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CCAFS Climate-Smart Agriculture Learning Platform, South Asia

Harbingers of Change: Government of Nepal taking the lead in scaling out Climate-Smart Villages

The Government of Nepal has initiated the implementation of Climate-Smart Village (CSV) approach for scaling out a range of adaptation options in agriculture through policy decisions.

By Arun Khatri-Chhetri (CCAFS South Asia) and Balaram Thapa (LI-BIRD)

Nepal is within the top ten most affected countries in the world due to climate change. In recent decades, people in Nepal are experiencing an increasing frequency and severity of droughts, heavy rainfalls leading to floods and landslides and heat/cold waves. Weather is becoming more erratic and farmers are facing difficulties in managing agricultural activities, particularly in partially-irrigated and rainfed areas.

Government's response to climate change

In response to the global climate change problem, the Government of Nepal has already initiated many adaptation and mitigation related policies and programmes with an increasing realization of climate change impact on agriculture and allied sectors. For example, National Climate Change Policy (NCCP), National Adaptation Programme of Action (NAPA), Local Adaptation plans of Action (LAPA) and Agriculture Development Strategies (ADS) are prioritizing many climate change adaptation and mitigation options relevant for the agricultural sector. These policies aim to promote climate-smart technologies, target capacity strengthening of agriculture extension staff and farmers on climate-smart interventions.

Promoting climate-smart agricultural practices and technologies is one of the key strategies set out in Nepal's Intended Nationally Determined Contribution (INDC). Despite INDC not having a special focus on agriculture for mitigation commitments, it highlights the need for multilateral and bilateral support for enabling farmers to adopt climate resilient farming practices.

Gaps in policy implementation

Formulation of new policies and institutions, particularly after the year 2000, reflects Nepal Government's rising focus on management of climate change impacts in the country. Recent research conducted by various organizations including CCAFS and its national and local partners shows the availability of a large number of climate- smart technologies, practices and services suitable for different agro-ecological regions of Nepal. Despite the availability of policies and institutions, climate finance and ample prevalence of scientific knowledge base about climatic risks and their likely impacts, a gap exists between policy formulation and implementation.

There are relatively little actions that integrate top-down government programmes, scientific innovations, and stakeholder needs, to address the problems of a large number of farmers. The Government of Nepal is gradually realizing that the effective implementation of adaptation and mitigation options in agriculture will be limited in the absence of a more integrated approach, requiring the engagement of local organizations and constructive participation by multiple stakeholders and decision-makers at the local level.

A step forward

"The concept of Climate-Smart Villages (CSV) will be gradually Implemented by carrying forward the climate adaptation programme" - Policies and Programmes, 2017-2019, Government of Nepal .

The Climate-Smart Villages have been conceived as models of local actions that ensure food security, promote adaptation and build resilience to climatic stresses. These are sites where researchers, local partners and farms collaborate to evaluate and maximize synergies across a portfolio of climate–smart agricultural interventions. The inclusion of the Climate-Smart Village (CSV) approach in the *'Policies and Programmes'* document reflects the Nepal Government's interest in the new approach of scaling out a range of climate-smart practices, technologies and services in agriculture. This policy initiation was influenced by and informed regarding the participatory development and evaluation of CSV approach started by CCAFS in collaboration with the Ministry of Agricultural Development (MoAD), Nepal Agricultural Research Council (NARC), District Agriculture Development Offices (DADOs), Village Development Committees (VDCs) and farmers groups in the selected districts of Nepal.

Understanding the significance of the Government's involvement in scaling out CSVs, CCAFS in partnership with its local partner, Local Initiatives for Biodiversity, Research, and Development (LI-BIRD), has extended commitment for providing technical support to the National Planning Commission (NPC) and the Ministry of Agricultural Development (MoAD) to implement the programme in a few districts of Nepal.

Solar irrigation pumps illuminating lives in Dhundi village, Gujarat

The world's first solar pump irrigators' cooperative operating in Dhundi village, Gujarat, is greening the ways of farming, incentivising sustainable groundwater use and offering farmers an additional, stable and counter-climatic income source.

By Tushaar Shah, Neha Durga, Shilp Verma and Rahul Rathod (IWMI)

In much of western and peninsular India, farmers use free or highly subsidized electricity to pump groundwater for irrigating their crops. The annual farm power subsidy burden of the Government of India has crossed USD 10 billion and continues to grow as the low marginal cost of energy creates incentives for groundwater over-abstraction. As India briskly moves towards greater adoption of renewable energy, solar-powered irrigation pumps offer an opportunity to reverse such incentives and offer farmers an additional, reliable and counter-climatic source of income – as demonstrated through the IWMI-CCAFS initiative titled, 'Solar Power as Remunerative Crop' (SPaRC).

Solar irrigation pumps are currently being promoted by government agencies in India primarily as off-grid, green pumping solutions. Under its innovative SPaRC partnership, IWMI and CCAFS are arguing that a smarter promotion strategy would be to view solar irrigation pumps as a composite water-energy-climate-livelihood solution.

Dhundi: Home to the world's first solar pump irrigators' cooperative

IWMI and CCAFS came together in late-2015 to pilot the world's first solar pump irrigators' cooperative in Dhundi village, Gujarat. Six smallholder farmers in Dhundi organized themselves into a cooperative and were offered 7.5 – 10.8 kWp (kilo-watt-peak) capacity solar irrigation pumps which were connected to each other in a micro-grid. In May 2016, the cooperative entered into a 25-year power purchase agreement (PPA) with the local electricity utility – Madhya Gujarat Vij Company Ltd. (MGVCL) – which offers the cooperative a feed-in-tariff of USD 0.07/kWh (kilo-watt-hour) for evacuating their surplus solar power to the electricity grid. IWMI and CCAFS add to this tariff with a USD 0.02/kWh 'Green Energy Bonus' and another USD 0.02/kWh 'Groundwater Conservation Bonus' to make the effective tariff USD 0.11/kWh.(See Figure)

Benefits to farmers and society

Since May 2016, more than half the energy generated (nearly 48,000 kWh) has been sold to MGVCL and the six member farmers have earned an additional income of more than USD 5,300 from the sale of surplus solar power.

In the process, the cooperative has reduced carbon dioxide emissions by 56.5 tons through replacement of diesel and injection of clean solar power into the grid.

If replicated and scaled-up, the Dhundi-model of solar pump promotion will offer multiple benefits for farmers, electricity utilities, Government and society. Solarizing 1 Giga-watt capacity of electric irrigation pumps through the Dhundi approach will annually generate 1500 million units of green power; reduce farm power subsidy bill by USD 70 million; put an additional income of more than USD 59 million into the hands of the farmers; avoid groundwater draft of 1.7 billion cubic meters; and reduce carbon dioxide emissions by 1.23 million metric tons. Since farmers in Dhundi have installed solar panels on their fields at an elevation that allows them to cultivate shade-loving crops below the panels, this model also significantly reduces the land footprint of solar expansion.

Policy Impact

The efficacy of the Dhundi model can be gauged by the response of the farmers and the positive media and policy attention the pilot has received. The first six farmers contributed about 5% of the capital cost of solar panels, pumps and the micro-grid while the rest was subsidized by the IWMI-CCAFS project. In 2017, three new farmers are joining the cooperative and are contributing nearly 30% of the capital cost.

The State Government is currently drafting a state-wide solar irrigation promotion policy to enable replication and scaling up of the Dhundi model across Gujarat.

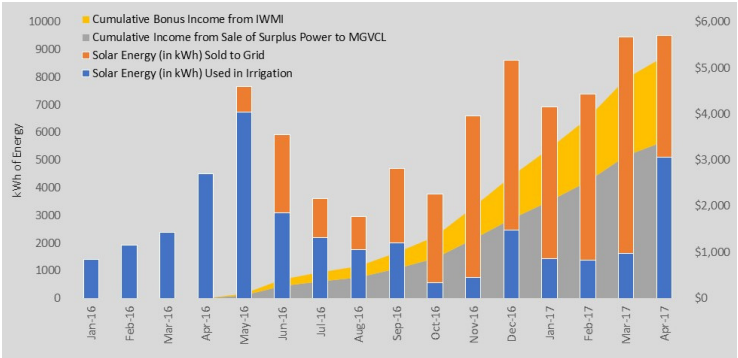

Figure:Electricity sold and income earnerd by the Dhundi Cooperative *updated till 30 April 2017*

Taming the ferocity of floods through underground storage

Underground Taming of Floods for Irrigation (UTFI) project seeks to address the crisis of floods and droughts, thereby, helping rural communities become more climate resilient.

By Paul Pavelic and
Nitasha Nair (IWMI)

The inhabitants of the Indo-gangetic plains have suffered a great deal on account of violent flooding which continues to be a recurring woe almost every year. This highly fertile and populous region accounts for almost 50% of India's agricultural output which becomes severely debilitated due to floods, a phenomena which is only seen to intensify in recent history due to climate change. Given the need for critical support to farmers in this area, a paradigm shift has to be undertaken in terms of interventions and approaches towards flood mitigation.

Understanding UTFI

Underground Taming of Floods for Irrigation (UTFI) project is trying to address the dual problem of floods and ground water depletion in the aforesaid area. UTFI involves the practice of targeted recharge of excess wet season flows in aquifers. This ensures protection of lives and assets in downstream urban areas while also creating favourable conditions for boosting agricultural productivity and improving livelihoods within the prism of building resilience to climatic shocks. The novelty of the UTFI approach lies in the strategic operation of recharge structures and the creation of linkages between communities in urban centres and those in rural areas upstream. Thus, the project's uniqueness lies in its integrated approach of controlling flood hazards and enhancing access to reliable water supplies.

Piloting UTFI in India

In late 2015, the project put in place the first UTFI pilot trial of its kind in a small village in Rampur district situated in north western Uttar Pradesh. The village was selected after detailed regional mapping followed up with detailed ground truthing. The area faces real problems with declining groundwater levels that makes accessing domestic and irrigation water difficult in the summer months. In addition to t that, the area lies close to the Himalayan foothills making it prone to seasonal flooding.

The local community are very keen on the idea and are involved in its operation as it addresses problems that are very real to them. They have given their full support to the project and have aided in converting one of the village community owned ponds into a UTFI facility by retrofitting it with gravity-fed recharge wells to harvest excess river flows via an adjacent irrigation canal.

With almost two years of field testing and evaluation completed, the results to date look quite promising. A picture is starting to emerge about how well UTFI works and how it can be fine-tuned further. Over 4,000 cubic metres of surface flows were added to groundwater last year. Much effort is given to ensuring that appropriate information and training flows to the community so that UTFI fully serves their needs.The community members are beginning to perceive the benefits from greater water availability and pumping costs.

The project is receiving strong support from government agencies at the district through to the national level. The idea has been inculcated by the state in the district irrigation plan. With external support, the project is planning to expand the number of demonstration sites in India and develop a similar pilot trial in Bangladesh.

Mitigation co-benefits of increased water and nutrient efficiency in irrigated rice in Bangladesh

In Bangladesh, agricultural development practices that increased water and nutrient efficiency in irrigated rice contributed to increased yields, climate resilience and greenhouse gas mitigation.

By Juliana White (Low Emissions Development, CCAFS)

Irrigated rice represents at least 10-12% of all greenhouse gas emissions from agriculture. In 2015, 28 Parties – including Bangladesh, China, and Vietnam – pledged to reduce emissions from rice as part of the global agreement on climate change adopted by the United Nations Framework Convention on Climate Change (UNFCCC). With the conclusion of COP 22, the "COP of Action", in 2016, country leaders are now seeking practical innovations and solutions to meet both mitigation commitments and food security goals, while development practitioners and technical experts seek to contribute to climate change adaptation and mitigation goals. Many agricultural development projects are already in action, providing solid evidence of mitigation co-benefits in the irrigated rice sector.

Characterizing mitigation co-benefits in irrigated rice

The United States Agency for International Development (USAID) engaged the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) to characterize the greenhouse gas emissions of USAID's current investments in agricultural development and analyze strategic opportunities for low emissions development that complement USAID's current agricultural investments. CCAFS and the Food and Agriculture Organization of the United Nations (FAO) conducted dozens of analyses and have published nine info notes that quantify the potential climate change mitigation benefits from agricultural projects.

In Bangladesh, CCAFS and FAO analysed Accelerating Agriculture Productivity Improvement (AAPI), a project funded by USAID Feed the Future and the USAID Office of Global Climate Change and implemented by the Ministry of Agriculture and the International Fertilizer Development Center (IFDC). AAPI aimed to improve food security and accelerate income growth for 1.3 million farmers in rural areas of southwest Bangladesh.

CCAFS and FAO found that AAPI achieved significant mitigation co-benefits from changes in irrigation and fertilization practices, reducing absolute emissions by up to 44% and emissions relative to production by up to 48%.

The following agricultural practices promoted by AAPI resulted in changes in GHG emissions:

Alternate Wetting and Drying (AWD): AWD is an irrigation technique for lowland rice involving periodic flooding and drying of fields. AWD reduces water and fuel consumption while decreasing greenhouse gas, namely methane, emissions. In irrigated rice, flooding submerges the field and leaves behind organic residual material in rice paddies. As organic matter undergoes anaerobic decomposition, it releases methane into the atmosphere. Periodic drying disrupts the duration of anaerobic decomposition, halving methane emissions.

Urea Deep Placement (UDP): UDP is a fertilizer practice in which the farmer places a urea briquette which is placed 7-10 centimetres below the soil surface, either by hand or with an applicator. UDP is cost effective for farmers as it requires less fertilizer while reducing nitrous oxides emissions and preserving and increasing yields. In AAPI, adoption of UDP was widespread.

Assessing the feasibility of low emissions practices: AWD and UDP

Research undertaken on AWD and UDP lead to multiple observations, highlighting not only the benefits but also the varying contexts of applicability and possible challenges to widespread adoption. While AWD accrued the most farmer and mitigation benefits per hectare, it is only feasible in certain areas and under certain irrigation regimes. To achieve widespread adoption of AWD, the study recommended assessments of the geographical suitability in the country context and probable barriers for farmer uptake. CCAFS, in collaboration with the International Rice Research Institute(IRRI) and the Government of Bangladesh, is currently analysing the geographic suitability of AWD and related LED practices for irrigated rice, barriers to farmer uptake and adoption of LED practices and interventions at meaningful scales, and potential incentives and enabling conditions. In a previous study of benefits and costs of mitigation technologies in paddy rice, CCAFS found that even within a country, variation exists in policies, practices and irrigation infrastructure which influences to a large extent, farmers' willingness and ability to adopt practices like AWD.Similar suitability studies and assessments within a country context are necessary to encourage widespread implementation of UDP.

Crop yield forecasts strengthen food security planning in Nepal

CCAFS Regional Agricultural Forecasting Toolbox (CRAFT) continues to help stakeholders make informed decisions in Nepal.

By Dhiraj Gyawali (WFP), Paresh B.Shirsath and Arun Khatri-Chhetri (CCAFS South Asia)

After facing a double digit slump in the previous years, Rupandehi district in Nepal, witnessed an escalation in wheat production this year, as a result of favourable weather conditions and widespread availability of farm inputs. The vagaries of the monsoon season which is infamous in the region for brining uncertainty to the agricultural sector, was predicted to be favourable this year, and one of the contingents making such foresight was the CCAFS Regional Agricultural Forecasting Toolbox (CRAFT).

The CCAFS Regional Agricultural Forecasting Toolbox (CRAFT) is an open source, flexible crop-forecasting platform which includes a crop simulation module, a weather and seasonal forecast module and a geographic information system module. This toolbox has been implemented in Nepal to forecast the yields of wheat and paddy since November, 2014. The first phase of the results suggests a strong agreement with the Ministry's estimates.The second phase of the implementation starting from January, 2017 with CRAFT v 3.0 aims to deliver yield forecasts at the sub-national level.

Upgraded tool

Recently, a new version of the CRAFT (v 3.0) has been released by CCAFS. As its predecessors, this version is also integrated with external engines including a crop modelling engine for spatial crop simulations and a seasonal weather forecasting module called the Climate Predictability Tool (CPT) developed by the International Research Institute for Climate and Society (IRI), Columbia, USA. As an upgrade to the second version, the latest CRAFT supports multi-crop model capabilities using the harmonized data format (ACE) and crop model data translation tools developed by the Agricultural Model Intercomparison and Improvement Project (AgMIP) in addition to the existing Cropping System Model (CSM) of DSSAT. The new model also seamlessly integrates the older CRAFT databases onto the latest version. CRAFT uses gridded data schemes for spatial variability through the use of two predefined reference grids of 5 arc and 30 arc minute resolutions and three spatial scales are considered at the country, state/province, and district levels depending on the schematization.

Based on the pre-defined inputs at each grid level and using the climate forecasts through seasonal predictors in CPT, the crop yields get estimated. Predicted yields are then aggregated for the area of interest at different spatial resolutions. CRAFT allows hindcast analysis, de-trending and post-simulation calibration of model predictions from historic agricultural statistics as well as comparison of the outputs among various scenarios and visualizations.

Future Prospects

The successful implementation in Phase-I has brought about a strong demand from the Government for sub-national scale forecasts. To achieve this ambitious target, a lot of additional efforts are required in coordination with relevant stakeholders within the Government as well as national / international research agencies. Besides, further research on climate aspects is deemed as highly important. Incorporation of the Department of Hydrology and Meteorology's (DHM) station data wherever possible, is also crucial. Another aspect identified for the next phase is the inclusion of reliable satellite estimates like Climate Hazard Group InfraRed Precipitation with Station data (CHIRPS) and Rainfall Estimator (RFE), after adequate blending with station data. Efforts are also being made in collaboration with the International Centre for Integrated Mountain Development (ICIMOD) to identify in season crop area in Nepal. Understanding the unavoidable risk of frequent turnover of state officials, the next phase for CRAFT is now being designed to meet the need for continued training to government staff and developing food-security analysts through regular mentoring of university professors and students. The Agriculture and Forestry University has expressed a strong commitment to include crop modelling in its graduate curriculum with CRAFT as a part of it.

Can remote sensing technology shape the future of crop insurance in India?

Advanced innovation in technology promises further improvements in climate resilient farming.

By Pramod K.Aggarwal, Paresh B.Shirsath and Sheshakumar Goroshi (CCAFS South Asia)

Indian farmers have since times immemorial been victims of the vagaries of weather and climate. Each year, varying patterns of rain, natural disasters like floods and droughts, bring forth different challenges for the farmers. Against this backdrop, crop insurance acts as a risk transfer mechanism and provides a safety-net to farmers in case of crop failure. Besides risk transfer, it enhances technology adoption, inputs usage and finally welfare of the farming community.

Issues in existing safety nets

Although deployed on field, some crop insurance schemes have not been able to produce optimum safety nets for the farmers. The Government of India recently launched a flagship scheme,the Pradhan Mantri Fasal Beema Yojna (PMFBY),an ambitious and affordable insurance scheme, through which crop insurance is slated to reach more than 60 million farmers. It is largely a yield index insurance scheme with the village as the insurance unit. It is pertinent to mention that under such schemes,crop losses are being estimated using Crop Cutting Experiments (CCEs) which are not only costly but also highly time consuming. Further, the monitoring, verification and compilation processes associated with it, lead to significant delays in settlement of claims adding to the farmer's vexations. Although efforts have been made to estimate yield loss over a large area using coarse resolution remote sensing weather and vegetation indices, the objective assessment of the technologies in agriculture insurance with the village as the insurance unit is yet to be done.

Improvised solutions

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) South Asia is testing different technologies such as remote sensing from unmanned aerial vehicles, space satellites with different resolutions, hand-held NDVI sensors, digital photography etc. for loss assessments in crop insurance. Technologies such as unmanned aerial vehicles are useful for various factors as they fill many crucial gaps in information acquired through satellites especially during the monsoon season with a marked cloud cover. Drone based imagery also helps in identifying the area discrepancies between insured and actual crop acreage besides providing high resolution images for crop loss assessments. Handheld NDVI sensors on the other hand proves to be very useful in carrying out rapid assessments and are cheaper than drones. Simple technologies like digital camera imagery capturing green bands and its subsequent utility in studying crop yields are also being explored. Field work for testing these technologies has been completed in the kharif and rabi season of 2016-17 with Soybean and Sorghum crops in four districts of Maharashtra with a diverse agro-climatological setup.The technological evaluation, data analysis, simulation and modelling activities are currently being done.

Expected Outputs

CCAFS, through these evaluations aims to assess these technologies individually and in conjunction with simulation and modelling techniques to develop a methodology to estimate yield loss at the smallest administrative unit.

Finally, recommendations will be made on the best possible and most cost effective solution for making accurate crop loss assessments at the village level for the larger benefit of the farming communities.

About CCAFS

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a research initiative seeking to overcome the threats to agriculture and food security in a changing climate. CCAFS invests in research to address the crucial tradeoffs between climate change, agriculture, and food security and works to promote more adaptable and resilient agriculture and food systems in five focus regions: South Asia,Southeast Asia, West Africa, East Africa and Latin America.

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