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The UNESCO-IUGS International Geoscience Programme (IGCP) in the service of society since 1972

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Abstract

Developing an advanced understanding of the Earth's fundamental processes and resources is essential to fulfil the United Nations 2030 Agenda for Sustainable Development. The International Geoscience Programme (IGCP) is the oldest and most successful example of scientific cooperation between a non-governmental organization – the International Union of Geological Sciences (IUGS) – and an intergovernmental organization – UNESCO. During almost 50 years, this programme has been the gateway to successful scientific careers in pioneering research for thousands of IGCP project scientists.

After almost 50 years of evaluating International Geoscience Programme (IGCP) projects, the programme itself was evaluated through statistical analysis of the annual progress report during four periods: 1981-1982, 1991-1992, 2001-2002 and 2011-2012. Subsequently, these trends were compared to the trends of the last 4 years (2015-2018). This study provided insight into trends and changes in the location of studies, participating countries, involvement of developing countries, gender equality, etc. To fully understand the added value of the IGCP brand identity and its seed funding, project leaders over a period of 5 years (2008-2012) were asked to complete a survey about its work.

Overall, both studies confirmed the value of the main aim of the IGCP: enabling and facilitating international collaboration between Earth scientists. Even though IGCP funding has been reduced, the IGCP brand still opens doors to new collaborators, new research and national funding agencies, often impacting the career of the involved researchers very positively.

Introduction

Developing an advanced understanding of the Earth's fundamental processes and resources is essential to achieve the Sustainable Development Goals (SDGs), which are at the heart of the 2030 Agenda for Sustainable Development, adopted by all United Nations (UN) Member States in 2015. UNESCO is the only UN organization with a mandate to support research and capacity building in the Earth Sciences and the International Geoscience and Geoparks Programme (IGGP) is its flagship programme to reach transformative results in this field.

The IGGP consists of two pillars:

1) International Geoscience Programme (IGCP): Since its creation in 1972, this programme has harnessed the intellectual capacity of a worldwide network of Earth scientists to lay the foundation for our planet's future, focusing among others on responsible and environmental resource extraction, natural hazard resiliency and preparedness, and adaptability in the era of a changing climate.
2) UNESCO Global Geoparks (UGGp): These are laboratories for sustainable development, which promote the recognition and conservation of our Earth's heritage and are managed with a holistic concept of protection, education and sustainable development to support local communities through a bottom-up approach. As of April 2019, there are 147 UNESCO Global Geoparks within 40 UNESCO Member States, covering an area of over 250,000 km^2.

Our focus in particular will be on the evolution and value of the IGCP. Since its creation in 1972, the IGCP, parented by both UNESCO and the International Union of Geological Sciences (IUGS), has brought together thousands of Earth scientists from around the world to facilitate international scientific cooperation in the Earth sciences. IGCP brings together international scientists and provides them with seed money to devise and conduct joint international research, publishing collective results. So far UNESCO, IUGS and extra-budgetary sources, have supported seed funding to 3710 IGCP projects.

In the early years, the Programme enhanced scientific exchange through the correlation of geological strata and research data, focusing on basic geoscientific research and on making connections between events throughout the Earth's history. The success of the programme is not only linked to the high quality of the projects carried out throughout these years, but also to the flexibility of the programme that could be adapted to the changing circumstances and needs of human society. Today, the collaborative IGCP projects primarily deal with global issues from an Earth science perspective within its five programmatic themes:

- Earth Resources: Sustaining our society
- Global Change: Evidence from the geological record
- Geohazards: Mitigating the risks
- Hydrogeology: Geoscience of the water cycle
- Geodynamics: Deep Earth - Control our environment

High on the list of selection criteria for these projects are scientific quality, the benefit to society from the research, the emphasis of capacity building and the extent of the international, multidisciplinary collaboration likely to be generated by a proposed project, particularly through North-South and South-South cooperation. IGCP seed funding, generally ranging between 3,000 to 10,000 USD per year, is particularly allocated to support scientists from developing countries, who generally have less access to research funding.

Each project has an average lifespan of five years and its progress is assessed annually through a rigorous peer-review process conducted by the IGCP Council following the evaluation reports from members of the Scientific Board. The Scientific Board and IGCP Council are also responsible for the evaluation of new project proposals.

The Scientific Board consists of around 50 specialists responsible for scientific review. Board members are appointed as specialists in their given field within one of the five IGCP themes, while

also maintaining a balanced worldwide geographic distribution. The IGCP Council comprises of six members, a chairperson and five experts, one for each IGCP theme.

To maintain momentum, focus and on scientific advancement, the programme itself was evaluated on request of UNESCO's Member States in 2014 and will be assessed again in 2019.

This study presents the statistics on past IGCP projects, comparing current data against the data analysis from the last 4 years (2015-2018) and the results of the IGPC project leader survey which looks to identify added-value aspects of IGCP.

The annual progress reports of IGCP projects of the last 43 years were statistically analysed to evaluated trends and changes in for example region of study, participating countries, involvement of developing countries and gender equality throughout the programme's history. These results were compared to the analysis of the IGCP reports of the last 4 years (2015-2018), to assess the most modern trends.

Additionally, past IGCP project leaders were contacted to complete an online survey about the added value of the IGCP brand and the IGCP seed funding to scientific research and collaboration projects.

Statistics on past IGCP projects (1981-1982, 1991-1992, 2001-2002, and 2011-2012)

The IGCP Secretariat has carried out a statistical study covering past IGCP project annual reports during four time periods (1981-1982, 1991-1992, 2001-2002, and 2011-2012). A total of 196 IGCP projects or 336 annual reports were analysed. In all, these 196 IGCP projects, active in these four time frames, 489 project leaders and participants from 161 different countries were involved. This study added valuable new information as exact counts of how many countries, male vs female scientists, number of publications per project etc had never been done before. Overviews of each IGCP project, especially their scientific accomplishments, have been provided in each of the IGCP annual reports provided by the UNESCO Secretariat in the past. The programme on its own was reviewed in 2005 on the sixtieth birthday of UNESCO as an institution (Petitjean et al. 2006). These reports did provide a very good overview of the accomplishments of the individual projects and the programme, they did not cover the fundamental changes in composition of the projects through time.

Project topic and region of study

Although the current five IGCP scientific themes (Earth Resources, Global Change, Geohazards, Hydrogeology and Geodynamics) were only introduced in 2007, the previous IGCP projects also fit easily in one of these five categories.

Over the past 40 years some important changes in research topics can be detected. There is a strong increase in research with an important societal relevance such as geohazards, hydrogeology and climate change (Fig. 1A). However, the number of projects focussing on Earth Resources has reduced since the 1990s (Fig. 1A).

There has also been a shift in trend in study locations for research projects. This shift reflects changes in international relationships and the changing focus of IGCP itself.

IGCP has always had the primary goal to facilitate international collaboration amongst geo-scientists. In the 1970s and 1980s IGCP was focused on an East-West collaboration, enabling scientific exchange between scientists from both sides of the ´wall´. From the 1990s this changed to a North-South, with increasing South-South focus, centring on the collaboration between scientists from industrialized and developing countries. Consequently, there has been a drop in projects only focussing on Europe, but an increase in projects focussing specifically on Africa (Fig. 1B).

Generally, most projects can be considered as global. This means they have study sites in multiple regions in the world (Fig. 1B).

Project leaders and participating countries

The foundation of IGCP is the promotion of scientific collaboration. Based on the average number of project leaders per IGCP project the concept of collaboration at even the higher levels has strongly increased over the years. While each IGCP project had averagely less than 2 project leaders per project in the 1980s, this number has increased to 5 project leaders per project in the last decade (Fig. 2A). This shift from 2 to 5 project leaders on average might be due to the fact that geoscientific inquiries have become more complex that answering them requires a larger teams of scientists with a different expertise. Also collaboration is an essential part of scientific research, and IGCP greatly puts emphasis this aspect also during the evaluation of the project proposals.

When considering the gender of the project leaders, we do see a positive increase in female project leaders, from 0% women (this number might be inaccurate, it was not always possible to determine the gender of the project leaders in this time frame) in the 1980s to 19% in the period 2011-2012 (Fig. 2B). However, the participation of women in the project leader groups is still low and not in line with either UNESCO's policy or the expectations of a modern society.

The project leaders are still primarily based in western countries in Europe and North America (Fig. 3A). Nevertheless, there is a steady increase in project leaders from Africa and Asia (Fig. 3A). Overall, 33% of the project leaders are based in a developing country, (based the UN Human Development Index (HDI during the relevant period).

A similar trend can be seen in the list of participating countries per project. There is a steady increase in participation of scientists from Africa and Asia (Fig. 3B). The general involvement of developing nations has remained rather unchanged over the past 40 years. IGCP has already taken steps to give extra support to scientists from developing nations, thanks to funding of the Swedish International Development Cooperation Agency (SIDA) and through mentoring scientists, particularly from African nations with the application process. With Africa as a focal point for the upcoming UNESCO missions, this emphasis will continue in the future.

Project results

The number of IGCP projects has decreased drastically since the 1990s, mostly due to decrease in funding (Fig. 4). In contrast, the output, the number of meetings or workshops and the number of publications, has increased (Fig. 4). Nonetheless, it should be noted that the importance of scientific publications within research has increased over the years. Consequently, the reporting format of the annual reports has adapted to this trend. It is possible that the list of publications in older reports is incomplete.

Summary

In general, the IGCP projects have increased in scope of research topics with important societal relevance (climate change, geohazards or water related studies).

There is also an increased involvement of developing nations (especially African countries) at both leading and participating level. A similar trend is visible in the participation of female scientists.

Despite the decrease in projects and funding, the number of meetings, workshops and scientific publications per IGCP project has increased.

A number of questions remain unanswered. Due to the current reporting format, we were unable to assess the exact ratios of male vs female scientists, junior vs senior scientists and scientists from developed vs developing nations, especially at the participating level. To address this issue changes have been made to the IGCP progress report template, which all project have to submit annually to the UNESCO Secretariat. As of 2014 the template now also request project leaders to list the number of male vs female scientists, junior vs senior scientists and scientists from developed vs developing nations at both project leader and project participant level.

It is also unclear if explicit efforts have been made to involve female and/or young scientists and/or scientists from developing nations.

Data collection around the number of scientists attending meetings and workshops organized within the projects was also ambiguous.

Consequently, the IGCP annual report was adapted in 2015 to ensure that these issues were addressed.

Comparison of past trends versus the current situation of IGCP project

In 2018, scientists from 105 countries participated in the research and capacity building activities of 27 active IGCP projects (Fig. 5). This is in line with the trend shown before, indicating greater country involvement in IGCP projects, resulting in a worldwide coverage. In 2018 a total number of 160 IGCP Project Leaders came from 57 different countries, which reflects the trends shown. These 160 project leaders brought together 4485 project participants. Of all the project participants, 56% are young scientists (<35 years old) and 65% of all participating scientists come from developing nations.

The analysis of the 2018 annual reports confirms the trend observed during last four years and of the four time periods (1981-1982, 1991-1992, 2001-2002, and 2011-2012). The reach and diversity of IGCP project increases continuously from year to year (Fig. 6).

By identifying gender equality as a global priority for its Organization, UNESCO has committed to making a positive and lasting contribution to women's empowerment and gender equality around the world. IGCP projects show very promising results on gender equality, with women comprising of 32% of all participating scientists in 2018. Women make up 32% of the participants from developing countries, 34% of young scientists and 27% of project leaders (Fig. 7). This is a really positive increase and evolution, especially compared to IGCP projects of the 1970s, 1980s and 1990s.

Survey of the added value of the IGCP brand and seed funding (2008-2012)

To assess the added value of the IGCP identity and IGCP funding, the IGCP secretariat contacted project leaders of the 5 year period 2008-2012. In total 266 IGCP project leaders were contacted and asked if they could fill in an online survey about IGCP. A total of 75 project leaders (28.2%) responded.

IGCP funding

Considering IGCP funding is limited to only 5,000 to 10,000 USD per project year, most projects run for 5 years, the IGCP secretariat was wondering if the funding itself makes a difference in the budget required to organize meetings, workshops, 77.6% of the respondents say 'yes', it does make a difference, but that they would prefer to receive a bit more funding (Table 1). However, according to 69% of the project leaders the IGCP affiliation makes it easier to acquire additional funding. The majority of this additional funding comes mostly from more than one source (Table 1). Overall national funding agencies (72.9%) seem to be the biggest additional source, followed by university funding (51.4%), international funding sources (25.7%) and private funding (21.4%). 10% of the respondents did not have an additional funding source.

IGCP: More than research

The main focal point of IGCP is global cooperation. When we asked the project leaders if their IGCP project facilitated the interaction with new collaborators in disciplines and/or countries they had previously never met, 90.7% said 'yes' (Table 1). Most of them consider this the most important benefit. Especially scientists from developing countries claim IGCP was crucial in establishing new collaborations.

According to 89.3% of the correspondents IGCP project also encouraged the project leaders to be more involved in educational, training or capacity building activities (Table 1). This side of IGCP allows (under)graduate students from developing countries – thanks to IGCP funding – to be trained by specialists.

The IGCP funding, with grants for students, facilitates and encourages 89% of the project leaders to attract more scientists from developing countries, in particular young and/or female scientists (Table 1). The connection between IGCP and the association of Early-Career Earth Scientists (YES) helps as well.

IGCP and UNESCO missions

Since IGCP is parented by UNESCO, the programme should be in line with the UNESCO missions. We asked the project leaders to rank, on a scale from 0 to 10, how much their project contributed in completing the tasks set forward in the UNESCO mission statement (see Fig. 8). UNESCO missions related to exchange of knowledge, capacity building and cooperation were ranked 7 or more (Fig. 8).

IGCP and IUGS media

Since publishing scientific results is important to validate research, we asked the project leaders if they had ever used the IUGS media channels to publish their results, if they were aware they existed and if 'yes', why they have used or not used them.

65.8% of the correspondents have published their results in the IUGS journal 'Episodes' (Table 1), 78.6% have published in an IUGS book (Table 1) and 76.1% have published updates about their projects in the IUGS newsletter (Table 1). Overall 28.3% of the respondents are very positive about the IUGS media, praising the wide distribution, good international exposure and open-access. However, 39.1% of the respondents were not familiar with IUGS media. Also 32.6% was aware of its existence, but decided not to publish in any of the IUGS media, because of the low impact factor, because the 'Episode' journal is not well known the journal was also seen as too general and there was criticism around the very slow submission publication process. IUGS took into account these comments and improved the paper publishing process for the *Episodes* journal by shortening the time between the submission of a paper until the final publication after review.

Overall benefit of IGCP

Overall, 93.3% of the correspondents said that leading an IGCP project had a long-lasting impact on their research (Table 1), especially thanks to joint international publications, the ability to increase their scientific network, international recognition of their (young) research groups, often located in developing countries whilst enabling scientists from developing countries to access state-of-the-art laboratories in developed nations.

93% of the project leaders confirm that the IGCP brand, the logo and UNESCO and IUGS affiliation benefited their research (Table 1). Often the IGCP recognition facilitates researchers to obtain additional funding from their national funding agencies.

Summary

In general, all respondents were extremely positive about the International Geoscience Programme. To quote some of the answers:

"IGCP funding is like holy water, a couple of sprinkles encourage funding from a wide array of sources."

"The IGCP affiliation opened doors for research collaborations."

"IGCP has been the most important factor in my career."

"Thanks to IGCP our research group was consolidated and became known and recognized scientifically ban international specialised audience."

The general complaint by all respondents is that the funding given by IGCP is too limited.

Conclusions

The International Geoscience Programme (IGCP), which has been running for nearly 50 years, is still as strong as at the beginning.

Network expansion and collaboration are the foundation of UNESCO IGCP projects and this leads to new research, new collaborations, especially North-South and South-South (i.e. developed-developing world and between developing nations itself), knowledge exchange and scientific recognition.

Although the IGCP funding is rather limited, it is considered by the scientists as a '*rolling stone that creates a funding avalanche*'.

Over the years, the scientific topics have been well adapted to societies´ needs, changing over the years as does our society.

There is a significant increase in gender and developing versus developed world diversity among the IGCP project participants. Additionally, IGCP projects help create opportunities for young scientists.

Consequently, there is still a great demand from Earth scientists across the globe for IGCP, since the programme and the UNESCO and IUGS affiliation can be considered as a quality mark for good research.

Acknowledgments

We would like to thank all IGCP project leaders who completed the survey. Their answers were crucial in this assessment of the added value of IGCP.

References

Petitjean, P., Zharov, V., Glaser, G., Richardson, J., de Padirac, B. and Archibald, G. (eds.) 2006. Sixty years of science at UNESCO 1945-2005. Paris, UNESCO

Figure captions

Figure 1: A) Graph, which shows the evolution of the study regions of the IGCP projects throughout the years. Global indicates that the project has multiple study sites in different parts of the world. B) Graph which shows the evolution of the research themes of the IGCP projects throughout the years. Although the five themes indicated here were only introduced in 2007, older projects where divided into these themes by studying their project description.
Figure 2: A) Graph, which shows the evolution of the number of project leaders - minimum, maximum and average number - of the IGCP projects throughout the years. B) Graph which shows the evolution of the male/female diversity of the IGCP project leaders throughout the years. The total written in white in the bars indicates the total number of project leaders for that time frame.
Figure 3: Graph, which shows the evolution of the number of countries per region involved in IGCP projects throughout the years. A) at the level of the project leaders. B) at the level of the participating scientists.
Figure 4: Graph, which shows the evolution of the number of IGCP projects and the average output (i.e. meetings, workshops, publications ...) per IGCP project throughout the years.
Figure 5: Geographic visualisation of all 105 countries participating in IGCP Projects active in 2018
Figure 6: Graph, which displays the evolution of the IGCP between 2015 and 2018, including the number of active projects, percentage of scientists from developing countries, percentage of young scientists, percentage of female scientists, number of participating countries, and number of researchers participating in these projects.
Figure 7: Graph, which depicts the participation levels of women in the IGCP for the projects active in 2018. Within the female participation level, a further division was made based on the percentage of female participants from developing countries, the percentage of female young scientists, and percentage of female project leaders.
Figure 8: Graph, which shows how well the surveyed project leaders averagely consider their IGCP project to contribute to completing the UNESCO mission statements.

Table captions

Table 1: Table listing the answer (yes, no or no difference) to the most relevant questions from the project leader survey.
Table 1:

	Yes	No	No difference
IGCP FUNDING			
Did the IGCP funding awarded to your project make a difference in the budget required to organize meetings, workshops, ...?	77.6	22.4	/
Did the IGCP affiliation make it easier to acquire this additional funding?	69.0	14.1	16.9
IGCP: MORE THAN RESEARCH			
Did the IGCP project facilitate you to interact with new collaborators in disciplines and/or countries you previously had never met?	90.7	9.3	/
Did the IGCP project encourage you to be more involved in educational, training or capacity building activities?	89.3	10.7	/

Did this IGCP project encourage you to facilitate participation with scientists from developing countries, in particular young and female scientists?	89.0	11.0	/
IUGS MEDIA			
Did you publish any of the results of your project in 'Episodes', the journal of IUGS?	34.2	65.8	/
Did you publish your results of your IGCP project in an IUGS books or as a chapter in an IUGS book?	21.4	78.6	/
Did you publish a newsletter about your IGCP project, its progress or a call for new project participants in the IUGS Electronic Bulletin?	23.9	76.1	/
Did you attend the International Geological Congress (IGC), organized every four years by IUGS, to present the research of your IGCP project to the scientific community?	51.4	48.6	/
OVERALL BENEFIT OF IGCP			
Has an IGCP project had a lasting impact on your research (e.g. new collaborations, new projects, introduction to new techniques) even after the project ended?	93.3	4.0	2.7
Overall, has the IGCP brand (logo and UNESCO and IUGS affiliation) benefited your research and research collaborations?	93.0	4.2	2.8