SERVIR-HKH

Closing the STEM gender gap

Training women in Earth observation and geospatial information technology

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Training women in Earth observation and geospatial information technology

Authors
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Gender gap in science and technology

Gendered patterns in job choices perpetuate social inequality and the prevalence of scientific solutions that ignore the perspectives of women.

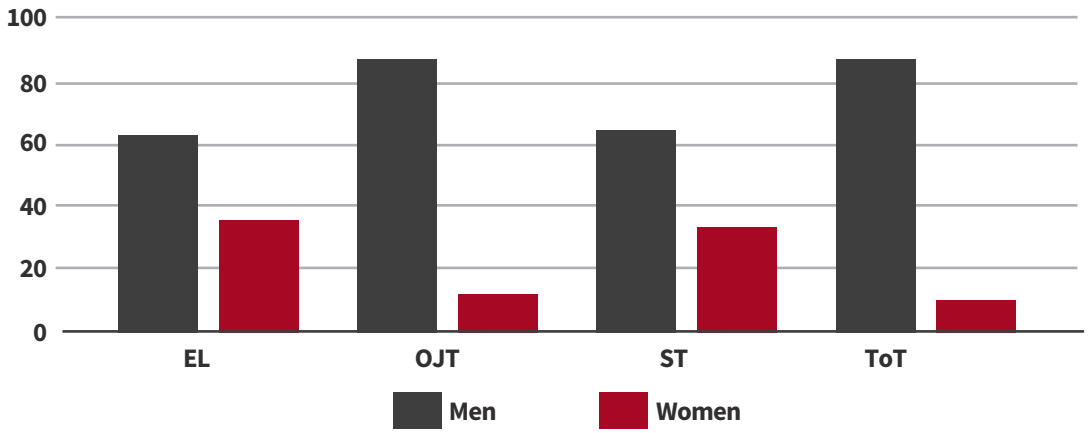
Geospatial science and technology has emerged as one of the fastest-growing fields in recent times. Professionals in a variety of disciplines are using geospatial knowledge and technologies to collect, manage and analyse geographic information and understand real-world problems. Over the next couple of decades, jobs across the globe will increasingly require digital literacy and information and communications technology skills, and likely involve the use of geospatial technologies such as Earth observation (EO) and geospatial information technology (GIT). Despite the rapid growth of EO and GIT, the number of women professionals in this sector remains low across the world. Historically, men have benefited more from education and technology because of gender norms and practices. The EO and GIT sector too is dominated by

men, whether in academia or industry (Goodrich et al., 2021). This gender gap in technology is especially pronounced in countries in the Hindu Kush Himalaya (HKH) region.

In its Global Gender Gap Report 2021, the World Economic Forum highlights that on average women are underrepresented in science, technology, engineering, and mathematics (STEM) professions. The persistence of gendered patterns in job choices (Schwab et al., 2017) can have far-reaching consequences for women and society. It would increase the gender pay gap and perpetuate social inequality, considering that STEM fields pay higher salaries and offer better job security than non-STEM fields (Beede et al., 2011). Further, scientific solutions that ignore the perspectives of women, who make up half of humanity, might be limited.

Studies have found that a diverse group of solution-seekers can outperform a competent but homogeneous group (Krentz et al., 2021; Hunt et al., 2015). Increasing gender diversity in STEM may give rise to more dynamic and effective solutions. It is hence imperative to develop women's capacity to pursue and excel in STEM professions, including in cutting-edge sectors like GIT and EO.

From 2015 to 2020 (graph below), a majority of the participants benefitting from and contributing to SERVIR-HKH events were men. We have sought to address this through our Women in GIT training series.



EL: exposure and learning, OJT: on-the-job training, ST: standard training, ToT: training of trainers

*Figures are in percentage

Building women's capacity in EO/GIT

We developed an assessment, design, implementation, and monitoring approach to promote user engagement and improve partnerships.

To bridge the technology and gender gap and to promote a gender-balanced workforce in the region, in 2018 we piloted the "Empowering women in GIT" (WoGIT) training – the first of its kind – catering exclusively to young women professionals. The training introduced EO/GIT concepts and enhanced the ability of young aspiring women to apply such technologies in their respective fields. The event was instrumental in sparking participants' interest in EO and GIT and building their capacity.

In subsequent years, we provided the training to more women in the HKH region, customizing training materials to address the context of each country. Between 2018 and 2021, we trained 410 women from diverse academic and professional backgrounds. Some of the key outcomes of these trainings are summarized in the following section.

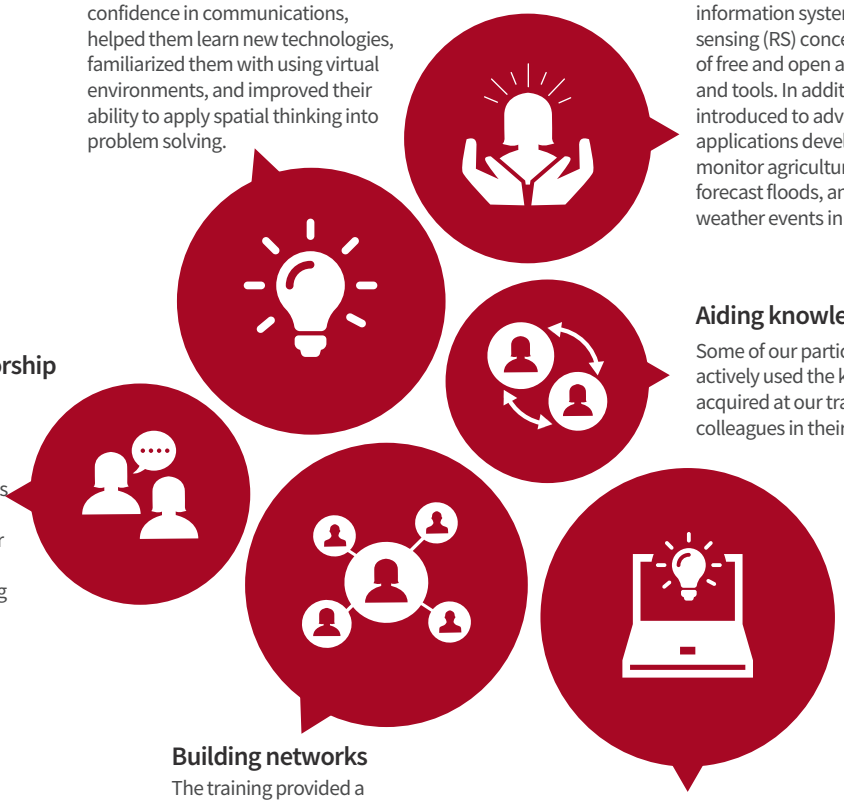
Outcome highlights

Imparting soft skills

The trainings enhanced participants' confidence in communications, helped them learn new technologies, familiarized them with using virtual environments, and improved their ability to apply spatial thinking into problem solving.

Building awareness

Participants learned geographic information system (GIS) and remote sensing (RS) concepts, and become aware of free and open access software, data, and tools. In addition, participants were introduced to advanced SERVIR science applications developed and deployed to monitor agricultural drought, land cover, forecast floods, and assess high-impact weather events in the HKH region.



Aiding knowledge transfer

Some of our participants have actively used the knowledge and skills acquired at our training to train other colleagues in their organizations.

Extending mentorship opportunities

We continue to provide technical support to participants to help solve their problems, and mentor participants seeking guidance on furthering their research and academic portfolios.

Building networks

The training provided a platform for participants to network with fellow professionals and share knowledge and experiences. Post-training, most participants continued to stay connected with each other through social media.

Fostering cross-disciplinary learning

Our WoGIT trainings brought together participants from different educational backgrounds, institutions, and geographic regions. We updated each iteration of the training to incorporate training material to cater to a multidisciplinary audience, and foster cross-disciplinary learnings and exchange. Later iterations of the training catered to country-specific examples as well.

EO and GIT for sustainable solutions in the HKH

The HKH region is one of the most fragile and vulnerable in the world. With its complex topography, high temperature variability, and ecological diversity, the region faces a range of challenges – melting glaciers, degrading ecosystems, changing environments, globalization, and socioeconomic pressures.

Concurrently, advances in EO and geospatial and digital technologies have dramatically improved our ability to understand and respond to the impacts of climate change and other human-induced threats. These technologies have become instrumental in measuring and monitoring the effectiveness of development policies and programmes as well as our natural and social environments. Improvements in spatial and temporal resolutions along with increased availability of and access to free and open-source geospatial data and tools have also opened up opportunities to harness such technologies in cross-disciplinary research and the development of sustainable solutions.

The HKH region is at an early stage of adopting these technologies for monitoring and evaluating dynamic biophysical and social processes. On the one hand, there is an increasing acceptance of data, capacities, and services in EO and GIT by national agencies to improve decision-making processes. On the other, there is a huge data, capacities, and services gap. This situation presents opportunities to harness technologies for the benefit of the HKH region and its people (Bajracharya et al., 2021).

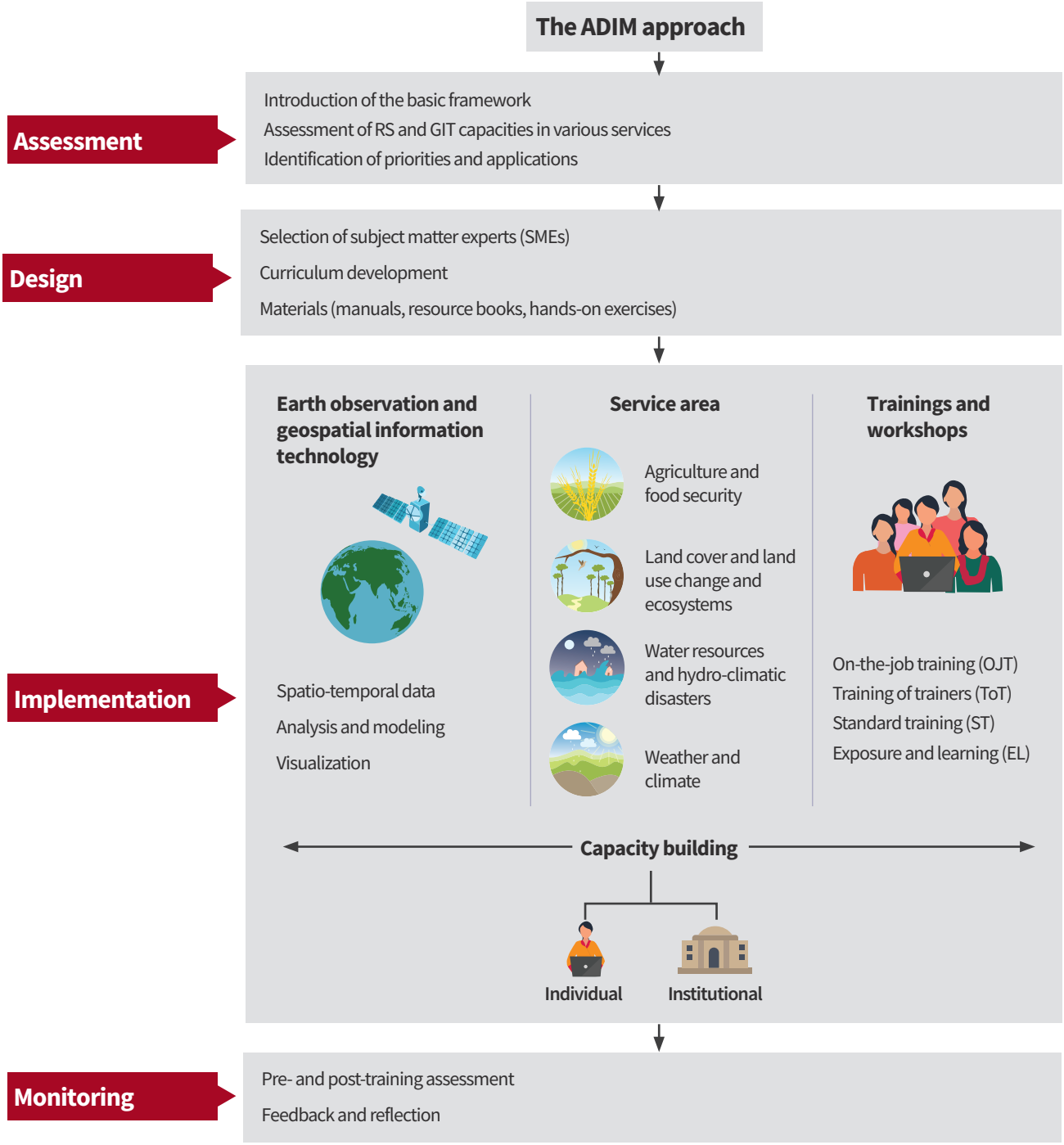
SERVIR-HKH: Capacity building and user engagement

ICIMOD implements SERVIR Hindu Kush Himalaya (SERVIR-HKH), the HKH hub of SERVIR, a joint initiative of the National Aeronautics and Space Administration (NASA), the United States Agency for International Development (USAID), and leading geospatial organizations in Asia, Africa, and Latin America. SERVIR-HKH collaborates with leading organizations in the HKH region to assist developing countries in utilizing EO and GIT information for informed decision-making. By promoting open access data, developing innovative decision support products, and delivering reliable information in the region, the initiative seeks to enhance the capacity of government and development stakeholders to incorporate EO and GIT in their decision-making processes.

Capacity building and user engagement are integral to SERVIR-HKH. Therefore, we developed a robust assessment, design, implementation, and monitoring (ADIM) approach that incorporates four types of training – on-the-job training (OJT); standard training (ST); training of trainers (ToT); and exposure and learning (EL) – within four thematic areas: agriculture and food security (AFS); land use and land cover change and ecosystems (LULCC&E); water resources and hydro-climatic disasters (WRHD); weather and climate (WC) (Thapa et al., 2021a).

This approach helped us promote active user engagement, strengthen existing partnerships and build new partnerships by assessing country-specific gaps, designing user-specific materials, collaboratively developing and testing new services, and monitoring the impacts of our capacity building efforts (Thapa et al., 2021b).

Assessment, design, implementation, and monitoring (ADIM) approach for capacity building



Adapted from: Thapa et al., 2021a

Our WoGIT journey

Between 2018 and 2021, we organized nine WoGIT trainings (two in-person, and seven virtual) in five HKH countries, benefitting a total of 410 women from diverse academic disciplines and professions. For each iteration of the course, we received a very high number of applicants, exceptional feedback from course alumni, and further requests for more in-depth training sessions. Our virtual trainings allowed us to reach more women from remote areas, which would have been logistically challenging for in-person trainings.

Milestones in our WoGIT journey

We partnered with the Robotics Association of Nepal (RAN) to organize the first WoGIT training and designed the course for participants who are completely new to EO and GIT concepts. We adopted a blended approach that included theoretical sessions and practical hands-on exercises, and used real-world examples from across the HKH region. RAN posted announcements for the training at various science and engineering colleges in Kathmandu, Nepal, and interested candidates applied online. We selected and trained 84 participants affiliated to 33 institutions from a pool of over 300 applicants.

We limited the number of participants to 40 to make the training manageable and more effective. We received an overwhelming response to our open call for applications from Nepalese women as well as from women and men in other HKH countries, which shows there is a huge demand for the training in other HKH countries as well.

We trained women from Nepal and Pakistan, benefitting a total of 65 women affiliated to 37 institutions. Given the travel restrictions due to the COVID-19 pandemic, we organized these trainings virtually on the Microsoft Teams platform.

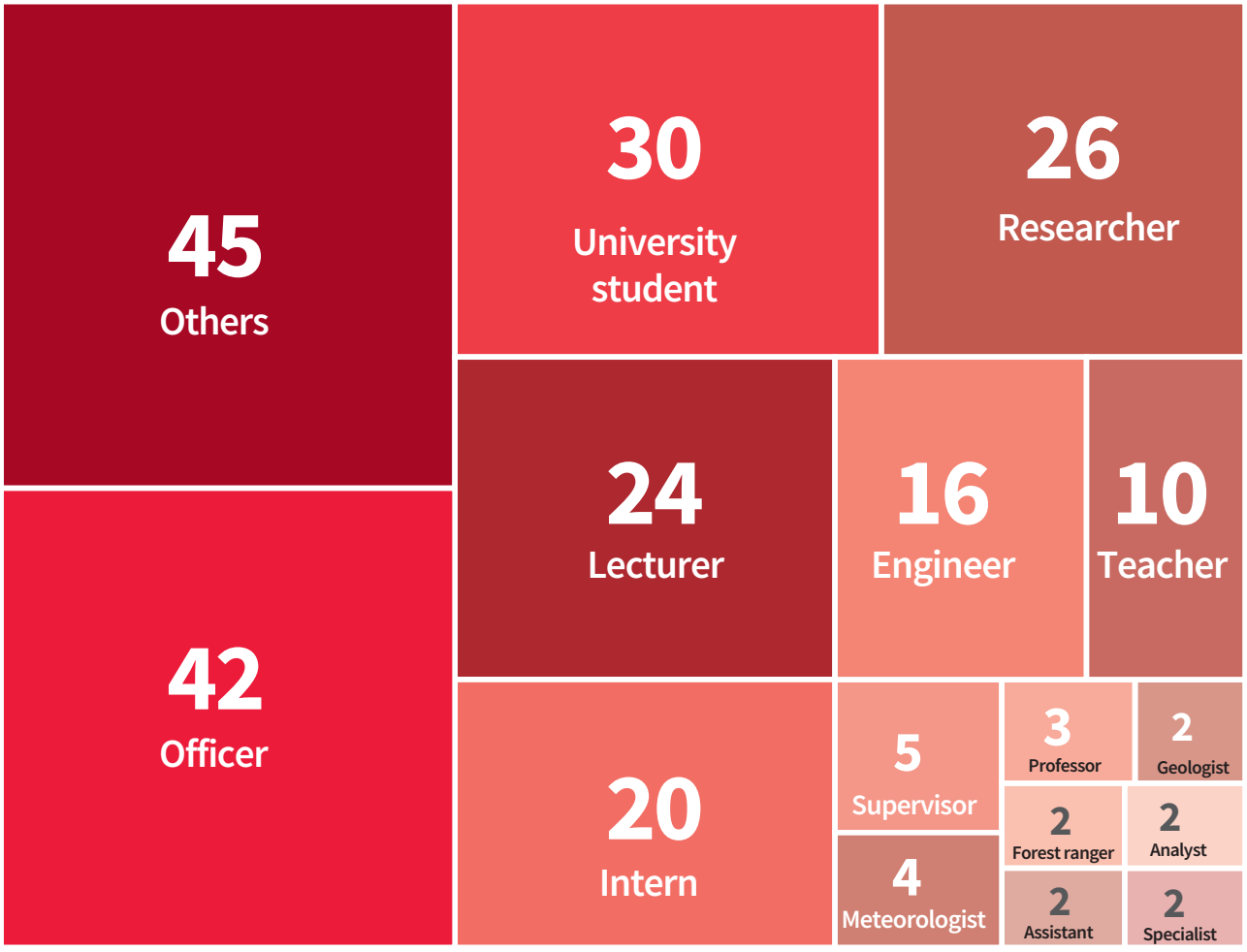
We scaled out the virtual training to five HKH countries – Afghanistan, Bhutan, Bangladesh, Nepal and Pakistan, reaching 235 women from 166 diverse institutions.

Number of participants (and institutions) joining our WoGIT trainings in 2018–2021

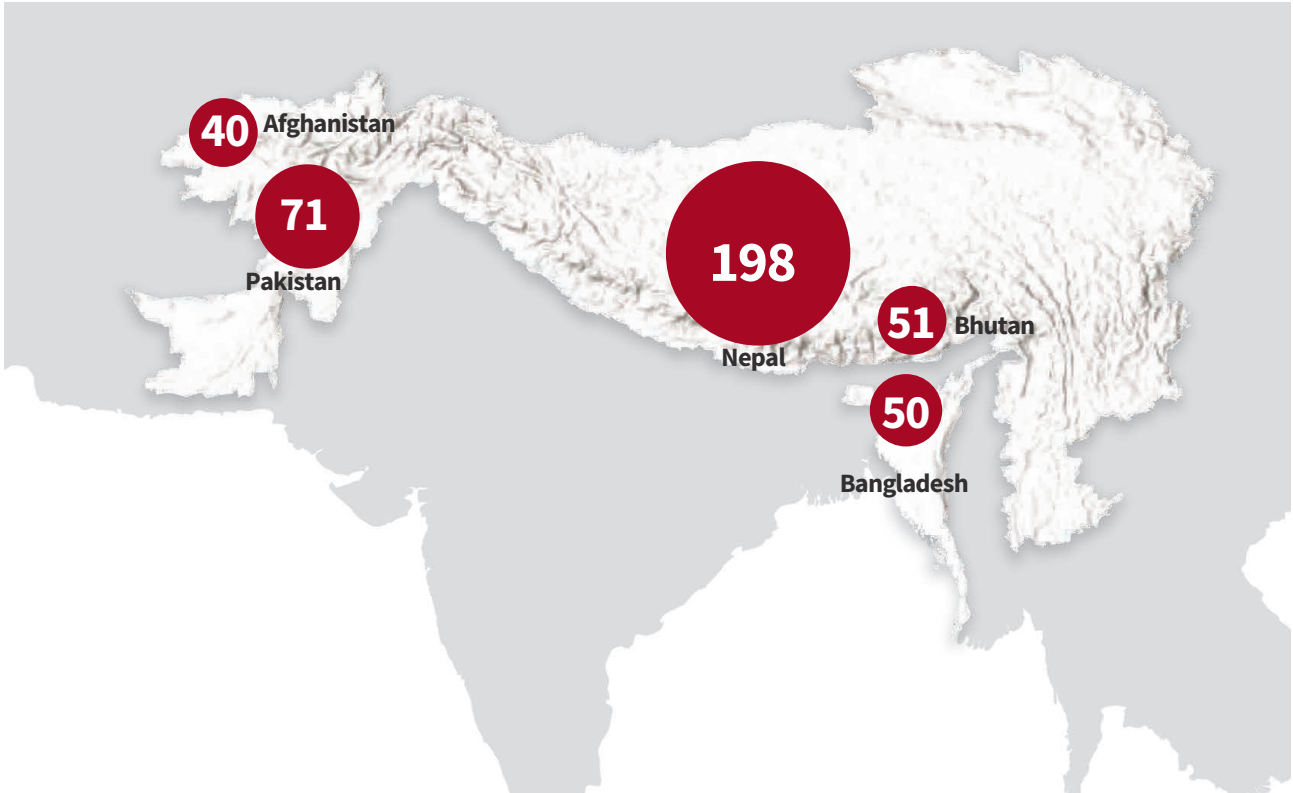
Country	2018	2019	2020	2021
Afghanistan	-	-	-	40 (29)
Bangladesh	-	-	-	50 (30)
Bhutan	-	-	-	51 (31)
Nepal	84 (33)	40 (28)	25 (9)	49 (39)
Pakistan	-	-	26 (24)	45 (37)

* The figure in brackets is the number of institutions represented by the participants

Participants joining our WoGIT trainings in 2021 came from a variety of professions



Spatial distribution of people who participated in our training



We customized training materials to cater to country-specific needs and challenges.

For each training, we modified and updated the course structure and deliverables in keeping with the participants' subject knowledge and needs. The trainings allowed participants to get acquainted with the most recent advances in the EO and GIT domains. The trainings also demonstrated how we have been working with partner institutions to develop solutions related to the core thematic areas under our initiative: agriculture and food security; land cover and land use change and ecosystems; water resources and hydro-climatic disasters; and weather and climate. We covered a variety of topics ranging from the basics of GIS and RS, mapping using open-source tools, image calculation and spectral indices, and stream and catchment delineation, as well as demonstrated various SERVIR-HKH services such as the Streamflow Prediction Tool, the Glacier Dynamics Application, the Regional Drought Monitoring and Outlook System, and the National Agricultural Drought Watch. Additionally, we customized training materials to cater to country-specific needs and challenges. For example, the Bangladesh training incorporated concepts and hands-on exercises on mapping flood inundation and damage assessments. Similarly, the Pakistan and Nepal trainings included monitoring and mapping agricultural droughts and forests. The Afghanistan training included monitoring agricultural drought and glaciers, and the Bhutan training included streamline delineation.

Assessing training impact

We carried out pre-and post-training surveys to assess the quality of each training. Participants were asked to rate their scientific knowledge and skills related to training topics before and after the training. By comparing their self-assessments pre-and post-training, we were able to assess how the training had enhanced their knowledge and skills. Participants were also asked to rate the quality and usefulness of the training materials and presentations provided, the interaction with subject matter experts (SMEs), time allotted to each session, etc. This allowed us to assess their overall experience and find out how we can further improve the trainings.

Analysis of pre-and post-training surveys showed that the training had significantly improved participants' scientific knowledge

*Figures are in percentage

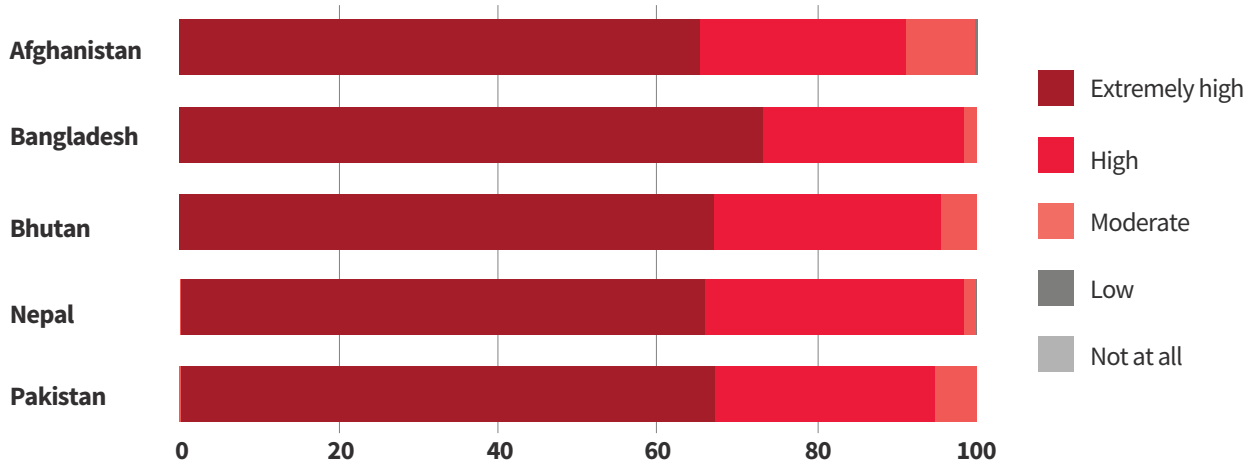
An analysis of pre-and post-training surveys conducted at the WoGIT 2021 series showed that the training had significantly enhanced participants' scientific understanding. Post-training, there was a marked increase in the number of participants who reported having a 'high' or 'moderate' level of scientific knowledge. We observed a major shift from 'none' to higher levels for Bhutan (44%) followed by Bangladesh and Pakistan (40% each), Nepal (35%) and Afghanistan (21%).

Analysis of pre-and post-training surveys showed that the training had significantly improved participants' scientific knowledge

*Figures are in percentage

Participants reported that the training had significantly enhanced their technical skills. Post-training, the number of participants who reported having "advanced" or "intermediate" skills had increased markedly. These shifts were more pronounced in Bangladesh (65%), followed by Bhutan (63%), Pakistan (61%), Nepal (52%), and Afghanistan (35%).

Participants' response (in %) on the relevance and quality of the training (2021)



Around 95% of the participants who attended our trainings in 2021 rated the training "extremely high" and "high" in terms of relevance.

Around 95% of the participants who attended our trainings in 2021 rated the training "extremely high" and "high" in terms of relevance, suggesting that all participants would be able to apply the knowledge gained during the training.

Proactive engagement after the training

After receiving our trainings, our alumni were able to pass on their knowledge and skills to many others in their respective countries. Some of them trained other colleagues in their organizations, and some helped build new partnerships.

- In response to the requests made by numerous participants from our 2021 trainings, we are planning to organize advanced trainings for selected alumni from our 2021 trainings.
- Following our WoGIT training for Bhutan, the Department of Curriculum and Professional Development in Bhutan requested us for a ToT course on GIS/RS. We are in the process of signing a memorandum of understanding with the Bhutanese Ministry of Education to provide training and develop course materials for strengthening the capacity of upper high school teachers.
- Following the WoGIT training for Bangladesh in 2021, the Local Government Engineering Department in Bangladesh requested us to organize advanced training in EO/GIT applications for their department.

Participants' voices

Each iteration of the WoGIT training included a feedback session. During those sessions, participants shared how the training had boosted their confidence and equipped them with knowledge and skills required to tackle issues in their respective fields. Post-training, we reached out to several participants for their feedback and incorporated it in blogs published on our website. We also requested some participants to share their views on empowering women in STEM and their personal experiences in that regard.

The SERVIR data products and the rainfall forecast modelling introduced in the training will help me improve the quality of our irrigation advisory service. This will support our beneficiary farmers in their efforts to achieve climate resilience and food and livelihood security.

Bareerah Fatima
Program Liaison Officer at the Pakistan Council of Research in Water Resources, and a participant of the 2020 WoGIT training for Pakistan

This training has revitalized my dream to realize my full potential as a gender and climate change researcher working on issues like urban sprawl, land degradation, and mapping gendered vulnerabilities.

Kainat Javed
Research Assistant at the Global Change Impact Study Centre, Pakistan, and a participant of the WoGIT Pakistan 2021 edition

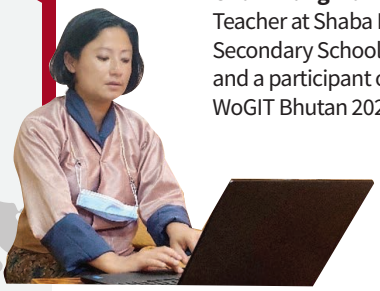
This training has inspired me to pursue a PhD focusing on glacial lakes using GIS and RS tools. Such trainings can encourage more women and bring different EO and GIT perspectives to mainstream research.

Rama Ghimire
an EIA consultant, and a participant of the 2021 WoGIT training for Nepal

The training was really empowering. It also established a network of ICIMOD resource persons and women from different fields. I am optimistic that this network will be very helpful for future queries and collaborations regarding EO and GIT.

Anju Sharma Poudel
PhD scholar of botany at Tribhuvan University, and a participant of the 2020 WoGIT training for Nepal

Capacity-building programmes focusing on empowering women – specifically women educationists – can help bridge the gender gap in the GIT field.



Choki Wangmo
Teacher at Shaba Higher Secondary School in Bhutan, and a participant of the WoGIT Bhutan 2021 edition

Nepal

Bhutan

Bangladesh

I am now able to carry out the analysis and generate required maps using QGIS and Google Earth Engine, which was only possible because of this resourceful training.

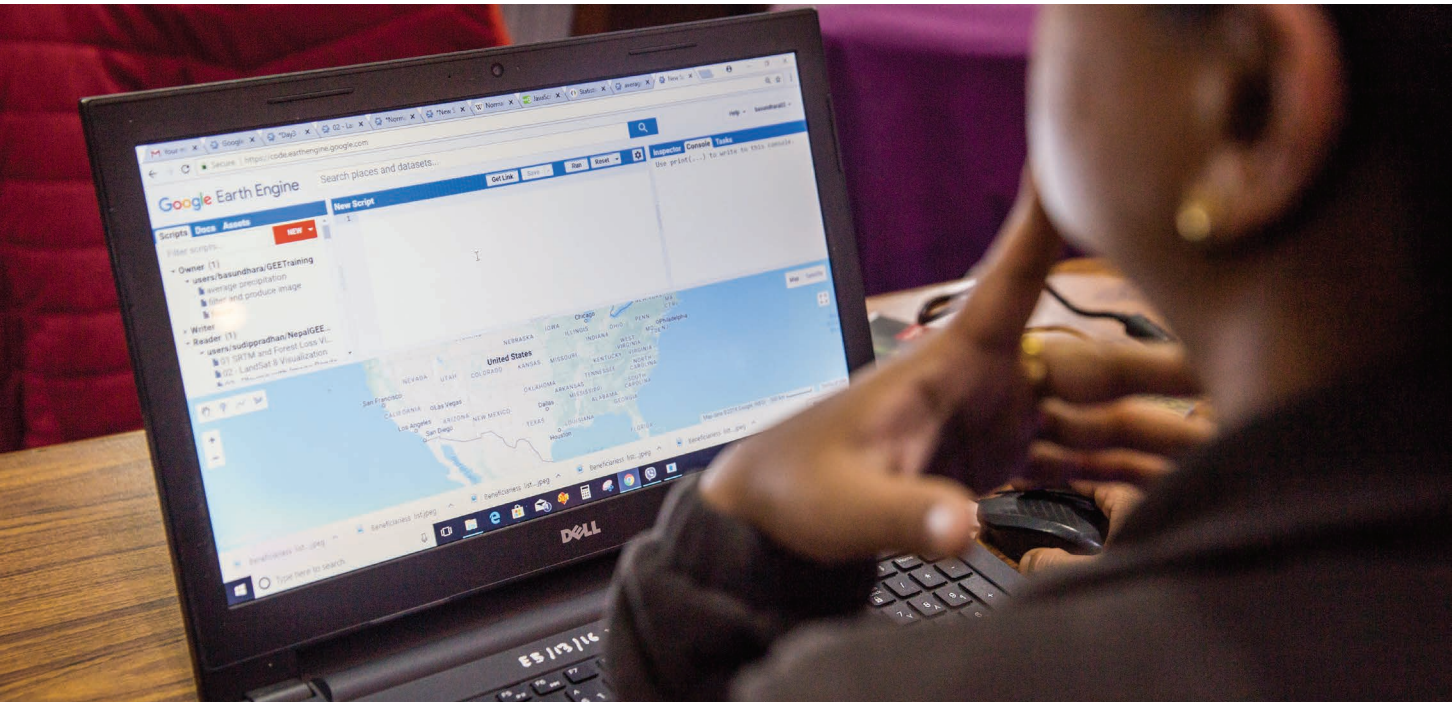
Taslima Zahan
Scientific Officer at the Bangladesh Agricultural Research Institute (BARI) and a participant of our 2021 WoGIT training for Bangladesh

Lessons learnt

Promoting women in EO and GIT will make this field more diverse and inclusive, expand its possibilities, and help bring positive social change.

Below are some of the key lessons we learned during the WoGIT trainings:

- There was great interest in our trainings – from individual women professionals who wanted to attend as well as our partner organizations who wanted their women staff to participate. While we could not accommodate all requests for participation, we still wanted to ensure that those who were interested in accessing the training material could do so and made our training materials available for free download on our website.
- Our first WoGIT training in 2018 covered a range of EO/GIT concepts and exercises within just four days. The post-training assessment revealed that most participants made little or no progress on denser concepts like geoprocessing with Python and required more time and handholding to understand such concepts. In successive training events, we whittled down the training material, focusing on effective delivery rather than including everything.
- A large trainee-trainer ratio can be quite challenging and hectic for trainers, especially during the hands-on exercises. Learning from our first training event, we accommodated a maximum of 50 participants in successive training events to allow for better trainee-trainer interactions and effective delivery.
- Each training accommodated a heterogeneous group of women from diverse academic and professional backgrounds and geographic regions. The understanding of the subject matter varied within each cohort; an engineer did not necessarily grasp the applications of GIT in ecology fully and needed additional guidance from resource persons and peers. However, given the diversity of disciplines represented at the training, we were able to understand local and regional needs and concerns better. It also ensured healthy discussions and fostered cross learning between different academic disciplines. We ensured that our course materials included examples from diverse disciplines.
- Participants from different countries had different levels of knowledge and skillsets. In general, Afghan participants were relatively unaware of the topics and technological improvements in EO and GIT, while the Bhutanese participants were relatively well informed and exhibited a strong academic base and acumen. To address the specific cultural context and language needs of each country, we used native SMEs for each training event, which allowed participants to communicate easily in their language. Our in-country team of SMEs in Afghanistan supported the Afghanistan



edition of the training, providing much-needed translation and hands-on support throughout.

- Most of the Afghan participants missed out on some of the live sessions due to power and internet outages resulting from the political turmoil in the country. Despite the deteriorating security situation, 40 of the 50 registered participants were able to finish the training within the stipulated time.
- Most participants were also juggling household chores and childcare duties and facing internet and power outages while attending the training virtually. As a result they often missed out on the live sessions. They requested that we spread the four-day coursework and hands-on exercises over a two-week period.
- It was a good idea to provide participants with training resources ahead of the workshop and recordings of the session each day. This helped them catch up on lessons and allayed problems caused by slow internet and internet/power outages; a separate channel of communication on WhatsApp/Viber eased communication.
- Evaluating the training impact using self-assessment tools – pre- and post-training surveys – has its share of limitations. We realized that the responses on the pre-training survey did not accurately reflect the participants' knowledge and skillsets. We could conduct tracer surveys and capacity assessments annually to track the impact of our trainings.

Way forward

Our WoGIT trainings have equipped over 400 women in the HKH region with basic knowledge and skills in EO/GIT. These women are competent, confident and motivated to pursue careers in EO and GIT. Through this initiative, we hope to enable more women to use EO and GIT for informed decision making in the HKH region.

Based on requests for follow-up training, we are designing advanced regional training incorporating advanced and specialized EO/GIT concepts. We plan to design collaborative mini-projects related to SERVIR-HKH services. We will offer advanced training to our WoGIT alumni following a competitive selection process.

There is an urgent need to build a skilled workforce that can keep up with the rapid innovations in EO and GIT. We hope to continue refining and updating our training materials to sustain women's interest in EO and GIT and encourage them to participate in our trainings.

To strengthen the network of our WoGIT alumni, we hope to create an alumni roster and facilitate networking, mentorship, and authorship opportunities. Such networks can allow women in the region to face common challenges in pursuing STEM and GIT professions and find ways to address them.

To address the gender gap, we will need interventions at multiple stages to bring about a change in people's mindsets and encourage more women to adopt STEM careers. Significant efforts will be needed to revamp school curriculums, especially at the primary level, to instil an interest in STEM among children. This would entail incorporating collaborative, multidisciplinary, computationally driven approaches that foster problem solving and critical thinking.

Promoting women leaders and role models in EO and GIT will not only make this field more diverse and inclusive; it will also expand the possibilities of this field and help bring positive social change.

Blogs about the WoGIT trainings

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About SERVIR

A joint initiative of NASA, USAID, and leading geospatial organizations in Asia, Africa, and Latin America, SERVIR partners with countries in these regions to address critical challenges in climate change, food security, water and related disasters, land use, and air quality. Using satellite data and geospatial technology, SERVIR co-develops innovative solutions through a network of regional hubs to improve resilience and sustainable resource management at local, national and regional scales.

ICIMOD implements the SERVIR Hindu Kush Himalaya (SERVIR-HKH) Initiative – one of five regional hubs of the SERVIR network – in its regional member countries, prioritizing activities in Afghanistan, Bangladesh, Myanmar, Nepal, and Pakistan.

For more, please visit servir.icimod.org or write to servirhkh@icimod.org.

About ICIMOD

The International Centre for Integrated Mountain Development (ICIMOD), is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush Himalaya – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

REGIONAL MEMBER COUNTRIES

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