

International Science Programme (ISP) Annual report 2022



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Cover photo: Monitoring and analysis of water quality in canals of Vientiane Capital, Laos.

1. Executive summary

In 2022, the International Science Programme (ISP) at Uppsala University has continued to build research capacity and postgraduate education in low and lower-middle income countries. During 2022, ISP has fulfilled most of the objectives and strategies outlined in ISP's [Strategic Plan 2019-2024](#).

ISP success stories

In 2022, ISP supported groups have been actively involved in the fight against Ebola in Uganda (chemistry) and a Rwandan PhD student, Ms Ange Cynthia Umuhire, was awarded the prestigious *L'Oréal-UNESCO for Women in Science sub-Saharan Africa Young Talents Awards* (physics) and , Dr Lydie Mpinganzima, received an award for Best Female Scientist during the 1st Rwanda STI (Science, Technology and Innovation) Conference 2022, organised by the National Council of Science and Technology in Rwanda (mathematics).

In 2022, ISP was awarded an Erasmus+ CBHE (Capacity Building in Higher Education) grant for the project PEP, directed towards French-speaking West Africa. This sort of funding is new to ISP, and can be seen as a successful attempt to secure funding outside Sweden.

The ISP supported groups have increased the number of staff, postgraduated students, PhD and MSc graduations including the share of females on all mentioned levels. They have also increased the number of scientific publications and conference contributions. ISP has also increased the visibility of ISP's activities, for instance through all the webinars arranged by ISP during the International Year of the Basic Sciences for Sustainable Development.

The digitalization of conferences and meetings in the wake of the Covid-19 pandemic, made it possible to arrange meetings, workshops, seminars and international conferences without any costs for travel, hotels and per-diem. This new kind of international interaction has continued during 2022.

Research findings and the SDGs

There are many examples of research findings by the ISP supported research groups and networks that are linked to the Sustainable Development Goals (SDGs). Such findings can be found in the fields of (in alphabetical order) Atmospheric physics, Chemical physics, Computational physics, Herbal drug safety, Mathematical modelling, Materials physics, Medical physics, Nanophysics, Plasma physics, Seismology, Space physics, Spectroscopy and Water chemistry.

Most research results are connected to *SDG 3 – Good Health and Well-Being* and *SDG 7 – Affordable and Clean Energy*.

Because many of the ISP supported networks include researchers from more than one university and country, the results are connected to and shared among a large number of higher education institutions (HEIs).

Use of research results (including technical development)

Researchers from the supported groups and networks have used their research results and skills as consultants for governments, NGOs and companies (Burkina Faso, Ethiopia, Laos, Nepal) and facilitators for solar cell installation (Kenya, Tanzania). In Nepal, group members assisted the Nepal Engineers Association (NEA) in establishing good practices in lightning protection and electrical safety.

The ISP supported research groups and networks have also contributed to technical development and services in their home countries and beyond. Examples are, repairing scientific equipment for different educational and research organizations (Bangladesh), preparing necessary reagents for Ebola test kits (Uganda), setting up a mini sewage treatment plant and a water treatment facility (Uganda),

Outreach (including policy influence)

The outreaching activities performed by the ISP supported research groups and networks were directed toward governmental bodies, organizations, the general public, undergraduate students, schools, industries and other similar stakeholders. The groups and networks have worked in different ways to popularize their research results:

- Through media (TV, radio, newspapers).
- Through events (contests, webinars, meetings with local community).
- Through education (school visits, training programs).

ISP supported groups and networks have had considerable policy influence, mostly on a national level when members act as consultants to national governments (e.g., investigating wastewater quality and current performance of decentralized wastewater treatment facilities in Laos, elaborating on a national strategic plan for nutrition in Burkina Faso, setting up an Energy Research Institute in Kenya and overseeing contaminants in the packing industry in Tanzania). In Uganda, the network's results on mathematical disease modeling (e.g. Covid-19, Malaria, HIV/AIDS, TB) have been utilized by the Uganda Medical Research Council and Uganda Virus Research Institute.

Gender

During 2022, ISP has continued to address the gender gap in science in the supported research groups and networks. The groups and networks in physics and mathematics could apply for and use the ISP Gender Equality Grants, while groups and networks in chemistry have had the possibility to use their regular ISP project allocations for gender activities. It is clear that most groups and networks are aware of the gender bias in science, and carry out activities to reduce it.

The variety of gender equality promoting activities carried out have addressed different and essential tasks, as required for a serious and sustainable gender work. Similar to last year, there are different "tracks" for the activities that were carried out:

1. Encouraging female undergraduate students to continue to Master studies and/or PhD studies in chemistry, mathematics and physics through
 - Financial support to female PhD students (Bangladesh, Burkina Faso, Kenya, Zambia), MSc students (Ethiopia, Kenya, Tanzania, Uganda, Zambia) and postdoctoral fellowships (Burkina Faso, Kenya).
 - Supporting equipment, e.g. laptops, consumables and chemicals to PhD students (Bangladesh, Rwanda).
 - Launching conferences, awareness campaigns and career guidance directed to female students (Burkina Faso, Mali, Nepal).
 - Mentoring, training/workshops, webinars and recruitment drives for female students (Burkina Faso, Laos, Nepal, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe).
2. Affirmative actions directed to female students, e.g., preference to female PhD students during PhD admissions (Bangladesh), allocated slots (66%) at the MSc program in chemistry for women (Uganda), research grants and travels grants directed to woman only (Kenya, Tanzania, Zambia)

3. To inspire female students through role-model sessions, e.g. meetings, seminars (Burkina Faso, Nepal, Uganda).
4. Many groups see the need to engage primary and high school female students in the basic sciences in order to promote their selection to university programs in science and technology, e.g., by motivating visits, by science camps, and by science workshops (Ethiopia, Rwanda, Tanzania, Uganda).

Supported groups and networks

In total, 43 research groups and 20 networks were supported by ISP in 2022. It is the same supported groups and networks as 2021.

No new groups/networks received ISP support in 2022.

Staff

In 2022, in total 1,000 staff members were involved in ISP supported activities, and 24% of them were women. These numbers don't deviate much from what's been typical since 2014, although there has been a slow but steady increase of woman staff members.

Students

In 2022, in total 1,326 postgraduate students were reported to be active in research groups and networks. The number of students has increased considerably since 2010. Close to 450 PhD students have been active each year since 2016, but in 2022, ISP had an all-time high with 626 PhD students. The yearly number of MSc students usually exceeds 600 (696 in 2022).

The average share of female PhD postgraduate students increased to 29% in 2022 compared to the average of 23% for 2008-2013. The share of female MSc students has also increased, from 27% to 30%. Looking at data over time, it also becomes evident that the share of female PhD and MSc graduates has increased markedly in all three ISP programs.

These increases are more pronounced in the mathematics and physics programs than in the chemistry program, where the share of female students were more significant from the start. This important result is probably an effect of ISP's efforts since 2014 to increase the participation of women in postgraduate studies among mathematics and physics groups and networks in Africa.

ISP monitors whether admitted PhD students continue to graduation (PhD retention). The share of PhD students continuing each year, has increased from a yearly average of 81% (same for women as for men) in 2011-2013, to 88% in 2022. The retention for men PhD students is 89% and for women PhD students 88%.

The average time PhD students take to graduation essentially has remained the same over the years (close to 5 years), but is in 2022 higher for both sandwich (5,2 years) and local students (5,7 years). The prolonged time might be an effect of the Covid-19 pandemic, with closed universities, bad internet connection and travel restrictions. The time required for the PhD study may be extended because of mainly teaching duties, in particular when PhD students are also staff members at their institutions.

Publications

The number of publications reported by the supported groups and networks, has increased since last year (702 in 2022, 601 in 2021). However, the number published in quality journals has decreased (53% in 2022 and 60% in 2021). Also, 89 (13%) publications were in journals by “predatory publishers”. This is higher than last year, even though ISP has continued to make particular efforts to inform its partners about the risk of wasting scientific research results in predatory journals.

The rate of acknowledgements of ISP in published articles remains low; it has ranged between 27% and 33% since monitoring started in 2016, but in 2022 it is even lower (26%). One reason for this may be that groups and networks report all their publications to ISP, as a reflection of the overall research capacity, and also when particular research results published have been obtained using other funding.

Conference contributions

For 2022, in total 473 contributions at scientific conferences were reported by groups and networks, 58% of them at international conferences. The high number might be an effect of the Covid-19 pandemic, since many conferences since turned into hybrid mode, making online participation easy.

Arranged meetings

A total of 127 scientific meetings with in total 7,195 participants were arranged by ISP supported groups and networks in 2022. These are a decrease from last year, but still impressive numbers.

Expenditures

In 2022, the total expenditures of research groups and networks amounted to 93% of the funding provided by ISP, which was 21.7 million SEK.

The yearly research funding from other sources than ISP has increased steadily since data on this started to be collected in 2015, and was in 2022 44 million SEK (22 million SEK in 2021). If in-kind contributions are added to other funding, 78% of the total funding is from other sources than ISP. This is a huge increase since the introduction of this indicator.

In 2022, a majority of the requested audits of funds transferred for local use could be approved by ISP without comments. This is a welcomed development compared to previous years.

Challenges

ISP builds research capacity in low and lower-middle income countries. In addition to considerable successes, ISP also encounters several challenges and obstacles in its work at partner institutions. These may for instance be related to the partners’ research infrastructure, e.g., expertis, instruments, funding, and institutional environment such as procurement, import clearance, and financial administration.

Even though there is a positive decreasing trend of the gender gap in science, still more men than women are active researchers.

ISP works in many fragile states. Political turmoil may affect supported groups and networks if Sida asks ISP to withdraw or suspend support because of violent political development. This is the case for the three supported groups and networks in Myanmar. One of the groups is still active, but with no funds from ISP.

In 2022, predatory publishers continued to claim victims among ISP supported groups and networks.

ISP still needs to improve the engagement of previous partners, so that they can help strengthen more recently supported groups and networks.

Lessons learnt

ISP will continue to promote gender equality, e.g. through the ISP Gender Equality Grants.

Post Covid-19 pandemic, it is still important to discuss which parts of the work that effectively can be performed online, and what need exists for traveling and meetings in real life (IRL). For ISP, travels has been reduced to some extent. However, IRL meetings constitute a crucial part of ISP's operational method because on-site observation of opportunities and problems with respect to people, laboratories, working strategies, institutional environment, and other conditions is generally the fastest and most efficient route towards making best use of the ISP support.

There is a need to continue arranging seminars and workshops about predatory publishers and how to avoid them. Seminars and workshops (both online and IRL) about predatory publishers and how to avoid them, have attracted great interest among our supported groups and networks. They will be arranged by ISP also in the future.

ISP will continue the attempts to increase the visibility of the program and of supported groups and networks, by engagement in social media and in newsletters, as well as via webinar series like the ones organized in 2022 by ISP under the umbrella of IYBSSD2022 (the International Year for Basic Sciences for Sustainable Development 2022).

Other ISP cooperation

In 2022, ISP continued the cooperation with Stockholm University, TICA (Thailand Interantional Cooperation Agency), the American Institute of Physics (AIP), Thailand Center of Excellence in Physics (ThEPCenter) and Unisa-iThemba in South Africa.

ISP has also continued to cooperate with UPE (Unit for Professional English) and with the Division for Internationalisaton at Uppsala University, and the International Year of the Basic Sciences for Sustainable Development (IYBSSD2022).

ISP has continued to coordinate the Sida bilateral programs for research cooperation, on the Swedish side, in Bolivia (new), Cambodia, Ethiopia, Mozambique, Rwanda, Tanzania and Uganda. The research support to Uganda was concluded June 30, 2022. ISP has also administrated the payments of subsistence allowance to students in all bilateral programs while in Sweden.

2. What is ISP?

ISP is short for the International Science Programme and refers to a unit at Uppsala University in Sweden.

ISP assists low and lower-middle income countries in Africa, Asia and Latin America to build and strengthen research capacity and higher education in the basic sciences chemistry, mathematics and physics, where such capacity is non-existing or weak, by support to institutionally based research groups and scientific networks. When so required, the work is carried out in close cooperation with researchers at better equipped host institutions. Although the program is hosted by Uppsala University, ISP is a truly international program. Host institutions for research collaboration and for sandwich students may be located at other Swedish universities, in other Nordic and European countries, or in the regions of supported partners.

ISP is also coordinator on the Swedish side for the Sida bilateral research cooperation in Bolivia, Cambodia, Ethiopia, Mozambique, Rwanda and Tanzania. The Sida research support to Uganda was concluded June 30, 2022.

[For more details about ISP, please see Appendix 4]



Figure 1. The 12th ANRAP workshop on “Chemical Studies and Bioassay of Antidiabetic Plant Materials” was held at Bangladesh University of Health Sciences (BUHS), Mirpur, Dhaka, Bangladesh.

3. What does ISP do?

ISP's ultimate goal is to increase the research capabilities in the target countries, and to promote the use of results in the fight against poverty, for example by innovations and increased employability. In a long-term perspective, the results and acquired skills are expected to favorably impact society by promoting social and economic growth and by developing human resources useful for addressing development challenges. Once groups and networks have reached sufficient strength, ISP may redirect its resources to environments with greater need for support.

In the following sections, each of the ISP objectives and strategies¹ will be reviewed. In the Appendices, all objectives and strategies are listed, indicating which section in the report they are linked. *[Please see Appendix 4.5]*

In short, ISP promotes:

1. Better planning of and improved conditions for carrying out scientific research and postgraduate training.
2. Better-qualified postgraduate students (Master's and PhD levels).
3. Increased production of high-quality research results.
4. Increased use by society of research results and of graduates in development.
5. Improved gender balance in the basic sciences.
6. An expanded global perspective through increased collaboration between scientists in the global South and the global North.

Below we will see how and where ISP's support has succeeded in fulfilling of ISP's objectives and strategies.

¹ISP's Strategic Plan 2019-2024: https://isp.uu.se/digitalAssets/504/c_504322-l_1-k_isp_strategic_plan_2019-2024_final-paged.pdf

4. ISP success stories

Over the years, perhaps the most evident ISP success stories are the increases in numbers of:

- Students on PhD and MSc level,
- Female students on PhD level,
- Graduates on PhD and MSc level,
- Female graduates on both PhD and MSc level,
- Female staff members,
- Scientific publications,
- Contributions at scientific conferences.

These hard facts show that the ISP *modus operandi* works very well and should continue. One reason for the success is that ISP throughout the years has continued developing and adapting its operational methods, taking advice from evaluations, in close collaboration with its partners, and has safeguarded a strong local ownership. The support has kept the needs of each partner in mind and has been managed on a collegial scientist-to-scientist basis.

In the long-term perspective, the number of female PhD have increased considerably. This is first and foremost attributed to supported groups' and networks' hard work to fight the gender bias in science. ISP has contributed to this mind-set by providing grants, mentoring and ISP staff role-models. There are, however, variations between years, and in 2022, a small decrease of the share of female students in mathematics, both on PhD level and MSc level, was observed.

ISP's sandwich model for PhD and MSc students has continued to work very well. The sandwich student alternates between the home institution and a better equipped scientific host institution.² The model gives students access and exposure to more advanced training facilities, new cultures (both academic and non-academic) and international research collaboration. This is done without detaching students from their home institution (and families) for several years. ISP has previously shown³ that the "brain-drain" of students is very low in the ISP programs. Almost 90% of the PhD graduates work in their home country after their graduation. A large majority is working at universities or research institutes, many holding positions as lecturers or associate professors. The results confirm that the sandwich model is an excellent way to build capacity at a partner institution at a relatively low cost.

The ISP Gender equality grants have continued to prove its usefulness and value; supported groups and networks have shown an enormous inventiveness when using the small grant for outreach activities. *[For more details, please see 5.1 Gender equality]*

A success story for ISP chemistry:

During the recent outbreak of Ebola in Uganda, the medical services ran short of some key reagents necessary for Ebola testing, and ordering the reagents directly from manufacturers could take time before delivery. Yet the country needed extensive screening of all potential contacts. An ISP supported chemistry group at Makerere University (MAK) collaborated with colleagues from MAK College of Health Sciences, who developed a rapid diagnostic kit for Ebola virus screening. By utilizing facilities in the group's laboratory (provided by ISP), group members successfully prepared the

² www.handbook-internationalisation.com/de/handbuch/gliederung/#/Beitragsdetailansicht/174/654/The-Sandwich-Model---A-Successful-Case-of-Capacity-Building

³ Rebecca Andersson, [Tracing ISP Graduates 2014-2017](#), 2018.

colloidal nano gold reagent which was missing in the test kits, and the Ebola task force carried out on the crucial screening.

A success story for ISP physics:

The Fondation L'Oréal and UNESCO have established an award, the *L'Oréal-UNESCO for Women in Science sub-Saharan Africa Young Talents Awards*. Each year, 20 African women researchers (15 PhD students and 5 Postdocs) are rewarded. In 2022, Ms Ange Cynthia Umuhire, PhD student in the ISP supported physics group in Rwanda, was declared among the winners. Ms Umuhire's research is in space weather prediction and forecast.

A success story for ISP mathematics:

Dr Lydie Mpinganzima, received an award for Best Female Scientist during the 1st Rwanda STI (Science, Technology, Innovation) Conference 2022, organised by the National Council of Science and Technology in Rwanda. Dr Mpinganzima was an ISP PhD student at Linköping University, Sweden. She graduated in 2014.

In 2022, ISP was awarded an Erasmus+ grant for the project PEP (Capacity Building for Professional English Programs), directed towards French-speaking West Africa. This funding is new to ISP, and can be seen as a successful attempt to reach funding outside Sweden.

The digitalization of meetings and conference during the Covid-19 pandemic has continued to make it possible to arrange international conferences, seminars and meetings without any costs for travel, accommodation and per-diem. In the beginning of the pandemic, ISP helped groups and networks to acquire Zoom licenses and internet access. It is quite remarkable that the conversion from IRL (in real life) meetings to digital ones occurred so rapidly and painlessly. On the negative side, the digital meetings lack the informal "in-between" talks during coffee breaks and lunches, and closer interactions with students at the supported institutions. Obviously, it is also impossible to evaluate working environment, instruments etc. in supported groups and networks, in an online meeting.

One example of successful digital meetings is the [African Mathematics Seminar \(AfMS\)](#), which during 2022 organised 13 webinars with approx. 700 participants in total. Another example of a successful online event is the 100 digital research workshops on the necessity of academic planning and a well-established research culture that Dr Cecilia Öman, assistant director for ISP chemistry, has held with supported partners and their institutional leadership and interested staff and students. Other examples of successful virtual meetings are the 14 webinars that ISP arranged in connection to the International Year of the Basic Sciences for Sustainable Development (IYBSSD2022). In total, 780 participants from 58 countries in Europe, Africa, Asia, Latin America, North America and Oceania participated.



Figure 2. Dr Jared Ongaro shows and demonstrates the equipment used for AfMS, bought with ISP support.

During 2022, ISP has continued its efforts to further increase its visibility, both internally at Uppsala University (UU) and externally outside UU. This has been partly achieved by publishing the ISP #IYBSSD2022 webinars under IYBSSD's international webpage <https://www.iybssd2022.org/>.

To make the results of ISP's work more visible and easily accessible, the ISP webpage, which is an important communication tool, has been edited and the posts on ISP's Facebook (FB) account has continued to be long and explanatory. This might be the reason that the ISP FB account has more than 5,300 followers today. The ISP website has as of today close to 98,055 visits from 176 different countries.⁴ ISP has furthermore been active on LinkedIn since 2022, thus creating a professional network in Sweden and the Global South.

⁴ The figures are from 2023-04-19.

5. What is ISP's impact on development?

5.1 Research findings and the SDGs

One of ISP's specific objectives is *to improve supported partners' ability to on a longer term use research results and acquired skills (...) having a favorable impact on society.*

Examples of this can be found in the contribution by ISP supported groups and networks to the strive of the research community to create a more sustainable world. Below are some of the research findings and their relation to the [UN Sustainable Development Goals - SDGs](#) presented.

Most of the research results reported to ISP align with *SDG 3 – Good Health and Well-Being*. In Bangladesh, a physics group developed a real-time interpreter for Bangla Sign Language (BdSL) through deep machine learning models for an accurate and reliable recognition of BdSL Alphabets and Numerals. This interpreter has the potential to help over 200,000 hearing and speech-impaired individuals in Bangladesh. In Burkina Faso, a chemistry group studied how toxic thallium could be removed from water by nanosorbent from natural bauxites. The findings of the physics group in Nepal, imply that bio-synthesized ZnO could play a vital role for the development of newer antimicrobial agents based on ZnO blended with common herbs available in Nepal, providing an alternative approach to treat gram-positive infections.

Three physics groups addressed cancer treatment:

- In Bangladesh, a group studied nanoparticles for possible biomedical applications in cancer therapy.
- In Kenya, the group utilized machine learning for spectral diagnosis of prostate cancer in its early stages.
- In Myanmar, a group used metal iodides and magnetite nano-particles as possible drug carriers for cancer treatment.

The results of mathematical disease modeling (e.g. Covid-19, Malaria, HIV/AIDS, TB) have been utilized by the Uganda Medical Research Council and Uganda Virus Research Institute.

A few of the ISP supported activities are connected to *SDG 6 – Clean Water and Sanitation*. A physics group in Myanmar studied graphite carbon nitrate ($g\text{-C}_3\text{N}_4$) as a potential material for removing toxic elements from wastewater.

Many supported groups and networks also contribute to *SDG 7 – Affordable and Clean Energy*. For example, physics groups have studied different ways to improve solar cells, solar water heaters and how to store energy (Bangladesh, Ethiopia, Kenya, Nepal, Tanzania, Uganda, Zambia). The Materials Science and Solar Energy Network (MSSEESA), with research groups in four countries in Eastern Africa (Kenya, Tanzania, Uganda and Zambia) developed a parabolic solar cooker integrated with a heat storage block. The network also realized a Perovskite Lead-Free Silicon Tandem Solar Cell as well as studied a bifacial solar module, which is a solar panel that can convert sunlight into electricity on both sides of the panel.

Further, there are many connections to *SDG 9 – Industry, Innovation and Infrastructure* through the many activities aiming to enhance scientific research. For example, a physics group in Bangladesh found that La-substituted BiFeO_3 is suitable for applications such as microwave devices, computer

technology, actuators⁵, and transducers⁶. A physics group in Myanmar studied EC materials to be used for smart windows or mirrors. A physics group in Uganda studied different coatings for lightweight spacecrafts.

In Ethiopia, a physics group investigated the formation and stability of self-assembled monolayers for applications such as solar cells, heterogeneous catalysts, and molecular sensors. A physics group in Uganda studied the disturbances affecting radio signals through the ionosphere. This work's results are of high relevant for better modeling of radio wave scintillation since the intensity of VHF/UHF scintillations observed by ground-based receivers depends on the magnitude and spectral distribution of density fluctuations.

Many research findings are connected to *SDG 11 – Sustainable Cities and Communities*. In Laos, geological fault areas were mapped using a resistivity meter, seismic refraction Tomography (SRT) and Reflection measurements. It is important to map the potential seismic hazards near the faults. In Nepal, the vulnerability of the rural electric mini-grids to lightning was investigated. In Ethiopia, earthquakes were monitored.

Some of the research findings are connected to *SDG 2 – Zero Hunger*. In East Africa, a study affirmed that solid waste (SW) and solid biomass (SB) are ideal for producing biochar⁷ with good qualities improve soil properties and mitigate climate change. In Southern Mali, the physics group monitored agricultural land erosion using satellite images and climate variables. The study revealed an increasing trend in erosion over the studied zones due to climate change.

Please also see the activities described in section 5.1, where ISP supported groups and networks work with gender equality is described (*SDG 5 – Gender Equality*).

An important part of ISP's overall goal is to strengthen higher education at partner institutions. Target 4B in *SDG 4 – Quality Education*, calls for an expansion of the enrolment in higher education and scientific programs through fellowships, which is one of ISP's main activities through supported groups and networks. [See section 6.3 *Students in supported activities*].

Some research findings are linked to *SDG 13 – Climate Action*. A physics study in Rwanda investigated Seasonal cycles of the emissions of Black Carbon and key aerosols (PM2.5). For *SDG 13* please also see section 5.4 *Outreach and policy influence*.

Finally, there is a general alignment of ISP's work with *SDG 17 – Partnerships to achieve the SDGs*, more specifically Target 17.9 aiming to “*enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the*

⁵ “An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a “mover”.” <https://en.wikipedia.org/wiki/Actuator> 2023-05-22.

⁶ “A transducer is a device that converts energy from one form to another. Usually a transducer converts a signal in one form of energy to a signal in another.[1] Transducers are often employed at the boundaries of automation, measurement, and control systems, where electrical signals are converted to and from other physical quantities (energy, force, torque, light, motion, position, etc.). The process of converting one form of energy to another is known as transduction.” <https://en.wikipedia.org/wiki/Transducer> 2023-05-22

⁷ Biochar is a substance similar to charcoal, but it is obtained by burning organic material from wastes from agriculture and forestry.

sustainable development goals, including through North-South, South-South and triangular cooperation”.

[For a full list of activities, please see Appendix 1.2]

5.2 Use of research results (including technical development)

One of ISP’s specific objectives is *to improve supported partners’ ability to, on a longer term, use research results and acquired skills (...) having a favorable impact on society.*

This section presents the use of research findings and reported skills. Researchers from ISP supported groups and networks have used their research results and skills as consultants for governments, NGOs and companies (Burkina Faso, Ethiopia, Laos, Nepal) and facilitators for solar cells installation (Kenya, Tanzania). In Nepal, group members assisted the Nepal Engineers Association (NEA) in establishing good practices in the area of lightning protection and electrical safety.

The ISP supported research groups and networks have also used their research results and skills in technical development and services. Some examples are presented below.

- During the recent outbreak of Ebola in Uganda, the medical services ran short of some key reagents necessary for Ebola testing, and ordering for the reagents directly from manufacturers could take time before delivery. Yet the country needed extensive screening of all potential contacts. An ISP supported chemistry group collaborated with colleagues from Makerere University College of Health Sciences, who developed a rapid diagnostic kit for Ebola virus screening. By utilizing facilities in the group’s laboratory (provided by ISP), group members successfully prepared the colloidal nano gold reagent which was missing in the test kits, and the Ebola task force carried on with the crucial screening.
- In Kenya, the group trained technicians on PV systems design, sizing, installation and maintenance. The continued participation of the group members in the installation of PV systems in factories, homes and schools enhances the uptake of the PV systems, with a direct positive effect on the environment.
- In Tanzania, the physics group organized workshops on solar cooking. Stakeholders were invited to discuss issues pertaining to the wide adoption of solar cooking technology.
- The chemistry network NITUB (Network of Instrument Technical Personnel and User Scientists of Bangladesh) repaired 108 non-functioning pieces of scientific equipment for different educational and research organizations in Bangladesh. The reported book value of these scientific instruments is approximately USD 430,000. NITUB engineers also fabricated low-cost equipment: pH meter and conductivity meter. NITUB engineers assembled the equipment modules and programmed the instruments. The fabricated two instruments cost about BDT 25,000/-(≈240 USD) and are undergoing trial. These two instruments are expected to be given to a higher secondary school in Dhaka.
- In 2021, a physics group in Mali improved the rice irrigation schedule. In 2022, the group organized a discussion with irrigation technicians and farmers where the agrometeorological model for irrigation planning (cropwat) was presented. The same group also organized an awareness seminar with a women association on the economic benefit of using improved cookstoves and bio-charcoal briquettes as cooking fuel.

- In Bolivia, the interaction between native pollinators (stingless bees) and local crops has been studied. This research leads to improved management and production of stingless bee products and also of the crops that they pollinate.



Figure 3: Studying stingless bees' activities in the field with Guarani communities, Bolivia.



Figure 4: Do vibrations caused by insects induce chemical responses in plants?

- In Nepal, the physics group leader developed a national training manual for engineers and technicians on protective measures against lightning and safety measures against low voltage electrical hazards. He also led a team of electrical engineers for a national Training of Trainers (TOT) on safety/protective measures against electrical and lightning hazards.
- A chemistry group in Uganda is involved in a collaborative effort with an NGO Community Integrated Development Initiatives (CIDI), to setup a mini sewage treatment plant and a water treatment facility at Kabojja, Kampala. The group offers consultancy, guidance, and monitoring of both effluent quality and water quality. The mini sewage treatment plant was cleared by the National Environment Management Authority (NEMA) to commence activities, offering sewage treatment service to communities around Kampala. The water treatment plant has also been cleared by Uganda National Bureau of Standards (UNBS) to start water production.
- In Zimbabwe, a group has developed antimicrobial tests, after requests from other universities. Thanks to the skills in bioassays, and the available set of equipment, the group is able to carry out various antimicrobial assays such as antifungal, antibacterial, antimycobacterial and antiproliferative assays. There are plans to register a company to facilitate the marketing and sale of the products.

[A detailed list of all reported activities can be found in Appendix 1.3]

5.3 Outreach (including policy influence)

This section describes how supported groups and networks have *increased the visibility of the program* (one of ISP's specific strategies) and how they have *improved supported partners' ability to, on a longer term, (...) engage in outreach activities having a favorable impact on society* (one of ISP's specific objectives).

The outreach activities and policy influence activities of ISP supported groups and networks are directed towards governmental bodies, organizations, the general public, undergraduate students, schools, industry and other stakeholders. The activities aim to describe the research results and their relevance to a broader audience, as well as to impact decision-making on different levels in society.

Groups and networks worked in different ways to popularize science:

Through media:

- In Uganda, the gender network EANWoBAS (Eastern Africa Network for Women in Basic Science) organized an one-day activities to celebrate the International PI-day on March 19 at Budo Junior School. The day started with the Run4Math, a cross-country run that is an event that the network organizes every year. EANWoBAS donated three mango trees to the school and named the trees ISP, UGAWOM and Kavulu. Mr Kavulu is the head teacher of Budo junior school but about to retire and a great supporter of EANWoBAS activities. This activity was published in *New Vision*, one of the leading newspapers in Uganda.



Figure 5. RUN4MATH 4 in the newspaper New Vision, March 23, 2022, page 27.



Figure 6. Children plant the ISP tree.

- Physics group members participated in 10 national media interviews to raise awareness of lightning hazards (Nepal).
- Two PhD defenses by a chemistry partner were reported in local media (Burkina Faso).⁸
- A chemistry group initiated collaboration with the Green Economy media group focusing on issues of green chemistry, sustainable chemistry and environmental protection. The group members were offered airtime to disseminate research findings, give caution, guidance and views on trending environmental pollution and protection topics. Some of the segments on dissemination of the research outputs were recorded in the group's laboratory at Makerere University and ISP was acknowledged for the support. The segments are aired on SMART 24 TV Channel 372 on DSTV, and Channel 394 on GoTV. (Uganda)

⁸ Semporé Judith Nomwendé, <https://lefaso.net/spip.php?article110016> and Stéphanie C. W. Tiendrébéogo, <https://lefaso.net/spip.php?article110486>.

Through events:

- Organizing the first-ever International Mathematics Olympiad for high school students in Ethiopia. The event was supported by World Bank by providing prizes to seven winners. (Ethiopia)
- Organizing the National Round of the Bangladesh Physics Olympiad. (Bangladesh)
- Arranging a workshop in algebra for secondary school teachers. (Rwanda)
- Organizing an awareness campaign at the Faculty of Science to promote physical science to bachelor students. (Mali)
- Organizing several workshops for mathematics teachers both at primary and secondary school levels. (Uganda)
- Participating in an outreach activity to a school in the outskirts of Nairobi, giving motivational talks and explaining what physics and its various branches are, and describing career opportunities for students. (Kenya)
- Organizing an open house to inspire students to pursue science and assists them in planning their future endeavors. Many high school and college students attended the event. The students and alumni of the nanophysics group were present at the lab to explain research activities to visitors. (Bangladesh)
- Organizing, together with the Uganda Mathematical Society, the annual National Mathematics Contest for Primary schools, Secondary schools, National Teachers' Colleges (NTCs) and Primary Teachers' Colleges (PTCs) and universities. This year the National Mathematics Contest for all these levels had 14,332 participants of which 8,033 were in the Primary School category, 3,977 in the O level category, 2,274 in the A level category 08 in Primary Teacher's College category and 40 at university level. Prizes were awarded to the best performers in each category. A selection of five students in the Secondary school category participated in the 63rd International Mathematical Olympiad, which took place in Oslo Norway in July 2022. (Rwanda)
- A physics group in Bangladesh is engaged in the telemedicine program that has been going on since 2015 at centers established by local entrepreneurs in rural areas. It has continued through 2022. However, the number of patients declined severely in 2022, indicating a lack of cash due to the Covid-19 pandemic and inflation caused by the Ukraine war (charge BDT 150/EUR 1.62 per consultation). This program has advanced features with cloud archiving of all data, patient video consultations and written prescriptions. Besides, it also has some online diagnostic devices.

Through education:

- To encourage high school students to participate in the Rwanda Mathematics Competition, the Department of Mathematics at University of Rwanda visited Secondary Schools. (Rwanda)
- A physics group visited STEM schools and did stargazing on the occasion of some sky events such as eclipses. The group also organized STEM teacher training workshops. In 2022, they trained about 20 teachers in Basic Astronomy for High schools. (Rwanda)
- Members of a physics group took part in the organization of training of secondary school physics teachers funded by the Institute of Physics (IoP), which took place twice in 2022. The overall goal is to improve students' understanding and enjoyment of physics and ultimately increasing number of students opting to take physics at higher levels. Eleven schools with 23 physics teachers from public schools in Dar es Salaam participated since year one, i.e. 2020. (Tanzania).

- The physics group devised a short training program for promising high school students promoted to grade 12 from different public and private schools to attract them into science in general and physics in particular. (Ethiopia)
- Members of the physics research groups write teaching materials related to Astrophysics and Space science. (Rwanda)
- Through the network's refresher courses in mathematics, teachers across Uganda, have been equipped with better mathematics teaching methods. (Uganda)
- The physics group has organized an awareness campaign at the Faculty of Science and Technique to promote physical science to bachelor students. (Mali)
- The deputy group leader in a chemistry group sits on the Board of the Science Foundation College, which is aimed at promoting basic science. (Uganda)
- The research group organized a stakeholders workshop for teachers and high school students in forms 3 and lower 6. The research group shared information on the various pollutants emanating from anthropogenic that affect the aquatic and terrestrial environments. The participants were given activities which included discussion topics and group oral and dramatic presentations. The event provided the research group with a platform to provide awareness of various pollutants, their sources and their effects. It also provided the participants a forum to share information on ways to protect our environment from pollutants emanating from man's day-to-day activities. 80 people attended the event. (Zimbabwe)
- Mathematics networks members organized two days' workshop on mathematics in industries and about 45 participants from different fields attended. In the workshop, several papers were presented. (Tanzania)



Figure 7. Television recording about the importance of research at USFX, Bolivia.

The policy influence by the groups and networks is considerable, mostly on a national level when members act as consultants to national governments. For example:

- In Uganda, the results on mathematical disease modeling (e.g. Covid-19, Malaria, HIV/AIDS, TB) have been utilized by the Uganda Medical Research Council and Uganda Virus Research Institute.

- In Burkina Faso, network members have been involved in the elaboration of the strategic *Plan of Nutrition* in Burkina Faso at the request of the government and they have also participated in the creation of a National Association of Nutritionists of Burkina Faso. They have furthermore been involved with the Burkinabe National Information Platform for Nutrition.
- In Kenya, a physics group leader serves as a committee member of a forum to deliberate on enhancing research and development in renewable energy, setting up a Kenyan Energy Research Institute.
- In Laos, a chemistry group collaborated with the Department of Natural Resources and Environment Inspection at Ministry of Natural Resources and Environment for sampling site surveys and data analysis on wastewater quality and current performance of decentralized wastewater treatment facilities in some cities in Laos.
- In Tanzania, the research results and skills of the chemistry group members have been used at the Tanzania Bureau of Standards for developing food contaminants and packaging standards. The National Environment Management Council (NEMC) has used the research and skills for developing new strategies for enforcement of environmental laws, e.g. related to the banning of plastic carrier bags and development of alternative carrier bags.
- Mathematics networks members are part of the committee of experts at the Higher Education Authority involved in accrediting learning programs in higher learning institutions in Zambia. Some are also part of the team of experts engaged by the Ministry of Education.
- A member of a chemistry group at University of Zambia was appointed chair for various technical committees for the statutory body, Zambia Environmental Management Agency (ZEMA) on the Minamata Convention and the establishment of Chemical Observatories (ChemObs). He was also appointed to the Scientific Advisory Committee for the National Biosafety Authority to offer guidance on molecular biology and biochemistry matters.
- Another chemistry group member at University of Zambia was appointed a member of the Expert Group, for the Zambia UNCTAD⁹ Technology Assessment Project on Energy and Agriculture under the Ministry of Technology and Science.

⁹ UNCTAD = United Nations Conference on Trade and Development



Figure 8. The University of Zimbabwe Research, Innovation and Industrialisation Week 2022. The research group members with the Dean of Science Prof I. Sithole-Niang (Centre) showcased their research products in the form of herbal creams to the public. A PhD student in IPICS ZIM:01, Ms Lydia Mugayi (second from left, in red) won the second prize for the best oral presentation.

[A full list of reported activities can be found in Appendix 1.4]

5.4 Gender equality

This section describes ISP's specific objective to improve gender equality in supported research groups and scientific networks, and ISP's specific strategy to continue promoting gender equality among supported partners.

In 2017, ISP introduced ear-marked extra funds for activities designed to promote gender balance in science at the supported institutions, i.e. the Gender Equality Grants. The maximum amount is 30,000 SEK/year over a three-year period.

In 2022, ISP continued addressing the gender gap in science in ISP supported research groups and networks. Groups and networks in physics and mathematics could apply for the ISP Gender Equality Grants, while groups and networks in chemistry have had the possibility to use their regular ISP allocations for gender equality promoting activities.

An increased awareness of gender issues is clearly observed in the majority of the supported groups and networks with an increased number of Gender Equality Grant applications from physics partners. This additional grant was awarded to 27 groups and network in 2022: 22 within physics and five within mathematics. In addition, a continued network grant was awarded to the Eastern Africa Network for Women in Basic Science (EANWoBAS). EANWoBAS works to improve the gender balance and gender bias awareness in the basic sciences. It is coordinated from Uganda and includes female mathematicians and physicists from Kenya, Rwanda, Tanzania, Uganda and Zambia.

The total budget in 2022 for the activities promoting gender equality was 972 700 SEK. Out of these, 772 700 SEK were awarded to groups and networks and 200 000 SEK to the EANWoBAS network.

Some of the supported groups in the physics and mathematics programs also used part of their regular project allocation for activities to improve the gender balance, which is the normal case within the chemistry program.

A positive effect of the ISP Gender Equality Grants is the further improved collaboration connected to EANWoBAS. The network often co-organizes workshops and school visits with other ISP supported groups, as well as with different university departments.

In 2022, many activities have been organized to target the low participation of women and girls in education and research activity within STEM disciplines. The activities target all kind of different needs, at different levels of education: recruitment of female students to science via outreach activities and school visits, training and internship for undergraduate students, financial support to female students and mentorship activities for students' retention at university. The activity reports for 2022 mentioned that the introduction of gender quotes is to be considered for student admission to education or PhD positions, but also for the staff recruitment.

In some countries or universities where ISP supports research groups/networks, it is mentioned that one reason for the poor gender balance is also the lack of a university gender policy, resulting in "Female students who do not benefit from any particular support or incentive measures to face the social difficulties linked to long studies". This hinders female students with social and financial constraints to choose Master's and Doctoral studies.

The low number of females that choose a career in science, technology and engineering is a severe problem worldwide and is a waste of talent and resources. No woman still completed a PhD in physics, space and climate science and related areas in Rwanda, but the supported group at the supported Rwanda Astrophysics, Space and Climate Science Research Group (RASCSRG) can celebrate that with the ISP funding for improving gender balance, within two years, three women will graduate at the level of MSc, one in astrophysics, another one in space science, and another one in cosmology!

The good news is that ISP has noted a positive trend showing an increased number of female students in MSc and PhD programs in the supported groups and networks. As mentioned in some of the activity reports, the ISP funds for improving the gender balance have been of significant impact when used to support female students because these funds address the fact that in many countries, female students lack economic support from their families to continue their university education.

The activities that have been carried out in 2022, have varied in nature but mostly target dire local needs. In the list below, also activities "without" the Gender Equality Grants are listed. We see four different "tracks" for the activities that were carried out:

1. Encouraging female undergraduate students to continue to Master studies and/or PhD studies in chemistry, mathematics and physics through
 - Financial support to female PhD students (Bangladesh, Burkina Faso, Kenya, Zambia), MSc students (Ethiopia, Kenya, Tanzania, Uganda, Zambia) and postdoctoral fellowships (Burkina Faso, Kenya).
 - Supporting equipment, e.g. laptops, consumables and chemicals to PhD students (Bangladesh, Rwanda).

- Launching conferences, awareness campaigns and career guidance directed to female students (Burkina Faso, Mali, Nepal).
- Mentoring, training/workshops, webinars and recruitment drives for female students (Burkina Faso, Laos, Nepal, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe).

2. Affirmative actions directed to female students

- A Bangladeshi physics group has given preference to female PhD students during PhD admissions. The group is also practicing a flexible attitude towards female students, giving them appropriate leave or permitting them to work from home during pregnancy.
- Another Bangladeshi physics group has after hard work to receive gender equity, a percentage of more than 40% women among staff and students. Therefore, they have shifted the focus from prioritizing female students to offering them access to cutting-edge training resources.
- Since the majority of graduate students being trained at the Department of Chemistry, Makerere University are male, an Ugandan chemistry group decided to allocate at least 66% of the available slots to female students, to make sure that they also well represented in graduate studies. They also recruited female undergraduate students for master's studies. The group will continue these successful efforts.
- The Department of Mathematics at University of Zambia financed awards to the best performing undergraduate female students in mathematics.
- The Department of Mathematics at University of Dar es Salaam, Tanzania, supported two first year females' postgraduate students participated to EAUMP-ICTP summer school in Nairobi, Kenya.
- In Zambia, funds are reserved to help underprivileged female undergraduates to pursue postgraduate research in basic sciences. The male candidates are many; hence, recruiting male students is relatively easy.
- In Tanzania, a chemistry network supported 12 female staff and students to attend the network conference in Arusha, and to stay for a one-day meeting, where issues of gender mainstreaming and strategies for gender improvements in the network were discussed.

3. To inspire female students through role-model sessions

- In Nepal, the group organized several motivational talk programs both online and physically at various schools and colleges of Tribhuvan University. The participants in the interaction program were highly benefitted and motivated by exchanging their research experiences with each other.
- The supported physics group in Uganda organized meetings with female undergraduate and postgraduate students at four universities. In these meetings, female scientists shared their experiences to motivate the students. The female students could freely discuss employment opportunities as well as the challenges they face at school and at home.

- In Burkina Faso, the supported physics group organized meetings for exchanges of ideas, advice, and sharing of experience, between female students at the bachelor, master and doctoral levels.



Figure 9 and 10. Two women ANRAP-fellows Kalpana Thapa and Karuna Bajracharya (both MSc students), from Central Department of Chemistry, Institute of Science and Technology, Tribhuvan University, Kathmandu, Nepal, came to Dhaka, Bangladesh in 2022 for a three-months Fellowship.

4. Many groups see the need to engage female students in primary school and high school in the basic sciences to improve their access to university programs in science and technology. Secondary schools in Ethiopia, Kenya, Rwanda, Tanzania, Uganda, Zambia were visited by various ISP groups in mathematics and physics as well as by EANWoBAS (Eastern Africa Network for Women in Basic Science).

For example, a team of staff from the Department of Physics, Makerere University, Uganda, visited eight schools in Northern Uganda to promote and motivate girls to pursue science education beyond the secondary school level.

In Mali, the physics research group has created and supported a local network of “Female Students in Physics” that organized discussions with female students at bachelor levels and at secondary schools.

In Ethiopia, the physics group has conducted outreach activities for six weeks to create awareness among 27 (14 female and 13 male) high school students regarding science in general and physics in particular. The outreach activities consist of a short program to familiarize the students (with an emphasis on female students) with research in physics. The expected objective is to bring young high school students in general and female in particular into science and more specifically into physics when they join university. The group implemented this activity already some years ago but they are not yet able to assess the impact of their training activities since they did not set up a follow-up process. They have however noted that there is a high demand for training from students, their teachers and

parents. From the direct interaction and the evaluation release by the participants to the science camps, one can learn that talented students like to learn physics. Due to family influence and the limited prospect for job opportunities in the country, most students, particularly, female do not opt for physics as their future career.

The physics network ESARSWG decided that node representatives would visit high school students, and hold sensitization meetings with all students. Each node in the network got USD 500 to facilitate movements of sensitization teams, printing posters and stationeries for use during the organized meetings/activities. Special focus was of course put on female students, talking to them and encourage them to take on science courses. The sensitization teams included women scientists who are role models in society so that young females can follow as examples. Female students were invited to talks at departments and scientific laboratories to learn more and develop an interest in sciences.

The EAUMP node at University of Nairobi organized a Mathematics Clinic at different girls' schools, to encourage them in mathematics problem-solving skills.

The education sector in Uganda is still constrained by many challenges despite the increase in the number of children enrolled in schools. It is still a major challenge to transfer teachers to disadvantaged areas commonly referred to as "hard to reach areas".

Northern Uganda is a region which has been involved in war for more than twenty years; forcing the majority people into internal displaced people's (IDP) camp. The number of girls attending secondary school in most rural parts of northern Uganda is still low. In July 2022, a team of staff from the Department of Physics, Makerere University, visited eight schools in northern Uganda to promote/motivate girls to pursue science education beyond the secondary school level. The students were also given access to equipment; these are equipment taught in class but have never used them practically. The mobile lab has excited both students and teachers in rural schools.



Figure 11. Mobile lab demonstration and career guidance in rural schools in northern Uganda.

With the ISP funds for gender equality the group organised outreach activities at three girls' secondary schools in South Western Uganda. The outreach activities aimed at motivating the girl pupils into sciences and to excel in science subjects. The aim was also to change their attitude and mindset towards science, particularly mathematics and physics. Most girls

have been brought up thinking that mathematics and physics are for the male gender. During the outreach activities, the female lecturers and teachers shared their experiences in a way

to motivate the girls. Some interesting topics in astronomy were covered. They also had the opportunity to use a telescope to observe very far objects.

Some groups organized events at their university directed to secondary school students and teachers. An example of such an event is the 1st EANWoBAS-Zambia Essay Writing competition for female pupils in grade 12. The competition was based on the question: “How has the Covid-19 pandemic changed your attitude towards science and mathematics?” and attracted the participation of 92 girls from 25 Schools. The top three students were awarded various prizes. In the occasion of the award ceremony, EANWoBAS-Zambia node organised various science demonstrations in physics, chemistry and biology to demonstrate to the schools that participated in the award giving ceremony.

A Science Camp in mathematics and physics for advanced secondary school girls from various governmental schools was organized in Tanzania. Each school was represented by five girls and one teacher. The main objective of the Science Girls Camps is to increase the number of female students joining higher learning institutions to study science, technology, engineering, and mathematics (STEM) subjects or pursue STEM-related professions. The activity was very successful according to the evaluation of the participants, students and teachers. Starting as an activity with just 15 attendees in 2016, it has now grown to include up to 60 participants from 10 regions of Tanzania.



Figure 12. Students viewing stars using a telescope at the roof of the Physics Department during the Science Camp in Tanzania.

[For a full list of gender activities, please see Appendix 1.1]

6. ISP in numbers

In the following section it is described in numbers how ISP supported groups and networks fulfil ISP's objectives and strategies;

In Supported groups and networks:

- To plan, manage and carry out high-quality scientific research (ISP specific objective).
- To facilitate partners' collaboration with better resourced host institutions. (ISP general objective).
- To build on local, needs-based ownership of research activities and training, applying a collegial approach to collaboration, and with a focus of improving the local conditions for developing scientific activities. (ISP general strategy)

In Students in supported activities:

- To support scientific research groups and scientific networks in partner countries to develop their research activities and postgraduate training (ISP general objective).
- To improve supported partners' ability to train high-quality postgraduates at the Master and PhD levels (ISP specific objective).

In Publications, Conference contributions, Arranged meetings:

- To improve supported partners' ability to disseminate research results at high-quality venues (ISP specific objective).
- To continue increasing the visibility of the program (ISP specific strategy).
- To continue contributing to the enhancement of quality at all levels with supported partners, including establishment of a well-developed academic and scientific research culture (ISP specific strategy).

In Expenditures:

- To increase supported partners' financial independence of ISP, with the ultimate goal of becoming self-sufficient and sustaining on grants awarded in open competition (ISP specific objectives).
- To continue increasing supported partner's skills with regard to financial management (ISP specific strategy).

6.1 Supported groups and networks

In 2022, in total **43 research groups** were supported in 14 countries [Table 1]. There were 18 research groups in chemistry, one in mathematics, and 24 in physics. [For a list of all research groups and what they do, please see Appendix 2.1]

Five of the countries are classified as low-income economies and nine as lower-middle income economies, while nine are denoted as least developed countries (LDC). All countries were classified as fragile, six on the "red alert" level, and eight on the "orange warning" level. Regarding the nine LDCs, five were also low-income economies, and five belonged to the most fragile category.

Table 1. Research groups supported in 2022, and the situation in the countries with regard to income level (World Bank fiscal year 2022),¹⁰ UN developmental state (2022) - LDC = Least Developed Country,¹¹ and fragility (2020).¹² Countries that score between 60.0 and 89.9 are classified in the orange “Warning” category; those scoring between 90.0 and 120.0 in the red “Alert” category. Bold annotations indicate a change of compared to the previous year.

Country	Chemistry (IPICS)	Mathematics (IPMS)	Physics (IPPS)	World Bank income level	UN Developmental State	Fragile State Index Rating (0-120)
Bangladesh ¹³	BAN:04 BAN:05		BAN:02/1 BAN:02/2 BAN:04 BAN:05	Lower-middle	LDC	84.5
Bolivia	BOL:01			Lower-middle	Not a LDC	73.4
Burkina Faso	BUF:01 BUF:02		BUF:01	Low	LDC	90.5
Ethiopia	ETH:01 ETH:02	AAU	ETH:01 ETH:02 ETH:03	Low	LDC	99.3
Kenya			KEN:01/2 KEN:02 KEN:03 KEN:04 KEN:05	Lower-middle	Not a LDC	88.2
Laos ¹⁴	LAO:01 LAO:04		LAO:01	Lower-middle	LDC	75.5
Mali			MAL:01	Low	LDC	98.6
Myanmar			MYA:01 MYA:02	Lower-middle	LDC	100
Nepal ¹⁵			NEP:01	Lower-middle	LDC	80.6
Rwanda	RWA:01		RWA:01	Low	LDC	83.7
Tanzania	TAN:02		TAN:01/2	Lower-middle	Not a LDC	78.2
Uganda	UGA:01 UGA:02		UGA:01/1 UGA:02	Low	LDC	92.1
Zambia	ZAM:01 ZAM:02		ZAM:01	Lower-middle	LDC	84.9
Zimbabwe	ZIM:01 ZIM:02 ZIM:03		ZIM:01	Lower-middle	Not a LDC	99.1
Total number	18	1	24			

¹⁰ datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups 2023-04-19.

¹¹ www.un.org/development/desa/dpad/wp-content/uploads/sites/45/publication/ldc_list.pdf 2023-04-19.

¹² <https://fragilestatesindex.org/> 2023-04-19.

¹³ UN General Assembly resolution A/RES/76/8 adopted on 24 November 2021, decided that Bangladesh, Laos and Nepal will graduate five years after the adoption of the resolution, i.e. on 24 November 2026.

¹⁴ Ibid.

¹⁵ Ibid.

One of ISP's specific strategies is *to continue supporting research groups in complementarity with Sida's bilateral programs and facilitate regional cooperation*. ISP supports research groups and networks in complementarity with Sida's bilateral programs in Bolivia, Cambodia, Ethiopia, Rwanda, Tanzania and Uganda (the Sida research support to Uganda was concluded June 30, 2022).¹⁶

Another of ISP's general strategy is *to facilitate partners' collaboration with better resourced host institutions*. ISP facilitates regional cooperation since the early 1980's, when it was decided to start supporting **scientific networks**. ISP believes that regional and interregional cooperation is a fruitful approach to overcome many constraints, adding value to participating scientists and their institutions by generating complementary scientific activities, giving access to advanced equipment, and increasing the human capital needed for good standard postgraduate education.

In addition to the research groups, totally **20 scientific networks** with nodes in 38 countries were supported in 2022 [Table 2]: eight in chemistry, seven in mathematics, and four in physics. In addition, a network formed to promote the participation of women in basic sciences was supported.

[Please see the list of all networks and what they do in Appendix 2.2]

Table 2. Scientific networks supported by ISP, by region and by ISP program.

Region	Chemistry	Mathematics	Physics	Gender	Total
Africa	ANCAP ANEC NAPRECA RABiotech	BURK:01 APREA CoRS EAALG PDEAPP EAUMP	AFSIN EAARN ESARSWAG MSSEESA	EANWoBAS	15
Asia	ANFEC ANRAP CAB-CCS NITUB	SEAMaN			5
Total	8	7	4	1	20

One of ISP's specific strategies says that ISP should *focus on supporting physics, chemistry and mathematics in present partner countries (...)*. In 2022, no **new support** was initiated.

No groups or networks had their **final year** of ISP support in 2022.

In all, ISP supported in total 43 research groups and 20 scientific networks in 2022. That is the same numbers as in 2021. [Table 3].

¹⁶ For example, two chemistry groups in Uganda applied for continued funding through the Sida bilateral research program in Uganda, but they were denied support. ISP then continued to support them through the ISP core program. The same thing happened to a Rwandan group and ISP started to support it.

Table 3. Number of research groups and scientific networks supported in 2020, 2021 and 2022, and the yearly averages 2008-2013 and 2014-2019.

Supported activities	Average 2008-2013	Average 2014-2019	2020	2021	2022
Number of groups and networks supported each year.	49	59	56	63	63

6.2 Staff in supported activities

In 2022, in total 1,000 staff members (893 in 2021) were involved in ISP supported activities, 24% (21% in 2021) of them were women.

Since 2013, there has been a slow but steady increase of women staff members in the mathematics and physics groups/networks, from 12% to 19% (physics) and from 12% to 17% (mathematics) in 2022. In chemistry the share of women staff members has remained around 30%.

In all, 17% (22% in 2021) of the 69 group leaders and network coordinators, and 25% (20% in 2021) of the 48 deputies, were women.

The distribution according to discipline and gender was:

- Chemistry: 15% women leaders and 31% deputies.
- Mathematics: 11% women leaders and 11% deputies.
- Physics: 7% women leaders and 14% women deputies.
- ISP EANWoBAS: 100% woman leaders and 100% deputy leaders.¹⁷

These figures differ a bit from the situation in 2021 with more women leaders and deputy leaders in chemistry, but fewer women leaders in the mathematics and the physics program.

[For table of gender proportion of staff, please see Appendix 2.3]

6.3 Students in supported activities

The students reported to ISP enjoy ISP support to various degree. Some may even be supported by other sources. Still, the ISP groups and networks make up the platform for the students' training, and therefore all reported students are accounted for here.

PhD and MSc students

In 2022, in total 1,326 postgraduate students (Master, Licentiate and PhD level) were active in ISP supported research groups and networks. That is slightly more than last year (1,209 students). There has in fact been a small but steady increase of postgraduate students every year since 2010. Close to 450 PhD students have been active each year since 2016, but, in 2021, there was an all-time high with 699 students. The yearly number of MSc students has since 2016 usually exceeded 600 (696 in 2022).

The exact number of the **PhD students** in 2022 was 626 (586 in 2021). The average share of woman PhD students has increased from 23% in 2008-2013 to 29% in 2022.

115 (31% women) were PhD sandwich students and 511 (28% women) were local students. The distribution according to discipline and gender was:

¹⁷ In 2022: Chemistry: 26% and 44%, Mathematics: 33% and 0%, Physics: 15% and 10%, ISP EANWoBAS: no data. EANWoBAS is an ISP supported gender network in Africa, mainly for physics and mathematics.

- Chemistry: 220 PhD students, 35% women (37% in 2021)
- Mathematics: 175 PhD students, 16% women (17% in 2021)
- Physics: 231 PhD students, 32% women (29% in 2021).

When it comes to **MSc students** there is a small but steady increase of MSc students and also of woman MSc students compared to 2014 (27% women). Out of 700 MSc students in 2022, 30% are women. 32 (16 women) of them were sandwich MSc students. The distribution according to discipline and gender was:

- Chemistry: 290 MSc students, 40% women (44% in 2021)
- Mathematics: 215 MSc students, 24% women (27% in 2021)
- Physics: 285 MSc students, 40% women (36% in 2021).
- ISP EANWoBAS: 4 MSc students, 100% women (n/a for 2021).



Figure 13. Students in Laos.

There are more students in all programs, and the **share** of woman students is higher in all programs and levels, except for mathematics masters students. This might be connected to the Covid-19 pandemic, because it is known that women/ girls have suffered more than men of the socio-economic consequences of the pandemic.

Retention of PhD students

One of ISP's ambitions is to contribute to the improvement of conditions for postgraduate students at the supported partner universities. This can be achieved in several ways, for example by making sure that there is a conducive research environment, well-developed academic culture, well managed research projects, functional instrumentation, and, if need be, availability of fellowship funds. One indication of satisfactory conditions for postgraduate education is that students do not drop out to any significant extent, but continue their studies to graduation. ISP has made a particular effort, starting in 2014, to promote the inclusion of woman students in postgraduate programs at the universities of the mathematics and physics partners in Africa.

ISP's ambition has shown result: the PhD retention has increased almost 10% from a yearly average of 81% (same for women as for men) in the years 2011-2013, to 88% in 2021. In 2022, the retention for men PhD is 89% and for women PhD 88%.

PhD and MSc graduations

Considering all data, it becomes evident that the share of woman PhD graduates in all three ISP programs has increased markedly since 2008 when the data collecting started. In the chemistry program it has increased from a yearly average of 28% in 2008-2013 to 41% in 2022. The corresponding increase in the mathematics program is from 12% to 14%, and in the physics program from 7% to 30%. The same trend is observed



Figure 14: Presentation of research progress by PhD students in Burkina Faso.

for MSc graduates. In the mathematics and physics programs the increase might be explained by the efforts since 2014 to increase female participation in postgraduate studies among mathematics and physics groups and networks in Africa.

The average time PhD students take to graduation essentially has remained the same over the years (close to 5 years), but is in 2022 higher for both sandwich (5,2 years) and local students (5,7 years). The prolonged time might be an effect of the Covid-10 pandemic, with closed universities, bad internet connection and travel restrictions.

Like previous years, the percentage of woman PhD students and PhD graduates in chemistry are higher than in mathematics and physics. This follows an international trend.

Actual numbers for PhD graduates in 2022:

- 97 PhD students graduated (30% women).
- Of these, 17 were PhD sandwich students (7% women) and 75 were local students (39% women).
- Chemistry: 25 PhD graduates, 41% women (41% in 2021)
- Mathematics: 36 PhD graduates, 14% women (14% in 2021)
- Physics: 36 PhD graduates, 42% women (30% in 2021).

Actual numbers for MSc, MPhil and Lic graduates in 2022:

- 232 MSc students graduated (41% women).
- Of these 28 were MSc sandwich students (79% women) and 224 were local students (32% women).
- Chemistry: 111 MSc graduates, 47% women (51% in 2021)
- Mathematics: 55 MSc graduates, 25% women (27% in 2021)
- Physics: 66 MSc graduates, 42% women (31% in 2021).

[For tables and lists, please see Appendix 2.4]



Figure 15: Ms Stephanie C W Tiendrebéogo's PhD thesis defense in Burkina Faso.

6.4 Publications

One of ISP's specific strategies is *to continue contributing to the enhancement of quality at all levels with supported partners, including establishment of a well-developed academic and scientific research culture*. This is measured by the number of articles in quality journals and contributions to high-level conferences. ISP also keeps track of the number of seminar series research groups and networks arrange.

In 2022, the ISP supported research groups and networks published 702 articles. Compared with last year this is an increase:

- In chemistry, 272 publications in 2022 (253 in 2021).
- In mathematics, 195 publications in 2022 (208 in 2021).
- In physics, 112 publications in 2022 (140 in 2021).

Since 2010, ISP started to distinguish between "quality publications" and publications in journals of unknown quality. From 2018, articles also in journals by "predatory" publishers have been distinguished.

The quality publications are defined as those appearing:

- with Clarivate Analytics Impact Factors (IF)¹⁸ in Web of Science (WoS)¹⁹ and/or in the [Norwegian Register for Scientific Journals, Series and Publishers](#). The latter is operated jointly between The National Board of Scholarly Publishing (NPU) and Norwegian Directorate for Higher Education and Skills on behalf of The Norwegian Ministry of Education and Research.

The publications in journals of unknown quality are those in journals not listed in the two above databases but not published by predatory publishers.

Journals by predatory publishers are considered to be those appearing in:

- [Cabell's Predatory Report](#).

In 2022, 584 (53%) journal articles reported were in quality journals, whereas 89 (13%) were in journals by predatory publishers. It is worrying that the percentage for "predatory publications" has gone up since 2021, even though ISP has continued to make particular efforts to inform about the risk of wasting scientific research results in predatory journals.²⁰ In 2022, two networks in Africa reported the majority of the articles in journals by predatory publishers. The articles are mainly by network members that are distant from ISP's influence, which may explain the disappointing outcome. It clearly demonstrates the need to better reach out to these networks, attempting to raise the participant's awareness of the importance to avoid publishing in journals by predatory publishers.

¹⁸ http://en.wikipedia.org/wiki/Impact_factor 2023-05-17

¹⁹ <https://www.webofscience.com/wos/woscc/basic-search/> 2023-05-20

²⁰ https://awandahl.github.io/isp_60_choosing_journal/ 2023-05-17

Table 4. Summary of publication data for 2022, by category and program. The number of publications (Publ.) in scientific journals is specified to those with and without Thomson Reuters (TR) impact factors (IF) or/and NCDR ranking, and whether ISP funding was acknowledged (Yes) or not (No).

Publication category	Africa		Asia		Latin America		Total	
	yes	No	yes	no	yes	no	yes	no
Publ. in Scientific Quality Journals (TR or/and NCDR ranked)	98	192	11	21	3	48	112	261
Publ. in Other Scientific Journals (“unranked”)	25	133	19	16	1	17	45	166
Publ. in Journals by “predatory publishers”	15	62	0	1	0	11	15	74
Books, Chapters, Popular Publ., Technical Reports, etc.	8	14	3	2	2	0	13	16
Total number of publications (yes/no)	146	401	33	40	6	76	185	517
Grand total	547		73		82		702	

One of ISP’s specific strategies says that ISP should *continue increasing the visibility of the program*. That’s one of the reasons ISP requires that groups and networks to give credit to ISP/Sida when they publish or present at a conference.

However, the rate of **acknowledgements** of ISP in published articles remains low; it has ranged between 27% and 33% since monitoring started in 2016, but in 2022 it is even lower (26%). Observing these low figures, one should however consider the nature of ISP support, which is intended to strengthen the research capacity and is directed to institutionally affiliated research groups and scientific networks. As research capacity increases, attraction of additional research funding in openly competitive calls will increase, resulting in research activities that do not acknowledge ISP support when published. Nevertheless, the supported ISP partner will continue to report all publications to ISP, because they are a reflection of the overall research capacity and not only of ISP funding as such.

There are differences in acknowledgment rate with regard to the three ISP programs, differences that have been consistent over five years. In the chemistry program, acknowledgement rate spans between 29% and 37% (26% in 2022), in the mathematics program between 6% and 16% (14% in 2022) and in the physics program between 31% and 46%. However, physics has an all-time high with 63% in 2021 and 64% in 2022. The rate of acknowledgement in the mathematics program is always lower than the other two, and the following issues may contribute to the differences:

- In the mathematical sciences, there may be less of a “tradition” to acknowledge financial support in publications, possibly manifested in the fact that many journals in mathematical sciences do not feature any acknowledgement section at all, which may impair the possibilities to express acknowledgement of ISP support.
- The mathematics program consists primarily of networks and publications reported by scientific networks appear to lack acknowledgement of ISP support to a larger degree than publications reported by research groups. The explanation for this may be that in many of the networks, ISP supports networking more than research activities. Still, research activities carried out by network members are reported when published, as an expression of the

development of research capacity that is partially a result of the networking supported by ISP. But ISP is not acknowledged because the research itself was supported by other sources.

[See the full list of publications in Appendix 2.5]

6.5 Conferences contributions

For 2022, in total 473 (339 in 2021) contributions at scientific conferences were reported by groups and networks, 58% of them at international meetings (36% in 2021). The number of international contributions continues to be high (in 2019 it was only 24%). The high number might be an effect of the Covid-19 pandemic, since many conferences afterwards turned into hybrid mode, making online participation easy. [Table 5]

Table 5. Yearly number of conference contributions, and share at international meetings, in previous Sida agreement periods and in 2020, 2021 and 2022.

Indicator	2008-13*	2014-19	2020	2021	2022
o) Total number of yearly conference contributions and proportion international.	235	392	317	339	473
	39%	36%	47%	36%	58%

Usually, there is a significant variation over the years in the distribution of contributions between international, regional and national meetings. In 2022, the national/local contributions were in minority (16%), followed by regional (25%) and then international contributions (58%).

Besides the share of contributions at international meetings, also the share of oral communications may be seen as a quality indicator. This measure has in previous years used to oscillate around 70%, but in 2022, the percentage was 82% for oral contributions (85% in 2021).

[Please see the full list of conference contributions in Appendix 2.6]

6.6 Arranged scientific meetings

A total of 113 scientific meetings with in total 7,195 participants were arranged by ISP supported groups and networks in 2022. These are impressive numbers even compared to previous years; in 2021, the number of meetings was 138 and with more participants (9,052).

In Africa, 80 meetings were arranged in 16 countries:

- 8 (14 in 2021) by chemistry partners
- 39 (60 in 2021) by mathematics partners
- 33 (29 in 2021) by physics partners.

In Asia, 33 meetings were arranged in four countries:

- 18 (23 in 2021) by chemistry partners
- 0 (0 in 2021) by mathematics partners
- 15 (12 in 2021) by physics partners.

[Please see the full list of Arranged meetings in Appendix 2.7]

6.7 Expenditures

In 2022, the total expenditures of research groups and scientific networks amounted to 93% of the funding provided by ISP (79% in 2021), which was 21.7 million SEK (including balances brought forward from 2021, making up 16% of the available ISP funds).

The reported research funding from other sources than ISP is higher than in 2021 (44 million in 2022, 22 million SEK in 2021), making up 60% of the total available research funding on an aggregated level (i.e. ISP funding + other research funding). Counting also the institutional co-funding reported, ISP contributed to 22% of the total resources available to the supported research groups and scientific networks. Overall, the institutional co-funding of ISP's partners accounted for 45% of their totally available resources, similar to the corresponding figure in 2022.

Still, some groups and networks don't answer the questions about in-kind contributions in the annual Activity reports (in 2022 six networks and nine research groups), but ISP's goal is to make all supported partners aware of how to present these figures. In 2022, ISP has continued the monitoring of these figures since we often see miss-calculations, e.g. when a network reports extreme manpower cost. We then write to the group/network to get a more adequate figure.

Table 6. ISP indicators of the outcome d and e. Total values for previous Sida agreements periods, and the figures for 2020, 2021 and 2022

Indicator	2008-2013	2014-2019	2020	2021	2022
d) Expenditures (MSEK) in relation to final yearly budgets (including balances brought forward)*	85% (113/132)	87% (156/180)	72% (19/26)	79% (27/34)	93% (20/22)
e) Yearly amount of funding granted from other sources than ISP. **	11.5 MSEK	34.7 MSEK	53,9 MSEK	22 MSEK	44 MSEK²¹
a. In % regarding research grants only	34%	50%	67%	64%	60%
b. In % including also in-kind contributions	n/a	73%	81%	70%	78% ²²

*Expenditures includes transfers to groups/networks for payments from local accounts, which may not have been fully used locally the same year.

**Share of funding from other sources than ISP.

Management of Expenditures

Each group and network has a yearly allocation, decided by the ISP board after an application and assessment procedure involving the programs' scientific reference groups. The use of the allocated funding is distinguished between

- expenditures carried out locally, after the transfer of funds to a local account, and
- expenditures by payments to third parties carried out by ISP.

In both cases, the transactions are formally requested by the accountable group leader or network coordinator, and should follow the budget for the use of funding for the year in question.

Funds transferred to groups/networks for payments from local accounts may not always be spent directly, and are to be accounted for each year. The degree of feasibility to manage funds locally

²¹ For a list of all other funding, please see *Appendices Expenditures 2.8*.

²² In-kind for 2022: 59.6 MSEK.

depends on the local financial management system and the administrative competence of the local staff. ISP has the ambition to increasingly transfer the responsibility for the management of the funding to the supported activities and has monitored this since 2015.

- In total, 42% of the expenditures by research groups and networks were managed locally (53% in 2021).
- In 2022, three research groups managed all of the funds requested locally (one chemistry and one physics group in Africa and one chemistry group in Latin America).

When it comes to the ability to manage the funds locally, ISP operates in countries (except for Rwanda) which have a low position on Transparency International’s²³ Corruption Perceptions Index. It might be so that supported research groups and networks want ISP to manage the transfers simply because it otherwise is a risk that the funds partly might get lost on the way. [For table of Corruption Perception Index, please see Appendix 2.8].

One of ISP’s specific strategies says that ISP should *clarify the possibility to budget postdoctoral activities within awarded allocations*. Groups and networks already have the possibility to budget postdoctoral activities if they motivate the need for it. During 2022, ISP has made the possibility more visible by highlighting it in the financial guidelines.

External Audits

ISP requests for an external audit of funds transferred for local use whenever the transferred amount exceeds 284,000 SEK in a granting period. Almost all partners performed excellently in delivering requested audit reports: The financial follow-up of 2022 included 22 requests, and ISP has received 18 audit reports. All 18 were approved, although six of them with minor comments from ISP. Four audit reports are postponed: For physics one was postponed for having found the auditors too late and the other was delayed because it was difficult to find an accredited auditor in Mali to follow the standard required by ISP. [Table 7]

Of course, no transfers of funds for local use are carried out until audit reports have been received, considered and approved by ISP, except for transfers comprising approved balances brought forward (if any), and a 20% share of the allocation for the year.

Table 7. Overview, per program, of the number of audit requests of 2022 (in some cases including 1 or 2 preceding years), regarding funds transferred for local use, and the number of cases where audit reports were received.

Program	Requested	Received	Approved in full	Accepted with comm./corrections	Disapproved	Absent	Postponed/ Review pending
Chemistry	8	6	5	1	0	0	2
Mathematics	0	0	0	0	0	0	0
Physics	14	12	7	5	0	0	2
Total	22	18	12	6	0	0	4

[For full details, please see Appendix 2.8]

²³ <https://www.transparency.org/en#> 2023-05-25.

7. ISP challenges

In previous sections of the Annual report, ISP's gender work has been described [see sections 4. *ISP Success stories* and 5.1 *Gender equality*]. Even though much has been achieved, there still are more men than women researchers in science, especially in mathematics and physics. Here, there is a need for continued work to raise consciousness about the importance of gender equality, mainstreaming and equal opportunities among supported partners.

Many of the ISP supported groups and networks work in politically vulnerable states. This is in itself a risk since ISP support is linked to the Swedish government's foreign aid policy, and Swedish aid can be withdrawn or paused, like in Myanmar. The military coup d'état in Myanmar (February 2020) has continued to impinge the Burmese supported research groups and networks; many staff members have been fired for criticizing the military and students have been expelled for the same reason. Two of the ISP supported research groups (both at University of Mandalay) have been badly affected, and activities have more or less been put on hold. The third group (at University of Yangon) has continued with activities.

Also, the Ebola outbreak in Uganda 2022 hampered the activities for ISP supported groups and networks.

In some cases, the policy of universities in low and lower-middle income countries still has a focus on the number of publications, rather than on the quality of the publication, when it comes to career promotion. Therefore, researchers and students might publish their papers in journals without checking the quality of the impact factor. Unfortunately, some articles end up in journals by predatory publishers. ISP works to raise the awareness and knowledge of this phenomenon among supported groups and networks. Here, there is a need for stronger measures.

Strategies completely fulfilled in 2022

In 2020, ISP refined the monitoring and evaluation of ISP's performance to better show the results and the efficiency of the program (ISP specific strategy) by updating data retrieval forms in the Activity report requests. In 2022, more or less all groups and networks provided the Activity reports in a satisfactory way.

In 2019, ISP developed a retrospective data document, based on the theory of change. This document serves as an instrument for systematic baseline assessment and chronology of capacity development stages with supported partners (ISP specific strategy). In 2022, this approach was fully implemented in all three ISP programs, and used as a background document particularly in the meetings of the Scientific Reference Groups.

Strategies partly fulfilled in 2022

In 2019, ISP started the work to develop and implement guideline criteria for the phase out of ISP support (ISP specific strategy). Based on the experiences of using the above-mentioned retrospective data documents, guideline criteria are intended to be developed.

The retrospective data document can also be used to develop an instrument for **periodical planning of progress expectations** with supported partners at a time course over a number of support agreement cycles (ISP specific strategy). ISP plans to implement the document in this sense when new support is initiated.

Strategies failed in 2022

In 2022, ISP did not *further increase the transparency in the “application by invitation” modality* (ISP specific strategy), when new support was initiated, mainly because no new support was initiated. It was however decided that information about the procedure would be published on the ISP website, <https://isp.uu.se/where-we-operate/>.

Moreover, ISP did not improve on the fulfillment of the specific objective *to make better use of previously supported partners in the development of new support*. This has for a long time been ISP’s ambition, but it has not been widely and systematically implemented. Today some previous partners contribute as hosts for sandwich students, and as scientific collaborators and mentors. In the future, ISP aims to put a stronger focus on how to attain this specific objective.

8. Lessons learnt 2022

The Covid-19 pandemic taught ISP that many meetings, seminars etc. can be arranged digitally. This will improve the contact between the partners and ISP, for example between two physical visits. Compared to the IRL meetings, digital meetings are cheaper, more inclusive (as more people can interact without the need to travel long distances) and much more environmental-friendly. Important to remember, though, is that digital interaction never fully can replace physical ones. ISP will continue to elaborate hybrid meetings and how to travel less frequently.

The international travelling by ISP staff members has decreased and will continue to decrease in the future. However, the physical meetings, seminars and conferences give better opportunities to comment, discuss, share experience and knowledge (as well as having informal chats in-between the meetings) than the digital meetings. It is very important to interact with people by physical presence, to see the working environment of supported partners, to meet and discuss with students, and to follow up the implementation of new instruments and new procedures, i.e. follow the progress of the supported group/network.

ISP sees a need to continue to improve templates and guidelines for the annual activity reporting. ISP also recognizes the importance of organizing e-meetings for groups and networks on how to fill-out the activity report forms, the financial report forms as well as the application forms.

ISP will continue to support gender pursuits in supported groups and networks, e.g. through the ISP Gender Equality Grants. These grants generate an impressive variety (and number) of activities targeting gender bias at different education levels. An increased awareness of gender issues is clearly seen in the majority of ISP supported groups and networks. Surely, the women scientific ISP staff (Carla Puglia and Barbara Brena in physics and Cecilia Öman in chemistry) serve as role-models for groups and networks.

The problem with predatory publishing must be taken seriously, and ISP will continue to make group and network members aware of how to choose journals wisely.

ISP will continue to make the program better known within and outside Uppsala University. Hopefully the information about the success of ISP’s work can attract funding from supplementary sources. The ISP model can serve as best practice for scientific capacity building in low and lower-middle income countries.

9. Other ISP cooperation

ISP's specific objectives say that ISP should *continue cooperation with other organisations to the benefit of the program*.

Besides the ISP core program, reported in the previous sections, ISP carries out assignments by Sida and engages in collaboration with other bodies.

In short, the cooperation with Stockholm University, Sweden, with Thailand International Cooperation Agency (TICA), Thailand, and with American Institute of Physics (AIP), USA, continued in 2022. The cooperation agreements negotiated in 2021 with ThEPCenter and with Unisa-iThemba also continued.

ISP was also granted an Erasmus+ CBHE (Capacity Building in Higher Education) project, PEP, together with UPE, Unit for Professional English and Division of Internationalisation at Uppsala University.

ISP furthermore celebrated the International Year of the Basic Sciences for Sustainable Development (IYBSSD2022) by giving 14 webinars.

A pilot phase of the new project EFFORT together with STUNS, Makerere University in Uganda and University of Rwanda was approved by Sida.

9.1 Stockholm University

The agreement with the Faculty of Science, Stockholm University (SU), continued. SU contributes with SEK 1 million per year (2021-2025).

The funds from SU are used mainly for two ISP supported research groups at National University of Laos, one in environmental chemistry at the Department of Chemistry (IPICS LAO:01), and one in geoscience at the Department of Physics (IPPS LAO:01).

[More information in Appendix 3.2 and at isp.uu.se/our-sponsors/stockholm-university/su/]

9.2 Al-Baha University

The agreement between Al Baha University (ABU) and Uppsala University was terminated in April 2019.

In 2022 only one PhD student remained in the program, Mr Mohammed Albuhayri. He successfully defended his PhD thesis "*Asymptotics of implied volatility in the Gatheral double stochastic volatility model*" in November 2022 at Mälardalen University in Sweden and has returned to ABU.

9.3 American Institute of Physics (AIP)

Since 1999, ISP has had an informal agreement with American Institute of Physics (AIP) about the books that they receive from various publishers for review in the AIP journal "Physics Today". AIP collects these (new) books and sends them in batches to different departments of physics indicated

by ISP. ISP pays the shipping charges. A typical batch contains about 300 books. In 2022, ISP sent AIP books to partners in Bolivia Burkina Faso, Sri Lanka och Tanzania.²⁴

9.4 Thailand International Cooperation Agency (TICA)

In 2015, ISP partnered with [the Thailand International Cooperation Agency \(TICA\)](#) and the Thailand Research Fund (TRF).

The partnership offers scholarships to PhD students in Bangladesh, Cambodia, Laos, Myanmar, Nepal and Vietnam, in 2019 extended to Bhutan and Sri Lanka. Students are registered at Thai universities, where they spend two years of their PhD training, with one intermittent year in Sweden.

In 2019, the responsibilities of TRF were transferred to the Thailand Science Research and Innovation (TSRI) at the National Research Council of Thailand (NRCT) under the Thai Ministry of Education, Science, Research and Innovation.

In 2022, two Myanmar PhD students successfully defended their PhD theses in Thailand, and are now back in Myanmar as lecturers. Two students still study in Thailand.

[More detailed information in Appendix 3.3]



Figure 17: Thiri Yadanar Htun, TICA-ISP PhD graduate.

9.5 Thailand Center of Excellence in Physics (ThEPCenter)

ISP has had a long-lasting cooperation in physics with University of Chang Mai²⁵. In 2019, Prof Thiraphat Vilaithong, Executive Director of [ThEPCenter](#), visited ISP and requested a formalized cooperation based on previous relations. In January 2021, a Memorandum of Understanding (MoU) was signed between ISP and ThEPCenter.

The MoU implies that the Thai universities connected to the ThEPCenter may act as hosts for ISP physics postgraduate students and researchers from ISP partner countries. ISP may act as coordinator for Thai physics postdoctoral fellows at Swedish universities.

9.6 UNISA-iThemba

A new Memorandum of Understanding (MoU) between ISP and the UNESCO-UNISA-ITLABS/NFR Africa Chair in Nanoscience Nanotechnology, in Pretoria, South Africa, was signed in June 2021.

The agreement allows PhD students and postdoctoral fellows in physics from both African and Asian ISP supported groups and networks to spend up to one year of training in one of the UNESCO-UNISA affiliated academic and technical resources, and member institutions.

²⁴ <https://www.aip.org/news/2014/physics-today-uppsala-university-books-partnership> 2022-05-16.

²⁵ Between 1982 and 2005. More information in [The International Science Programme in Sri Lanka and Thailand: Three decades of research cooperation](#) by Rebecca Andersson and Marta Zdravkovic, 2017.

9.7 EFFORT

EFFORT, Efficient SDG fulfilment for regions in transition – linking society to research addressing development challenges, is a planned cooperation initiated by STUNS Energi (the Foundation for collaboration between the universities of Uppsala, Business and Society, Uppsala, Sweden) to be implemented by ISP, provided that a pilot phase is decided to be funded by Sida.

EFFORT aims to establish a societal PhD program by enrolling civil servants in ISP partner countries in bilateral “sandwich” PhD programs and creating a multidisciplinary forum addressing practical Sustainable Development Goal (SDG) fulfillment, by conducting of high-quality research in fields pertinent to regional development challenges. In an initial stage, EFFORT draws on the existing relationships between Rwanda, Sweden and Uganda, and includes participation by the United Nations Development Programme (UNDP), to enhance the capacity for societally relevant research and use of SDG-related results, methods and solutions.

In 2022, considerable time was devoted to planning activities and setting up of working committees in each country, and in November meetings were held for the purpose in Kigali, Rwanda, and Kampala, Uganda.

9.8 Unit for Professional English (UPE), Uppsala University

In 2022, ISP physics (IPPS) in collaboration with the Unit for Professional English (UPE), Department of English, Uppsala University (UU), organized two online courses in English for researchers and students from ISP supported groups and networks in West Africa, namely Burkina Faso, Ivory Coast, Mali and Senegal. In these countries, most people speak and use French as a working language and often have less knowledge or experience of using English professionally. This initiative aims to increase the researchers' and students' written and spoken English skills of the researchers and students to increase international competitiveness.

A total of 26 PhD students and 21 West African teachers were involved, along with two teachers from UPE. Since the courses were much appreciated by the participants, the courses are continuing in the year 2023, but now under the umbrella of the Erasmus+ CHBE project PEP [*more information below*] and with participation of students from all ISP programs in West Africa.

9.9 Erasmus+ CBHE project PEP

In 2022, ISP was granted an Erasmus+ CBHE (Capacity Building in Higher Education) project called PEP Professional English Programs, together with UPE, Unit for Professional English and Division of Internationalisation at Uppsala University. Partners in the project are University of Galway in Ireland, University Joseph Ki-Zerbo and University Nazi Boni in Burkina Faso, University of Sciences, Techniques and Technologies of Bamako and University of Arts and Humanities of Bamako in Mali, University San Pedro and Institut National Polytechnique Félix Houphouët-Boigny (INPHB) in Ivory Coast.

The main objective of PEP is to train French-speaking university staff in English, and establish Units for English proficiency in the participating universities.

During spring semester 2022, ISP prepared the application together with Division for Internationalisation. During autumn semester 2022, much time was spent on coaching the African partners how to deal with EU administration and the EU CBHE portal. In addition to learning the EU

funding landscape, ISP considers this time valuable for supported groups and networks to build their capacity when applying independently for EU funding.

With this project, ISP continues to address need for French-speaking West Africa to develop their English language proficiency, in order to fully participate in the international science community whereas English is the lingua franca.

9.10 IYBSSD2022

From July 2022 to July 2023, the International Year of the Basic Sciences for Sustainable Development (IYBSSD) is celebrated, and as the basic sciences are the cornerstones for ISP, ISP has engaged a specific activities connected to IYBSSD, namely the ISP #IYBSSD2022 webinars. In total, 14 webinars were arranged, and they had a total number of 780 participants from 58 countries in Europe, Africa, Asia, Latin America, North America and Oceania.

Moreover, ISP has been part of the IYBSSD International Advisory Committee, and has as such participated in these meetings.

[For a list of all webinars, please see Appendix 3.6]

9.11 Pan-African Centre for Mathematics (PACM)

The Pan-African Centre for Mathematics (PACM) is a joint initiative between ISP, University of Rwanda (UR), Stockholm University (SU) and International Centre for Theoretical Physics (ICTP). The project aims at starting a Master's program in fundamental mathematics under the centre EAFIR (East African Institute for Fundamental Research), which is an ICTP-affiliated regional centre in Kigali, Rwanda. The program will have Pan-African recruitment and provide full funding to the students.

The centre has not started its activities yet, but ISP has during 2022 participated in several discussions and meetings.

9.12 African Network for Women in Astronomy

African Network for Women in Astronomy (AfNWA) was set up in 2019 to connect and support women in astronomy across the African continent. Every year the network assigns awards to women astronomers in recognition of their scientific achievements and contributions to society. ISP alumna Priscilla Muheki is one of the founders of the network.²⁶

ISP sponsors the Women in Astronomy in Africa Awards. In 2022, ISP sponsored the first Early Career Award of AfNWA. The Early Award acknowledged Dr Marie Korsaga, the first woman astronomer in Burkina Faso and the Senior Award was assigned to Prof Renée Kraan-Korteweg from South Africa. Dr Korsaga is a postdoctoral researcher at the Observatoire Astronomique de Strasbourg in France, and a lecturer at the Université Joseph Ki-Zerbo in Burkina Faso. Dr Korsaga works on dark matter using observations from optical, infrared and radio telescopes. She is also a passionate advocate for women in STEM in the global and African astronomy communities. Prof Renee Kraan-Korteweg is a senior and internationally well recognized astronomer working at the University of Cape Town in South Africa. Prof Kraan-Korteweg has recently discovered a new supercluster of galaxies hidden behind the Milky Way galaxy. The award acknowledged not only her scientific skills but also her

²⁶ AfNWA is part of the African Astronomical Society (AfAS). AfNWA website: <https://afnwa.org/>

efforts of great impact in promoting women in astronomy in Africa. The award ceremony was held in Cape Town, South Africa on March 2, 2022. ISP participated online.

9.13 Sida bilateral research cooperation

By assignment by Sida, ISP is managing a number of activities related to the Sida bilateral programs for research cooperation. In 2022, these assignments comprised the coordination on the Swedish side of the programs with:

- Bolivia
- Cambodia
- Ethiopia
- Mozambique
- Rwanda
- Tanzania
- Uganda – Concluded June 30, 2022

ISP is also administrating the payments of subsistence allowance to participants in the bilateral programs while in Sweden.

[For more details, please see Appendix 3.1]

10. More about ISP

10.1 Other ISP activities

A publication related to ISP's 60th Anniversary (in 2021) was prepared in 2022. The book will be published in spring 2023.

ISP moved to new premises at Uppsala University (UU) April 18, from the Biomedical Centre (BMC) to house 19 at the Ångström Laboratory.

For webinars arranged by ISP, please see section 9.10 *IYBSSD2022*.

Student activities

ISP arranged two student activities for ISP students in Sweden. In the Fellow evening at ISP office on May 25, 19 students participated in the speed networking, the quiz ("Do you know Swedish?") and mingle. On November 22, ISP arranged a Christmas fika. 16 students participated.

Visits and travels

Delegations, visits and travels in 2022 was still affected by the Covid-19 pandemic to some extent, so the number for 2022 has not reached pre-pandemic proportions.

[Please see Appendices 4.1 for lists of visits and travels]

Research, laboratory and network management coaching

Since 2016 ISP offers research, laboratory and network management coaching to 13 supported African research groups and networks in chemistry. The coaching was implemented as on-site workshops during 2016-2019, but replaced by on-line webinars in 2020. Associate Professor Cecilia Öman, deputy director of ISP chemistry is the founder and the manager of this program.

The purpose with the ISP coaching program is to facilitate an enabling environment for scientific researchers and technicians at scientific institutions with weak scientific infrastructure. The workshops bring together scientific researchers, technicians, librarians, scientific institution management, and users of scientific findings, for lectures and discussions with the aim of inspiring scientific stakeholders to be innovative change-makers.

In 2022, ISP held around 100 research management webinars with approx. 150 participants (of them approx. 300 have been involved since the start in 2016²⁷). The attendance is firm, with the same participants attending every session. About, 30% have had temporary obstacles, due to other assignments, or weak internet or electricity access, or computer problem. In some countries participants share computer or use their cell phones.

The research, laboratory and network management coaching agenda is built on evaluation planning. Evaluation planning describes how we monitor and evaluate the way we address our activities, as well as how we intend to use evaluation results for activity improvement and decision making.

²⁷ Participants tend to enter the ISP monthly on-line coaching when they enter a university program and leave when they leave the same program.

Participants are guided through their ambitions, outcome challenges, activities, milestones, output, outcome and sustainable impact. The topics addressed during the coaching are chosen by the participants themselves and have been identified by the participants as challenges²⁸ to the reaching of their goals. We sort out the challenges together during the coaching and find solutions. We also implement institutional strategies with the purpose of ensuring that the same challenges are not perceived by another researcher again.

The set-up is two-fold; each researcher's, technician's and network members' own career ambitions combined with the ambitions of the management of the institution. Special attention is given to the capacity, power and resources for transparency, accountability and corrective measures. We also collect data in order to measure progress and handle risks.

Progress markers are measurable indicators of outcome and include, but are not restricted to: number of submitted research grant applications, submitted manuscripts, implemented research findings, functioning advanced scientific equipment, as well as income through consultancy and laboratory services.

Outcome are actions taken by the participants and other stakeholders as a result of the activities in the programme. Outcome include, but are not restricted to: time management templates, improved internet access, team-building discussions, participants empowered to speak up, engage on the Trello platform and upload presentations, participant making presentation on how to seek grants and write manuscripts, presentation of research projects, monthly local meetings on aspect addressed in the coaching such as grant application and manuscript draft reviews, compilation of grants givers, workshops by librarians, department procedures for literature review, motivate the management to recruit technicians, procedures for timely access to reagents, reviewing potential new partners and contacting them, lean business plan review, market survey, reaching out to first customers, policy brief guidelines.



Figure 18. Associate Professor Cecilia Öman in action.

²⁸ Examples of topics are applying for research grants, ensuring access to functioning pieces of advanced scientific equipment, writing manuscripts and publish papers and implementing scientific finding.

10.2 ISP organization

The operation of ISP is regulated in an ordinance established by the Swedish government in 1988²⁹ through the then Office of Universities and Higher Education (Universitets- och högskoleämbetet, UHÄ).

ISP Board

The ordinance requires the Uppsala University Board to establish additional directions needed for the operation of the program. These are established in the Instruction, latest revised and decided by the Vice-Chancellor 22 March 2016.³⁰

The ISP Board, appointed for 2021-04-01 to 2024-03-31, had the following composition (deputies included):

- 50% Female
- 50% Male

In 2022 there were two new board members:

- The representative for Uppsala University, Dr Eva Söderman
- The representative for Uppsala University, Prof Fan Yang Wallentin

In 2022, the Board had no votes *per capsulam*, but a hybrid meeting in Uppsala and Zoom on December 16.

ISP Executive Committee

The ISP Executive Committee (EC) is a standing working committee to the Board, regulated by the Rules of Procedure,³¹ established by the Board in June 2019. It met four times in 2022. All meetings were hybrid meetings.

The members are all Uppsala University staff and the composition was:

- 44% Female
- 56% Male

The ISP Scientific Reference Groups

The ISP Scientific Reference Groups has among its tasks to evaluate the applications from invited research groups and networks. The reference groups are composed by renowned senior scientists; half of the members are from the regions where ISP operates, and half are from Nordic countries.³²

ISP Chemistry (IPICS)

The IPICS scientific reference group had its annual meeting online, October 4-8. It had the following composition: 50% F and 50% M (3 women and 3 men).

²⁹ UHÄ-FS 1988:18; SFS 1992:815.

³⁰ The ordinance and a translation to English can be found at www.isp.uu.se/about-isp/board/ 2020-06-01.

³¹ The Rules of Procedure can be found at https://www.isp.uu.se/digitalAssets/502/c_502308-l_1-k_160613-isp-rules-of-procedure.pdf 2022-05-20.

³² Terms of Reference for the Scientific Reference Groups https://www.isp.uu.se/digitalAssets/496/c_496672-l_1-k_tor-for-isp-ref-groups-v2.pdf 2022-05-20



Figure 19. IPICS Reference Group meeting with applicants 2022.

ISP Mathematics (IPMS)

The IPMS scientific reference group met on Zoom on 12, 18 and 27 October. The group had the following composition: 25% female and 75% male (1 woman and 3 men).

ISP Physics (IPPS)

The IPPS scientific reference group had its annual meeting online on October 4-7. It had the following composition: 20% female and 80% male (1 woman and 5 men).



Picture 20. IPPS Reference Group meeting with applicants 2022.

ISP Staff

In 2022, ISP had 16 staff members, 50% female and 50% male.



Picture 16. ISP staff (including two ISP Board members, Lars Österlund and Kersti Hermansson). Photo from April 2022.

[For full details, please see Appendix 4.2]