Jointly published by Akadémiai Kiadó, Budapest and Springer, Dordrecht

Scientometrics
DOI: 10.1007/s11192-007-1813-x

International earth science literature from Turkey – 1970–2005: Trends and possible causes

CANDAN GOKCEOGLU,[a] ARAL I. OKAY,[b] EBRU SEZER[c]

[a] *Department of Geological Engineering, Hacettepe University, Beytepe, Ankara (Turkey)*
[b] *Eurasia Institute of Earth Sciences, Istanbul Technical University, Maslak, Istanbul (Turkey)*
[c] *Department of Computer Engineering, Hacettepe University, Beytepe, Ankara (Turkey)*

We investigated the publication trends in the international earth science literature coming out of Turkey in the period of 1970–2005 using the Science Citation Index Expanded database. A database of 2310 earth science publications with at least one of the authors with an address in Turkey was compiled. The number of earth science publications from Turkey shows a very rapid increase starting in the 1990's in parallel with the increase in the total scientific output of Turkey. In the last decade the annual growth rate has been 16%. There was also a concomitant increase in the number of citations. The causes of the sharp increase in the publication numbers are, in order of importance, changes in the rules of academic promotion and appointment, changes in academic attitudes towards publishing, increasing support for research, financial incentives for publishing, and expansion of higher education. However, the sharp increase in the publication numbers was not accompanied by a similar increase in the impact of the publications as measured by the citations. Although publications with first authors from outside Turkey make up only 20% of the Turkish earth science publications in the period 1970–2005, these account for 38% of the total citations, and constitute 48 out of 100 most cited papers.

Introduction

Starting in the 1980's, a considerable increase in the scientific output from Turkey, as measured by the number of papers published in international journals is observed.

Received March 9, 2007

Address for correspondence:
CANDAN GOKCEOGLU
Department of Geological Engineering, Hacettepe University
Beytepe, 06800, Ankara, Turkey
E-mail: cgokce@hacettepe.edu.tr

0138–9130/US $ 20.00

In the 1980's Turkey lagged behind Egypt in terms of scientific output among Islamic countries [1]; in the year 2005 the number of SCI publications from Turkey constituted over 40% of the combined SCI publication output of 37 Islamic countries, followed by Iran (13%) and Egypt (8%). The number of papers in the SCI journals was 464 in 1983 with the 41st position in the ranking of countries, it increased to 13,290 in 2005 with ranking 19$^{th.}$ – a more than 22-fold increase in the last two decades. Especially, in the last decade there was an extremely rapid growth rate (16% annually) of Turkey's share in the world publication output. Here, we investigate the pattern of this increase and its causes in the particular case of the earth science literature stemming from Turkey between the years 1970 and 2005. We choose the earth sciences because we are familiar with the problems and development of earth sciences in Turkey from the late 1970's.

Method

To asses the development of earth science literature from Turkey, we used the Science Citation Index Expanded (Web of Science) published by Institute of Scientific Information (now Thomson Scientific), USA for the period 1970–2005. In the first stage of the search, the journal lists of geosciences and related areas were downloaded from the ISI website (www.isinet.com) (Table 1). These journals were systematically searched and publications, which have at least one author with an address in Turkey, were selected. During the selection the author addresses were checked to exclude publications by non-earth scientists such as civil engineers, mining engineers and biologists. This produced a list of about 1343 earth scientists with an address in Turkey. As some earth scientist publish in non-earth science categories such as agriculture, soil sciences, physical chemistry etc, a further search was made under the name of each of the 1343 Turkish earth scientists to complete their international publication record and to locate co-authors missing in the first list. The final publication list of earth scientist in Turkey for the period 1970–2005 included 2310 publications by 1343 earth scientist. Citations to each of 2310 publications up to the year 2005 were also recorded. We estimate that our data contains over 95% of the actual publications and citations by earth scientist with an address in Turkey in the period 1970–2005. As our aim was to asses the earth science research in Turkey, we excluded the small number of corrections, meeting abstracts, and obituaries, and the analysis of data was performed on 2123 publications dominated by research papers and some reviews. The complete data set was put into a database, in the PostgreSQL and is available online at http://prens.hacettepe.edu.tr/prj/main/index.php.

Table 1. Journals in the different Science Citation Index categories analyzed in this study

Subject category	Number of journal
Engineering, Geological	25
Geochemistry & Geophysics	65
Geography, Physical	29
Geology	38
Geosciences, Multidiciplinary	139
Mineralogy	26
Paleontology	37
Water Resources	58

Trends in earth science research in Turkey – 1970–2005

Increase in the number of publications

Starting at very low levels in the 1970's the annual earth science publications from Turkey showed an asymptotic increase starting in the mid-1990 and with no sign of leveling off (Figure 1). There were only a total of 51 publications during the ten year period between 1970 and 1979, equivalent to about a quarter of the earth science papers published *only* in the year 2005 (Table 2). In the 13-year period from 1980 to 1992, the total number of publications rose to 304 with an erratic and slight annual increase; the annual average was 23.4. A constant increase in the number of publication was observed in the period of 1993–1998, and the annual average reached to 72.2.

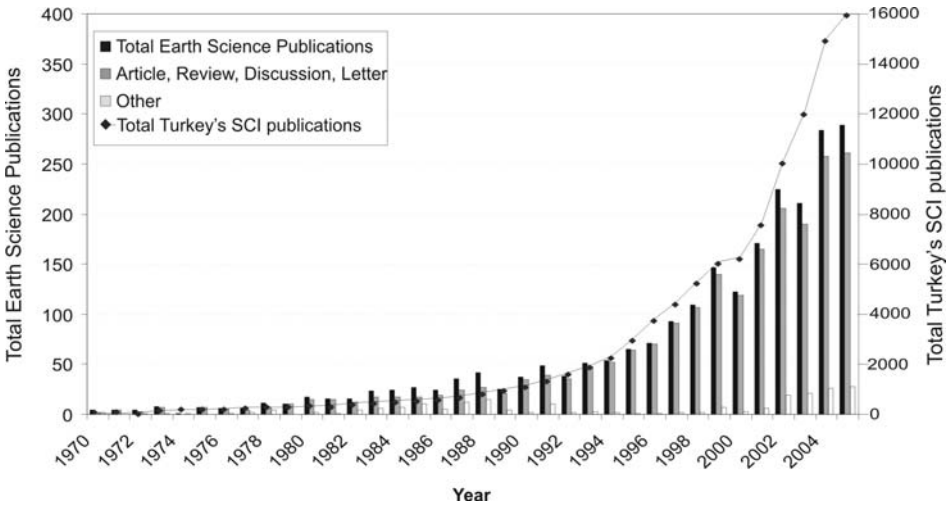

Figure 1. The annual number of earth science publications with at least one author address in Turkey compared to the total of Turkey's SCI publications

Table 2. Number of publications by Turkish earth scientists shown in four major periods between 1970 and 2005

Period	Number of article, review, letter and discussion	Av. annual number of article, review, letter and discussion	Equ. between time (x) and number of article, review, letter and discussion (y)
1970–2005	2123	59.0	$Y=2.56e^{0.1269x}$ (r=0.99)
1970–1979	51	5.1	Y=0.67x+1.4 (r=0.68)
1980–1992	304	23.4	$Y=12.4e^{0.083x}$ (r=0.92)
1993–1998	433	72.2	$Y=40.5e^{0.155x}$ (r=0.99)
1999–2005	1335	190.7	Y=23.8x+95.6 (r=0.93)

A sharp increase exists from 1999 to present, and the yearly average approaches 190.7. The pattern of changes in the earth science publications over the years is similar to that of the total publication output from Turkey including the slight decrease in the year 2000 (Figure 1). However, in the last few years the increase in the earth science publications from Turkey has been less than that of the total publications. The share of earth science publications in total Turkey's SCI publications is generally between 2 and 3 % (Table 3).

Trends in the citations

The total number of citations to a publication is an important indicator of its impact to the scientific community. Ideally self citations should be excluded in a citation analyses. However, these seldom exceed twenty percent and thus they do not significantly influence the overall picture [2]. Three years after publication the Jaccard-based measure indicates a self-citation share of 15% for the world total; after ten years this share amounts to 9%. Author self-citations become after such a long period practical negligible [3]. We computed the total number of citations given to the 2123 publications in the period 1970–2005 (Table 3).

To establish the impact of the average earth science publication from Turkey, the number of citations in a particular year to a set of papers published in the two previous years were calculated. For example, the mean citation rate per publication for the year 1980 was calculated as 1981–1982 citations to 1980 publications divided by the number of publications in 1980. Table 3 shows that the impact factor of the average earth science publication from Turkey is highly erratic with a marked decrease since 2000. A pattern of decreasing impact was found for astronomy [4] and social science articles [5] originating from Turkey indicating that the quality of the publications did not keep up with the sharp increase in the quantity of the publications.

Citation distributions are extremely skewed. A large part of the scientific articles are never or seldom cited in the subsequent scientific literature [6]. The relationship between number of citations and number of publication is shown in Table 4. Sixhundred-twenty-two publications or 29.2% of the publications had no citations, and

1444 publications or 68% of the publications had fewer than 5 citations. The top 100 most cited papers account for 43.2% of the citations. It is possible to find similar patterns in the literature.

Table 3. The earth science publications and citations from Turkey

Year	Number of article, reviews, letters and discussions with at least one author address in Turkey	Number of citations to all earth science publications from Turkey	Number of authors	Average number of authors per publication	Earth science publications as percentage of total Turkish publications	Citation rate
1970	2	0	2	1.0	NA	0.5
1971	4	0	7	1.8	NA	3.0
1972	3	7	5	1.7	NA	0.0
1973	7	7	10	1.4	3.4	0.6
1974	0	4	0	0.0	0.0	0.0
1975	7	6	11	1.6	3.0	0.6
1976	5	7	14	2.8	2.1	1.2
1977	5	9	9	1.8	1.3	1.4
1978	8	11	15	1.9	2.7	1.3
1979	10	20	20	2.0	3.8	0.7
1980	16	18	41	2.6	4.5	0.9
1981	15	33	31	2.1	4.5	1.5
1982	13	58	28	2.2	3.0	1.0
1983	20	59	55	2.8	3.8	0.9
1984	18	70	45	2.5	3.3	1.3
1985	18	83	59	3.3	3.6	2.5
1986	20	107	48	2.4	3.3	0.9
1987	24	118	63	2.6	3.4	1.3
1988	28	116	75	2.7	3.2	1.2
1989	23	125	74	3.2	2.3	3.2
1990	36	198	92	2.6	3.3	1.7
1991	38	253	120	3.2	3.0	1.1
1992	35	170	100	2.9	2.3	2.2
1993	50	231	144	2.9	2.5	1.8
1994	53	336	151	2.8	2.4	1.4
1995	65	359	217	3.3	2.1	1.7
1996	69	459	191	2.8	1.9	0.9
1997	89	499	284	3.2	2.1	1.8
1998	107	669	335	3.1	2.0	1.3
1999	140	818	421	3.0	2.3	1.7
2000	118	866	409	3.5	1.9	3.7
2001	165	1484	534	3.2	2.2	2.2
2002	205	1868	778	3.8	2.1	2.7
2003	188	1828	640	3.4	1.6	1.7
2004	258	2520	850	3.3	1.7	NA
2005	261	3370	877	3.4	1.6	NA

Table 4. Citation pattern of publications by Turkish earth scientists

Number of citation	Number of publication
0	622
1–5	822
6–10	270
11–15	132
16–20	73
21–25	64
26–30	37
31–40	40
41–60	29
61–80	15
81–100	3
101–200	12
201–300	3
301–400	0
401–500	0
501–600	1

For example, among the 75,000 Norwegian ISI-indexed articles published in the period 1981–1998, 40% have never been cited or have only been cited once or twice (counting citations 1981–2002), while ten percent of the papers have received half of the citations [6].

The most cited paper with 567 citations is by Sengor & Yilmaz [7] published in Tectonophysics. It was the first comprehensive model of the plate tectonic evolution of Turkey. The second most cited paper was written on the evolution of the Altaid tectonic collage and Paleozoic crustal growth in Eurasia by Sengor & al. [8]. The third one was published by Xu & al. [9]. The subject of this paper was diamond from the Dabie-Shan metamorphic rocks and it was published in *Science*. The publications of McClusky & al. [10], Stein & al. [11], Okay & al. [12], Reilinger & al. [13], Okay [14], Okay & al. [15] and Murray & al. [16], which appeared in *Journal of Geophysical Research, Geophysical Journal International, European Journal of Mineralogy*, *Tectonics* and *Nature*, are highly cited publications on plate tectonics, active tectonics, earthquake activity and mineralogy. Generally, the publications having more than 100 citations were published by the academic staff working in geology and geophysical departments of the Istanbul Technical University and their international colleagues.

A disproportionate number of highly cited papers from Turkey have North American and west European earth scientists as their first author. Papers with first authors from outside Turkey make up 20% of the Turkish earth science publications in the period 1970–2005 (Table 5). This ratio is similar to that for the whole of the Turkish science publications [17]. However these publications account for 38% of the total citations, and constitute 48 out of 100 most cited papers. A similar pattern of high impact articles co-authored by non-Turkish authors was recognized in the chemistry and

social science publications by Yurtsever & Gülgöz [18], and Gülgöz & al. [5], respectively This indicates that increase in the number of earth science publications from Turkey is not necessarily accompanied in an increase in the quality of science.

Table 5. Summary of first authorship of the publications considered

First author	Number of publication	Total citation	Average citation	Top 100 in number of citation
Foreign author	419	6388	15.2	48
Turkish author	1704	10398	6.1	52

Trends in the authorship

The 2310 publications in the period 1970–2005 were authored by 2616 earth scientists, of these 1343 had addresses in Turkey and 1273 outside. Table 3 shows the changes in the number of authors and publications against time. There is a trend of increasing number of authors per publication over the years (Table 3). This has changed from 1.30 in the 1970's to 3.8 in the 1990's. The trend of increasing multi-authorship is a well established phenomenon observed both on a national (e.g., Uzun & Özel [4]; Tonta [19]) and international level (e.g., Sampson [20]; Bird [21]) in different fields of science. However, in the field of earth sciences there was no significant change in the last five years (Table 3). This is probably related to the change in the rules for promotion to the associate professorships, the Interuniversity Council has requested since 2001 at least three SCI-indexed articles, one of which must be authored solely by the candidate himself or with one of his/her students.

The frequency of publication in a given field is given by Lotka's Law [22], which states that "... the number (of authors) making n contribution is about $1/n^2$ of those making one; and the proportion of all contributors, that make a single contribution, is about 60%". This means that out of all the authors in a given field, 60% will have just one publication, and 15% will have two publications ($(1/2)^2$ x 60), 7% authors will have three publications ($(1/3)^2$ x 60), and so on [22]. In the database used in this study, 1572 authors have one publications and the share of these authors is 60.4% while those having two publications is 14.8%. 7.8% of all authors have three contributions (Figure 2). These values show a good agreement with the Lotka's Law.

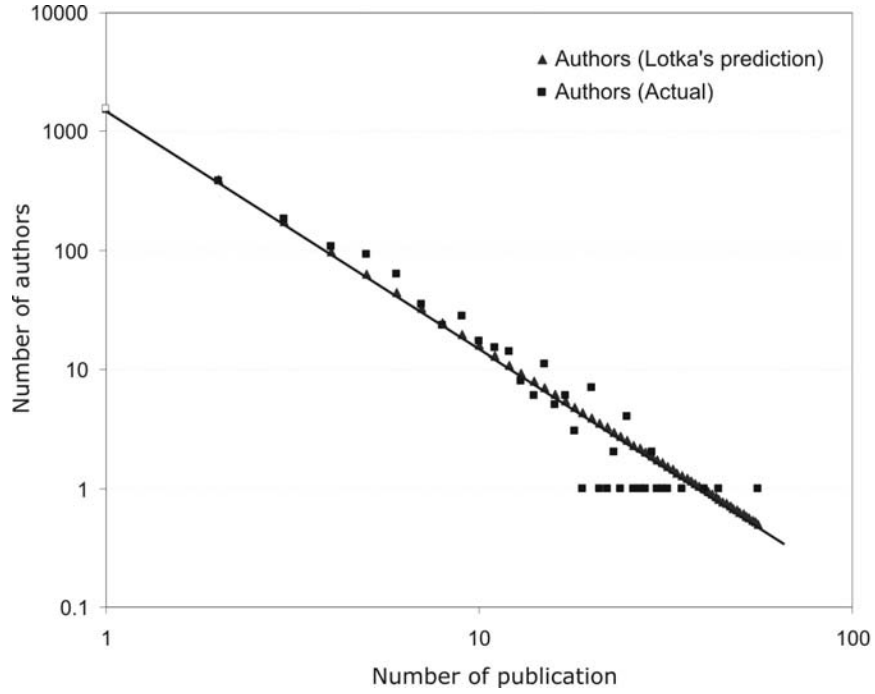

Figure 2. Lotka's plot for authors of all publications and the actual data

Journals and earth science subfields

Earth scientists from Turkey have used a total 332 different international journals since 1970 to publish their work. The journals with the high number of publications by Turkish earth scientists are listed in Table 6. The top journal for Turkish earth scientists is *Tectonophysics*, which publishes papers on tectonics, geophysics and related fields (http://www.elsevier.com). In *Tectonophysics* there were 86 publications in the period 1970–2005, with at least one author address in Turkey. The citation average of all publications in *Tectonophysics* is 17.5, whereas those authored by Turkish earth scientists is 21.9. The first publication in the *Tectonophysics* written by Turkish earth scientists was about the tectonic structures along the North Anatolian Fault Zone [23]. The most cited article published in *Tectonophysics* is by Sengor & Yilmaz [7], which had a total citation of 567 by the end of 2005. Interestingly if this paper is excluded, the citation average for Turkish earth scientist in the *Tectonophysics* publications drops to 15.0, illustrating the decisive effect of a few papers on the citation pattern.

Table 6. The journals frequently used by Turkish earth scientists, their impact factors, and the distribution of the top 100 most cited publications among these journals

Journal	Number of Articles, Reviews, Discussions, Letters published by Turkish earth scientists	Number of publications in the rank of top 100 most cited publications	Impact factor (2003)
Tectonophysics	86	13	1.633
Environmental Geology	83	0	0.605
Engineering Geology	75	0	0.687
Marine Geology	64	4	1.497
International Geology Review	55	0	0.885
Bulletin of the Seismological Society of America	54	3	1.681
Geological Journal	52	0	0.929
Journal of Volcanology and Geothermal Research	49	4	1.457
Geophysical Journal International+	49	3	1.636
Energy Sources	40	0	0.403
International Journal of Earth Sciences (+Geologische Rundschau)	39	3	1.878
Geophysical Research Letters	34	2	2.422
Journal of Asian Earth Sciences	29	0	0.853
Sedimentary Geology	28	0	1.255
Geological Magazine	28	2	1.488
International Journal of Rock Mechanics and Mining Sciences	27	0	0.649
Geology	25	9	3.065
Computers & Geosciences	24	0	0.709
Geodinamica Acta	24	1	1.429
International Journal of Coal Geology	24	1	0.786
Pure and Applied Geophysics	23	0	0.767
Geophysical Prospecting	23	0	0.464
Journal of Geophysical Research	23	6	2.992
Turkish Journal of Earth Sciences	22	0	Unknown
Journal of the Geological Society	21	7	2.435
Journal of the Geological Society of India	20	0	0.299
Terra Nova	20	1	1.667
Journal of Geodynamics	14	1	0.754
Nature	13	5	30.979
Tectonics	13	3	2.308
Contributions to Mineralogy and Petrology	12	2	2.831
Geophysical Journal of the Royal Astronomical Society	10	2	1.415
Bulletin de la Societe Geologique de France	10	1	0.956
Earth and Planetary Science Letters	10	2	3.528
Journal of Geology	10	1	2.442
Geological Society of America Bulletin	9	4	2.206
Palaeogeography Palaeoclimatology Palaeoecology	8	1	1.766
Journal of Metamorphic Geology	8	1	2.283
Journal of Structural Geology	8	2	1.949
Science	7	4	29.162
Ecologae Geologicae Helvetiae	6	1	0.463
Oceanologica Acta+	6	1	0.913
Annual Review of Earth and Planetary Sciences	4	2	3.618
Deep-Sea Research Part A + I	4	2	2.304
AAPG Bulletin-American Association of Petroleum Geologists	3	1	1.380
Energy Conversion and Management	3	1	0.620
European Journal of Mineralogy	2	2	1.185
Earth-Science Reviews	2	1	4.014
Marine Micropaleontology	2	1	1.859

The second most published journal by Turkish earth scientists is *Environmental Geology*; here 83 papers authored by Turkish earth scientist appeared in the period 1970–2005. *Environmental Geology* publishes on aspects of interactions between humans, ecosystems and the earth (http://link.springer.de). Compared with the articles in *Tectonophysics*, the articles in *Environmental Geology* are less cited. The average citation per publication in *Environmental Geology* is 3.2, whereas it is ~1,6 for the papers by the Turkish earth scientists; the most cited article is by Ercanoglu & Gokceoglu [24] with ten total citations; it deals with the assessment of landslides by fuzzy approach.

The other top journal for Turkish earth scientists is *Engineering Geology* with 75 publications. *Engineering Geology* publishes case histories, and comprehensive reviews in the field of engineering geology (http://www.elsevier.com). Considering the relatively small number of engineering geologists in Turkey, the number of publication of Turkish earth scientists in *Engineering Geology* is high. The average citation in *Engineering Geology* is 3.6, whereas the average number of citation to publications authored by Turkish earth scientists 2.6; the most cited article by Gokceoglu & Aksoy [25] had 18 citations; it deals with the assessment of landslides. Most of the articles published by the Turkish earth scientists in the *Engineering Geology* are written by the staff of the Hacettepe University in Ankara with 16%.

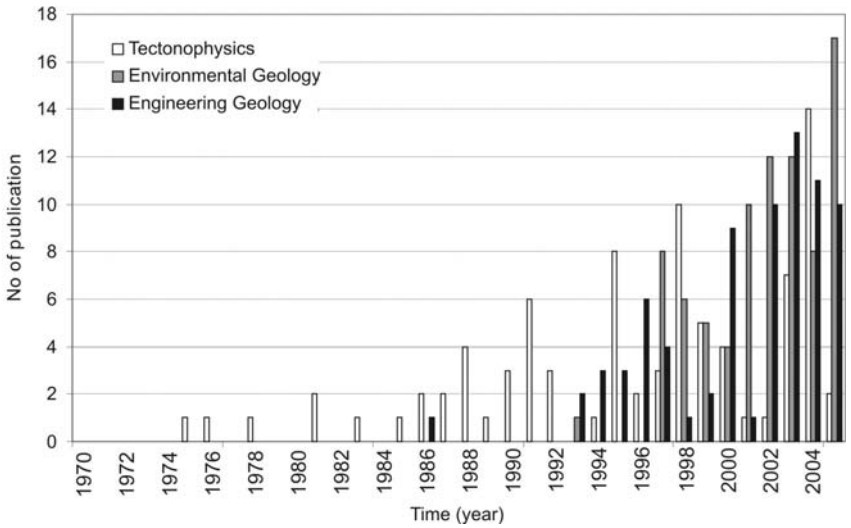

Figure 3. The number of publications in the top three journals preferred by Turkish earth scientists

Figure 3 shows the number of publications in *Tectonophysics*, *Engineering Geology* and *Environmental Geology* against time. The Turkish earth scientists have been

publishing in *Tectonophysics* for 30 years, whereas in *Environmental Geology* and *Engineering Geology* only in the last decade illustrating the rapid development of applied geology in Turkey.

Table 6 also lists the distribution of the 100 most cited publications by Turkish scientists among different journals. *Tectonophysics* has most of the highly cited publications. As expected papers in prestigious journals with high impact factors such as *Nature*, *Science*, *Geological Society of America Bulletin*, *Tectonics* etc., fall within the 100 most cited publications of the Turkish earth scientists. Applied geology subjects have no or very few highly cited papers; this may be explained that the average number of citations depends to a high degree on the specific field of research [2].

The different subfields of earth sciences with the number of publications by the Turkish earth scientists are given in Table 7. The publications are dominated by the general geological sciences, tectonics, structural geology, stratigraphy, followed by the applied geological sciences.

Table 7. The earth science subfields with the number of publications from Turkey

Subject category	No of publications
Geosciences, Multidisciplinary	978
Geochemistry & Geophysics	573
Geology	256
Water Resources	184
Environmental Sciences+	162
Engineering, Geological+	147
Energy & Fuels+	135
Mineralogy+	121
Oceanography	117
Paleontology+	105
Multidisciplinary Sciences+	90
Engineering, Chemical+	66
Geography	1
Geography, Physical+	57
Engineering, Petroleum+	54
Mining & Mineral Processing	50
Meteorology & Atmospheric Sciences	33
Engineering, Civil	30
Agriculture, Soil Science+	29
Computer Science, Interdisciplinary Applications+	25
Biology	11
Engineering, Environmental	20
Astronomy & Astrophysics	19
Materials Science, Multidisciplinary+	20
Construction & Building Technology	16
Remote Sensing+	16
History & Philosophy of Science	7
Imaging science & Photographic Technology+	11
Microscopy+	11

Discussion

In this section we discuss factors, which have been leading to the sharp increase in the number of publications and citations stemming out of Turkey. About 90% of earth science publications from Turkey are written by scientists from the university departments, specially from the Istanbul Technical University, Hacettepe University, Middle East Technical University, Ankara University, Dokuz Eylul University and Istanbul University. Therefore expansion of higher education and changes in the rules of academic promotion and appointment, as well as increase in support for research are directly related to the scientific output.

Changes in the rules of promotion and appointment in the universities

In Turkey the promotion to associate professorship and hence to tenure is governed by the regulations from the Interuniversity Council (IC). Since 2001, the IC requires at least three publications in SCI journals in order to apply for the associate professorship. Even before 2001 many of the mainstream universities required international publications for promotion. Most of the established geology and geophysics departments require a certain number of publications in SCI journals for promotion to an assistant and full professorship. This is thought to be the most important factor in the increase in the publication numbers.

Changes in the attitudes of academia towards publishing

In the 1970's and 1980's the primary duty of a university lecturer in Turkey was considered teaching and writing text books for students. The promotion and appointment to associate professorship was through the completion of a dozentship thesis, which followed a PhD thesis. There was no requirement for a lecturer to publish his/her dozentship thesis. The norm was for the earth scientist to publish in local journals in Turkish. This attitude slowly changed in the late 1980's with opening of the country to the Western Europe and USA, including the liberalization of the exchange regime, and removal of barriers against international travel; the change accelerated with the introduction of internet in the middle of 1990s. In 1982, the thesis requirement for promotion to the associate professorship was changed in favor of submittal of a number of publications. Initially publications in local journals were considered adequate for promotion but this changed gradually and in 2001 publications in SCI journals were required for the promotion. At present PhD students in the earth science departments in Turkey accept that publications in SCI journals are prerequisite for academic promotion and appointment. This change in the attitudes is probably the second most important factors in sustaining the growth of scientific publications.

Support for earth science research

Most of the earth science research in Turkey is financially supported by TUBITAK, the Scientific and Technological Research Council of Turkey and by the university research funds with minor support coming from state companies such as MTA (Geological Survey) and TPAO (Turkish Petroleum). R&D expenditures, as percent of gross domestic product (GDP), increased by a factor of two from 0.32% in 1990 to 0.67 in 2002 [26]. However, this is still one-third of the EU average, which is 1.9%. Universities account for about 60% of the R&D expenditures in Turkey in 2000 [27].

Incentives for publication in the international journals

Since 1993 TUBITAK has been providing modest awards for papers published in SCI journals. The SCI journals have been divided into three categories based on their impact factor; the top 25% forming class A, the next 50% class B and the lowest 25% class C (www.tubitak.gov.tr). The awards for publications in class A journals are four times than those in class C. The awards are divided by the number of authors, only those with a given address in Turkey being eligible for the awards. In addition to TUBITAK many universities provide additional awards for international publications since the early 1990's.

Expansion of higher education

Higher education in Turkey showed a sharp expansion in the 1990's. At present there are 27 universities with earth science (geology and/or geophysics) departments, compared to four earth science departments in the period 1933–1960. Overall in Turkey the R & D personnel per 10,000 labor force showed a steady increase from 6.7 in 1990 to 13.6 in 2002 [27]. The increase in the number of earth scientists in the academia led to some increase in the scientific output. However, approximately 90% of the earth science publications come from established departments.

Wider coverage of Turkish journals by the SCI

Up until 2004 there were only three journals published in Turkey, *Turkish Journal of Chemistry*, *Turkish Journal of Veterinary & Animal Sciences* and *Turkish Journal of Pediatrics*, which were covered by the SCI. In 2004 the *Turkish Journal of Earth Sciences* published by TUBITAK in Ankara became part of the SCI journal spectrum. However, the change is too soon to make an effect in the publication and citation pattern of earth science publications coming out of Turkey. Currently the *Turkish Journal of Earth Sciences* lags behind in the list of journals favored by the Turkish earth

scientists (Table 6). The inclusion of the *Turkish Journal of Earth Sciences* should be seen as the result rather than a cause of the increase in the earth science publications from Turkey.

Conclusions

The earth science publications from Turkey in international journals showed a rapid increase starting in the 1990's in parallel with the increase in the total scientific output of Turkey. The increase was brought about by changes in the rules of promotion and appointment in the academia, by changes in the academic attitudes towards publishing, by increasing support for research, by financial incentives, and by the expansion of higher education. On the down side the rigid rules for promotion resulted in publication for publication sake and in an increase in the number of papers appearing in low-impact journals (Table 6). The average citation to publication ratio of Turkish earth scientists is also below average for most journals, and the citation rate of the average publication shows a decrease since the year 2000. Papers with non-Turkish first authors make up a disproportionate number of highly cited earth science articles from Turkey.

*

We thank the anonymous reviewer for his constructive and enlightening comments, which improved the manuscript. Aral Okay thanks the Turkish Academy of Sciences for financial support.

References

1. T. BRAUN, W. GLÄNZEL, H. MACZELKA, A. SCHUBERT, World science in the eighties. National performances in publication output and citation impact, 1985–1989 *versus* 1980–1984 part I. all science fields combined, physics, and chemistry, *Scientometrics,* 29 (3) (1994) 299–334.
2. W. MARX, H. SCHIER, M. WANITSCHEK, Citation analysis using online databases: feasibilities and shortcomings, *Scientometrics,* 52 (2001) 59–82.
3. A. SCHUBERT, W. GLÄNZEL, B. THUS, The weight of author self-citations. A fractional approach to the self-citation counting, *Scientometrics*, 67 (3) (2006) 503–514.
4. A. UZUN, M. E. ÖZEL, Publication patterns of Turkish astronomers, *Scientometrics,* 37 (1) (1996) 159–169.
5. S. GÜLGÖZ, O. A. YEDEKCIOGLU, E. YURTSEVER, Turkey's output in social science publications: 1970–1999, *Scientometrics*, 55 (1) (2002) 103–121.
6. D. W. AKSNES, G. SIVERTSEN, The effect of highly cited papers on national citation indicators, *Scientometrics,* 59 (2004) 213–224.
7. A. M. C. SENGOR, Y. YILMAZ, Tethyan evolution of Turkey – A plate tectonic approach, *Tectonophysics*, 75 (3–4) (1981) 181–241.
8. A. M. C. SENGOR, B. A. NATALIN, V. S. BURTMAN, Evolution of the Altaid tectonic collage and Paleozoic crustal growth in Eurasia, *Nature*, 364 (6435) (1993) 299–307.
9. S. T. XU, A. I. OKAY, S. Y. JI, A. M. C. SENGOR, S. WEN, Y. C. LIU, L. L. JIANG, Diamond from the Dabie-Shan metamorphic rocks and its implication for tectonic setting, *Science*, 256 (5053) (1992) 80–82.

10. S. MCCLUSKY, S. BALASSANIAN, A. BARKA, C. DEMIR, S. ERGINTAV, I. GEORGIEV, O. GURKAN, M. HAMBURGER, K. HURST, H.-G. KAHLE, K. KASTENS, G. KEKELIDZE, R. KING, V. KOTZEV, O. LENK, S. MAHMOUD, A. MISHIN, M. NADARIYA, A. OUZOUNIS, D. PARADISSIS, Y. PETER, M. PRILEPIN, R. REILINGER, I. SANLI, H. SEEGER, A. TEALEB, M. N. TOKSOZ, G. VEIS, Global Positioning System constraints on plate kinematics and dynamics in the eastern Mediterranean and Caucasus, *Journal of Geophysical Research-Solid Earth*, 105 (B3) (2000) 5695–5719.
11. R. S. STEIN, A. A. BARKA, J. H. DIETRICH, Progressive failure on the North Anatolian fault since 1939 by earthquake stress triggering, *Geophysical Journal International*, 128 (3) (1997) 594–604.
12. A. I. OKAY, S. T. XU, A. M. C. SENGOR, Coesite from the Daibe Shan eclogites, Central China, *European Journal of Mineralogy*, 1 (4) (1989) 595–598.
13. R. E. REILINGER, S. C. MCCLUSKY, M. B. ORAL, R. W. KING, M. N. TOKGOZ, A. A. BARKA, I. KINIK, O. LENK, I SANLI, Global Positioning System measurements of present-day crustal movements in the Arabia-Africa-Eurasia plate collision zone, *Journal of Geophysical Reserach-Solid Earth*, 102 (B5) (1997) 9983–9999.
14. A. I. OKAY, Petrology of a diamond and coesite-bearing metamorphic terrain-Dabie Shan, China, *European Journal of Mineralogy*, 5 (4) (1993) 659–675.
15. A. I. OKAY, A. M. C. SENGOR, M. SATIR, Tectonics of an ultrahigh-pressure metamorphic terrane – the Dabie-Shan Tongbai-Shan Orogen, China, *Tectonics*, 12 (6) (1993) 1320–1334.
16. J. W. MURRAY, H. W. JANNASCH, S. HONJO, R. F. ANDERSON, W. S. REEBURGH, Z. TOP, G. E. FRIEDERICH, L. A. CODISPOTI, E. IZDAR, Unexpected changes in the oxic anoxic interface in the Black Sea, *Nature*, 338 (6214) (1989) 411–413.
17. W. GLÄNZEL, National characteristics in international scientific co-authorship relations, *Scientometrics,* 51 (1) (2001) 69–115.
18. E. YURTSEVER, S. GÜLGÖZ, The increase in the rate of publications originating from Turkey. *Scientometrics*, 46 (2) (1999) 321–336.
19. Y. TONTA, Contribution of Turkish researchers to the world's biomedical literature (1988–1997), *Scientometrics*, 48 (1) (2000) 71–84.
20. Z. J. SAMPSON, Authorship counts: Forty years of the Physical Review and Physical Review Letters, *Scientometrics,* 32 (1995) 219–226.
21. J. E. BIRD, Authorship patterns in marine mammal science, 1985–1993, *Scientometrics*, 39 (1) (1997) 99–105.
22. N. MEHTA, Measuring organizational scientific productivity: A study at NCL, *Current Science,* 88 (2005) 223–230.
23. Y. TATAR, Tectonic structures along North Anatolian Fault Zone, Northeast of Refahiye (Erzincan), *Tectonophysics,* 29 (1–4) (1975) 401–409.
24. M. ERCANOGLU, C. GOKCEOGLU, Assessment of landslide susceptibility for a landslide-prone area (north of Yenice, NW Turkey) by fuzzy approach, *Environmental Geology,* 41 (6) (2002) 720–730.
25. C. GOKCEOGLU, H. AKSOY, Landslide susceptibility mapping of the slopes in the residual soils of the Mengen region (Turkey) by deterministic stability analyses and image processing techniques, *Engineering Geology*, 44 (1–4) (1996) 147–161.
26. A. UZUN, Science and technology policy in Turkey. National strategies for innovation and change during the 1983–2003 period and beyon, *Scientometrics*, 66 (3) (2006) 551–559.
27. Y. TUBITAK, *Research, Development and Innovation in Turkey*. Research Monograph, (2004), http://vizyon2023.tubitak.gov.tr/yayinlar/.