DESIGNING CS FARMING SY STEMS TOWARDS CARBON-NEUTRAL SUSTAINABLE AGRICULTURE IN ANDHRA PRADESH AND TELANGANA, INDIA

CASE STUDY PROGRESS REPORT

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Andhra Pradesh and Telangana, India

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Background

Worldwide, agriculture both contributes to and is sensitive to climate change impacts as well as threatened by climate change. As per estimates about three-fourths of the total emissions from agriculture and land use, originate in the developing countries. Agriculture accounts for 13.5% of global greenhouse gas (GHG) emissions or about 1.8 Gt carbon equivalent/year or 6.6 Gt of CO_2 equivalent/year, mainly in the form of methane (CH_4), and nitrous oxide (N_2O) from fertilized soils, enteric fermentation, biomass burning, rice production as well as manure and fertilizer production. Agriculture and forestry capture a great deal of carbon absorption and fixation through photosynthesis, and thus offer a solution to climate change. The FAO Profile on Climate Change-2009 notes that agriculture has the technical potential to mitigate between 1.5 and 1.6 Gt C equivalent/year (5.5-6.0 Gt of CO_2 equivalent/year), mainly through soil carbon sequestration in the developing countries. Gauntness Studies estimated that there would be at least 10% increase in irrigation water demand in arid and semi-arid region of Asia with a 1°C rise in temperature. The recent report from the Intergovernmental Panel on Climate Change (IPCC) highlights that as one of the most densely populated regions in the world, South Asia is among the most vulnerable spots to climate change and climate variability. In the absence of adaptation and mitigation, climate change can have major consequences on food security and development in the decades to come.

Business-as-usual scenarios of population growth and food consumption patterns indicate that agricultural production will need to increase by 70 percent by 2050 to meet global demand for food. Thus, climate change could result in the increased demand for irrigation water, further aggravating resource (water, nutrients, energy) scarcity. The impacts of climate change will reduce productivity and lead to a greater instability in production in agricultural sector (crop and livestock production, fisheries and forestry) in communities that already have high levels of food insecurity and environmental degradation and limited options for coping with adverse weather conditions. In the region, the inefficient use and mismanagement of production resources, especially land, water, energy and agro-chemicals, have vastly impacted health of the natural resource base resulting into global warming led climatic variability.

Several climate-smart agricultural practices (CSAPs) developed, refined and tested by several agencies and research organizations, demonstrated improved productivity, resilience and adaptive capacity for different commodities and agro-ecological zones within the region. However, the perception of farmers on climate vulnerability and responses of the CSAPs vary with bio-physical and socio-economic diversity of farm households. The lack of integration of bio-physical and socio-economic knowledge in technology targeting, limits the large-scale adoption by diaspora of farmers specially marginalized and women farmers. Therefore, development and targeting portfolios of CSAPs require in-depth understanding of the diversity of farming practices, and assessment of various interventions on the adaptive capacity of farming community as well as food security. With this background, a pilot project was developed with following activities.

Major activities

1. Identifying the contrasting, but representative locations for the study, and characterizing them in biophysical and socio-economic terms. Locations, where interventions are intended need to be representative of specific agro¬ecologies to be able to scale main findings. When applied to contrasting agro-ecologies, the potential of the approach is put to test–an important element for scaling it. Characterization of pilot sites will include (i) biophysical characteristics (soil characteristics and topography, climatic and weather variables, water bodies and natural vegetation); and (ii) socio-economic characteristics (population, main economic activities, farmers' organizations, policies, urban settlements and markets). Characterization of locations will include a generic characterization of the: farming systems, main crops produced, animals reared, main challenges they face in relation to climate change and climate variability, and opportunities to reduce their carbon and water footprints. Desk study and participatory tools such as semi-structured interviews and focus groups will be used in this activity.

2. Designing and applying adapted household survey to understand the diversity of farming systems in each location. A household survey will be designed covering the relevant features of each location to understand functioning of different agricultural systems to understand the diversity of farming systems. Survey will include basic household characteristics, their resource endowment and the way those resources are managed including crops and livestock, inputs and outputs of agricultural activities as well as off and non-farm activities carried out by different members of the family. Special emphasis will be given to identify those households where disadvantage segments of the populations are present due to gender, age, ethnicity or any other marginalization factor.

Base line study design

- The data requirement is high compared to other technology adoption/impact studies, as water and carbon footprints are measured alongside the income of farmers. To avoid measurement errors in the detailed household survey, more focus is required on data collection (data quality, monitoring of surveys etc.), and sample size shall be adjusted accordingly. Hence sampling size and strategy is critical for the study.

- The possible applicable approach will be to subdivide study districts into clusters based on agro-ecological conditions. From each cluster, villages will be selected (randomly, preferably) for the intervention.
- Interaction with local experts and remote sensing data will be used to generate village clusters.

- If a district is divided into two dusters, about 10 villages will be selected from each cluster (around 50% as intervention, 50% as control).
- It is important to designate villages as control and intervention before starting the survey work.
- From two districts, the sampling procedure would yield about 40 villages (assuming two clusters per district, and 10 villages per cluster).
- After the village selection, focus group interviews will be conducted to get more data on village characteristics (distance to dealers and extension office, type of soil, abiotic and biotic risks, non-farm employment opportunities, etc.).
- The list of farm households residing in these villages will be obtained from the village Panchayat, and the identification of farmers will be made through consultation with village elders.
- About 15 households will be selected per village (i.e., 600 households in total) for the baseline survey. A Computer Assisted Personal Interview (CAPI) software shall be used for the data collection.

3. Analyze datasets from household survey to capture diversity of farming systems and define relatively homogeneous groups of farming systems through typologies. Data from survey will be processed through multivariate statistics (e.g. principal component analysis and hierarchical clustering) to identify relatively homogeneous and significantly different types of farming systems in relation to their resource endowment, and the way they manage those resources. Participatory typology methods will be combined with statistical methods to ensure the appropriate representation of diversity of such farming systems.
4. Identifying and quantifying the agronomic and environmental performance of current agricultural practices as well as locally adapted climate smart alternatives. The performance of current and alternative crop and livestock practices (including forage and crop residue management as well as manure) will be quantified through different technical, economic and environmental indicators, for example, yield, labor productivity, economic profitability, water use efficiency, greenhouse gas emissions, soil conservation. The technical coefficients to quantify such indicators will come from mixed sources including field experiments, measurements in farmers' field, data from the household surveys as well as specific models and expert knowledge.
5. Target technologies to different types of farming systems through modeling and participatory research. Based on the main challenges and opportunities identified (Activity 1); the main features of the different types of farms (Activity 3); and the analysis of the technical performance of current and alternative crop and livestock practices (Activity 4), targeted alternatives will be designed through integrated multi-criteria analyses at the farm household level. This will help know the best fit for different groups of farming systems, and develop specific implementation strategies and pathways for each type of farming system. Participatory methods to assess the feasibility of the proposed alternatives are needed to ensure successful implementation.

Key deliverables

- Survey design and final methodological toolkit
- Training of field team for baseline survey
- Baseline survey report
    - General biophysical and socio-economic characterization
    - Climate risks and vulnerability assessment
    - Current water and carbon footprints of the area
    - Potential water and carbon saving targets possible for both locations
    - Report on farming system typologies of the pilot sites
- A list of climate smart agricultural practices for the pilot sites
- Report on technology targeting to different types of farming systems
- Training on climate smart agricultural practices
- Technical backstopping of DRF team for implementation of climate smart agricultural practices at the pilot sites
- Monitoring and evaluation template methodology for monitoring of interventions implemented on field
- Project monitoring and evaluation template

Key issues

- Agriculture is the second highest contributor to GHG emissions at 19.6% of total emissions, and is also highly vulnerable to climate change.
- Lack of awareness about the importance of adoption of climate smart interventions.

Current challenges

- Supporting farmers to adopt new climate smart agricultural practices while increasing yield and reducing production costs.
- Difficulty in conducting on-field training and capacity building of staff and community members.
- Delays/uncertainty in piloting demonstrations due to logistical issues caused by COVID-19 lockdown restrictions.
- Farmers are not aware about new technology.
- The size of the fields is too small because fields are not leveled.
- Zero tillage machine is very old, which is not working properly.

Meetings and training of farmers

Conducted meetings and trainings with group of farmers in selected villages of Srikakulam district, Andhra Pradesh through demonstration of different interventions i.e. zero tillage (ZT), direct seeded rice (DSR), laser land leveling (LLL), leaf color chart (LCC), green seeker (GS), multi nozzle boom sprayer (MNBS) and machines calibration. During the visit of farmers' field, discussed with farmers' group in selected villages with field staff of Dr Reddy's Foundations (DRF). The major cropping systems are maize-maize and rice-maize where the farmer's field size is very small comparatively. We distributed required implements to small holding farmers, and trained them about LCC, GS and MNBS with DRF field staff. Also visited progressive farmers' field with DRF field staff and planned about the *rabi* sowing crop and shared the data collection sheet and urea calculator.

Similarly, visited farmers' field of Nalgonda district, Telangana to see the DSR crops and discussed about the problems faced by them. Many problems were observed regarding field situations and machines. The LLL was shifted from Raichur to Nalgonda District, and tractor drivers, DRF staff and farmers were trained. Farmers and DRF staff were also trained for using the LCC, green seeker, weedicide nozzles, and in calibration of machines. Datasheet and urea calculator were shared with farmers and DRF field staffs.

Future action plan

- ZT sowing of green gram, maize, cowpea, and black gram in upcoming *rabi* season.
- Providing two ZT machines to village farmers group.
- Providing one dibbler to small holding farmers.
- Providing two green seekers to village farmers group.