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Cereal Systems Initiative for South Asia

CSISA Rapid Response and Resilience-building in Nepal's Agrifood Systems and Russia–Ukraine crisis response: Building food system resilience to global supply chain and climate shocks in Nepal

Annual Report

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CSISA

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CIMMYT International Maize and Wheat Improvement Center

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IWMI International Water Management Institute

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CGIAR INITIATIVE ON Transforming Agrifood Systems in South Asia

CSISA Covid Response Resilience Activity Partners

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Acronyms

AKCs	Agriculture Knowledge Centers
CAIDMP	Center for Agriculture Infrastructure Development and Machinery Promotion Center
COVID-19	Coronavirus
CIMMYT	International Maize and Wheat Improvement Center
CSISA	Cereal Systems Initiative for South Asia
DWRI	Department of Water Resources and Irrigation
FtF	Feed the Future
GoN	Government of Nepal
GWRDB	Groundwater Resources Development Board
HRVS	Household Risk and Vulnerability Panel Survey
ICAR–NIAP	Indian Council of Agricultural Research - National Institute of Agricultural Economics and Policy Research
IFPRI	International Food Policy Research Institute
IIDS	Institute for Integrated Development Studies
ILRI	International Livestock Research Institute
IVR	Interactive Voice Response
MoALD	Ministry of Agriculture and Livestock Development
MoEWRI	Ministry of Energy, Water Resources, and Irrigation
NARC	Nepal Agriculture Research Council
NPC	National Planning Commission
NRB	Nepal Rastra Bank
PMAMP	Prime Minister Agriculture Modernization Project
RJKIP	Rani Jamara Kulariya Irrigation Project
SAWTEE	South Asia Watch on Trade, Economics and Environment
SIPs	Solar-Powered Irrigation Pumps
STWs	Shallow Tube Wells
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WECS	Water and Energy Commission Secretariat
WFP	World Food Program
WUA	Water User Association

Russia–Ukraine crisis response: Building food system resilience to global supply chain and climate shocks in Nepal

This USAID/Nepal-Mission supported 'buy-in' Activity responds to these complex and urgent challenges and will be implemented as part of Cereal Systems Initiative for South Asia (CSISA), to deliver a rapid and coordinated response to the effects of global supply chain distortions and their implications for smallholder farming households and poor consumers in Nepal. The Activity has two major development objectives:

Objective I. USAID/Nepal and development partners' ability to respond to agrifood systems crises improved through data-driven insights and strategic guidance.

The outputs of Objective I will provide USAID and policymakers with a solid evidence base from which to assess (1) potential agricultural productivity at a seasonal time-step, (2) economic and national food security consequences of the Russian-Ukrainian conflict, and (3) the impact of ongoing price volatility on Nepal's agricultural economy on smallholder farming households and poor consumers. Strategic use of project outputs by USAID and its partners is anticipated to enhance development activities that contribute to increased agrifood systems resilience in Nepal. This evidence base will be informed by state-of-the-art agricultural and economic forecast modeling, to provide monthly agrifood systems 'situation reports' and insights into 'best-bet' development investment and policy options best able to mitigate the effects of global supply chain disruption on these two demographic groups.

Objective II. Smallholder farmers' resilience to economic shocks and climate change improved through sustainable and inclusive irrigation development.

Irrigation is a cornerstone of efforts to increase yields and build farmers' resilience to climate variability and economic shocks such as those associated with the Russia–Ukraine conflict. Building on support provided by USAID/Nepal to foster irrigation development and enhance farmers' resilience in the face of the COVID–19 crisis, this activity will continue to support the public and private sector in sustainable and inclusive irrigation development, including scaling out a previously piloted digital groundwater monitoring system for Nepal. Activities in Objective II will develop locally targeted irrigation scaling strategies, management advisories, and gender-equitable business models, including access to finance for irrigation pumps (with a focus on, but not limited to, solar irrigation). By coordinating and sequencing these actions, CSISA's efforts in irrigation development will build further resilience in Nepal's agricultural systems to economic and climatic shocks, including recent fuel and agricultural commodity price volatility.

Objective 1: USAID/Nepal and development partners' ability to respond to agrifood systems crises increased through data-driven insights and strategic guidance

WORK PACKAGE I:

GENERATE MONTHLY SITUATION REPORTS AND FORECASTS OF THE IMPLICATIONS OF GLOBAL PRICE VOLATILITY ON POOR CONSUMERS AND SMALLHOLDER FARMERS

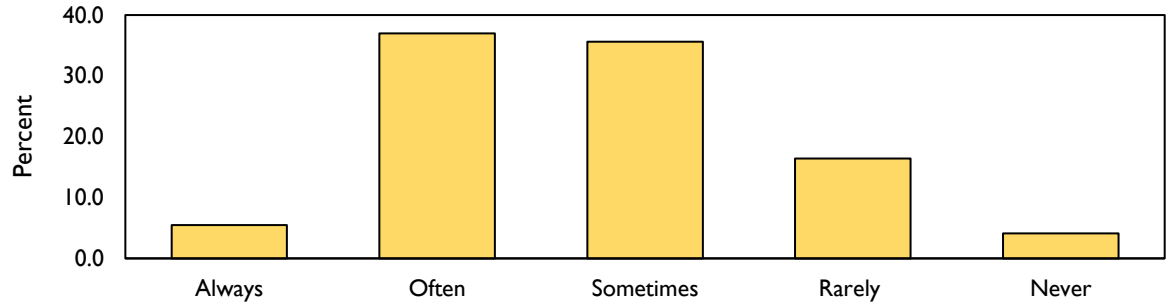
1.1 Agrifood systems situation report

From December 2022 onwards, the Activity produced regular monthly Agrifood System situation reports, focusing on interpreting national level market trends and their impacts on Nepal's agrifood system. The twenty monthly reports generated so far aimed to generate data-driven insights and strategic guidance to support stakeholders, including government policymakers, development organizations, and the public sector to better understand the trends and impacts of complex market dynamics. The reports draw on economic forecasting and scenario modelling to predict how fluctuations in prices affect poor consumers and smallholder farming households, emphasizing impacts of price volatility, primarily in national markets, for rice, maize, horticultural products, edible oils, fertilizers and diesel fuel. In order to do this, price monitoring, data are collected from various sources, namely Nepal Rastra Bank (NRB), World Food Program (WFP), field data from the CSISA Activity, and high frequency market and household data collected by Institute for Integrated Development Studies (IIDS). After careful analysis of the data, the Activity published and disseminated the situation report to relevant stakeholders at national and provincial level every month and the activity is expected to continue through IIDS – a CSISA partner after September 2024

The monthly situation report highlighted two major analyses with implications for households: macroeconomic and microeconomic trends. Under macroeconomic trends, the reports covered inflation, wages and salary, labor migration (issuance of labor permits), and remittance inflows. These trends were analyzed on both a year-on-year and month-on-month basis. The data for macroeconomic trends were sourced from the monthly and annual reports of Nepal Rastra Bank. The report also included information from market surveys conducted by IFPRI/IIDS. Price changes were compared with the previous year and the previous month. In this section, a significant comparison was made between national-level average prices and the average prices in western provinces.

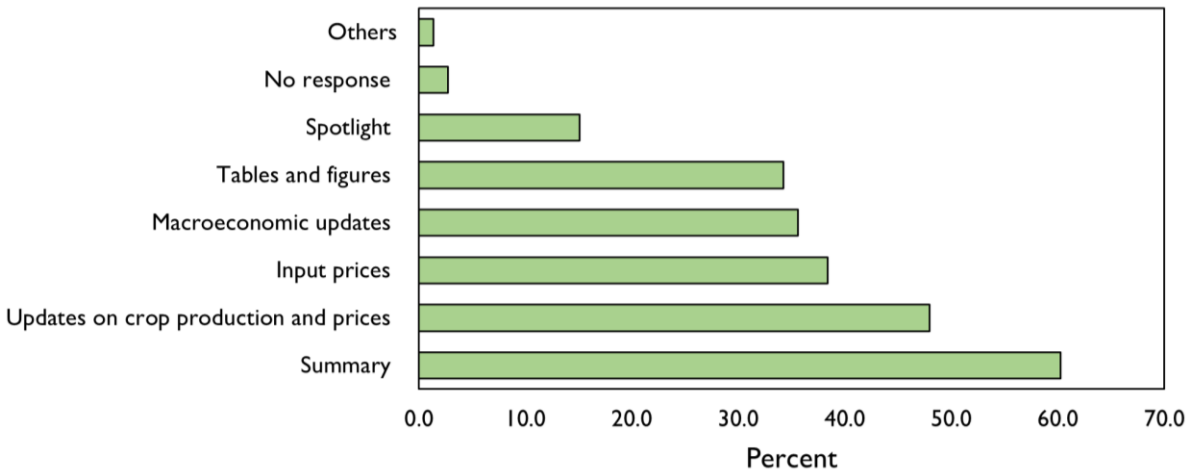
In addition to these regular sections, the report spotlighted other key issues in different months. One such issue was the social safety net, with details on coverage, transfer amounts, frequency, eligibility criteria, modes of transfer, and other prerequisites for social security allowances. These were based on three rounds of household surveys in the Feed the Future Zone of Influence districts. Other topics addressed monetary policies, the budget speech, the Agriculture Census, the National Household Living Standards Survey, development plans, and key issues highlighted by prominent Nepali media outlets.

A short follow-up survey of stakeholders who received the reports on a monthly basis highlighted how the reports have been read and utilized, with data presented below.



Above: Percentage of stakeholders who read the Activity's situation reports (n = 73).

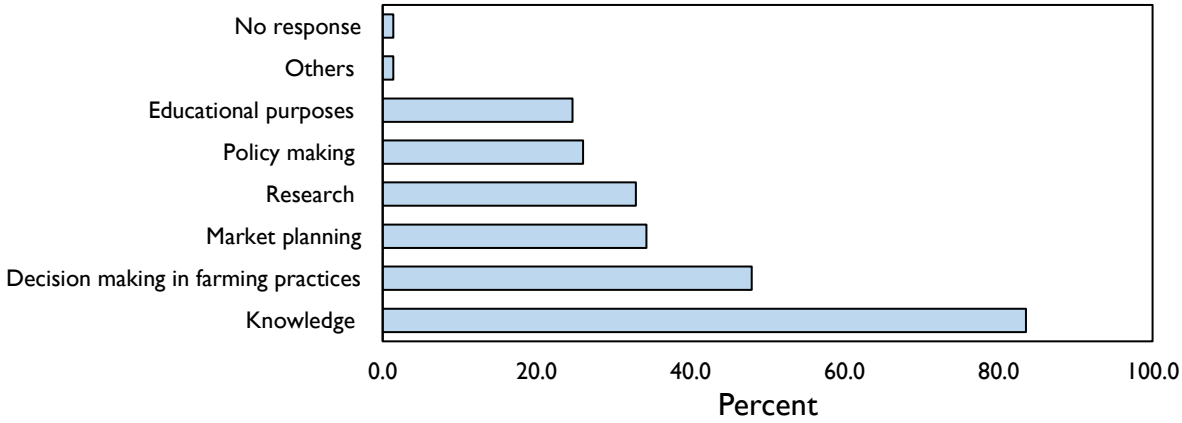
The analysis of the provided important insights into stakeholders' engagement and preferences for the Activity's situation reports. Many stakeholders reported reading the reports frequently, with most either reading them often or sometimes. A smaller group engaged less consistently, showing rare or occasional interest, while only a few always read the reports or never read them. In terms of content preferences, stakeholders clearly favored certain sections of the Nepal Agrifood Systems report. The summary emerged as the most popular, followed by updates on crop production and prices. Sections covering input prices and macroeconomic updates also held strong interest. Content like tables, figures, and the spotlight section were less favored, with limited appeal among stakeholders. Only a minor portion indicated preferences for other sections or did not provide any response. Overall, these findings suggest stakeholders typically engage with the reports, showing a preference for actionable, concise, and economically focused content.



Above: Percentage of stakeholders who reported their preferences on various sections of the Nepal Agrifood Systems report (*n* = 73).

Overall, the monthly Agrifood System situation reports provide critical insights into the market trends and their implications for Nepal's agrifood system, particularly in the context of the economic shocks following the Russia–Ukraine crisis. The reports are expected to be an asset to planners, policymakers,

investment partners and researchers working in these areas. They highlight fluctuations in the prices of essential commodities (e.g., food, fuel, fertilizers) alongside key macroeconomic indicators (e.g., inflation and remittance inflows).



Above: Percentage of stakeholders who indicated how they use the reports (*n* = 73).

Through detailed data analysis and economic forecasting, the reports emphasize the impact of price volatility on consumers and smallholder farmers and have identified trends in both food and non-food inflation, social safety net effectiveness, and the overall resilience of Nepal's food system amid global economic challenges. Data clearly show that inflation on food and non-food commodities has been persistently high during this two year-period, which is likely to have impacted negatively on the livelihood of poor and marginalized groups in Nepal. The Agrifood Systems reports emphasize that building resilience in Nepal's agrifood system is crucial for mitigating the effects of global crises and climate shocks. Expanding domestic production, strengthening market monitoring, and reinforcing social safety nets are key to ensuring food security and stability in Nepal.

1.2 Agrifood systems situation dashboard

The Nepal Food Security Dashboard, designed and developed under the Cereal Systems Initiative for South Asia (CSISA) with USAID support, provides essential data on agriculture and food security in Nepal. It helps policymakers address the economic challenges triggered by global inflation, supply chain disruptions, and the Ukraine crisis, serving as a critical tool for decisionmakers in government, the private sector, NGOs, and development organizations.

The dashboard covers a range of aspects to describe the food security situation in Nepal, including food prices, production and trade, food consumption, seasonal price patterns, maps, and a crop calendar. It allows users to track food price trends, monitor production and trade statistics, and analyze food consumption data. It also features district-level maps on food security, poverty, and malnutrition, and provides timely monthly reports on Nepal's agrifood systems.

Since August 2024, the Institute for Integrated Development Studies (IIDS), a leading Nepali think tank, has taken over the maintenance of the dashboard, ensuring its continued operation and local ownership, and contributing to capacity building within Nepal for managing and sustaining critical food security tools. The dashboard is also prominently featured on both the IFPRI Food Security Portal and the IIDS website, enhancing its accessibility to a wide range of stakeholders. The dashboard's integration into these major

platforms ensures its broad reach and relevance in supporting food security policy and decision-making in Nepal.

1.3 Agrifood systems policy guidance notes

This subsection presents two major policy reports that provide insights and recommendations for enhancing Nepal's agricultural resilience and food security amid economic and climate-related challenges. The first report, conducted by CSISA in collaboration with USAID/Nepal, its partners and the Government of Nepal (GoN), focused on the agrifood system's vulnerabilities. Through simulations of hypothetical policies, it explored short- and medium-term measures to stabilize smallholder livelihoods and protect low-income consumers from shocks. The analysis included quantitative assessments of potential interventions, such as subsidies, to evaluate the financial relief required to counteract economic and climate-related impacts. Specifically, initial simulations centered on the effects of the 2023 El Niño event, which was anticipated to lead to a drought in winter 2023–4. The report highlighted how similar events, such as the severe 1992 El Niño, had previously caused a 17.7% decrease in rice production, underscoring the necessity for adaptive policy responses to safeguard agrifood productivity and rural resilience.

The second report, addressed Nepal's fertilizer usage challenges, focusing on demand and supply gaps for essential nutrients – nitrogen (N), phosphorus pentoxide (P_2O_5) and potassium oxide (K_2O) across major crops—rice, maize, wheat, potato and tomato. With mineral fertilizers contributing to over 50% productivity gains in the past century, the report underscores the importance of precise fertilizer management for sustaining crop productivity. Despite a 212% rise in synthetic fertilizer use since 2000, application rates in Nepal have remained among the lowest in South Asia. These low rates have limited food security gains despite a modest improvement in cereal productivity. Given these states of affairs, this study aimed to (1) estimate demand based on cultivated area, crop type, soil nutrient level and irrigation access, across 20 Terai districts within the FtF ZoI, and (2) evaluate the shortfall in N, P_2O_5 and K_2O supply relative to projected needs.

The preliminary results indicated substantial fertilizer shortfalls across 20 FtF districts in western Nepal, with a combined demand of 59,854 tons for N, 10,938 tons for P_2O_5 and 9,143 tons for K_2O, but with shortfalls reaching 43,718 tons for N, 4,552 tons for P_2O_5 and 8,265 tons for N, P_2O_5 and K_2O, respectively. High-demand districts such as Kanchanpur, Kailali, and Bardiya are especially affected; for example, K_2O deficits in Kanchanpur alone reach 1,327 tons, and K_2O shortfalls exceed 1,100 tons in both Kanchanpur and Bardiya. These supply gaps threaten agricultural productivity, particularly for key crops such as maize, rice, wheat, potato and tomato. Mitigating these gaps will require improved distribution systems, targeted financial support, and effective nutrient management practices to enhance fertilizer use efficiency. The final and detailed report is expected to be released by November 2024.

Both reports identified key challenges in Nepal's agricultural sector, such as low fertilizer use for major crops and significant gaps between fertilizer supply and demand. Findings revealed that despite increases in fertilizer use, productivity has remained low for rice, wheat, maize, tomato and potato, exacerbated by inefficient market systems, inadequate distribution networks, and limited awareness of nutrient management among farmers. Current government subsidies and distribution efforts have failed to meet demand consistently, resulting in shortages and low nutrient recovery. In addressing these gaps, the report

emphasized the need for coordinated strategies, including enhanced data utilization for forecasting, optimized logistics, and expanded private sector engagement to improve fertilizer availability.

Recommendations from the latter include establishing a robust data-driven fertilizer demand forecasting system, improving digital soil mapping, and integrating private sector involvement to enhance fertilizer access. In addition, findings highlighted the need for collaborative data-sharing networks among researchers and policymakers, improved soil management practices, and stronger public–private partnerships to foster resilience. Such coordinated approaches are essential to bridge fertilizer supply gaps, strengthen distribution logistics, and support food security and sustainability in Nepal's agricultural landscape.

1.4 Capacity development and improved self-reliance

The key focus of the Activity's work with regard to capacity building is to strengthen the skills and expertise of Nepali researchers whose specialization is in macroeconomics. Specifically, through collaborations with CSISA;s partners, the two early career agricultural researchers worked as Activity interns to develop in-depth knowledge and experience offered by the Activity. They are expected to benefit from on-the-job training and capacity development in data acquisition, management, and forecast modelling. In this, the Activity followed three approaches to build the capacity of its national partners, namely (1) organizing capacity strengthening workshops, (2) engaging partners in data acquisition, analysis and interpretation, and (3) mentoring the young researchers to address important issues related to agrifood systems in Nepal.

Above: CSISA training collaboration to ensure capacity improvement of IIDS staff and thereby contribute to the sustained management of Nepal's Agrifood System dashboard through IIDS.

In addition, CSISA's interaction and working experience with IIDS colleagues indicated the need for strengthening the latter's skills in using STATA. In response, the Activity organized a training programme on its use, on August 2, 2023 at IIDS and facilitated their participation in the "Working With Tools For Survey Design, Data Collection, & Data Analysis" training program, organized by IFPRI and ICAR–NIAP

in New Delhi. Similarly, the CSISA has been exposed to the features of the data dashboard and the skills required for regularly updating the dashboard.

For the completion of the Activity's field and market surveys which were used to support the monthly Agrifood Systems Reports, the IIDS team was engaged from the conceptualization stage and its skills in preparation of survey instruments, sampling framework and compilation and analysis of data have improved. A few months into the IIDS partnership, the lead role for preparing the agri-food situation report was transferred to IIDS colleagues. This contributed to strengthening their writing ability, as well as boosting their confidence in taking responsibility. In addition, wherever opportunities arise, the Activity encourages IIDS colleagues to attend important capacity-building events, for example, by facilitating them to attend the livestock modeling training organized by ILRI and the economic modeling training organized by CSISA.

By completion of the Activity, these researchers were positioned to take a leading role in sustaining periodic situation reports and dashboard updates. The technical skills imparted to participants have enabled them to engage in discussions on policy rationales and consequences in an informed manner, and will bring additional perpetual benefits in the long run. CSISA also provided intensive in-person training and more than 10 virtual orientations to selected, specified IIDS staff on Tableau software uses and operationalization, to improve capacity and thereby ensure the sustained management of Nepal's Agrifood System Dashboard. These capacity building activities supported IIDS to be able soon to independently operationalize the dashboard and host it on its own servers.

WORK PACKAGE II:

IMPROVING POLICIES AND PROGRAMS TO MITIGATE THE IMPACTS OF PRICE SHOCKS ON SMALLHOLDER FARMERS AND POOR CONSUMERS

2.1 Evidence generation on trans-border informal trade in inputs and outputs

To identify major products informally traded at various locations and examine the nature of informal trade in agricultural inputs and outputs across Nepal's border with India, the activity conducted structured interviews. Participants included traders, processors, wholesalers, retailers, agrovets, customs agents, clearing agents, and government officials at customs and plant quarantine facilities, among other sites. Researchers interviewed 74 key informants across five major border points: Birgunj, Bhairahawa, Biratnagar, Birtamode, and Kakarvitta. The team also analyzed formal trade data using disaggregated eight-digit classification for both pre- and post-COVID periods.

Following a comprehensive primary survey conducted across various locations and feedback from various stakeholders, CSISA and SAWTEE prepared a draft report, to be finalized after a validation workshop in May 2024, for government officials, think tanks, civil society, academia, and other experts from Nepal. On September 30, 2024, the findings were presented during the CSISA Virtual Closure event under Objective I, titled "Building Food System Resilience to Global Supply Chain and Climate Shocks in Nepal: Insights from CSISA".

Transborder trade in agricultural inputs and outputs between Nepal and India is significant due to price differentials and subsidies. Nepalese farmers rely on importing seeds and fertilizers from India, where they

are more readily available and cheaper, spurred by India's high fertilizer subsidies. For outputs, informal trade of rice and vegetables is common, driven by households and traders who capitalize on low prices and consumption subsidies in India. This dynamic has created challenges for Nepal's domestic rice mills, which struggle to compete despite national efforts to boost paddy production and processing. Vegetable imports, primarily on a small scale, often use informal channels to bypass stringent non-tariff barriers, while reverse trade flows, such as during India's 2023 tomato crisis, have also been observed. Informal trade analysis faces due to lack of formal documentation, and reliance on primary surveys which itself is extremely difficult with low incentive for truthful reporting, reliance on recall data and no systems to cross validation. Informal agri-food trade organizations and mechanisms provide some data. Practices such as bulk packaging and labeling can obscure product identification, adding complexity to the analysis.

Informal trade can be seen as a "wicked problem", meaning it is complex, and resistant to simple solutions, due to fluctuating, incomplete, or contradictory requirements. In Nepal, informal trade meets food demand and supplies inputs such as fertilizers, but undermines policy effectiveness. A balance, such as quasi-formal trade, may be necessary. The most important and potent force for reallocating trade towards formal channels would entail derisking trade that is embedded in policy certainty (both at and within border). Simplifying regulatory barriers, harmonizing sanitary and phytosanitary standards, and rationalizing tariffs can reduce incentives to bypass formal trade. Policy certainty and trade facilitation measures, such as seed certification harmonization and rapid agri-food testing, are essential. In addition, factoring informal trade into agricultural planning is crucial for effective policy design.

2.2 Evaluate and generate recommendations to improve social safety nets

To assess social safety nets in Nepal, the Activity was requested by USAID to develop a report providing an overview of the country's social safety net landscape, focusing on non-contributory social assistance programs. The component evaluates the effectiveness and coverage of the social safety net, using publications and data from the National Planning Commission (NPC), UN agencies such as UNICEF and UNDP, World Bank, and others. The review process incorporates household-level data from the Nepal Household Risk and Vulnerability Panel Survey (HRVS) and primary surveys conducted under the USAID Feed the Future initiative. The report found that Nepal's social safety net programs mainly use unconditional cash transfers to support vulnerable groups and remote areas, without means testing. These programs have recently become more inclusive, with increased benefit values outpacing inflation. Recommendations include rigorous impact assessments, clear roles for provincial and local governments, and alternative identity verification systems until formal documentation is universal. The study also highlights the need for rapid scaling-up during crises, means-testing old age allowances, streamlining programs to focus resources on those in greatest need, and improved agency coordination to enhance efficiency and resource utilization. The study found that Nepal's social safety net programs primarily utilize unconditional cash transfers to support vulnerable groups and remote areas, although testing and adaptation of program design has been limited. These programs have recently become more inclusive, with benefit values rising faster than inflation. Recommendations for potential enhancement include conducting thorough impact assessments, clarifying roles for provincial and local governments, and developing alternative identity verification systems until formal documentation is universally available. The study also highlighted the importance of rapid scaling-up during crises, considering means testing for old age allowances, focusing resources on those in greatest need, and improving agency coordination to enhance overall efficiency and resource utilization.

Objective II: Building smallholder farmers' resilience to economic shocks and climate change through sustainable and inclusive irrigation development

WORK PACKAGE I:

COMPREHENSIVE EXPANSION OF DIGITAL GROUNDWATER MONITORING IN NEPAL TO GUIDE IRRIGATION INTENSIFICATION THAT BOOSTS RESILIENT AGRICULTURAL PRODUCTION ESPECIALLY FOR STAPLES AND EDIBLE OILS

1.1 Scaled-out groundwater monitoring system

CSISA's digitized groundwater data collection system, which started as a pilot project by CSISA and the Ground Water Resources Development Board (GWRDB) in early 2021 in Banke and Bardiya districts, has now expanded to include 18 additional districts within the Feed the Future (FtF) zones. These are Siraha, Morang, Nawalparasi West, Saptari, Rupandehi, Dang, Kapilbastu, Sunsari, Chitwan, Kailali, Parsa, Bara, Jhapa, Kanchanpur, Rautahat, Dhanusha, Sarlahi, and Mahottari. Currently, data are being collected from 283 shallow tubewells and 41 deep tubewells across these areas.

The dissolution of GWRDB in July 2023 created uncertainty surrounding the handover of responsibilities to a new institution. This led to challenges to the leadership and interruptions in monitoring activities, with data collection particularly impacted by the dissolution. To ensure continuity, CSISA sought guidance from the Ministry of Energy, Water Resources, and Irrigation (MoEWRI), which assigned the Department of Water Resources and Irrigation (DWRI) to take over monitoring. As DWRI is new to groundwater monitoring and a new partner to CSISA/CIMMYT, the Activity prioritized building its institutional capacity in digital ground monitoring, with CSISA offering to continue monitoring and data collection until September 2024. On July 8, 2024, the Activity facilitated general orientation/training on digital groundwater monitoring and dashboard operation, at Everest Hotel, Kathmandu, to officials of DWRI, MoEWRI and the Water and Energy Commission Secretariat (WECS). The aim was to enhance the capacity of government agencies to run the monitoring system and to project the datasets on to the dashboard, after CSISA transfers the dataset and dashboard to DWRI. Also in July, the Activity facilitated a two-day coaching session for seven key staff of DWRI (2 women, 5 men) on groundwater data collection methods using the Kobo Collect app and Kobo Toolbox for data submission and analysis.

As part of the interim arrangement to which it had committed, CSISA continued to monitor wells. In 2023, this was stalled for almost six months, but resumed in 2024, with data collected for February, March and April, and June to September. Together with the training, the DWRI has secured budget for monitoring, and will commission this to start from October 2024 onwards.

1.2 Groundwater monitoring system upgraded to improve features of the system

At the request of DWRI, CSISA added several new features to the dashboard and modified some existing features, to better align with DWRI's needs. One notable change was the update of the groundwater webpage in line with the Nepal government's standard branding requirements. This included changes to the logos, color, fonts, layout and information, and is an indication of the government's ownership of this initiative. Another important update to the dashboard is in the 'Download Monitoring Data' tab, where the feature for downloading groundwater data has been improved by incorporating a request form. To access the data, users are required to complete the form, providing their name, phone number, email address, and the purpose of the download. This information will be documented in an Excel file, allowing DWRI to track the number of groundwater downloads and their usage. Further functionality has been added at the backend of the dashboard, which integrates a map that displays well location and the data collection sites. It acts as a checkpoint to verify that data collection was done as stated at specific sites, thus ensuring its authenticity. Another notable update is the inclusion of 'approval' and 'pending' status for data collected by enumerators. After review and approval by designated DWRI staff, the data are ready to be uploaded to the website for subsequent downloading. This process enhances the accuracy of the data available to researchers.

In close communication with DWRI, modification to the dashboard is ongoing. When complete, it will be transferred in its entirety to the government server. Of note here is that unlike GWRDB, which is an independent government body, DWRI is an integral entity of the Nepal government, and therefore has relatively stringent rules and regulations around partnership, and data and information security. This explains why the process of onboarding DWRI is taking longer than would perhaps be expected, as CSISA has had to complete multiple levels of scrutiny and assurance.

1.3 Data and evidence for natural resources management policies

Responding to stakeholder demands from farmers, cooperatives and government agencies, GWRDB and CSISA have co-developed and piloted a digital groundwater monitoring system for Nepal. Along with upgrading and scaling out the groundwater monitoring system, this work package under CSISA also aims to generate data and evidence to inform natural resources management policies. This is working towards integrated and sustainable groundwater management that utilizes data and analytics from the groundwater monitoring system to guide decision-making and planning. In this regard, in February 2023 the Activity conducted two province-level stakeholder consultation workshops to elicit insights from various stakeholders on the planned irrigation development priorities in Lumbini and Sudurpashchim provinces, with a particular focus on groundwater management. Based on the discussions of the workshop, a detailed report outlined the need to explore perspectives of different farmer groups on current and preferred information channels, in order to inform and devise future advisory content and delivery mechanism, and to pilot crop specific and season-oriented irrigation advisories using preferred information channels.

Based on the workshop findings, the Activity developed season-oriented irrigation advisories for rice and wheat, using dissemination mechanisms such as factsheet distribution, interactive voice responses (IVR) and SMS-based advisories (see section 2.2.A for more details). Similarly, qualitative research was undertaken in Banke and Kailali districts to explore farmer perspectives on current irrigation management practices and future preferences for irrigation-related advisories (see section 2.1 for details of the research methodologies and preliminary findings).

WORK PACKAGE II:

ACCESS TO RESILIENCE-ENHANCING AND INCLUSIVE IRRIGATION INCREASED

2.1 Actionable and targeted irrigation partnership and scaling strategies

The limited research that exists on groundwater irrigation, information sources and mechanisms is largely based on survey data; there has been limited qualitative exploration of the constraints farmers face when making decisions about their groundwater irrigation management practices at the local level. To fill this research gap, the Activity conducted a qualitative study, "*Constraints and opportunities in irrigation-led agricultural intensification in rice production systems: farmer perspectives from Nepal*" in four localities in Kailai and Banke districts. In each district two villages were selected (two in Kailari and Joshipur municipalities of Kailali district, two in Khajura and Duduwa municipalities of Banke district), based on their responsiveness to irrigation intensity. During the initial field visit, a mapping exercise was conducted in each village to gain a spatial and holistic understanding of the study sites, involving men and women village leaders who knew the village well. A second field visit used a snowball sampling method to conduct 14 semi-structured interviews in each village, capturing diverse farmer perspectives based on their current irrigation management practices and pumpset ownership/usage. Participant selection was based on three typologies of farmer – always the household head, who practiced varying irrigation intensities: high, medium and low. Of a total of 56 interviews, 15 were with women. The research also explored the intra-household gendered division of agricultural labor and household decision-making regarding irrigation management practices.

Data was analyzed based on four asset categories (financial, physical, informational, human resources) to determine constraints and opportunities. Overall, there has been an increase in the availability of shallow tube wells (STWs) with the support of various government and non-government programs and schemes. Farmers have also accessed subsidies to purchase pumpsets, with an increasing preference for electric pumpsets due to the availability of *krishi* meters which significantly lower the costs. However, there are concerns regarding the unplanned installation of STWs by farmers, without their prior consultation about the adequate distance required between two STWs for optimal use. Farmers typically use groundwater during nursery establishment and transplantation, but many rely on rainwater, and make decisions regarding supplementary irrigation as a crop saving rather than an intensification technique. A few progressive farmers tend to ensure avoiding the appearance of cracks in the field and provide supplemental irrigation on a regular basis.

According to farmers' perspectives identified by the study, financial constraints were typically related to high costs of irrigation, risk averseness among farmers, lack of profitability, limited access to finance, unequal access to government subsidies, and variations in costs of STW installation. Other constraints were transportation issues in locations with diesel pumpset use, voltage issues, seasonal variability, lack of proven benefits of additional irrigation, quality issues regarding groundwater vs. rainwater, and lack of localized weather information. Farmers also highlighted existing gaps in the current subsidy system, ineffective extension system and the need for timely access to fertilizers to further support the current agricultural system.

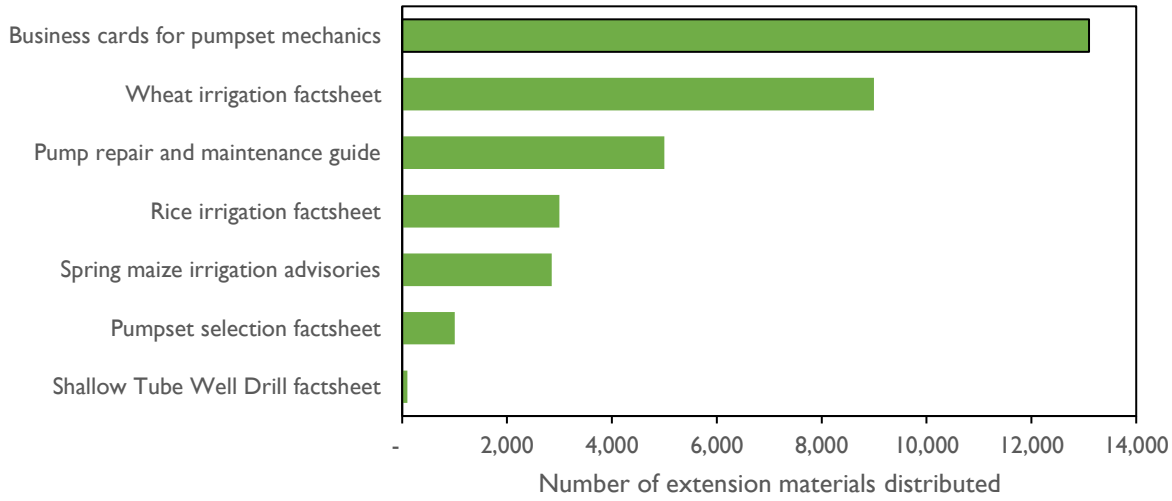
2.2 Consolidating management practices

2.2.A Policy briefs and adaptive irrigation management materials

Enhancing cereal productivity hinges on timely irrigation, which is a critical factor in its success. However, farmers encounter challenges in achieving effective irrigation due to their limited knowledge of essential crop growth stages and how these stages determine irrigation requirements. There is also a lack of awareness about water-saving technologies, and farmers often make suboptimal choices when selecting irrigation pumps. This leaves many farmers in Nepal struggling to manage water resources efficiently, particularly in the face of increasingly severe and prolonged drought events during crucial crop growth periods.

To increase farmer knowledge about these issues, CSISA has developed information and educational materials about efficient irrigation management in cereal crops, as well as guidelines on pumpset selection, repair and maintenance. These are (1) poster on efficient irrigation management in rice, (2) leaflet on efficient irrigation management in rice (click here), (3) brochure on efficient irrigation management in wheat (click here), (4) brochure containing pumpset selection guidelines (click here), (5) brochure on pumpset repair and maintenance (click here), and (6) leaflet on efficient borewell drilling technique (click here). It also produced audio-visual material about efficient irrigation and fertilizer management of wheat (click here), in collaboration with the Agronomy Division of the Nepal Agriculture Research Council (NARC), based in Khumaltar, Lalitpur district.

During the reporting period, the Activity collaborated closely with government partners, including agriculture knowledge centers (AKCs) situated in Kailali, Kanchanpur, Banke, Bardiya and Kapilvastu districts. It also engaged with the rice Super Zone offices of the Prime Minister Agriculture Modernization Project (PMAMP) located in Kanchanpur and Kapilvastu districts, and the maize Super Zone office located in Dang. These interactions aimed to gather valuable insights and feedback from these key stakeholders. The Activity also established a productive partnership with the Agronomy Division of the Nepal Agriculture Research Council (NARC), based in Khumaltar, Lalitpur district. This collaboration was instrumental in enhancing the content of NARC's communication materials, ensuring that they are not only informative but also farmer friendly. In addition, the irrigation extension materials developed in collaboration with PMAMP serve as valuable resources for farmers. Irrigation management leaflets and brochures empower farmers with knowledge to combat drought effectively during critical crop growth stages. These materials also provide principles by which to work towards improved irrigation efficiency and raise awareness about water-saving technologies. Finally, pump selection guidelines offer valuable insights into selecting fuel-efficient pumps with low operational costs, thus helping farmers make informed decisions. Pumpset repair and maintenance guidelines provide essential support for addressing minor pump issues, benefiting both pump owners and service providers alike. These collaborative efforts are aimed at enhancing agricultural practices and sustainability, with emphasis on the Terai region of the country. During the reporting period, the Activity also printed and disseminated 34,050 extension materials containing valuable information on efficient irrigation management in rice, wheat and spring maize, as well as business cards for irrigation entrepreneurs. The details are shown in the bar graph below.



Above: Bar graph showing number of extension materials disseminated to farmers across the Terai districts of Lumbini and Sudurpashchim provinces

These informative and practical materials were distributed to farmers through various channels, including agrovets, cooperatives and machinery dealers. It is noteworthy that the rice irrigation brochure received endorsement from Kailali's AKC. CSISA conducted focus group discussions with farmers in Kapilvastu, Dang, Banke, Kailali and Kanchanpur districts to identify major barriers to access to and adoption of advisories. The most reported constraints were lack of advisories, farmers' lack of knowledge, lack of context-specific advisories, low literacy rate of farmers, timely unavailability of advisories, and complexity of advisories. The figure below provides more detail.

Above: Word cloud showing barriers to irrigation advisory adoption and usage, obtained from farmers in focus group discussions

To address barriers to use, as identified by farmers in focus group discussions, CSISA used an interactive voice response (IVR) digital tool to disseminate irrigation advisories combined with agronomic management and disease management information. The advisories were produced in local dialects such as Tharu, Awadhi and Rana Tharu. This IVR service supported 7,234 farmers to implement efficient irrigation and fertilizer management practices. CSISA has also forged close partnerships with other AKCs and municipal government offices to seek their endorsement for these essential advisories. This collaborative effort aims to harness government resources and support for the effective dissemination of the advisories through the Activity's programs. Collectively, these initiatives represent a sustainable approach to enhancing awareness and delivering vital information to farmers, ultimately contributing to the betterment of agricultural practices.

Above: A leaflet created by Beej Bridhi Krishal Cooperative, Munuwa, Kailali district, in partnership with CSISA, providing information for farmers about efficient irrigation management in spring maize cultivation. The leaflet serves as a valuable tool to optimize farmers' irrigation and fertilizer use.

2.2.B Consolidate irrigation and natural resources in Rani Jamara Kulariya Irrigation Project, Kailali district

Guidelines targeted at water user associations in the Activity sites

The Activity produced a brief discussing the use of the Chameleon Soil Water Sensor for soil moisture measurement and irrigation scheduling in Nepal, particularly targeting local municipalities falling within command areas of the Rani Jamara Kulariya Irrigation Project (RJKIP). The sensor is a simple, user-friendly tool which supports farmers to monitor soil moisture levels in real-time, improving irrigation efficiency. It uses LED lights to indicate soil moisture (blue for wet, green for moist, red for dry conditions), and the

farmer takes readings with one of two types of tool: a basic card reader for use with a single sensor and a more advanced Wi-Fi reader for an array of three sensors.

The brief highlights the importance of soil moisture monitoring for Nepalese agriculture, and provides guidelines for municipalities facing water scarcity challenges in how to do so, especially in dry periods. It explains how traditional irrigation methods, such as using bamboo sticks or identifying soil cracks, are being replaced by sensor technology, which enhances accuracy and efficiency.

The use of sensors offers several key benefits for agricultural practices. They provide accurate data to guide irrigation decisions and enable real-time monitoring, allowing farmers to access soil moisture information both on-site and remotely. The technology is scalable, fitting both smallholder farms and larger operations. Although the initial investment, estimated at around NPR 9,000 per sensor kit, may be significant for individual farmers, the long-term savings from optimized water use and reduced crop loss make it cost-effective. The brief outlines policy recommendations to support broader adoption of the Chameleon Sensor, including government subsidies, awareness campaigns, farmer training workshops, and partnerships with research institutions. These recommendations were shared at a review reflection workshop held on August 14, 2024, at the RJKIP Water User Association office in Tikapur, Kailali, with municipal technical personnel, irrigation engineers, WUA representatives, farmers, and other stakeholders in attendance. Municipality agriculture technicians showed interest in the technology and requested additional training sessions to deepen their understanding of sensor use. If farmer demand arises from this research and subsequent training events, municipalities can utilize their miscellaneous funds to offer technical and financial support for soil moisture sensing.2.3 Business models for irrigation expansion and intensification co-developed with public and private sector partners

Groundwater use business model report, co-authored with national stakeholders

The Activity produced a report highlighting the underutilization of groundwater in RJKIP areas and exploring the potential of groundwater use for improving agriculture production and farm income, and reducing food imports. The report findings will be used to build food system resilience to the increasing impacts of the climate crisis, that have been further intensified by the Russia–Ukraine war, which has increased fuel and fertilizer costs, disrupted value chains, and increased production and irrigation costs for farmers.

To address the challenges faced by farmers in RJKIP (which include inadequate irrigation throughout the year, inequity in groundwater access, limited access to credit for irrigation and agriculture services, price fluctuations in the market, limited information), the report identifies opportunities for different groundwater business models and their suitability for use in the study area. The report serves as a guiding document for policymakers, entrepreneurs and implementors to explore sustainable, equitable and inclusive groundwater development. The research for the report was conducted in the RJKIP area, covering three municipalities in Kailali district and utilizing two types of data. *Primary data* was obtained from field visits (November 1–4, 2023) involving consultation with diverse stakeholders, through (1) key informant interviews with government officials, water users associations, machinery suppliers, agrovets and cooperatives, and (2) focus group discussion with men and women farmers in the tail section of the RJKIP area.

To obtain *secondary data*, the Activity analyzed existing reports, scientific papers, policies related to groundwater, energy, agriculture, and inclusion. It also analyzed household-level survey data from 160

households across head, mid, and tail regions of the RJKIP irrigation command area, collected as part of the CGIAR Initiative on NEXUS Gains.

The following is a summary of findings and recommendations based on the report's insights into addressing the irrigation challenges in Nepal's agricultural sector in the context of global crises.

Key findings

Groundwater use and access. The RJKIP faces challenges in effectively delivering water to all farmers, particularly those at the tail end of the irrigation network. Consequently, farmers rely on groundwater, particularly in the project's tail section. Despite groundwater's potential, it remains underutilized due to high upfront costs for smallholders, particularly women and marginalized groups. For example, irrigation costs for spring rice are disproportionately high, reaching up to 71% of total production costs where diesel pumps are used (see the next point for comments on the cost of electric pump use, which at 12% of total production costs is significantly less than the cost of diesel pumps, when farmers use electric pumps purchased at a subsidized rate).

Energy constraints. Energy costs remain a significant challenge to accessing groundwater. Electric and solar-powered pumps offer a cheaper and sustainable alternative, yet adoption is low due to lack of farmer awareness and disseminated information, poor infrastructure, and for electric pumps, slow electrification rates in some districts.

Water market inequities. An informal water market exists in the project area, with farmers without wells or pumps paying neighboring landowners for water, fuel and pumps. The absence of regulations, however, has led to considerable variation in pricing which has perpetuated inequity and widened the gap between control over resources.

Opportunities for solar irrigation. Solar-powered irrigation pumps (SIPs) present a promising solution to reduce irrigation costs, but adoption is hindered by the high upfront cost, lack of a business model, limited farmer awareness, and limited information dissemination.

Opportunities for a groundwater use business model. A well-designed, inclusive business model to address the irrigation needs of the RJKIP area would bridge existing gaps in irrigation accessibility. It would also foster fair, equitable and sustainable groundwater access for all.

Types of business model for the RJKIP area. Potential business models for irrigation expansion and intensification could be producer driven (community driven, pay per use), buyer driven, supply chain or service-based, and include renting, public sector procurement, and involvement of intermediaries.

Recommendations

Encourage solar irrigation. Accelerate market expansion of solar irrigation pumps (SIPs), which are environmentally friendly and run on energy that is cheap over the long term. Currently, SIPs are 60% government subsidized, and so their future scale out would need a suitable business model.

Improve energy access. Expand the electrification of agricultural fields and provide affordable electricity to reduce irrigation costs.

Improve access to credit. Facilitate access to affordable credit for irrigation and agriculture equipment and services, prioritizing marginalized farmers.

Capacity building. Provide technical training tailored to specific needs of farmers, for example, in the installation, maintenance, and operation of irrigation equipment (e.g., pumps and other agricultural machinery), irrigation scheduling, and operation and maintenance of irrigation pumps, focusing on women and marginalized farmers.

Policy support. Ensure groundwater access and irrigation policies are inclusive, with simplified processes for accessing subsidies and credits.

Market access and value chain. Support the establishment of local markets and improve market linkages for farmers, especially smallholders.

Technical brief: conjunctive use of surface and groundwater by RJKPI water user associations, co-developed with stakeholders

This technical brief focuses on opportunities for conjunctive use of surface and groundwater in the RJKIP area, which is one of the oldest and largest farmer-managed irrigation systems in Nepal. The Government of Nepal has been modernizing the system to enable year-round irrigation across 38,000 hectares of agricultural land, including its extension beyond the RJKP area, which currently covers 14,300 hectares. Farmers currently face significant challenges due to uneven water distribution, especially in the tail section of the system.

Approach and methodology. The research was conducted in the RJKIP area, using *primary data* obtained from field visits made during November 1–4, 2023, through consultation with stakeholders by means of key informant interviews with government officials, water users associations, machinery suppliers, agrovets and cooperatives, and focus group discussions with men and women farmers in the tail section of the project area.

The study also used *secondary data* obtained from reports, scientific papers and policies related to groundwater, energy, agriculture and inclusion. Household-level survey data from 160 households in the head, mid and tail regions of the RJKIP command area, collected as part of the CGIAR NEXUS Gains Initiative, were also analyzed.

This study aims to understand water distribution patterns of the RJKIP, evaluate surface water and groundwater availability, and assess the feasibility of conjunctive water use in the region. To achieve this, it analyzed key parameters including cropping patterns, groundwater dependency, and revenue loss from unproductive land.

Key findings

Temporal and spatial scarcity of water. Farmers face water shortages, especially during the dry season, due to canal repair and maintenance. The tail-end sections (Jamara and Kulariya) do not receive sufficient water even outside the dry season, which is exacerbated by ongoing construction and design flaws.

Revenue loss. Large areas (up to two-thirds) of land remain fallow during the dry season due to lack of irrigation, leading to significant economic loss. For example, farmers could produce crops such as spring

rice and wheat, and estimated revenue losses amount to USD12 million for rice and USD10 million for wheat, annually.

Groundwater dependency. Groundwater, although available, is not accessible to all farmers due to the high upfront investment requirement and high energy cost. This issue is particularly severe for smallholders and marginalized farmers, who lack the necessary financial means and information.

Inequitable water distribution. Farmers in the head sections of the irrigation system receive adequate water, while those in mid- and tail sections must rely on groundwater or alternative sources, this creates social conflict.

Benefits of conjunctive use in RJKIP. Conjunctive use ensures year-round irrigation, reducing fallow land and encouraging crop diversification, which enhances farmers' incomes, economic benefits, and food security. It also promotes equitable water distribution across the head, mid, and tail sections of the irrigation system, fostering social harmony. Furthermore, by diversifying water sources, conjunctive use strengthens resilience to climate challenges such as droughts and floods, ensuring more stable agricultural production.

Conjunctive use plan for RJKIP. A conjunctive use plan should focus on expediting construction work of the project to improve distribution and management of surface water, install deep tubewells in strategic locations, identify groundwater recharge areas, and develop a framework to coordinate use of surface and groundwater resources. Such a plan should also prioritize engaging local communities in its planning and implementation, develop water allocation schedules based on crop demand, and create enabling policies and financial support.

Challenges to conjunctive use for RJKP. Studies and data on the interplay between surface and groundwater systems in the project area are limited. However, this is a potential challenge which needs to be investigated.

The conjunctive use of surface water and groundwater in RJKIP is critical for addressing seasonal water scarcity, improving agricultural productivity, and building resilience to climate change. By integrating both surface and groundwater, farmers can diversify crops, increase revenue, and reduce the economic losses caused by water shortages during the dry season. This approach will also ensure more equitable water distribution, especially for marginalized farmers, and foster sustainable irrigation practices in the region. However, investigation is needed into the interplay between surface and groundwater.

Policy brief, co-authored with national stakeholders

This technical brief emphasizes the challenges and opportunities in groundwater access for irrigation in RJKIP and explores innovative groundwater business models in RJKIP, Kailali district in Sudurpashchim Province, as a tool to improve smallholder farmers' resilience to economic shocks and climate change through sustainable, equitable and inclusive access to the groundwater for irrigation.

Key points

Only 1.55 million hectares out of and estimated 2.5 million hectares of irrigable land in Nepal have irrigation facilities, of which just one-third receive year-round irrigation. Inadequate irrigation is one of the leading causes of unstable food production in Nepal, and the country's groundwater resources are critical to meet the domestic, irrigation needs and ensure ecological balance. In comparison to the

availability of 8,800 million m^3 of groundwater in the Terai region, only 1,312 million m^3 is withdrawn for irrigation (Shrestha et al., 2018), representing about 15% of replenishable groundwater availability.

Need for groundwater development in RJKIP

A primary goal of RJKIP is to boost agricultural productivity and farmer revenue through year-round irrigation. However, farmers, especially in the tail sections of the project's system do not receive adequate water for irrigation. In such cases, with scarce and unreliable canal supplies, groundwater becomes essential; groundwater-based irrigation allows farmers precise control over irrigation timing and volume for crops such as spring paddy, hybrid maize and vegetables.

Constraints for groundwater use in RJKIP area

In the RJKIP area, groundwater access is constrained by inaccessible and unaffordable energy sources, primarily diesel and electricity. The transition to electricity from diesel pumps is slow due to unstable voltage and eligibility criteria for applying subsidized electricity tariffs, disproportionately affecting women and marginalized farmers without formal documents and information. An absence of dedicated policies on groundwater use has led to an informal water market, exacerbating inequalities. There is also a lack of groundwater databases and monitoring systems, along with poor coordination among government agencies involved in groundwater use for irrigation and drinking water.

Opportunities for groundwater development in RJKIP

The Government of Nepal has no standalone groundwater policy, but various policies recognize the importance of groundwater for irrigation and promote private sector engagement and investment in irrigation. Likewise, studies show that there is abundant replenishable groundwater resources in Nepal's Terai region. There is low adoption of solar irrigation pumps in the study area but considerable potential for expansion.

Scope for innovative business model in RJKIP

Implementing innovative business models in the RJKIP area is essential for ensuring just and equitable year-round irrigation for all. These models can assist smallholder farmers by pooling resources, providing affordable financing, and promoting new, cheap and environment friendly irrigation technologies, ultimately enhancing agricultural productivity and resilience against climate change and market fluctuations.

Among these, a producer-driven groundwater model holds more potential benefits for women, marginalized, and tenant farmers by ensuring equitable access to groundwater through collective ownership, transparent pricing, and fair irrigation scheduling. This approach alleviates financial burdens, reduces dependency on external service providers, and fosters social cohesion.

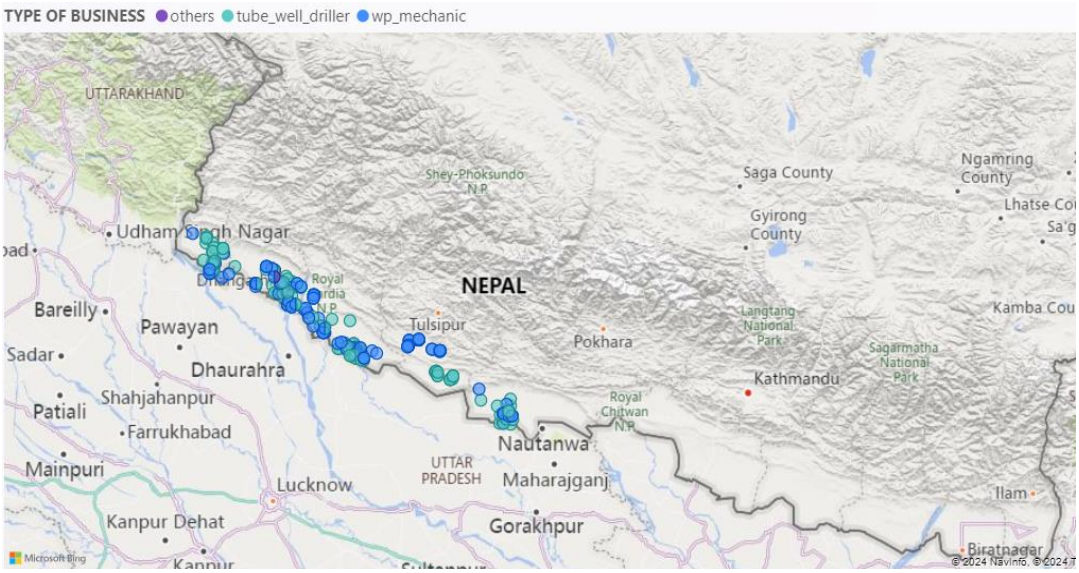
Business support program for irrigation entrepreneurs

The Activity designed a business support program for existing irrigation entrepreneurs who had the most potential, to inform them of available support appropriate to their (local) needs. CSISA began by mapping all of Nepal's irrigation entrepreneurs it could identify, particularly mechanics and tubewell drillers, and then conducted a market assessment of their businesses to understand their status and develop site-appropriate support programs or action plans. The Activity used the results of the assessment to prepare business models for three different types of irrigation entrepreneur – irrigation service provider, mechanic and tubewell driller – which it validated through presentation to different stakeholders and incorporating their suggestions. Next, CSISA conducted a support program which included business development to

support stakeholders with management and development, a repair and maintenance program to enable irrigation service providers maintain their pumpsets, and support for mechanics to enhance their skills and expand their businesses. Tubewell drillers were trained how to bore mechanized shallow tubewells, which could support them to provide services in larger areas, saving time and labor. In addition, irrigation entrepreneurs were supported in developing and disseminating business promotional materials to expand their services.

Utilizing this approach, CSISA supported 162 irrigation entrepreneurs (73 mechanics, 59 irrigation service providers, 30 tubewell drillers) to develop and expand their businesses, and for 25 of them, facilitated formal registration with the local government. The Activity followed up by the end of September 2024 and found that the majority (93.2%) were continuing their businesses; the rest had limited their services. A total of 4,181 farmers benefitted from these irrigation entrepreneurs during the project period. After receiving the support, 82.58% of entrepreneurs reported an increase in profit from their services. Further details of the support program are described below.

Mapping of irrigation-specific private sector stakeholders



Above: Mapping of irrigation-specific private sector stakeholders in Nepal

During the reporting period, CSISA started mapping major irrigation-specific private sector stakeholders, mechanics, and tubewell drillers in the working districts, with the aim of understanding their status and supporting them to promote their businesses. By the end of the Activity, it had mapped a total of 389 irrigation entrepreneurs (161 mechanics, 145 tubewell drillers, 83 irrigation service providers). Recognizing the importance of this database, CSISA has created a dashboard for all these stakeholders. The dashboard will be handed over to government organization, the Center for Agriculture Infrastructure Development and Machinery Promotion Center (CAIDMP)/Ministry of Agriculture and Livestock Development (MoALD), which will further expand the database and share it with the public. This will support farmers to access irrigation and machinery stakeholders whenever necessary.

Market assessment of various irrigation schemes and financing options for smallholders to purchase them and potentials of becoming water entrepreneurs

The Activity also conducted a market assessment of irrigation schemes, through group discussions with identified irrigation stakeholders and key informant interviews. Its primary goal was to evaluate existing irrigation schemes and potential irrigation businesses in the six targeted districts (Kanchanpur, Kailali, Banke, Bardiya, Dang, Kapilvastu), to enable them upskill and expand their business horizons through different Activity-targeted interventions, and to further extend their irrigation services to smallholder farmers. The assessment provided valuable action plans, including coaching and follow-up for existing and potential irrigation enterprises to establish and operate their businesses, facilitation in business registration, support in developing and disseminating business promotional materials, providing basic business management training, and offering basic repair and maintenance training. Other specific training to support enterprises to expand their businesses for year-round services is explained briefly below.

Development of a business model for irrigation entrepreneurship

CSISA developed business models for three types of irrigation entrepreneur service provision businesses: well drilling irrigation services, irrigation pump repair enterprises, and water pump renting services. These business models were shared with a larger audience for validation, including banks, cooperatives, machinery dealers, tubewell drillers, repair and maintenance entrepreneurs, and farmers. They will serve as comprehensive frameworks that provide structured approaches to creating and delivering value to customers, developing the business, and supporting not only the businessperson but also those who are planning to support such irrigation businesses.

In January 2024, CSISA conducted two significant workshops to promote irrigation entrepreneurship and improve irrigation services in the targeted districts, with the particular aim of discussing access to finance and banking services with banking and finance institutions. The program brought together representatives from banks, cooperatives, machinery dealers, tube well drillers, repair and maintenance entrepreneurs, and farmers, with a focus on sharing business models and enhancing access to banking services. Participants provided valuable feedback, emphasizing the need for collateral-free loans, risk mitigation training, and comprehensive data records. Both events underscored the importance of connecting irrigation entrepreneurs with financial institutions and explored initiatives including the Kisan debit card and Kisan credit card to support sustainable financial practices for irrigation businesses. Participants stressed the importance of formal business registration to avail government and non-governmental benefits, as well as to enhance access to banking and financial services.

Capacity building and technical advice/training for irrigation entrepreneur businesses

During the reporting period, the Activity organized a series of training events to support irrigation entrepreneurs. The training focused on improving business efficiency, increasing customer bases, addressing basic repair issues during peak seasons, and expanding operations for year-round service. Key topics covered included business management, basic repair and maintenance of irrigation pumps and electric water pumps, and the use of mechanized shallow tubewell technology. Six business management training courses for the 128 identified irrigation entrepreneurs and other irrigation-related enterprises were held in November and December 2023. These provided insights into business management, emphasizing financial record-keeping, customer segmentation, and strategic advertising. The training

helped to link these enterprises with financial institutions, enabling better access to banking services for business initiation or expansion, ultimately empowering them to grow and deliver quality services.

December 2023 and January 2024 saw the completion of nine events of basic repair and maintenance training for 125 irrigation entrepreneurs and one irrigation-related enterprise. Training was delivered in close coordination with local agricultural machinery dealers, and focused on basic repair and maintenance of petrol and diesel-operated water pumps. However, there is a growing demand for advanced training, particularly for repair and maintenance of electric pumps, given their increasing adoption. Such training not only benefits the entrepreneurs directly involved but also the smallholder farmers who rely on their services. Moreover, expanding the service portfolio of these enterprises is crucial for their sustainability and growth. A second repair training was conducted, addressing the lack of confidence that some irrigation service providers expressed after the first event. This comprised six refresher sessions, conducted in August 2024 across five districts, with a total of 73 participants, 12 of whom were women. After the training, most participants reported they could perform basic servicing and repairs. Female participants also gained confidence in starting engines, which is crucial to providing irrigation service.

The Activity also facilitated five five-day intensive technical training events on the repair and maintenance of electric-operated water pumps. These were conducted between March and April 2024 for a total of 48 irrigation mechanics whose skills were previously limited to repairing diesel- and petrol-operated water pumps. The objective of the training was to leverage the expertise of mechanics in engine-operated agricultural machinery and skill them to offer repair services for electric motor-operated machines. The average score of 75% correct answers on the post-evaluation exam indicated the effectiveness of the training. The Activity also provided trainees with essential electric motor tools, to encourage them begin immediately to provide irrigation pump repair and maintenance services to farmers.

Above: Bhola Prasad Chaudhary (CSISA resource person), instructing participants how to check internal wiring, during electric water pump repair training. June 2, 2024. Photo: Hemraj Lamichhane.

The Activity facilitated a three-day mechanized tubewell drilling training event for irrigation entrepreneurs, from March 18 to 21, 2024, in Rajapur-5, Bardiya district. Sixteen active participants from different districts learned to drill tubewells using power tillers, which not only enables them to conduct their work faster but also saves time and labor costs. The technology, developed by CSISA in collaboration with a local workshop and tubewell drillers, is popular in Rajapur Municipality, where groundwater is accessed by breaking through hard rock formations. The aim is to scale out the technology to other districts which require similar groundwater and drilling methods.

Above: Ms. Sabitri Chaudhary, pump owner, practicing general servicing of a diesel pumpset, in Lamahi-5, Lamahi, Kapilvastu. August 11, 2024. Photo: Uma Chaudhary

Above: Participants using tools used in mechanized tubewell drilling, during training in Rajapur-5, Bardiya. March 18, 2024. Photo: Shreya Malla

Enabling effective COVID-19 crisis response in Nepal through appropriate agricultural machinery, resilience enhancing irrigation, and entrepreneurship

From April to late September 2021, Nepal faced its second major and third minor wave of COVID-19, bringing additional threats to agri-food systems and livelihoods. Lockdowns, transportation disruptions, and social distancing measures reduced interactions among farmers and value chain actors, while rising infection rates led to significant labor shortages, especially affecting marginalized and women farmers. Small and medium enterprises across the Feed the Future (FtF) Zone suffered severe economic impacts. Food and nutrition security deteriorated due to increased costs of imported staples, unreliable cross-border trade, and shortfalls in national production both before and during the pandemic. The crisis exacerbated the need for reliable, timely information on input and output market access, crop diseases, pests, insurance, and credit, highlighting existing inequalities that limit access to information for women and marginalized groups and increase their economic burden.

In response, USAID/Nepal provided an additional USD 3 million buy-in as part of the broader CSISA portfolio, aiming to deliver rapid response and resilience-building support for Nepal's agri-food systems. Immediate interventions were implemented from September 2021 until March 2024 to help rebuild critical elements of the country's agri-food systems, with a focus on aiding marginalized groups in the FtF Zone that were disproportionately affected by the pandemic's second wave.

Key areas of intervention included facilitating access to finance for small- and medium-sized agricultural input and service businesses, along with recovery efforts in the post-harvest value chain. Emphasis was placed on financial products designed for businesses handling perishable farm products and expanding digital banking services to enable socially distanced agricultural finance transactions. The Activity also focused on scaling agricultural mechanization services through geographic expansion to new districts not previously covered under Objective I, aiming to enhance national food security and support agricultural economies during crises. Additionally, Objective III targeted ensuring small enterprises recovered fully from the shocks of COVID-19, while simultaneously building the resilience of critical elements of the agri-food system to withstand future disruptions, including potential future pandemics.

Objective III of this CSISA Activity buy-in was largely completed by March 2024, with detailed updates provided in the last semi-annual report. The Activity aimed to enhance the adoption of agricultural machinery, strengthen irrigation practices, and support local entrepreneurship, contributing to the agricultural sector's recovery from the COVID-19 crisis. No technical details are therefore provided in this report as they are covered in the previous report, although information on Activity impacts are presented in the 'targets vs. impacts' section below.

Challenges faced during the reporting period

Challenges specific to the CSISA-Ukraine response

Weak financial sector. In response to the liquidity crisis that followed the COVID–19 pandemic, banks delayed and declined loans, and in the following years declined requests for small loans, depriving smallholder farming households of much needed access to finance. To address this, CSISA pivoted its strategy from banks to cooperatives. This wise move came with a cost – the loanee has to become a cooperative member, making them liable to the cooperative's relatively high interest rate. To support small entrepreneurs to access finance, CSISA arranged to pay 50% of the interest for the first year of the loan. A merger between Mega Bank and Nepal Investment Bank resulted in lack of clarity on institutional governance, slowing decisions on loans and Kisan cards facilitated by CSISA, impacting the Activity's efficiency.

Underdeveloped and uncertain market systems, especially for agri-businesses. Business scaling was part of the Activity's planned interventions, but was hindered by several factors: fluctuation in demand and supply, competition with products from across the border with India/border infiltration, high costs associated with branding, and businesses' risk averse behavior.

Sustaining machinery entrepreneurship. Machinery entrepreneurs struggled with a) competing markets in the season, and b) during the off-season, sustaining income while needing a year-round source of income. Some women entrepreneurs were particularly disadvantaged, being constrained by their family obligations and social set-up. The Activity tried to offset these challenges through specialized training and coaching selected entrepreneurs on additional skills, for example, farmers who provide pumpset rental service were trained in repair and maintenance so that they have additional income as mechanics.

Institutional challenges to groundwater monitoring. The Government of Nepal's decision to dissolve GWRDB was a severe setback to CSISA's activities. It meant that the Activity had to start from ground zero with a new institution, DWRI, in the second year of implementation. Challenges emerged in terms of the Activity meeting DWRI's new priorities, and in influencing its decision-making on setting priorities for research and scaling. Furthermore, stringent government rules around data security have delayed the process of transfer to DWRI of the digital groundwater monitoring system and the dashboard.

Lack of support from the Department of Irrigation. RJKIP has a huge investment in modernizing and expanding existing canals. However, the department does not promote groundwater use or conjunctive use of surface and groundwater in the RJKIP area.

Lack of government support resulting in cancelling activities. CSISA had scheduled a policy workshop for government and other stakeholders to address conjunctive use of water in RJKIP, to be held at the end of the program. However, due to the non-prioritizing by Department of Irrigation of conjunctive water use in RJKIP, the workshop and related activities had to be cancelled.

Challenges specific to the CSISA-Response and Resilience Activity

Other than ongoing challenges resulting from the dissolution of the GRDB as detailed in the text, no major challenges were noted during the reporting period.

Targets vs. achievements

CSISA Ukraine Supplemental Fund

To ensure responsible groundwater usage within environmentally safe limits, the Activity employs a digital groundwater monitoring system and enhances government capacity for sustainable management. The focus is on scaling sustainable and inclusive irrigation practices. CSISA supported efforts to optimize irrigation use through awareness campaigns, technical assistance, and capacity-building activities in water management. These efforts will boost efficient water resource use for dry-season irrigation across six Activity districts: Kapilvastu, Dang, Banke, Bardiya, Kailali, and Kanchanpur, within the Feed the Future Zone of Influence. Activities are targeted based on data-driven evidence of higher yield responsiveness to irrigation, informed by landscape and soil characteristics and an assessment of challenges and opportunities for integrated or irrigation advisories experienced by farmers. CSISA developed inclusive, resilience-enhancing advisories and business models that improve the livelihoods of 20,651 farmers through better agricultural water management. The collaboration includes three international partners (IWMI Nepal, iDE Nepal, and Cornell University) and involves close coordination with national stakeholders, including municipalities, provincial governments, private sector actors, the Prime Minister's Agriculture Modernization Project (PMAMP), the Department of Agriculture, the Department of Irrigation, and the Ground Water Resources Development Board (GWRDB).

Life of the Project's target vs achievement by Indicator			
Indicator	**Target**	**Achievement**	**Deviation**
EG.3-2: Number of individuals participating in USG food security programs [IM-level]	**20,000**	**20,651**	**3%**
Male	**12,000**	**13,082**	**9%**
Female	**8,000**	**7,569**	**-5%**
15-29	**2,000**	**2,511**	**26%**
30+	**18,000**	**18,140**	**1%**

CSISA Response and Resilience Activity

CSISA Response and Resilience Activities largely ceased after March 2024, with earlier updates provided in the previous mid-year report. However, the impacts assessed by the Activity MELIA team over the past six months are detailed here. The Activity achieved major milestones by onboarding 732 small and medium-sized agricultural input suppliers, known as agrovets, and establishing strong connections with banks and financial institutions. This effort significantly benefited local communities, with 29.5% of agrovets owned by women and 57.9% by marginalized groups, including Dalits, disadvantaged Janajatis, and disadvantaged Madheshi. The total disbursed loan amount reached USD $590,256, averaging USD $6,213 per recipient. These funds were crucial in supporting agrovets' operations, enabling them to secure vital agricultural inputs such as seeds, animal feed, veterinary medicine, agricultural tools, bio-fertilizers, vitamins, pesticides, and biopesticides. The 732 MSMEs reached a total of 41,511 farmers. Notably, 77.1% of these farmers belong to marginalized groups, including Dalits, disadvantaged Janajatis, and disadvantaged Madheshi, while 39% of beneficiaries were female and 15% were youth.

Life of the Project's target vs achievement by Indicator

Indicator	**Target**	**Achievement**	**Deviation**
EG.3-2: Number of individuals participating in USG food security programs [IM-level]	60,175	59,146	-2%
EG.3.2-24: Number of individuals in the agriculture system who have applied improved management practices or technologies with USG assistance [IM-level]	35,625	41,511	17%
ES.5-1 Number of USG social assistance beneficiaries participating in productive safety nets [IM-level]	280	287	3%

GNDR-2 Percentage of female participants in USG-assisted programs designed to increase access to productive economic resources [IM-level]	35%	39%	11%
YOUTH-3 Percentage of youth participants in USG-assisted programs designed to increase access to productive economic resources who are youth (15-29) [IM-level]	15%	18%	20%

Cereal Systems Initiative for South Asia

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