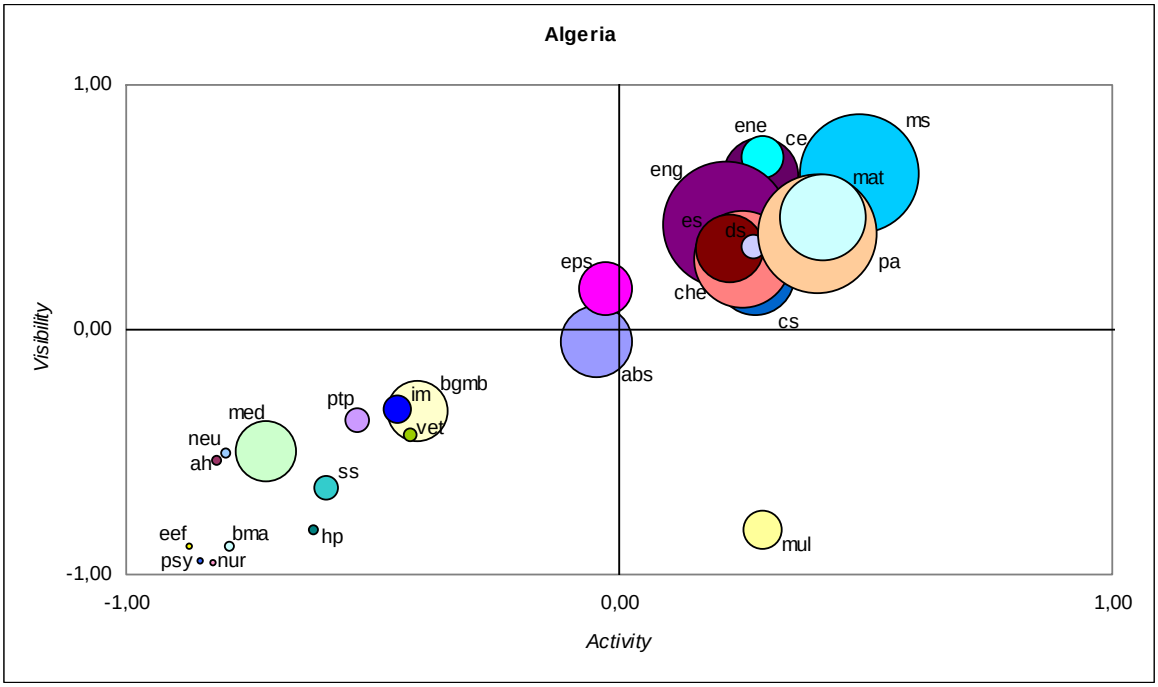
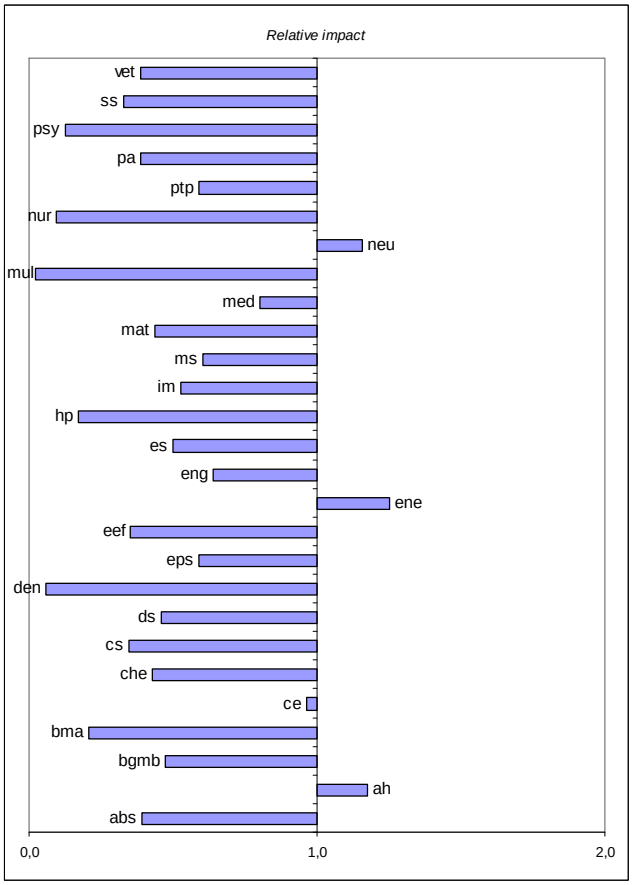


Figure 11. Relative impact of the Algerian scientific output by subject areas (SJCR 1996–2009).



4.6. Kenya

Population (thousands): **39 802**
Land area (thousands of Km^2): **593**
Population density (pop/Km^2): **67**
GDP based on PPP valuation (US $ million): **62 423**
GDP per Capita (PPP valuation, $): **1 568**
Annual real GDP growth (average over 2001-2009): **4.1**

4.6.1. General data (output and impact)

Table 26. Total output and impact of the Kenyan scientific activity (SJCR 1996–2009).

Kenya 1996–2009	Total
Documents	11.420
Citable documents	10.980
Citations	126.919
Self citations	22.571
Citations per document	11,11
H index	104

Table 27. Annual output and impact of the Kenyan scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	637	635	586	607	567	603	673	807	802	864	986	1.154	1.193	1.306	11.420
P. Doc	633	622	570	585	556	592	644	780	754	820	948	1.094	1.144	1.238	10.980
Cit	10.446	11.676	9.476	11.557	11.729	9.109	9.097	11.194	10.058	10.204	7.850	7.116	5.057	2.350	126.919
S-Cit	1.792	1.800	1.661	2.043	1.807	1.585	1.413	2.221	1.783	1.819	1.855	1.312	1.029	451	22.571
CxD	16,4	18,39	16,17	19,04	20,69	15,11	13,52	13,87	12,54	11,81	7,96	6,17	4,24	1,8	11,11
SCxD	2,81	2,83	2,83	3,37	3,19	2,63	2,1	2,75	2,22	2,11	1,88	1,14	0,86	0,35	1,98
CD	554	536	518	543	510	539	582	706	675	714	813	853	834	680	9.057
UD	83	99	68	64	57	64	91	101	127	150	173	301	359	626	2.363
IC(%)	63,27	59,69	62,8	64,42	62,96	58,21	53,94	75,22	74,19	73,15	78,09	74,61	75,69	74,89	*67,94*
% World	0,06	0,05	0,05	0,05	0,05	0,05	0,05	0,06	0,05	0,05	0,05	0,06	0,06	0,06	0,05

Table 28. Output and impact of the Kenyan scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	4.308	37,72	7.112	62,28
Citable documents	4.202	38,27	6.778	61,73
Cites	73.090	57,59	53.829	42,41
Self cites	12.101	53,61	10.470	46,39
Cites per doc.	16,97		7,57	
Self cites per doc.	2,81		1,47	
Cited docs.	3.782	41,76	5.275	58,24
Uncited docs.	526	22,26	1.837	77,74
% International collaboration	*60,76*		*75,12*	
% world	0,051		0,06	

4.6.2. Research areas

Table 29. Bibliometric indicators by subject areas (Kenya-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**KEN**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	3.952	34,61	35.622	9,01	4,93	3,74	0,88
Arts and humanities	60	0,53	108	1,80	0,37	0,36	1,14
Biochemistry, genetics and molecular biology	1.737	15,21	13.456	7,75	1,35	0,47	0,40
Business, management and accounting	88	0,77	382	4,34	0,41	0,31	0,87
Chemical engineering	61	0,53	281	4,61	0,13	0,09	0,76
Chemistry	194	1,70	1.279	6,59	0,25	0,11	0,52
Computer science	35	0,31	142	4,06	0,07	0,04	0,66
Decision sciences	3	0,03	13	4,33	0,06	0,03	0,56
Dentistry	19	0,17	120	6,32	0,39	0,25	0,75
Earth and planetary sciences	469	4,11	5.078	10,83	1,03	0,95	1,07
Economics, econometrics and finance	147	1,29	1.165	7,93	1,28	1,02	0,93
Energy	99	0,87	936	9,45	0,62	1,32	2,49
Engineering	167	1,46	431	2,58	0,12	0,06	0,60
Environmental science	1.374	12,03	14.740	10,73	3,43	2,86	0,97
Health professions	32	0,28	339	10,59	0,43	0,36	0,97
Immunology and microbiology	2.135	18,70	38.475	18,02	6,00	5,02	0,97
Materials science	69	0,60	382	5,54	0,10	0,07	0,80
Mathematics	34	0,30	99	2,91	0,08	0,03	0,51
Medicine	2.599	22,76	41.139	15,83	0,82	1,12	1,59
Multidisciplinary	236	2,07	7.458	31,60	1,99	1,41	0,82
Neuroscience	56	0,49	664	11,86	0,27	0,12	0,54
Nursing	59	0,52	251	4,25	0,49	0,28	0,66
Pharmacology, toxicology and pharmaceutics	199	1,74	1.627	8,18	0,67	0,47	0,81
Physics and astronomy	69	0,60	331	4,80	0,08	0,03	0,50
Psychology	53	0,46	297	5,60	0,35	0,15	0,52
Social sciences	656	5,74	2.619	3,99	1,55	1,26	0,94
Veterinary	553	4,84	4.165	7,53	5,90	7,66	1,51
Total	**11.420**	**100**	**126.919**	**11,11**			**1,16**

Figure 12. Activity and visibility of the Kenyan scientific output by subject areas (SJCR 1996–2009).

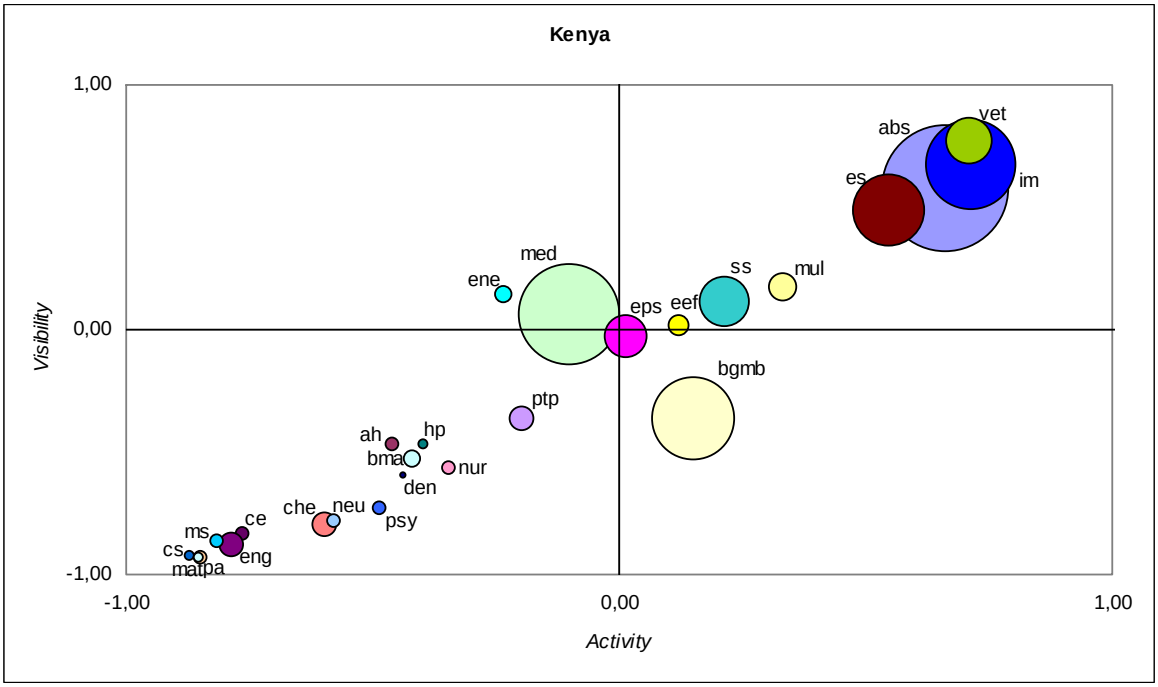
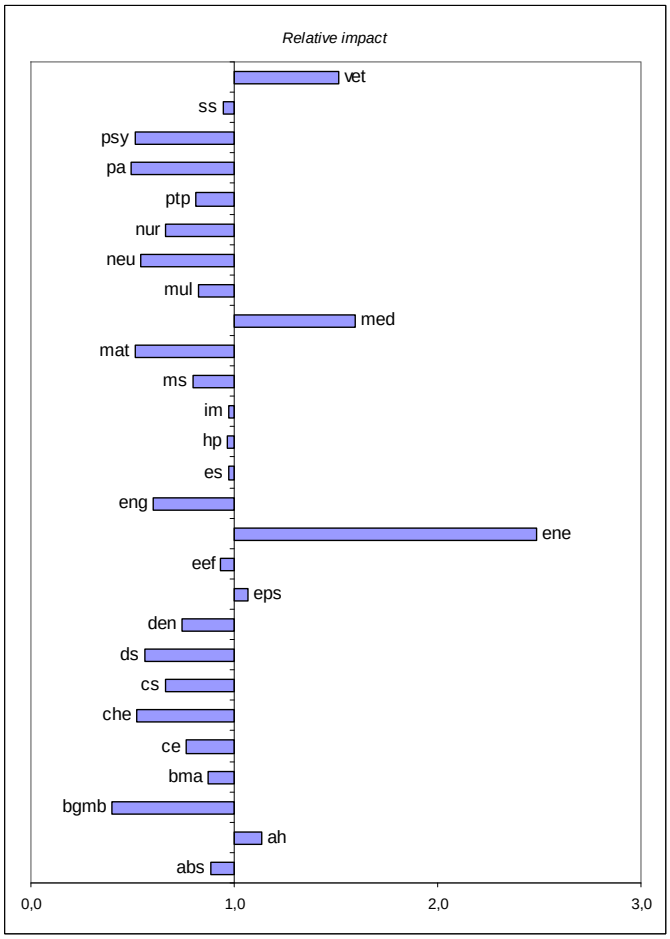


Figure 13. Relative impact of the Kenyan scientific output by subject areas (SJCR 1996–2009).



4.7. Tanzania

Population (thousands): **43 739**
Land area (thousands of Km^2): **945**
Population density (pop/Km^2): **46**
GDP based on PPP valuation (US $ million): **53 167**
GDP per Capita (PPP valuation, $): **1 216**
Annual real GDP growth (average over 2001-2009): **6.9**

4.7.1. General data (output and impact)

Table 30. Total output and impact of the Tanzanian scientific activity (SJCR 1996–2009).

Tanzania 1996–2009	Total
Documents	5.239
Citable documents	5.073
Citations	53.122
Self citations	8.858
Citations per document	10,14
H index	75

Table 31. Annual output and impact of the Tanzanian scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	239	254	226	240	237	215	246	357	363	437	567	602	589	667	5.239
P. Doc	237	250	220	238	233	207	240	349	354	416	546	585	564	634	5.073
Cit	3.817	5.413	3.244	3.306	3.464	3.254	3.003	5.099	4.748	4.890	4.678	4.039	2.555	1.612	53.122
S-Cit	571	622	537	586	451	535	581	800	891	864	889	783	462	286	8.858
CxD	15,97	21,31	14,35	13,78	14,62	15,13	12,21	14,28	13,08	11,19	8,25	6,71	4,34	2,42	10,14
SCxD	2,39	2,45	2,38	2,44	1,9	2,49	2,36	2,24	2,45	1,98	1,57	1,3	0,78	0,43	1,69
CD	219	231	200	215	211	194	219	324	319	379	489	469	421	361	4.251
UD	20	23	26	25	26	21	27	33	44	58	78	133	168	306	988
IC(%)	76,99	72,83	68,14	70	61,6	66,98	67,48	78,99	77,69	81,01	79,19	79,73	80,31	81,56	*74,46*
% World	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,02	0,03	0,03	0,03	0,03	0,03	0,02

Table 32. Output and impact of the Tanzanian scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	1.657	31,63	3.582	68,37
Citable documents	1.625	32,03	3.448	67,97
Cites	25.501	48,00	27.621	52,00
Self cites	3.883	43,84	4.975	56,16
Cites per doc.	15,39		7,71	
Self cites per doc.	2,34		1,39	
Cited docs.	1.489	35,03	2.762	64,97
Uncited docs.	168	17,00	820	83,00
% International collaboration	*69,15*		*79,78*	
% world	0,02		0,03	

4.7.2. Research areas

Table 33. Bibliometric indicators by subject areas (Tanzania-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**TAN**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	1.358	25,92	10.037	7,39	3,69	2,52	0,72
Arts and humanities	21	0,40	57	2,71	0,28	0,45	1,72
Biochemistry, genetics and molecular biology	375	7,16	3.344	8,92	0,64	0,28	0,46
Business, management and accounting	29	0,55	100	3,45	0,29	0,19	0,69
Chemical engineering	42	0,80	265	6,31	0,20	0,20	1,05
Chemistry	68	1,30	328	4,82	0,19	0,07	0,38
Computer science	19	0,36	1.199	63,11	0,08	0,79	10,26
Decision sciences	2	0,04	2	1,00	0,09	0,01	0,13
Dentistry	62	1,18	430	6,94	2,79	2,16	0,82
Earth and planetary sciences	319	6,09	2.194	6,88	1,53	0,98	0,68
Economics, econometrics and finance	73	1,39	756	10,36	1,39	1,59	1,22
Energy	76	1,45	444	5,84	1,04	1,50	1,54
Engineering	109	2,08	1.439	13,20	0,17	0,49	3,06
Environmental science	592	11,30	4.591	7,76	3,22	2,13	0,70
Health professions	37	0,71	529	14,30	1,09	1,34	1,30
Immunology and microbiology	1.100	21,00	16.352	14,87	6,74	5,10	0,80
Materials science	30	0,57	193	6,43	0,10	0,08	0,92
Mathematics	24	0,46	24	1,00	0,12	0,02	0,18
Medicine	1.740	33,21	22.709	13,05	1,20	1,48	1,31
Multidisciplinary	83	1,58	1.836	22,12	1,53	0,83	0,58
Neuroscience	24	0,46	520	21,67	0,25	0,23	0,99
Nursing	33	0,63	251	7,61	0,60	0,67	1,18
Pharmacology, toxicology and pharmaceutics	93	1,78	771	8,29	0,68	0,53	0,82
Physics and astronomy	35	0,67	141	4,03	0,09	0,04	0,42
Psychology	17	0,32	94	5,53	0,24	0,12	0,51
Social sciences	289	5,52	1.361	4,71	1,49	1,56	1,11
Veterinary	253	4,83	1.814	7,17	5,89	7,97	1,44
Total	**5.239**	**100**	**53.122**	**10,14**			**1,06**

Figure 14. Activity and visibility of the Tanzanian scientific output by subject areas (SJCR 1996–2009).

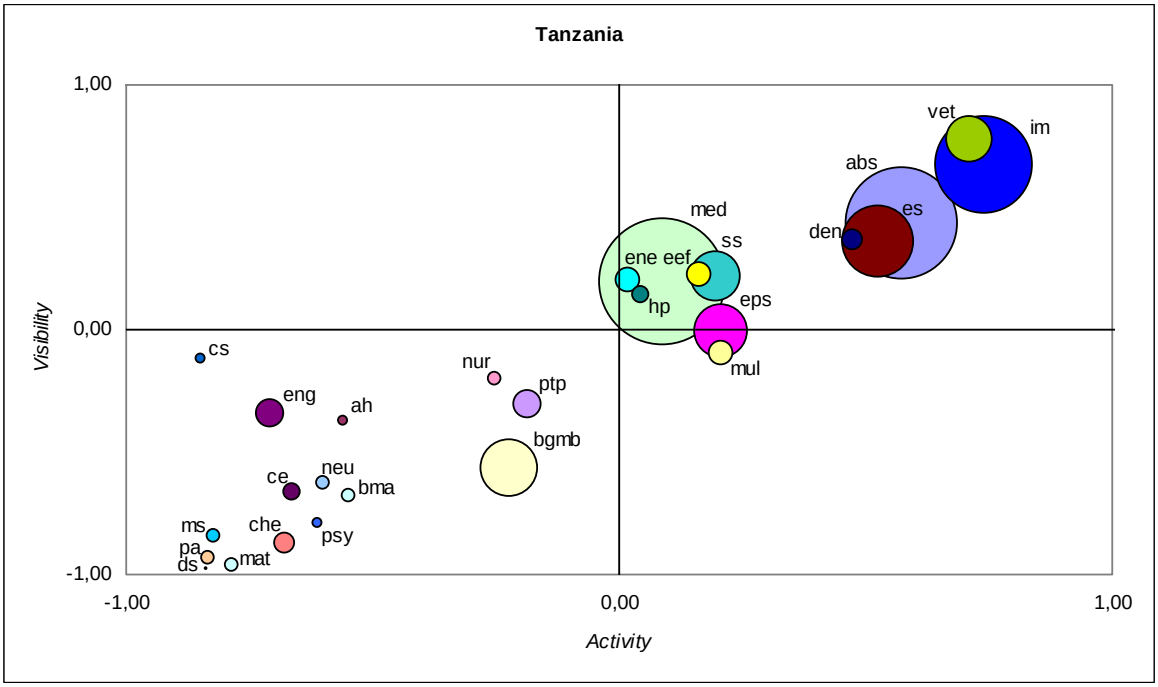
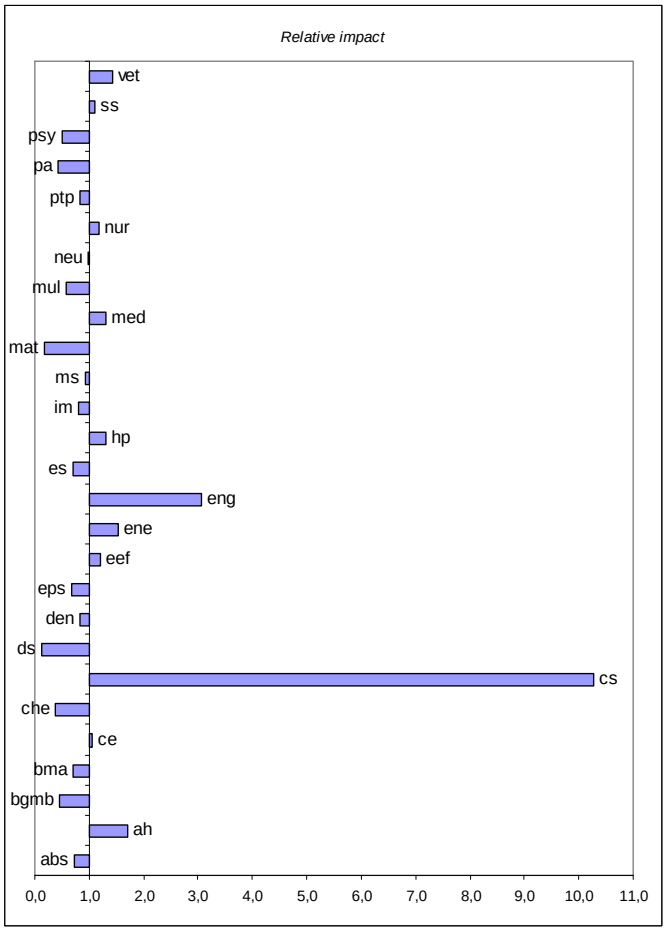


Figure 15. Relative impact of the Tanzanian scientific output by subject areas (SJCR 1996–2009).



4.8. Cameroon

Population (thousands): **19 522**
Land area (thousands of Km^2): **476**
Population density (pop/Km^2): **41**
GDP based on PPP valuation (US $ million): **46 347**
GDP per Capita (PPP valuation, $): **2 374**
Annual real GDP growth (average over 2001-2009): **3.3**

4.8.1. General data (output and impact)

Table 34. Total output and impact of the scientific activity in Cameroon (SJCR 1996–2009).

Cameroon 1996–2009	Total
Documents	4.939
Citable documents	4.820
Citations	35.724
Self citations	7.613
Citations per document	7,23
H index	59

Table 35. Annual output and impact of the scientific activity in Cameroon (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	179	211	210	199	204	211	240	330	358	430	560	572	604	631	4.939
P. Doc	178	204	208	197	198	210	236	326	352	419	547	553	589	603	4.820
Cit	1.805	2.692	2.931	2.819	2.868	2.329	2.495	3.154	4.004	2.671	3.174	2.360	1.475	947	35.724
S-Cit	372	551	524	464	542	507	683	745	697	621	771	555	358	223	7.613
CxD	10,08	12,76	13,96	14,17	14,06	11,04	10,4	9,56	11,18	6,21	5,67	4,13	2,44	1,5	7,23
SCxD	2,08	2,61	2,5	2,33	2,66	2,4	2,85	2,26	1,95	1,44	1,38	0,97	0,59	0,35	1,54
CD	144	180	176	169	181	186	214	294	307	335	443	414	378	281	3.702
UD	35	31	34	30	23	25	26	36	51	95	117	158	226	350	1.237
IC(%)	60,34	64,93	66,19	70,85	67,16	60,66	59,58	73,33	74,86	73,49	70,54	69,93	78,31	76,55	*69,05*
% World	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,03	0,03	0,02

Table 36. Output and impact of the scientific activity by periods in Cameroon (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	1.454	29,44	3.485	70,56
Citable documents	1.431	29,69	3.389	70,31
Cites	17.939	50,22	17.785	49,78
Self cites	3.643	47,85	3.970	52,15
Cites per doc.	12,34		5,10	
Self cites per doc.	2,51		1,14	
Cited docs.	1.250	33,77	2.452	66,23
Uncited docs.	204	16,49	1.033	83,51
% International collaboration	*64,24*		*73,86*	
% world	0,02		0,03	

4.8.2. Research areas

Table 37. Bibliometric indicators by subject areas (Cameroon-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**SAF**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	1.439	29,14	8.497	5,90	4,15	3,17	0,58
Arts and humanities	25	0,51	42	1,68	0,36	0,50	1,06
Biochemistry, genetics and molecular biology	415	8,40	2.944	7,09	0,75	0,36	0,37
Business, management and accounting	9	0,18	73	8,11	0,10	0,21	1,63
Chemical engineering	77	1,56	273	3,55	0,39	0,31	0,59
Chemistry	268	5,43	1.308	4,88	0,81	0,41	0,38
Computer science	61	1,24	133	2,18	0,28	0,13	0,35
Decision sciences	13	0,26	52	4,00	0,61	0,42	0,52
Dentistry	1	0,02	9	9,00	0,05	0,07	1,06
Earth and planetary sciences	271	5,49	2.124	7,84	1,38	1,41	0,77
Economics, econometrics and finance	48	0,97	328	6,83	0,97	1,02	0,80
Energy	47	0,95	161	3,43	0,68	0,81	0,90
Engineering	175	3,54	514	2,94	0,29	0,26	0,68
Environmental science	355	7,19	2.263	6,37	2,05	1,56	0,58
Health professions	9	0,18	14	1,56	0,28	0,05	0,14
Immunology and microbiology	786	15,91	10.177	12,95	5,11	4,72	0,70
Materials science	136	2,75	559	4,11	0,47	0,36	0,59
Mathematics	196	3,97	687	3,51	1,05	0,86	0,62
Medicine	1.124	22,76	10.941	9,73	0,82	1,06	0,98
Multidisciplinary	50	1,01	1.027	20,54	0,98	0,69	0,53
Neuroscience	16	0,32	103	6,44	0,18	0,07	0,29
Nursing	25	0,51	78	3,12	0,48	0,31	0,49
Pharmacology, toxicology and pharmaceutics	244	4,94	1.291	5,29	1,91	1,32	0,52
Physics and astronomy	415	8,40	2.130	5,13	1,13	0,79	0,53
Psychology	11	0,22	46	4,18	0,17	0,08	0,38
Social sciences	166	3,36	400	2,41	0,91	0,68	0,57
Veterinary	81	1,64	435	5,37	2,00	2,84	1,08
Total	**4.939**	**100**	**35.724**	**7,23**			**0.76**

Figure 16. Activity and visibility of the scientific output by subject areas in Cameroon (SJCR 1996–2009).

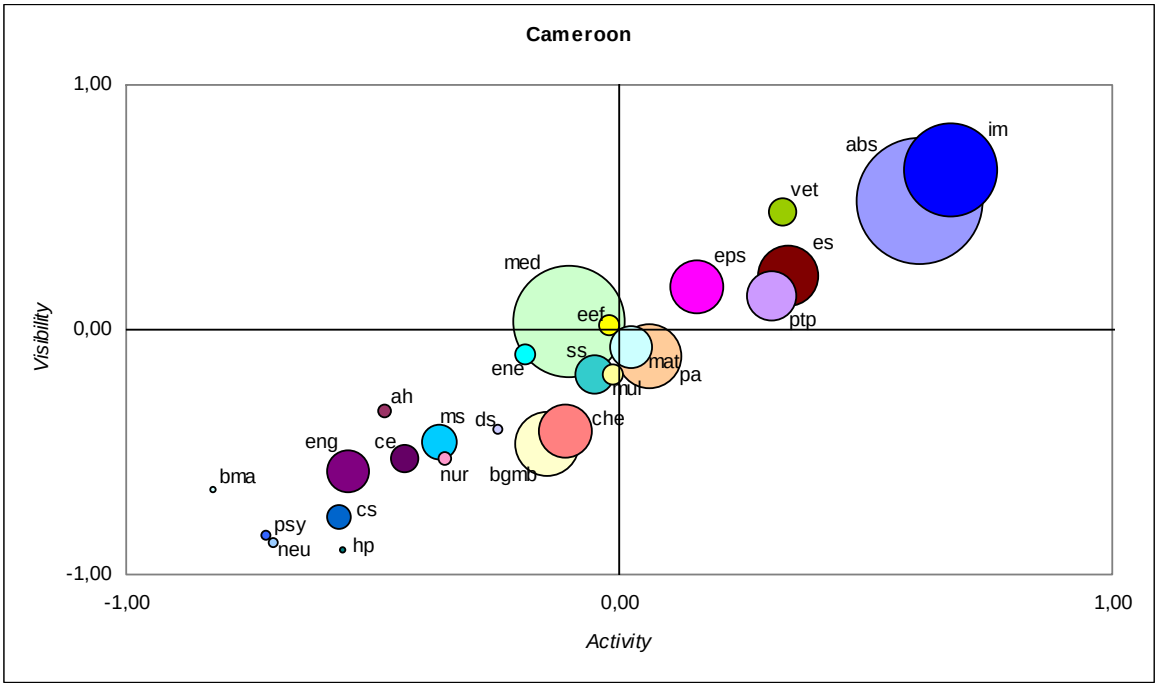
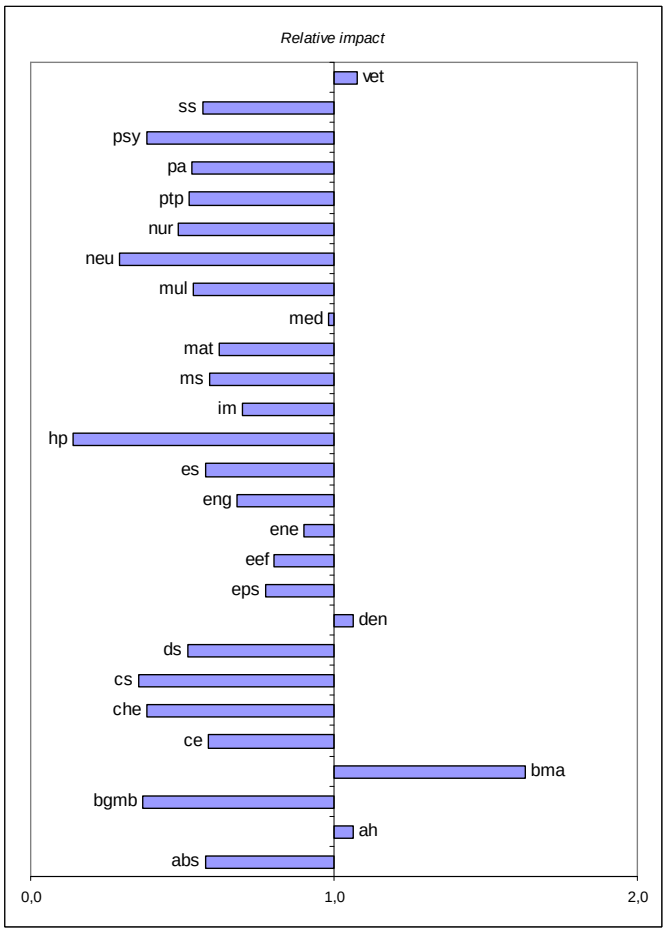


Figure 17. Relative impact of the scientific output by subject areas in Cameroon (SJCR 1996–2009).



4.9. Ethiopia

Population (thousands): **82 825**
Land area (thousands of Km^2): **1 104**
Population density (pop/Km^2): **75**
GDP based on PPP valuation (US $ million): **72 196**
GDP per Capita (PPP valuation, $): **872**
Annual real GDP growth (average over 2001-2009): **8.0**

4.9.1. General data (output and impact)

Table 38. Total output and impact of the Ethiopian scientific activity (SJCR 1996–2009).

Ethiopia 1996–2009	Total
Documents	4.849
Citable documents	4.764
Citations	34.574
Self citations	6.882
Citations per document	7,13
H index	57

Table 39. Annual output and impact of the Ethiopian scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	260	249	247	241	207	204	224	348	327	380	473	535	554	600	4.849
P. Doc	260	245	242	238	205	199	223	341	324	371	466	528	543	579	4.764
Cit	2.789	2.891	2.811	3.573	2.542	2.432	1.945	3.267	2.595	2.466	2.752	2.314	1.376	821	34.574
S-Cit	507	568	590	558	455	425	486	595	547	470	619	477	357	228	6.882
CxD	10,73	11,61	11,38	14,83	12,28	11,92	8,68	9,39	7,94	6,49	5,82	4,33	2,48	1,37	7,13
SCxD	1,95	2,28	2,39	2,32	2,2	2,08	2,17	1,71	1,67	1,24	1,31	0,89	0,64	0,38	1,42
CD	215	219	209	211	184	172	197	288	270	298	365	384	351	269	3.632
UD	45	30	38	30	23	32	27	60	57	82	108	151	203	331	1.217
IC(%)	56,15	57,43	61,54	55,6	57,97	53,43	51,34	67,24	73,09	74,47	71,67	71,21	67,15	65,33	*63,12*
% World	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,03	0,03	0,02

Table 40. Output and impact of the Ethiopian scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	1.632	33,66	3.217	66,34
Citable documents	1.612	33,84	3.152	66,16
Cites	18.983	54,91	15.591	45,09
Self cites	3.589	52,15	3.293	47,85
Cites per doc.	11,63		4,85	
Self cites per doc.	2,20		1,02	
Cited docs.	1.407	38,74	2.225	61,26
Uncited docs.	225	18,49	992	81,51
% International collaboration	*56,21*		*70,02*	
% world	0,02		0,03	

4.9.2. Research areas

Table 41. Bibliometric indicators by subject areas (Ethiopia-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**ETH**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	1.846	38,07	9.586	5,19	5,42	3,69	0,51
Arts and humanities	10	0,21	21	2,10	0,14	0,26	1,33
Biochemistry, genetics and molecular biology	508	10,48	3.747	7,38	0,93	0,48	0,38
Business, management and accounting	25	0,52	70	2,80	0,27	0,21	0,56
Chemical engineering	37	0,76	219	5,92	0,19	0,25	0,98
Chemistry	200	4,12	1.430	7,15	0,61	0,46	0,56
Computer science	26	0,54	99	3,81	0,12	0,10	0,62
Decision sciences	5	0,10	41	8,20	0,24	0,34	1,06
Dentistry	5	0,10	36	7,20	0,24	0,28	0,85
Earth and planetary sciences	369	7,61	3.708	10,05	1,91	2,54	0,99
Economics, econometrics and finance	100	2,06	778	7,78	2,05	2,51	0,91
Energy	35	0,72	277	7,91	0,52	1,44	2,08
Engineering	85	1,75	248	2,92	0,14	0,13	0,68
Environmental science	404	8,33	2.671	6,61	2,38	1,90	0,60
Health professions	11	0,23	69	6,27	0,35	0,27	0,57
Immunology and microbiology	526	10,85	6.727	12,79	3,48	3,22	0,69
Materials science	57	1,18	670	11,75	0,20	0,45	1,69
Mathematics	47	0,97	151	3,21	0,26	0,20	0,57
Medicine	1.093	22,54	9.195	8,41	0,81	0,92	0,85
Multidisciplinary	34	0,70	1.319	38,79	0,68	0,91	1,01
Neuroscience	34	0,70	458	13,47	0,38	0,31	0,61
Nursing	22	0,45	57	2,59	0,43	0,23	0,40
Pharmacology, toxicology and pharmaceutics	97	2,00	777	8,01	0,77	0,82	0,79
Physics and astronomy	79	1,63	542	6,86	0,22	0,21	0,71
Psychology	10	0,21	50	5,00	0,15	0,09	0,46
Social sciences	250	5,16	839	3,36	1,39	1,48	0,79
Veterinary	419	8,64	2.146	5,12	10,53	14,49	1,03
Total	**4.849**	**100**	**34.574**	**7,13**			**0.75**

Figure 18. Activity and visibility of the Ethiopian scientific output by subject areas (SJCR 1996–2009).

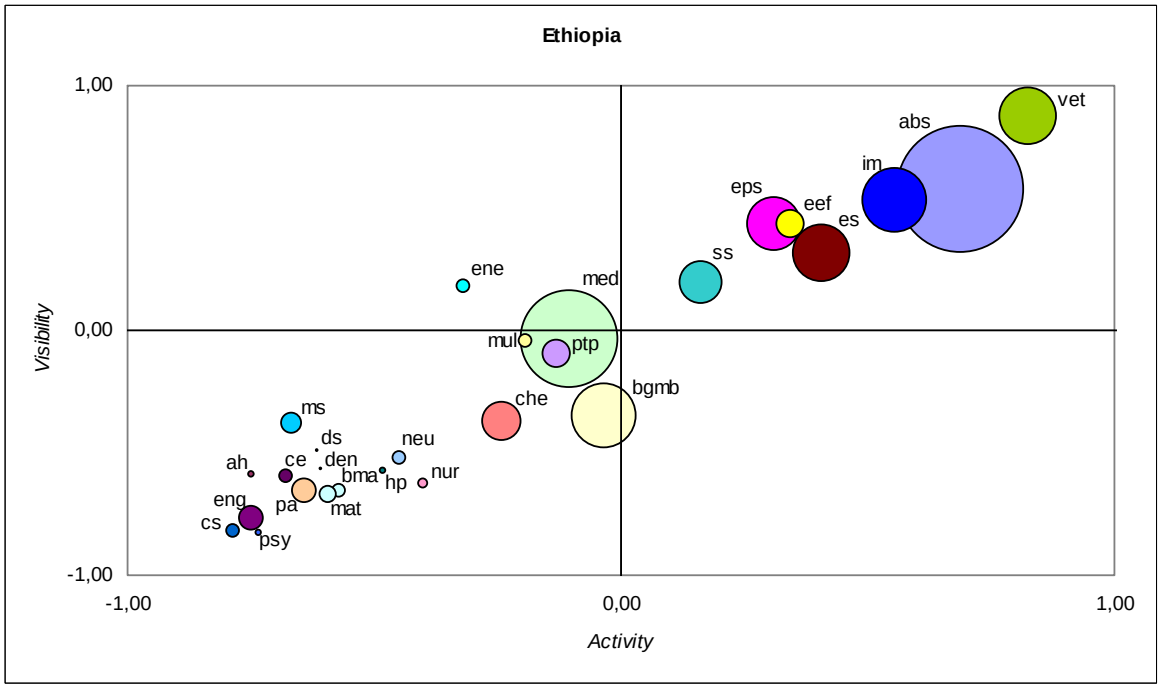
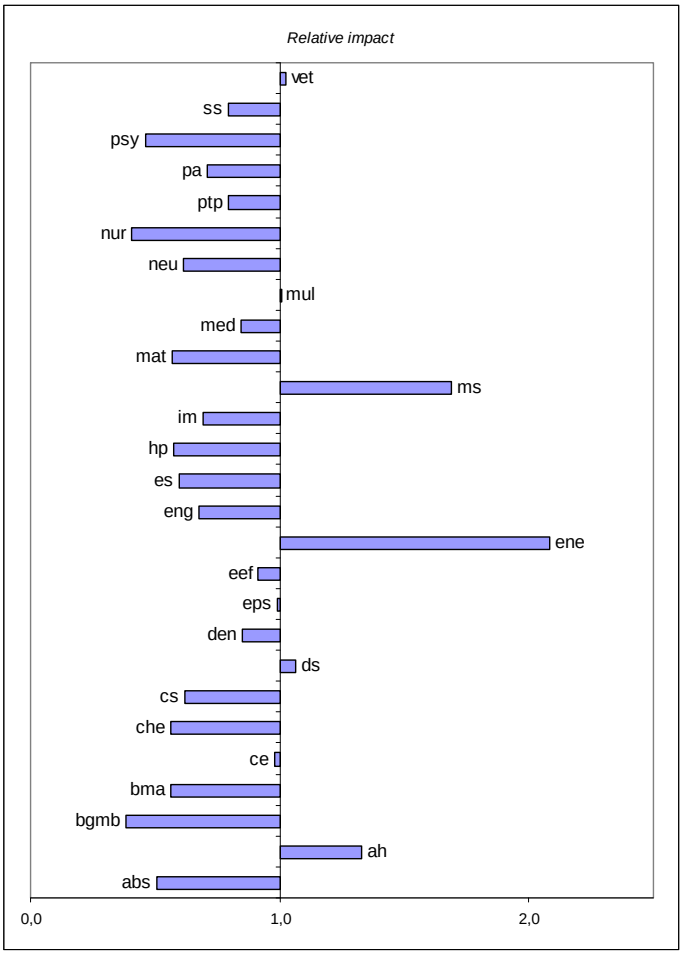


Figure 19. Relative impact of the Ethiopian scientific output by subject areas (SJCR 1996–2009).



4.10. Uganda

Population (thousands): **32 710**
Land area (thousands of Km^2): **241**
Population density (pop/Km^2): **136**
GDP based on PPP valuation (US $ million): **46 632**
GDP per Capita (PPP valuation, $): **1 426**
Annual real GDP growth (average over 2001-2009): **7.7**

4.10.1. General data (output and impact)

Table 42. Total output and impact of the Uganda scientific activity (SJCR 1996–2009).

Uganda 1996–2009	Total
Documents	4.395
Citable documents	4.151
Citations	49.796
Self citations	8.233
Citations per document	11,33
H index	75

Table 43. Annual output and impact of the Uganda scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	137	144	167	190	186	179	172	271	347	374	451	549	563	665	4.395
P. Doc	131	140	161	183	178	171	163	254	326	350	432	519	524	619	4.151
Cit	2.038	2.881	2.811	5.038	4.787	3.665	2.394	4.215	4.618	4.474	4.460	3.861	3.140	1.414	49.796
S-Cit	274	441	493	694	645	599	469	708	835	714	814	736	543	268	8.233
CxD	14,88	20,01	16,83	26,52	25,74	20,47	13,92	15,55	13,31	11,96	9,89	7,03	5,58	2,13	11,33
SCxD	2	3,06	2,95	3,65	3,47	3,35	2,73	2,61	2,41	1,91	1,8	1,34	0,96	0,4	1,87
CD	112	128	141	177	167	166	148	247	307	333	393	439	423	376	3.557
UD	25	16	26	13	19	13	24	24	40	41	58	110	140	289	838
IC(%)	59,12	74,31	68,26	67,89	66,67	63,13	59,88	81,55	76,08	82,62	84,26	77,05	82,06	83,31	*73,30*
% World	0,01	0,01	0,01	0,02	0,02	0,01	0,01	0,02	0,02	0,02	0,02	0,03	0,03	0,03	0,02

Table 44. Output and impact of the Uganda scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	1.175	26,73	3.220	73,27
Citable documents	1.127	27,15	3.024	72,85
Cites	23.614	47,42	26.182	52,58
Self cites	3.615	43,91	4.618	56,09
Cites per doc.	20,10		8,13	
Self cites per doc.	3,08		1,43	
Cited docs.	1.039	29,21	2.518	70,79
Uncited docs.	136	16,23	702	83,77
% International collaboration	*65,61*		*80,99*	
% world	0,01		0,03	

4.10.2. Research areas

Table 45. Bibliometric indicators by subject areas (Uganda-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**UGA**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	982	22,34	7.380	7,52	3,18	1,97	0,74
Arts and humanities	10	0,23	23	2,30	0,16	0,20	1,45
Biochemistry, genetics and molecular biology	360	8,19	3.133	8,70	0,73	0,28	0,45
Business, management and accounting	25	0,57	101	4,04	0,30	0,21	0,81
Chemical engineering	14	0,32	12	0,86	0,08	0,01	0,14
Chemistry	28	0,64	99	3,54	0,09	0,02	0,28
Computer science	30	0,68	53	1,77	0,15	0,04	0,29
Decision sciences	3	0,07	31	10,33	0,16	0,18	1,34
Dentistry	21	0,48	117	5,57	1,13	0,63	0,66
Earth and planetary sciences	88	2,00	647	7,35	0,50	0,31	0,73
Economics, econometrics and finance	51	1,16	797	15,63	1,15	1,79	1,84
Energy	14	0,32	45	3,21	0,23	0,16	0,85
Engineering	35	0,80	38	1,09	0,07	0,01	0,25
Environmental science	431	9,81	2.994	6,95	2,80	1,48	0,63
Health professions	47	1,07	487	10,36	1,65	1,31	0,94
Immunology and microbiology	1.111	25,28	18.525	16,67	8,12	6,17	0,90
Materials science	18	0,41	74	4,11	0,07	0,03	0,59
Mathematics	36	0,82	50	1,39	0,22	0,04	0,25
Medicine	1.851	42,12	28.112	15,19	1,52	1,96	1,53
Multidisciplinary	34	0,77	986	29,00	0,75	0,47	0,75
Neuroscience	37	0,84	384	10,38	0,46	0,18	0,47
Nursing	57	1,30	308	5,40	1,23	0,87	0,84
Pharmacology, toxicology and pharmaceutics	61	1,39	375	6,15	0,54	0,28	0,61
Physics and astronomy	10	0,23	23	2,30	0,03	0,01	0,24
Psychology	32	0,73	414	12,94	0,54	0,55	1,19
Social sciences	297	6,76	1.423	4,79	1,82	1,74	1,13
Veterinary	110	2,50	411	3,74	3,05	1,93	0,75
Total	**4.395**	**100**	**49.796**	**11,33**			**1,19**

Figure 20. Activity and visibility of the Uganda scientific output by subject areas (SJCR 1996–2009).

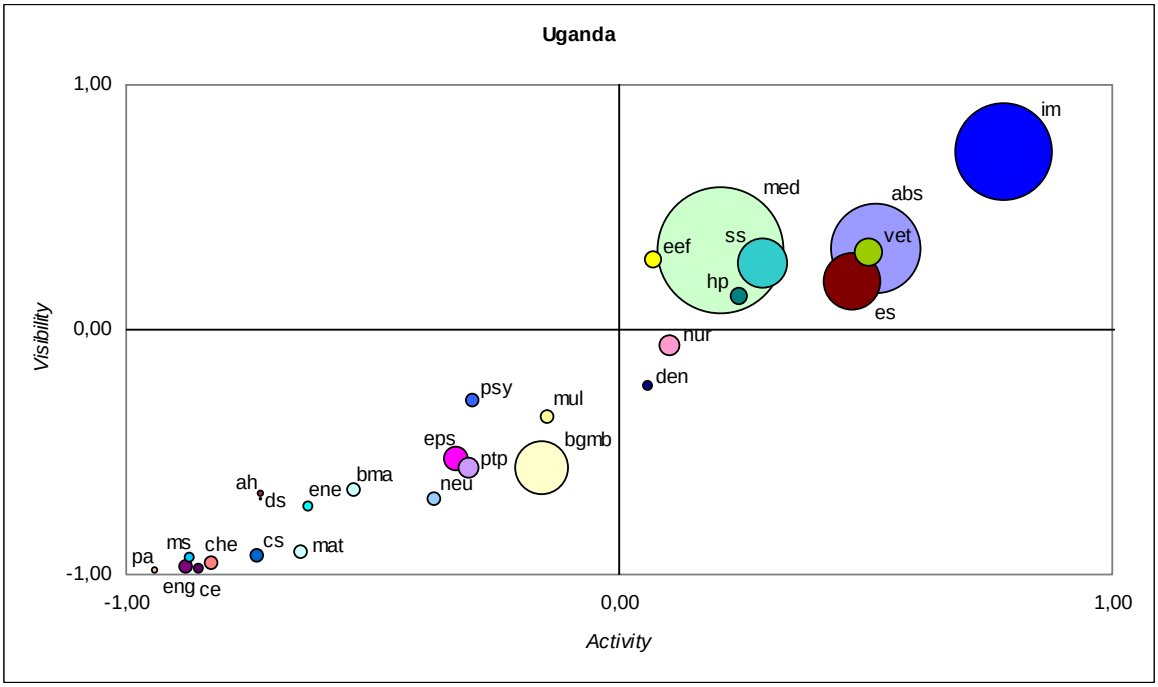
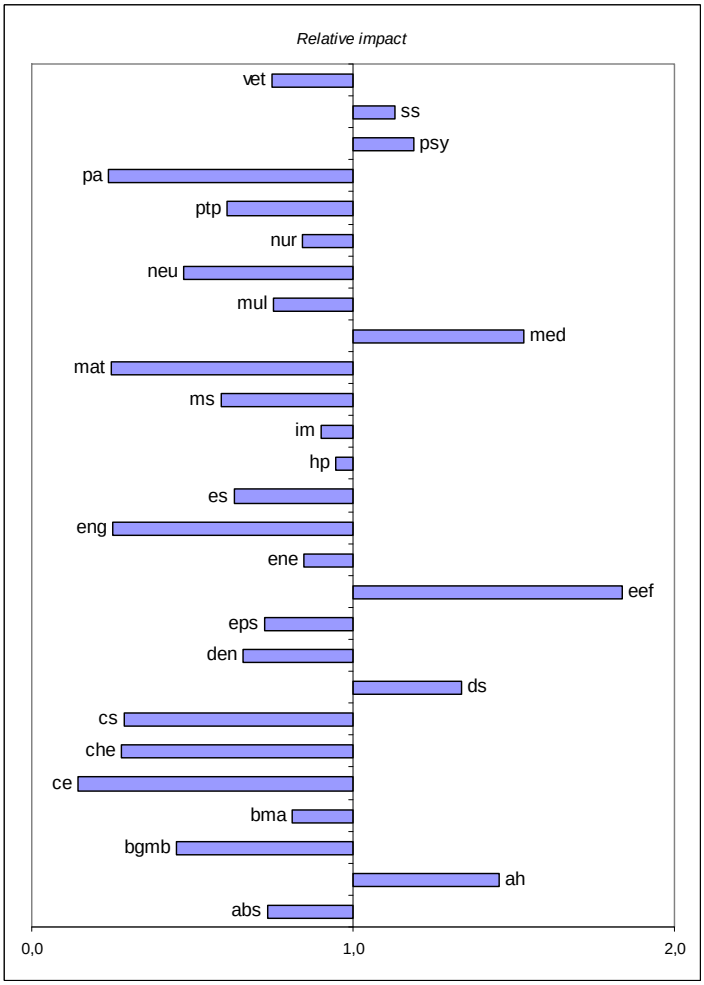


Figure 21. Relative impact of the Uganda scientific output by subject areas (SJCR 1996–2009).



4.11. Zimbabwe

Population (thousands): **12 523**
Land area (thousands of Km^2): **391**
Population density (pop/Km^2): **32**
GDP based on PPP valuation (US $ million): **2 193**
GDP per Capita (PPP valuation, $): **175**
Annual real GDP growth (average over 2001-2009): **-5.4**

4.11.1. General data (output and impact)

Table 46. Total output and impact of the Zimbabwe scientific activity (SJCR 1996–2009).

Zimbabwe 1996–2009	Total
Documents	4.082
Citable documents	3.975
Citations	35.989
Self citations	4.282
Citations per document	8,82
H index	59

Table 47. Annual output and impact of the Zimbabwe scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	340	340	305	340	298	290	268	299	237	245	269	314	280	257	4.082
P. Doc	337	335	303	333	290	279	255	293	224	234	264	311	271	246	3.975
Cit	3.480	3.423	3.953	3.545	2.977	3.111	2.744	3.074	2.306	2.348	1.967	1.674	1.061	326	35.989
S-Cit	472	403	387	428	306	320	300	279	262	350	315	253	146	61	4.282
CxD	10,24	10,07	12,96	10,43	9,99	10,73	10,24	10,28	9,73	9,58	7,31	5,33	3,79	1,27	8,82
SCxD	1,39	1,19	1,27	1,26	1,03	1,1	1,12	0,93	1,11	1,43	1,17	0,81	0,52	0,24	1,05
CD	283	290	251	284	251	245	229	264	197	205	210	221	201	108	3.239
UD	57	50	54	56	47	45	39	35	40	40	59	93	79	149	843
IC(%)	59,12	55,88	59,67	55,88	55,37	52,76	60,82	73,58	70,04	77,55	71,75	71,02	82,5	77,82	*65,98*
% World	0,03	0,03	0,03	0,03	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,02	0,01	0,01	0,02

Table 48. Output and impact of the Zimbabwe scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	2.181	53,43	1.901	46,57
Citable documents	2.132	53,64	1.843	46,36
Cites	23.233	64,56	12.756	35,44
Self cites	2.616	61,09	1.666	38,91
Cites per doc.	10,65		6,71	
Self cites per doc.	1,20		0,88	
Cited docs.	1.833	56,59	1.406	43,41
Uncited docs.	348	41,28	495	58,72
% International collaboration	*57,07*		*74,89*	
% world	0,026		0,02	

4.11.2. Research areas

Table 49. Bibliometric indicators by subject areas (Zimbabwe-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**ZIM**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	1.128	27,63	9.607	8,52	3,94	3,55	0,83
Arts and humanities	48	1,18	38	0,79	0,83	0,45	0,50
Biochemistry, genetics and molecular biology	272	6,66	2.777	10,21	0,59	0,34	0,53
Business, management and accounting	27	0,66	185	6,85	0,35	0,52	1,38
Chemical engineering	32	0,78	211	6,59	0,20	0,23	1,09
Chemistry	66	1,62	575	8,71	0,24	0,18	0,68
Computer science	32	0,78	157	4,91	0,18	0,15	0,80
Decision sciences	17	0,42	99	5,82	0,96	0,79	0,75
Dentistry	10	0,24	441	44,10	0,58	3,26	5,21
Earth and planetary sciences	359	8,79	3.251	9,06	2,21	2,14	0,90
Economics, econometrics and finance	53	1,30	854	16,11	1,29	2,65	1,89
Energy	40	0,98	235	5,88	0,70	1,17	1,54
Engineering	108	2,65	432	4,00	0,22	0,22	0,93
Environmental science	438	10,73	3.625	8,28	3,06	2,48	0,75
Health professions	23	0,56	307	13,35	0,87	1,15	1,22
Immunology and microbiology	495	12,13	6.716	13,57	3,89	3,09	0,73
Materials science	43	1,05	177	4,12	0,18	0,11	0,59
Mathematics	56	1,37	223	3,98	0,36	0,28	0,70
Medicine	1.185	29,03	12.125	10,23	1,05	1,17	1,03
Multidisciplinary	28	0,69	668	23,86	0,66	0,44	0,62
Neuroscience	23	0,56	318	13,83	0,31	0,21	0,63
Nursing	21	0,51	106	5,05	0,49	0,41	0,79
Pharmacology, toxicology and pharmaceutics	73	1,79	775	10,62	0,69	0,79	1,05
Physics and astronomy	32	0,78	157	4,91	0,11	0,06	0,51
Psychology	42	1,03	198	4,71	0,77	0,36	0,43
Social sciences	234	5,73	1.133	4,84	1,55	1,92	1,14
Veterinary	263	6,44	1.772	6,74	7,85	11,49	1,35
Total	**4.082**	**100**	**35.989**	**8,82**			**0.92**

Figure 22. Activity and visibility of the Zimbabwe scientific output by subject areas (SJCR 1996–2009).

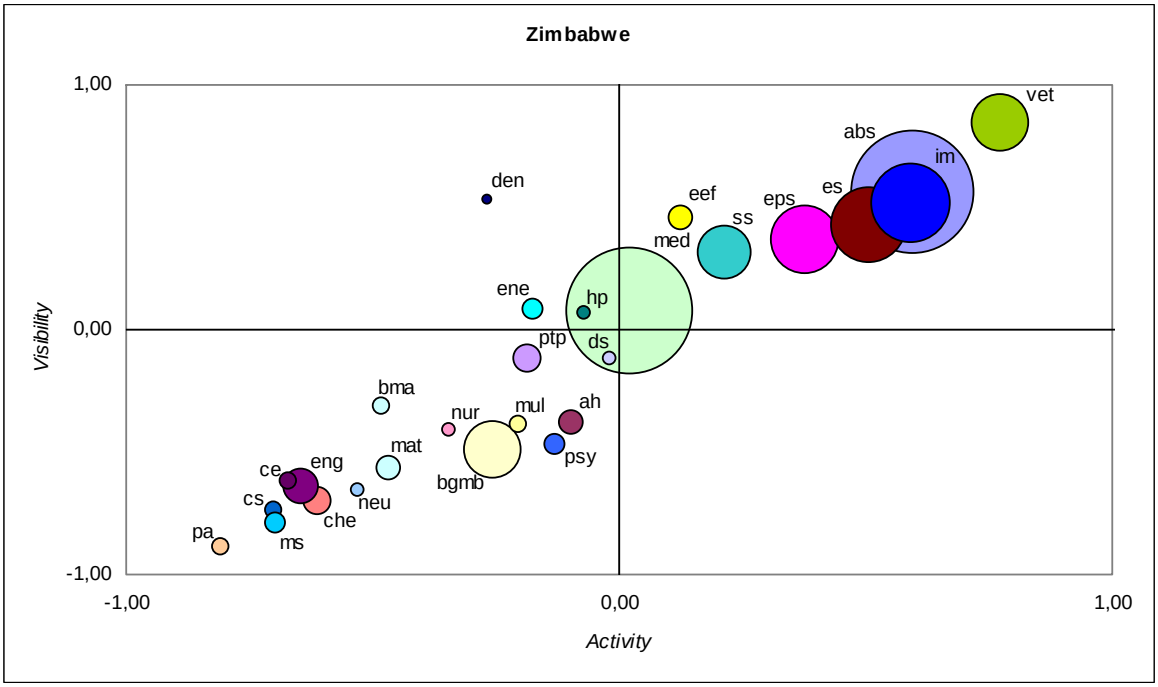
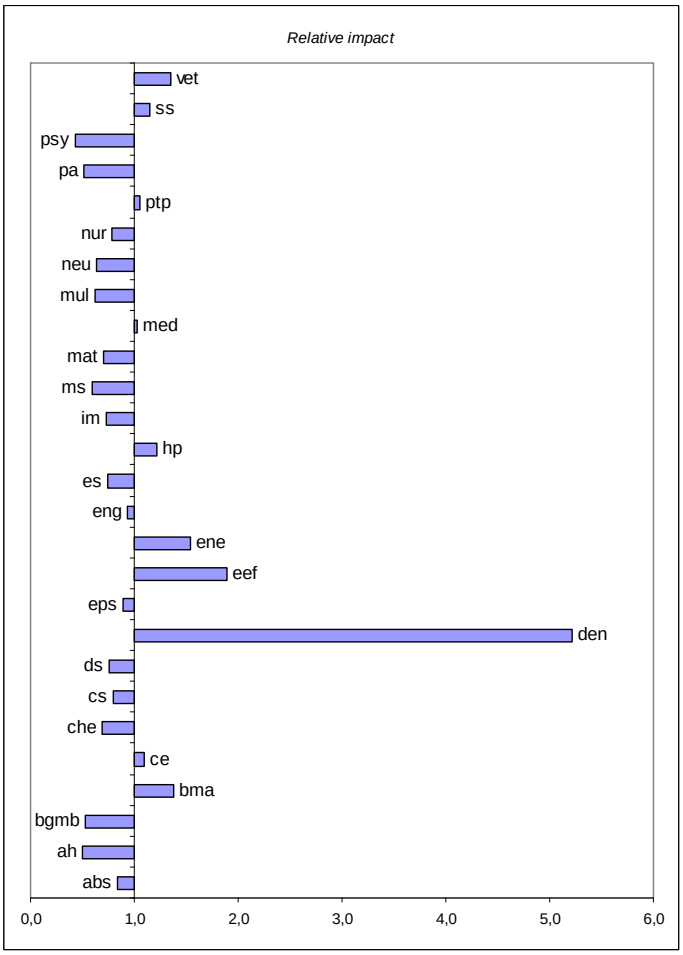


Figure 23. Relative impact of the Zimbabwe scientific output by subject areas (SJCR 1996–2009).



4.12. Ghana

Population (thousands): **23 837**
Land area (thousands of Km^2): **239**
Population density (pop/Km^2): **100**
GDP based on PPP valuation (US $ million): **36 558**
GDP per Capita (PPP valuation, $): **1 534**
Annual real GDP growth (average over 2001-2009): **5.5**

4.12.1. General data (output and impact)

Table 50. Total output and impact of the Ghana scientific activity (SJCR 1996–2009).

Ghana 1996–2009	Total
Documents	4.039
Citable documents	3.910
Citations	30.016
Self citations	3.752
Citations per document	7,43
H index	54

Table 51. Annual output and impact of the Ghana scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	169	189	183	211	190	175	176	237	275	336	355	471	467	605	4.039
P. Doc	166	186	181	207	187	170	171	232	269	317	345	458	447	574	3.910
Cit	1.921	1.915	2.239	2.549	2.245	2.104	1.790	2.282	2.998	2.881	2.511	1.953	1.798	830	30.016
S-Cit	223	213	232	326	270	261	199	321	339	434	354	263	216	101	3.752
CxD	11,37	10,13	12,23	12,08	11,82	12,02	10,17	9,63	10,9	8,57	7,07	4,15	3,85	1,37	7,43
SCxD	1,32	1,13	1,27	1,55	1,42	1,49	1,13	1,35	1,23	1,29	1	0,56	0,46	0,17	0,93
CD	134	152	153	176	162	158	146	204	222	271	271	310	305	234	2.898
UD	35	37	30	35	28	17	30	33	53	65	84	161	162	371	1.141
IC(%)	52,66	62,96	65,03	63,03	58,95	54,86	52,84	62,45	64,73	70,83	70,70	64,76	69,59	59,83	*62,37*
% World	0,01	0,02	0,02	0,02	0,02	0,01	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,02

Table 52. Output and impact of the Ghana scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	1.293	32,01	2.746	67,99
Citable documents	1.268	32,43	2.642	67,57
Cites	14.763	49,18	15.253	50,82
Self cites	1.724	45,95	2.028	54,05
Cites per doc.	11,42		5,55	
Self cites per doc.	1,33		0,74	
Cited docs.	1.081	37,30	1.817	62,70
Uncited docs.	212	18,58	929	81,42
% International collaboration	*58,62*		*66,13*	
% world	0,02		0,02	

4.12.2. Research areas

Table 53. Bibliometric indicators by subject areas (Ghana-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**GHA**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	1.141	28,25	6.032	5,29	4,02	2,68	0,52
Arts and humanities	33	0,82	44	1,33	0,57	0,62	0,84
Biochemistry, genetics and molecular biology	278	6,88	2.733	9,83	0,61	0,40	0,51
Business, management and accounting	63	1,56	224	3,56	0,83	0,76	0,72
Chemical engineering	47	1,16	206	4,38	0,29	0,27	0,73
Chemistry	126	3,12	833	6,61	0,46	0,31	0,52
Computer science	26	0,64	70	2,69	0,14	0,08	0,44
Decision sciences	2	0,05	0	0,00	0,11	0,00	0,00
Dentistry	3	0,07	38	12,67	0,18	0,34	1,50
Earth and planetary sciences	203	5,03	1.048	5,16	1,26	0,83	0,51
Economics, econometrics and finance	83	2,05	791	9,53	2,04	2,94	1,12
Energy	69	1,71	312	4,52	1,22	1,87	1,19
Engineering	130	3,22	256	1,97	0,26	0,15	0,46
Environmental science	405	10,03	1.927	4,76	2,86	1,58	0,43
Health professions	9	0,22	34	3,78	0,34	0,15	0,34
Immunology and microbiology	666	16,49	9.099	13,66	5,29	5,02	0,74
Materials science	88	2,18	236	2,68	0,37	0,18	0,39
Mathematics	17	0,42	14	0,82	0,11	0,02	0,15
Medicine	1.163	28,79	12.109	10,41	1,04	1,40	1,05
Multidisciplinary	50	1,24	680	13,60	1,19	0,54	0,35
Neuroscience	9	0,22	65	7,22	0,12	0,05	0,33
Nursing	35	0,87	133	3,80	0,82	0,62	0,59
Pharmacology, toxicology and pharmaceutics	100	2,48	543	5,43	0,96	0,66	0,54
Physics and astronomy	77	1,91	235	3,05	0,26	0,10	0,32
Psychology	19	0,47	60	3,16	0,35	0,13	0,29
Social sciences	393	9,73	1.371	3,49	2,63	2,78	0,82
Veterinary	79	1,96	481	6,09	2,38	3,74	1,22
Total	**4.039**	**100**	**30.016**	**7,43**			**0,78**

Figure 24. Activity and visibility of the Ghana scientific output by subject areas (SJCR 1996–2009).

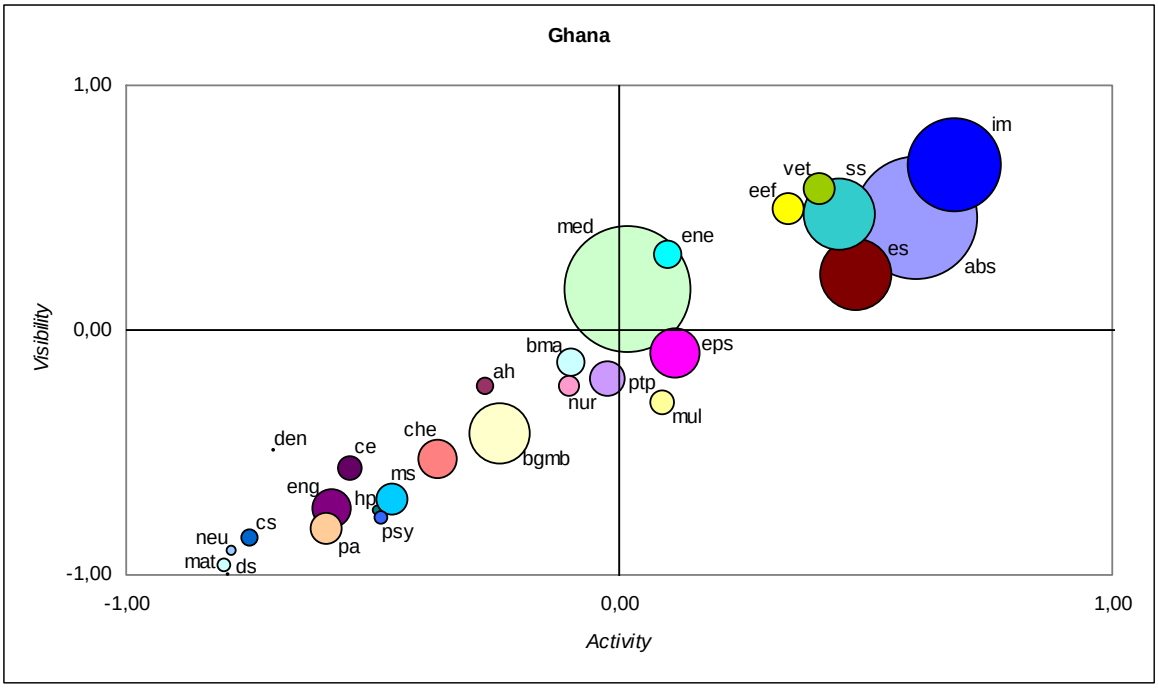
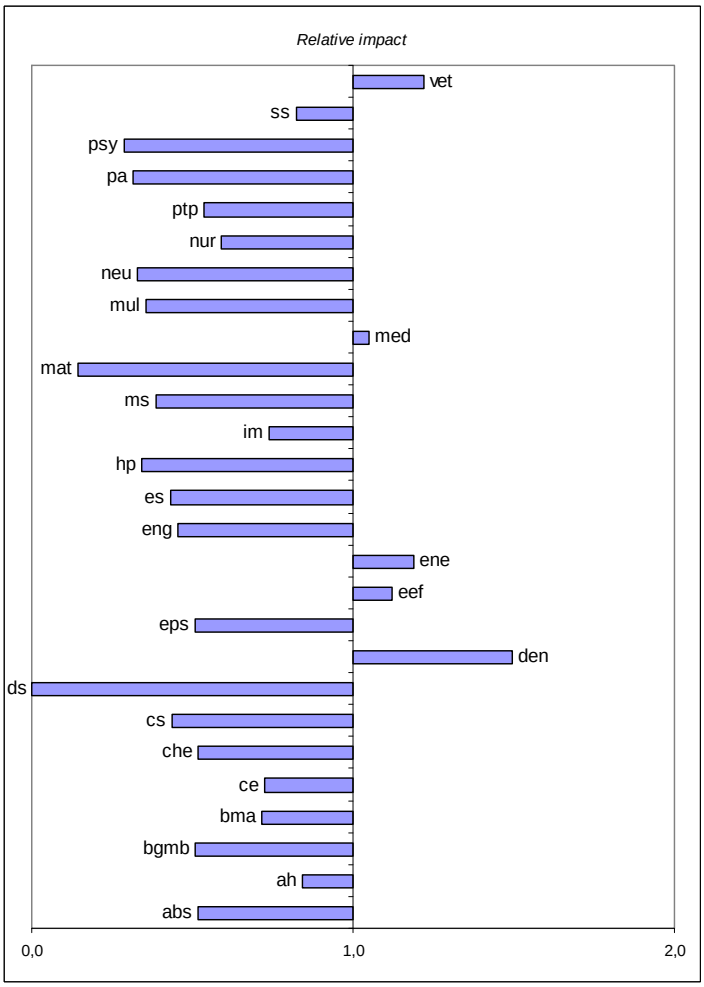


Figure 25. Relative impact of the Ghana scientific output by subject areas (SJCR 1996–2009).



4.13. Senegal

Population (thousands): **12 534**
Land area (thousands of Km^2): **197**
Population density (pop/Km^2): **64**
GDP based on PPP valuation (US $ million): **20 841**
GDP per Capita (PPP valuation, $): **1 663**
Annual real GDP growth (average over 2001-2009): **3.8**

4.13.1. General data (output and impact)

Table 54. Total output and impact of the Senegal scientific activity (SJCR 1996–2009).

Senegal 1996–2009	Total
Documents	3.416
Citable documents	3.272
Citations	28.678
Self citations	3.931
Citations per document	8,40
H index	62

Table 55. Annual output and impact of the Senegal scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	204	176	212	225	188	170	173	302	246	307	259	297	329	328	3.416
P. Doc	201	175	206	215	177	157	166	290	231	293	241	290	313	317	3.272
Cit	2.587	2.681	2.329	2.331	2.202	2.247	1.892	3.045	2.227	2.673	1.654	1.372	946	492	28.678
S-Cit	428	417	395	338	287	269	300	353	302	286	208	134	137	77	3.931
CxD	12,68	15,23	10,99	10,36	11,71	13,22	10,94	10,08	9,05	8,71	6,39	4,62	2,88	1,5	8,40
SCxD	2,1	2,37	1,86	1,5	1,53	1,58	1,73	1,17	1,23	0,93	0,8	0,45	0,42	0,23	1,15
CD	167	150	176	191	167	148	148	253	205	236	191	190	191	139	2.552
UD	37	26	36	34	21	22	25	49	41	71	68	107	138	189	864
IC(%)	65,2	57,39	64,62	62,22	61,7	57,06	58,96	68,54	74,8	74,59	77,22	71,72	75,08	83,84	*68,07*
% World	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,02	0,02	0,02	0,01	0,02	0,02	0,02	0,02

Table 56. Output and impact of the Senegal scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	1.348	39,46	2.068	60,54
Citable documents	1.297	39,64	1.975	60,36
Cites	16.269	56,73	12.409	43,27
Self cites	2.434	61,92	1.497	38,08
Cites per doc.	12,07		6,00	
Self cites per doc.	1,81		0,72	
Cited docs.	1.147	44,95	1.405	55,05
Uncited docs.	201	23,26	663	76,74
% International collaboration	*61,02*		*75,11*	
% world	0,02		0,02	

4.13.2. Research areas

Table 57. Bibliometric indicators by subject areas (Senegal-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**SEN**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	810	23,71	6.199	7,65	3,38	2,88	0,75
Arts and humanities	6	0,18	1	0,17	0,12	0,01	0,11
Biochemistry, genetics and molecular biology	254	7,44	2.722	10,72	0,66	0,42	0,56
Business, management and accounting	10	0,29	68	6,80	0,16	0,24	1,37
Chemical engineering	39	1,14	547	14,03	0,29	0,76	2,32
Chemistry	136	3,98	959	7,05	0,59	0,37	0,55
Computer science	37	1,08	127	3,43	0,24	0,15	0,56
Decision sciences	6	0,18	13	2,17	0,41	0,13	0,28
Dentistry	16	0,47	73	4,56	1,11	0,68	0,54
Earth and planetary sciences	217	6,35	1.714	7,90	1,59	1,42	0,78
Economics, econometrics and finance	20	0,59	118	5,90	0,58	0,46	0,69
Energy	30	0,88	211	7,03	0,63	1,32	1,85
Engineering	65	1,90	259	3,98	0,16	0,16	0,92
Environmental science	255	7,46	2.222	8,71	2,13	1,91	0,79
Health professions	21	0,61	48	2,29	0,95	0,23	0,21
Immunology and microbiology	773	22,63	11.788	15,25	7,27	6,81	0,82
Materials science	75	2,20	368	4,91	0,37	0,30	0,71
Mathematics	87	2,55	159	1,83	0,68	0,25	0,32
Medicine	1.302	38,11	10.929	8,39	1,37	1,32	0,85
Multidisciplinary	9	0,26	581	64,56	0,25	0,49	1,68
Neuroscience	13	0,38	15	1,15	0,21	0,01	0,05
Nursing	15	0,44	76	5,07	0,42	0,37	0,79
Pharmacology, toxicology and pharmaceutics	36	1,05	203	5,64	0,41	0,26	0,56
Physics and astronomy	91	2,66	273	3,00	0,36	0,13	0,31
Psychology	2	0,06	4	2,00	0,04	0,01	0,18
Social sciences	156	4,57	484	3,10	1,23	1,03	0,73
Veterinary	75	2,20	296	3,95	2,68	2,41	0,79
Total	**3.416**	**100**	**28.678**	**8,40**			**0,88**

Figure 26. Activity and visibility of the Senegal scientific output by subject areas (SJCR 1996–2009).

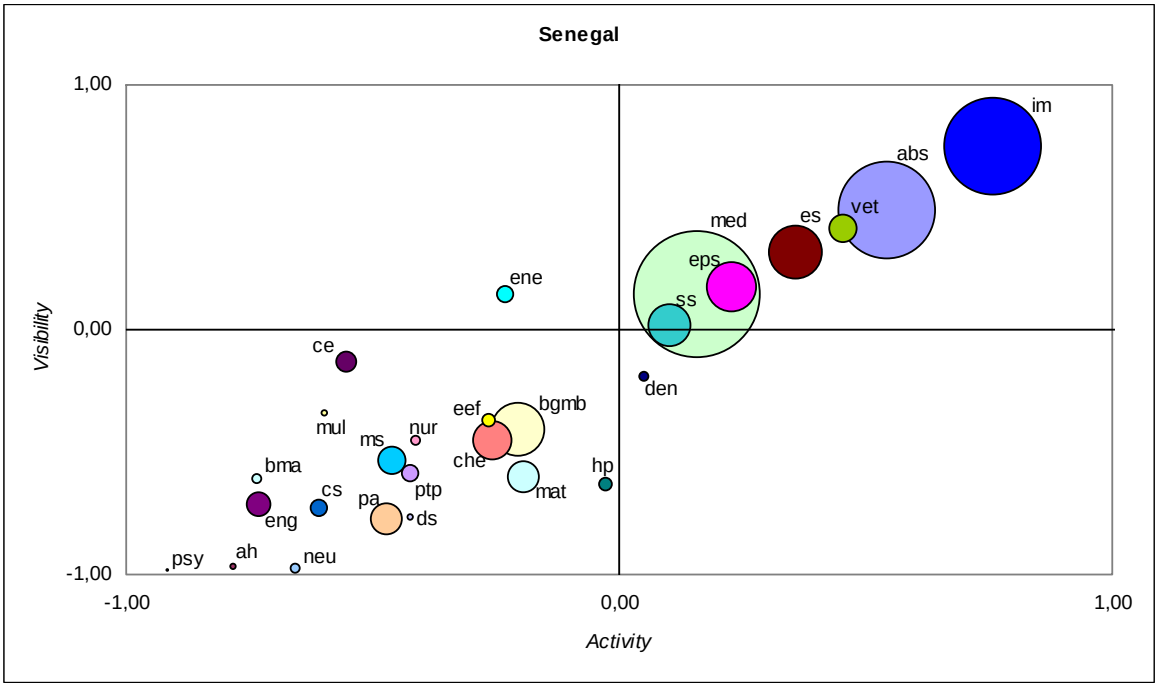
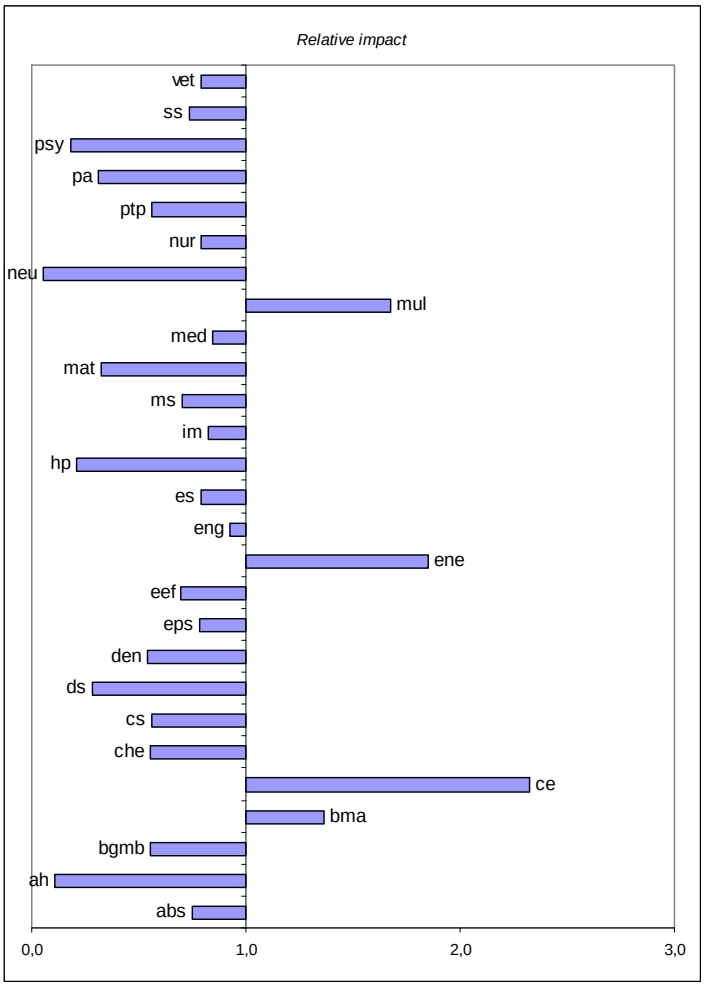


Figure 27. Relative impact of the Senegal scientific output by subject areas (SJCR 1996–2009).



4.14. Cote d´Ivoire

Population (thousands): **21 075**
Land area (thousands of Km^2): **322**
Population density (pop/Km^2): **65**
GDP based on PPP valuation (US $ million): **33 766**
GDP per Capita (PPP valuation, $): **1 602**
Annual real GDP growth (average over 2001-2009): **0.9**

4.14.1. General data (output and impact)

Table 58. Total output and impact of the Cote d´Ivoire scientific activity (SJCR 1996–2009).

Cote d´Ivoire 1996–2009	Total
Documents	2.426
Citable documents	2.342
Citations	21.008
Self citations	2.443
Citations per document	8,66
H index	55

Table 59. Annual output and impact of the Cote d´Ivoire scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	106	162	181	175	141	103	109	180	167	168	186	222	291	235	2.426
P. Doc	106	160	175	172	134	100	107	167	157	159	176	218	283	228	2.342
Cit	1.023	1.512	2.189	3.170	2.207	1.222	1.729	1.990	1.448	1.265	1.108	1.215	664	266	21.008
S-Cit	96	173	271	348	232	152	167	248	169	186	153	137	81	30	2.443
CxD	9,65	9,33	12,09	18,11	15,65	11,86	15,86	11,06	8,67	7,53	5,96	5,47	2,28	1,13	8,66
SCxD	0,91	1,07	1,5	1,99	1,65	1,48	1,53	1,38	1,01	1,11	0,82	0,62	0,28	0,13	1,01
CD	78	128	157	141	120	79	93	142	137	121	128	134	136	79	1.673
UD	28	34	24	34	21	24	16	38	30	47	58	88	155	156	753
IC(%)	62,26	60,49	71,82	64,57	77,3	63,11	65,14	73,33	64,07	69,05	77,42	70,72	51,89	64,26	*66,82*
% World	0,01	0,01	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 60. Output and impact of the Cote d´Ivoire scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	977	40,27	1.449	59,73
Citable documents	954	40,73	1.388	59,27
Cites	13.052	62,13	7.956	37,87
Self cites	1.439	58,90	1.004	41,10
Cites per doc.	13,36		5,49	
Self cites per doc.	1,47		0,69	
Cited docs.	796	47,58	877	52,42
Uncited docs.	181	24,04	572	75,96
% International collaboration	*66,38*		*67,25*	
% world	0,01		0,01	

4.14.2. Research areas

Table 61. Bibliometric indicators by subject areas (Cote d´Ivoire-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**CIV**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	620	25,56	6.047	9,75	3,64	3,83	0,95
Arts and humanities	4	0,16	24	6,00	0,12	0,48	3,79
Biochemistry, genetics and molecular biology	186	7,67	1.600	8,60	0,68	0,34	0,45
Business, management and accounting	5	0,21	6	1,20	0,11	0,03	0,24
Chemical engineering	17	0,70	31	1,82	0,18	0,06	0,30
Chemistry	115	4,74	737	6,41	0,70	0,39	0,50
Computer science	9	0,37	9	1,00	0,08	0,01	0,16
Decision sciences	8	0,33	15	1,88	0,76	0,20	0,24
Dentistry	2	0,08	7	3,50	0,19	0,09	0,41
Earth and planetary sciences	101	4,16	844	8,36	1,04	0,95	0,83
Economics, econometrics and finance	19	0,78	152	8,00	0,78	0,81	0,94
Energy	13	0,54	42	3,23	0,38	0,36	0,85
Engineering	17	0,70	29	1,71	0,06	0,03	0,40
Environmental science	137	5,65	905	6,61	1,61	1,06	0,60
Health professions	16	0,66	42	2,63	1,02	0,27	0,24
Immunology and microbiology	462	19,04	7.198	15,58	6,11	5,68	0,84
Materials science	32	1,32	95	2,97	0,22	0,11	0,43
Mathematics	43	1,77	55	1,28	0,47	0,12	0,23
Medicine	1.011	41,67	9.702	9,60	1,50	1,60	0,97
Multidisciplinary	126	5,19	328	2,60	5,01	0,37	0,07
Neuroscience	27	1,11	143	5,30	0,60	0,16	0,24
Nursing	21	0,87	30	1,43	0,82	0,20	0,22
Pharmacology, toxicology and pharmaceutics	53	2,18	605	11,42	0,84	1,05	1,13
Physics and astronomy	58	2,39	126	2,17	0,32	0,08	0,22
Psychology	4	0,16	12	3,00	0,12	0,04	0,28
Social sciences	62	2,56	177	2,85	0,69	0,51	0,67
Veterinary	37	1,53	593	16,03	1,86	6,59	3,21
Total	**2.426**	**100**	**21.008**	**8,66**			**0,91**

Figure 28. Activity and visibility of the Cote d´Ivoire scientific output by subject areas (SJCR 1996–2009).

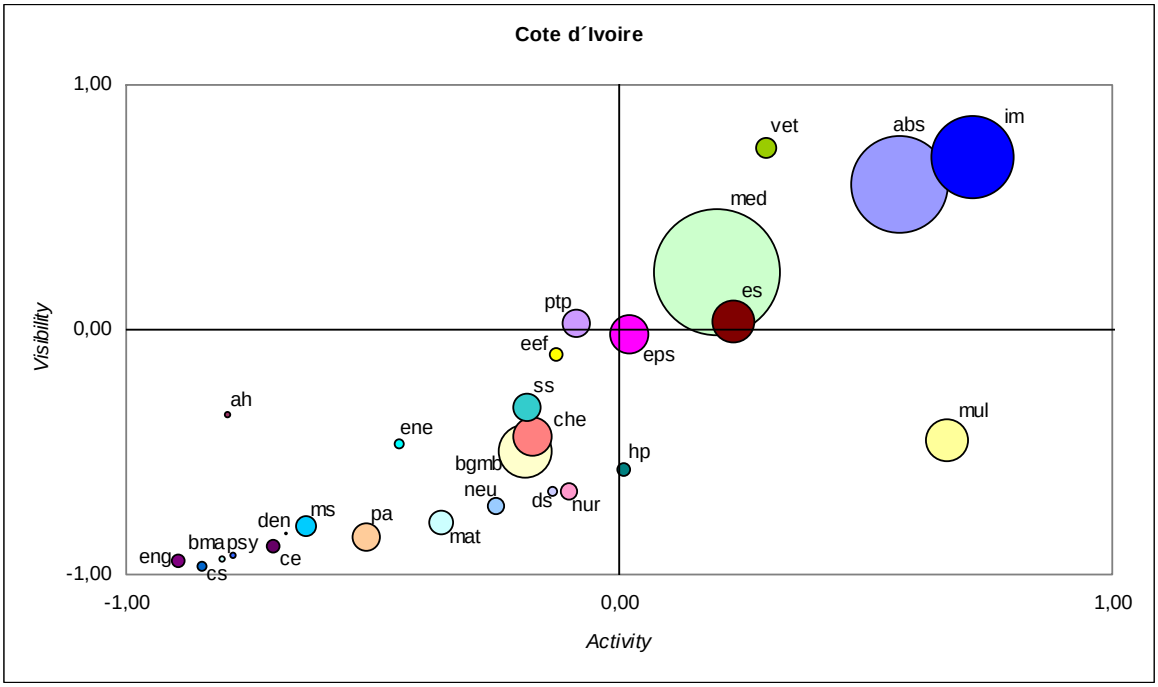
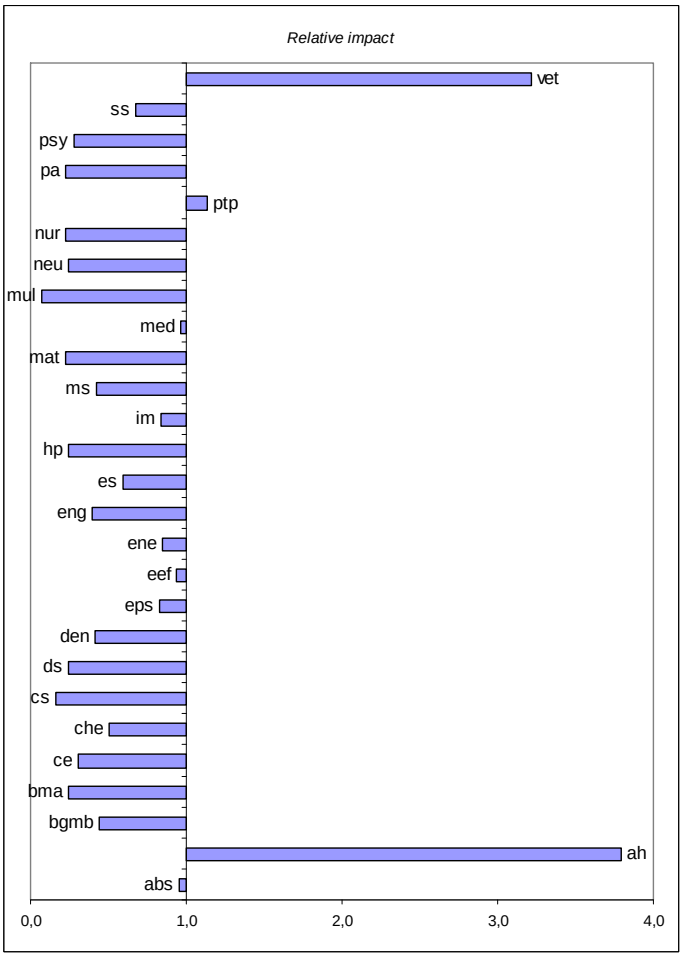


Figure 29. Relative impact of the Cote d´Ivoire scientific output by subject areas (SJCR 1996–2009).



4.15. Botswana

Population (thousands): **1 950**
Land area (thousands of Km^2): **582**
Population density (pop/Km^2): **3**
GDP based on PPP valuation (US $ million): **25 764**
GDP per Capita (PPP valuation, $): **13 214**
Annual real GDP growth (average over 2001-2009): **3.9**

4.15.1. General data (output and impact)

Table 62. Total output and impact of the Botswana scientific activity (SJCR 1996–2009).

Botswana 1996–2009	Total
Documents	2.343
Citable documents	2.303
Citations	16.067
Self citations	2.206
Citations per document	6,86
H index	45

Table 63. Annual output and impact of the Botswana scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	90	92	100	111	136	122	144	168	177	199	266	237	266	235	2.343
P. Doc	90	92	100	111	134	122	142	165	174	195	261	233	259	225	2.303
Cit	900	1.167	923	1.531	1.123	792	980	1.639	1.150	2.461	1.581	1.022	551	247	16.067
S-Cit	134	149	213	149	233	128	166	221	168	206	227	107	67	38	2.206
CxD	10	12,68	9,23	13,79	8,26	6,49	6,81	9,76	6,5	12,37	5,94	4,31	2,07	1,05	6,86
SCxD	1,49	1,62	2,13	1,34	1,71	1,05	1,15	1,32	0,95	1,04	0,85	0,45	0,25	0,16	0,94
CD	73	76	83	90	116	102	122	134	136	152	182	150	148	81	1.645
UD	17	16	17	21	20	20	22	34	41	47	84	87	118	154	698
IC(%)	44,44	54,35	46	49,55	35,29	31,15	36,11	44,64	48,02	58,29	56,39	63,71	58,65	60,43	*49,07*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 64. Output and impact of the Botswana scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	795	33,93	1.548	66,07
Citable documents	791	34,35	1.512	65,65
Cites	7.416	46,16	8.651	53,84
Self cites	1.172	53,13	1.034	46,87
Cites per doc.	9,33		5,59	
Self cites per doc.	1,47		0,67	
Cited docs.	662	40,24	983	59,76
Uncited docs.	133	19,05	565	80,95
% International collaboration	*42,41*		*55,73*	
% world	0,009		0,01	

4.15.2. Research areas

Table 65. Bibliometric indicators by subject areas (Botswana-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**BOT**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	477	20,36	3.142	6,59	2,90	2,60	0,64
Arts and humanities	32	1,37	77	2,41	0,96	2,03	1,52
Biochemistry, genetics and molecular biology	118	5,04	1.102	9,34	0,45	0,30	0,48
Business, management and accounting	43	1,84	215	5,00	0,97	1,36	1,01
Chemical engineering	30	1,28	239	7,97	0,32	0,59	1,32
Chemistry	211	9,01	1.515	7,18	1,34	1,05	0,56
Computer science	49	2,09	70	1,43	0,47	0,15	0,23
Decision sciences	11	0,47	22	2,00	1,09	0,39	0,26
Dentistry	1	0,04	5	5,00	0,10	0,08	0,59
Earth and planetary sciences	331	14,13	2.919	8,82	3,54	4,30	0,87
Economics, econometrics and finance	31	1,32	168	5,42	1,32	1,17	0,64
Energy	45	1,92	78	1,73	1,37	0,87	0,46
Engineering	76	3,24	189	2,49	0,27	0,21	0,58
Environmental science	255	10,88	1.764	6,92	3,10	2,71	0,63
Health professions	18	0,77	178	9,89	1,19	1,49	0,90
Immunology and microbiology	130	5,55	2.469	18,99	1,78	2,55	1,03
Materials science	52	2,22	187	3,60	0,38	0,27	0,52
Mathematics	87	3,71	147	1,69	0,98	0,41	0,30
Medicine	252	10,76	3.818	15,15	0,39	0,82	1,53
Multidisciplinary	15	0,64	372	24,80	0,62	0,55	0,65
Neuroscience	2	0,09	14	7,00	0,05	0,02	0,32
Nursing	42	1,79	139	3,31	1,70	1,22	0,52
Pharmacology, toxicology and pharmaceutics	24	1,02	186	7,75	0,40	0,42	0,77
Physics and astronomy	67	2,86	209	3,12	0,39	0,17	0,32
Psychology	18	0,77	142	7,89	0,57	0,58	0,73
Social sciences	409	17,46	1.116	2,73	4,71	4,23	0,64
Veterinary	92	3,93	380	4,13	4,79	5,52	0,83
Total	**2.343**	**100**	**16.067**	**6,86**			**0,72**

Figure 30. Activity and visibility of the Botswana scientific output by subject areas (SJCR 1996–2009).

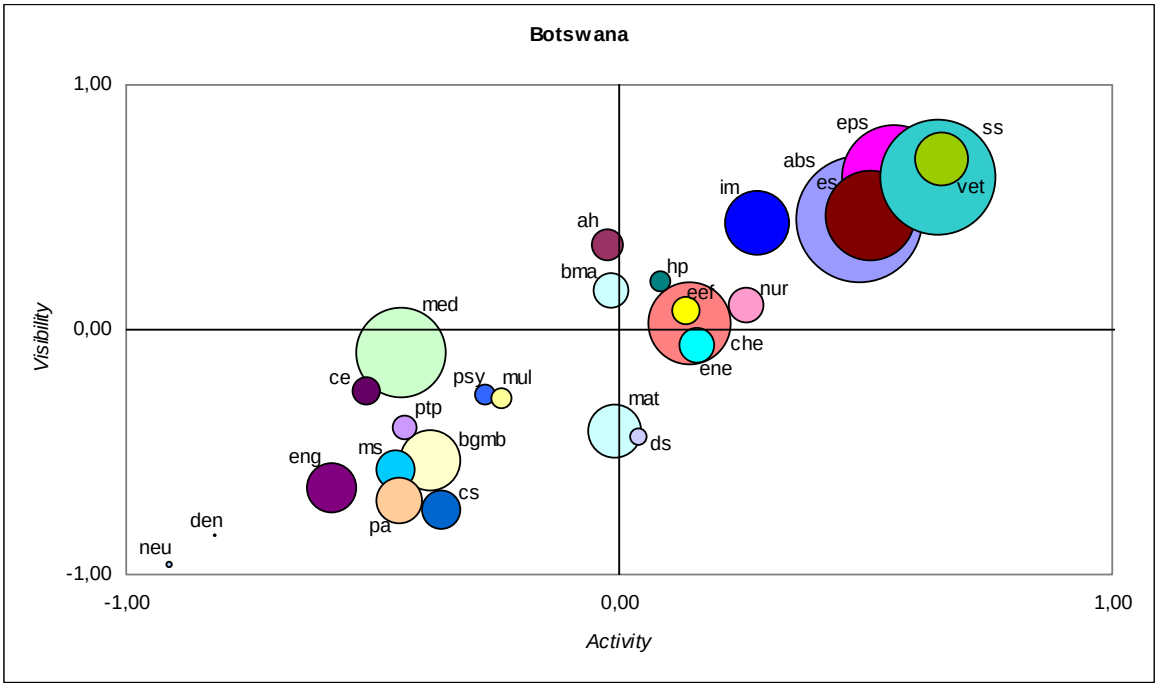
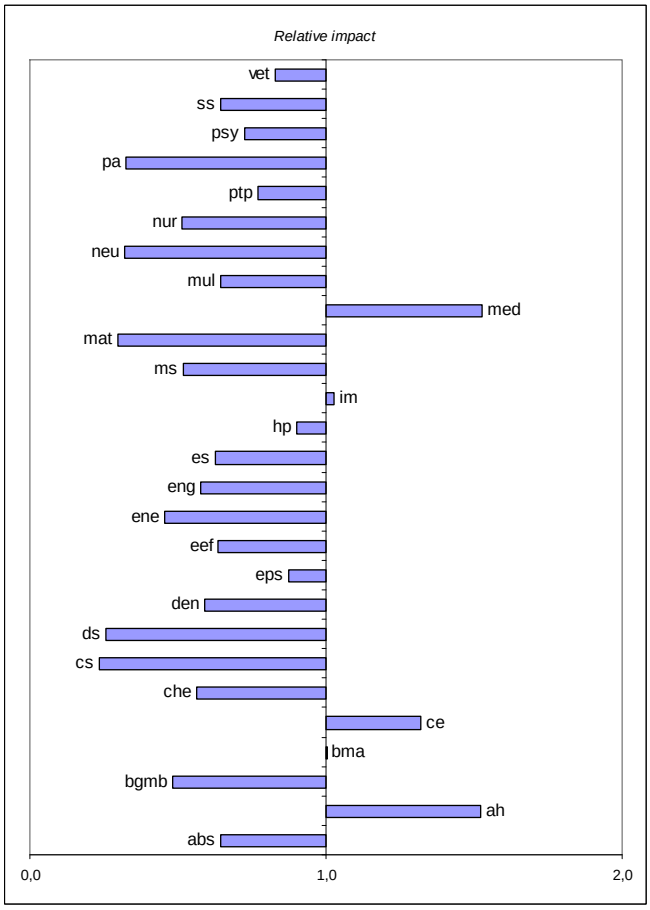


Figure 31. Relative impact of the Botswana scientific output by subject areas (SJCR 1996–2009).



4.16. Sudan

Population (thousands): **42 272**
Land area (thousands of Km^2): **2 506**
Population density (pop/Km^2): **17**
GDP based on PPP valuation (US $ million): **95 466**
GDP per Capita (PPP valuation, $): **2 258**
Annual real GDP growth (average over 2001-2009): **7.1**

4.16.1. General data (output and impact)

Table 66. Total output and impact of the Sudan scientific activity (SJCR 1996–2009).

Sudan 1996–2009	Total
Documents	2.296
Citable documents	2.232
Citations	14.277
Self citations	2.108
Citations per document	6,22
H index	41

Table 67. Annual output and impact of the Sudan scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	95	111	141	106	99	80	101	134	153	161	191	252	281	391	2.296
P. Doc	95	110	140	105	95	79	96	131	148	156	184	242	273	378	2.232
Cit	796	947	1.802	1.504	1.456	820	677	1.325	1.033	873	855	1.078	650	461	14.277
S-Cit	134	150	241	154	156	104	128	138	205	209	168	146	105	70	2.108
CxD	8,38	8,53	12,78	14,19	14,71	10,25	6,7	9,89	6,75	5,42	4,48	4,28	2,31	1,18	6,22
SCxD	1,41	1,35	1,71	1,45	1,58	1,3	1,27	1,03	1,34	1,3	0,88	0,58	0,37	0,18	0,92
CD	83	99	117	97	81	69	85	106	121	126	143	167	154	137	1.585
UD	12	12	24	9	18	11	16	28	32	35	48	85	127	254	711
IC(%)	53,68	63,96	65,25	70,75	55,56	53,75	54,46	63,43	62,09	62,73	72,25	69,84	59,79	54,99	*61,61*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,01

Table 68. Output and impact of the Sudan scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	733	31,93	1.563	68,07
Citable documents	720	32,26	1.512	67,74
Cites	8.002	56,05	6.275	43,95
Self cites	1.067	50,62	1.041	49,38
Cites per doc.	10,92		4,01	
Self cites per doc.	1,46		0,67	
Cited docs.	631	39,81	954	60,19
Uncited docs.	102	14,35	609	85,65
% International collaboration	*59,63*		*63,59*	
% world	0,009		0,01	

4.16.2. Research areas

Table 69. Bibliometric indicators by subject areas (Sudan-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**SUD**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	707	30,79	3.240	4,58	4,39	3,02	0,45
Arts and humanities	8	0,35	17	2,13	0,24	0,50	1,34
Biochemistry, genetics and molecular biology	239	10,41	2.404	10,06	0,93	0,74	0,52
Business, management and accounting	6	0,26	3	0,50	0,14	0,02	0,10
Chemical engineering	36	1,57	80	2,22	0,40	0,22	0,37
Chemistry	61	2,66	238	3,90	0,39	0,19	0,31
Computer science	30	1,31	120	4,00	0,29	0,29	0,65
Decision sciences	3	0,13	9	3,00	0,30	0,18	0,39
Dentistry	18	0,78	101	5,61	1,85	1,88	0,66
Earth and planetary sciences	82	3,57	326	3,98	0,90	0,54	0,39
Economics, econometrics and finance	7	0,30	27	3,86	0,30	0,21	0,45
Energy	34	1,48	145	4,26	1,06	1,82	1,12
Engineering	56	2,44	212	3,79	0,20	0,27	0,88
Environmental science	94	4,09	290	3,09	1,17	0,50	0,28
Health professions	6	0,26	43	7,17	0,40	0,40	0,65
Immunology and microbiology	429	18,68	5.159	12,03	6,00	5,99	0,65
Materials science	39	1,70	179	4,59	0,29	0,29	0,66
Mathematics	11	0,48	13	1,18	0,13	0,04	0,21
Medicine	727	31,66	5.133	7,06	1,14	1,25	0,71
Multidisciplinary	40	1,74	199	4,98	1,68	0,33	0,13
Neuroscience	12	0,52	67	5,58	0,28	0,11	0,25
Nursing	56	2,44	50	0,89	2,31	0,49	0,14
Pharmacology, toxicology and pharmaceutics	89	3,88	456	5,12	1,50	1,17	0,51
Physics and astronomy	86	3,75	422	4,91	0,51	0,39	0,51
Psychology	7	0,30	46	6,57	0,23	0,21	0,60
Social sciences	54	2,35	85	1,57	0,64	0,36	0,37
Veterinary	174	7,58	680	3,91	9,24	11,12	0,78
Total	**2.296**	**100**	**14.277**	**6,22**			**0,65**

Figure 32. Activity and visibility of the Sudan scientific output by subject areas (SJCR 1996–2009).

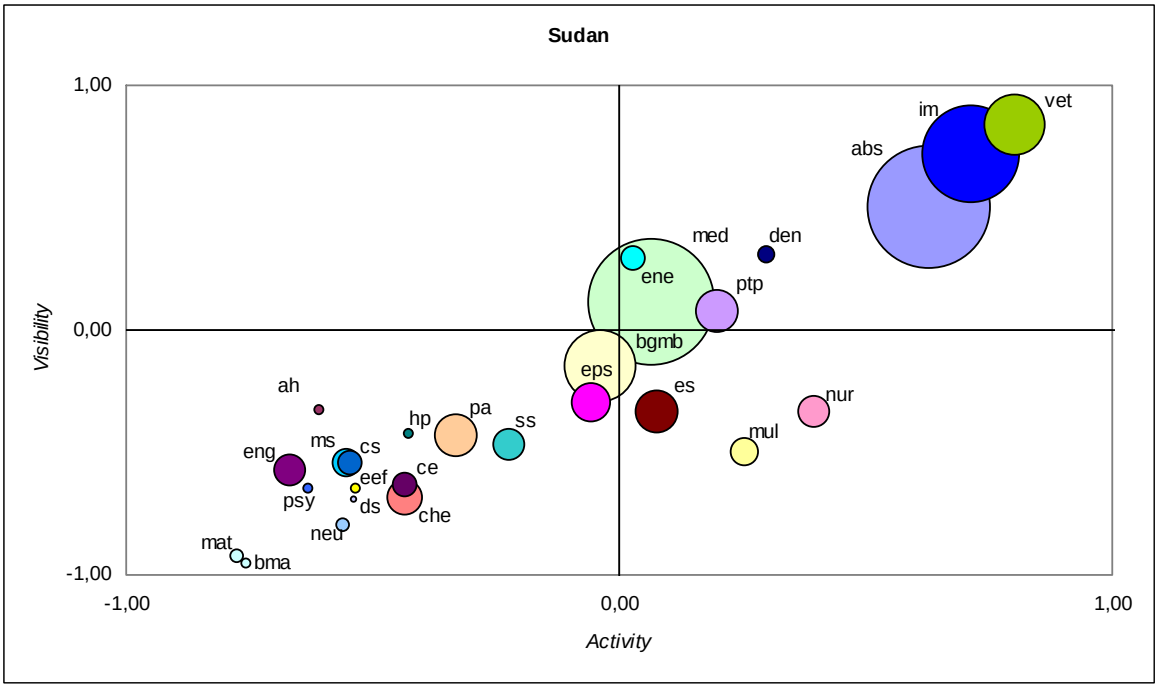
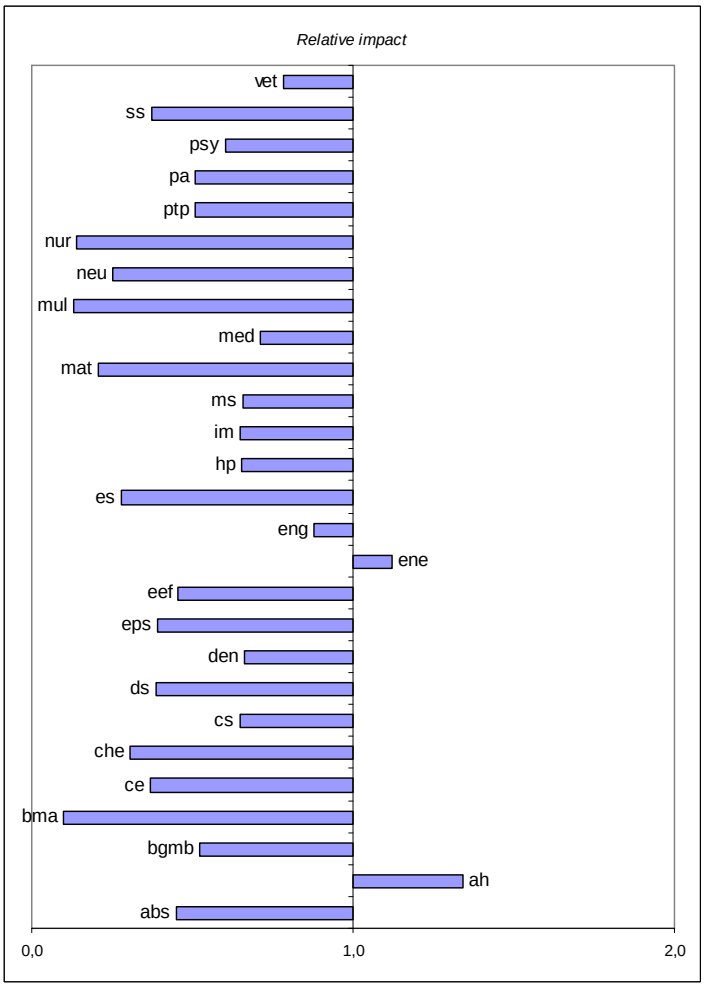


Figure 33. Relative impact of the Sudan scientific output by subject areas (SJCR 1996–2009).



4.17. Malawi

Population (thousands): **15 263**
Land area (thousands of Km^2): **118**
Population density (pop/Km^2): **129**
GDP based on PPP valuation (US $ million): **8 395**
GDP per Capita (PPP valuation, $): **550**
Annual real GDP growth (average over 2001-2009): **4.9**

4.17.1. General data (output and impact)

Table 70. Total output and impact of the Malawi scientific activity (SJCR 1996–2009).

Malawi 1996–2009	Total
Documents	2.150
Citable documents	2.021
Citations	25.921
Self citations	3.634
Citations per document	12,06
H index	63

Table 71. Annual output and impact of the Malawi scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	93	95	75	110	109	113	109	137	154	169	195	253	281	257	2.150
P. Doc	89	94	74	102	104	102	102	130	140	154	181	237	266	246	2.021
Cit	2.497	1.133	1.667	2.972	2.611	1.716	1.579	2.169	2.214	1.683	2.057	1.734	1.282	607	25.921
S-Cit	227	152	224	264	288	240	229	323	322	289	388	339	245	104	3.634
CxD	26,85	11,93	22,23	27,02	23,95	15,19	14,49	15,83	14,38	9,96	10,55	6,85	4,56	2,36	12,06
SCxD	2,44	1,6	2,99	2,4	2,64	2,12	2,1	2,36	2,09	1,71	1,99	1,34	0,87	0,4	1,69
CD	84	85	72	100	100	99	93	128	139	151	168	202	195	152	1.768
UD	9	10	3	10	9	14	16	9	15	18	27	51	86	105	382
IC(%)	68,82	72,63	68,00	72,73	66,06	53,1	54,13	75,18	73,38	79,29	84,62	79,45	83,63	86,38	*72,67*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 72. Output and impact of the Malawi scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	704	32,74	1.446	67,26
Citable documents	667	33,00	1.354	67,00
Cites	14.175	54,69	11.746	45,31
Self cites	1.624	44,69	2.010	55,31
Cites per doc.	20,13		8,12	
Self cites per doc.	2,31		1,39	
Cited docs.	633	35,80	1.135	64,20
Uncited docs.	71	18,59	311	81,41
% International collaboration	*65,07*		*80,28*	
% world	0,01		0,01	

4.17.2. Research areas

Table 73. Bibliometric indicators by subject areas (Malawi-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**MLW**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	403	18,74	2.641	6,55	2,67	1,36	0,64
Arts and humanities	3	0,14	0	0,00	0,10	0,00	0,00
Biochemistry, genetics and molecular biology	134	6,23	1.348	10,06	0,55	0,23	0,52
Business, management and accounting	12	0,56	47	3,92	0,30	0,18	0,79
Chemical engineering	5	0,23	7	1,40	0,06	0,01	0,23
Chemistry	25	1,16	162	6,48	0,17	0,07	0,51
Computer science	11	0,51	33	3,00	0,11	0,04	0,49
Decision sciences	1	0,05	2	2,00	0,11	0,02	0,26
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	53	2,47	290	5,47	0,62	0,26	0,54
Economics, econometrics and finance	26	1,21	197	7,58	1,20	0,85	0,89
Energy	12	0,56	65	5,42	0,40	0,45	1,42
Engineering	23	1,07	69	3,00	0,09	0,05	0,70
Environmental science	111	5,16	650	5,86	1,47	0,62	0,53
Health professions	17	0,79	72	4,24	1,22	0,37	0,39
Immunology and microbiology	567	26,37	10.955	19,32	8,47	7,00	1,04
Materials science	17	0,79	43	2,53	0,13	0,04	0,36
Mathematics	10	0,47	15	1,50	0,12	0,03	0,27
Medicine	1.090	50,70	15.126	13,88	1,83	2,02	1,40
Multidisciplinary	14	0,65	562	40,14	0,63	0,52	1,04
Neuroscience	8	0,37	25	3,13	0,20	0,02	0,14
Nursing	42	1,95	225	5,36	1,85	1,22	0,83
Pharmacology, toxicology and pharmaceutics	17	0,79	144	8,47	0,31	0,20	0,84
Physics and astronomy	7	0,33	19	2,71	0,04	0,01	0,28
Psychology	15	0,70	29	1,93	0,52	0,07	0,18
Social sciences	127	5,91	356	2,80	1,60	0,84	0,66
Veterinary	24	1,12	94	3,92	1,36	0,85	0,79
Total	**2.150**	**100**	**25.921**	**12,06**			**1,26**

Figure 34. Activity and visibility of the Malawi scientific output by subject areas (SJCR 1996–2009).

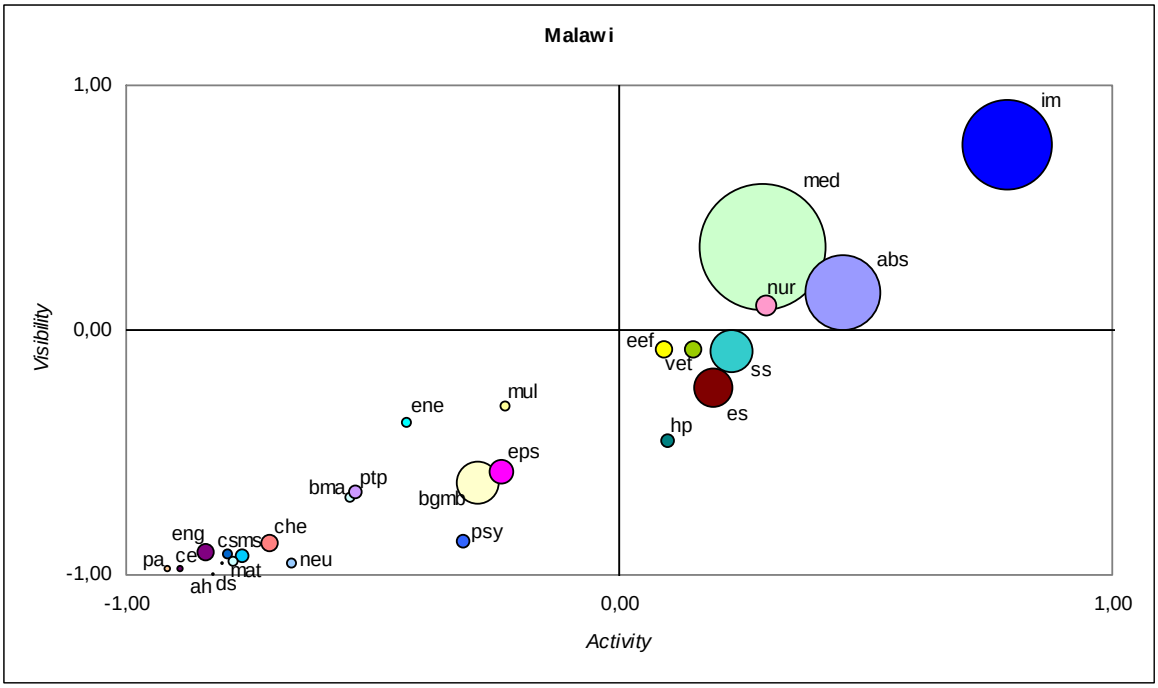
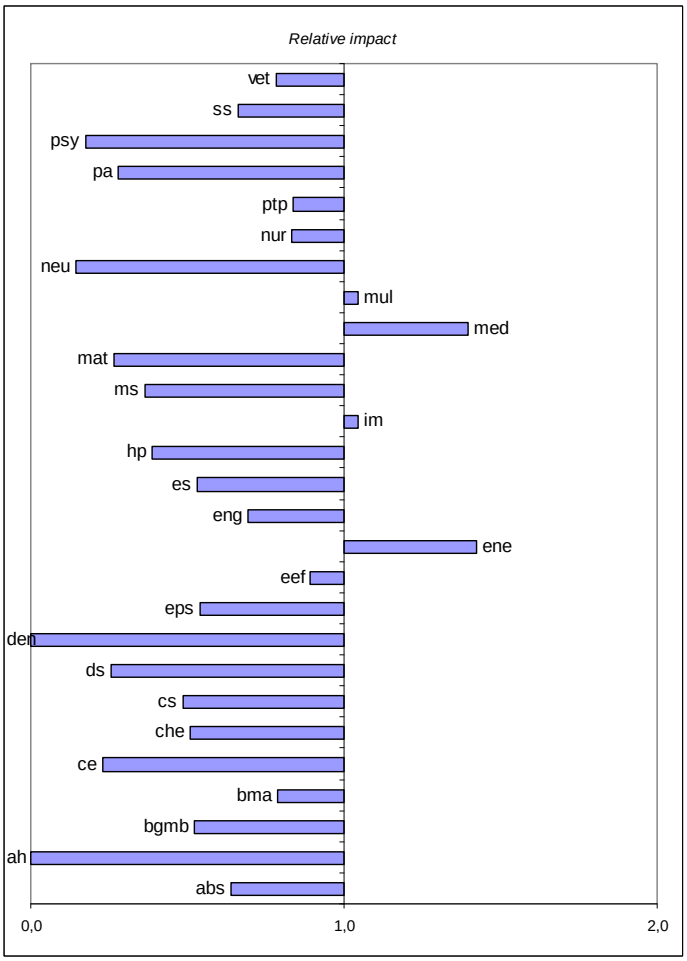


Figure 35. Relative impact of the Malawi scientific output by subject areas (SJCR 1996–2009).



4.18. Burkina Faso

Population (thousands): **15 757**
Land area (thousands of Km^2): **274**
Population density (pop/Km^2): **58**
GDP based on PPP valuation (US $ million): **19 395**
GDP per Capita (PPP valuation, $): **1 231**
Annual real GDP growth (average over 2001-2009): **5.4**

4.18.1. General data (output and impact)

Table 74. Total output and impact of the Burkina Faso scientific activity (SJCR 1996–2009).

Burkina Faso 1996–2009	Total
Documents	2.125
Citable documents	2.054
Citations	17.943
Self citations	2.930
Citations per document	8,44
H index	50

Table 75. Annual output and impact of the Burkina Faso scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	59	87	111	104	82	89	112	177	152	157	238	232	251	274	2.125
P. Doc	58	84	111	99	76	85	106	169	147	150	234	225	247	263	2.054
Cit	777	1.293	1.278	1.708	882	1.350	1.141	2.198	1.486	1.380	1.529	1.206	1.217	498	17.943
S-Cit	149	163	228	220	112	173	248	350	202	295	294	201	207	88	2.930
CxD	13,17	14,86	11,51	16,42	10,76	15,17	10,19	12,42	9,78	8,79	6,42	5,2	4,85	1,82	8,44
SCxD	2,53	1,87	2,05	2,12	1,37	1,94	2,21	1,98	1,33	1,88	1,24	0,87	0,82	0,32	1,38
CD	51	78	93	85	66	78	90	147	134	129	182	169	173	142	1.617
UD	8	9	18	19	16	11	22	30	18	28	56	63	78	132	508
IC(%)	64,41	72,41	69,37	68,27	62,2	62,92	55,36	84,18	86,84	87,26	87,82	83,62	85,26	81,75	*75,12*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 76. Output and impact of the Burkina Faso scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	644	30,31	1.481	69,69
Citable documents	619	30,14	1.435	69,86
Cites	8.429	46,98	9.514	53,02
Self cites	1.293	44,13	1.637	55,87
Cites per doc.	13,09		6,42	
Self cites per doc.	2,01		1,11	
Cited docs.	541	33,46	1.076	66,54
Uncited docs.	103	20,28	405	79,72
% International collaboration	*64,99*		*85,25*	
% world	0,01		0,01	

4.18.2. Research areas

Table 77. Bibliometric indicators by subject areas (Burkina Faso-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**BFA**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	621	29,22	4.626	7,45	4,16	3,43	0,73
Arts and humanities	7	0,33	1	0,14	0,23	0,02	0,09
Biochemistry, genetics and molecular biology	160	7,53	1.458	9,11	0,67	0,36	0,47
Business, management and accounting	3	0,14	40	13,33	0,07	0,23	2,68
Chemical engineering	21	0,99	208	9,90	0,25	0,46	1,64
Chemistry	52	2,45	370	7,12	0,36	0,23	0,56
Computer science	14	0,66	21	1,50	0,15	0,04	0,24
Decision sciences	2	0,09	1	0,50	0,22	0,02	0,06
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	84	3,95	614	7,31	0,99	0,81	0,72
Economics, econometrics and finance	21	0,99	352	16,76	0,98	2,19	1,97
Energy	9	0,42	39	4,33	0,30	0,39	1,14
Engineering	24	1,13	30	1,25	0,09	0,03	0,29
Environmental science	167	7,86	1.336	8,00	2,24	1,83	0,72
Health professions	6	0,28	33	5,50	0,44	0,25	0,50
Immunology and microbiology	504	23,72	7.117	14,12	7,62	6,57	0,76
Materials science	28	1,32	134	4,79	0,22	0,17	0,69
Mathematics	27	1,27	24	0,89	0,34	0,06	0,16
Medicine	840	39,53	6.886	8,20	1,43	1,33	0,83
Multidisciplinary	16	0,75	569	35,56	0,73	0,76	0,92
Neuroscience	8	0,38	18	2,25	0,20	0,02	0,10
Nursing	15	0,71	46	3,07	0,67	0,36	0,48
Pharmacology, toxicology and pharmaceutics	44	2,07	335	7,61	0,80	0,68	0,75
Physics and astronomy	35	1,65	54	1,54	0,22	0,04	0,16
Psychology	10	0,47	30	3,00	0,35	0,11	0,28
Social sciences	69	3,25	191	2,77	0,88	0,65	0,65
Veterinary	89	4,19	746	8,38	5,11	9,71	1,68
Total	**2.125**	**100**	**17.943**	**8,44**			**0,88**

Figure 36. Activity and visibility of the Burkina Faso scientific output by subject areas (SJCR 1996–2009).

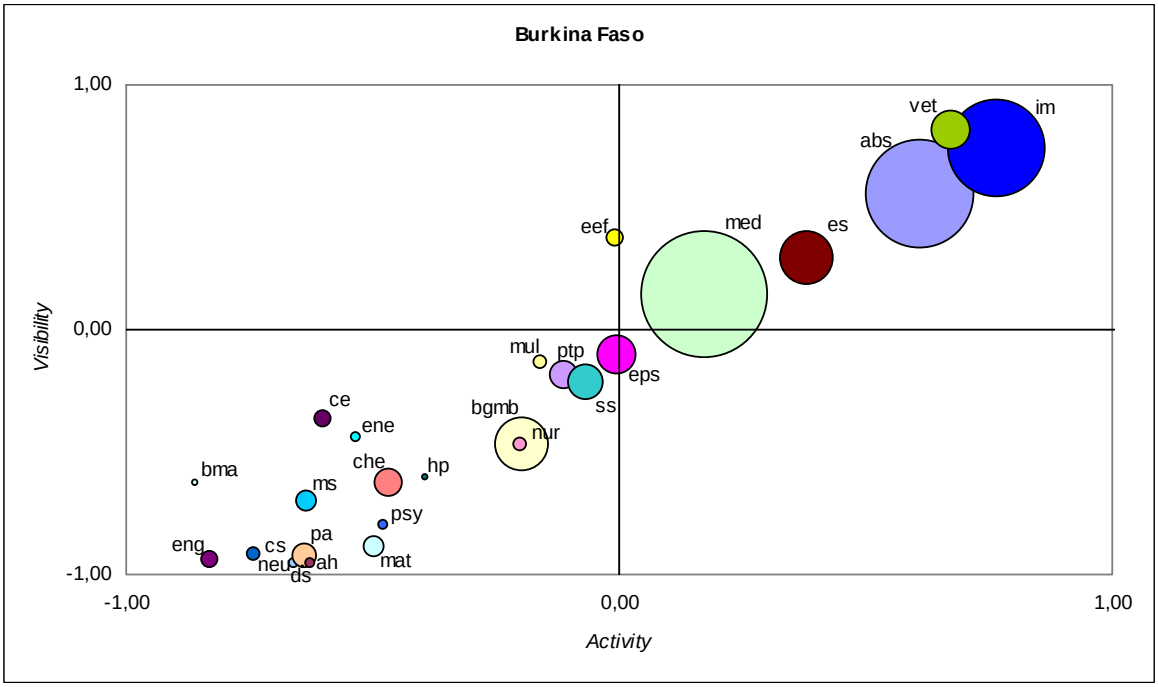
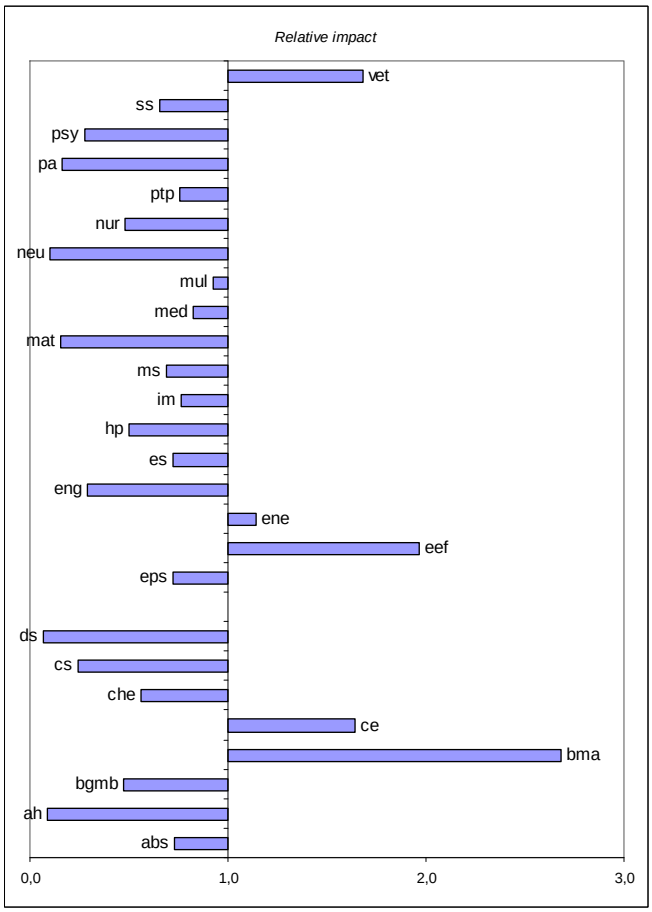


Figure 37. Relative impact of the Burkina Faso scientific output by subject areas (SJCR 1996–2009).



4.19. Zambia

Population (thousands): **12 935**
Land area (thousands of Km^2): **753**
Population density (pop/Km^2): **17**
GDP based on PPP valuation (US $ million): **19 606**
GDP per Capita (PPP valuation, $): **1 516**
Annual real GDP growth (average over 2001-2009): **5.4**

4.19.1. General data (output and impact)

Table 78. Total output and impact of the Zambia scientific activity (SJCR 1996–2009).

Zambia 1996–2008	Total
Documents	1.696
Citable documents	1.612
Citations	17.685
Self citations	2.107
Citations per document	10,43
H index	54

Table 79. Annual output and impact of the Zambia scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	83	106	100	87	74	91	70	108	93	131	156	191	210	196	1.696
P. Doc	78	101	97	87	71	88	66	100	90	120	152	183	198	181	1.612
Cit	657	1.568	1.621	1.174	1.180	1.305	1.042	1.667	1.420	1.207	1.734	1.424	1.141	545	17.685
S-Cit	76	167	161	142	75	133	111	183	154	157	307	199	163	79	2.107
CxD	7,92	14,79	16,21	13,49	15,95	14,34	14,89	15,44	15,27	9,21	11,12	7,46	5,43	2,78	10,43
SCxD	0,92	1,58	1,61	1,63	1,01	1,46	1,59	1,69	1,66	1,2	1,97	1,04	0,78	0,4	1,24
CD	71	87	75	76	67	78	56	96	86	111	133	152	150	112	1.350
UD	12	19	25	11	7	13	14	12	7	20	23	39	60	84	346
IC(%)	71,08	63,21	73,00	66,67	81,08	74,73	60,00	76,85	82,8	80,15	85,26	89,01	85,24	91,33	*77,17*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 80. Output and impact of the Zambia scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	611	36,03	1.085	63,97
Citable documents	588	36,48	1.024	63,52
Cites	8.547	48,33	9.138	51,67
Self cites	865	41,05	1.242	58,95
Cites per doc.	13,99		8,42	
Self cites per doc.	1,42		1,14	
Cited docs.	510	37,78	840	62,22
Uncited docs.	101	29,19	245	70,81
% International collaboration	*69,97*		*84,38*	
% world	0,01		0,01	

4.19.2. Research areas

Table 81. Bibliometric indicators by subject areas (Zambia-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**ZAM**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	373	21,99	2.992	8,02	3,13	2,25	0,79
Arts and humanities	7	0,41	22	3,14	0,29	0,53	1,99
Biochemistry, genetics and molecular biology	63	3,71	548	8,70	0,33	0,14	0,45
Business, management and accounting	28	1,65	149	5,32	0,87	0,86	1,07
Chemical engineering	7	0,41	10	1,43	0,10	0,02	0,24
Chemistry	16	0,94	72	4,50	0,14	0,05	0,35
Computer science	5	0,29	7	1,40	0,07	0,01	0,23
Decision sciences	1	0,06	2	2,00	0,14	0,03	0,26
Dentistry	2	0,12	2	1,00	0,28	0,03	0,12
Earth and planetary sciences	109	6,43	1.220	11,19	1,61	1,63	1,11
Economics, econometrics and finance	20	1,18	232	11,60	1,17	1,46	1,36
Energy	17	1,00	58	3,41	0,72	0,59	0,90
Engineering	32	1,89	56	1,75	0,15	0,06	0,41
Environmental science	116	6,84	1.169	10,08	1,95	1,63	0,91
Health professions	20	1,18	114	5,70	1,82	0,87	0,52
Immunology and microbiology	441	26,00	7.026	15,93	8,35	6,58	0,86
Materials science	13	0,77	33	2,54	0,13	0,04	0,36
Mathematics	10	0,59	24	2,40	0,16	0,06	0,42
Medicine	720	42,45	9.400	13,06	1,53	1,84	1,31
Multidisciplinary	7	0,41	251	35,86	0,40	0,34	0,93
Neuroscience	7	0,41	62	8,86	0,22	0,08	0,40
Nursing	15	0,88	38	2,53	0,84	0,30	0,39
Pharmacology, toxicology and pharmaceutics	19	1,12	230	12,11	0,43	0,47	1,20
Physics and astronomy	9	0,53	6	0,67	0,07	0,00	0,07
Psychology	18	1,06	108	6,00	0,79	0,40	0,55
Social sciences	88	5,19	389	4,42	1,40	1,34	1,04
Veterinary	115	6,78	567	4,93	8,27	7,48	0,99
Total	**1.696**	**100**	**17.685**	**10,43**			**1,09**

Figure 38. Activity and visibility of the Zambia scientific output by subject areas (SJCR 1996–2009).

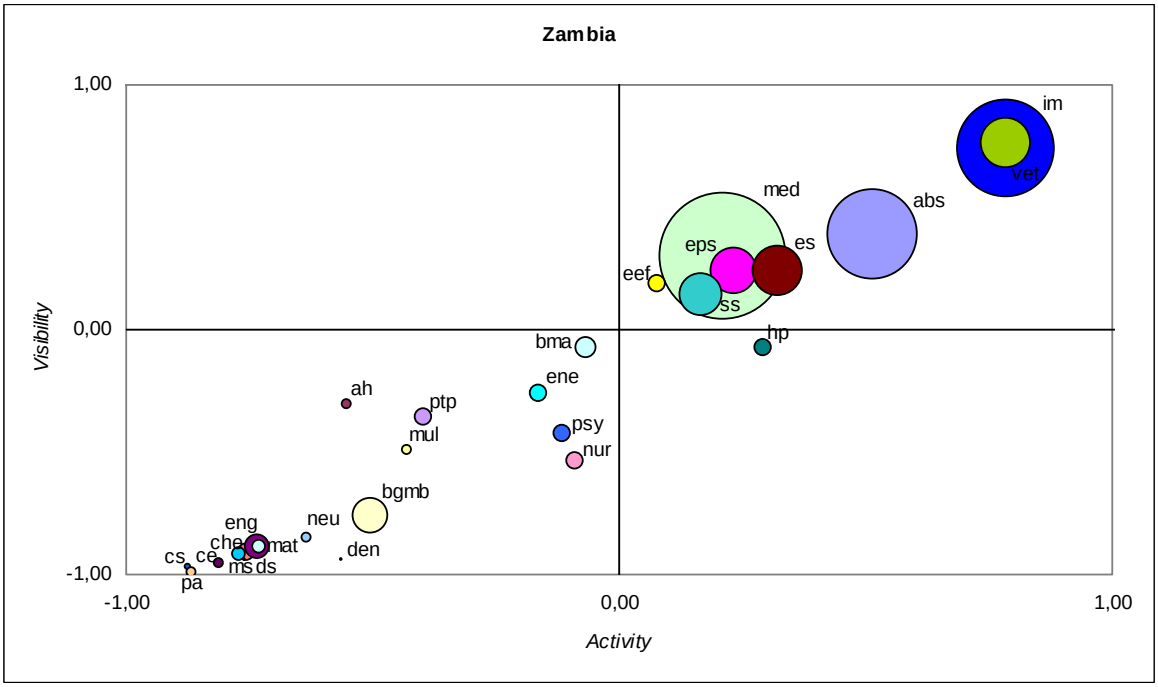
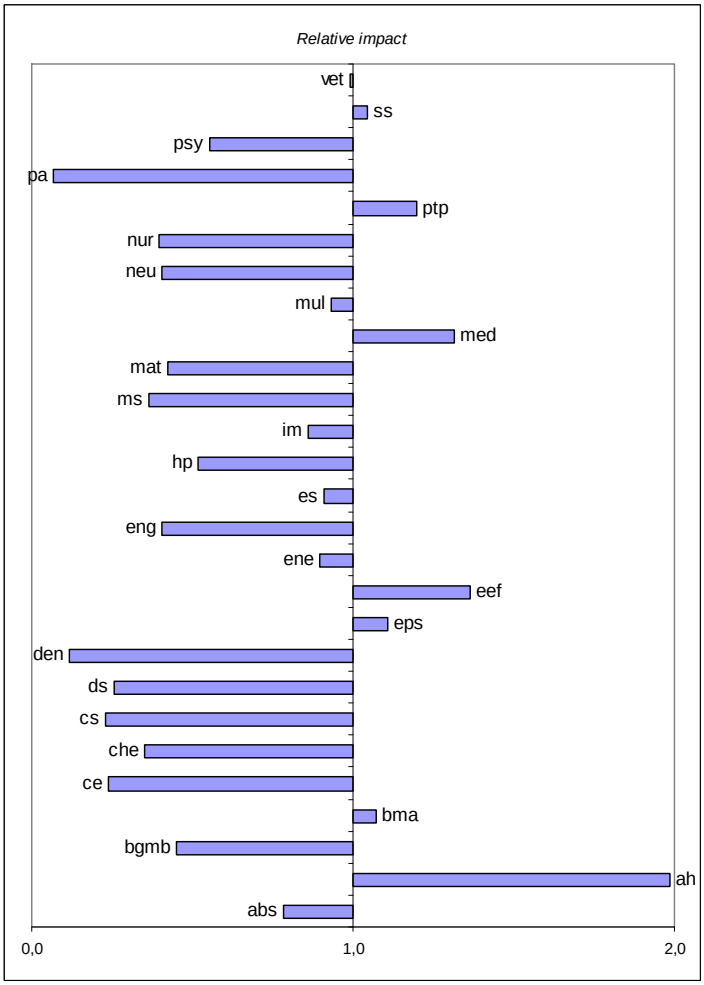


Figure 39. Relative impact of the Zambia scientific output by subject areas (SJCR 1996–2009).



4.20. Benin

Population (thousands): **8 935**
Land area (thousands of Km^2): **115**
Population density (pop/Km^2): **78**
GDP based on PPP valuation (US $ million): **13 454**
GDP per Capita (PPP valuation, $): **1 506**
Annual real GDP growth (average over 2001-2009): **4.1**

4.20.1. General data (output and impact)

Table 82. Total output and impact of the Benin scientific activity (SJCR 1996–2009).

Benin 1996–2009	Total
Documents	1.580
Citable documents	1.550
Citations	10.907
Self citations	1.923
Citations per document	6,90
H index	38

Table 83. Annual output and impact of the Benin scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	60	79	75	74	70	67	75	92	118	117	153	183	196	221	1.580
P. Doc	59	76	73	73	70	66	72	91	115	116	151	181	189	218	1.550
Cit	542	1.017	781	847	886	678	945	905	1.080	821	754	841	548	262	10.907
S-Cit	73	218	148	134	136	95	110	127	193	138	142	203	121	85	1.923
CxD	9,03	12,87	10,41	11,45	12,66	10,12	12,6	9,84	9,15	7,02	4,93	4,6	2,8	1,19	6,90
SCxD	1,22	2,76	1,97	1,81	1,94	1,42	1,47	1,38	1,64	1,18	0,93	1,11	0,62	0,38	1,22
CD	50	70	61	62	63	57	63	79	101	86	115	130	126	103	1.166
UD	10	9	14	12	7	10	12	13	17	31	38	53	70	118	414
IC(%)	78,33	72,15	82,67	75,68	70,00	74,63	80	82,61	83,05	86,32	84,31	84,7	86,73	84,62	*80,41*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 84. Output and impact of the Benin scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	500	31,65	1.080	68,35
Citable documents	489	31,55	1.061	68,45
Cites	5.696	52,22	5.211	47,78
Self cites	914	47,53	1.009	52,47
Cites per doc.	11,39		4,83	
Self cites per doc.	1,83		0,93	
Cited docs.	426	36,54	740	63,46
Uncited docs.	74	17,87	340	82,13
% International collaboration	*76,21*		*84,62*	
% world	0,01		0,01	

4.20.2. Research areas

Table 85. Bibliometric indicators by subject areas (Benin-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**BEN**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	716	45,32	4.940	6,90	6,45	6,03	0,68
Arts and humanities	2	0,13	0	0,00	0,09	0,00	0,00
Biochemistry, genetics and molecular biology	102	6,46	1.024	10,04	0,57	0,41	0,52
Business, management and accounting	4	0,25	8	2,00	0,13	0,07	0,40
Chemical engineering	12	0,76	28	2,33	0,19	0,10	0,39
Chemistry	40	2,53	178	4,45	0,38	0,18	0,35
Computer science	11	0,70	11	1,00	0,16	0,04	0,16
Decision sciences	0	0,00	0	-	0,00	0,00	-
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	44	2,78	215	4,89	0,70	0,47	0,48
Economics, econometrics and finance	14	0,89	45	3,21	0,88	0,46	0,38
Energy	5	0,32	11	2,20	0,23	0,18	0,58
Engineering	32	2,03	131	4,09	0,17	0,22	0,95
Environmental science	119	7,53	929	7,81	2,15	2,10	0,71
Health professions	6	0,38	22	3,67	0,59	0,27	0,33
Immunology and microbiology	167	10,57	2.357	14,11	3,39	3,58	0,76
Materials science	6	0,38	4	0,67	0,06	0,01	0,10
Mathematics	86	5,44	239	2,78	1,44	0,98	0,49
Medicine	425	26,90	3.352	7,89	0,97	1,07	0,79
Multidisciplinary	8	0,51	12	1,50	0,49	0,03	0,04
Neuroscience	11	0,70	62	5,64	0,38	0,13	0,26
Nursing	6	0,38	12	2,00	0,36	0,15	0,31
Pharmacology, toxicology and pharmaceutics	15	0,95	109	7,27	0,37	0,36	0,72
Physics and astronomy	62	3,92	280	4,52	0,53	0,34	0,47
Psychology	2	0,13	8	4,00	0,09	0,05	0,37
Social sciences	40	2,53	71	1,78	0,68	0,40	0,42
Veterinary	36	2,28	79	2,19	2,78	1,69	0,44
Total	1.580	100	10.907	6,90			**0,72**

Figure 40. Activity and visibility of the Benin scientific output by subject areas (SJCR 1996–2009).

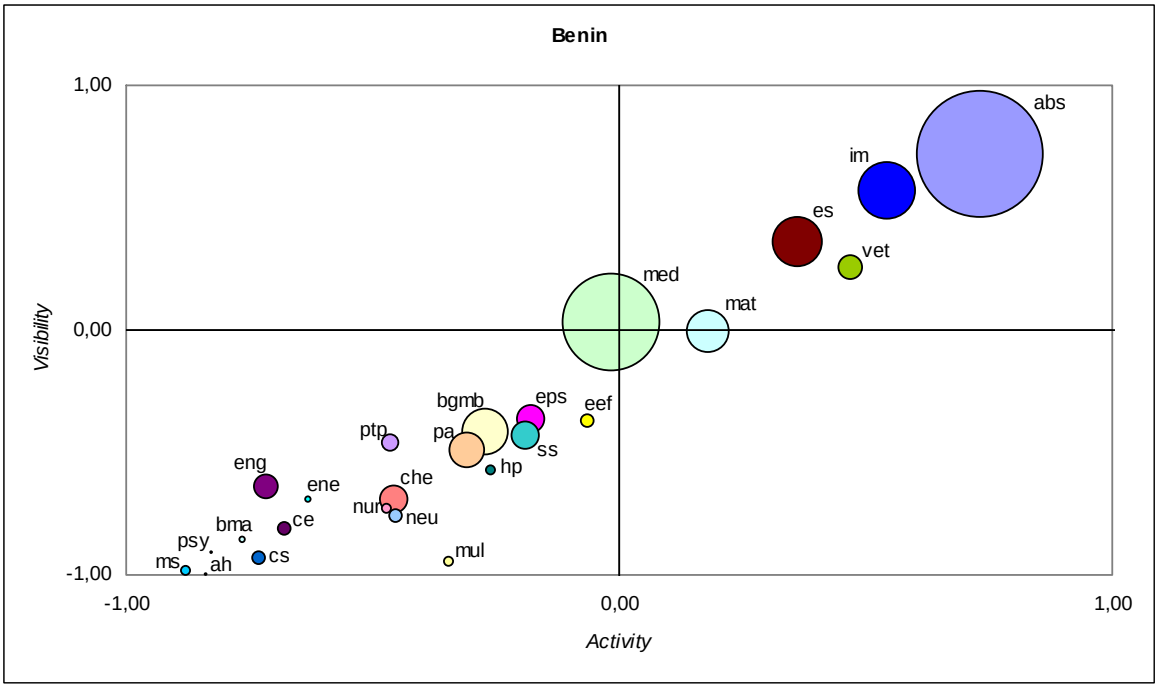
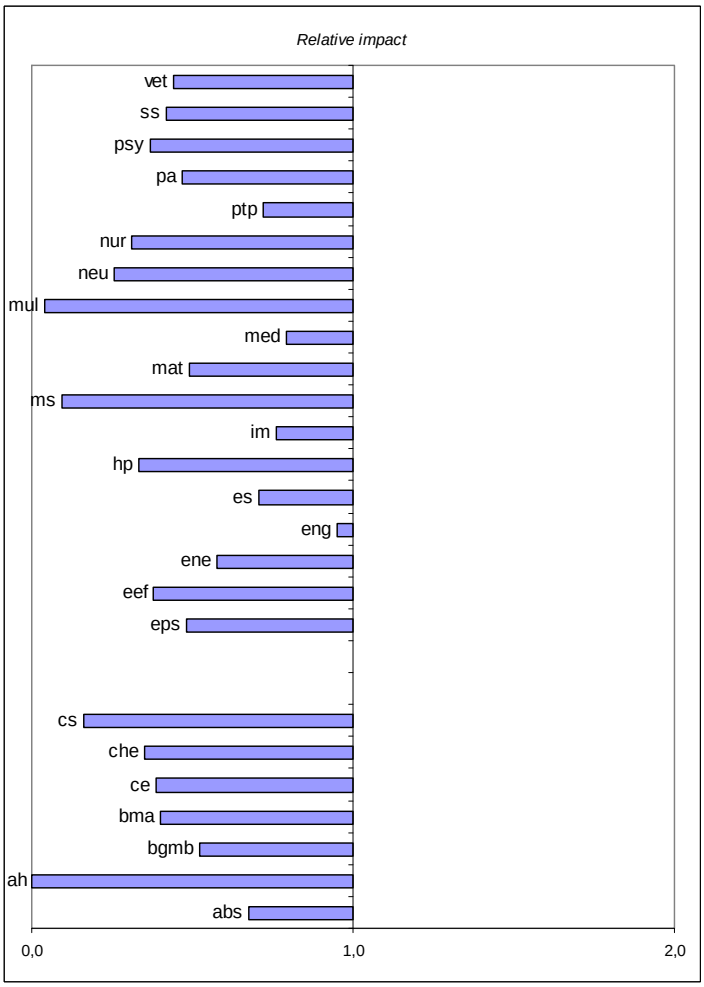


Figure 41. Relative impact of the Benin scientific output by subject areas (SJCR 1996–2009).



4.21. Madagascar

Population (thousands): **19 625**
Land area (thousands of Km^2): **587**
Population density (pop/Km^2): **33**
GDP based on PPP valuation (US $ million): **18 230**
GDP per Capita (PPP valuation, $): **929**
Annual real GDP growth (average over 2001-2009): **3.0**

4.21.1. General data (output and impact)

Table 86. Total output and impact of the Madagascar scientific activity (SJCR 1996–2009).

Madagascar 1996–2009	Total
Documents	1.518
Citable documents	1.474
Citations	13.197
Self citations	2.274
Citations per document	8,69
H index	45

Table 87. Annual output and impact of the Madagascar scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	60	65	69	85	78	76	61	113	104	124	139	180	198	166	1.518
P. Doc	60	63	69	81	76	73	58	111	100	120	137	179	187	160	1.474
Cit	640	1.053	1.108	1.206	1.075	833	807	1.455	757	1.056	1.123	1.024	808	252	13.197
S-Cit	108	134	135	175	220	136	123	191	182	214	205	244	147	60	2.274
CxD	10,67	16,2	16,06	14,19	13,78	10,96	13,23	12,88	7,28	8,52	8,08	5,69	4,08	1,52	8,69
SCxD	1,8	2,06	1,96	2,06	2,82	1,79	2,02	1,69	1,75	1,73	1,47	1,36	0,74	0,36	1,50
CD	51	61	65	78	70	63	53	105	91	106	108	139	142	86	1.218
UD	9	4	4	7	8	13	8	8	13	18	31	41	56	80	300
IC(%)	75	76,92	81,16	78,82	74,36	67,11	81,97	85,84	86,54	86,29	91,37	81,11	85,86	91,57	*81,71*
% World	0,01	0,01	0,01	0,01	0,01	0,01	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 88. Output and impact of the Madagascar scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	494	32,54	1.024	67,46
Citable documents	480	32,56	994	67,44
Cites	6.722	50,94	6.475	49,06
Self cites	1.031	45,34	1.243	54,66
Cites per doc.	13,61		6,32	
Self cites per doc.	2,09		1,21	
Cited docs.	441	36,21	777	63,79
Uncited docs.	53	17,67	247	82,33
% International collaboration	*76,48*		*86,94*	
% world	0,01		0,01	

4.21.2. Research areas

Table 89. Bibliometric indicators by subject areas (Madagascar-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**MAD**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	615	40,51	4.290	6,98	5,77	4,33	0,68
Arts and humanities	12	0,79	36	3,00	0,56	1,16	1,90
Biochemistry, genetics and molecular biology	111	7,31	796	7,17	0,65	0,27	0,37
Business, management and accounting	7	0,46	11	1,57	0,24	0,08	0,32
Chemical engineering	2	0,13	1	0,50	0,03	0,00	0,08
Chemistry	45	2,96	220	4,89	0,44	0,19	0,38
Computer science	6	0,40	4	0,67	0,09	0,01	0,11
Decision sciences	1	0,07	2	2,00	0,15	0,04	0,26
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	103	6,79	1.226	11,90	1,70	2,20	1,18
Economics, econometrics and finance	11	0,72	26	2,36	0,72	0,22	0,28
Energy	3	0,20	16	5,33	0,14	0,22	1,40
Engineering	7	0,46	5	0,71	0,04	0,01	0,17
Environmental science	185	12,19	1.606	8,68	3,48	3,00	0,79
Health professions	3	0,20	8	2,67	0,31	0,08	0,24
Immunology and microbiology	241	15,88	2.793	11,59	5,10	3,51	0,63
Materials science	5	0,33	6	1,20	0,06	0,01	0,17
Mathematics	27	1,78	37	1,37	0,47	0,13	0,24
Medicine	401	26,42	3.689	9,20	0,95	0,97	0,93
Multidisciplinary	18	1,19	804	44,67	1,14	1,46	1,16
Neuroscience	7	0,46	29	4,14	0,25	0,05	0,19
Nursing	2	0,13	0	0,00	0,12	0,00	0,00
Pharmacology, toxicology and pharmaceutics	31	2,04	231	7,45	0,79	0,64	0,74
Physics and astronomy	10	0,66	47	4,70	0,09	0,05	0,49
Psychology	1	0,07	1	1,00	0,05	0,00	0,09
Social sciences	33	2,17	207	6,27	0,59	0,96	1,48
Veterinary	17	1,12	72	4,24	1,37	1,27	0,85
Total	**1.518**	**100**	**13.197**	**8,69**			**0,91**

Figure 42. Activity and visibility of the Madagascar scientific output by subject areas (SJCR 1996–2009).

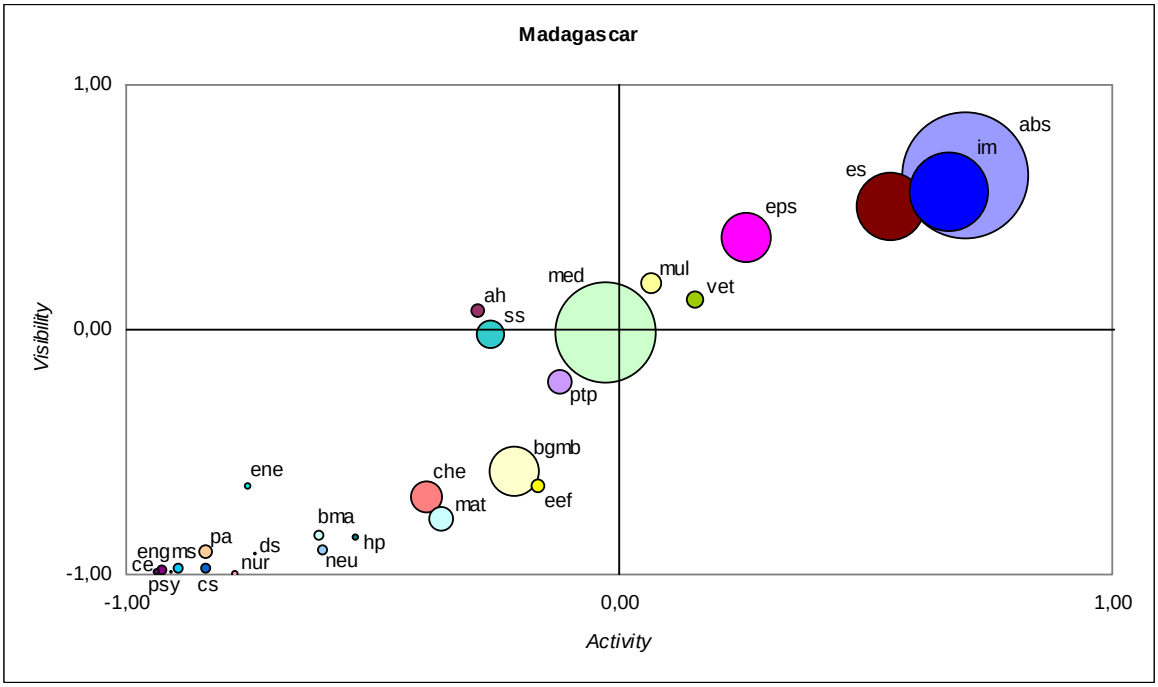
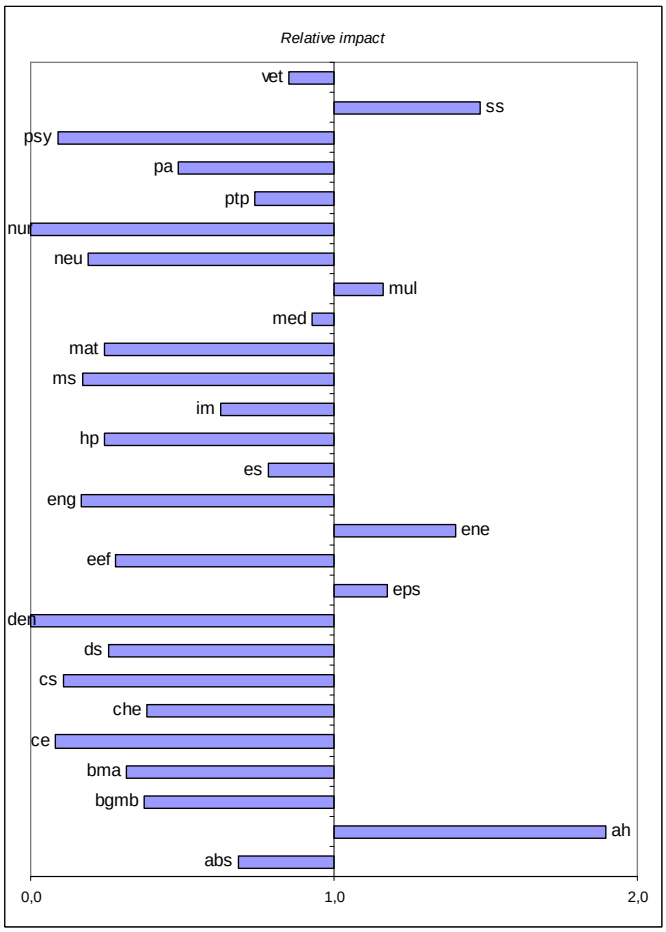


Figure 43. Relative impact of the Madagascar scientific output by subject areas (SJCR 1996–2009).



4.22. Lybia

Population (thousands): **6 420**
Land area (thousands of Km^2): **1 760**
Population density (pop/Km^2): **4**
GDP based on PPP valuation (US $ million): **99 491**
GDP per Capita (PPP valuation, $): **15 497**
Annual real GDP growth (average over 2001-2009): **4.4**

4.22.1. General data (output and impact)

Table 90. Total output and impact of the Lybian scientific activity (SJCR 1996–2009).

Lybia 1996–2009	Total
Documents	1.505
Citable documents	1.467
Citations	4.726
Self citations	311
Citations per document	3,14
H index	28

Table 91. Annual output and impact of the Lybian scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	59	68	81	59	72	64	54	77	97	110	129	148	196	291	1.505
P. Doc	59	67	79	59	69	58	52	75	96	107	123	147	193	283	1.467
Cit	327	474	524	377	276	289	246	334	347	366	483	328	256	99	4.726
S-Cit	30	11	16	22	8	12	21	13	20	20	26	30	45	37	311
CxD	5,54	6,97	6,47	6,39	3,83	4,52	4,56	4,34	3,58	3,33	3,74	2,22	1,31	0,34	3,14
SCxD	0,51	0,16	0,2	0,37	0,11	0,19	0,39	0,17	0,21	0,18	0,2	0,2	0,23	0,13	0,21
CD	49	47	57	40	44	42	32	50	60	60	75	82	72	55	765
UD	10	21	24	19	28	22	22	27	37	50	54	66	124	236	740
IC(%)	69,49	57,35	53,09	54,24	34,72	45,31	53,7	57,14	62,89	65,45	61,24	54,05	58,16	49,14	*55,43*
% World	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 92. Output and impact of the Lybian scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	457	30,37	1.048	69,63
Citable documents	443	30,20	1.024	69,80
Cites	2.513	53,17	2.213	46,83
Self cites	120	38,59	191	61,41
Cites per doc.	5,50		2,11	
Self cites per doc.	0,26		0,18	
Cited docs.	311	40,65	454	59,35
Uncited docs.	146	19,73	594	80,27
% International collaboration	*52,56*		*58,30*	
% world	0,01		0,01	

4.22.2. Research areas

Table 93. Bibliometric indicators by subject areas (Lybian-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**LYB**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	110	7,31	563	5,12	1,04	1,59	0,50
Arts and humanities	4	0,27	14	3,50	0,19	1,26	2,21
Biochemistry, genetics and molecular biology	111	7,38	561	5,05	0,66	0,52	0,26
Business, management and accounting	18	1,20	13	0,72	0,63	0,28	0,15
Chemical engineering	126	8,37	402	3,19	2,11	3,40	0,53
Chemistry	175	11,63	596	3,41	1,73	1,40	0,27
Computer science	49	3,26	179	3,65	0,73	1,32	0,59
Decision sciences	2	0,13	9	4,50	0,31	0,55	0,58
Dentistry	6	0,40	15	2,50	0,94	0,85	0,30
Earth and planetary sciences	88	5,85	356	4,05	1,47	1,78	0,40
Economics, econometrics and finance	1	0,07	2	2,00	0,07	0,05	0,23
Energy	134	8,90	335	2,50	6,37	12,73	0,66
Engineering	183	12,16	480	2,62	1,00	1,84	0,61
Environmental science	103	6,84	290	2,82	1,95	1,51	0,25
Health professions	4	0,27	20	5,00	0,41	0,57	0,46
Immunology and microbiology	65	4,32	526	8,09	1,39	1,84	0,44
Materials science	115	7,64	369	3,21	1,29	1,82	0,46
Mathematics	32	2,13	75	2,34	0,56	0,71	0,41
Medicine	369	24,52	1.202	3,26	0,88	0,88	0,33
Multidisciplinary	15	1,00	90	6,00	0,96	0,46	0,16
Neuroscience	17	1,13	57	3,35	0,61	0,28	0,15
Nursing	4	0,27	3	0,75	0,25	0,09	0,12
Pharmacology, toxicology and pharmaceutics	42	2,79	117	2,79	1,08	0,90	0,28
Physics and astronomy	60	3,99	303	5,05	0,54	0,85	0,52
Psychology	2	0,13	5	2,50	0,10	0,07	0,23
Social sciences	14	0,93	21	1,50	0,25	0,27	0,35
Veterinary	16	1,06	53	3,31	1,30	2,62	0,66
Total	**1.505**	**100**	**4.726**	**3,14**			**0,33**

Figure 44. Activity and visibility of the Lybian scientific output by subject areas (SJCR 1996–2009).

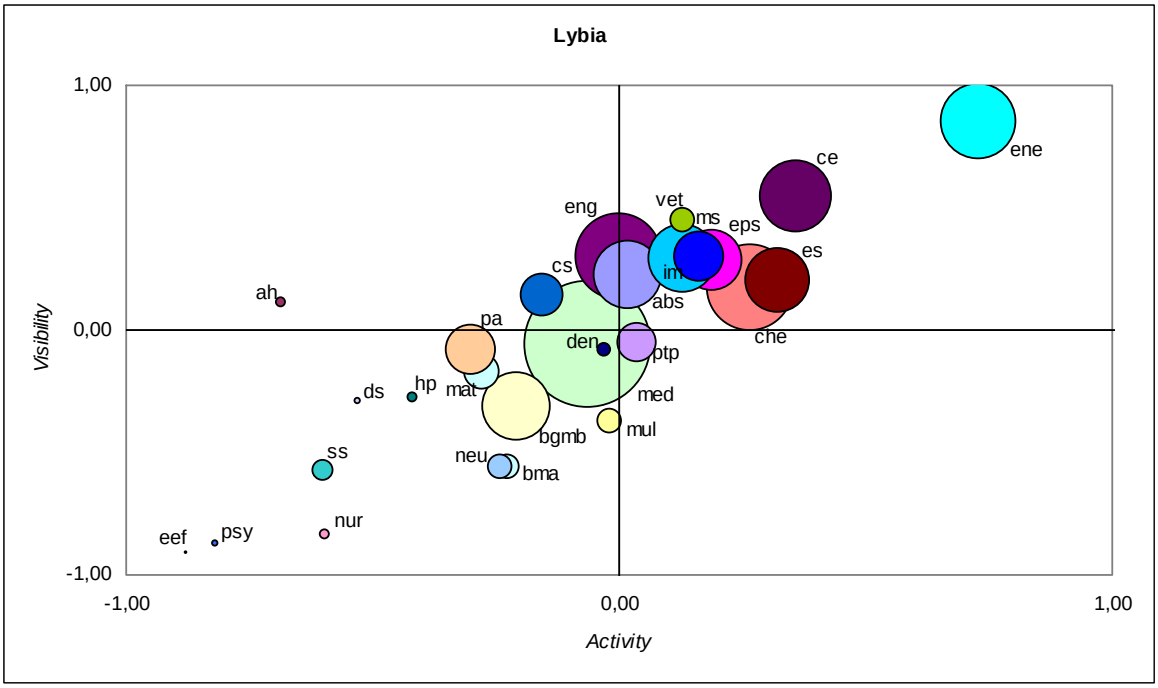
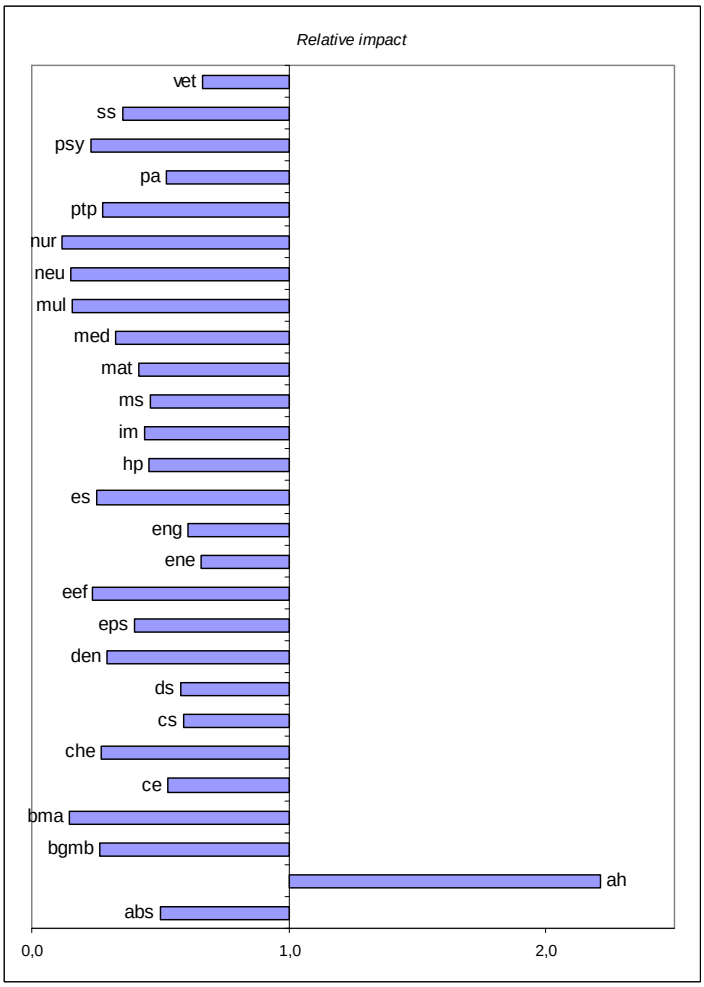


Figure 45. Relative impact of the Lybian scientific output by subject areas (SJCR 1996–2009).



4.23. Congo

Population (thousands): **3 683**
Land area (thousands of Km^2): **342**
Population density (pop/Km^2): **11**
GDP based on PPP valuation (US $ million): **15 614**
GDP per Capita (PPP valuation, $): **4 239**
Annual real GDP growth (average over 2001-2009): **4.5**

4.23.1. General data (output and impact)

Table 94. Total output and impact of the Congo scientific activity (SJCR 1996–2009).

Congo 1996–2009	Total
Documents	1.238
Citable documents	1.171
Citations	8.600
Self citations	882
Citations per document	6,95
H index	38

Table 95. Annual output and impact of the Congo scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	47	41	67	49	49	33	56	90	85	115	141	158	148	159	1.238
P. Doc	47	41	65	47	45	29	50	82	82	108	132	149	140	154	1.171
Cit	638	423	859	355	664	262	542	670	866	918	938	689	475	301	8.600
S-Cit	22	22	65	47	52	21	70	88	95	109	97	93	62	39	882
CxD	13,57	10,32	12,82	7,24	13,55	7,94	9,68	7,44	10,19	7,98	6,65	4,36	3,21	1,89	6,95
SCxD	0,47	0,54	0,97	0,96	1,06	0,64	1,25	0,98	1,12	0,95	0,69	0,59	0,42	0,25	0,71
CD	39	32	54	34	41	28	45	67	70	90	112	112	96	87	907
UD	8	9	13	15	8	5	11	23	15	25	29	46	52	72	331
IC(%)	70,21	68,29	74,63	61,22	69,39	54,55	51,79	64,44	68,24	71,3	80,14	78,48	75,68	85,53	*69,56*
% World	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 96. Output and impact of the Congo scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	342	27,63	896	72,37
Citable documents	324	27,67	847	72,33
Cites	3.743	43,52	4.857	56,48
Self cites	299	33,90	583	66,10
Cites per doc.	10,94		5,42	
Self cites per doc.	0,87		0,65	
Cited docs.	273	30,10	634	69,90
Uncited docs.	69	20,85	262	79,15
% International collaboration	*64,30*		*74,83*	
% world	0,004		0,01	

4.23.2. Research areas

Table 97. Bibliometric indicators by subject areas (Congo-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**CON**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	266	21,49	2.199	8,27	3,06	3,40	0,81
Arts and humanities	7	0,57	9	1,29	0,40	0,44	0,81
Biochemistry, genetics and molecular biology	66	5,33	624	9,45	0,47	0,32	0,49
Business, management and accounting	2	0,16	10	5,00	0,09	0,12	1,01
Chemical engineering	8	0,65	32	4,00	0,16	0,15	0,66
Chemistry	32	2,58	176	5,50	0,38	0,23	0,43
Computer science	4	0,32	3	0,75	0,07	0,01	0,12
Decision sciences	1	0,08	3	3,00	0,19	0,10	0,39
Dentistry	2	0,16	1	0,50	0,38	0,03	0,06
Earth and planetary sciences	74	5,98	37	0,50	1,50	0,10	0,05
Economics, econometrics and finance	3	0,24	20	6,67	0,24	0,26	0,78
Energy	3	0,24	5	1,67	0,17	0,10	0,44
Engineering	13	1,05	175	13,46	0,09	0,37	3,12
Environmental science	88	7,11	1.286	14,61	2,03	3,68	1,32
Health professions	6	0,48	21	3,50	0,75	0,33	0,32
Immunology and microbiology	197	15,91	1.821	9,24	5,11	3,51	0,50
Materials science	8	0,65	5	0,63	0,11	0,01	0,09
Mathematics	9	0,73	7	0,78	0,19	0,04	0,14
Medicine	595	48,06	3.316	5,57	1,73	1,34	0,56
Multidisciplinary	11	0,89	176	16,00	0,86	0,49	0,42
Neuroscience	5	0,40	66	13,20	0,22	0,18	0,60
Nursing	10	0,81	32	3,20	0,77	0,52	0,50
Pharmacology, toxicology and pharmaceutics	54	4,36	667	12,35	1,68	2,83	1,22
Physics and astronomy	17	1,37	41	2,41	0,19	0,06	0,25
Psychology	5	0,40	9	1,80	0,30	0,07	0,17
Social sciences	25	2,02	79	3,16	0,55	0,56	0,75
Veterinary	17	1,37	29	1,71	1,67	0,79	0,34
Total	**1.238**	**100**	**8.600**	**6,95**			**0,73**

Figure 46. Activity and visibility of the Congo scientific output by subject areas (SJCR 1996–2009).

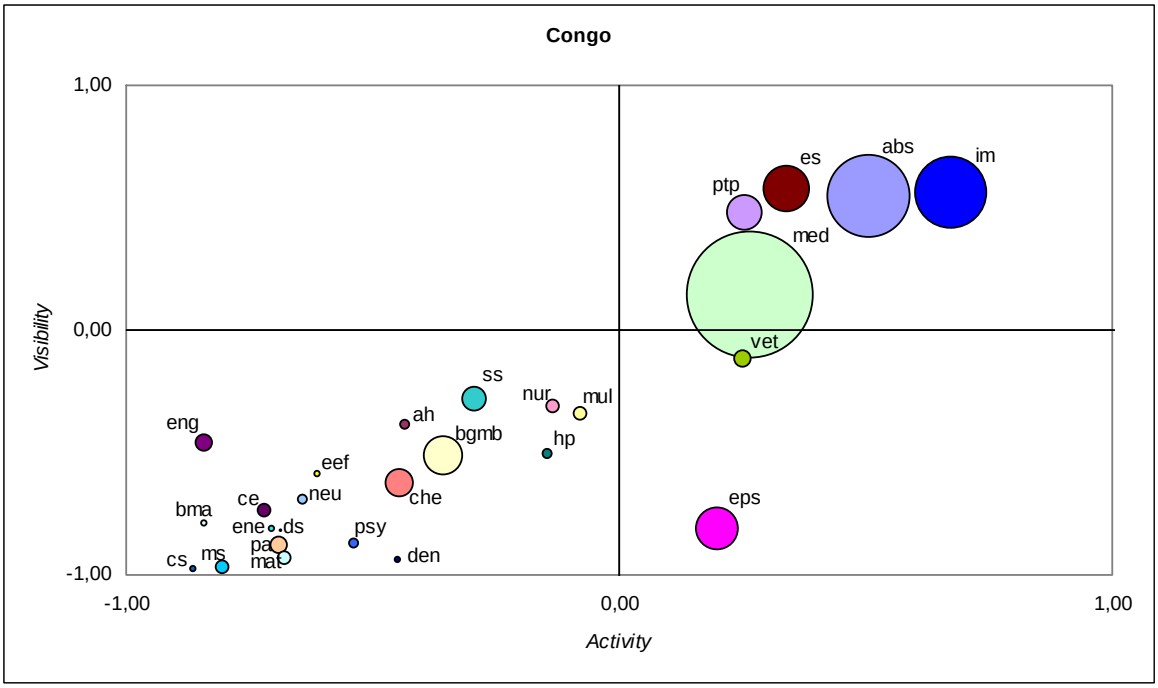
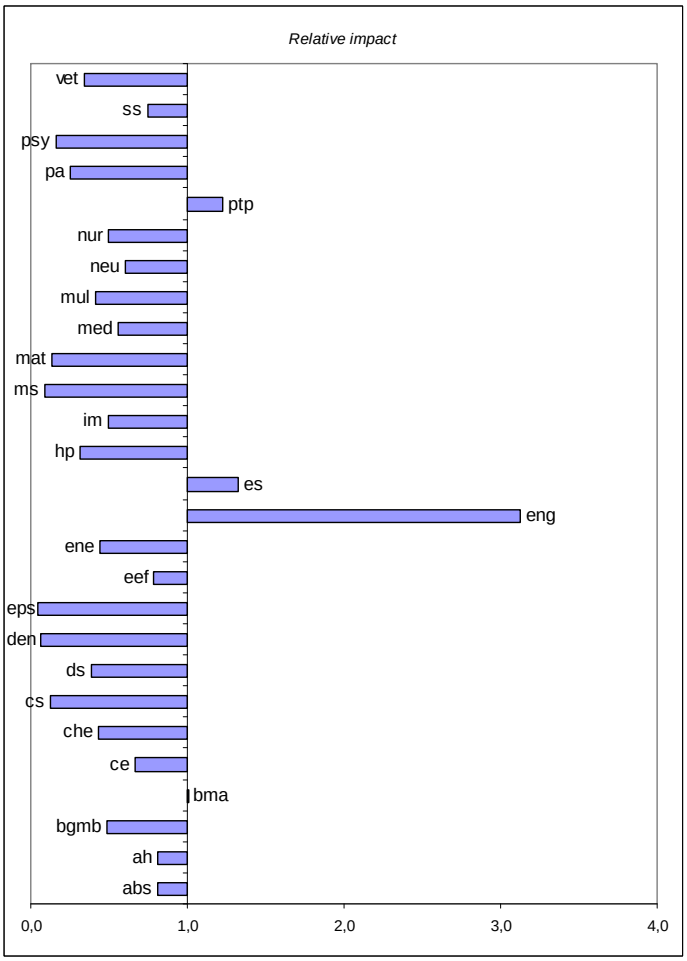


Figure 47. Relative impact of the Congo scientific output by subject areas (SJCR 1996–2009).



4.24. Gambia

Population (thousands): **1 705**
Land area (thousands of Km^2): **11**
Population density (pop/Km^2): **151**
GDP based on PPP valuation (US $ million): **2 003**
GDP per Capita (PPP valuation, $): **1 175**
Annual real GDP growth (average over 2001-2009): **5.0**

4.24.1. General data (output and impact)

Table 98. Total output and impact of the Gambia scientific activity (SJCR 1996–2009).

Gambia 1996–2009	Total
Documents	1.161
Citable documents	1.081
Citations	24.396
Self citations	2.360
Citations per document	21,01
H index	68

Table 99. Annual output and impact of the Gambia scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	77	70	71	73	68	62	48	75	86	91	111	101	116	112	1.161
P. Doc	71	66	67	70	59	58	45	72	78	83	107	94	105	106	1.081
Cit	1.871	2.127	3.250	2.684	2.101	1.584	966	1.604	1.809	1.911	1.741	1.423	982	343	24.396
S-Cit	174	232	214	204	182	161	93	195	205	199	194	130	133	44	2.360
CxD	24,3	30,39	45,77	36,77	30,9	25,55	20,13	21,39	21,03	21	15,68	14,09	8,47	3,06	21,01
SCxD	2,26	3,31	3,01	2,79	2,68	2,6	1,94	2,6	2,38	2,19	1,75	1,29	1,15	0,39	2,03
CD	71	63	67	71	63	60	45	73	80	85	101	87	101	77	1.044
UD	6	7	4	2	5	2	3	2	6	6	10	14	15	35	117
IC(%)	74,03	80	84,51	82,19	72,06	75,81	70,83	93,33	88,37	92,31	89,19	83,17	92,24	92,86	*83,64*
% World	0,01	0,01	0,01	0,01	0,01	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 100. Output and impact of the Gambia scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	469	40,40	692	59,60
Citable documents	436	40,33	645	59,67
Cites	14.583	59,78	9.813	40,22
Self cites	1.260	53,39	1.100	46,61
Cites per doc.	31,09		14,18	
Self cites per doc.	2,69		1,59	
Cited docs.	440	42,15	604	57,85
Uncited docs.	29	24,79	88	75,21
% International collaboration	*77,06*		*90,21*	
% world	0,01		0,01	

4.24.2. Research areas

Table 101. Bibliometric indicators by subject areas (Gambia-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**GAM**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	145	12,49	1.451	10,01	1,78	0,79	0,98
Arts and humanities	0	0,00	0	-	0,00	0,00	-
Biochemistry, genetics and molecular biology	117	10,08	2.172	18,56	0,90	0,39	0,96
Business, management and accounting	0	0,00	0	-	0,00	0,00	-
Chemical engineering	1	0,09	0	0,00	0,02	0,00	0,00
Chemistry	0	0,00	0	-	0,00	0,00	-
Computer science	1	0,09	1	1,00	0,02	0,00	0,16
Decision sciences	0	0,00	0	-	0,00	0,00	-
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	10	0,86	142	14,20	0,22	0,14	1,40
Economics, econometrics and finance	11	0,95	155	14,09	0,94	0,71	1,66
Energy	1	0,09	2	2,00	0,06	0,01	0,53
Engineering	4	0,34	6	1,50	0,03	0,00	0,35
Environmental science	15	1,29	140	9,33	0,37	0,14	0,84
Health professions	2	0,17	7	3,50	0,27	0,04	0,32
Immunology and microbiology	495	42,64	10.836	21,89	13,69	7,36	1,18
Materials science	0	0,00	0	-	0,00	0,00	-
Mathematics	2	0,17	34	17,00	0,05	0,06	3,01
Medicine	598	51,51	13.515	22,60	1,86	1,92	2,28
Multidisciplinary	13	1,12	879	67,62	1,08	0,86	1,76
Neuroscience	5	0,43	13	2,60	0,23	0,01	0,12
Nursing	3	0,26	43	14,33	0,24	0,25	2,23
Pharmacology, toxicology and pharmaceutics	8	0,69	29	3,63	0,27	0,04	0,36
Physics and astronomy	1	0,09	0	0,00	0,01	0,00	0,00
Psychology	1	0,09	2	2,00	0,06	0,01	0,18
Social sciences	19	1,64	86	4,53	0,44	0,21	1,07
Veterinary	52	4,48	417	8,02	5,46	3,99	1,61
Total	1.161	100	24.396	21,01			**2,20**

Figure 48. Activity and visibility of the Gambia scientific output by subject areas (SJCR 1996–2009).

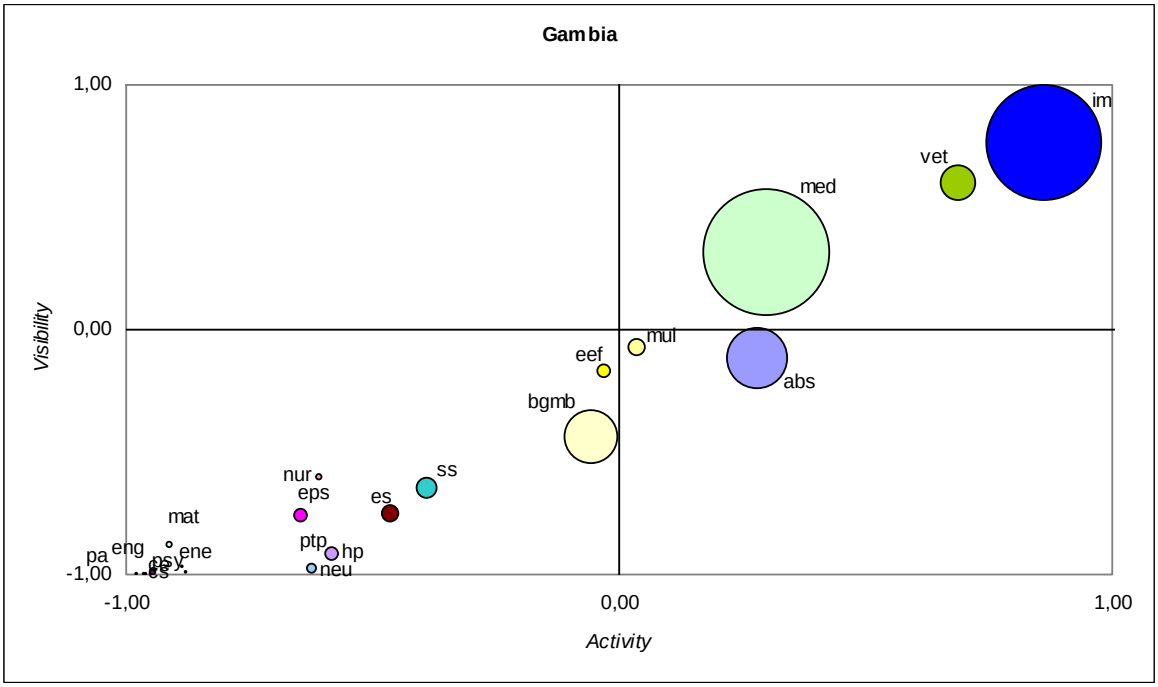
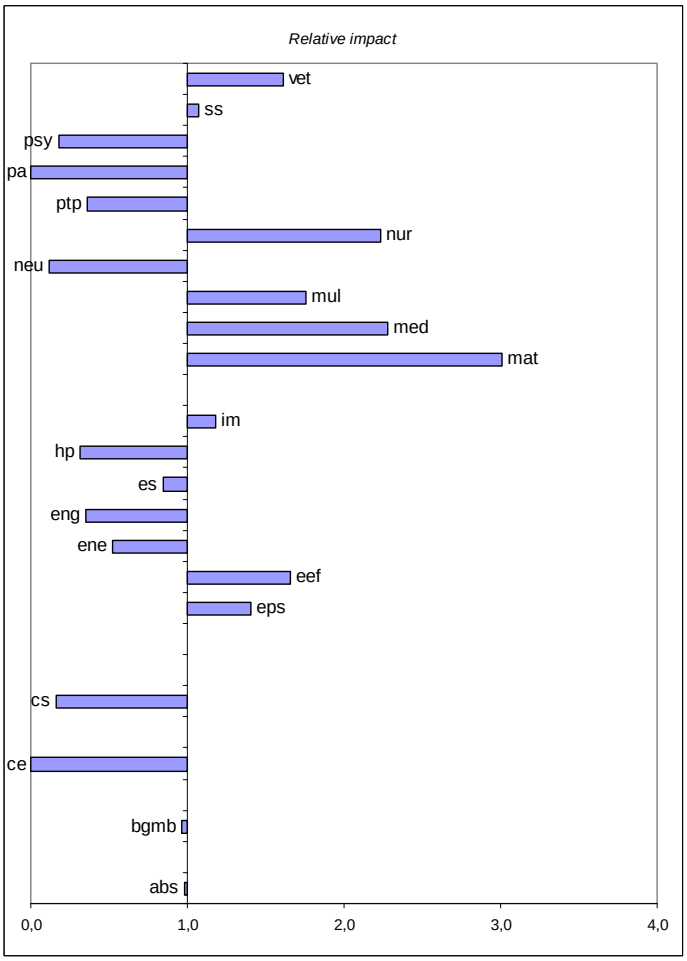


Figure 49. Relative impact of the Gambia scientific output by subject areas (SJCR 1996–2009).



4.25. Mali

Population (thousands): **13 010**
Land area (thousands of Km^2): **1 240**
Population density (pop/Km^2): **10**
GDP based on PPP valuation (US $ million): **15 898**
GDP per Capita (PPP valuation, $): **1 222**
Annual real GDP growth (average over 2001-2009): **5.7**

4.25.1. General data (output and impact)

Table 102. Total output and impact of the Mali scientific activity (SJCR 1996–2009).

Mali 1996–2009	Total
Documents	1.133
Citable documents	1.104
Citations	11.375
Self citations	1.230
Citations per document	10,04
H index	40

Table 103. Annual output and impact of the Mali scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	51	53	75	52	34	53	57	80	79	91	122	122	127	137	1.133
P. Doc	51	53	74	52	32	53	57	79	77	87	119	119	119	132	1.104
Cit	422	1.233	912	549	561	1.352	672	849	955	1.135	985	679	621	450	11.375
S-Cit	42	82	104	32	41	121	90	93	141	146	118	77	92	51	1.230
CxD	8,27	23,26	12,16	10,56	16,5	25,51	11,79	10,61	12,09	12,47	8,07	5,57	4,89	3,28	10,04
SCxD	0,82	1,55	1,39	0,62	1,21	2,28	1,58	1,16	1,78	1,6	0,97	0,63	0,72	0,37	1,09
CD	42	47	55	49	30	46	51	72	74	82	99	99	92	88	926
UD	9	6	20	3	4	7	6	8	5	9	23	23	35	49	207
IC(%)	88,24	90,57	70,67	78,85	79,41	75,47	70,18	85	94,94	93,41	85,25	87,7	90,55	89,05	*84,24*
% World	0,00	0,00	0,01	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01

Table 104. Output and impact of the Mali scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	375	33,10	758	66,90
Citable documents	372	33,70	732	66,30
Cites	5.701	50,12	5.674	49,88
Self cites	512	41,63	718	58,37
Cites per doc.	15,20		7,49	
Self cites per doc.	1,37		0,95	
Cited docs.	320	34,56	606	65,44
Uncited docs.	55	26,57	152	73,43
% International collaboration	*79,06*		*89,41*	
% world	0,004		0,01	

4.25.2. Research areas

Table 105. Bibliometric indicators by subject areas (Mali-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**MAL**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	382	33,72	2.940	7,70	4,80	3,44	0,75
Arts and humanities	7	0,62	23	3,29	0,43	0,86	2,08
Biochemistry, genetics and molecular biology	81	7,15	1.221	15,07	0,64	0,47	0,78
Business, management and accounting	1	0,09	1	1,00	0,05	0,01	0,20
Chemical engineering	1	0,09	3	3,00	0,02	0,01	0,50
Chemistry	19	1,68	199	10,47	0,25	0,19	0,82
Computer science	1	0,09	4	4,00	0,02	0,01	0,65
Decision sciences	1	0,09	4	4,00	0,20	0,10	0,52
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	43	3,80	244	5,67	0,95	0,51	0,56
Economics, econometrics and finance	8	0,71	58	7,25	0,70	0,57	0,85
Energy	4	0,35	65	16,25	0,25	1,03	4,27
Engineering	7	0,62	9	1,29	0,05	0,01	0,30
Environmental science	95	8,38	478	5,03	2,39	1,04	0,46
Health professions	2	0,18	0	0,00	0,27	0,00	0,00
Immunology and microbiology	246	21,71	3.458	14,06	6,97	5,04	0,76
Materials science	6	0,53	94	15,67	0,09	0,19	2,25
Mathematics	2	0,18	8	4,00	0,05	0,03	0,71
Medicine	447	39,45	4.337	9,70	1,42	1,32	0,98
Multidisciplinary	19	1,68	1.058	55,68	1,62	2,23	1,45
Neuroscience	5	0,44	96	19,20	0,24	0,20	0,87
Nursing	3	0,26	20	6,67	0,25	0,25	1,04
Pharmacology, toxicology and pharmaceutics	36	3,18	330	9,17	1,23	1,06	0,91
Physics and astronomy	1	0,09	16	16,00	0,01	0,02	1,65
Psychology	1	0,09	33	33,00	0,07	0,19	3,04
Social sciences	40	3,53	155	3,88	0,95	0,83	0,92
Veterinary	25	2,21	163	6,52	2,69	3,34	1,31
Total	**1.133**	**100**	**11.375**	**10,04**			**1,05**

Figure 50. Activity and visibility of the Mali scientific output by subject areas (SJCR 1996–2009).

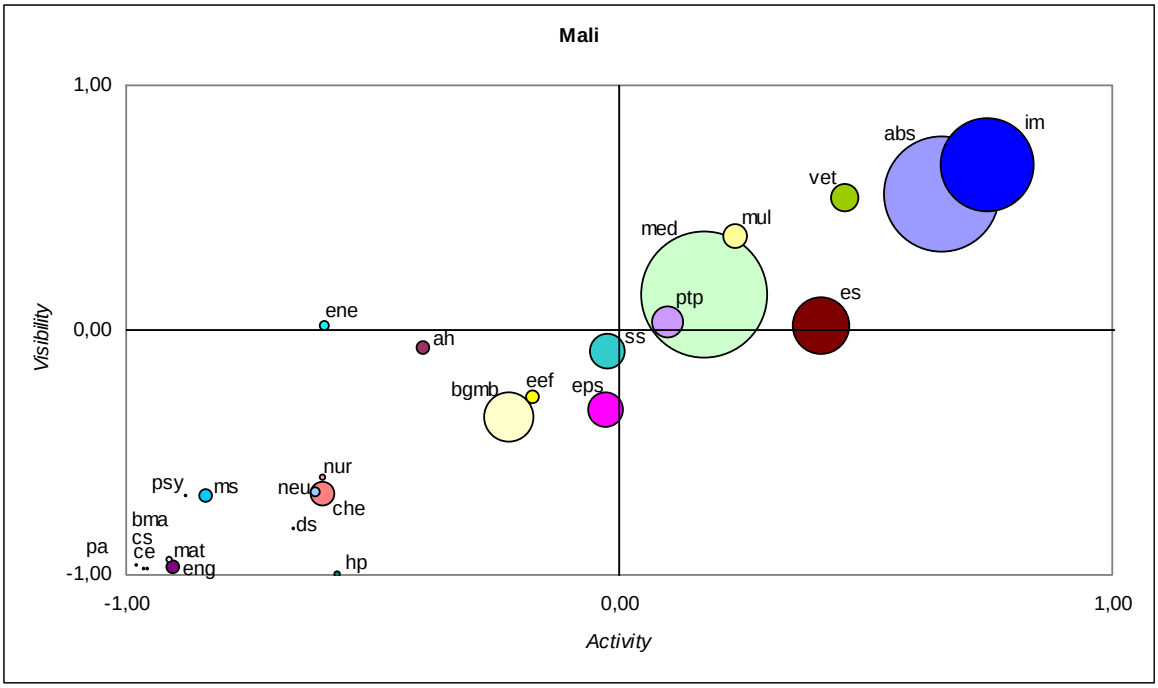
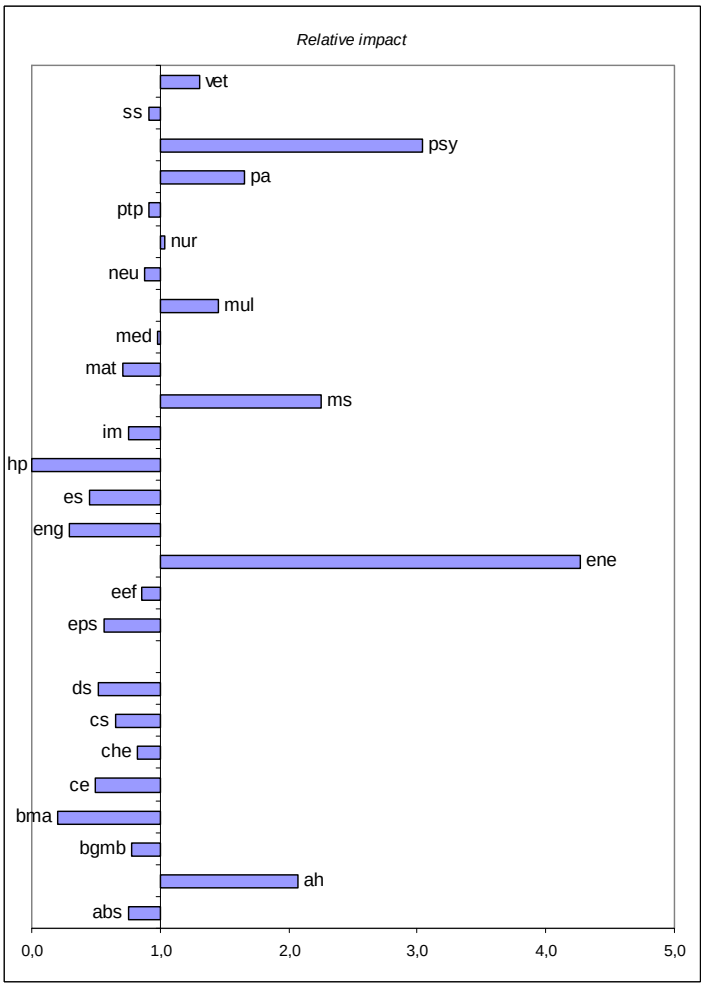


Figure 51. Relative impact of the Mali scientific output by subject areas (SJCR 1996–2009).



4.26. Gabon

Population (thousands): **1 475**
Land area (thousands of Km^2): **268**
Population density (pop/Km^2): **6**
GDP based on PPP valuation (US $ million): **21 951**
GDP per Capita (PPP valuation, $): **14 886**
Annual real GDP growth (average over 2001-2009): **1.9**

4.26.1. General data (output and impact)

Table 106. Total output and impact of the Gabon scientific activity (SJCR 1996–2009).

Gabon 1996–2008	Total
Documents	1.053
Citable documents	998
Citations	13.383
Self citations	1.751
Citations per document	12,71
H index	51

Table 107. Annual output and impact of the Gabon scientific activity (SJCR 1996–2009).

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Doc	45	53	68	65	51	45	60	70	82	100	112	89	105	108	1.053
P. Doc	45	52	67	64	46	43	54	64	78	96	107	83	99	100	998
Cit	824	1.019	1.320	1.189	1.382	600	1.028	1.135	1.262	1.153	1.102	646	479	244	13.383
S-Cit	112	151	169	117	182	76	179	133	176	172	135	86	47	16	1.751
CxD	18,31	19,23	19,41	18,29	27,1	13,33	17,13	16,21	15,39	11,53	9,84	7,26	4,56	2,26	12,71
SCxD	2,49	2,85	2,49	1,8	3,57	1,69	2,98	1,9	2,15	1,72	1,21	0,97	0,45	0,15	1,66
CD	42	48	59	53	44	39	51	59	74	81	98	74	70	62	854
UD	3	5	9	12	7	6	9	11	8	19	14	15	35	46	199
IC(%)	84,44	77,36	79,41	70,77	70,59	66,67	65	90	89,02	89	91,96	91,01	87,62	85,19	*81,29*
% World	0,00	0,00	0,01	0,01	0,00	0,00	0,00	0,00	0,01	0,01	0,01	0,00	0,01	0,01	0,01

Table 108. Output and impact of the Gabon scientific activity by periods (SJCR 1996–2009).

Indicators	1996-02	%	2002-09	%
Documents	387	36,75	666	63,25
Citable documents	371	37,17	627	62,83
Cites	7.362	55,01	6.021	44,99
Self cites	986	56,31	765	43,69
Cites per doc.	19,02		9,04	
Self cites per doc.	2,55		1,15	
Cited docs.	336	39,34	518	60,66
Uncited docs.	51	25,63	148	74,37
% International collaboration	*73,46*		*89,11*	
% world	0,005		0,01	

4.26.2. Research areas

Table 109. Bibliometric indicators by subject areas (Gabon-SJCR 1996–2009).

	Output and impact				Relative indicators		
Subject Areas	**GAB**	**%**	**Cit**	**CxD**	**AI**	**VI**	**RI**
Agricultural and biological sciences	198	18,80	1.877	9,48	2,68	1,87	0,93
Arts and humanities	12	1,14	5	0,42	0,80	0,16	0,26
Biochemistry, genetics and molecular biology	96	9,12	1.797	18,72	0,81	0,59	0,97
Business, management and accounting	1	0,09	0	0,00	0,05	0,00	0,00
Chemical engineering	1	0,09	0	0,00	0,02	0,00	0,00
Chemistry	15	1,42	141	9,40	0,21	0,12	0,74
Computer science	3	0,28	1	0,33	0,06	0,00	0,05
Decision sciences	3	0,28	8	2,67	0,66	0,17	0,35
Dentistry	0	0,00	0	-	0,00	0,00	-
Earth and planetary sciences	29	2,75	238	8,21	0,69	0,42	0,81
Economics, econometrics and finance	1	0,09	2	2,00	0,09	0,02	0,23
Energy	2	0,19	41	20,50	0,14	0,55	5,39
Engineering	8	0,76	17	2,13	0,06	0,02	0,49
Environmental science	69	6,55	782	11,33	1,87	1,44	1,03
Health professions	0	0,00	0	-	0,00	0,00	-
Immunology and microbiology	396	37,61	5.611	14,17	12,07	6,95	0,77
Materials science	3	0,28	3	1,00	0,05	0,01	0,14
Mathematics	17	1,61	39	2,29	0,43	0,13	0,41
Medicine	401	38,08	4.873	12,15	1,37	1,26	1,22
Multidisciplinary	16	1,52	816	51,00	1,47	1,46	1,33
Neuroscience	13	1,23	292	22,46	0,67	0,52	1,02
Nursing	6	0,57	18	3,00	0,54	0,19	0,47
Pharmacology, toxicology and pharmaceutics	11	1,04	47	4,27	0,40	0,13	0,42
Physics and astronomy	6	0,57	21	3,50	0,08	0,02	0,36
Psychology	4	0,38	79	19,75	0,28	0,39	1,82
Social sciences	21	1,99	113	5,38	0,54	0,51	1,27
Veterinary	24	2,28	185	7,71	2,78	3,23	1,55
Total	**1.053**	**100**	**13.383**	**12,71**			**1,33**

Figure 52. Activity and visibility of the Gabon scientific output by subject areas (SJCR 1996–2009).

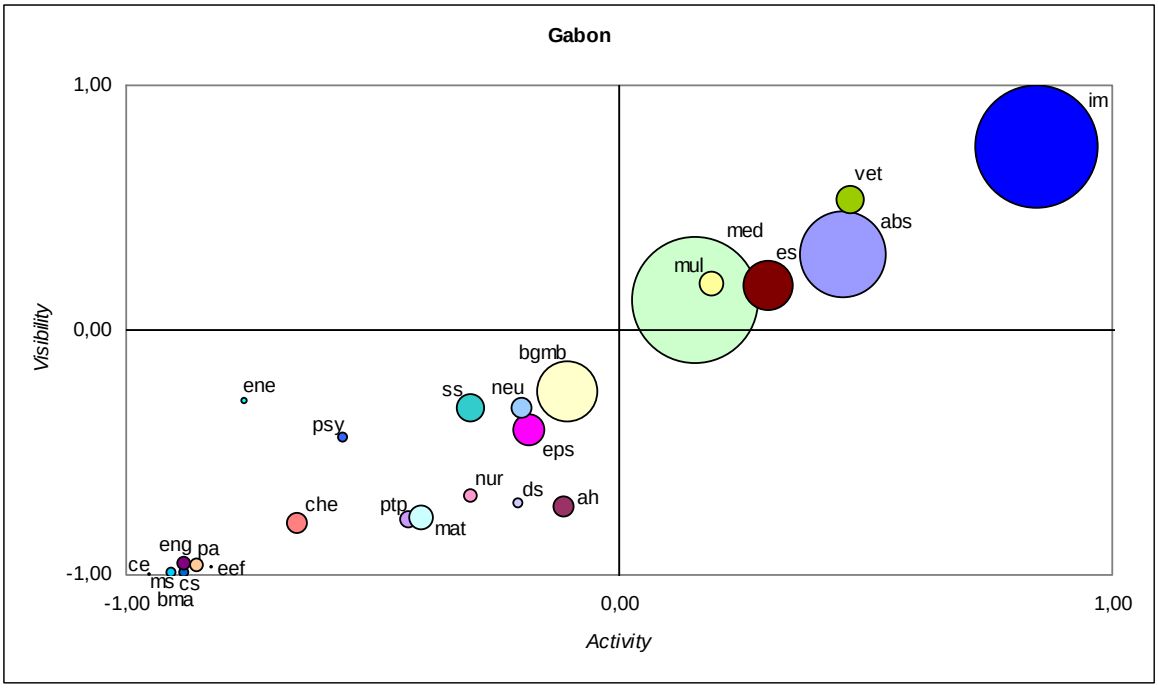
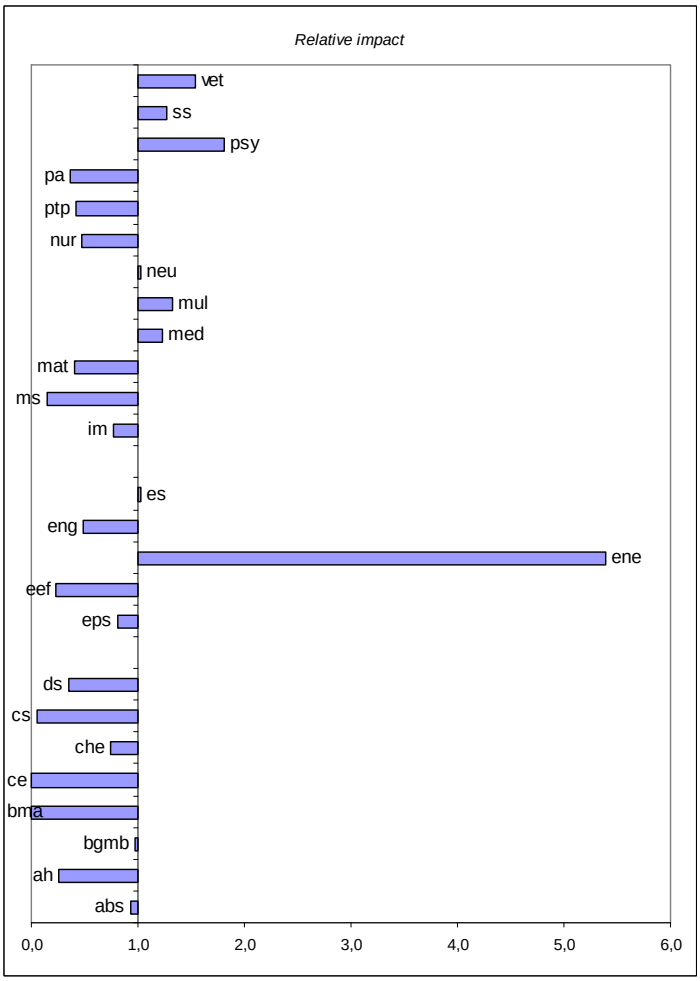


Figure 53. Relative impact of the Gabon scientific output by subject areas (SJCR 1996–2009).



5. Comparative analysis by subject area

This section compares all the studied countries in the 27 Scopus subject areas.

The activity and visibility indicators applied to each of the 27 Scopus subject areas can be observed through multiple representations. In each graph and for each country:

the size of the bubbles expresses the volume of the scientific production (**Doc**),

the position in the vertical axis reflects the relative visibility (**RVI**, Relative Visibility Index),

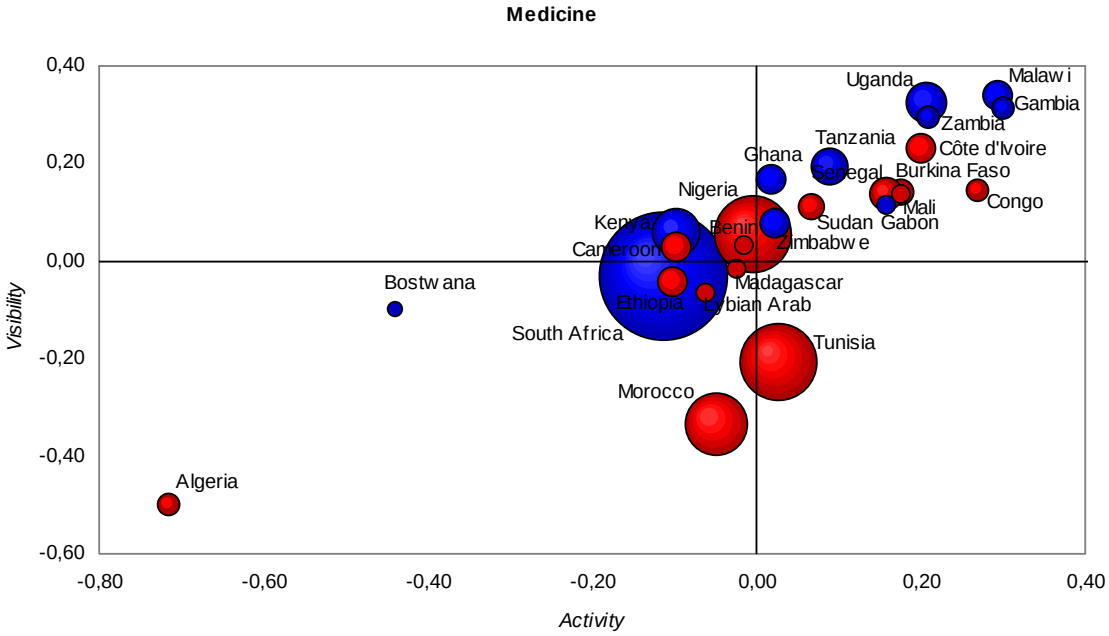
the position in the horizontal axis reflects the relative activity (**RAI**, Relative Activity Index),

and the colour of the bubbles shows the relative impact (**RI**): blue, if the citation per paper of the country is over the world mean; red, if it is under the world mean.

The quadrant of the positive values for RVI and RAI (top right in the figure) shows the countries with high level of specialization and impact in each field. Relative measures were calculated according Glänzel (2000).

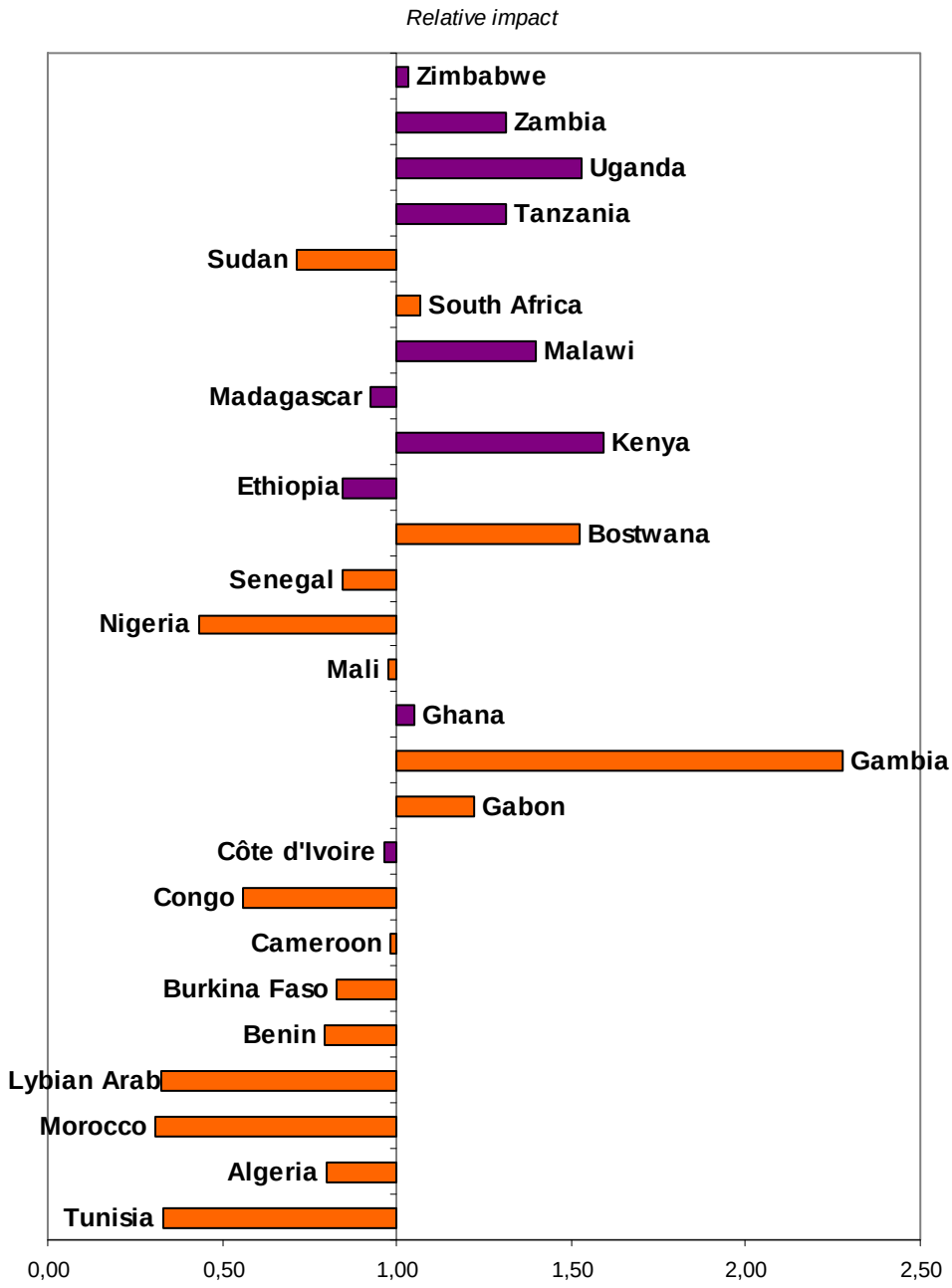
5.1. Medicine

Figure 54. Activity and visibility in the context of *medicine*.



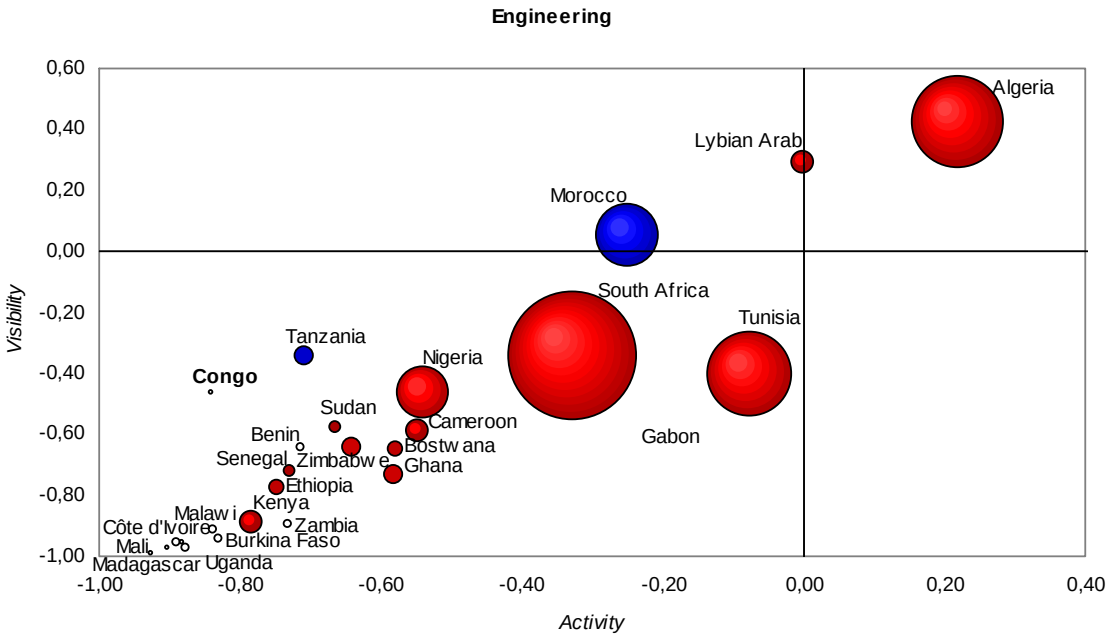
	Doc	RAI	RVI	RI
South Africa	18090	-0,11	-0,03	1,07
Nigeria	6806	-0,01	0,05	0,43
Tunisia	6507	0,03	-0,21	0,33
Morocco	4545	-0,05	-0,33	0,31
Kenya	2599	-0,10	0,06	1,59
Uganda	1851	0,21	0,32	1,53
Tanzania	1740	0,09	0,19	1,31
Senegal	1302	0,16	0,14	0,85
Zimbabwe	1185	0,02	0,08	1,03
Ghana	1163	0,02	0,17	1,05
Cameroon	1124	-0,10	0,03	0,98
Ethiopia	1093	-0,10	-0,04	0,85
Malawi	1090	0,29	0,34	1,40
Côte d'Ivoire	1011	0,20	0,23	0,97
Burkina Faso	840	0,18	0,14	0,83
Sudan	727	0,07	0,11	0,71
Zambia	720	0,21	0,30	1,31
Algeria	665	-0,71	-0,50	0,80
Gambia	598	0,30	0,32	2,28
Congo	595	0,27	0,14	0,56
Mali	447	0,17	0,14	0,98
Benin	425	-0,02	0,03	0,79
Gabon	401	0,16	0,12	1,22
Madagascar	401	-0,02	-0,02	0,93
Lybian Arab	369	-0,06	-0,06	0,33
Bostwana	252	-0,44	-0,10	1,53

Figure 55. Relative Impact in the context of *medicine*.



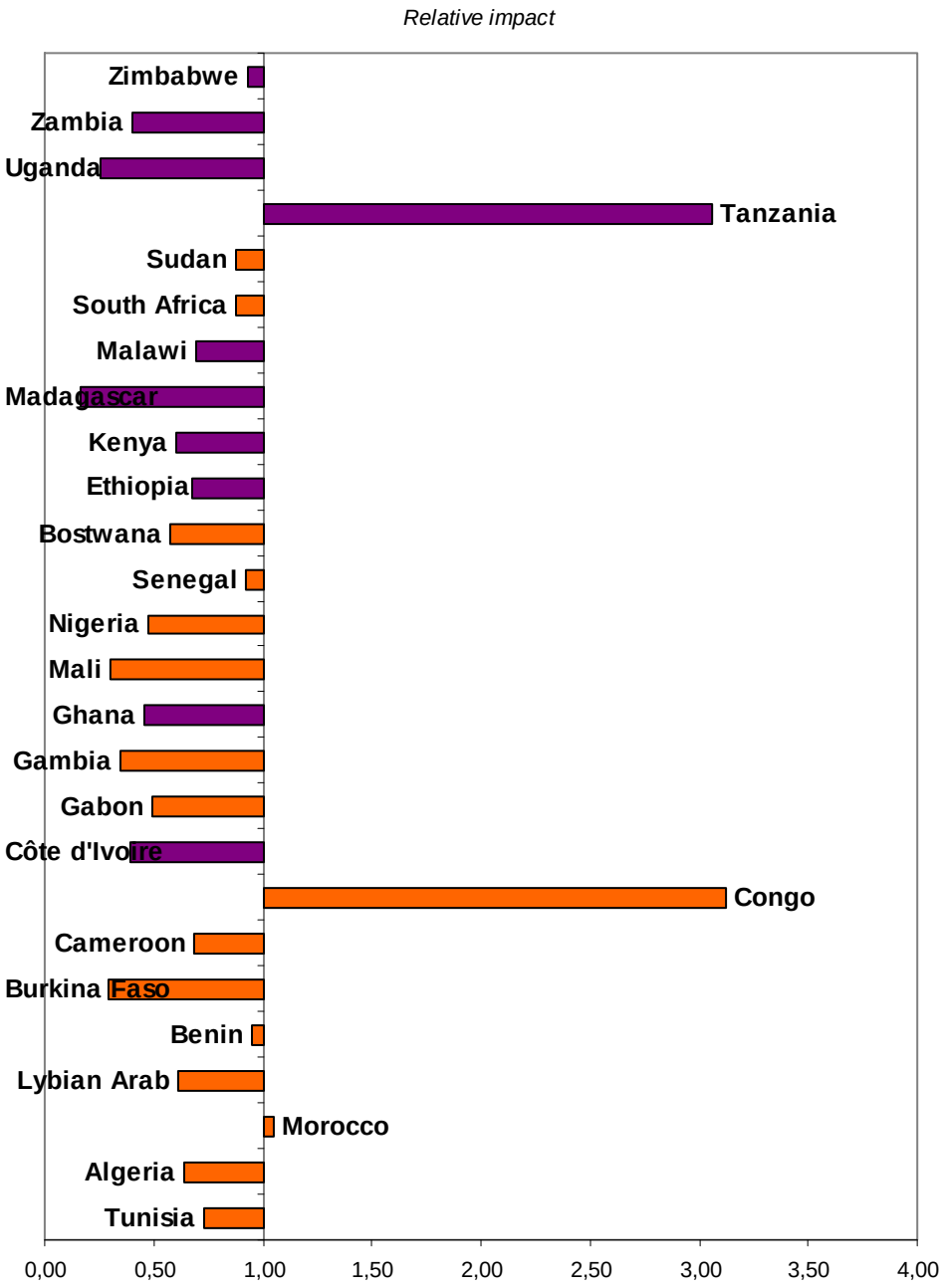
5.2. Engineering

Figure 56. Activity and visibility in the context of *engineering.*



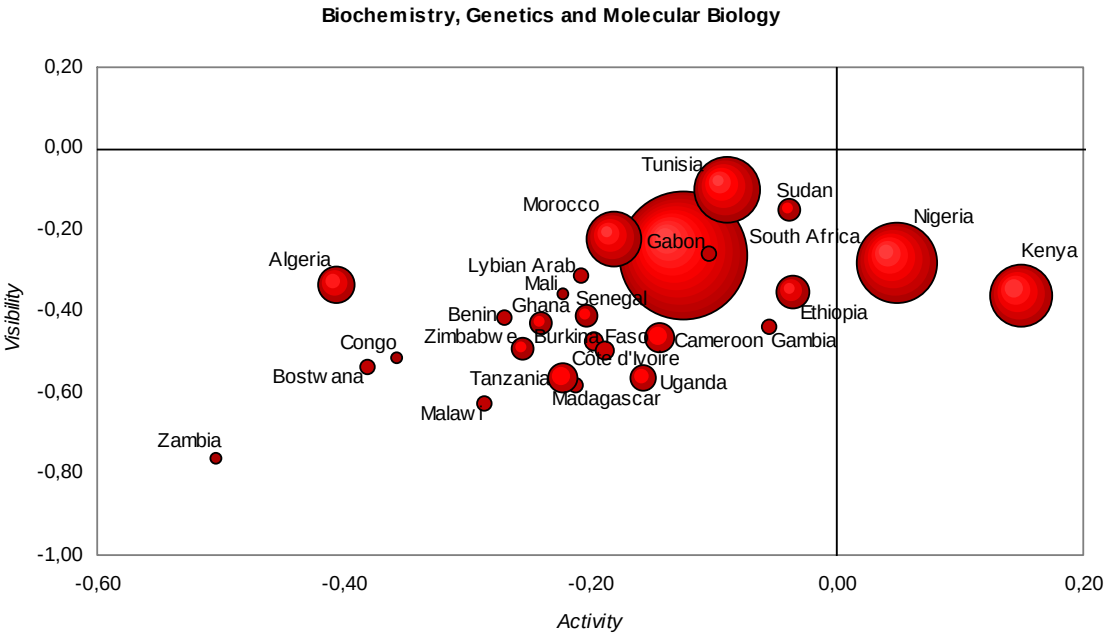
	Doc	RAI	RVI	RI
South Africa	5050	-0,33	-0,34	0,88
Algeria	2737	0,22	0,43	0,64
Tunisia	2319	-0,08	-0,40	0,73
Morocco	1321	-0,25	0,06	1,05
Nigeria	899	-0,54	-0,46	0,47
Lybian Arab	183	0,00	0,30	0,61
Cameroon	175	-0,55	-0,59	0,68
Kenya	167	-0,79	-0,88	0,60
Ghana	130	-0,58	-0,73	0,46
Tanzania	109	-0,71	-0,34	3,06
Zimbabwe	108	-0,64	-0,64	0,93
Ethiopia	85	-0,75	-0,77	0,68
Bostwana	76	-0,58	-0,65	0,58
Senegal	65	-0,73	-0,72	0,92
Sudan	56	-0,67	-0,58	0,88
Uganda	35	-0,88	-0,97	0,25
Benin	32	-0,72	-0,64	0,95
Zambia	32	-0,73	-0,89	0,41
Burkina Faso	24	-0,83	-0,94	0,29
Malawi	23	-0,84	-0,91	0,70
Côte d'Ivoire	17	-0,89	-0,95	0,40
Congo	13	-0,84	-0,46	3,12
Gabon	8	-0,88	-0,95	0,49
Mali	7	-0,90	-0,97	0,30
Madagascar	7	-0,93	-0,99	0,17
Gambia	4	-0,95	-0,99	0,35

Figure 57. Relative Impact in the context of *Engineering*.



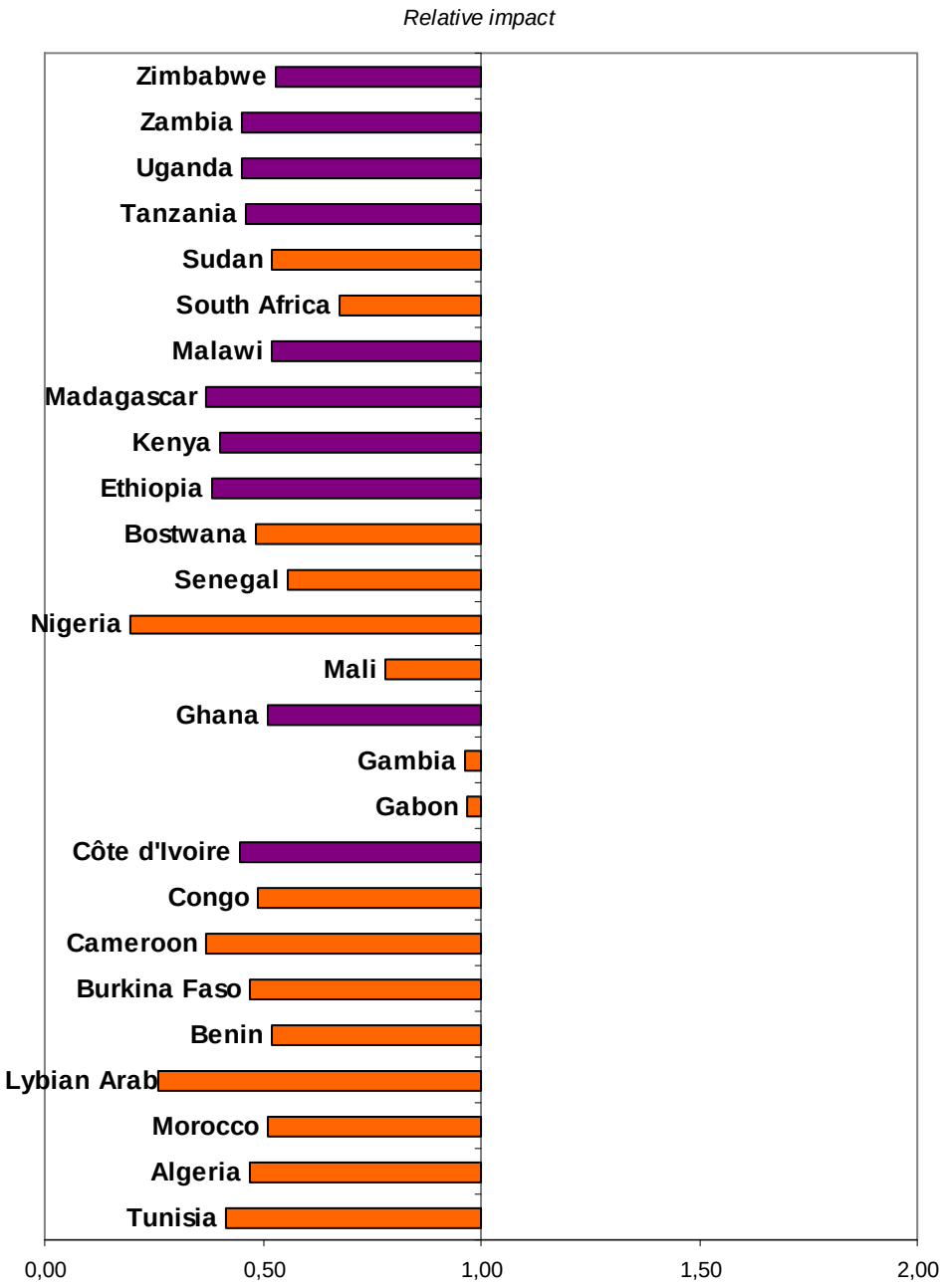
5.3. Biochemistry, genetics and molecular biology

Figure 58. Activity and visibility in the context of *biochemistry, genetics and molecular biology.*



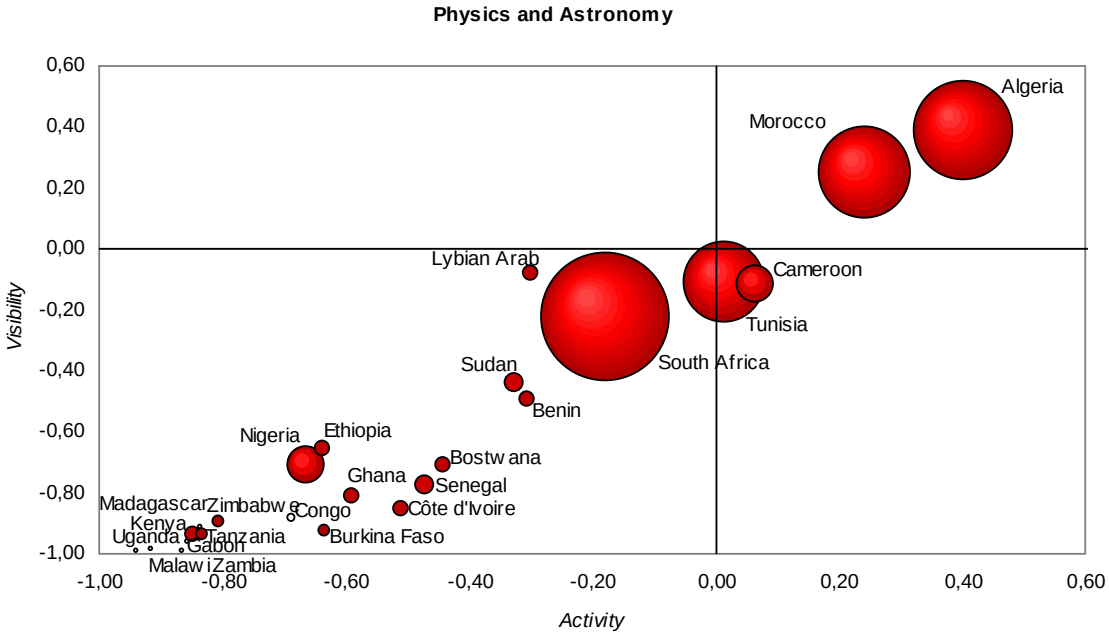
	Doc	RAI	RVI	RI
South Africa	7175	-0,12	-0,26	0,68
Nigeria	3075	0,05	-0,28	0,20
Tunisia	2090	-0,09	-0,10	0,42
Kenya	1737	0,15	-0,36	0,40
Morocco	1412	-0,18	-0,22	0,51
Algeria	685	-0,41	-0,33	0,47
Ethiopia	508	-0,03	-0,35	0,38
Cameroon	415	-0,14	-0,47	0,37
Tanzania	375	-0,22	-0,57	0,46
Uganda	360	-0,16	-0,57	0,45
Ghana	278	-0,24	-0,43	0,51
Zimbabwe	272	-0,26	-0,49	0,53
Senegal	254	-0,20	-0,41	0,56
Sudan	239	-0,04	-0,15	0,52
Côte d'Ivoire	186	-0,19	-0,50	0,45
Burkina Faso	160	-0,20	-0,47	0,47
Malawi	134	-0,29	-0,63	0,52
Bostwana	118	-0,38	-0,54	0,48
Gambia	117	-0,05	-0,44	0,96
Madagascar	111	-0,21	-0,58	0,37
Lybian Arab	111	-0,21	-0,31	0,26
Benin	102	-0,27	-0,41	0,52
Gabon	96	-0,10	-0,26	0,97
Mali	81	-0,22	-0,36	0,78
Congo	66	-0,36	-0,52	0,49
Zambia	63	-0,50	-0,76	0,45

Figure 59. Relative Impact in the context of *biochemistry, genetics and molecular biology*.



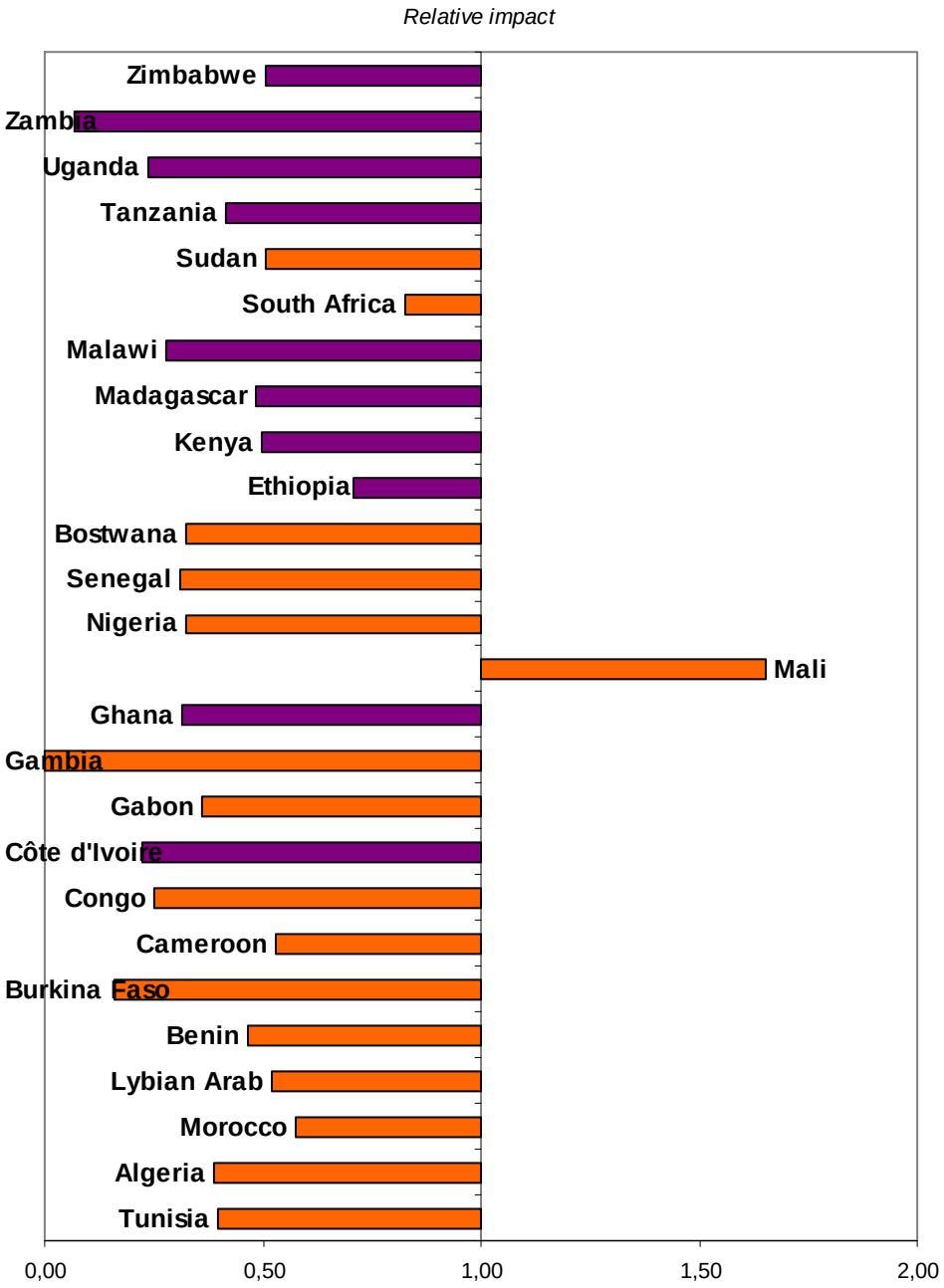
5.4. Physics and astronomy

Figure 60. Activity and visibility in the context of *physics and astronomy.*



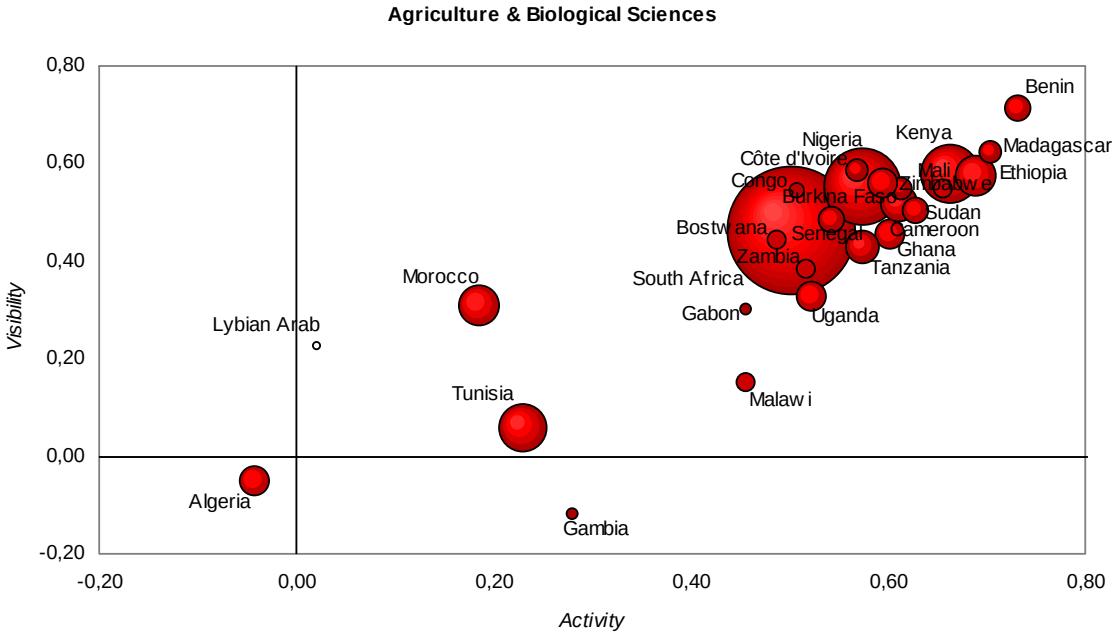
	Doc	RAI	RVI	RI
South Africa	4231	-0,18	-0,22	0,83
Algeria	2513	0,40	0,39	0,39
Morocco	2195	0,24	0,25	0,57
Tunisia	1694	0,01	-0,10	0,40
Cameroon	415	0,06	-0,11	0,53
Nigeria	371	-0,66	-0,71	0,32
Senegal	91	-0,47	-0,78	0,31
Sudan	86	-0,33	-0,44	0,51
Ethiopia	79	-0,64	-0,65	0,71
Ghana	77	-0,59	-0,81	0,32
Kenya	69	-0,85	-0,93	0,50
Bostwana	67	-0,44	-0,70	0,32
Benin	62	-0,31	-0,49	0,47
Lybian Arab	60	-0,30	-0,08	0,52
Côte d'Ivoire	58	-0,51	-0,85	0,22
Tanzania	35	-0,83	-0,93	0,42
Burkina Faso	35	-0,64	-0,92	0,16
Zimbabwe	32	-0,81	-0,89	0,51
Congo	17	-0,69	-0,88	0,25
Madagascar	10	-0,84	-0,91	0,49
Uganda	10	-0,94	-0,99	0,24
Zambia	9	-0,87	-0,99	0,07
Malawi	7	-0,92	-0,98	0,28
Gabon	6	-0,86	-0,96	0,36
Gambia	1	-0,98	-1,00	0,00
Mali	1	-0,98	-0,96	1,65

Figure 61. Relative Impact in the context of *physics and astronomy*.



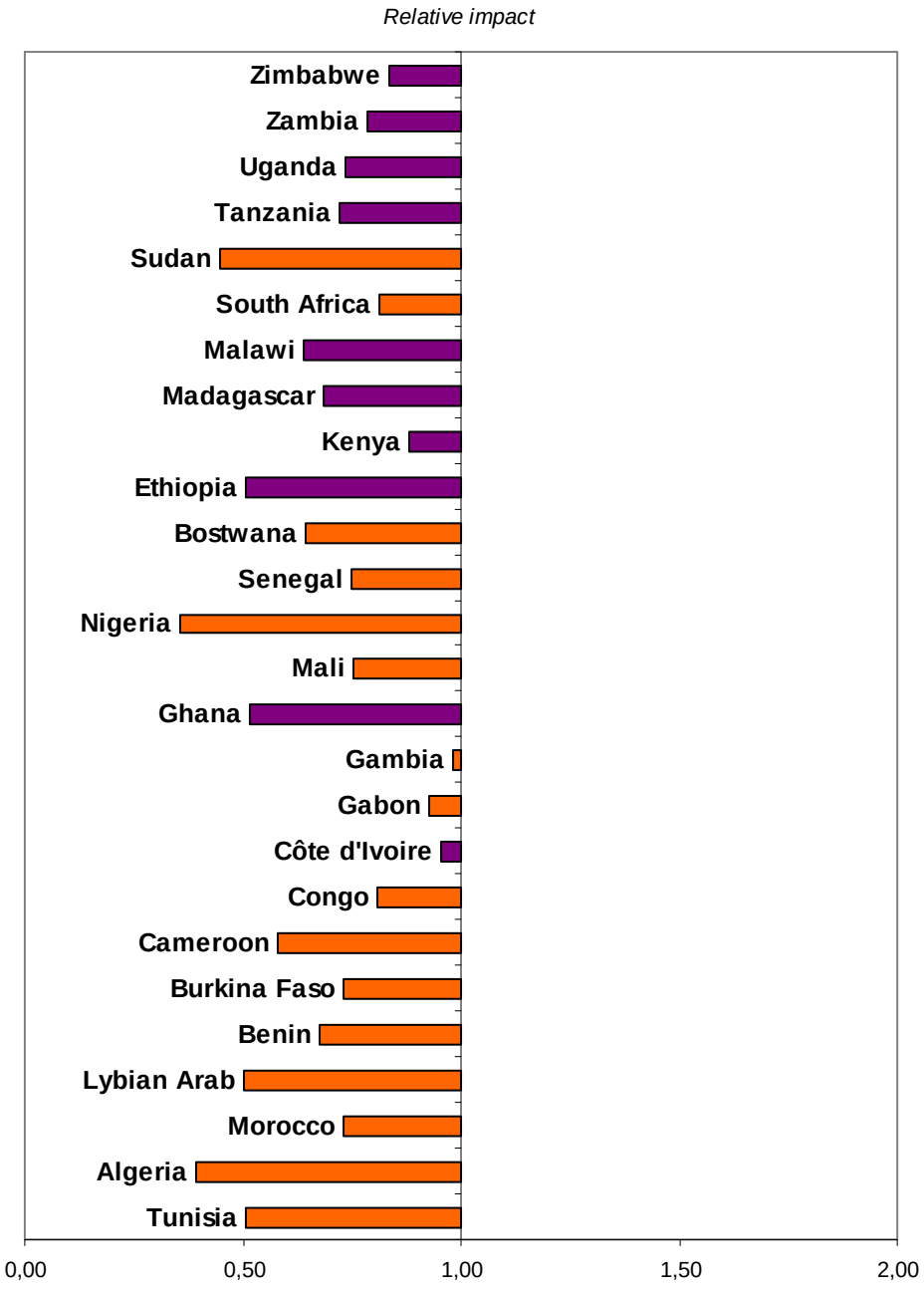
5.5. Agriculture and biological science

Figure 62. Activity and visibility in the context of *agriculture and biological science*.



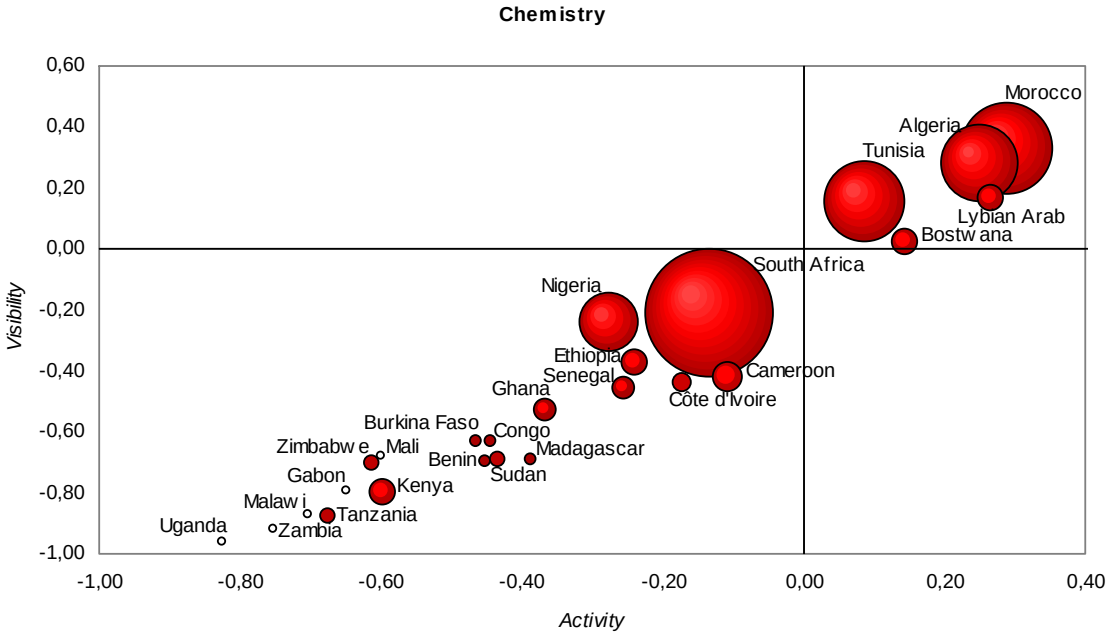
	Doc	RAI	RVI	RI
South Africa	17.367	0,50	0,46	0,81
Nigeria	6.449	0,57	0,55	0,36
Kenya	3.952	0,66	0,58	0,88
Tunisia	2.494	0,23	0,06	0,51
Ethiopia	1.846	0,69	0,57	0,51
Morocco	1845	0,18	0,31	0,73
Cameroon	1439	0,61	0,52	0,58
Tanzania	1.358	0,57	0,43	0,72
Ghana	1.141	0,60	0,46	0,52
Zimbabwe	1.128	0,59	0,56	0,83
Uganda	982	0,52	0,33	0,74
Algeria	930	-0,04	-0,05	0,39
Senegal	810	0,54	0,48	0,75
Benin	716	0,73	0,72	0,68
Sudan	707	0,63	0,50	0,45
Burkina Faso	621	0,61	0,55	0,73
Côte d'Ivoire	620	0,57	0,59	0,95
Madagascar	615	0,70	0,62	0,68
Bostwana	477	0,49	0,44	0,64
Malawi	403	0,46	0,15	0,64
Mali	382	0,66	0,55	0,75
Zambia	373	0,52	0,39	0,79
Congo	266	0,51	0,55	0,81
Gabon	198	0,46	0,30	0,93
Gambia	145	0,28	-0,12	0,98
Lybian Arab	110	0,02	0,23	0,50

Figure 63. Relative Impact in the context of *agriculture and biological science*.



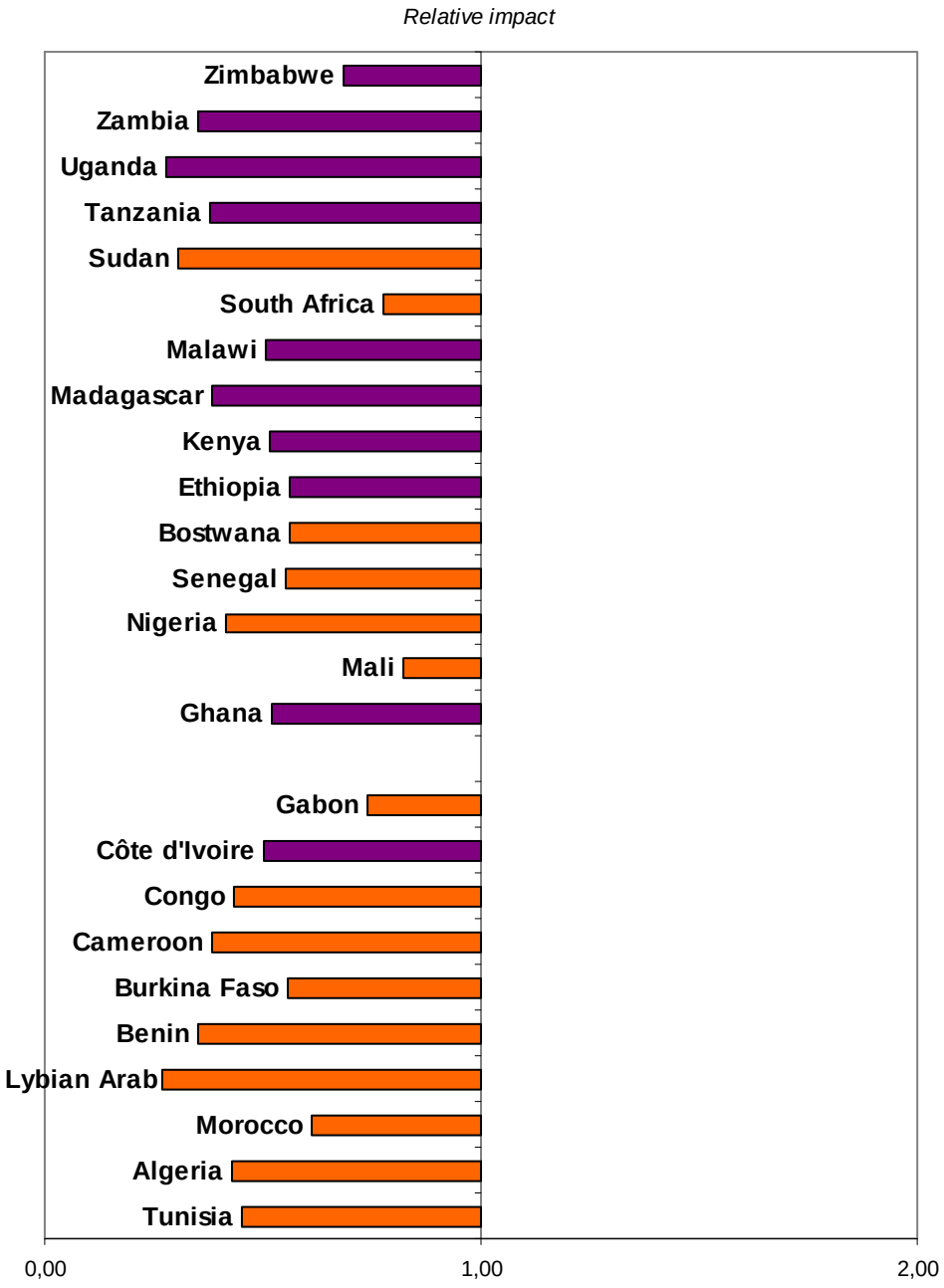
5.6. Chemistry

Figure 64. Activity and visibility in the context of *chemistry*.



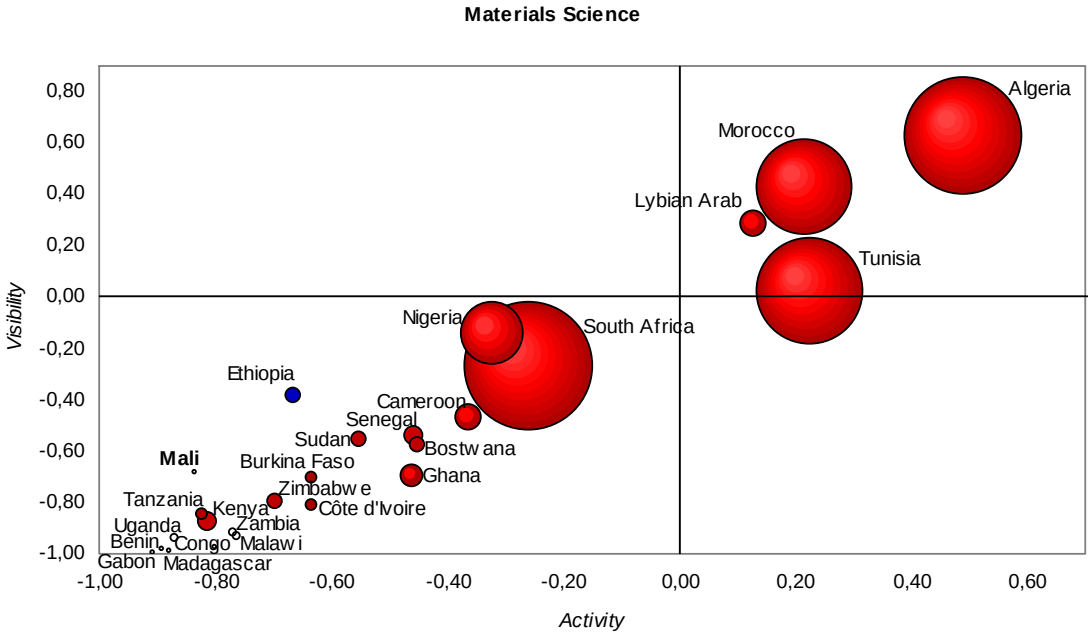
	Doc	RAI	RVI	RI
South Africa	4223	-0,13	-0,21	0,77
Morocco	2207	0,29	0,33	0,61
Tunisia	1779	0,09	0,16	0,45
Algeria	1622	0,25	0,28	0,43
Nigeria	948	-0,28	-0,24	0,42
Cameroon	268	-0,11	-0,42	0,38
Bostwana	211	0,14	0,02	0,56
Ethiopia	200	-0,24	-0,37	0,56
Kenya	194	-0,60	-0,80	0,52
Lybian Arab	175	0,27	0,17	0,27
Senegal	136	-0,26	-0,46	0,55
Ghana	126	-0,37	-0,53	0,52
Côte d'Ivoire	115	-0,17	-0,44	0,50
Tanzania	68	-0,68	-0,87	0,38
Zimbabwe	66	-0,61	-0,70	0,68
Sudan	61	-0,43	-0,69	0,31
Burkina Faso	52	-0,47	-0,63	0,56
Madagascar	45	-0,39	-0,69	0,38
Benin	40	-0,45	-0,69	0,35
Congo	32	-0,45	-0,63	0,43
Uganda	28	-0,83	-0,96	0,28
Malawi	25	-0,71	-0,87	0,51
Mali	19	-0,60	-0,67	0,82
Zambia	16	-0,75	-0,91	0,35
Gabon	15	-0,65	-0,79	0,74
Gambia	0	-1,00	-1,00	

Figure 65. Relative Impact in the context of *chemistry*.



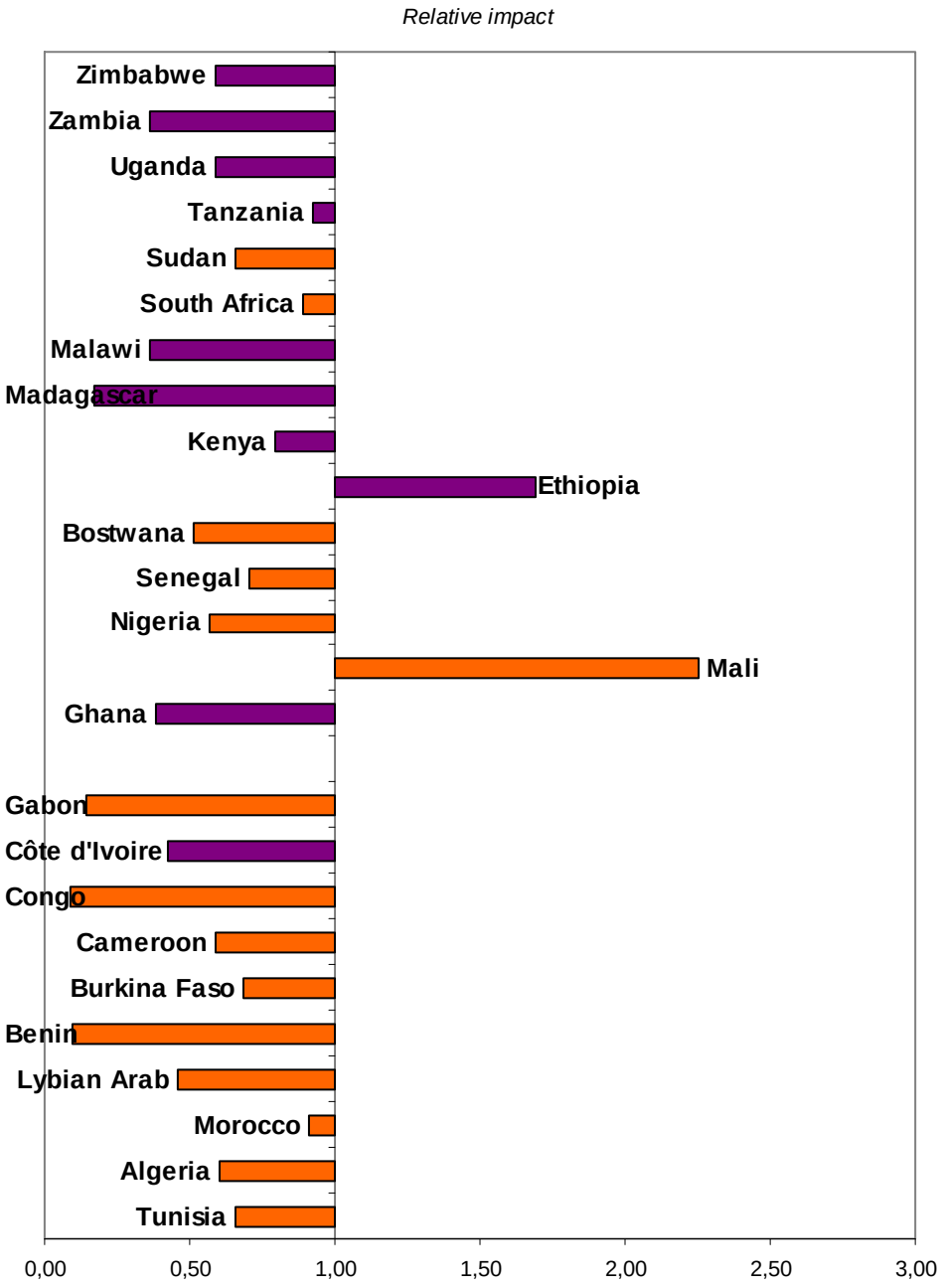
5.7. Materials science

Figure 66. Activity and visibility in the context of *materials science*.



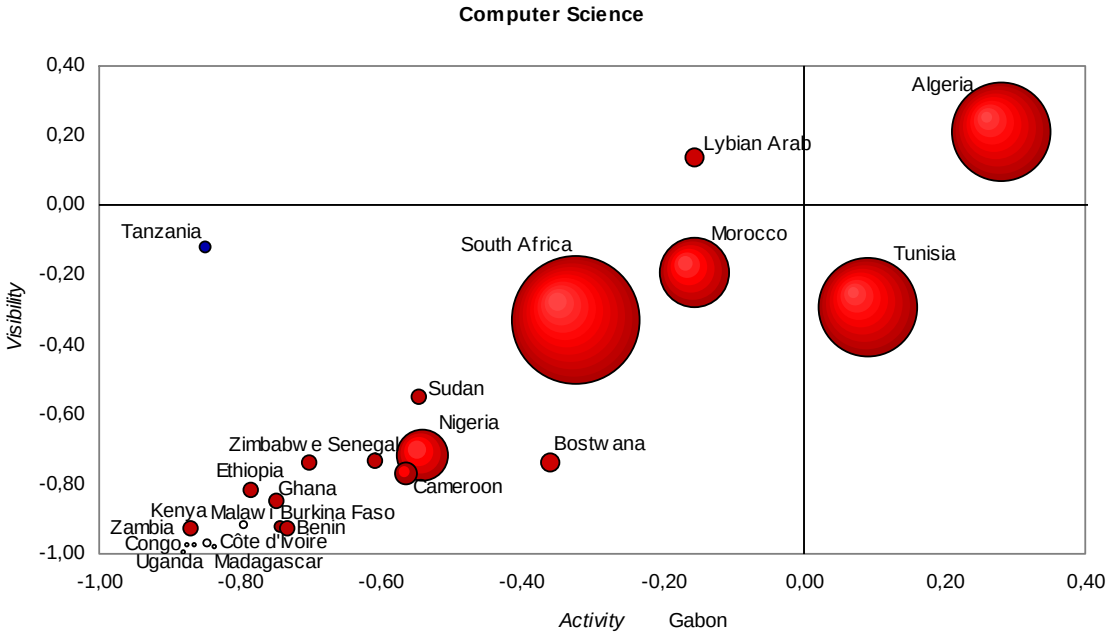
	Doc	RAI	RVI	RI
South Africa	2850	-0,26	-0,27	0,89
Algeria	2484	0,49	0,63	0,61
Tunisia	2077	0,23	0,02	0,66
Morocco	1655	0,22	0,43	0,91
Nigeria	748	-0,32	-0,14	0,57
Cameroon	136	-0,36	-0,47	0,59
Lybian Arab	115	0,13	0,29	0,46
Ghana	88	-0,46	-0,69	0,39
Senegal	75	-0,46	-0,54	0,71
Kenya	69	-0,81	-0,87	0,80
Ethiopia	57	-0,67	-0,38	1,69
Bostwana	52	-0,45	-0,57	0,52
Zimbabwe	43	-0,70	-0,79	0,59
Sudan	39	-0,55	-0,55	0,66
Côte d'Ivoire	32	-0,63	-0,81	0,43
Tanzania	30	-0,82	-0,84	0,92
Burkina Faso	28	-0,63	-0,70	0,69
Uganda	18	-0,87	-0,93	0,59
Malawi	17	-0,76	-0,93	0,36
Zambia	13	-0,77	-0,92	0,36
Congo	8	-0,80	-0,97	0,09
Mali	6	-0,84	-0,68	2,25
Benin	6	-0,88	-0,98	0,10
Madagascar	5	-0,89	-0,98	0,17
Gabon	3	-0,91	-0,99	0,14
Gambia	0	-1,00	-1,00	

Figure 67. Relative Impact in the context of *materials science*.



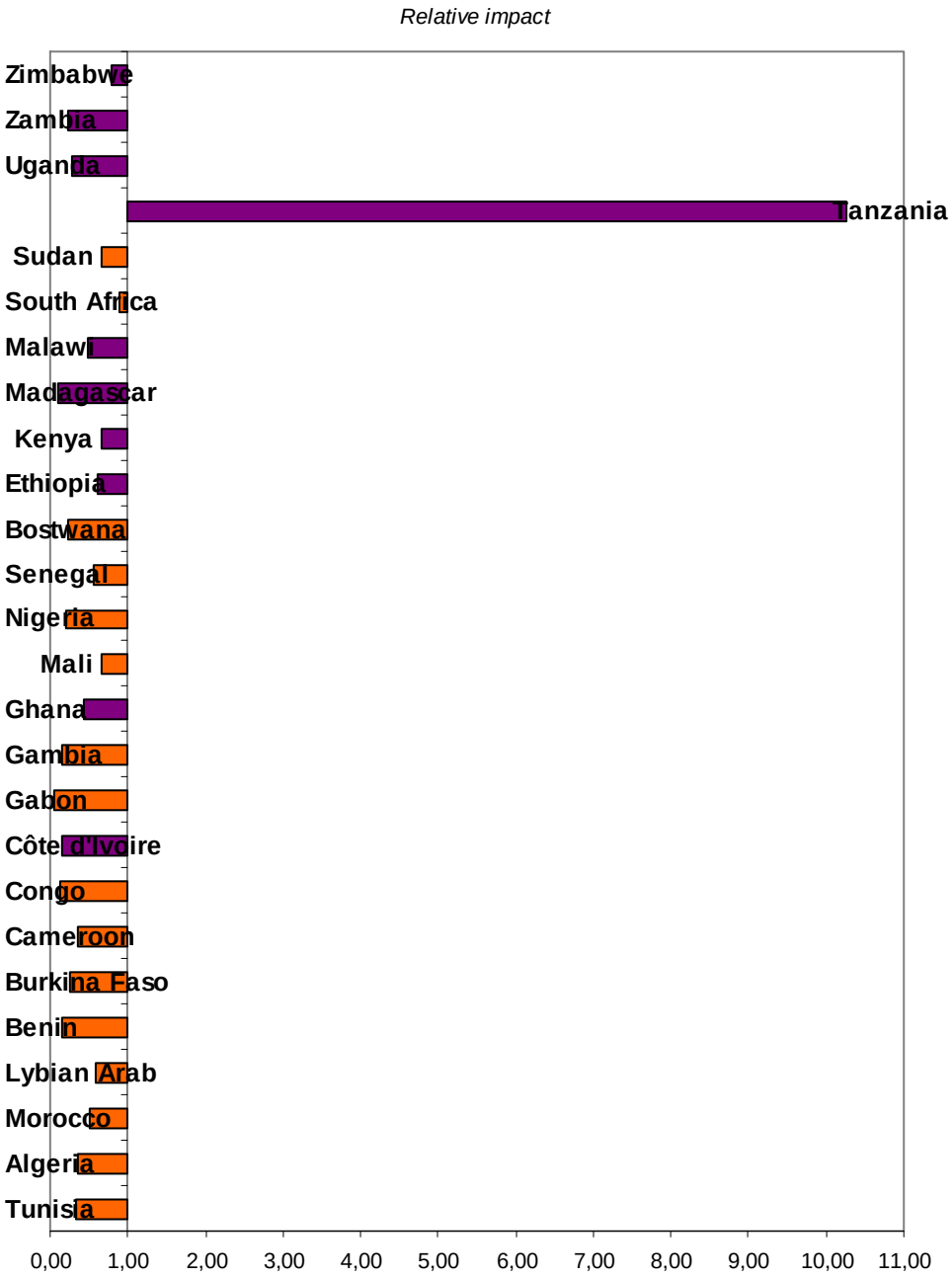
5.8. Computer science

Figure 68. Activity and visibility in the context of *computer science*.



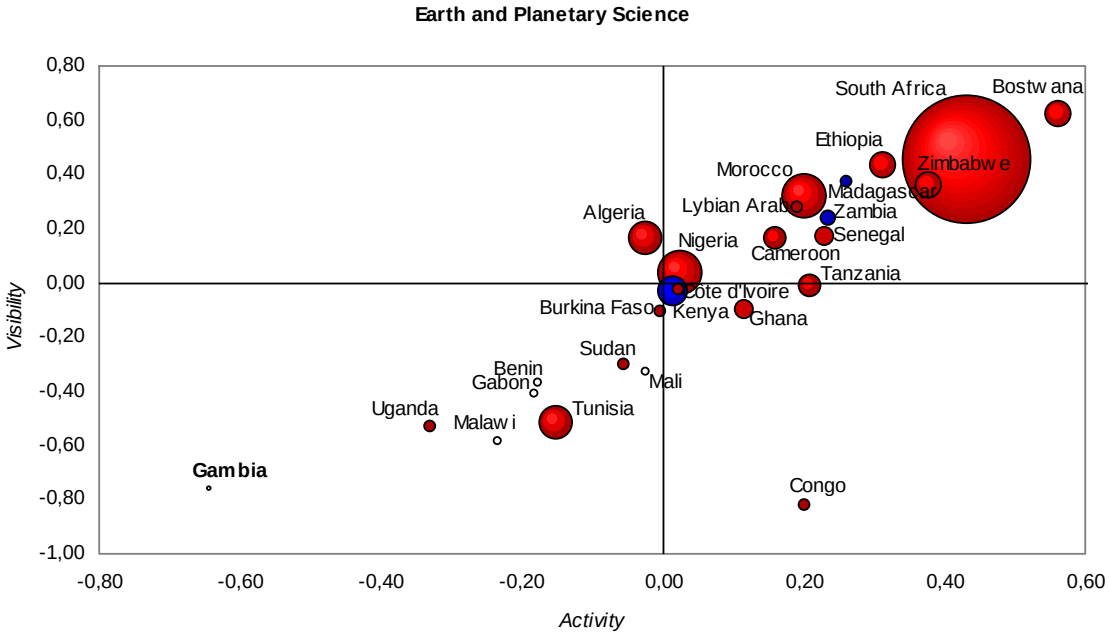
	Doc	RAI	RVI	RI
South Africa	1868	-0,32	-0,33	0,89
Tunisia	1188	0,09	-0,29	0,32
Algeria	1141	0,28	0,21	0,35
Morocco	589	-0,16	-0,19	0,52
Nigeria	329	-0,54	-0,72	0,21
Cameroon	61	-0,57	-0,77	0,35
Lybian Arab	49	-0,16	0,14	0,59
Bostwana	49	-0,36	-0,74	0,23
Senegal	37	-0,61	-0,73	0,56
Kenya	35	-0,87	-0,92	0,66
Zimbabwe	32	-0,70	-0,74	0,80
Uganda	30	-0,73	-0,93	0,29
Sudan	30	-0,55	-0,55	0,65
Ghana	26	-0,75	-0,85	0,44
Ethiopia	26	-0,79	-0,82	0,62
Tanzania	19	-0,85	-0,12	10,26
Burkina Faso	14	-0,74	-0,92	0,24
Malawi	11	-0,79	-0,91	0,49
Benin	11	-0,73	-0,93	0,16
Côte d'Ivoire	9	-0,85	-0,97	0,16
Madagascar	6	-0,84	-0,98	0,11
Zambia	5	-0,88	-0,97	0,23
Congo	4	-0,86	-0,98	0,12
Gabon	3	-0,88	-0,99	0,05
Gambia	1	-0,96	-1,00	0,16
Mali	1	-0,96	-0,98	0,65

Figure 69. Relative Impact in the context of *computer science*.



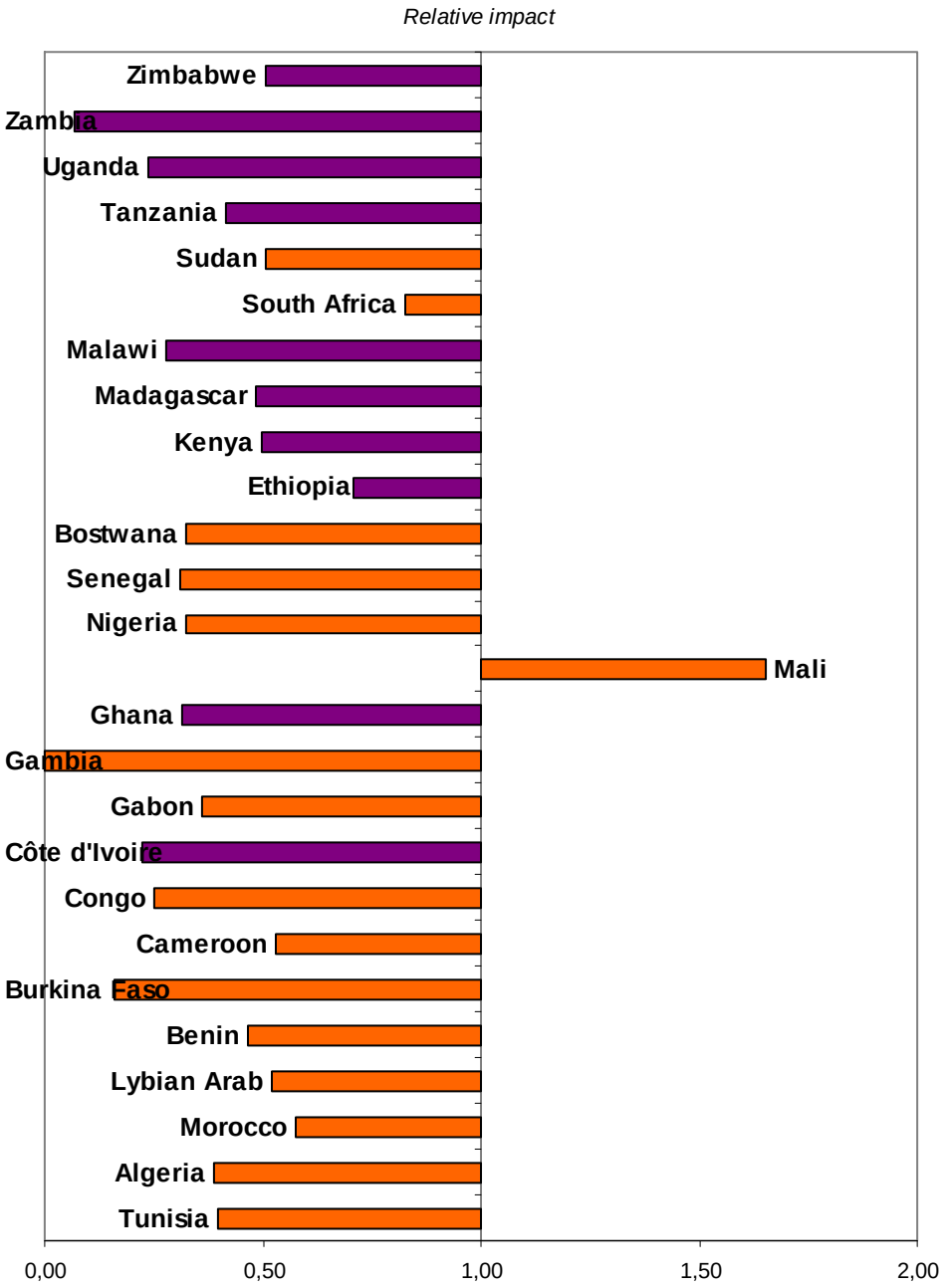
5.9. Earth and planetary sciences

Figure 70. Activity and visibility in the context of *earth and planetary sciences*.



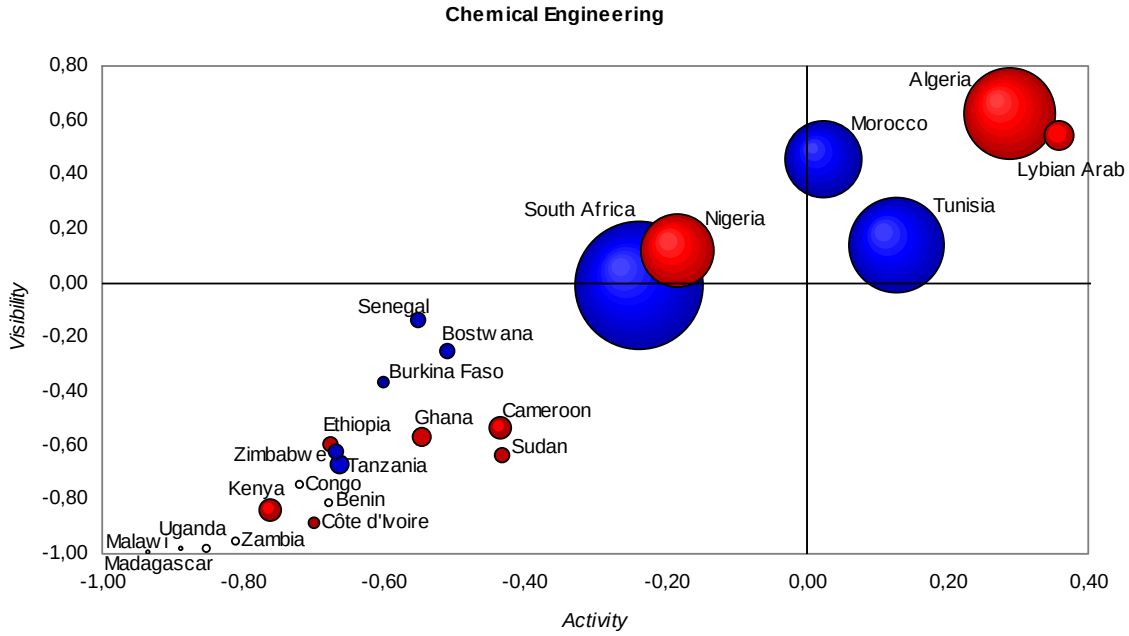
	Doc	RAI	RVI	RI
South Africa	8261	0,43	0,45	0,95
Morocco	1081	0,20	0,32	0,73
Nigeria	1039	0,02	0,04	0,39
Tunisia	653	-0,15	-0,51	0,49
Algeria	546	-0,03	0,17	0,59
Kenya	469	0,01	-0,03	1,07
Ethiopia	369	0,31	0,43	0,99
Zimbabwe	359	0,38	0,36	0,90
Bostwana	331	0,56	0,62	0,87
Tanzania	319	0,21	-0,01	0,68
Cameroon	271	0,16	0,17	0,77
Senegal	217	0,23	0,17	0,78
Ghana	203	0,12	-0,09	0,51
Zambia	109	0,23	0,24	1,11
Madagascar	103	0,26	0,37	1,18
Côte d'Ivoire	101	0,02	-0,02	0,83
Lybian Arab	88	0,19	0,28	0,40
Uganda	88	-0,33	-0,53	0,73
Burkina Faso	84	0,00	-0,10	0,72
Sudan	82	-0,05	-0,30	0,39
Congo	74	0,20	-0,82	0,05
Malawi	53	-0,24	-0,58	0,54
Benin	44	-0,18	-0,36	0,48
Mali	43	-0,02	-0,33	0,56
Gabon	29	-0,18	-0,41	0,81
Gambia	10	-0,64	-0,76	1,40

Figure 71. Relative Impact in the context of *earth and planetary sciences*.



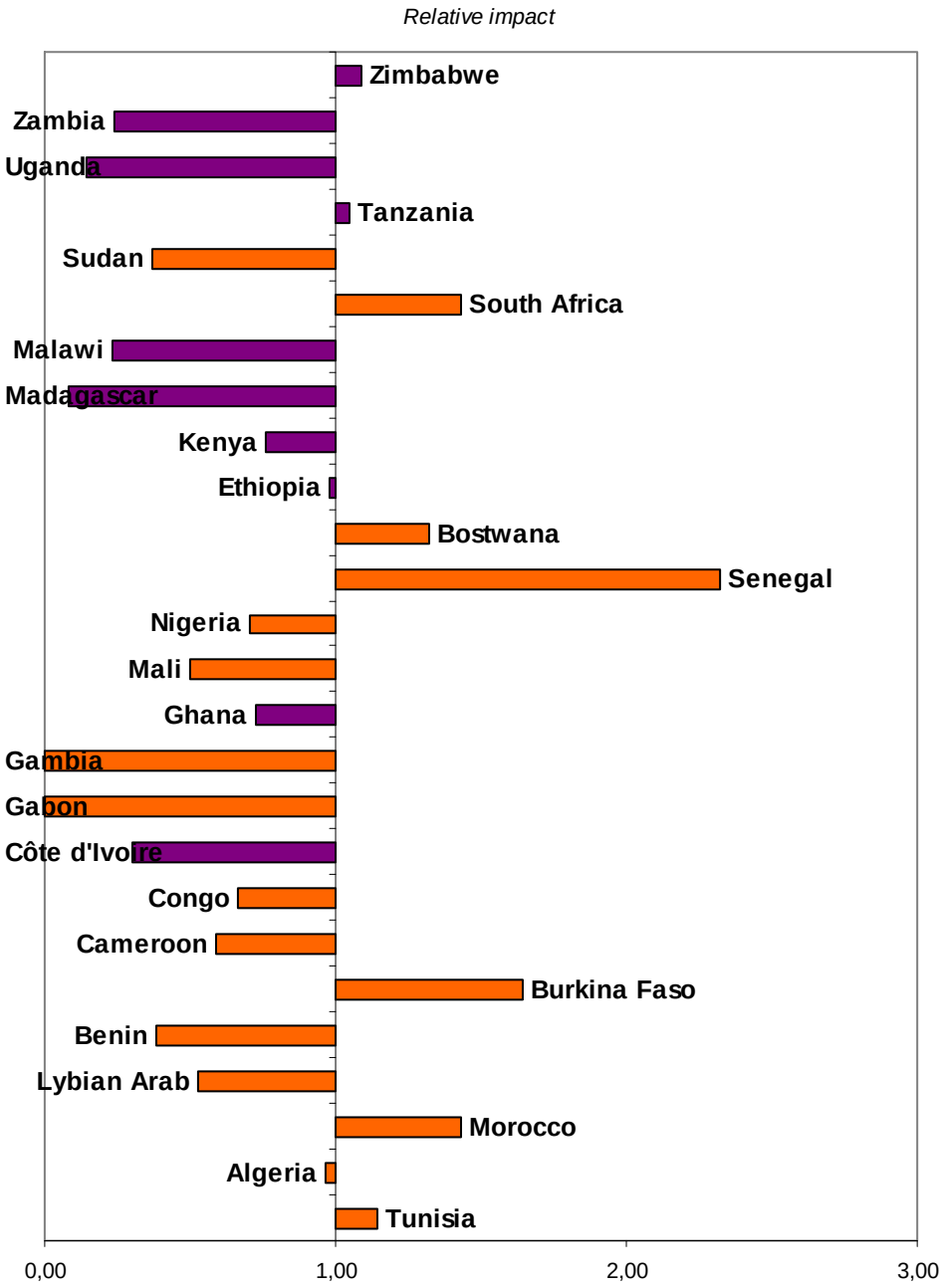
5.10. Chemical engineering

Figure 72. Activity and visibility in the context of *chemical engineering*.



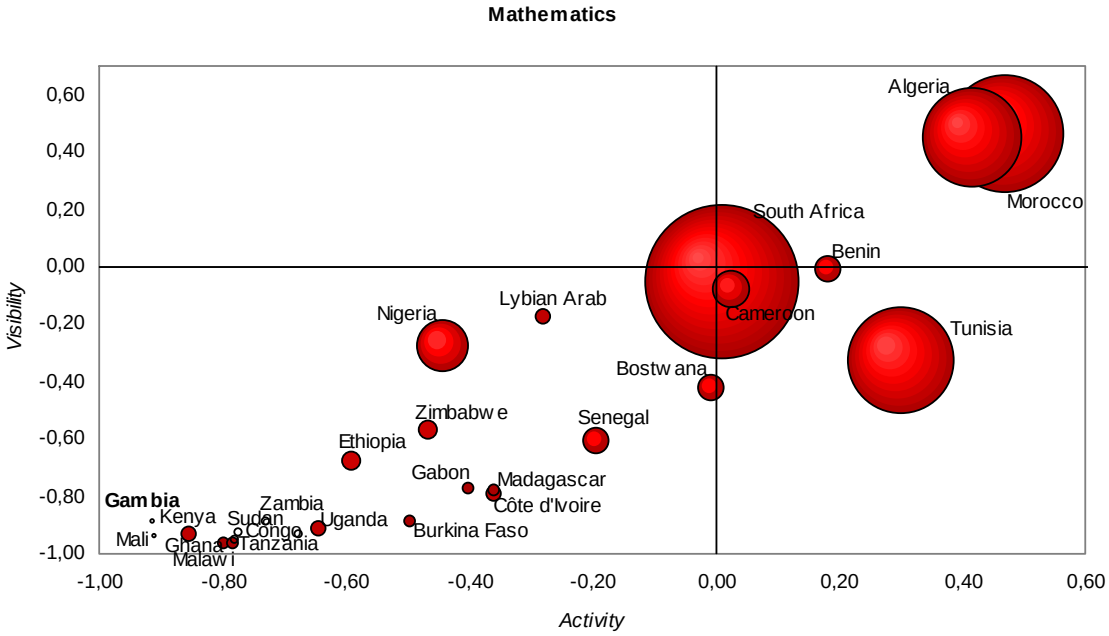
	Doc	RAI	RVI	RI
South Africa	1997	-0,24	-0,01	1,43
Tunisia	1137	0,13	0,14	1,14
Algeria	1037	0,29	0,63	0,96
Morocco	753	0,03	0,46	1,43
Nigeria	678	-0,18	0,12	0,71
Lybian Arab	126	0,36	0,55	0,53
Cameroon	77	-0,43	-0,53	0,59
Kenya	61	-0,76	-0,84	0,76
Ghana	47	-0,55	-0,57	0,73
Tanzania	42	-0,66	-0,67	1,05
Senegal	39	-0,55	-0,13	2,32
Ethiopia	37	-0,68	-0,60	0,98
Sudan	36	-0,43	-0,63	0,37
Zimbabwe	32	-0,67	-0,62	1,09
Bostwana	30	-0,51	-0,25	1,32
Burkina Faso	21	-0,60	-0,37	1,64
Côte d'Ivoire	17	-0,70	-0,89	0,30
Uganda	14	-0,85	-0,98	0,14
Benin	12	-0,68	-0,81	0,39
Congo	8	-0,72	-0,74	0,66
Zambia	7	-0,81	-0,96	0,24
Malawi	5	-0,89	-0,98	0,23
Madagascar	2	-0,94	-0,99	0,08
Mali	1	-0,96	-0,98	0,50
Gabon	1	-0,95	-1,00	0,00
Gambia	1	-0,96	-1,00	0,00

Figure 73. Relative Impact in the context of *chemical engineering*.



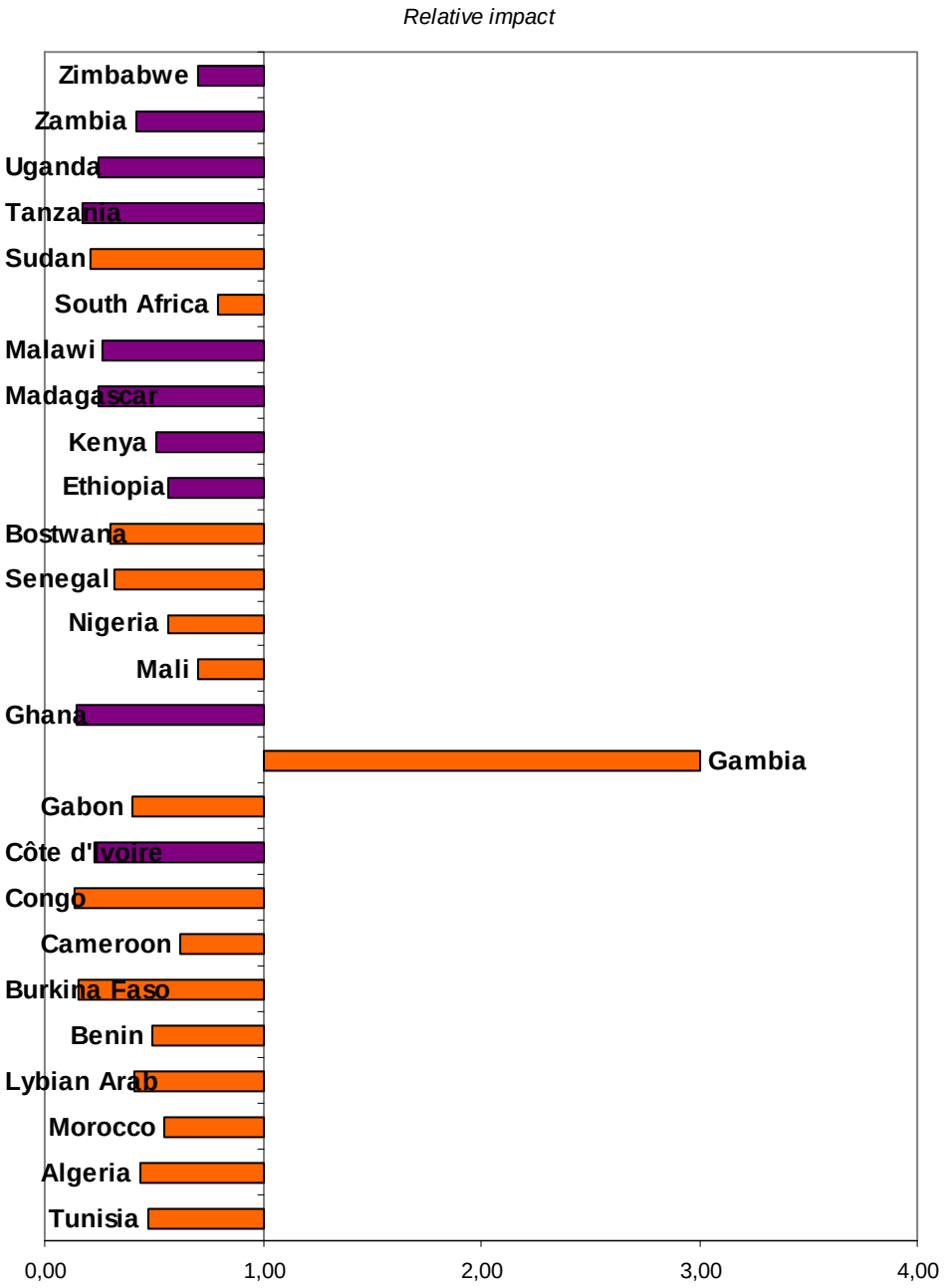
5.11. Mathematics

Figure 74. Activity and visibility in the context of *mathematics*.



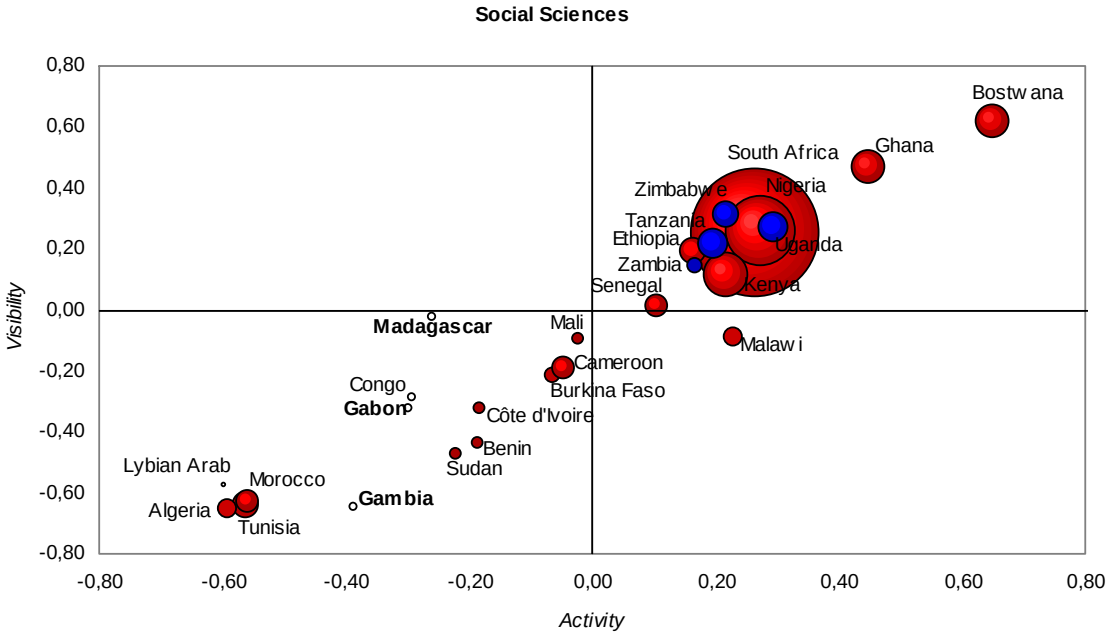
	Doc	RAI	RVI	RI
South Africa	3165	0,01	-0,05	0,80
Morocco	1886	0,47	0,46	0,55
Tunisia	1556	0,30	-0,33	0,47
Algeria	1316	0,41	0,45	0,44
Nigeria	360	-0,44	-0,27	0,57
Cameroon	196	0,03	-0,07	0,62
Senegal	87	-0,19	-0,60	0,32
Bostwana	87	-0,01	-0,42	0,30
Benin	86	0,18	-0,01	0,49
Zimbabwe	56	-0,47	-0,57	0,70
Ethiopia	47	-0,59	-0,67	0,57
Côte d'Ivoire	43	-0,36	-0,79	0,23
Uganda	36	-0,64	-0,91	0,25
Kenya	34	-0,85	-0,93	0,51
Lybian Arab	32	-0,28	-0,17	0,41
Madagascar	27	-0,36	-0,78	0,24
Burkina Faso	27	-0,50	-0,89	0,16
Tanzania	24	-0,78	-0,96	0,18
Gabon	17	-0,40	-0,77	0,41
Ghana	17	-0,80	-0,96	0,15
Sudan	11	-0,77	-0,92	0,21
Zambia	10	-0,73	-0,89	0,42
Malawi	10	-0,78	-0,95	0,27
Congo	9	-0,68	-0,93	0,14
Gambia	2	-0,91	-0,88	3,01
Mali	2	-0,91	-0,94	0,71

Figure 75. Relative Impact in the context of *mathematics*.



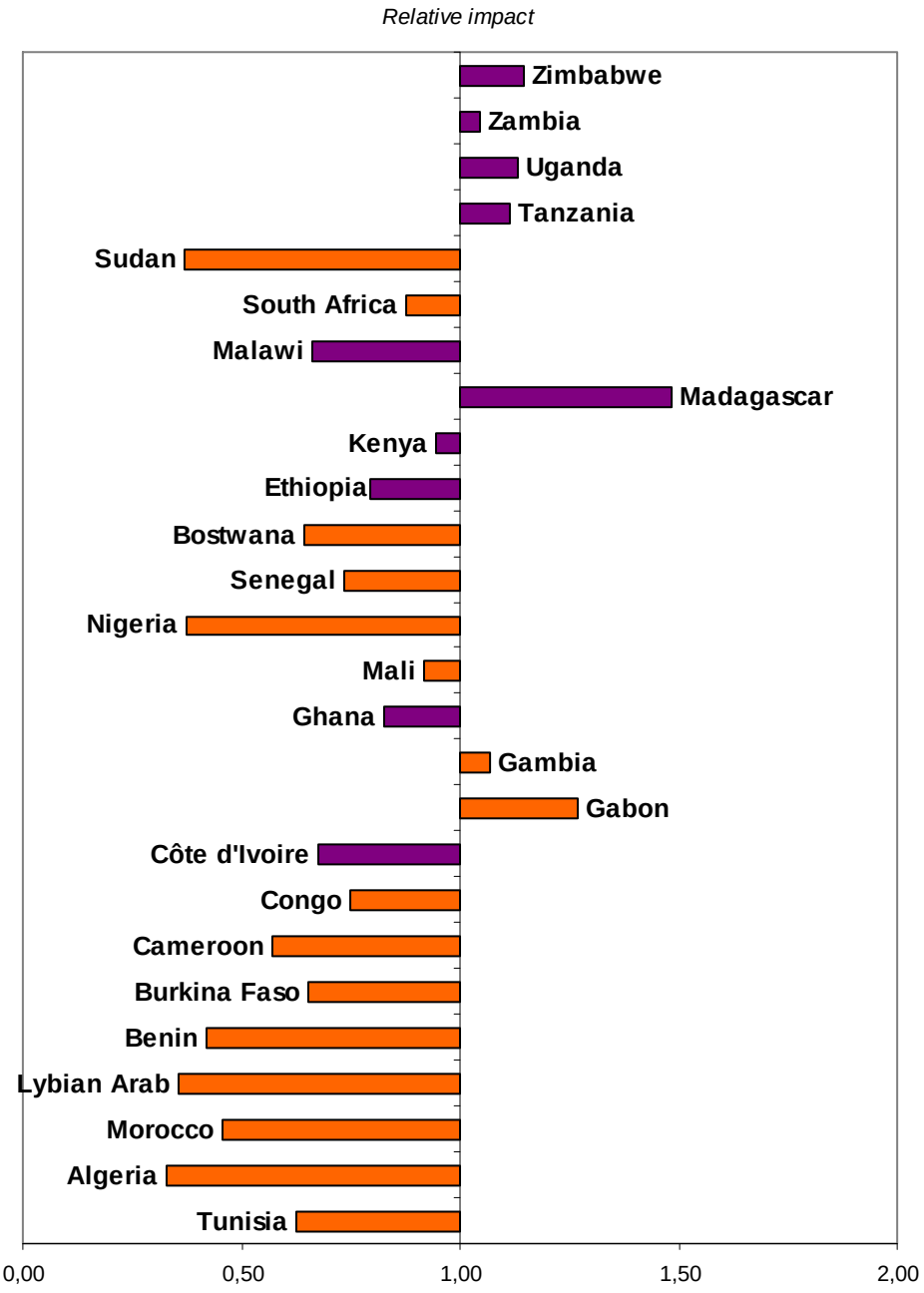
5.12. Social sciences

Figure 76. Activity and visibility in the context of *social sciences*.



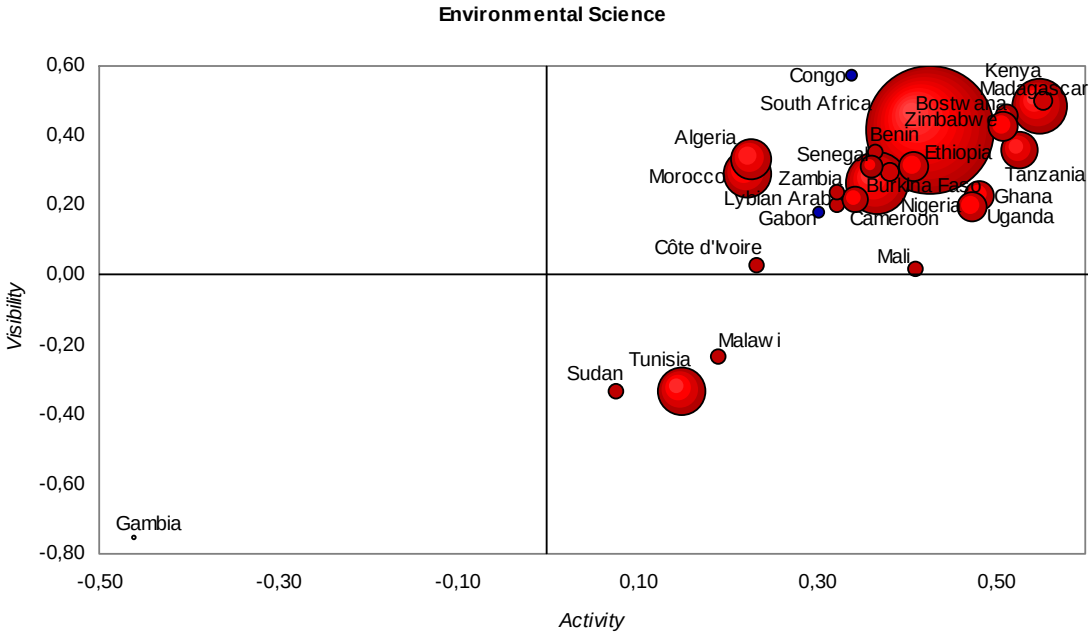
	Doc	RAI	RVI	RI
South Africa	5230	0,27	0,25	0,88
Nigeria	1602	0,27	0,26	0,37
Kenya	656	0,22	0,11	0,94
Bostwana	409	0,65	0,62	0,64
Ghana	393	0,45	0,47	0,82
Uganda	297	0,29	0,27	1,13
Tanzania	289	0,20	0,22	1,11
Ethiopia	250	0,16	0,19	0,79
Zimbabwe	234	0,22	0,31	1,14
Tunisia	230	-0,56	-0,64	0,62
Morocco	189	-0,56	-0,63	0,46
Cameroon	166	-0,05	-0,19	0,57
Senegal	156	0,10	0,01	0,73
Algeria	137	-0,59	-0,65	0,33
Malawi	127	0,23	-0,09	0,66
Zambia	88	0,17	0,15	1,04
Burkina Faso	69	-0,07	-0,21	0,65
Côte d'Ivoire	62	-0,18	-0,32	0,67
Sudan	54	-0,22	-0,47	0,37
Benin	40	-0,19	-0,43	0,42
Mali	40	-0,02	-0,09	0,92
Madagascar	33	-0,26	-0,02	1,48
Congo	25	-0,29	-0,28	0,75
Gabon	21	-0,30	-0,32	1,27
Gambia	19	-0,39	-0,65	1,07
Lybian Arab	14	-0,60	-0,57	0,35

Figure 77. Relative Impact in the context of *social sciences*.



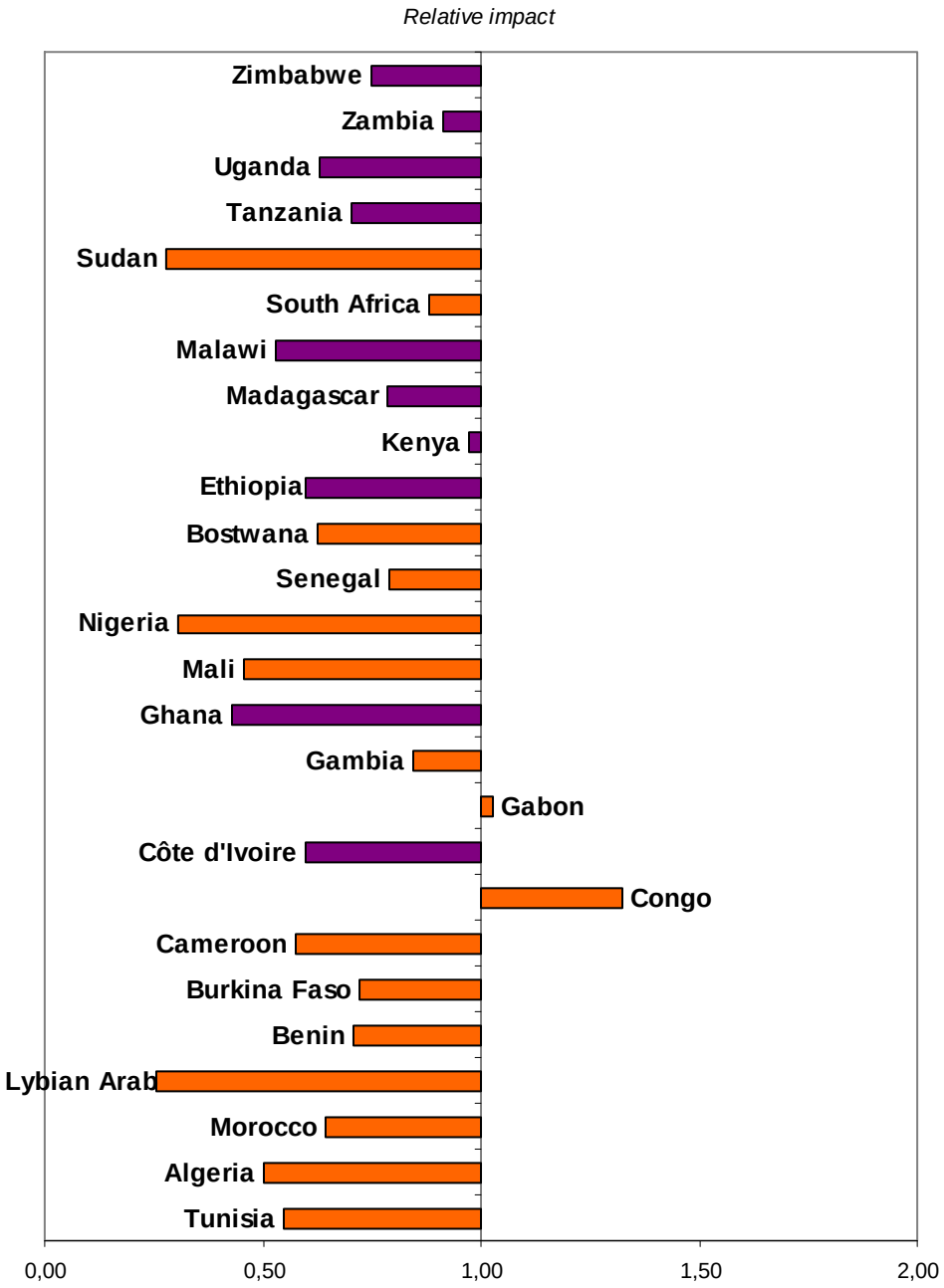
5.13. Environmental sciences

Figure 78. Activity and visibility in the context of *environmental sciences*.



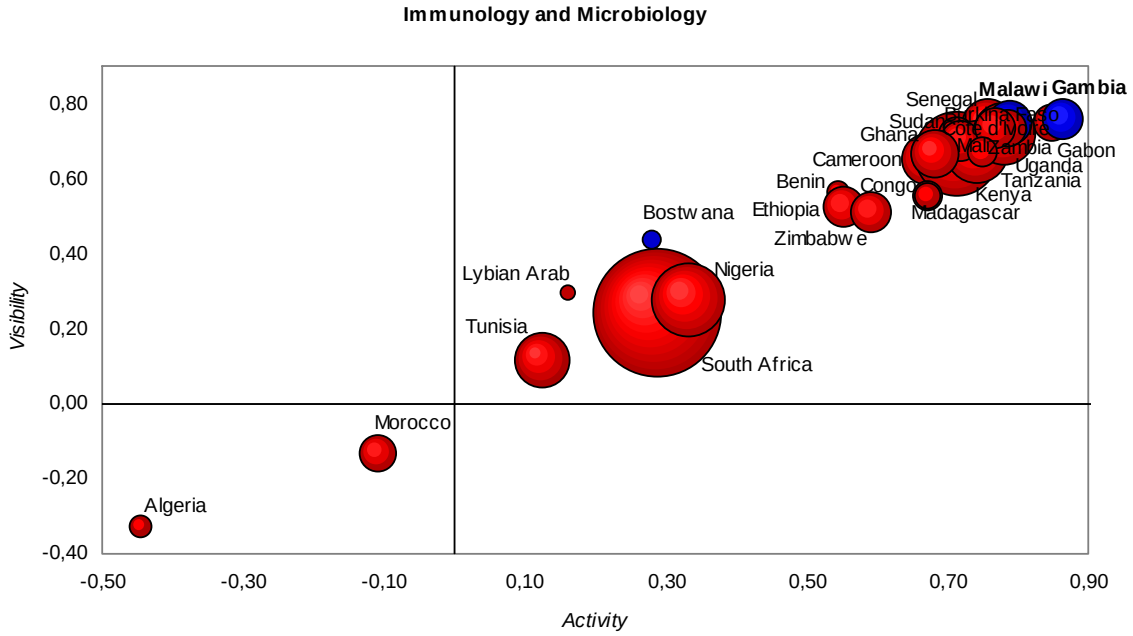
	Doc	RAI	RVI	RI
South Africa	7178	0,43	0,42	0,88
Nigeria	1879	0,37	0,27	0,31
Kenya	1374	0,55	0,48	0,97
Tunisia	1053	0,15	-0,33	0,55
Morocco	999	0,22	0,29	0,65
Algeria	802	0,23	0,33	0,50
Tanzania	592	0,53	0,36	0,70
Zimbabwe	438	0,51	0,43	0,75
Uganda	431	0,47	0,19	0,63
Ghana	405	0,48	0,23	0,43
Ethiopia	404	0,41	0,31	0,60
Cameroon	355	0,34	0,22	0,58
Bostwana	255	0,51	0,46	0,63
Senegal	255	0,36	0,31	0,79
Madagascar	185	0,55	0,50	0,79
Burkina Faso	167	0,38	0,29	0,72
Côte d'Ivoire	137	0,23	0,03	0,60
Benin	119	0,36	0,35	0,71
Zambia	116	0,32	0,24	0,91
Malawi	111	0,19	-0,24	0,53
Lybian Arab	103	0,32	0,20	0,25
Mali	95	0,41	0,02	0,46
Sudan	94	0,08	-0,33	0,28
Congo	88	0,34	0,57	1,32
Gabon	69	0,30	0,18	1,03
Gambia	15	-0,46	-0,75	0,84

Figure 79. Relative Impact in the context of *environmental sciences*.



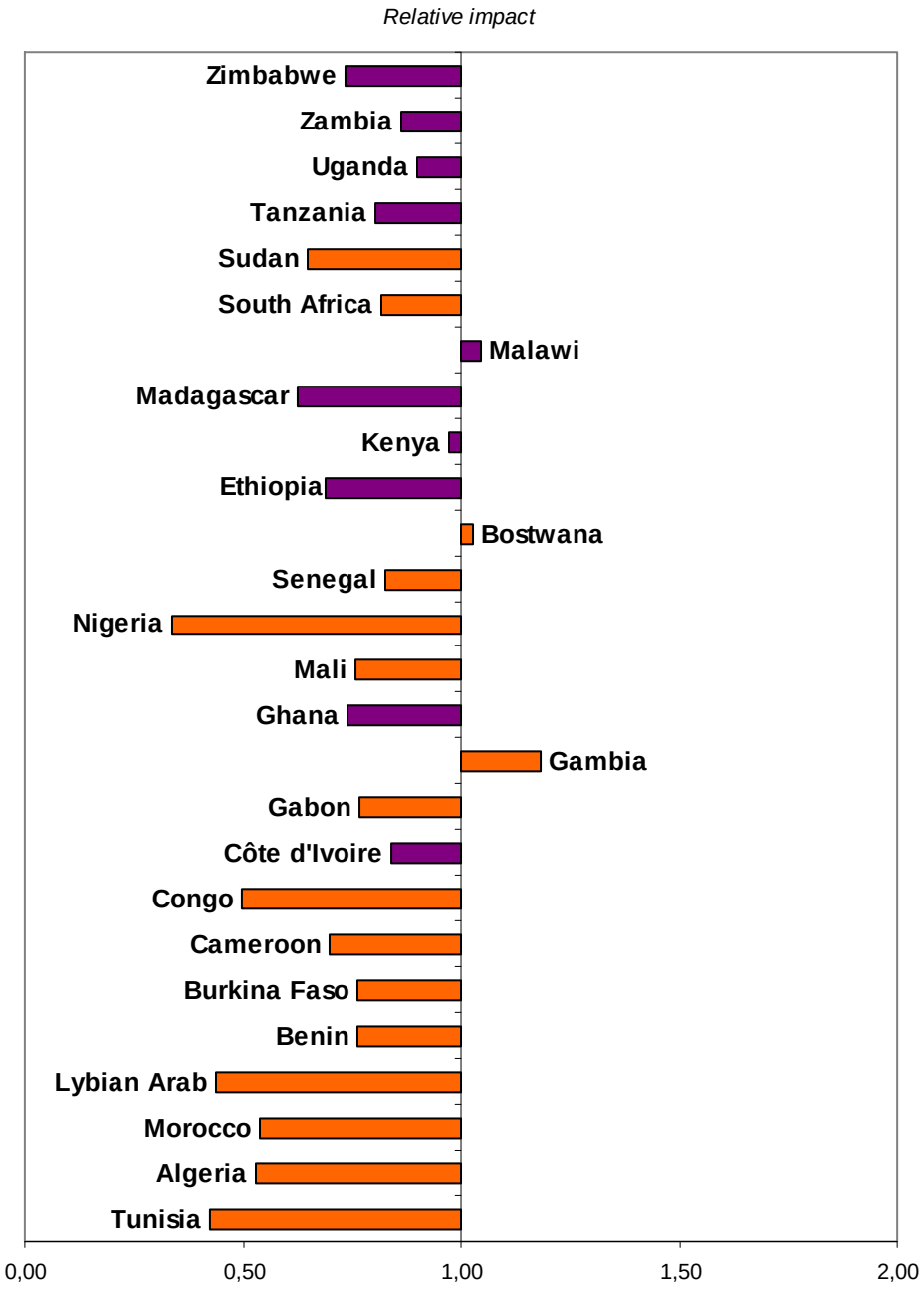
5.14. Immunology and microbiology

Figure 80. Activity and visibility in the context of *immunology and microbiology*.



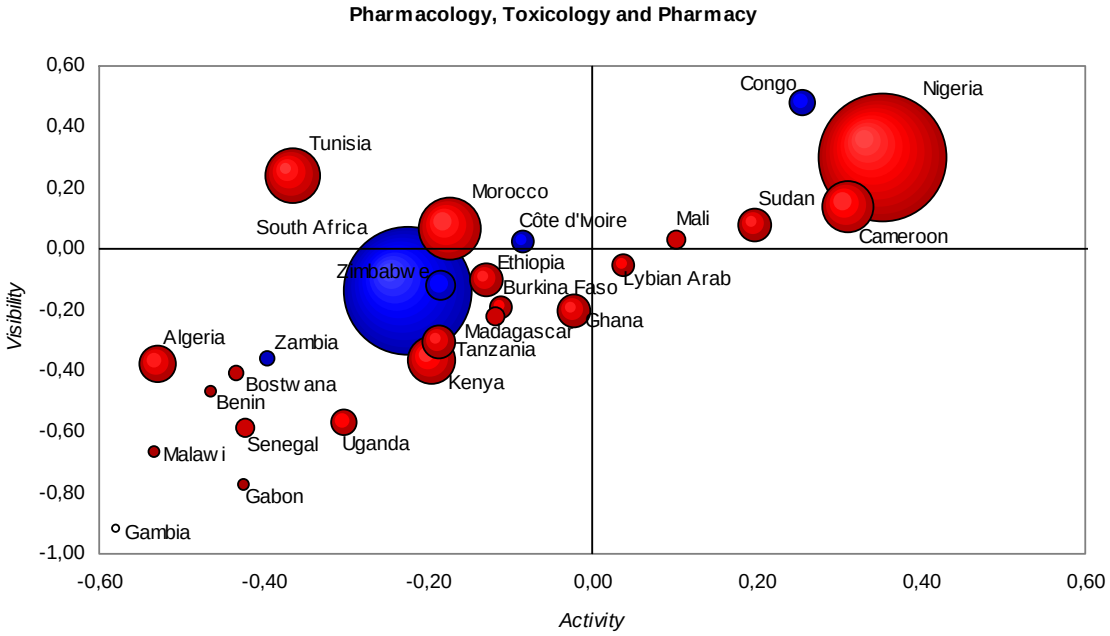
	Doc	RAI	RVI	RI
South Africa	4612	0,29	0,24	0,82
Kenya	2135	0,71	0,67	0,97
Nigeria	1541	0,33	0,28	0,34
Uganda	1111	0,78	0,72	0,90
Tanzania	1100	0,74	0,67	0,80
Tunisia	887	0,12	0,12	0,42
Cameroon	786	0,67	0,65	0,70
Senegal	773	0,76	0,74	0,82
Ghana	666	0,68	0,67	0,74
Malawi	567	0,79	0,75	1,04
Ethiopia	526	0,55	0,53	0,69
Burkina Faso	504	0,77	0,74	0,76
Gambia	495	0,86	0,76	1,18
Zimbabwe	495	0,59	0,51	0,73
Côte d'Ivoire	462	0,72	0,70	0,84
Morocco	452	-0,11	-0,13	0,54
Zambia	441	0,79	0,74	0,86
Sudan	429	0,71	0,71	0,65
Gabon	396	0,85	0,75	0,77
Mali	246	0,75	0,67	0,76
Madagascar	241	0,67	0,56	0,63
Congo	197	0,67	0,56	0,50
Algeria	172	-0,45	-0,33	0,53
Benin	167	0,54	0,56	0,76
Bostwana	130	0,28	0,44	1,03
Lybian Arab	65	0,16	0,30	0,44

Figure 81. Relative Impact in the context of *immunology and microbiology*.



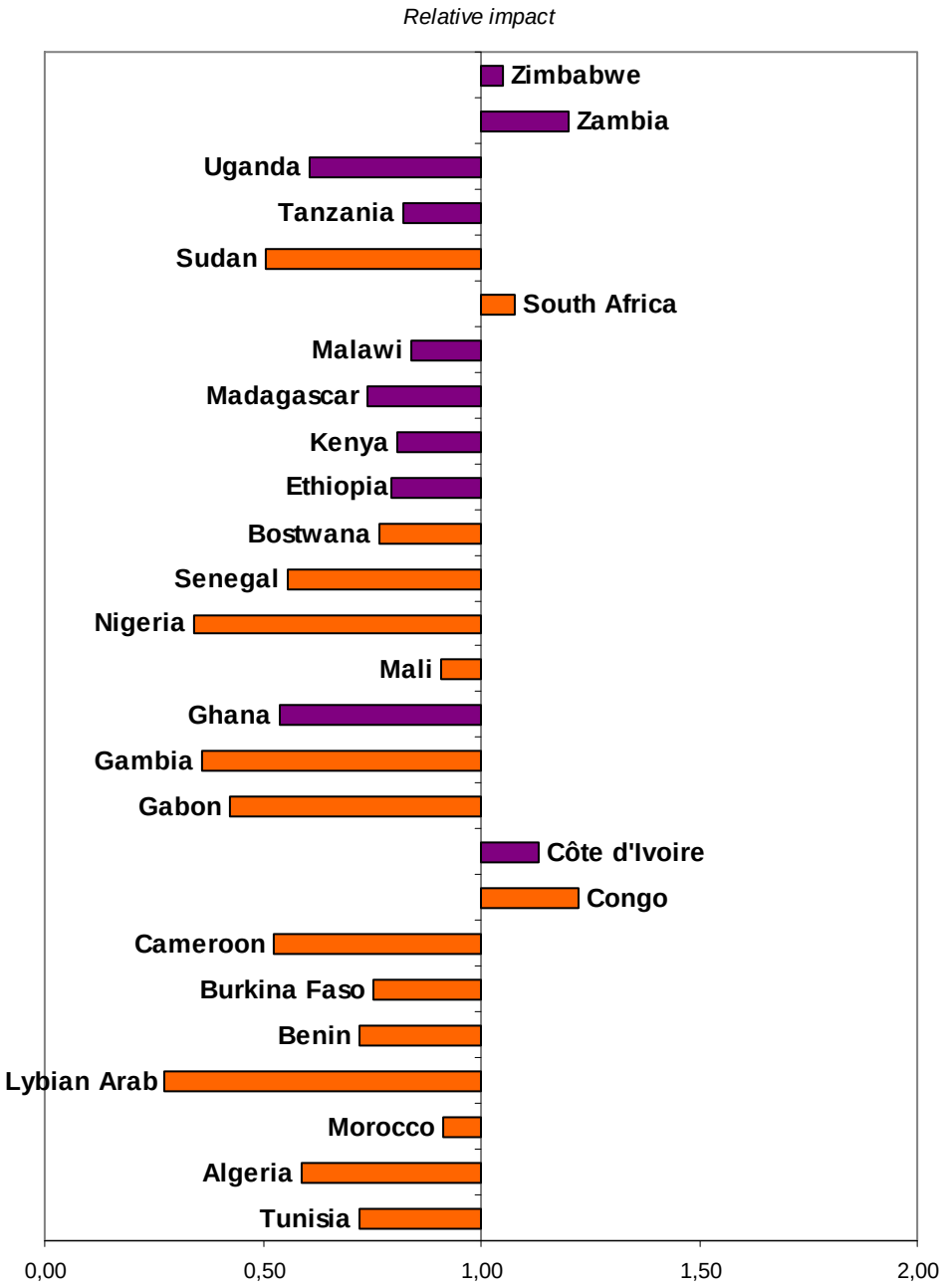
5.15. Pharmacology, toxicology and pharmacy

Figure 82. Activity and visibility in the context of *pharmacology, toxicology and pharmacy.*



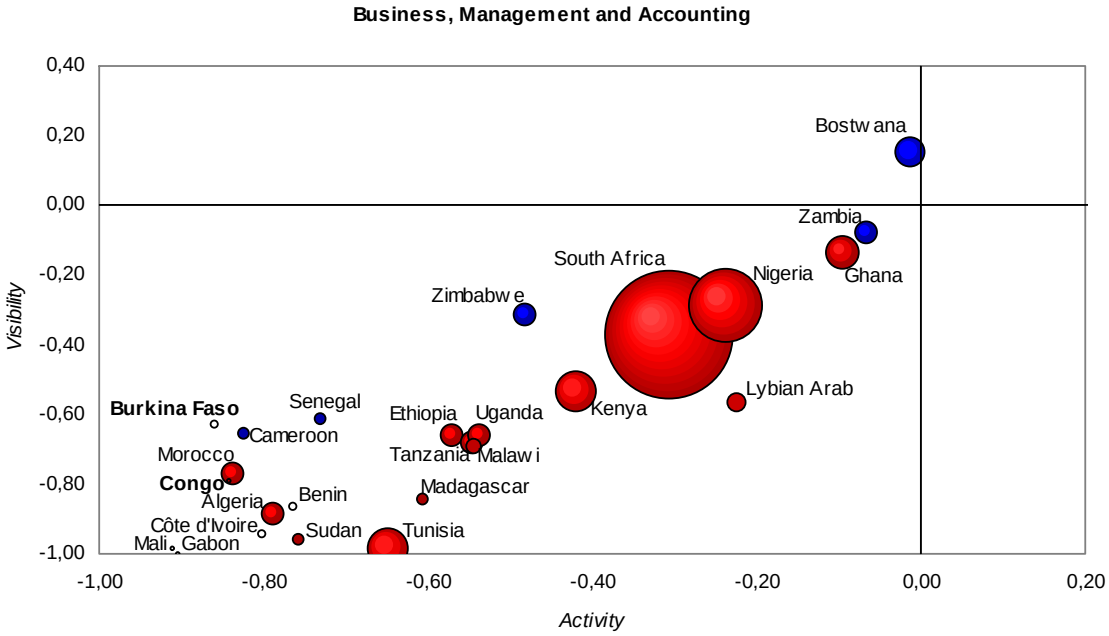
	Doc	RAI	RVI	RI
Nigeria	1348	0,35	0,30	0,34
South Africa	1347	-0,22	-0,14	1,08
Morocco	330	-0,17	0,07	0,91
Tunisia	268	-0,36	0,24	0,72
Cameroon	244	0,31	0,14	0,52
Kenya	199	-0,20	-0,36	0,81
Algeria	115	-0,53	-0,38	0,59
Ghana	100	-0,02	-0,20	0,54
Ethiopia	97	-0,13	-0,10	0,79
Tanzania	93	-0,19	-0,31	0,82
Sudan	89	0,20	0,08	0,51
Zimbabwe	73	-0,18	-0,12	1,05
Uganda	61	-0,30	-0,57	0,61
Congo	54	0,25	0,48	1,22
Côte d'Ivoire	53	-0,09	0,03	1,13
Burkina Faso	44	-0,11	-0,19	0,75
Lybian Arab	42	0,04	-0,05	0,28
Senegal	36	-0,42	-0,59	0,56
Mali	36	0,10	0,03	0,91
Madagascar	31	-0,12	-0,22	0,74
Bostwana	24	-0,43	-0,41	0,77
Zambia	19	-0,40	-0,36	1,20
Malawi	17	-0,53	-0,66	0,84
Benin	15	-0,46	-0,47	0,72
Gabon	11	-0,43	-0,77	0,42
Gambia	8	-0,58	-0,92	0,36

Figure 83. Relative Impact in the context of *pharmacology, toxicology and pharmacy*.



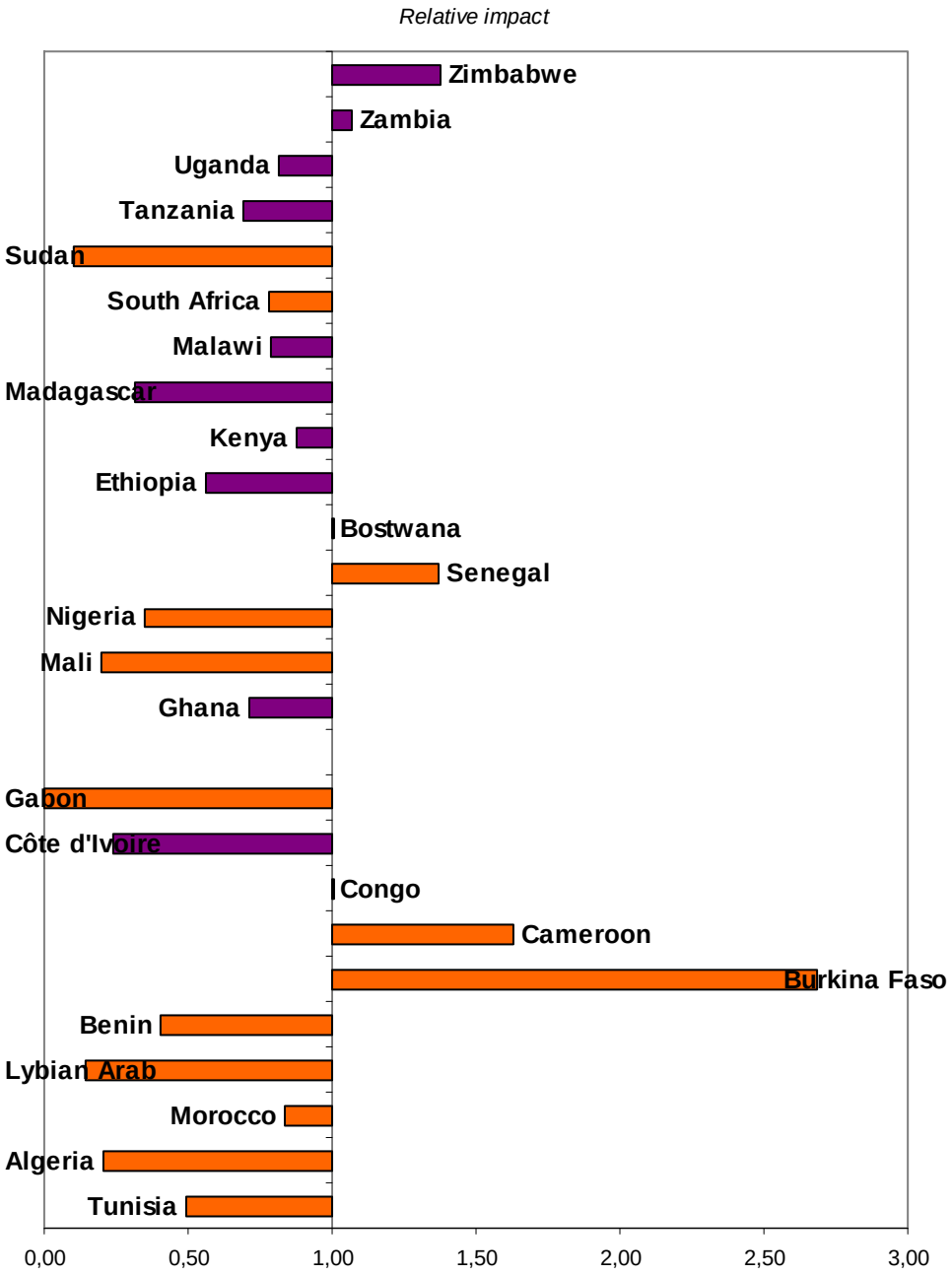
5.16. Business management and accounting

Figure 84. Activity and visibility in the context of *business management and accounting.*



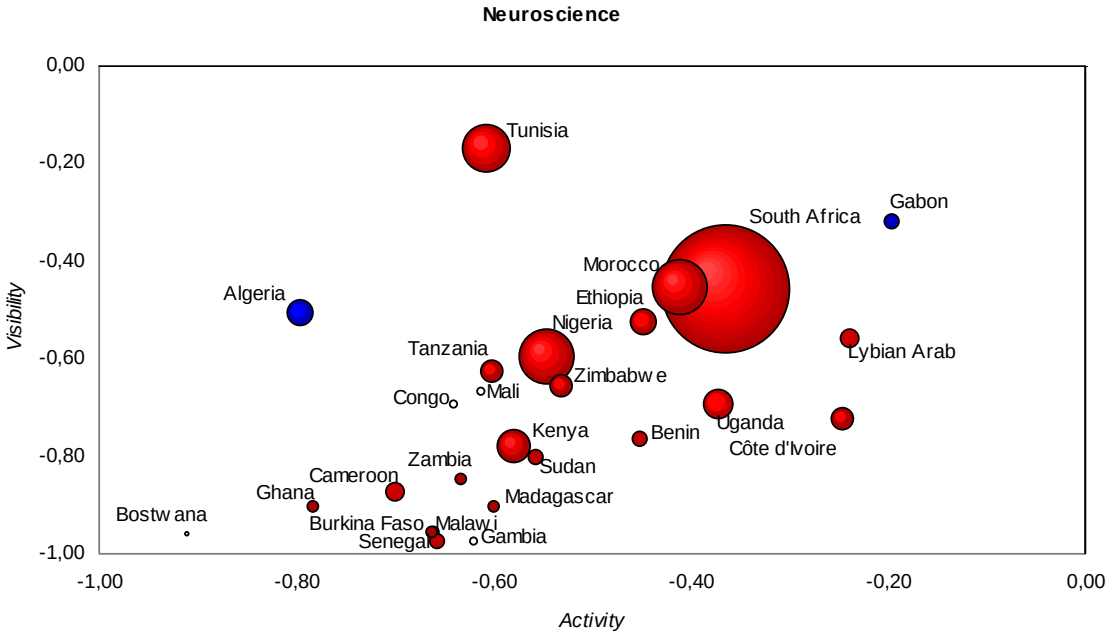
	Doc	RAI	RVI	RI
South Africa	820	-0,31	-0,37	0,78
Nigeria	288	-0,24	-0,28	0,35
Tunisia	89	-0,65	-0,99	0,49
Kenya	88	-0,42	-0,53	0,87
Ghana	63	-0,10	-0,14	0,72
Bostwana	43	-0,01	0,15	1,01
Algeria	32	-0,79	-0,89	0,21
Morocco	30	-0,84	-0,77	0,84
Tanzania	29	-0,55	-0,68	0,69
Zambia	28	-0,07	-0,08	1,07
Zimbabwe	27	-0,48	-0,31	1,38
Ethiopia	25	-0,57	-0,66	0,56
Uganda	25	-0,54	-0,66	0,81
Lybian Arab	18	-0,22	-0,56	0,15
Malawi	12	-0,54	-0,69	0,79
Senegal	10	-0,73	-0,61	1,37
Cameroon	9	-0,82	-0,66	1,63
Madagascar	7	-0,61	-0,84	0,32
Sudan	6	-0,76	-0,96	0,10
Côte d'Ivoire	5	-0,80	-0,94	0,24
Benin	4	-0,76	-0,86	0,40
Burkina Faso	3	-0,86	-0,63	2,68
Congo	2	-0,84	-0,79	1,01
Mali	1	-0,91	-0,98	0,20
Gabon	1	-0,90	-1,00	0,00
Gambia	0	-1,00	-1,00	

Figure 85. Relative Impact in the context of *business management and accounting*.



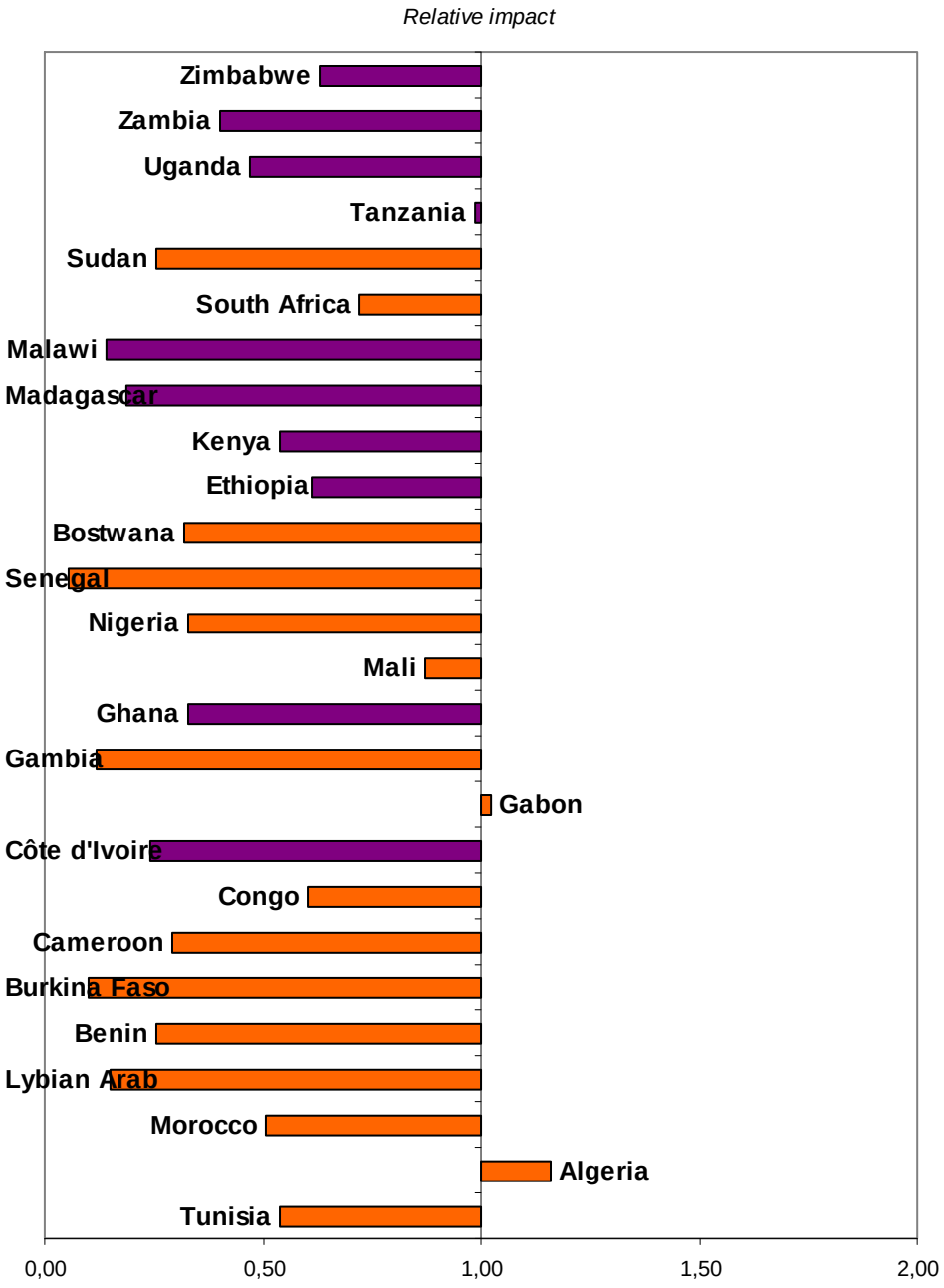
5.17. Neurosciences

Figure 86. Activity and visibility in the context of *neurosciences.*



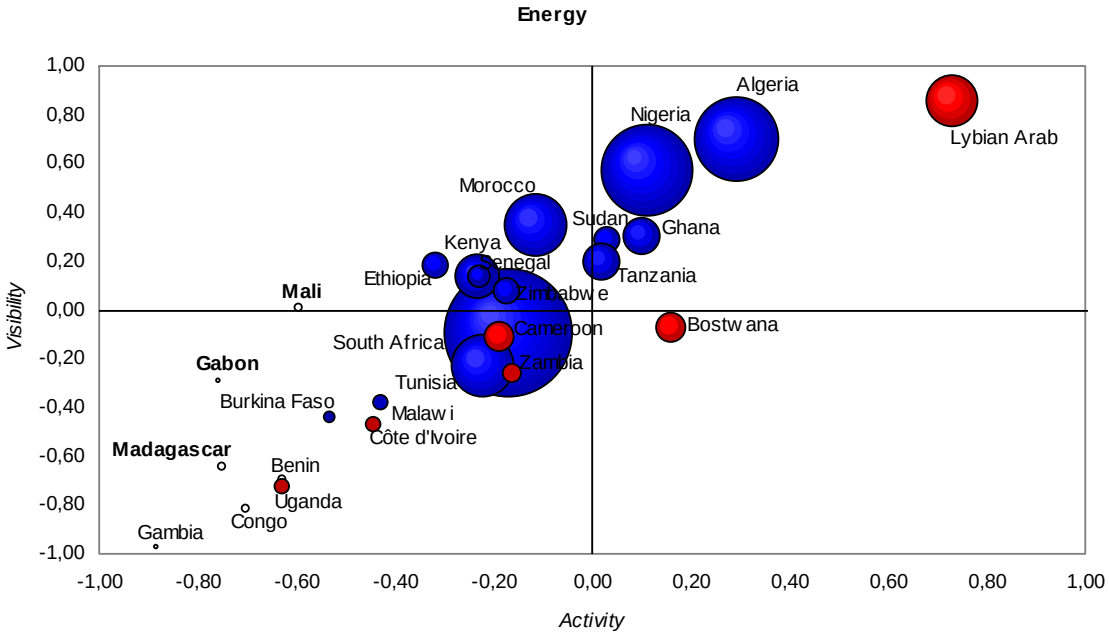
	Doc	RAI	RVI	RI
South Africa	703	-0,36	-0,46	0,72
Morocco	139	-0,41	-0,45	0,51
Nigeria	134	-0,55	-0,60	0,33
Tunisia	100	-0,61	-0,17	0,54
Kenya	56	-0,58	-0,78	0,54
Uganda	37	-0,37	-0,69	0,47
Ethiopia	34	-0,45	-0,52	0,61
Algeria	30	-0,80	-0,51	1,16
Côte d'Ivoire	27	-0,25	-0,72	0,24
Tanzania	24	-0,60	-0,62	0,99
Zimbabwe	23	-0,53	-0,65	0,63
Lybian Arab	17	-0,24	-0,56	0,15
Cameroon	16	-0,70	-0,87	0,29
Gabon	13	-0,20	-0,32	1,02
Senegal	13	-0,66	-0,98	0,05
Sudan	12	-0,56	-0,80	0,25
Benin	11	-0,45	-0,76	0,26
Ghana	9	-0,78	-0,90	0,33
Malawi	8	-0,66	-0,96	0,14
Burkina Faso	8	-0,66	-0,95	0,10
Zambia	7	-0,63	-0,85	0,40
Madagascar	7	-0,60	-0,90	0,19
Mali	5	-0,61	-0,67	0,87
Congo	5	-0,64	-0,69	0,60
Gambia	5	-0,62	-0,98	0,12
Bostwana	2	-0,91	-0,96	0,32

Figure 87. Relative Impact in the context of *neurosciences*.



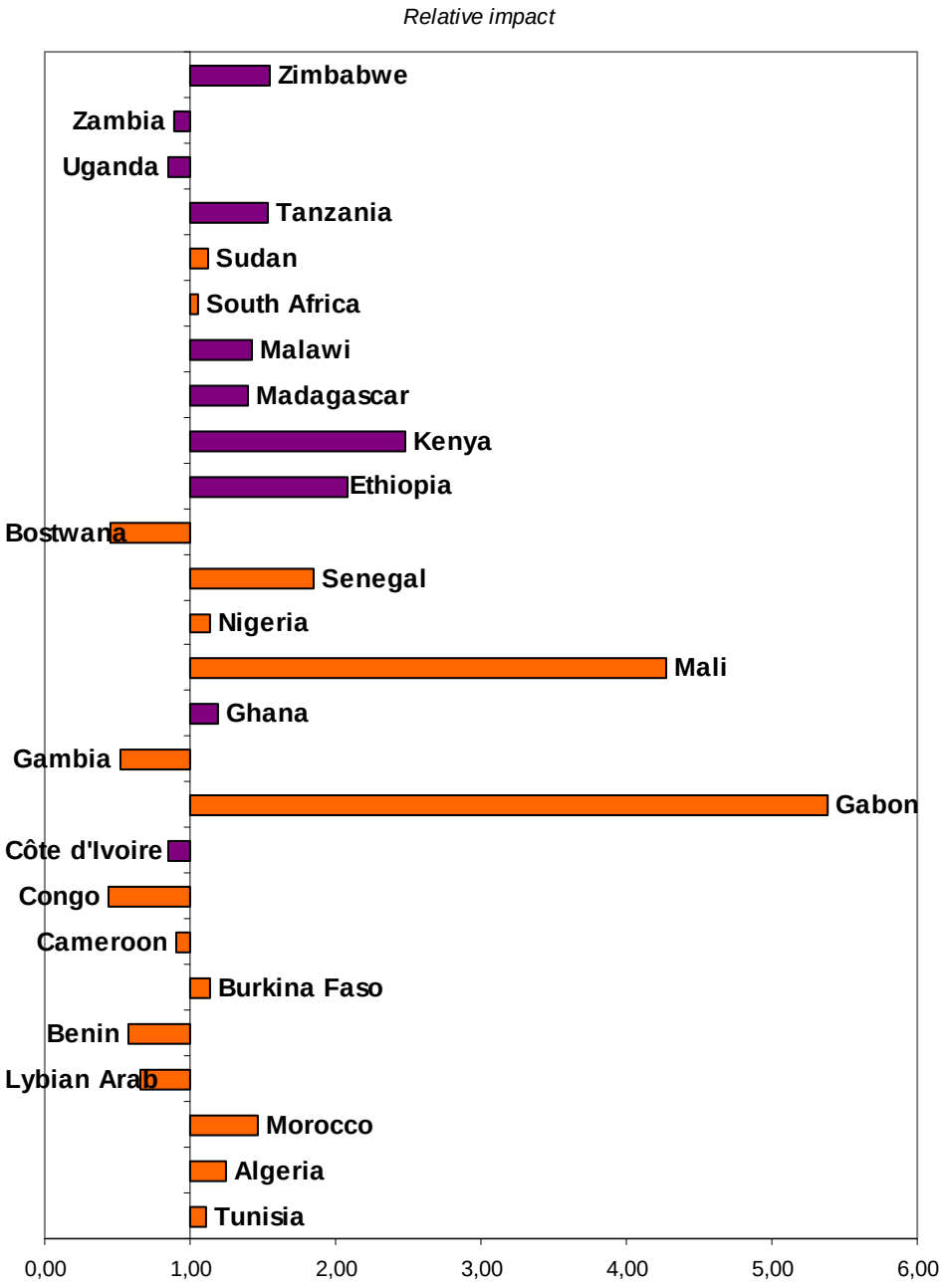
5.18. Energy

Figure 88. Activity and visibility in the context of *energy.*



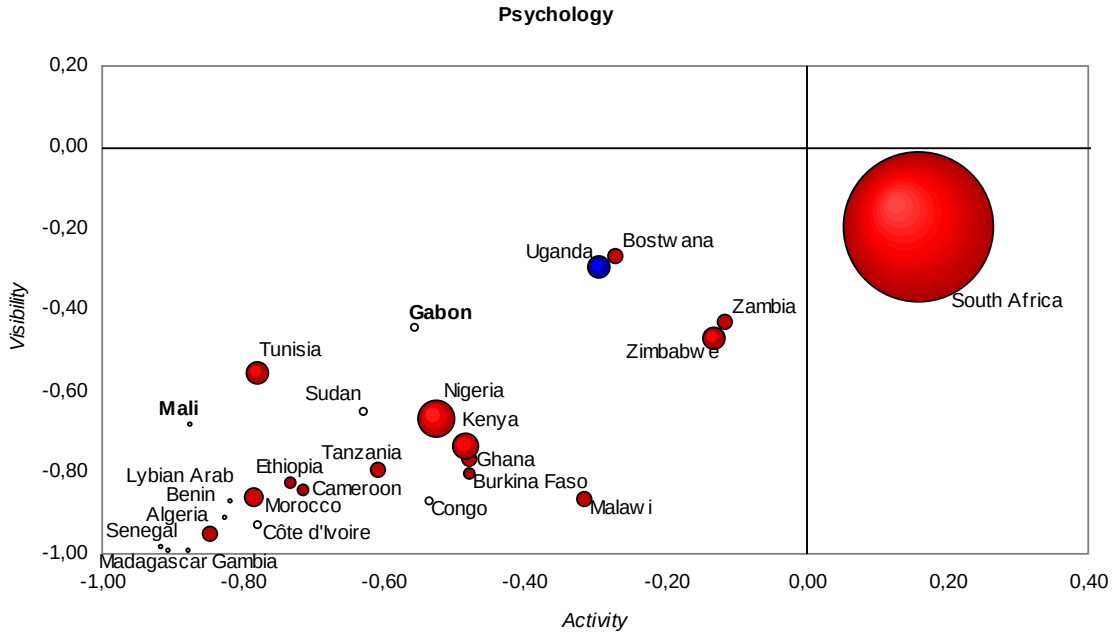
	Doc	RAI	RVI	RI
South Africa	812	-0,17	-0,09	1,06
Nigeria	433	0,11	0,58	1,14
Algeria	368	0,29	0,70	1,25
Morocco	201	-0,11	0,35	1,47
Tunisia	197	-0,22	-0,23	1,11
Lybian Arab	134	0,73	0,85	0,66
Kenya	99	-0,23	0,14	2,49
Tanzania	76	0,02	0,20	1,54
Ghana	69	0,10	0,30	1,19
Cameroon	47	-0,19	-0,11	0,90
Bostwana	45	0,16	-0,07	0,46
Zimbabwe	40	-0,18	0,08	1,54
Ethiopia	35	-0,32	0,18	2,08
Sudan	34	0,03	0,29	1,12
Senegal	30	-0,23	0,14	1,85
Zambia	17	-0,16	-0,26	0,90
Uganda	14	-0,63	-0,72	0,85
Côte d'Ivoire	13	-0,45	-0,47	0,85
Malawi	12	-0,43	-0,38	1,42
Burkina Faso	9	-0,53	-0,44	1,14
Benin	5	-0,63	-0,69	0,58
Mali	4	-0,60	0,01	4,27
Madagascar	3	-0,75	-0,64	1,40
Congo	3	-0,70	-0,81	0,44
Gabon	2	-0,76	-0,29	5,39
Gambia	1	-0,88	-0,97	0,53

Figure 89. Relative Impact in the context of *energy*.



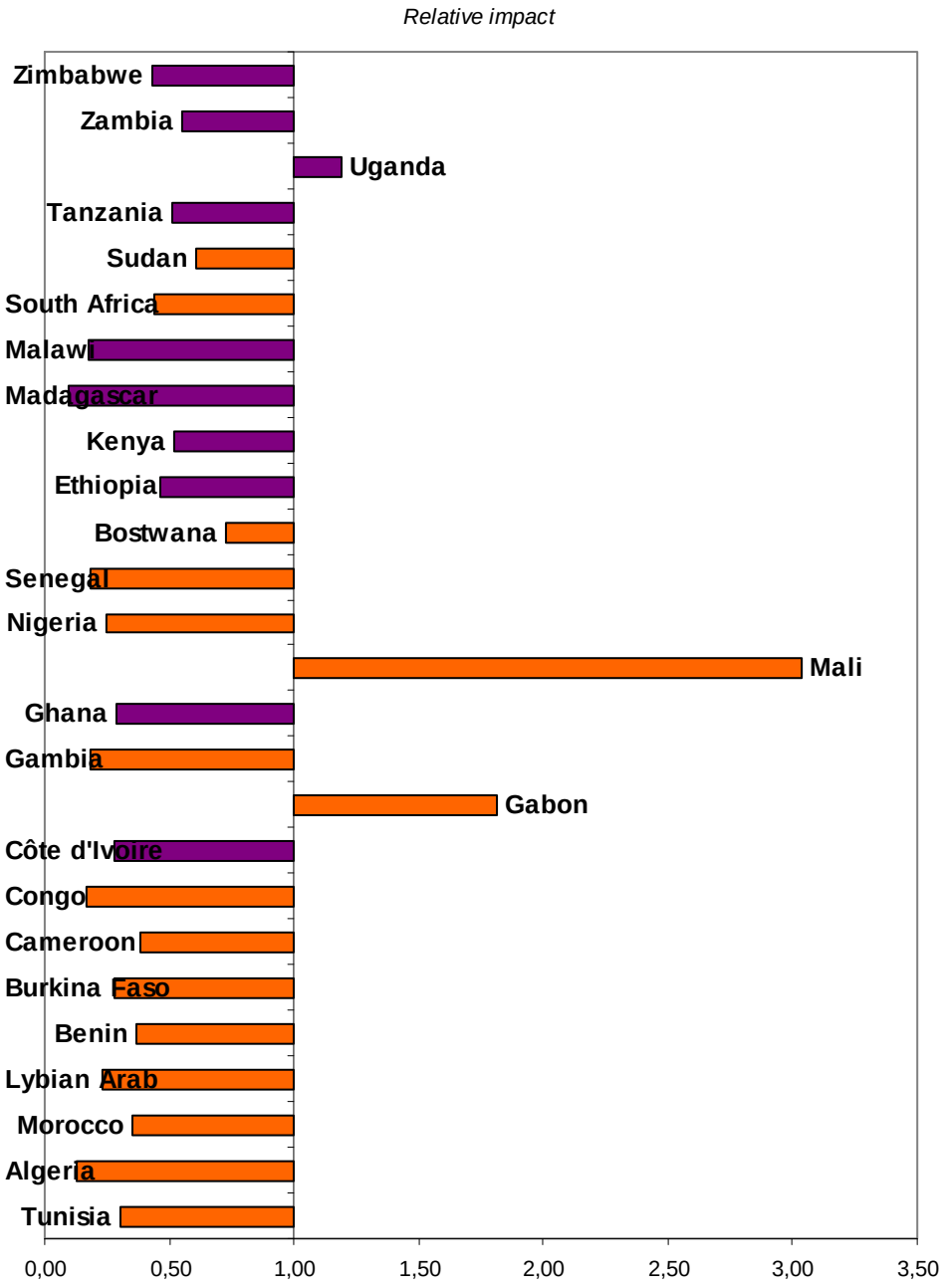
5.19. Pyschology

Figure 90. Activity and visibility in the context of *psychology*.



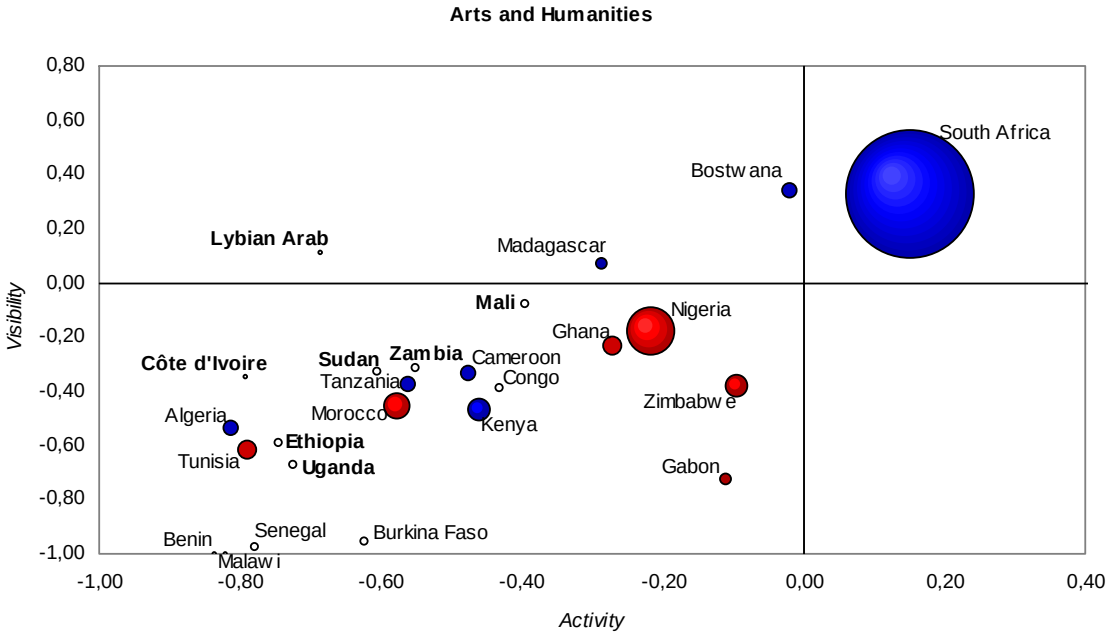
	Doc	RAI	RVI	RI
South Africa	1516	0,16	-0,19	0,44
Nigeria	103	-0,53	-0,67	0,25
Kenya	53	-0,48	-0,73	0,52
Zimbabwe	42	-0,13	-0,47	0,43
Tunisia	37	-0,78	-0,55	0,31
Uganda	32	-0,30	-0,29	1,19
Morocco	29	-0,79	-0,86	0,36
Ghana	19	-0,48	-0,77	0,29
Zambia	18	-0,12	-0,43	0,55
Bostwana	18	-0,27	-0,27	0,73
Tanzania	17	-0,61	-0,79	0,51
Algeria	16	-0,85	-0,95	0,13
Malawi	15	-0,31	-0,86	0,18
Cameroon	11	-0,71	-0,84	0,38
Ethiopia	10	-0,73	-0,83	0,46
Burkina Faso	10	-0,48	-0,80	0,28
Sudan	7	-0,63	-0,65	0,60
Congo	5	-0,54	-0,87	0,17
Côte d'Ivoire	4	-0,78	-0,93	0,28
Gabon	4	-0,56	-0,44	1,82
Benin	2	-0,83	-0,91	0,37
Lybian Arab	2	-0,82	-0,87	0,23
Senegal	2	-0,92	-0,98	0,18
Mali	1	-0,88	-0,68	3,04
Gambia	1	-0,88	-0,99	0,18
Madagascar	1	-0,91	-0,99	0,09

Figure 91. Relative Impact in the context of *psychology*.



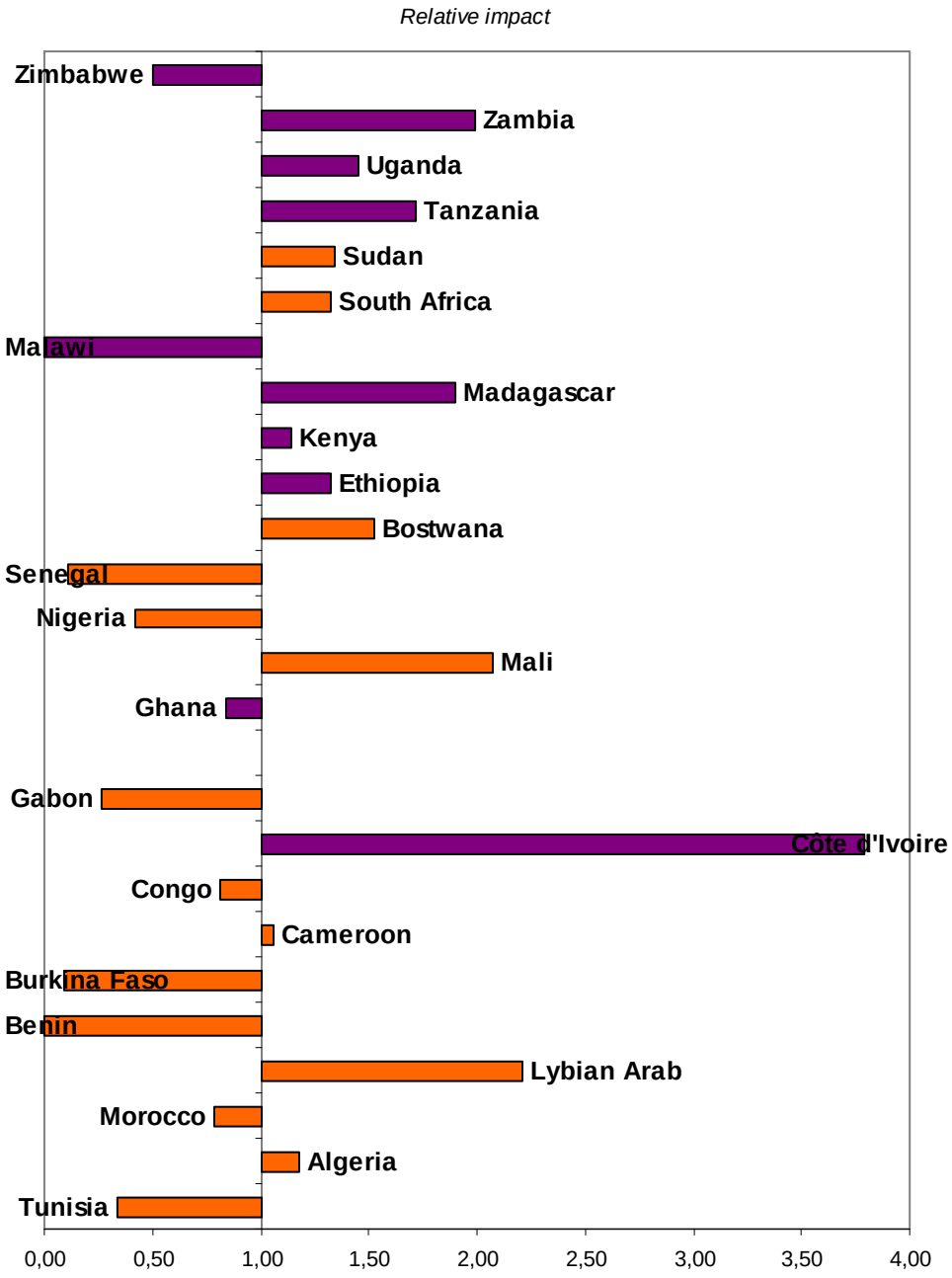
5.20. Arts and humanities

Figure 92. Activity and visibility in the context of *arts and humanities*.



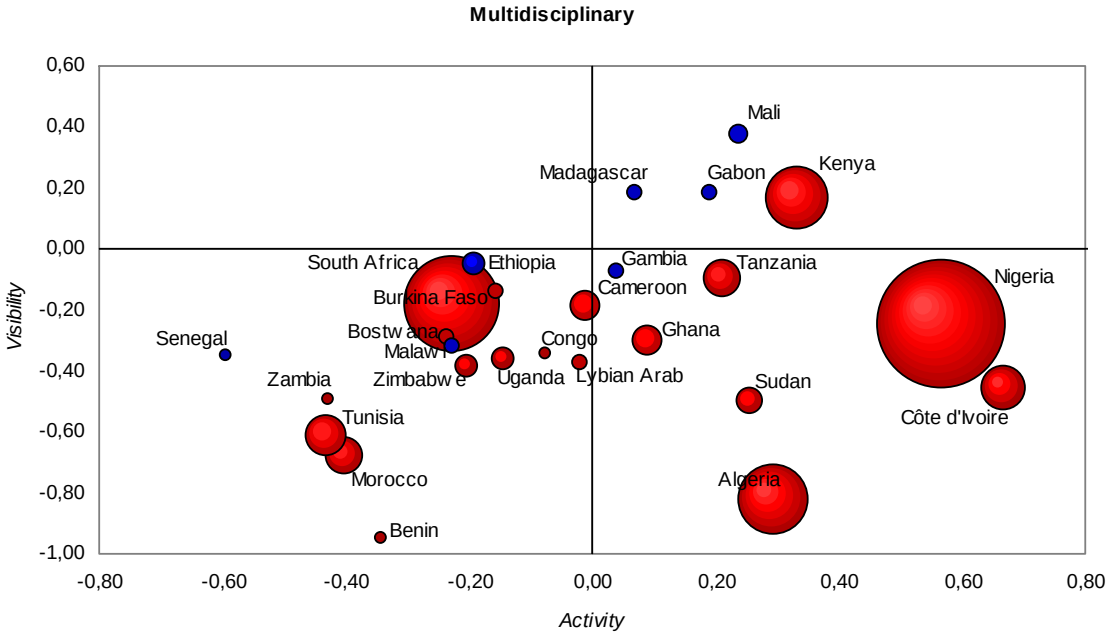
	Doc	RAI	RVI	RI
South Africa	1583	0,15	0,33	1,32
Nigeria	227	-0,22	-0,18	0,42
Morocco	69	-0,58	-0,45	0,79
Kenya	60	-0,46	-0,47	1,14
Zimbabwe	48	-0,10	-0,38	0,50
Tunisia	37	-0,79	-0,62	0,34
Ghana	33	-0,27	-0,23	0,84
Bostwana	32	-0,02	0,34	1,52
Cameroon	25	-0,48	-0,33	1,06
Tanzania	21	-0,56	-0,37	1,72
Algeria	21	-0,81	-0,54	1,17
Madagascar	12	-0,29	0,07	1,90
Gabon	12	-0,11	-0,73	0,26
Uganda	10	-0,72	-0,67	1,45
Ethiopia	10	-0,75	-0,59	1,33
Sudan	8	-0,61	-0,33	1,34
Mali	7	-0,39	-0,08	2,08
Zambia	7	-0,55	-0,31	1,99
Congo	7	-0,43	-0,39	0,81
Burkina Faso	7	-0,62	-0,95	0,09
Senegal	6	-0,78	-0,97	0,11
Côte d'Ivoire	4	-0,79	-0,35	3,79
Lybian Arab	4	-0,69	0,11	2,21
Malawi	3	-0,82	-1,00	0,00
Benin	2	-0,84	-1,00	0,00
Gambia	0	-1,00	-1,00	

Figure 93. Relative Impact in the context of *arts and humanities*.



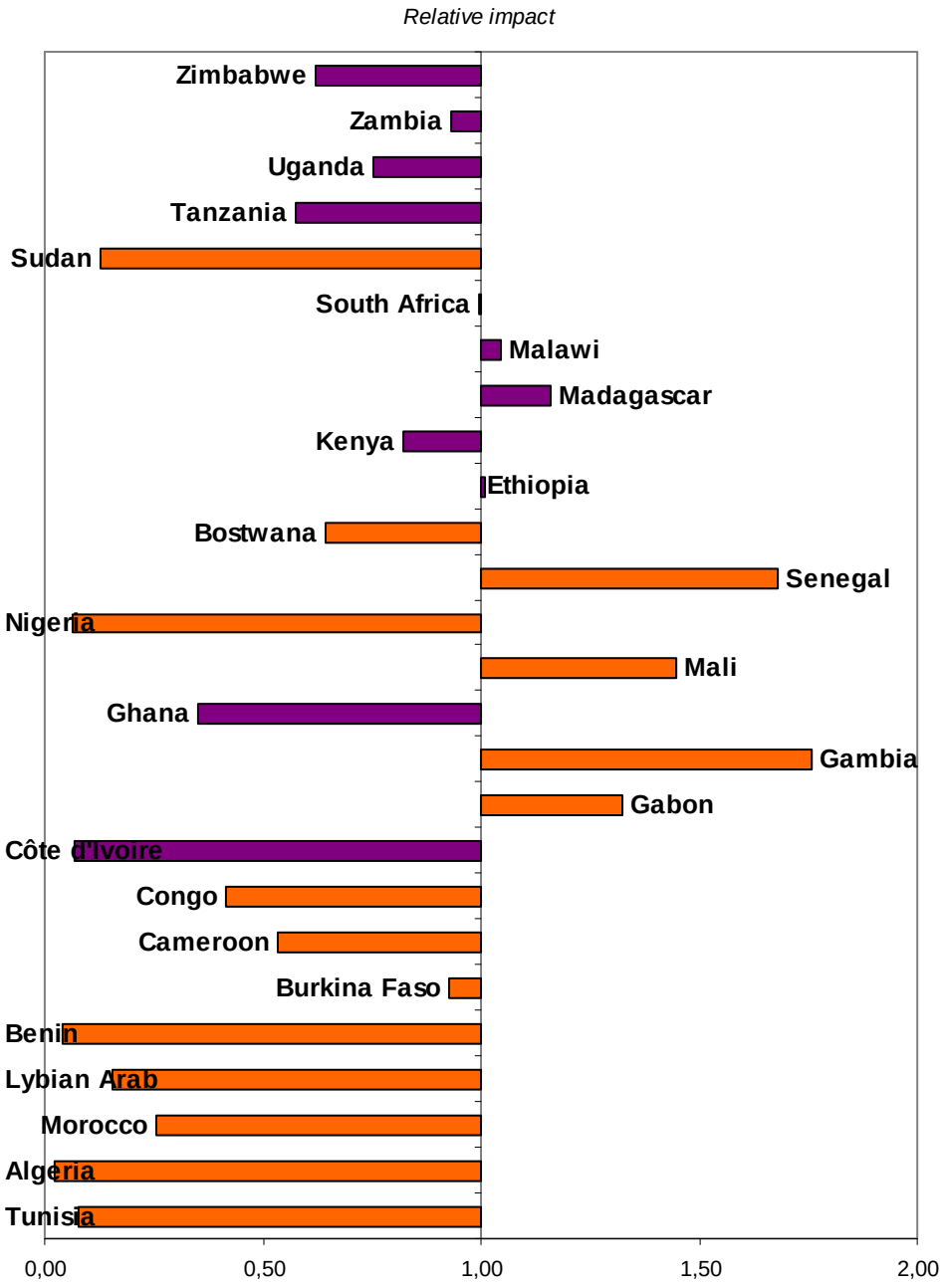
5.21. Multidisciplinary

Figure 94. Activity and visibility in the context of *multidisciplinary research.*



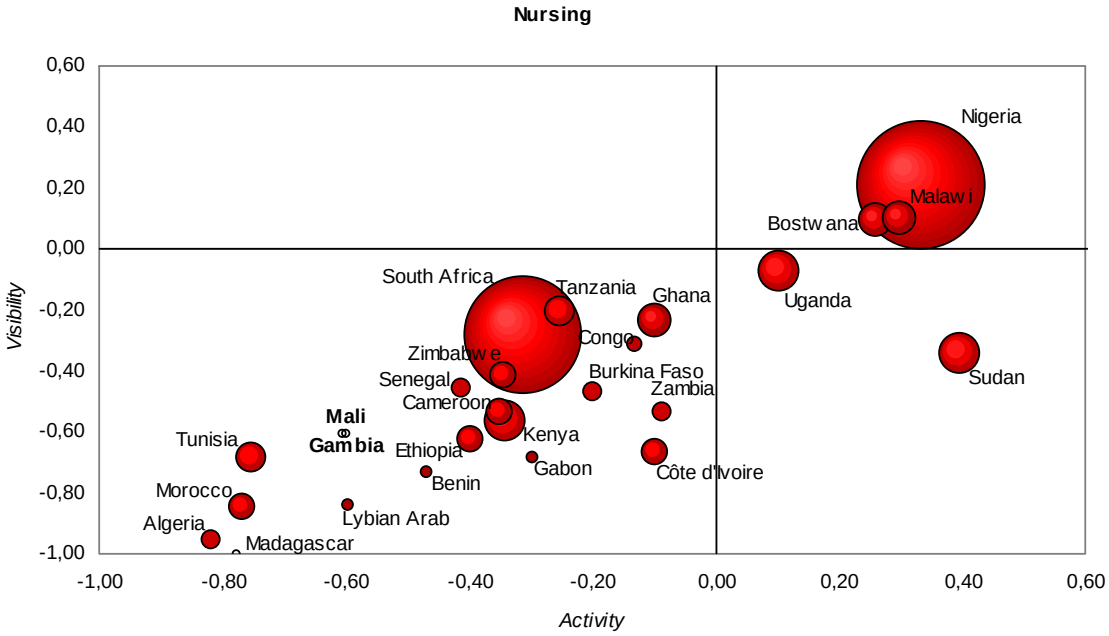
	Doc	RAI	RVI	RI
Nigeria	924	0,56	-0,24	0,06
South Africa	535	-0,23	-0,18	0,99
Algeria	274	0,29	-0,82	0,02
Kenya	236	0,33	0,17	0,82
Côte d'Ivoire	126	0,67	-0,46	0,07
Tunisia	91	-0,43	-0,61	0,08
Tanzania	83	0,21	-0,09	0,58
Morocco	80	-0,40	-0,68	0,25
Cameroon	50	-0,01	-0,18	0,53
Ghana	50	0,09	-0,30	0,35
Sudan	40	0,25	-0,50	0,13
Ethiopia	34	-0,19	-0,04	1,01
Uganda	34	-0,15	-0,36	0,75
Zimbabwe	28	-0,20	-0,38	0,62
Mali	19	0,24	0,38	1,45
Madagascar	18	0,07	0,19	1,16
Gabon	16	0,19	0,19	1,33
Burkina Faso	16	-0,16	-0,14	0,92
Bostwana	15	-0,24	-0,29	0,65
Lybian Arab	15	-0,02	-0,37	0,16
Malawi	14	-0,23	-0,32	1,04
Gambia	13	0,04	-0,07	1,76
Congo	11	-0,08	-0,34	0,42
Senegal	9	-0,59	-0,35	1,68
Benin	8	-0,34	-0,95	0,04
Zambia	7	-0,43	-0,49	0,93

Figure 95. Relative Impact in the context of *multidisciplinary research*.



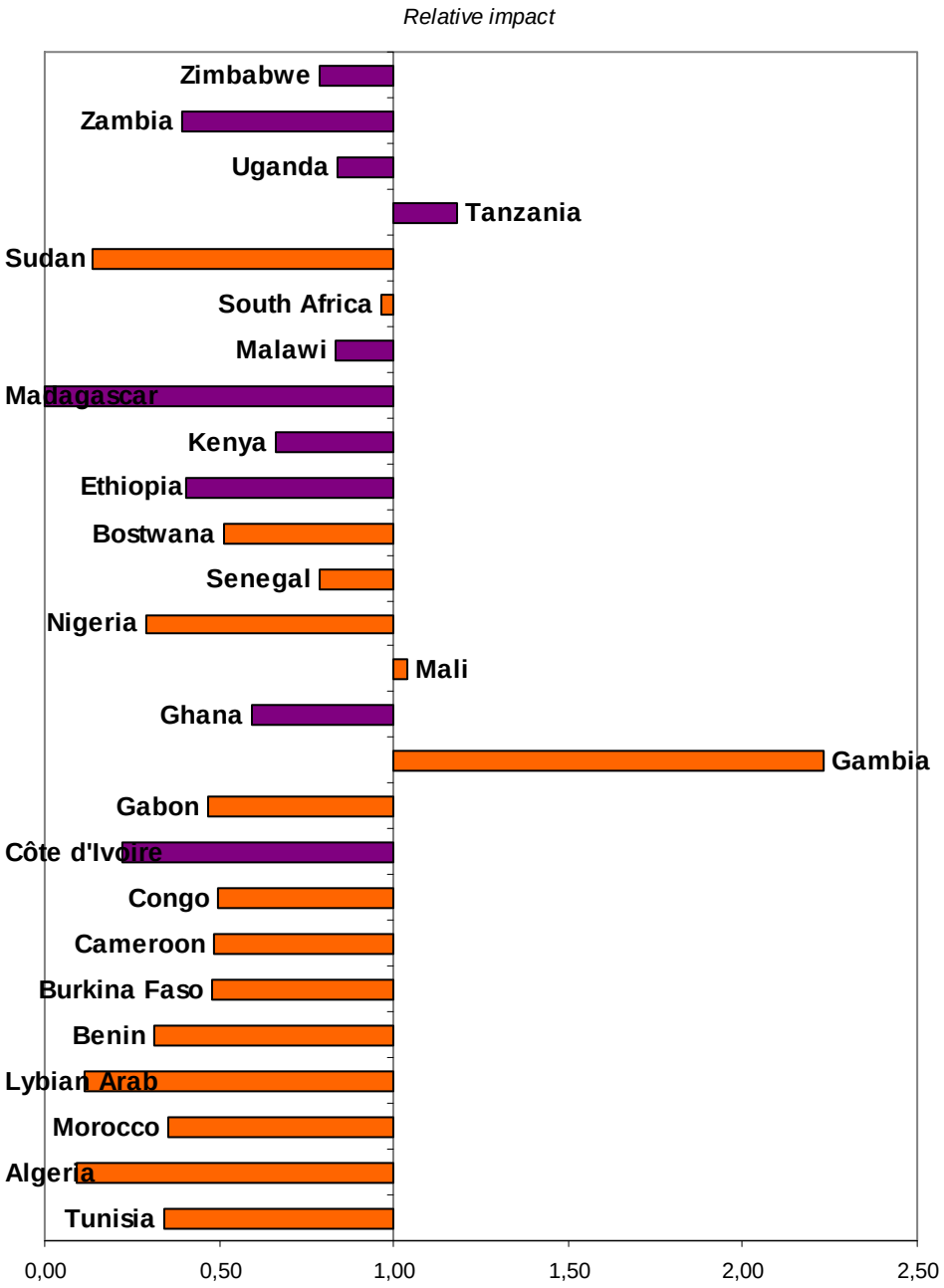
5.22. Nursing

Figure 96. Activity and visibility in the context of *nursing*.



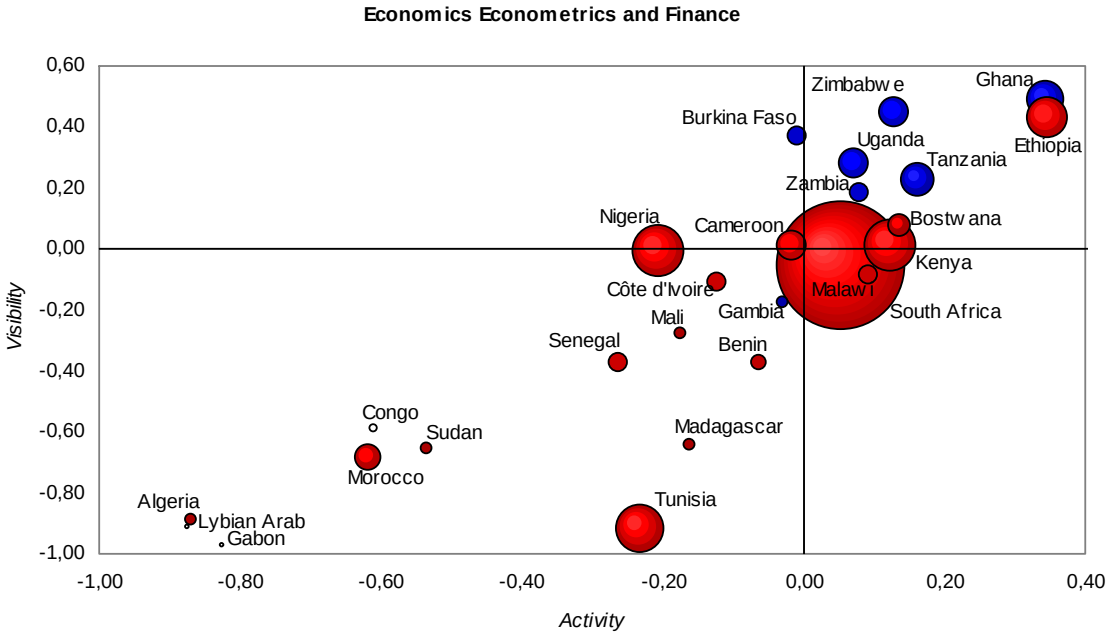
	Doc	RAI	RVI	RI
Nigeria	522	0,33	0,21	0,29
South Africa	453	-0,31	-0,28	0,96
Kenya	59	-0,34	-0,56	0,66
Uganda	57	0,10	-0,07	0,84
Sudan	56	0,40	-0,34	0,14
Malawi	42	0,30	0,10	0,83
Bostwana	42	0,26	0,10	0,52
Ghana	35	-0,10	-0,23	0,59
Tanzania	33	-0,25	-0,20	1,18
Tunisia	33	-0,75	-0,69	0,34
Cameroon	25	-0,35	-0,53	0,49
Morocco	25	-0,77	-0,85	0,35
Ethiopia	22	-0,40	-0,62	0,40
Zimbabwe	21	-0,34	-0,41	0,79
Côte d'Ivoire	21	-0,10	-0,67	0,22
Senegal	15	-0,41	-0,46	0,79
Burkina Faso	15	-0,20	-0,47	0,48
Zambia	15	-0,09	-0,54	0,39
Algeria	15	-0,82	-0,95	0,09
Congo	10	-0,13	-0,31	0,50
Gabon	6	-0,30	-0,68	0,47
Benin	6	-0,47	-0,73	0,31
Lybian Arab	4	-0,60	-0,84	0,12
Gambia	3	-0,61	-0,60	2,23
Mali	3	-0,60	-0,60	1,04
Madagascar	2	-0,78	-1,00	0,00

Figure 97. Relative Impact in the context of *nursing*.



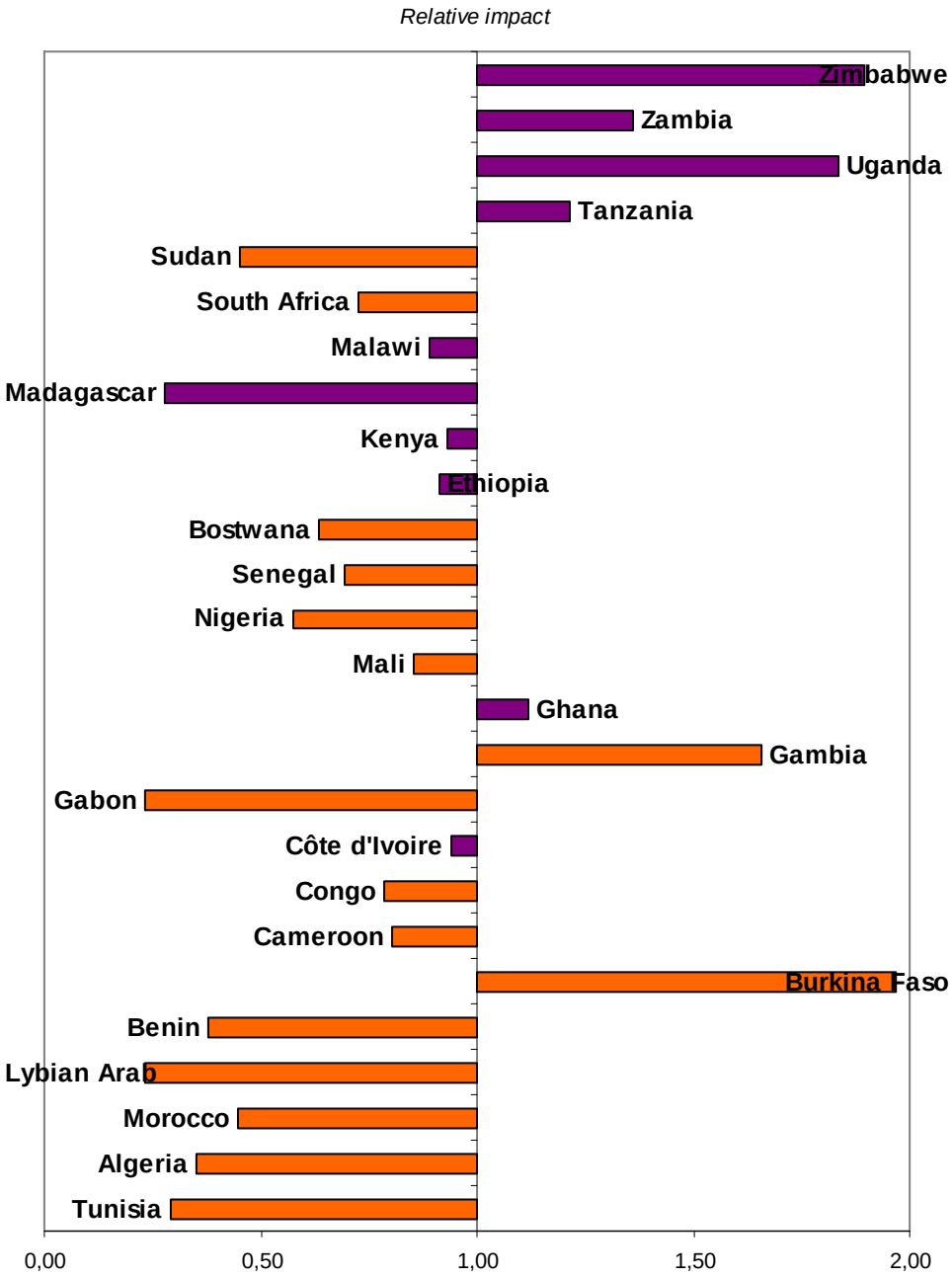
5.23. Economy, econometrics and finance

Figure 98. Activity and visibility in the context of *economy, econometrics and finance*.



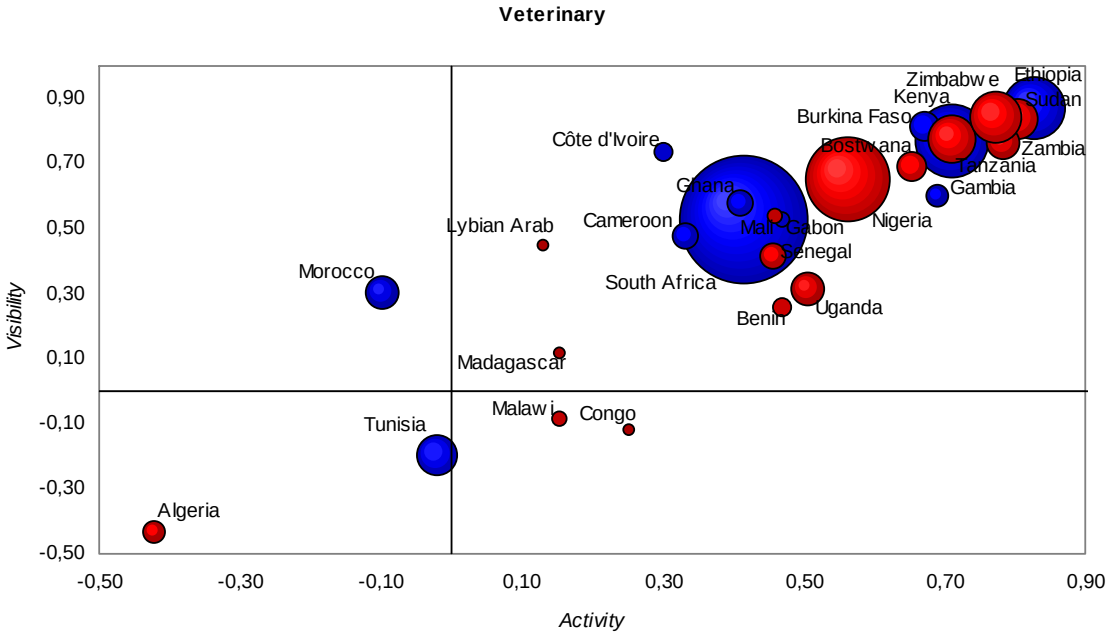
	Doc	RAI	RVI	RI
South Africa	917	0,05	-0,06	0,73
Nigeria	164	-0,21	-0,01	0,57
Kenya	147	0,12	0,01	0,93
Tunisia	139	-0,23	-0,92	0,29
Ethiopia	100	0,34	0,43	0,91
Ghana	83	0,34	0,49	1,12
Tanzania	73	0,16	0,23	1,22
Zimbabwe	53	0,13	0,45	1,89
Uganda	51	0,07	0,28	1,84
Cameroon	48	-0,02	0,01	0,80
Morocco	43	-0,62	-0,68	0,45
Bostwana	31	0,14	0,08	0,64
Malawi	26	0,09	-0,08	0,89
Burkina Faso	21	-0,01	0,37	1,97
Zambia	20	0,08	0,19	1,36
Senegal	20	-0,26	-0,37	0,69
Côte d'Ivoire	19	-0,12	-0,11	0,94
Benin	14	-0,06	-0,37	0,38
Madagascar	11	-0,16	-0,64	0,28
Gambia	11	-0,03	-0,17	1,66
Algeria	10	-0,87	-0,89	0,35
Mali	8	-0,17	-0,27	0,85
Sudan	7	-0,53	-0,65	0,45
Congo	3	-0,61	-0,59	0,78
Gabon	1	-0,83	-0,97	0,23
Lybian Arab	1	-0,88	-0,91	0,23

Figure 99. Relative Impact in the context of *economy, econometrics and finance*.



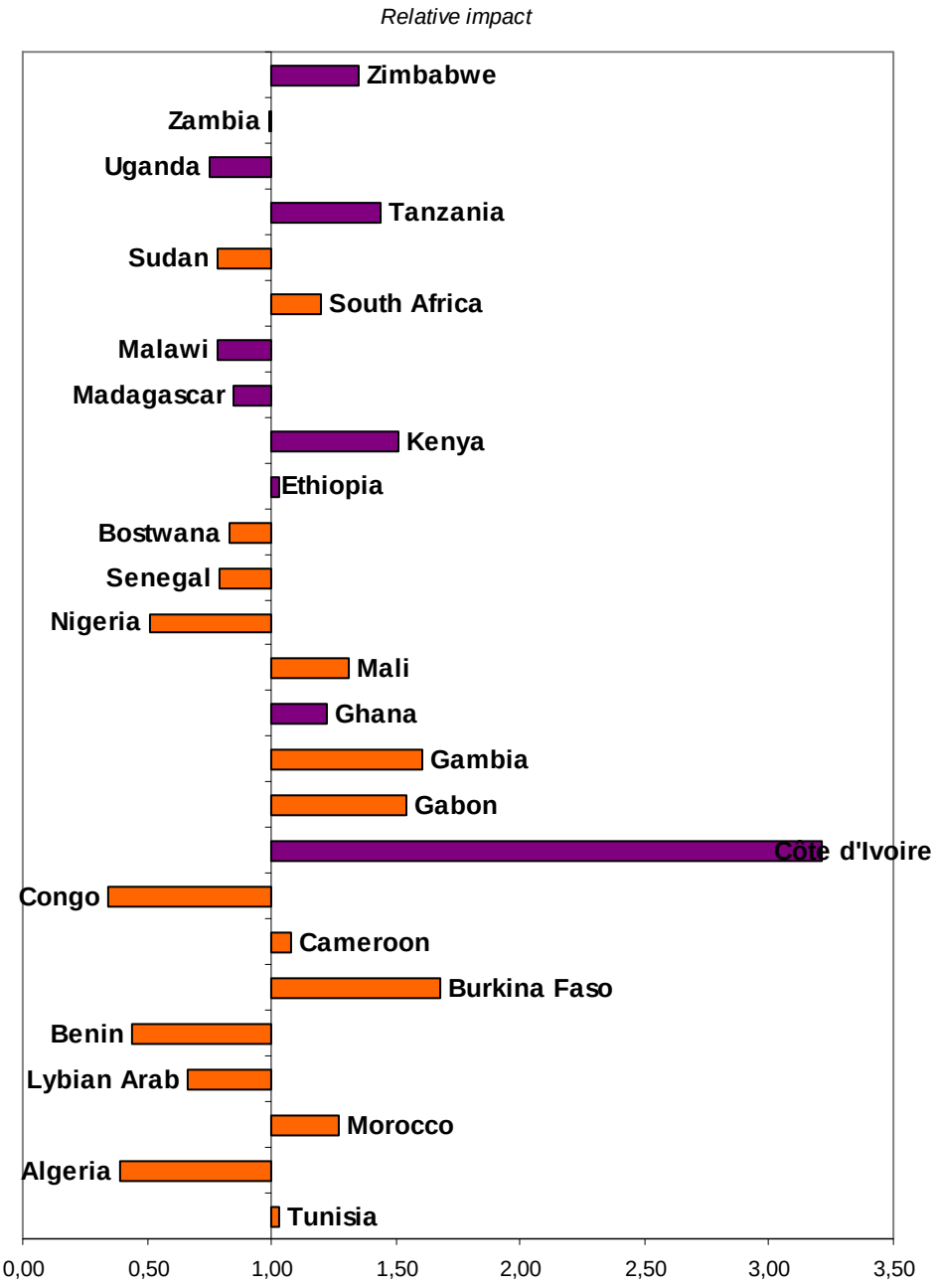
5.24. Veterinary

Figure 100. Activity and visibility in the context of *veterinary.*



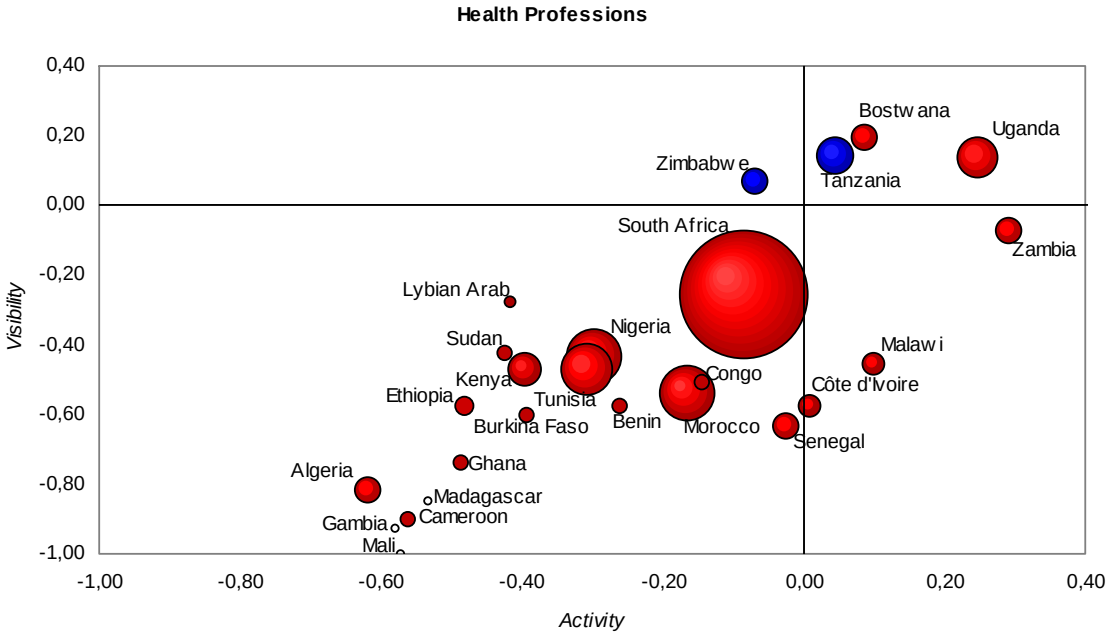
	Doc	RAI	RVI	RI
South Africa	1630	0,42	0,53	1,20
Nigeria	730	0,56	0,65	0,51
Kenya	553	0,71	0,77	1,51
Ethiopia	419	0,83	0,87	1,03
Zimbabwe	263	0,77	0,84	1,35
Tanzania	253	0,71	0,78	1,44
Tunisia	175	-0,02	-0,19	1,03
Sudan	174	0,80	0,83	0,78
Morocco	122	-0,10	0,30	1,27
Zambia	115	0,78	0,76	0,99
Uganda	110	0,51	0,32	0,75
Bostwana	92	0,65	0,69	0,83
Burkina Faso	89	0,67	0,81	1,68
Cameroon	81	0,33	0,48	1,08
Ghana	79	0,41	0,58	1,22
Senegal	75	0,46	0,41	0,79
Gambia	52	0,69	0,60	1,61
Algeria	48	-0,42	-0,43	0,39
Côte d'Ivoire	37	0,30	0,74	3,21
Benin	36	0,47	0,26	0,44
Mali	25	0,46	0,54	1,31
Gabon	24	0,47	0,53	1,55
Malawi	24	0,15	-0,08	0,79
Congo	17	0,25	-0,12	0,34
Madagascar	17	0,15	0,12	0,85
Lybian Arab	16	0,13	0,45	0,66

Figure 101. Relative Impact in the context of *veterinary*.



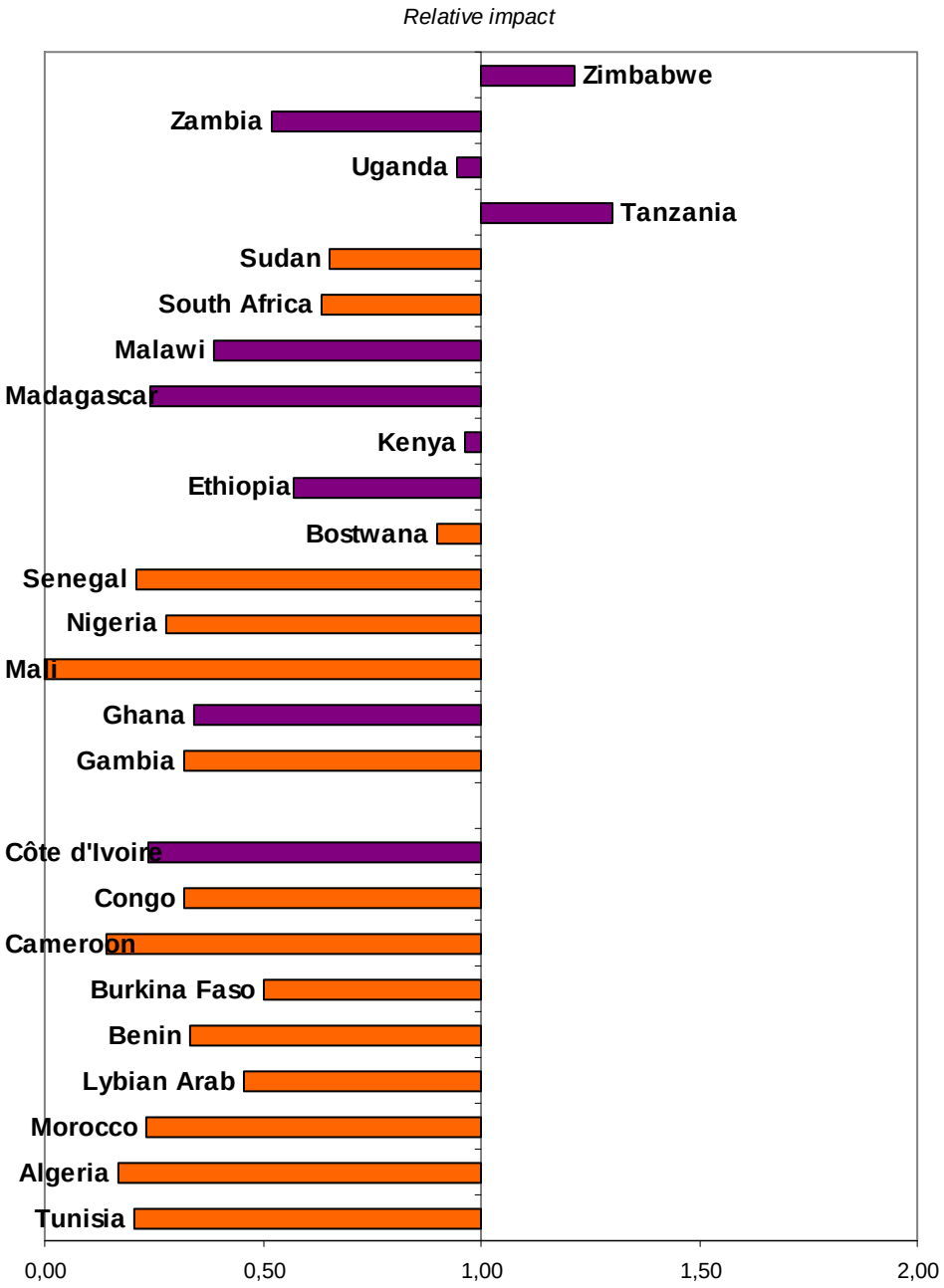
5.25. Health professions

Figure 102. Activity and visibility in the context of *health professions.*



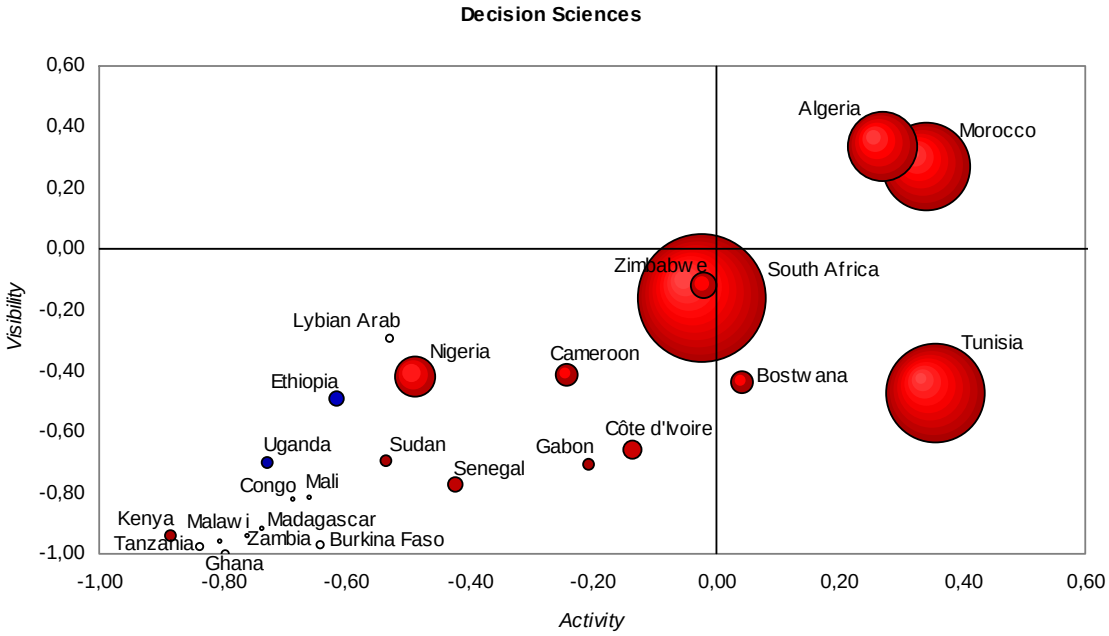
	Doc	RAI	RVI	RI
South Africa	447	-0,09	-0,26	0,63
Nigeria	87	-0,30	-0,43	0,28
Morocco	84	-0,16	-0,54	0,23
Tunisia	76	-0,31	-0,47	0,20
Uganda	47	0,25	0,14	0,94
Tanzania	37	0,04	0,14	1,30
Kenya	32	-0,40	-0,47	0,97
Zimbabwe	23	-0,07	0,07	1,22
Algeria	22	-0,62	-0,82	0,17
Senegal	21	-0,03	-0,63	0,21
Zambia	20	0,29	-0,07	0,52
Bostwana	18	0,09	0,20	0,90
Malawi	17	0,10	-0,46	0,39
Côte d'Ivoire	16	0,01	-0,58	0,24
Ethiopia	11	-0,48	-0,58	0,57
Ghana	9	-0,49	-0,74	0,34
Cameroon	9	-0,56	-0,90	0,14
Burkina Faso	6	-0,39	-0,60	0,50
Benin	6	-0,26	-0,57	0,33
Congo	6	-0,14	-0,51	0,32
Sudan	6	-0,42	-0,42	0,65
Lybian Arab	4	-0,42	-0,27	0,46
Madagascar	3	-0,53	-0,85	0,24
Gambia	2	-0,58	-0,93	0,32
Mali	2	-0,57	-1,00	0,00
Gabon	0	-1,00	-1,00	

Figure 103. Relative Impact in the context of *health professions*.



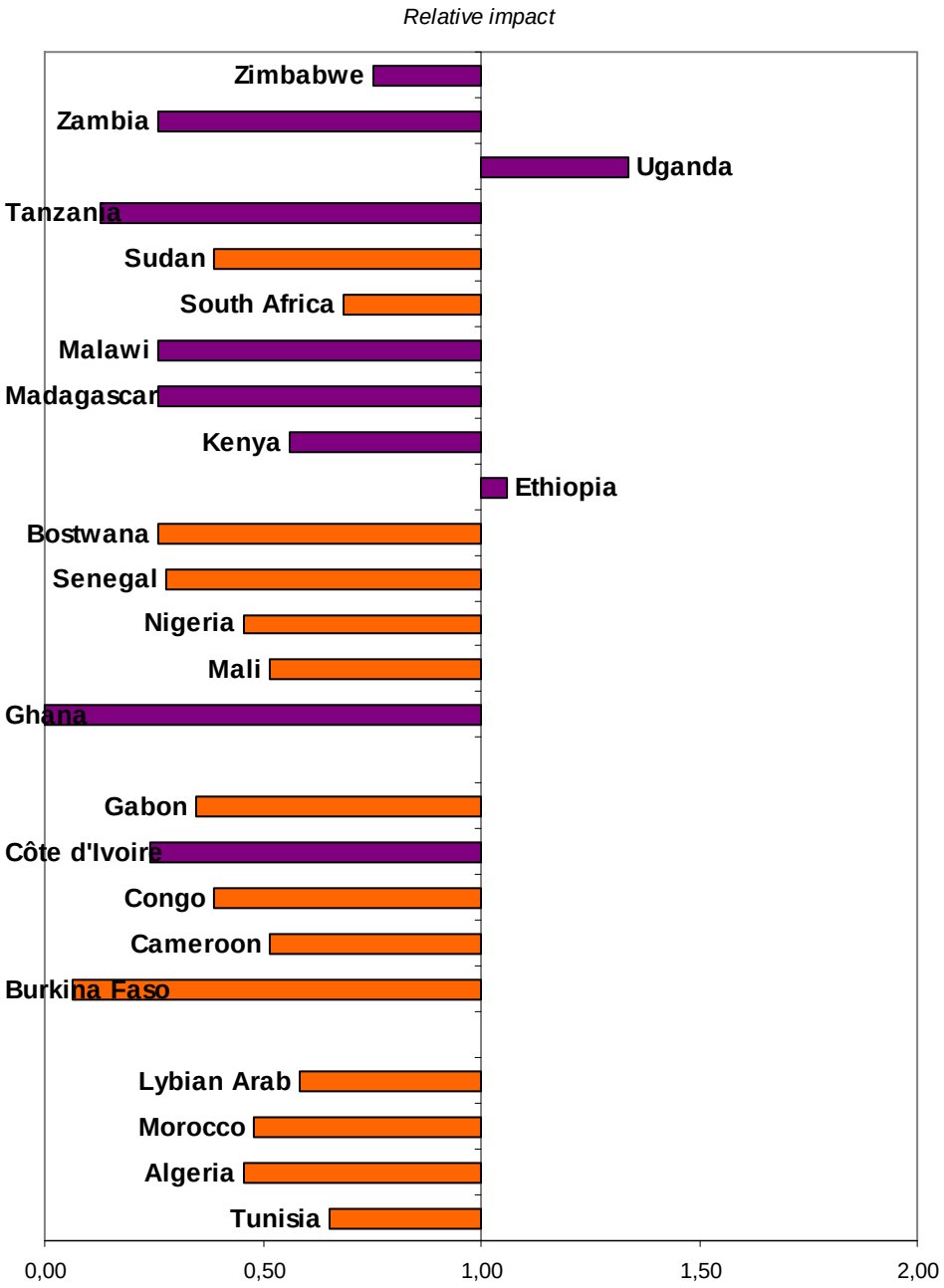
5.26. Decision sciences

Figure 104. Activity and visibility in the context of *decision sciences.*



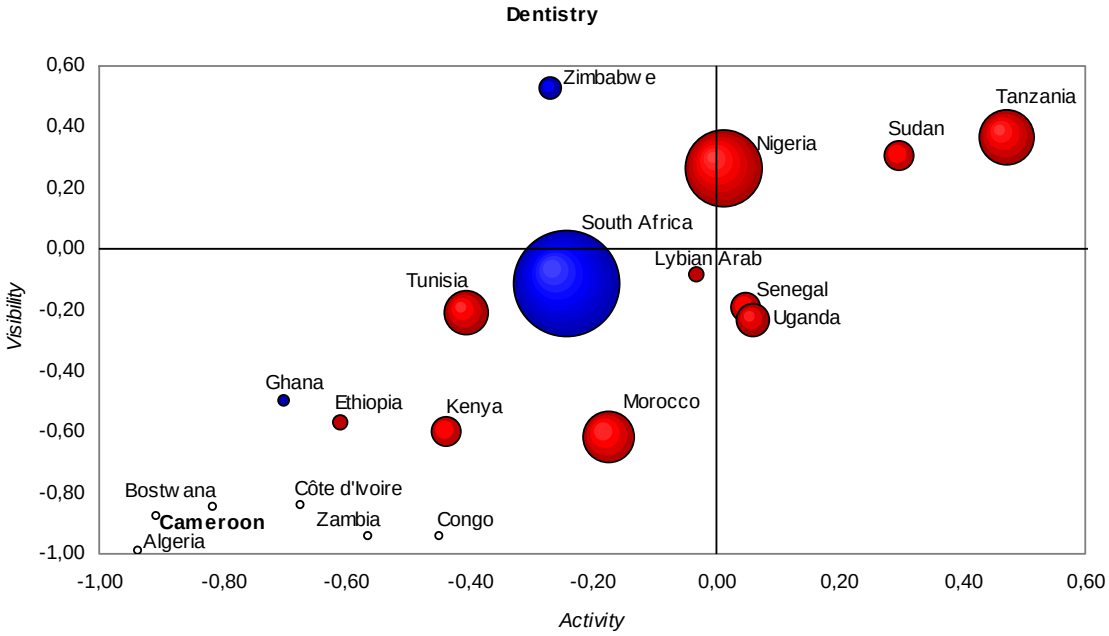
	Doc	RAI	RVI	RI
South Africa	338	-0,02	-0,16	0,69
Tunisia	202	0,36	-0,47	0,65
Morocco	159	0,34	0,27	0,48
Algeria	109	0,27	0,33	0,46
Nigeria	37	-0,49	-0,42	0,45
Zimbabwe	17	-0,02	-0,12	0,75
Cameroon	13	-0,24	-0,41	0,52
Bostwana	11	0,04	-0,44	0,26
Côte d'Ivoire	8	-0,13	-0,66	0,24
Senegal	6	-0,42	-0,77	0,28
Ethiopia	5	-0,61	-0,49	1,06
Uganda	3	-0,73	-0,70	1,34
Kenya	3	-0,89	-0,94	0,56
Sudan	3	-0,54	-0,69	0,39
Gabon	3	-0,21	-0,71	0,35
Lybian Arab	2	-0,53	-0,29	0,58
Tanzania	2	-0,84	-0,98	0,13
Burkina Faso	2	-0,64	-0,97	0,06
Ghana	2	-0,79	-1,00	0,00
Mali	1	-0,66	-0,82	0,52
Congo	1	-0,68	-0,82	0,39
Madagascar	1	-0,74	-0,92	0,26
Malawi	1	-0,81	-0,96	0,26
Zambia	1	-0,76	-0,94	0,26
Benin	0	-1,00	-1,00	
Gambia	0	-1,00	-1,00	

Figure 105. Relative Impact in the context of *decision sciences*.



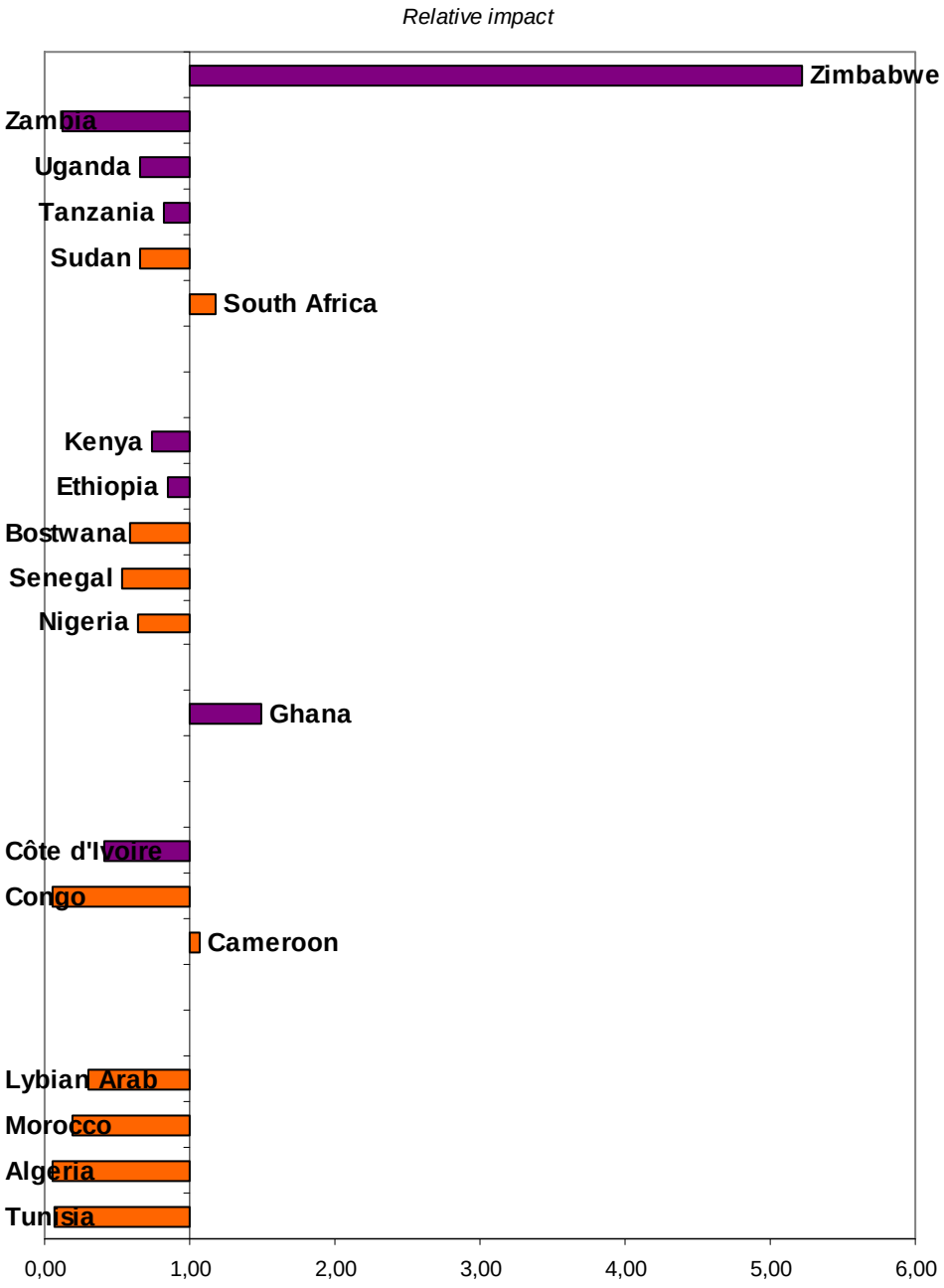
5.27. Dentistry

Figure 106. Activity and visibility in the context of *dentistry.*



	Doc	RAI	RVI	RI
South Africa	213	-0,24	-0,11	1,17
Nigeria	108	0,01	0,26	0,64
Tanzania	62	0,47	0,37	0,82
Morocco	54	-0,17	-0,61	0,19
Tunisia	40	-0,40	-0,21	0,07
Uganda	21	0,06	-0,23	0,66
Kenya	19	-0,44	-0,60	0,75
Sudan	18	0,30	0,31	0,66
Senegal	16	0,05	-0,19	0,54
Zimbabwe	10	-0,27	0,53	5,21
Lybian Arab	6	-0,03	-0,08	0,30
Ethiopia	5	-0,61	-0,57	0,85
Ghana	3	-0,70	-0,50	1,50
Côte d'Ivoire	2	-0,67	-0,84	0,41
Zambia	2	-0,56	-0,94	0,12
Algeria	2	-0,94	-0,99	0,06
Congo	2	-0,45	-0,94	0,06
Cameroon	1	-0,91	-0,87	1,06
Bostwana	1	-0,82	-0,85	0,59
Benin	0	-1,00	-1,00	
Burkina Faso	0	-1,00	-1,00	
Gabon	0	-1,00	-1,00	
Gambia	0	-1,00	-1,00	
Madagascar	0	-1,00	-1,00	
Malawi	0	-1,00	-1,00	
Mali	0	-1,00	-1,00	

Figure 107. Relative Impact in the context of *dentistry*.



5. Final considerations

This study illustrates recent changes in the scientometric profile of the most productive African countries (more than 1,000 research articles published between1996-2009). The performance of the 10 Pii partner countries with respect to the most productive African nations, as well as their strengths and weakness in each of the 27 subject areas of Scopus database, were also identified. The comparative nature of the study has enabled development trends in these 26 most productive countries to be viewed both in the regional and international context. The data provides an useful analysis tool for national or regional decision-making processes in the field of Science, Technology and Innovation.

Key findings related to the 10 PERii partner countries are summarised below.

Kenya

Kenya is the sixth most productive African country, closing a block of six countries with more than 10,000 research articles published in journals covered by Scopus (South Africa, Nigeria, Tunisia, Morocco and Algeria). It also holds the most advanced position in Science and Technology amongst the PERii partner countries, evidenced by the 11 420 papers published by authors from Kenyan institutons. *Agriculture and biological sciences* and *Medicine* are the two main subject areas in Kenyan scientific production. The most active and visible areas of research are *Veterinary*, *Immunology and microbiology*, *Agriculture and biological sciences*, *Environmental sciences*, *Multidisciplinary sciences*, *Social sciences* and *Economy, econometrics and finances.* There is a high relative impact in the field of *Energy*, *Medicine* and *Veterinary.* The proportion of international collaboration evolved from 60,8% in the period 1996-2002 to 75,1% in the period 2003-2009.

Tanzania

Tanzania opens a second block of less productive countries (1,000 to 10,000 papers published during the period), with 5,239 papers covered by Scopus. *Medicine*, *Agriculture and biological sciences* and *Immunology and microbiology* are the main subject areas in Tanzanian scientific production. The most active and visible areas of research are *Veterinary*, *Immunology and microbiology*, *Agriculture and biological sciences*, *Environmental sciences*, *Dentistry, Social sciences*, *Economy, econometrics and finances*, *Medicine*, *Energy*, and *Health Professions.* The higher relative impact is in the

fields of *Computer science* and *Engineering.* The proportion of international collaboration evolved from 69,2% in the period 1996-2002 to 79,8% in the period 2003-2009. The citation activity was higher during the period 2002-2009 (more than 50% of citations received).

Ethiopia

Ethiopian scientific production is mainly concentrated on *Agriculture and biological science*s, although *Medicine, Immunology and microbiology* and *Biochemistry, genetics and molecular biology* are also highly productive. The most active and visible areas of research are *Veterinary*, *Agriculture and biological sciences*, *Immunology and microbiology*, *Environmental sciences*, *Earth and planetary sciences, Economy, econometrics and finances*, and *Social sciences.* The higher relative impact is in the fields of *Energy* and *Materials Science.* The proportion of international collaboration evolved from 56,2% in the period 1996-2002 to 70% in the period 2003-2009.

Uganda

Medicine, *Immunology and microbiology* and *Agriculture and biological sciences* are the main subject areas in the scientific production from Uganda. The most active and visible areas of research are *Immunology and microbiology*, *Agriculture and biological sciences*, *Veterinary*, *Environmental sciences*, *Social sciences, Medicine*, *Economy, econometrics and finances*, and *Health Professions.* The higher relative impact is in the fields of *Economy, econometrics and finances* and *Medicine.* The proportion of international collaboration evolved from 65,6% in the period 1996-2002 to 81% in the period 2003-2009. The citation activity was higher during the period 2002-2009 (more than 50% of citations received).

Zimbabwe

Output in Zimbabwe, unlike that in other PERii countries studied, decreased during the period 2003-2009. The 53,4% of the scientific production was published in the period 1996-2002, and the 64,6% of cites were received during the same period. *Medicine*, and *Agriculture and biological sciences* are the main subject areas in the scientific production. The most active and visible areas of research are Veterinary, *Agriculture and biological sciences*, *Immunology and microbiology*, *Environmental sciences*, *Earth and planetary sciences, Social sciences, Economy, econometrics and finances*, and *Medicine.* The

higher relative impact is in less productive areas as *Dentistry* and *Economy, econometrics and finances.* The proportion of international collaboration evolved from 57,1% in the period 1996-2002 to 74,9% in the period 2003-2009.

Ghana

The output in Ghana increased during the period 2002-2009. The 68% of the scientific production was published between 2003-2009. *Medicine*, and *Agriculture and biological sciences* are the main subject areas in the scientific production. The most active and visible areas of research are *Immunology and microbiology*, *Agriculture and biological sciences*, *Social sciences*, *Veterinary*, *Environmental sciences*, *Economy, econometrics and finances*, and *Energy.* The higher relative impact is in *Dentistry*, *Veterinary* and *Energy.* The proportion of international collaboration shows a low evolution, from 58,6% in the period 1996-2002 to 66,1% in the period 2003-2009. However, more than a half of citations were received during the later period.

Cote d´Ivoire

Medicine is the most important subject area in the scientific production of Cote d´Ivoire. The most active and visible areas of research are *Immunology and microbiology*, *Agriculture and biological sciences*, *Veterinary*, *Medicine* and *Environmental sciences.* The higher relative impact is in the fields of Art and Humanities (with a low output) and Veterinary. The proportion of international collaboration, unlike in other countries, does not show an evolution over the whole period (66,4% in the period 1996-2002, 67,2% in the period 2003-2009).

Malawi

Malawi doubled its scientific production during the period 2002-2009 (67,3% of the total output), with a clear biomedical profile. *Medicine* is the most important subject area, covering the 50,7% of the whole scientific production and reaching the highest relative impact. The most active and visible areas of research are *Immunology and microbiology*, *Medicine*, *Agriculture and biological sciences*, and *Nursing.* The proportion of international collaboration evolved from 65,1% in the period 1996-2002 to 80,3% in the period 2003-2009.

Zambia

As for Malawi, medicine is the main subject areas in the scientific production from Zambia, followed by *Immunology and microbiology* and *Agriculture and biological sciences*. The most active and visible areas of research are *Immunology and microbiology*, *Veterinary*, *Agriculture and biological sciences*, *Environmental sciences*, *Earth and planetary sciences*, *Medicine*, *Social sciences,* and *Economy, econometrics and finances.* The higher relative impact is in the low productive areas of *Arts and Humanities* and *Economy, econometrics and finances*. However, *Medicine* also shows a high relative impact, with a citation per documents over the world mean. The proportion of international collaboration evolved from 70% in the period 1996-2002 to 84,4% in the period 2003-2009. The citation activity was higher during the period 2002-2009 (more than 50% of citations received).

Madagascar

Madagascar doubled its scientific production during the period 2002-2009 (67,5% of the total output), with a clear biomedical profile. *Agriculture and biological sciences* is the most important subject area, covering the 40,5% of the whole scientific production. The most active and visible areas of research are *Agriculture and biological sciences*, *Immunology and microbiology*, *Environmental science*, *Earth and planetary science,* and *Veterinary.* The higher relative impact is in *Arts and Humanities* and *Social sciences* (areas with a low output). The proportion of international collaboration evolved from 76,5% in the period 1996-2002 to 86,9% in the period 2003-2009.

Impact and next steps

The findings of this study allow for broader research into the changes in scientific output in developing countries to:

- utilize data to inform future policy-making;
- create firmer links between trends in scientific output and policy decisions; and
- gauge the impact of specific policy decisions on scientific output.

Possible next steps include widening this research to incorporate the Asian PERii partner countries or working with the African and Latin American countries already studied to extend analysis or to concentrate on areas of particular interest.

6. A brief bibliography

1. Braun, T., & Schubert, A. (1997). Dimensions of scientometric indicator datafiles world science in 1990-1994. Scientometrics, 38(1), 175-204.
2. Bugaje, I. M. (2006). Renewable energy for sustainable development in Africa: A review. Renewable and Sustainable Energy Reviews, 10(6), 603-612.
3. Frame, J. D. (1977). Mainstream research in Latin America and the Caribbean. Interciencia, 2, 143-148.
4. Glänzel, W. (2000). Science in Scandinavia: A bibliometric approach. Scientometrics, 48(2), 121-150.
5. Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. Proceedings of the National Academy of Sciences, 102(46), 16569–16572.
6. Hofman, K. J., Kanyengo, C. W., Rapp, B. A., & Kotzin, S. (2009). Mapping the health research landscape in Sub-Saharan Africa: A study of trends in biomedical publications. Journal of the Medical Library Association, 97(1), 41-44.
7. Jacsó, P. (2009). Errors of omission and their implications for computing scientometric measures in evaluating the publishing productivity and impact of countries. Online Information Review, 33, 376-385.
8. OECD. (2010). African Economic Outlook 2010. [Online] OECD. ISBN: 9789264086524. Retrieved 19/05/2011. Available at: http://www.sourceoecd.org/9789264086524
9. Onyancha, O. B. (2009). A citation analysis of sub-Saharan African library and information science journals using google scholar. African Journal of Library Archives and Information Science, 19(2), 101-116.
10. Onyancha, O. B., & Maluleka, J. R. (2011). Knowledge production through collaborative research in sub-Saharan Africa: how much do countries contribute to each other's knowledge output and citation impact? Scientometrics, 87, 315–336.
11. Owolabi, M. O., Bower, J. H., & Ogunniyi, A. (2007). Mapping Africa's way into prominence in the field of neurology. Archives of Neurology, 64(12), 1696-1700.
12. Pouris, A., & Pouris, A. (2009). The state of science and technology in Africa (2000–2004): A scientometric assessment. Scientometrics, 79(2), 297-309.

13. SCImagoResearchGroup. (2007). SCImago Journal & Country Rank. [Online] Retrieved 18/05/2011. Available at: http://www.scimagojr.com

14. SCImagoResearchGroup. (2010). SCImago Institutions Ranking. [Online] Retrieved 21/11/2011. Available at: http://www.scimagoir.com

15. Schoonbaert, D. (2009). Pubmed growth patterns and visibility of journals of Sub-Saharan African origin. Journal of the Medical Library Association, 97(4), 241-243.

16. Siegfried, N., Busgeeth, K., & Certain, E. (2006). Scope and geographical distribution of African medical journals active in 2005. South African Medical Journal, 96(6), 533-537.

17. Swingler, G. H., Pillay, V., Pienaar, E. D., & Ioannidis, J. P. A. (2005). International collaboration, funding and association with burden of disease in randomized controlled trials in Africa. Bulletin of the World Health Organization, 83(7), 511-517.

18. Toivanen, H., & Ponomariov, B. (2011). African regional innovation systems: bibliometric analysis of research collaboration patterns 2005–2009. Scientometrics, 88(2), 471-493.

19. Uthman, O. A., & Uthman, M. B. (2007). Geography of Africa biomedical publications: An analysis of 1996-2005 PubMed papers. International Journal of Health Geographics, 6.