

Developing and accessing adaptation strategies against climate vulnerability in cotton wheat cropping system Punjab, Pakistan

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Abstract

Agricultural production systems are complex, interlinked and highly dependent on natural ecosystem regarding resource acquisition. The policies must have synergy effect with climate change for the better adaptive capacity of nation. The objective of the stakeholder part in climate change research is vital and aimed at how we can make “Science easier to uptake” by different stakeholders for better adoption of proposed adaptations. The approach used in the research for engagement purpose was “Demand Driven” Approach. All the stakeholders including farmers, researchers, policy makers and academicians were helpful in formulation of adaptation package, RAPs and refinement of the project findings.

Agricultural policy must consider global food security as a challenge in the presence of climate change, water scarcity, the energy and financial crisis. Developing world must focus on fundamental human needs of food and fibre and try to eradicate the extreme poverty, hunger and inequality in masses. The escalating global food demand is expected to reach at 9.1 billion in 2050 and more than 10 billion by the end of century, this requires a centralized policy in the world and major changes in agricultural production systems. Crop yields can be improved by sustainable management practices, without degrading the soil and water resources of world. Sustainable practices at the same time beneficial for reducing GHG emission and carbon sequestration and contribute in protecting our climate (Nasir *et al.*, 2019).

Climate change is evident phenomena and global policies must be formulated to combat this challenge in future agricultural production systems. Adaptations are that process by which countries, communities and individuals found ways to manage the climate change impacts (Rurale *et al.*, 2021). Adaptation is a continuous process, and farming community continuously adapt the changes in Climate, but these adaptations are not centralized and focused. There is need to find out the Adaptations for specific region and time and try to enhance the adaptive capacity of farmers so that they can better respond to climate change, hence fight climate vulnerability (Ahmad *et al.*, 2019). Crop production is climate prone sector of the economy. Anticipation and adaptations of all these impacts of climate change is very important tool for the developing economies. There are certain planned and unplanned adaptations regarding climate vulnerability in agricultural systems that maintain the balance in ecosystem and minimize the economic losses. So, the entire engagement process was based upon the demand of the stakeholders. To start with the engagement process stakeholders were prioritized according to the

importance for the research domain, power-interest dimension, proximity, urgency and relevance of stakeholders. The identified stakeholders were policy makers, farmers, researchers and peer groups (influential to society in decision making process). Among these, two stakeholders found most relevant to the project outcomes and they were farmers and policy makers. Farmers were more interested in knowing about the adaptations and policy makers wanted to know about future scenarios. The needs of stakeholders helped us in making plans of refinement and interpreting our findings (Nasir *et al.*, 2020).

Designing the Adaptation Package regarding climate change by stakeholder engagement process

To minimize the climate losses there can be adaptation strategies on farm level as well as on national and policy level. To access the benefits of adaptations we formulated the adaptation packages through continuous engagement process with researchers, farmers and policy makers to combat the current and future climatic vulnerabilities. First session was organized for the expert opinion regarding adaptation strategies that are helpful in fields regarding climatic changes. Second meeting was held with progressive farmers at field for practical field issues and adaptation measures. Third session was held in Ayub Agricultural Research Institute (AARI) to attain their suggestions regarding current and future adaptations. Wide range of adaptation strategies were shared by team members and get their feedback on every aspect. For current and future climatic vulnerabilities different short term and long-term adaptations were compiled in which biophysical, socioeconomic and policy parameters were assessed. Important adaptation parameters for future were genetic improvements, draught resistant and heat

tolerant varieties, deep tillage, soil and water conservation practices, construction of water storage, efficient irrigation systems, crop diversification, agricultural insurance and farm mechanization (mechanical picker for cotton). For current adaptations regarding climatic hazards are increase in cropping intensity, fertigation, efficient irrigation and import of gene variety. The adaptation package was shared with crop modelers for their input. The challenges regarding engagement were to formulate adaptation package that can be incorporated in the modelling by crop modelers. The practicability of adaptations was also an issue that was tackled with farmers and field researchers' feedback regarding adaptations.

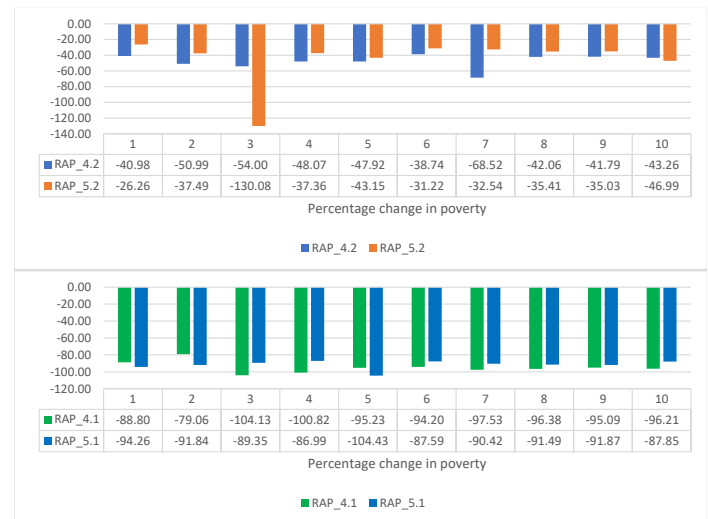
Figure 1. Proposed Adaptation strategies for Cotton Wheat Cropping System

Proposed Adaptation strategies for Cotton Wheat Cropping System	
Biophysical Adaptations	Development of virtual cultivars (Draught & heat tolerant varieties, short duration varieties), ensuring recommended plant population (seed rate, no of plants), Improved agri. Practices from sowing to harvesting (fertigation, Balanced fertilizer, Drainage), Efficient irrigation practices (Drip Irrigation), Changes in cropping patterns, Soil reclamation projects
Socioeconomic Adaptations	Construction of water storage, Crop diversification, Participatory Management Approach, Increasing the Off-farm income opportunities, Population control measures, Agro-forestry, Fisheries and Livestock Farms
Institutional and Policy factors	Agricultural insurance/finance, Farm mechanization (mechanical picker for cotton), Subsidies/Taxation, Input/output price policies, Trade, off-farm employment, Efficient Input/output markets, Govt. investments in agriculture (Infrastructure, R&D), Supportive trade policies, Farm consolidation

Socioeconomic impacts of adaptation package on farm household

The results shows that there would increase in net returns due to proposed adaptations, that will increase per capita income and reduce the poverty. The reduction in Poverty is evident in all climate scenarios for all RCPs and RAPs.

Figure 2. Percentage Change in Poverty due to Adaptation regarding Climate Change under RAP4.1, 4.2, 5.1and 5.2 for APSIM and DSSAT

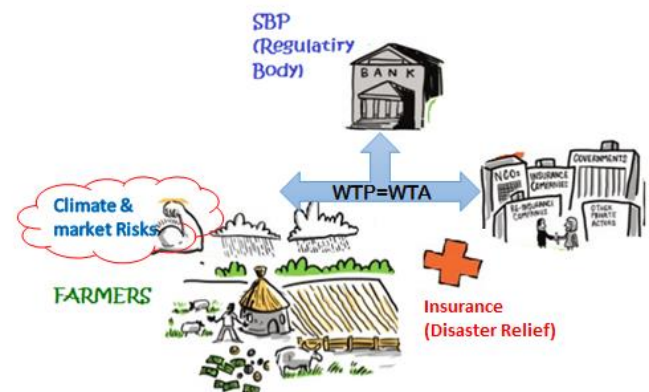


Data source: (Nasir *et al.*, 2019).

Policy recommendations / conclusions

The research findings evident the importance of stakeholder inclusion in research process and the continuous engagement faster the pace of adoption. The research must include all possible stakeholder (farmers, policymakers, researchers and consumers) interactions for better implementations of proposed interventions. The climate change is complex phenomenon that has vital impacts on farming community the adaptations like genetic cultivar improvement, high efficiency irrigation method, farm subsidy, financial support, insurance policies, improved farm practices could play important role to equip farmers to sustain farming in challenging world.

Figure 3. Insurance as financial intervention for climate change adaptation in Pakistan



Data source: (Nasir *et al.*, 2022)

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