



## Food system transformation CRoP – Climate Resilience of Production

### The issue

**Confronting the challenge of reducing hunger in times of COVID-19 is aggravated by the need of strengthening the capacity of all actors within the agriculture sector and making climate change adaptation solutions readily available to farmers without the physical presence of extension advisors.**

- While COVID-19 headlines have eclipsed climate change, the planet has not stopped warming or experiencing erratic rainfall patterns. Crop yields are highly sensitive to climate and most affected farmland is in already food-insecure developing countries. As climate changes, crops and production practices must change too.
- Restrictions to movement and gatherings to reduce the spread of COVID-19 impair agricultural extension advisors to reach out to farmers and train them one-on-one, through farmer field schools or field days. This leaves farmers and smallholders, already among the poorest and most vulnerable, the worst affected by the current pandemic and climate impacts.
- Lack of coordination among the individuals and organisations that demand and supply knowledge in agriculture results in incoherent adaptation measures on farms. The barriers to knowledge sharing among national extension service, the staff of development projects, private agribusinesses stakeholders created by COVID-19 take us away from the sector's goal to meet markets' growing food demand and achieve the 2030 Agenda for Sustainable Development.

**The current agricultural extension service system is unable to meet this new demand, and it will require evidence-based coordinated actions, renewed capacity and innovative information delivery mechanisms:**

- **Sector-wide coordination of actions is what assures mutually supportive policies, coherent research investments, incentives, agronomic management practices and technologies on farm in response to a warming climate in times of COVID-19.**  
Coordination is possible when all stakeholders working in agriculture and climate sciences have the same level of understanding and collaborate. Strengthening the capacity of all actors dealing with climate change, agricultural development, and food security is essential to ensure that countries overcome knowledge gaps limiting their capacity to identify pathways for policy and investment interventions needed to enact successful changes / transitions. These include farmers' subsidy programmes coherent with climate-smart crop production and public-private partnerships promoting business opportunities for sustainable mechanization in rural areas.
- **Using artificial intelligence, remote sensing and modelling to analyse large amounts of data is an effective way to develop new evidence in agriculture while respecting distance and safety measures.**

### Budget

USD 2.8 million  
(USD 2.8 million for a prototype in 3 years, 1 climatic zone, 3 crops – USD 8.5 million for a validated tool in 5 years, 2 climatic zones, 6 crops)

### Time frame

2021–2023

### SDGs



### Related FAO policy briefs

- ▶ [Data for decision-making to Food Systems and Zero Hunger](#)
- ▶ [Boosting Smallholder Resilience for Recovery](#)
- ▶ [Sustainable crop production and COVID-19](#)
- ▶ [Impacts of COVID-19 on agriculture: Italy's response](#)



Generating information for specific analyses is the first key step towards evidence-based advice to help farmers minimize crop failure risk.

Artificial intelligence and remote sensing make it possible to analyse near real time climate, weather and agricultural data and generate new evidence base respecting measures taken to control the pandemic.

- **Digital tools allow new ways to develop capacity and deliver information to farmers possible.**

Making educational content available through distance learning networks is a cost effective way to break the physical barriers caused by COVID-19 restrictions and open up new capacity development opportunities allowing scientists, students, and public, private and project-based rural advisors to learn from everywhere and with continuity.

Providing timely and specific advice to farmers through a mobile phone application can help them to quickly adapt their crop systems and agronomic practices in the absence of extension advisors and optimize crop yields and profits in a changing climate.

This proposal aims to address the three components of a responsive plan to strengthen crop production in times of COVID-19 and climate change.

## The action

- 1 **Creating a global taskforce for Climate Resilience of Production (global CRoP taskforce) to ensure coordination of actions from global to country and farm levels.**

The taskforce will connect international centers of excellence and national universities, working in the area of climate-smart crop production, with national rural advisory services of the Department of Agriculture of beneficiary countries and private sector companies (distributors, seed and fertilizer companies). This triangulation is important to ensure countries' state of the art capacities in the coordination of the activities. The taskforce will coordinate the following activities.

- 2 **Developing the evidence base to minimize crop failure risks on farms.**

The crop varieties most adapted to a given location and the most suitable planting date will be identified through a blended approach involving artificial intelligence (machine learning), remote sensing, modelling, expert knowledge and field work -compatible with social distancing- at the country level.

**Step approach to generating and managing new evidence base – How does it work?**

- National agro-ecological regions' map updated using observed climate and soil data.
- Interactive map developed linking each location with the crop varieties most adapted to climate, pests and diseases, and markets.
- Climate (past), soil moisture (real time) and weather (forecasts) data combined to inform farmers of levels of risk of planting on a given date (crop failure risk).

- Most suitable crop varieties for each agro-ecological region preselected based on expert knowledge.
- Varieties field tested in multiple sites in each agro-ecological region.
- Iterative validation and calibration of the model based on observed data.

The evidence from the experimental work will be used to develop harmonized agronomic guidelines for different climates in line with the principles of sustainable crop production promoted by FAO's Plant Production and Protection division (NSP). Specifically, this information will be used to develop curricula and also translated into high quality agronomic advice to farmers.

- 3 **Delivering digital agronomic content to train trainers and advise farmers from distance.**

Courses to strengthen the capacity of scientists, graduate students, and public, private and project-based rural advisors on climate-smart agronomic practices will be delivered online to ensure access despite COVID-19 movement and gathering restrictions. The content will be accessible also offline to provide in-field training and educate farmers, rural advisors and farm facing organizations on climate change when COVID-19 related restrictions will ease.

The results of the experimental work will be also made available to farmers through a risk prediction mobile phone application. This will help farmers make informed decisions about planting in the absence of a rural advisor. Depending on circumstances, additional outlets for dissemination of the information will include SMS / TV / radio / print.

## Expected results

- 1 **Global CRoP taskforce established** connecting academic and research centers of excellence in the area of climate-smart crop production with local universities of beneficiary countries.

- 2 **Agronomic recommendations about planting of given crops developed for given climatic conditions and common understanding of climate-adapted solutions achieved sector-wide.**

Harmonized guidelines on climate-smart solutions for crop production will ensure coherent actions in the field by all stakeholders working in agriculture in beneficiary countries.

- 3 **Capacity of stakeholders operating in agriculture strengthened and crop failure risks at planting minimized for thousands of farmers.**

Using the application, farmers will be able to choose the most adapted crop varieties and decide when is the best time to plant them. They will also be able to request mechanised planting services, making it easier for small rural entrepreneurs to reach out to customers. Additionally, local agribusinesses will be able to ensure quality seed availability of the varieties most adapted to local conditions. And seed companies will be able to distribute the most appropriate varieties to each location and keep on the market those that perform best.



## Partnerships

In order to ensure technical soundness, effectiveness and profitability of the sustainable crop production intensification practices, a global task force led by FAO's Plant Production and Protection Division (NSP), will connect centers of excellence in the area of climate-smart crop production and local universities of beneficiary countries:

- Council for Agricultural Research and Economics (Italy).
- Università Cattolica del Sacro Cuore: University Centre for International Solidarity; Transdisciplinary Research on Food Issues Center (Italy).
- Università degli Studi di Firenze: Department of Agriculture, Food, Environment and Forestry (Italy).
- Wageningen University & Research: Department of Wageningen Environmental Research and Wageningen Plant Research (The Netherlands).
- The Pennsylvania State University (United States of America).
- CGIAR Excellence in Agronomy 2030 initiative.
- African Conservation Tillage Network (Africa-wide).
- One university to be selected in each beneficiary country.
- One national agricultural research centre / institute to be selected in each beneficiary country.
- National rural advisory service in each beneficiary country.

Within FAO, a task force led by NSP, will be created with colleagues from Office of Climate and Biodiversity (OCB), Land and Water Division (NSL), Research and Extension Unit (OINR) and Food Systems and Food Safety Division (ESF). Its objective will be to streamline within the house field level solutions as well as possible pathways for policies and investment interventions suitable for each environment / region / country in which the project will operate. This will maximize FAO's impact in support of the countries because it will leverage NSP's usual collaboration with the Ministries of Agriculture in country counterparts and OCB's relations with the Ministries of Environment.

## Programme Links

- 1 The proposed project links directly to FAO's global goals of: *Eradication of hunger, food insecurity, and malnutrition; Elimination of Poverty; Sustainable management and utilization of natural resources.*
- 2 With regard to the new proposed outline of FAO's Strategic Framework 2022 - 31, the project applies all four cross-cutting/cross-sectional accelerators: *technology, innovation, data and complements (governance, human capital, and institutions)*, and it addresses specifically FAO aspirations regarding *Better production and Better environment.*
- 3 The project builds upon the achievements of the [GCP/INT/259/GER project](#) on artificial intelligence best-practices in agriculture.

The project is developing a [prototype](#) of a digital tool using high resolution climate and weather data to perform near real time analyses and provide useful and actionable information for on-farm decision making for maize production in Zambia: choose most adapted maize varieties; help identifying best day for planting. The partners for this activity are: The Pennsylvania State University, Zambia Agriculture Research Institute, University of Zambia.

- 4 The collaboration with The Pennsylvania State University is in support of MOU 222384 through which FAO's Plant Production and Protection Division (NSP) and the Service Provider have agreed to cooperate for the common goal of improving extension advice to farmers.

## Regional and Country focus

Developing solutions for tropical, subtropical and dryland crop systems can benefit the economic and food security well-being of millions of most vulnerable farm households.

While prioritizing these climates, it would be possible to address other climatic zones too.

The table below illustrates a selection of countries, some of which present topographic- or latitude-induced climatic variations which would make it possible to work in multiple climatic zones with the same country team and thus optimize costs.

		CLIMATE			
		TROPICAL	SUBTROPICAL	TEMPERATE	DRYLANDS
COUNTRIES	Senegal	•			•
	Ethiopia	•		•	
	Myanmar	•	•		
	Zambia		•	•	

The geographical scope of the activities will be decided based on the priorities of the organization, the availability of preexisting data, and the costs to collect / produce them.

## Budget

USD 2.8 million (USD 2.8 million for a prototype in 3 years, 1 climatic zone, 3 crops - USD 8.5 million for a validated tool in 5 years, 2 climatic zones, 6 crops).

**By design, this project has the potential to develop a global toolkit of COVID-19 responsive solutions to increase the resilience of crop systems in different climates. Its modular approach allows to tailor it to the resources available and stakeholders' priorities, depending on which FAO with its taskforce partners will identify the countries, the crops (species, varieties) and their number.**



Costs for the identification of adapted varieties commercially available and of related adaptation practices for 1 crop species in 1 climatic zone depend on the timeline and robustness of field calibration and validation. Central to the methodology is the field work, which can be undertaken only during the agronomic season.

The higher the number of replicates, the more robust the model. Some climates offer only 1 agronomic season per year. In this case, 2 - 3 years would be sufficient for a prototype and 5 years for a crop validated model. Reducing the time is possible, and it would require to undertake the field work on a wider area in either the same or other countries in the same climatic zone.

The first crop will be the most costly in relative terms. For additional crops, costs per species per country will be

lower because it will be possible to optimize the costs for data collection. Therefore adaptation solutions for crop systems of, for example, 1 traditional staple crop (often a cereal or root crop), 1 staple diversification alternative and 1 rotational crop (e.g. a legume crop) can be developed at a cost range between around 1 and 4.2 million USD per climatic zone depending on the level of robustness of the analyses.

The budget overview table in this section provides purely indicative cost estimates for the development of a digital tool for 1, 2 and 3 crop species. A more accurate budget will be developed at project appraisal, after having identified the country/ies, the number of sites, their extent, the crop/s, the amount and type of inputs (seeds, fertilizer, equipment ecc.), as well as the costs for transport and man days for data collection.

**A prototype can be developed in 3 years. It requires field work in at least 2 countries (and 3 – 4 sites) in the same climatic zone** (tropical / subtropical / temperate / drylands). The table below presents the yearly costs occurring at year 1, 2 and 3 to develop a prototype-level tool for 1 climatic zone and 1, 2 and 3 crops.

**A validated digital tool can be developed in 4 – 5 years.** The table below presents the costs for 1 climatic zone for 1, 2 and 3 crops and field validation in multiple sites in 4 countries. Costs are provided for 1 year of activities and refer to year 4 and 5.

**All combinations between a 1-crop prototype to a full-fledged validated digital tool for multiple crops are possible because additional components can be built in over time.**

	TOT COST (USD) per year per climatic zone			COST (USD) for Activities 1-2			COST (USD) for Activity 3		
	1 <sup>st</sup> crop	2 crops	3 crops	1 <sup>st</sup> crop	2 crops	3 crops	1 <sup>st</sup> crop	2 crops	3 crops
<b>PROTOTYPE – YEAR 1</b>	700 000	850 000	1 000 000	450 000	550 000	650 000	250 000	300 000	350 000
<b>PROTOTYPE – YEARS 2 &amp; 3</b>	650 000	800 000	900 000	300 000	400 000	500 000	350 000	400 000	400 000
<b>▶ TOT COST prototype in 3 years</b>	2 000 000	2 450 000	2 800 000						
<b>VALIDATED TOOL – YEARS 4 &amp; 5</b>	400 000	550 000	730 000	250 000	350 000	450 000	150 000	200 000	280 000
<b>▶ TOT COST validated tool in 5 years</b>	2 800 000	3 550 000	4 260 000						

## Contact

Plant Production and Protection Division – Natural Resources and Sustainable Production  
[NSP-Director@fao.org](mailto:NSP-Director@fao.org)

**Food and Agriculture Organization of the United Nations**  
 Rome, Italy

