



Integrating Gender Into Data Services: A Flexible, Multidisciplinary and Reflexive Approach

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Drawing on the concepts of Theory of Change and Participatory Impact Pathways Analysis, and our own experience of integrating gender and social inclusion in the Community Resilience Forest Management System in Nepal, we develop a five-step framework, which we call flexible, multidisciplinary and reflexive (FMR) approach to mainstreaming gender and social inclusion in the given context of data services. In this study, we demonstrate how this newly devised concept can be effectively implemented at different project stages—planning, monitoring and evaluation—to integrate gender and social inclusion in data services. As reflected in a Climate Resilient Forest Management System in Nepal, we present how the project has successfully harnessed an approach that has transformed a project team, improved understanding of the interface between the two disciplines and helped integrate gender and social inclusion in data services. This study contributes to many ongoing discussions and debates within academic literature about interdisciplinary research projects, and the integration of gender and social inclusion particularly into climate related research and data services.

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INTRODUCTION

With the rapid advancement in technology, the use of Earth observation (EO) data and Geospatial Information Technology (GIT) in evidence-based decision-making has been increased for addressing the complex issues of climate and environmental changes (Thapa et al., 2019). EO data informs a wide variety of applications including tracking biodiversity and wildlife trends, measuring land use change such as deforestation and mitigating and managing the impact of natural disasters including fires, floods, earthquakes and tsunamis. It also helps to illuminate sustainably managing natural resources such as energy, freshwater and agriculture, addressing emerging diseases and other health risks and predicting, adapting to and mitigating climate change (Anderson et al., 2017). As different genders as well as socioeconomic groups—women, men, disadvantaged communities, and ethnic minorities—react differently to the socioeconomic, environmental and climate changes, their impact on the groups is also different (Kadel et al., 2017; Paudel, 2021a; Shakya et al., 2022). For instance, deterioration of the natural resources has more negative effect on women and poor as they are the primary collectors and users (Chindarkar, 2012). Paudel (2021a) reports that forest fire incidents may differentially alter energy related responses among individuals belonging to different cast groups. In addition, the impact of 2015 Nepal earthquake on labor migration is statistically significant and negative only among males

(Shakya et al., 2022). Therefore, integrating gender equality and social inclusion (GESI) while addressing issues of climate and environmental changes is essential for addressing the differences and ensuring benefits to those who are impacted. Furthermore, both women and men benefit equally having access to these technologies to use (Goodrich et al., 2021). Integrating gender and social inclusion is also important in line with the central transformative promise of the Sustainable Development Goals (SDGs) to “leave no one behind”.

Nevertheless, integrating GESI in the domain of science and technology, which is mostly managed by men and technocrats, is challenging (Kadel et al., 2017). This is also evident from findings of the SERVIR program funded by U.S. Agency for International Development (USAID) and implemented by The National Aeronautics and Space Administration (NASA) and regional hubs across four continents. This program aims to strengthen the capacity of member countries in evidence based decision making using scientific data, earth observation information and geospatial technologies. Meanwhile, efforts have been underway to incorporate gender-related qualitative and quantitative information into geospatial applications to contribute to the growing interface between gender and geospatial technologies (SERVIR-Mekong, 2015). International Center for Integrated Mountain Development (ICIMOD) is hosting one the regional hub of SERVIR program for Hindu Kush Himalaya region viz., SERVIR-HKH. At ICIMOD, we developed a template of Theory of change (ToC) with guidelines to facilitate integrating the dimension of GESI in ToC. We also reviewed 57 project planning templates from SERVIR-HKH where the GESI consideration field was found to be left blank in around 82% of the project templates and the remaining were marked as not applicable (NA) (Climatelinks, 2021). This highlights the challenges involved in integrating GESI in different fields of application.

By mainstreaming GESI, any project or service becomes a powerful tool for raising awareness on gender and equity-related issues, thus enabling gender-responsive and equitable policymaking decisions that minimize inequality (SERVIR-Mekong, 2015). Having equal access of both women and men to the technology as well as better integration of socioeconomic data with EO and biophysical data are important for gender-responsive and equitable applications. The information products generated from such a combination of data can reveal the direct and indirect social impacts of climatic changes on different groups of people; it can also highlight the GESI dimension in the domain of EO and GIT (Walker and Vajjhala, 2009; Paudel, 2021b).

Further, despite many years and much investment in data services, there is still room for improvement in terms of articulating exactly what we are aiming to achieve in our activities and what our logic is regarding how we expect our actions to lead to the outcomes we seek. This is even more challenging for outcomes that are inclusive and gender-responsive for which integrating the two different disciplines must be well understood and valued. We may also find ourselves in need of being more efficient with how we develop evidence to show whether our activities

are performing and how our activities are impacting our outcomes of interest. There is also a need to be more efficient in communicating our progress and results reflecting whether they are also gender-responsive and inclusive. Specifically, the key challenges in development programming include:

- poor articulation of program purposes especially considering GESI dimension,
- difficulty in understanding the interface between the different disciplines,
- difficulty in understanding the complexity of change processes, also considering the diversity in population/stakeholders

By ensuring clarity in the definition and logic of these elements of our work, we can improve the relevance and effectiveness of our activities as well as monitoring and evaluation efforts. A very powerful method to help us in this regard is theory of change (ToC) and participatory Impact Pathway Analysis (PIPA).

In this paper, we present a five-step framework which we call flexible, reflexive and multidisciplinary approach to mainstreaming gender and social inclusion. In our effort to conceptualize this approach, we have drawn on extant literature, particularly, ToC and PIPA. This framework is also informed by our practical experience gained from the implementation of a service/project entitled “Climate Resilient Forest Management System (CRFMS) in Nepal” under the SERVIR-HKH implemented in Hindu Kush Himalaya Region. This service aims to enhance the decision-making capacity in forest management in Nepal at different levels—country, province and district—by providing precise and scientific information on climate change vulnerability and degradation of forest ecosystems in Nepal. Thus, due weightage is being given to all the marginalized sections of society, be they women, ethnic communities or socioeconomically disadvantaged groups, since they are very much dependent on forest ecosystems for their daily needs (ICIMOD, 1989; Gilmour and Fisher, 1991; Lama and Buchy, 2002; Sherpa, 2012; Paudel, 2018; Leone, 2019; Paudel et al., 2021). The framework describes the significance of a nonlinear change process and a flexible ToC and PIPA in different project stages from planning to implementation, monitoring and evaluation. In doing so, GESI issues can be addressed better in climate data services. We also highlight the potential challenges and lessons learnt from the project while working as part of a multidisciplinary team to achieve the vision of gender-transformative change in data services.

APPROACHES IN MAINSTREAMING GENDER EQUALITY AND SOCIAL INCLUSION

Theory of Change and Participatory Impact Pathways Analysis

ToC and PIPA are innovative approaches that are being increasingly used in complex programs where multiple

uncertainties are associated with the desired change. The United States Agency for International Development (USAID) defines a ToC as “a narrative description, usually accompanied by a graphic or visual depiction that describes how and why a purpose or result is expected to be achieved in a particular context” (USAID ADS 201, 2021). The Impact Pathways (IP) describes result chains and shows the linkages between the sequence of steps—activities to outputs, outputs to outcomes and outcomes to impacts (Douthwaite et al., 2007; Mayne and Johnson, 2015). PIPA is an actor-based approach to ToC which helps diverse stakeholders to come together and develop a collective understanding about a program or a project—its context, its change pathways, and the underlying assumptions (Kadel et al., 2021). Applying this approach, a project’s IP is made explicit wherein assumptions and hypotheses are described in the form of outcome and impact logic, which is also known as, Theory of Change” (Douthwaite et al., 2007; Mayne and Johnson, 2015). Therefore, ToC complements an IP and explores what has to happen for the causal linkages to be realized (Weiss, 1995; Blamey and Mackenzie, 2007; Rogers, 2008; Leeuw, 2012). It describes why the various links in a pathway are expected to work (Mayne and Johnson, 2015). It also considers central processes or drivers by which change comes about for individuals, groups or communities. These processes may be psychological, social, physical or economic and they could derive from a formal, research-based theory or from an unstated, tacit understanding about how things work (Funnell and Rogers, 2011). In PIPA, both process and product are equally important (Kadel et al., 2021). The process of PIPA follows a collaborative pattern of thinking and arrives at a collective understanding about the underlying causes behind a situation. It forges a consensus on the desired change and then brainstorms on how to achieve that change. So, in case of a service/ project that seeks to integrate GESI in its development and implementation, engaging diverse participants in terms of expertise, gender and socioeconomic group, ethnicity and location of the service users in a ToC development process not only helps identify the GESI gaps that stand as barriers to meeting the objectives that are gender-responsive and equitable, but also offers an opportunity to understand and include ideas from all sections concerned regarding the strategies and the priority outcomes proposed in the ToC. ToC ensures coherence all through a service or project’s design and implementation stages and is also to be used as a guide and as a prompter for the service/ project as to what its overarching goal is and what the results are expected to be. Thus, integrating GESI from the very outset of the ToC process is essential and impactful.

Here, it is important to note that while a ToC may not prove to be perfect at the design stage since many other aspects are at play in the development of a service or project, the fact remains that it could be gradually improved as the understanding of the stakeholders evolves. Hence, periodic reviews of the ToC become helpful in ensuring that all learnings are captured at all stages of implementation; this reinforces and strengthens the impact of a service/project. It also constantly fosters evaluative thinking and helps in arriving at a better understanding of all the complexities that are involved.

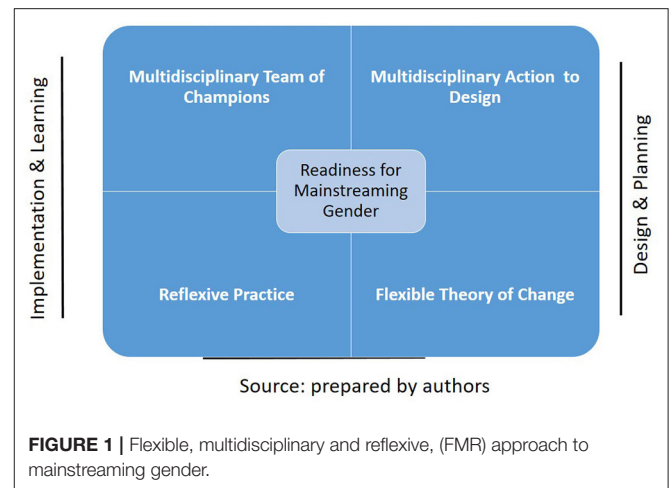


FIGURE 1 | Flexible, multidisciplinary and reflexive, (FMR) approach to mainstreaming gender.

Flexible, Multidisciplinary, and Reflexive Approach to Mainstreaming Gender

Drawing on Theory of Change (ToC) and Participatory Impact Pathways Analysis (PIPA) and our own experience of integrating GESI in CRFMS in Nepal, we develop a five-step framework, which we call flexible, multidisciplinary and reflexive (FMR) approach to mainstreaming gender and social inclusion (Figure 1). The framework is continuously supported by an ongoing readiness process in team as an enabling environment. The five-step of the framework includes: (i) readiness for gender-transformative change, (ii) multidisciplinary action in design, (iii) flexible approach toward ToC, (iv) reflexive practice, and (v) multidisciplinary team of champions. Step (i) is important to enable the process right from the beginning and the process continues at different scale at different stages. Steps (ii) and (iii) are primarily implemented at the design and planning stages whilst steps (iv) and (v) are considered during the implementation phase. Implementation of the framework aims to support and assess the process and progress of integrating gender and social inclusion into a Climate Resilient Forest Management System (CRFMS) in Nepal. It believes in nonlinear change process that is completion of one does not necessarily lead to the expected next level without understanding and addressing the complexity in change process. Thus, continuous assessment of the situation is required to make a right choice in management. Similarly, inviting diverse participants in design does not necessarily lead to the Gender-responsive ToC for which agreement has to be reached among participants which is always uncertain because of their different value systems, interests, organizational policies, and availability of the resources. Thus, flexibility in the process is important to adapt to the emerging situation. For example, boosting readiness for gender-transformative change may require efforts at different stages of project cycle management especially in a project like SERVIR where more technocrats and men manage the project.

Readiness for Gender-Transformative Change

Initially, we realized key two challenges for mainstreaming GESI in EO and GIT based services like CRFMS. The first was the GESI

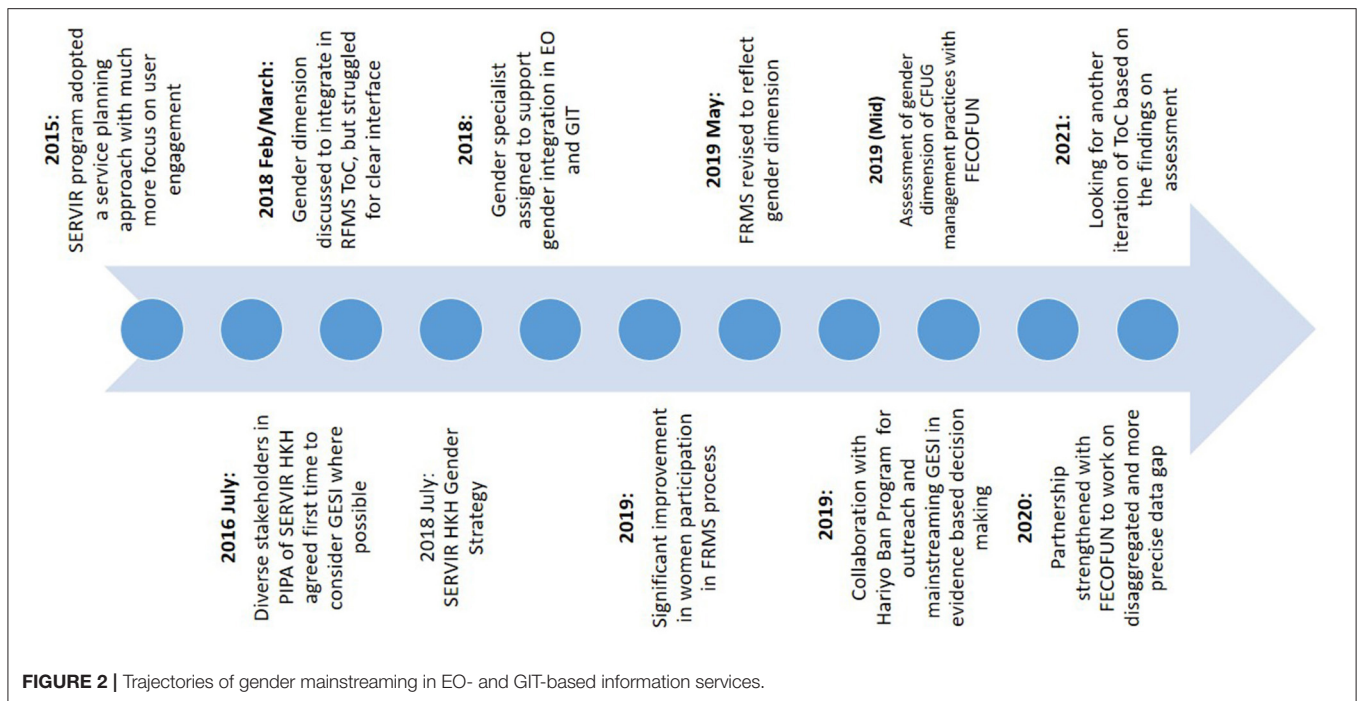


FIGURE 2 | Trajectories of gender mainstreaming in EO- and GIT-based information services.

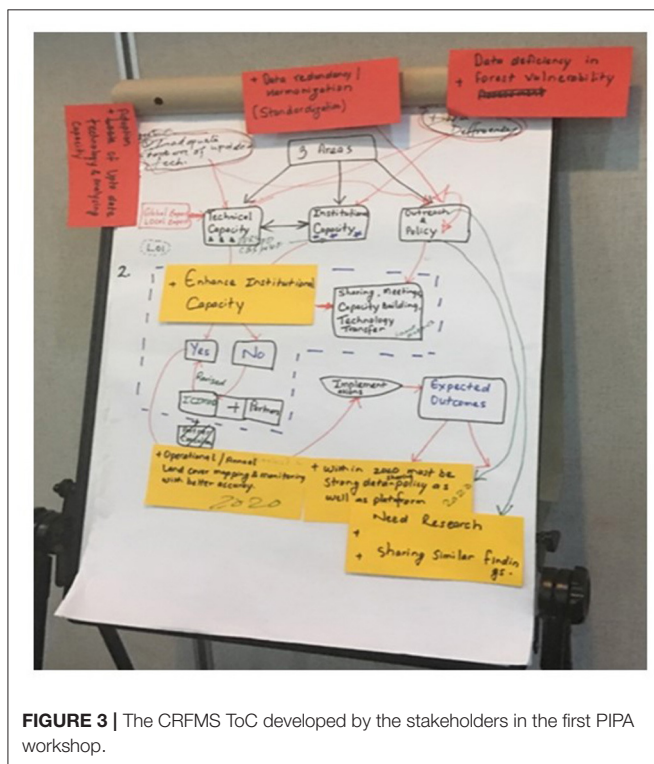


FIGURE 3 | The CRFMS ToC developed by the stakeholders in the first PIPA workshop.

value perspective of staff who are managing the project as they thought that EO-GIT domain is basically gender neutral. It was argued that EO and GIT based applications are developed based

on remote sensing data which are basically science data. Value perspective refers to a different way of looking at and working where individual work choices are driven by continuous learning through evidence seeking, monitoring, and evaluation (Hyatt and Ciantis, 2014; Kadel et al., 2017). Addressing this issue in EO and GIT domain was urgent as this discipline is dominated by men, both in the academia and in the workforce (Haggard, 2000; Schuurman, 2002). Second, it also depends on bigger picture of the program in terms of clarity on mainstreaming GESI and the GESI outcome in overall as a service part of the program contributing to the overall goal. Therefore, our framework intervened both at program and service level for preparing team integrating GESI in EO in climate data services.

In a nutshell, the process began in 2015 when the SERVIR program adopted a service planning approach to ensure that its services helped developing countries effectively solve the problems arising from climate and environmental changes. In terms of design, this meant that much more importance was to be given to facilitate a better understanding of the different types of impacts and needs felt by different population segments. Then we decided applying PIPA and conducted a workshop in 2016 for revisiting the ToC of SERVIR HKH—a CRFMS host program. We invited participation from wider groups of different disciplines to invite critical discussion about the project’s approach and benefits. SERVIR HKH is a joint program of USAID, NASA, and the International Center for Integrated Mountain Development (ICIMOD), aimed at strengthening the capacity of the country stakeholders from the HKH region to generate and use EO–GIT applications in evidence-based decision-making. People participated from different disciplines raised critical questions about project’s approach and its impact

from the experience. The PIPA workshop was a site of intense arguments, especially between the technical staff and the gender specialist, with the former opposing the idea of gender integration and the later supporting it. The participants struggled to make a direct connection between GESI and the EO–GIT applications. The technical staff believed the mainstreaming of GESI would not always be possible as their initial understanding of the field was a more gender neutral (Kadel et al., 2021). On their part, the gender specialists found it difficult to convince the staff about the importance of such mainstreaming since they themselves did not have any practical experience or deeper understanding about the interface between GESI and EO–GIT applications. Though it was difficult to make agreement initially, the discussions did not go worse, but helped individuals break away from the traditional patterns of thinking and acting (Klerkx et al., 2012). Additionally, they also agreed to start from simple and doable work like encouraging more women especially in capacity building activities. Though this was agreed without much thinking based on the practical ground, this was expected in addressing gender gap in workforce of EO–GIT, promoting equal access of women and men to this technology, and reducing opportunity gap in terms of its use. Without having much clarity, integrating GESI in EO–GIT applications were conditionally agreed wherever it was feasible. This also laid the groundwork for managers to formulate a gender mainstreaming strategy for the entire SERVIR–HKH program. All these provided a solid foundation for mainstreaming GESI in EO- and GIT-based climate and information services. At the same time process helped them to think differently about GESI value. At different times different efforts were made to prepare the team to work in mainstreaming gender in EO –GIT domain and related services including CRFMS. **Figure 2** shows the trajectories that were followed for mainstreaming gender in EO- and GIT-based services of CRFMS.

Multidisciplinary Action in Design

The provisioning of tailor-made climate and information services like CRFMS based on these applications was one of the key pathways for achieving the program's goal in SERVIR HKH. Considering the bigger picture of GESI lens in SERVIR HKH we in CRFMS tried to understand the stakeholders and their needs going beyond only engaging the technical staff in consultation. In order to do so the project staff were convinced first to break the stereotype of listening to small group and see only the technical problems while working on such applications and services. Different level of discussions even after the PIPA workshop in 2016 including gender sensitization training for staff helped to change their value perspective to GESI and its integration in EO and GIT domain.

While there is a general understanding that a ToC has to be placed at the higher level of a program on the complexity front, we localized our approach to the service level in order to contextualize the broader concept and render the operations more effective (Kadel et al., 2021). This provided opportunities for the relevant stakeholders from specific areas to come together and arrive at a deeper understanding about the context and the ToC for CRFMS, especially its gender dimension. As our

approach was more impact-centric, unlike the earlier practice of focusing on products and tools, we used PIPA at the design stage and professionals with different expertise and experience were invited to discuss it broadly and develop its ToC. At the PIPA workshop for CRFMS, SERVIR staff, ICIMOD experts, including a gender specialist, and country stakeholders got together to build a collective understanding about the service/project. The workshop discussions also focused on gender issues in relation to resilient forest management practices and their integration in CRFMS. But, as stated earlier, the participants found it difficult to connect the two disciplines of GESI and EO–GIT in the service/project package, so much so that the aspect of GESI was not mentioned in the initial ToC (**Figure 3**). During the workshop discussion we realized information gap from GESI lens as it was not used during the need assessment and country consultation to prepare for the workshop. As usual GESI regarded as a soft issue, one which got least priority at the steps of understanding, analysis, and integration. More so in the field of science and technology, which has for long been a stronghold of men (Haggar, 2000; Schuurman, 2002; Udas and Zwarteveen, 2010; Dasgupta and Stout, 2014; Shrestha et al., 2019). With CRFMS, we also wanted to be involved in the important exercise of disaggregating data—the absence of data disaggregation has been a major hindrance to any proper evaluation of GESI—and use them in a program like SERVIR which mostly relies on secondary data. Yet, the discussions went a long way in setting the agenda for a gender-responsive and equitable service/project.

A Flexible Theory of Change

Without having much clarity among participants, the initially developed ToC of CRFMS couldn't explicitly mention about GESI dimension. This is quite natural when the design participants have limited proven experience of how GESI and EO–GIT interface each other. Debating ideas, processes, or changes to concepts are found helpful during concept generation but it may take longer during concept selection (Victor and Sebastian, 2013). Therefore, we adopted a flexible ToC and PIPA in design to develop better understanding about a complex program or change process. And, complexity may not always be fully understood, at least in the beginning (Barnett and Gregorowski, 2013). With the belief that clarity on GESI particularly in each context would develop over time we kept the ToC of CRFMS open for iterative revisions and suggestions from experts belonging to various fields. This flexible nature of the ToC process was expected to pave way for GESI responsive decision-making in the forest management system.

We, after some time in CRFMS, felt necessary to assess how much the GESI aspect was integrated into forest management practices and its influence in the decision-making. This knowledge would give a right picture to the implementers about how GESI could or couldn't be integrated into it. Thus, an assessment was made based on available secondary data, at the district level, of the Community Forestry User Groups (CFUGs) regarding the extent to which their management gave priority to GESI issues. The assessment also examined the data on forest conditions and climate change vulnerability. During this process, it became glaringly apparent that the practice of disaggregating

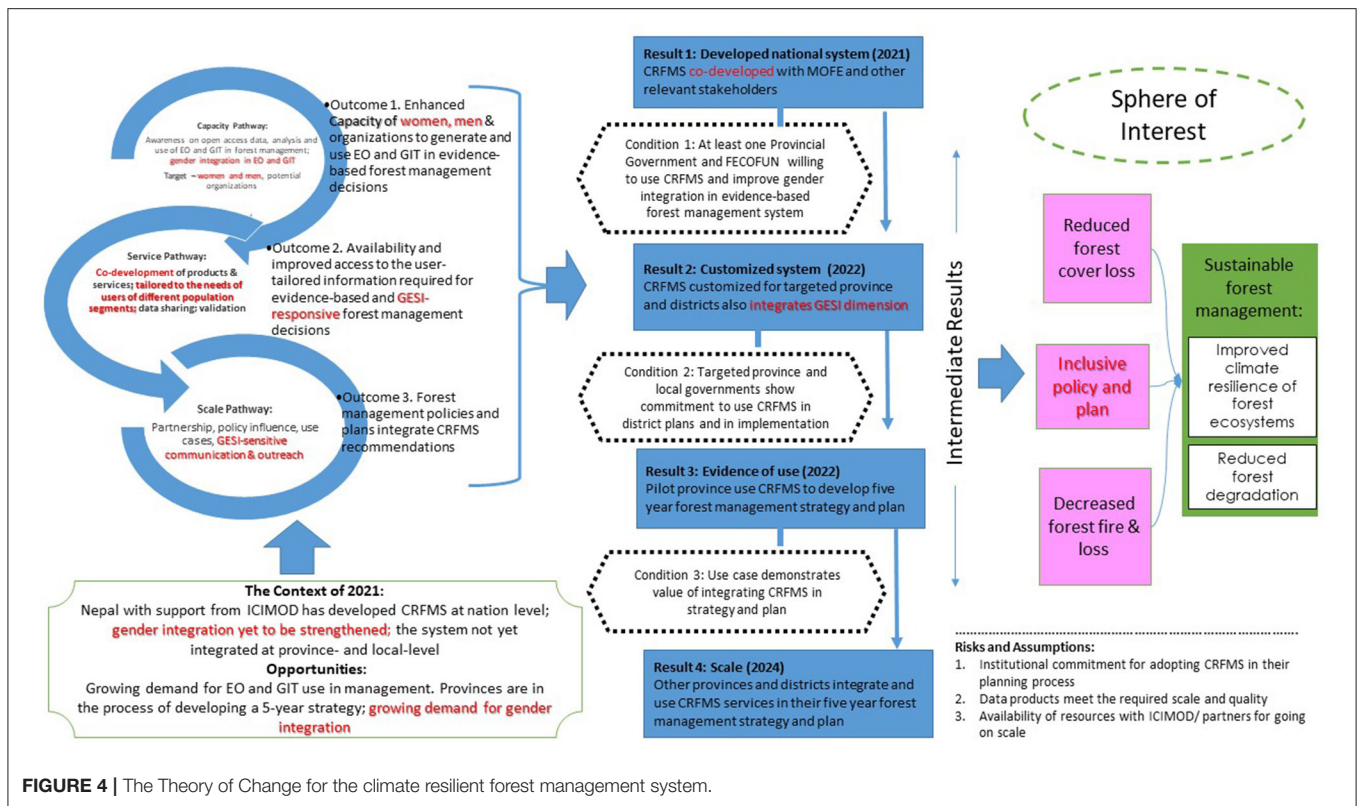


FIGURE 4 | The Theory of Change for the climate resilient forest management system.

data was non-existent on all fronts, which was a major hurdle, especially in terms of evaluating the GESI dimension. So, as part of a pilot study, a separate questionnaire was prepared to fill this conspicuous gap. However, field implementation is still pending due to COVID situation and travel restriction. The findings that emerged from the analysis of the CFUGs were used to revise the ToC for CRFMS so as to enhance its impact by making GESI a stronger component of it. **Figure 4** shows the ToC for the CRFMS at its most recent stage; here, the integration process of gender is clearly reflected in the comments and highlights.

Reflexive Practice

Another area of focus in the endeavor to mainstream GESI in EO- and GIT-based services is what is called “reflexive practice” through which relevant individuals and stakeholders are encouraged to continuously view their work (Schon, 1983), particularly applying GESI lens in our case. This helps to pinpoint how GESI could be integrated at different stages of the implementation of CRFMS. This was particularly required for this service/project since its preliminary ToC was not clear on GESI dimension.

Effective implementation of the practice requires strong monitoring and evaluation for evidence-based reflection for which we strengthened our monitoring and evaluation with focus on GESI. In this focal area of reflexive practice, the initial priority fell on the capacity building pathway and the need to encourage more women to participate for increased access to this technology. With this, it was also expected to contribute to a

gender balanced workforce in this domain (Goodrich et al., 2021; Thapa et al., 2021). Meanwhile, the database was strengthened with disaggregated data to monitor and track access to this technology through this project. Some monitoring and follow-up activities conducted with focus on outcome greatly helped the project to devise the appropriate strategy. For instance, the project conducted a targeted training program for young women on EO and GIT considering the regional context of less women force hired in this domain. It became difficult to increase women’s participation with the training targeted for staff of the member countries as there were very few women working in this domain. Follow up workshops we conducted revealed some gap and identified potential areas to further strengthen. Besides, following a very systematic approach we also conducted tracer studies was in 2019 and 2020 to assess whether the participants were using the learnings from the training and benefiting from it. It was conducted online using open-source online survey application tools—LimeSurvey in 2019 and SurveyMonkey in 2020. Respondents were asked polar or multiple-choice questions and requested to explain their choices. This study revealed some important aspect of the training in terms of knowledge and its application as well as gap areas to improve in coming days. An assessment was also made of the partnership strategy to see whether it had been helpful in mainstreaming GESI in evidence-based decision-making. Later it led to an opportunity to extend the collaboration of CRFMS with the Hariyo Ban program and work with Federation of Community Forestry Users Nepal (FECOFUN) to assess GESI

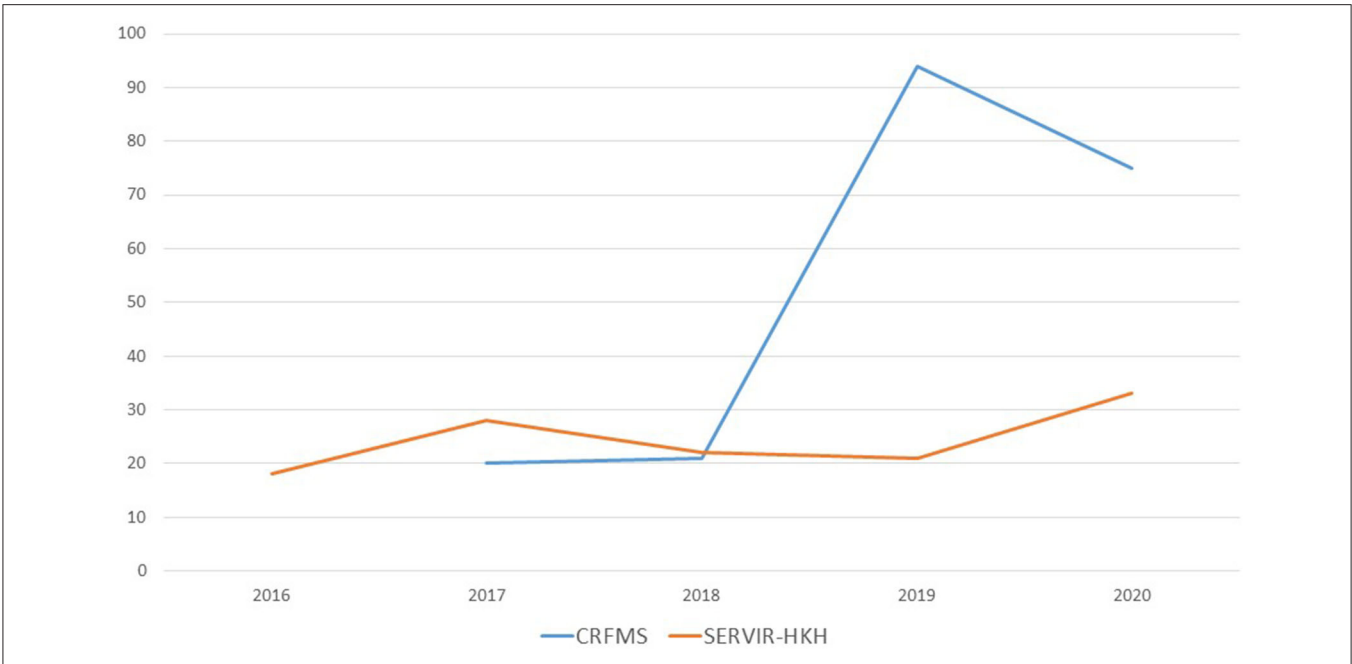


FIGURE 5 | The sex ratio of participation in CRFMS and SERVIR-HKH.

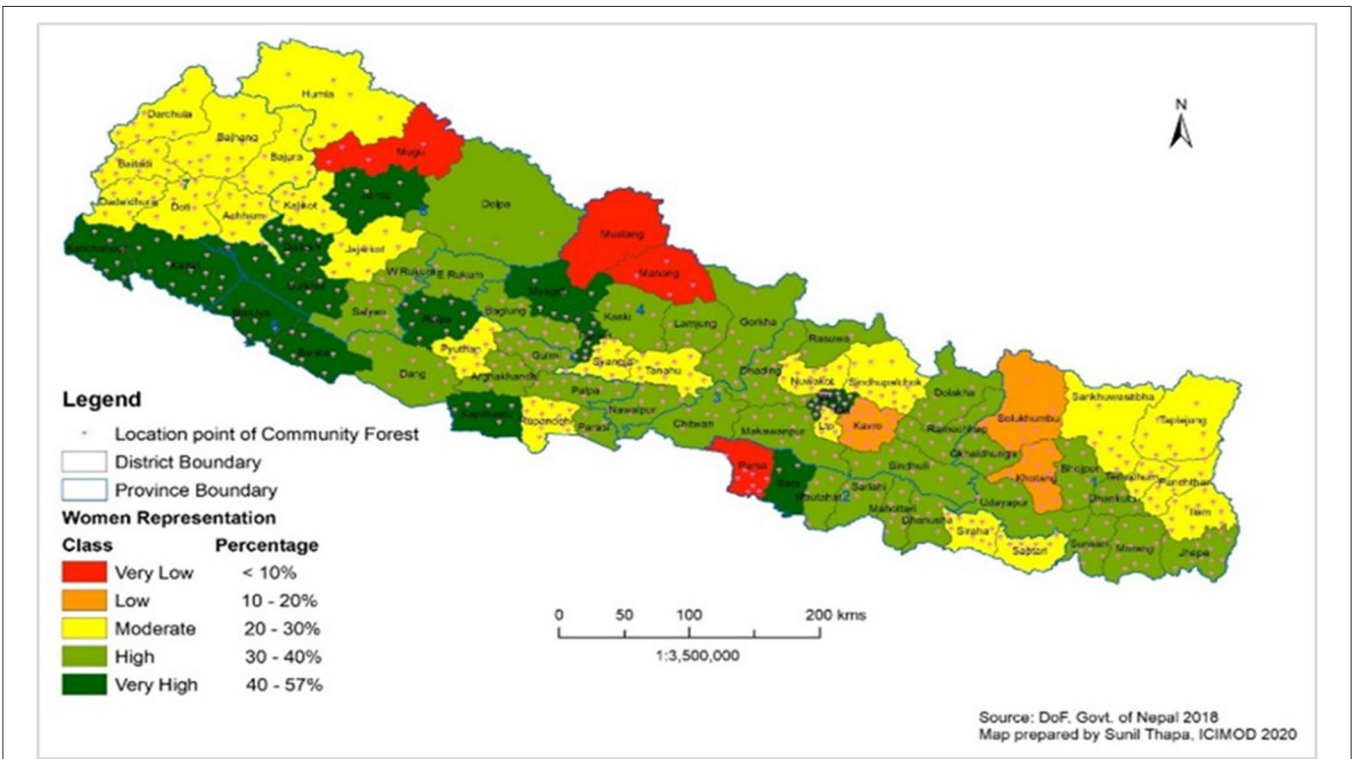


FIGURE 6 | Women representation in community forestry executive committee of Nepal.

aspect in the community forest management practices in three ecological zones of Nepal.

The reflexive practice involves both formal and informal processes. While mechanisms like periodic reviews, planning

meetings, and staff meetings aim to strengthen the practice, a culture of critical thinking and constructive feedback is also being inculcated, especially focusing on the GESI dimension and its integration in the service/project.

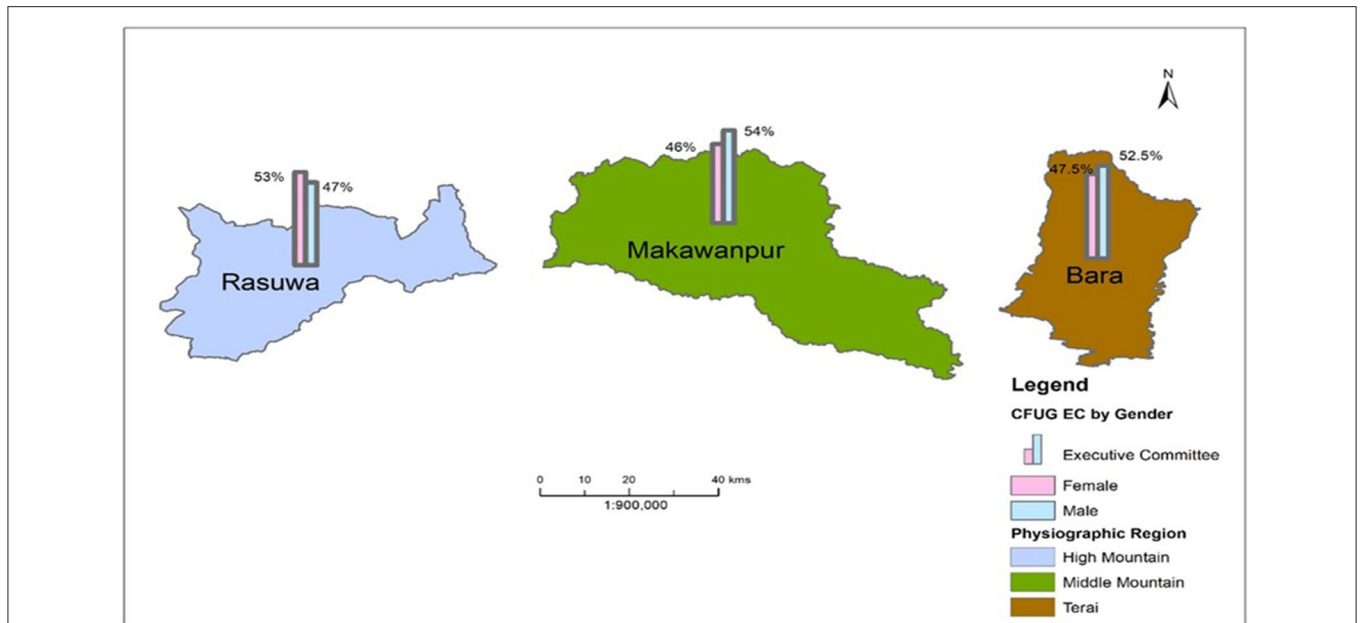


FIGURE 7 | Community forestry executive committee by gender.

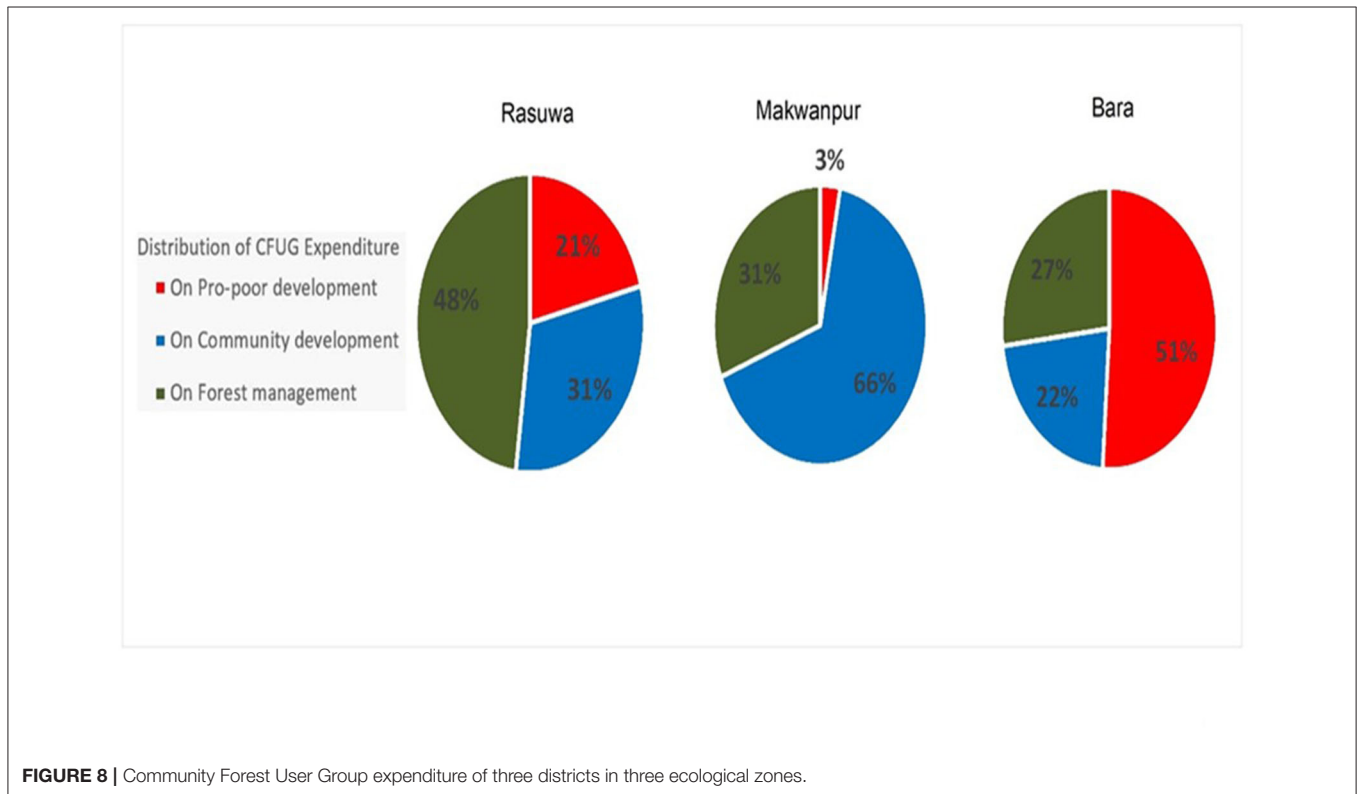


FIGURE 8 | Community Forest User Group expenditure of three districts in three ecological zones.

Promoting a Multidisciplinary Team of Champions

Champions have a crucial role to play in any innovation (Klerkx and Aarts, 2013). In this case, a group of three—consisting

of a monitoring and evaluation specialist, a domain specialist, and a gender specialist—took on the role of champions for gender integration in CRFMS’s EO-GIT services. Integrating

gender in TOC is crucial as it paves the way to practically and realistically mainstream gender at all stages and activities of a program (Goodrich et al., 2021). The monitoring and evaluation specialist who led the ToC design encouraged wider participation in PIPA to invite different perspectives about EO and GIT based applications and impact for addressing the complex issues of environmental and climate change. Participants were asked exclusively about GESI issues and its possible integration in CRFMS and, mention explicitly in the ToC after making an agreement among participants. This helped the domain specialist who was leading the CRFMS, and gender specialist to come together and make effort if gender can be integrated in this service. Coming three together was also driven by their individual commitment to intervene gender mainstreaming in EO and GIT domain which was lacking. The endeavor to create champions at SERVIR HKH began with the PIPA workshop in 2016, and since then, various efforts toward this end have brought in changes at different levels. Such as the appointment of a gender-focal person to support GESI integration in EO-GIT services. As for the three-member specialist group of champions, it has been building on the bigger picture at the program level by working closely with CRFMS to demonstrate the value of integrating GESI in evidence-based decision-making via the use of EO-GIT applications. Initially, the champions consciously integrated the facet of GESI in their own work, reflected and learnt from it. They then discussed this aspect with their colleagues and partners to arrive at a deeper understanding about GESI integration and to explore ways to do so. This model of champions leading the way in GESI integration can surely be adopted in other regimes as well.

RESULTS AND DISCUSSIONS

CRFMS aims to enhance the decision-making capacity in forest management in Nepal by providing precise and scientific information on climate change vulnerability and degradation of forest ecosystem. It is an ongoing service that constantly strives to widen its gender lens. While these are early days for CRFMS implementation-customization and validation at province level, it has already marked some results; and more importantly, several vital lessons have been learnt.

A Decade Long Gender Silence of the Technical Field Is Broken

In its span of over a decade, SERVIR has been supporting evidence-based decision-making via the use of EO-GIT applications in the HKH region. But this area had lacked the integration of the GESI aspect. That has now been rectified with the advent of CRFMS. Starting with PIPA at the design stage and by continuously revising its ToC, CRFMS has been able to break the gender silence in this field. In order to challenge the gender insensitive process of design and planning where only technical people would involve in design, PIPA provided an opportunity for individuals from different disciplines, including that of gender studies,

to come together and discuss about the service. The ToC of the service was kept flexible and made the GESI integration more explicit over time. In order to add scientific evidence to community-level forest management plans and enhance the decision-making process at the community forest level, CRFMS broadly analyzed four components: climate sensitivity, forest degradation, forest-fire risk, and community forest management. And, in the community forest management component, we explored the role of gender and social inclusion in the management practices of Nepal's CFUGs.

Enhanced the Capacity of the Staff and Stakeholders on GESI

The process of ToC revisions and PIPA gradually created awareness about the importance of GESI in a technical field like EO-GIT. As ToC revisions progressed, gender became a stronger component of the service/project. These processes also helped to form a multidisciplinary team to work together on GESI integration in EO- and GIT-based information services. Working in and as a team, the members understood each other's disciplines better, thereby fostering mutual trust and strong bonds. Moreover, gender specialists were given the opportunity to become a part of the planning and implementation modules of the service/project, while the technical staff went through a mandatory gender sensitization training program. The ToC design process, since it enabled gender to be progressively included in service/project design, changed the perspective of all those involved in CRFMS and built their capacity to understand the value of such inclusive integration. Besides, the reviews that the ToC underwent helped the stakeholders to fathom the complexity of the service and the importance of integrating the new learning in the design tools. The CRFMS data on participation also reflects the increased awareness of the staff and the stakeholders about the value of women's representation. The sex ratio of participation shows that the number of women reached by CRFMS since its PIPA workshop in 2018 significantly increased, which is even better than in the SERVIR-HKH as a whole (Figure 5). The sex ratio of participation was calculated as no of women per hundred men from individuals directly reached by the program in overall and CRFMS in particular. It was compared to assess whether the CRFMS with effort working differently increased access of both women and men to the technology.

Moreover, country partners like FECOFUN were also trained on mainstreaming gender in the EO-GIT applications; in the beginning, the FECOFUN representatives had difficulty in seeing the link between the service and GESI, but later, they realized the value of such an integration. Meanwhile, other services/projects under the SERVIR program have been slowly getting into GESI integration; for example, its drought monitoring and early warning system recently completed a gender study first time to strengthen the efficacy of its delivery mechanism.

Toward a Meaningful Integration of GESI in EO and GIT

In order to gain important insights into the policy environment and the state of policy–practice interface regarding gender equality and social inclusion in the community forestry sector, we jointly conducted a gender study with a team from Hariyo Ban, a consortium of four agencies: Cooperative for Assistance and Relief Everywhere (CARE), World Wide Fund For Nature (WWF), the Federation of Community Forestry Users Nepal (FECOFUN), and the National Trust for Nature Conservation (NTNC). The study aimed to analyze how gender and social inclusion in community forest management vary across the geographical zones in Nepal. Leone (2019) shows that in countries like Nepal with common property resources, the effectiveness of collective action institutions depends also on their gender composition. Therefore, it was also deemed necessary in CRFMS to assess how much the aspect of GESI influenced decision-making in forestry as that would give a right picture to the implementers about how GESI could be integrated in it. This partnership was made strategically going on scale exploring their interest to integrate science and data in community forest management, also addressing the issues of gender and social inclusion. Specifically, the study aimed to address the following two major domains by analyzing the secondary data/ information at the national level.

- (i) Understanding women’s voice and agency in CFUGs
- (ii) Allocation of community forest funds for rural development

Due to limited availability of data, only three districts were chosen for the gender analysis: Rasuwa (high altitude); Makwanpur (mid-hills), and Bara (plains). The data were collected in 2017–18 through a questionnaire survey—with 85 parameters—of all CFUGs in these three districts. However, as the data were missing in terms of a lot of parameters, our study focused on only those attributes that had relevance with the gender and social inclusion aspect. We feel we are not generalizing the results to whole Nepal, but we are indicating that our methods are replicable and can be applied to different areas in and outside Nepal.

Understanding of Women’s Voice and Agency in the Community Forestry User Groups

Analysis of the available data shows that the representation of women in community forestry executive committee across Nepal is very high to moderate except in few districts—Mustang, Manang, Humla and Parsa showing very low and Kavre and Khotang low (Figure 6). Having very low or low representation in these districts seems normal as the community forestry management practice particularly in Mustang, Manang and Humla districts is low. Also, most of the natural resource management practices are still followed by traditional system so called “Mukhiya system” in these districts. On the other hand, the large forest area in Parsa district is covered by Parsa wildlife reserve and Churiya range. Similarly, majority of the community forest in Kavre and Khotang districts was handed over during the 90s. During this period, the community forest policies and

the processes were not gender sensitive. For instance, head of the household who is mainly men in Nepalese context would be the member of CFUG. Further, “charging of membership fees” and “cost of the forest products” restricted the poor households to be part of the community forest user groups (Buchy and Rai, 2008; Agarwal, 2010).

Women representation in community forestry executive committee in Far-West region (Kailali, Bardiya, Banke, Dailkekh, Banke, Surkhet), where community forests were handed over more recently after revising the community forestry program development guideline in 2014. The major amendment was made to incorporate the spirit of gender and social inclusion (GON/MOFSC/DoF, 2014), which includes:

- i) 50% women representation in CFUG executive committee member,
- ii) one decision making position represented by women,
- iii) community forest user groups include one male and one female member in each household, and
- iv) 35% of user-groups income should be used for pro-poor interventions.

Figure 7 further shows that gender disaggregated dataset of three agro-ecological regions representing Rasuwa district as mountain, Makwanpur as mid-hills and Bara districts as terai. The composition of population in Rasuwa district is homogenous group mostly dominated by Tamang ethnic groups. In case of Makwanpur, it is heterogeneous group mainly dominated by Tamang ethnic groups and high caste groups (Brahmin, Chhetri and other). On the other hand, Madeshi-ethnic group called Bhojpuri dominates the Bara district. Irrespective of the ethnic and caste groups men dominants the committee especially in Makwanpur and Bara where timber value is high and accessible to the market. In countries like Nepal women are mainly responsible for collection and management of forest products essential to the daily lives of their household, however, decisions are mostly taken by men (Leone, 2019; Chitale et al., 2021) especially when money matters.

Apart from protecting forest, the community forest user groups (CFUGs) have been also collecting revenue from community forest resources and investing income for different development activities such as, community development, pro-poor development, and forest management. The community forest user groups have a legal right for collecting revenue and investment from the income generated from the forest resources. The community forest development guideline (2014) directed the compulsory provisions that the revenue generated should be invested 35% in pro-poor activities and 40% in forest and community development activities (GON/MOFSC/DoF, 2014). CFUGs are mostly generating income from different sources such as, selling forest products, membership fees, penalties, awards and donations from various governmental and non-governmental organizations. It is estimated that the annual income of CFUGs in Nepal is more than US\$10 million, where forest products contribute the most among sources of income (Pokharel, 2010). However, the revenue generation of the community forest user group depends on the availability of high-value species

such as timber, NTFPs, CFUG membership, and the age of the CFUG.

Categorized in three activities—community development, forest development activities, and pro-poor development—**Figure 8** compares the expenditure of community forest fund distribution to assess their decision-making practice in three districts of different ecological zones. The forest development activities include silvicultural operation, plantation, NTFP promotion and others. Community development activities are community building, road/foot trail construction, salary for school teachers, school building, drinking water and health/sanitation. Pro-poor development activities are mainly income generating activities.

The assessment shows that the prioritization of fund allocation between these three activities varies across the three districts. The average share of expenditure is highest in forest development activities in Rasuwa (48%), community development in Makwanpur (66%) and pro-poor development in Bara (51%); the second and third priorities varies accordingly (**Figure 8**). Despite the community forestry guidelines (2015), least priority is given to the pro-poor related activities except in Bara district. This indicates that revenue generation is mostly invested in collective benefits rather than individual benefit of the poor.

Besides, this study also revealed the data gaps related to certain GESI indicators. Therefore, as part of a pilot study, a separate and detailed questionnaire on GESI was prepared to fill this glaring gap. However, the field implementation is still pending due to COVID situation and restriction of mobility.

Exploring Opportunity for Adding Base Layer in the System

With the initial work, the system now is slowly taken into consideration for developing informed five-year plan at province level, where discussion is undergoing with stakeholders to explore opportunities for integrating GESI into climate and EO data with additional base layers.

Under Process of Developing a More Inclusive and Equitable Insurance Policy

We revised the “map of forest fire risk in Nepal” which was earlier prepared by Matin et al., for year 2018 with recent data and gave more emphasis on use of the map especially addressing the equity issues in the society. For example, we are working with FECOFUN, the parent body of the CFUGs for developing a more inclusive and equitable insurance policy using the revised map on forest fire risk in Nepal. One of the uses of the map is to provide life insurance facilities to CFUG members in high and very-high forest fire-risk districts in Nepal. Research shows the heterogeneous effect of forest fires in Nepal. The finding indicates that households that do not rely on firewood for fuel reside in areas characterized by large number of fire events and experience significant declines in residential property values (Paudel, 2021b). The policy aims women and other marginalized groups stand to gain, and not only in terms of insurance but also by way of accessing and benefit-sharing of the forest products as well as other resources. Now discussions are underway to bring more

of the marginalized sections of Nepal’s population under the umbrella of this scheme.

CHALLENGES AND LESSONS LEARNT

The specific context of CRFMS has provided interesting lessons on how to mainstream the aspect of GESI in EO- and GIT-based decision-making, especially in a scenario wherein the technocrats, and mainly men are managing the service without any or very few examples to fall back upon.

Understanding the EO–GIT–GESI Interface

Efficient and effective mainstreaming of GESI in EO–GIT applications would not be possible without having a deep understanding about the interface between these disciplines. One of the major challenges we faced integrating in EO and GIT domain was in convincing the technical team with evidence and solid experience from past. Even the gender specialists didn’t have solid examples and experience to convince the technical team explaining how the disciplines are interlinked. So, it was a tall order to drive home the nuances of the interface (Kadel et al., 2017); this required people from various disciplines to work together, which meant expenditure in terms of both time and resources. While the technical staff needed to be persuaded about the value of GESI integration and how they could do it, the gender specialists needed to be familiarized with the EO–GIT applications. So, the managers and the decision makers had an important role to play in coordinating the whole exercise whereby an effective interface could be set up between GESI and EO–GIT applications.

Breaking Down Silos in the EO–GIT Field

For long, the EO–GIT field has been dominated by male professionals. So, when it came to mainstreaming GESI in this field, silos needed to be broken down and experts from various disciplines—not least from gender studies—needed to put their heads together to set up a non-discriminatory system—as has happened in the case of CRFMS. Right from the design stage, CRFMS brought together a wide variety of experts. This multidisciplinary approach was further bolstered by the iterative process of ToC revisions which required constant interactions among all concerned. By considering the ToC as a “living” document, CRFMS has created ample space for change wherein conventional barriers could be broken and all relevant perspectives, inputs, and suggestions could be accommodated. However, such a team exercise doesn’t come cheap—in terms of money, time, and effort (Gardner, 2016). That said, the overall success in scaling boundaries has made it all worthwhile.

Organizational Accountability and Committed Leadership

An enabling environment has had a great role to play in executing this transformative process at CRFMS. Hence, all along, ICIMOD has been a great influencer, with its strong mandate for working toward gender-transformative change. ICIMOD’s commitment to gender equality and inclusive development is explicitly expressed as one of the seven strategic results it seeks to achieve:

“Significant advances made in approaches and knowledge that promote gender equality and inclusive development” (ICIMOD, 2017). Besides, its revised Gender and Equity Policy (ICIMOD, 2020) and its Gender Action Plans of regional programs ensure organizational accountability on GESI. This institutional context has been a source of strength to CRFMS in its bid to mainstream gender—not only in terms of being able to secure resource allocation but also in terms of motivating the staff.

It is an accepted fact that individuals are the ones who shoulder the responsibility of organizational accountability. Thus, in breaking silos and mainstreaming GESI in EO–GIT field, it has been the CRFMS workforce showing the way. It includes a monitoring and evaluation specialist, a gender specialist, and the service/project lead; they helmed the entire process—be it at the design stage or in the area of reflexive practice or at the discussion stage where diverse opinions were heard and disagreements were thrashed out. They ensured that the staff were continuously engaged and did not ever lose sight of the final goal—that of integrating GESI in the EO–GIT applications of CRFMS.

CONCLUSION

This research identifies key three bottlenecks for integrating GESI into climate and data services: silos in work culture, lack of understanding of the interface between the two disciplines and lack of adaptive management for gender-responsive and inclusive outcome. Implementation of the five-step framework, which we call flexible, multidisciplinary and reflexive (FMR) approach to mainstreaming gender and social inclusion, addresses these challenges. This framework is rooted in the concepts of Theory of Change (ToC) and Participatory Impact Pathways Analysis (PIPA) and our own experience of integrating GESI into Climate Resilience Forest Management System in Nepal.

PIPA provides the opportunity for people having different expertise and diverse views to come together, analyze the context and generate a shared vision, while all along giving due weightage to the gender and social dimension is important for integrating GESI into data science. However, the project contribution should be clearly delineated, and additional strategies should be used to ensure appropriate participation of people having different expertise and users of the application and data services in the ToC process. With the focus of the approach on impact, design participants are forced to think beyond the technology and applications contrary to the traditional practice. This helps them to explore opportunities about how the project benefits diverse groups of people for addressing their needs and problems, thus integrating GESI into data services. Conscious implementation of this process is a good beginning in addressing the silo in work culture which will be further enhanced by iterations of the ToC and reflexive practices.

Further, keeping the process flexible as required is essential for providing them some space for deeper understanding of the interface between the disciplines and adapting to the emerging

situation. This provides opportunity for making the ToC more explicit on GESI dimension through iterative process providing a good basis for monitoring and evaluation of gender outcome and discussion on the issue without breaking the chain of communication among stakeholders. As evidenced by Climate Resilient Forest Management System in Nepal, this will further enhance the adaptive management practices, thus resulting better integration into data services. The reflexive practice has an important role in effective implementation of this process both at individual and within the team responsible for the project. Also, the individuals having GESI value perspective makes the difference bringing its focus in ToC and its implementation. Therefore, developing GESI value perspective within individuals is another important consideration during the process. They should believe that the integration of the two disciplines adds value.

Given the context of technocrats and men dominating this field, champions have a critical role in this whole process, especially in keeping the project team intact in learning and reflexive practice, whereby the GESI lens is constantly used to deliberate over the activities of a project to push it toward being a GESI-responsive service. Having the champions from different disciplines with different expertise work together in a mission of integrating GESI in data services is more effective. This study contributes to many ongoing discussions and debates within academic literature about interdisciplinary research projects and the integration of gender and social inclusion particularly into climate related research and data services.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

LK, VC, and KG designed the conceptual framework of the manuscript and collected and analyzed data. LK prepared the first draft. VC and KG reviewed it and contributed toward finalizing the manuscript. All authors contributed to the article and approved the submitted version.

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