COUNTRY REPORT
SCOPING STUDY CLIMATE
SMART RICE
PAKISTAN

Promoting Global Best Practices and
Scaling of Low Emissions Technologies by
Engaging the Private and Public Sectors in the
Paddy Rice Sector

April 2021
COUNTRY REPORT
SCOPING STUDY CLIMATE SMART RICE
PAKISTAN

Promoting Global Best Practices and Scaling of
Low Emissions Technologies by Engaging the Private and
Public Sectors in the Paddy Rice Sector

April 2021
This study was financed by Climate and Clean Air Coalition (CCAC) initiative
https://www.ccacoalition.org/en

**Author**
Arjumand Nizami, PhD
Helvetas Swiss Intercooperation
https://www.helvetas.org/en/switzerland

**Contributors**
Shahrukh Khan
National Coordinator WAPRO, Helvetas Swiss Intercooperation Pakistan

Ali Imran Sheikh
Sourcing manager, Galaxy Rice Mills Pakistan,

Zafar Iqbal
Head, Smart Farmer Community Programme, Rice Partners Limited Pakistan

Munawar Khan Khattak
Agriculture specialist, Helvetas Swiss Intercooperation Pakistan

**Institutional Support**
Makiko Yahiro
Programme Officer/Regional Coordinator for Ecosystem Management Sub-programme
UN Environment's Regional Office for Asia and the Pacific (ROAP)

Marie-Yon Strucker
Project Consultant
UN Environment's Regional Office for Asia and the Pacific (ROAP)

W. Wyn Ellis, PhD
Executive Director
Sustainable Rice Platform (SRP)

Jens Soth, PhD
Senior advisor commodity projects
Helvetas Swiss Intercooperation Switzerland

**Members of Advisory Committee**
Anjum Buttar, PhD
Director General, Agriculture Extension Department, Government of Punjab

Shahid Tarar
Managing Director, Galaxy Rice Mills Pakistan

Arif Goheer
Senior Scientific Officer, Global Change Impacts Studies Centre, Ministry of Climate Change, Islamabad

Jawad Ali, PhD
Climate change and Water specialist, Helvetas Swiss Intercooperation

**Designer**
Salman

**Photos**
Tahir Saleem

The content of this report may be used for furthering research and development on climate smart rice with proper citation

**Recommended citation:**
# Table of Contents

Acronyms 6  
Executive Summary 7  

## 1. Background 9  
1.1 Introduction to the scoping study and objectives 9  
1.2 Rice sector in Pakistan 11  
1.3 Key definitional parameters in climate smart rice production 12  
1.3.1 Mitigation and Adaptation 12  
1.3.2 Short Lived Climate Pollutants (SLCPs) 12  
1.3.3 Alternate wetting and drying in rice cultivation 14  
1.3.4 Sustainable Rice Platform Standard (SRP) 15  

## 2. Approach and methodology for the study 17  
2.1 Desk Review 17  
2.2 Interviews and Focus Group Discussions 17  
Stakeholders’ consultation workshop 19  

## 3. National context of climate change 20  
3.1 Agriculture and water sectors 20  
3.2 Emissions from agriculture sector in Pakistan 22  
3.3 The Rice sector and emissions 23  

## 4. Policy landscape on adaptation and mitigation 24  
4.1 National policies / strategies 24  
4.1.1 National Climate Change Policy 2012 and Act 2017 24  
4.1.2 The National Water Policy 2018 25  
4.1.3 National Food Security Policy 2019 26  
4.1.1 The National Environment Policy 2005 26  
4.2 Provincial policies / strategies 26  
4.2.1 Provincial climate change policies 26  
4.2.2 Provincial agriculture policies 27  
4.2.3 Provincial water policies 27  
4.3 Policy gap analysis 28  

## 5. Actors’ analysis and perspectives in Pakistan’s rice sector 29  
5.1 Farmers 29  
5.2 Public sector duty bearers 29  
5.2.1 The provincial actors 30  
5.2.2 Federal actors 31  
5.3 Private sector 32  
5.3.1 Rice export companies / millers and their association 32  
5.3.2 Service providers 34  
5.3.3 Middlemen / arhtees 35  
5.4 Academia and research actors 35  
5.5 International development actors 36  

## 6. Actors' participatory initiatives in the field 38  
6.1 Water Productivity in Commercial Agriculture (WAPRO) 38  
6.2 Prime Minister's initiative on productivity enhancement of rice 38  
6.3 Transforming Indus Basin with Climate Resilient Agriculture & Water Management 38  
6.4 Initiatives to improve irrigation infrastructure. 39  
6.5 Lessons learned from different initiatives 39  

## 7. Stakeholders’ perspective - Issues that need to be addressed. 41  
7.1 Lack of research and evidence on low emission progress 41  
7.2 Improved governance regime and actors’ engagement 42
7.2.1 Readiness among actors within agriculture sector 43
7.2.2 Capacities in climate smart agriculture 45
7.2.3 The SRP Standard needs to be promoted 45
7.2.4 Diagnose and plan for addressing existing research gaps 47
7.2.5 Policy issues 47
7.2.6 Views of stakeholders concerning cornerstones of the project strategy 48

Farmers' perspective and socioeconomic analysis 50

Proposed intervention packages in SLCP 55

Barriers is application of SLCP packages 57

ANNEXES
Annex 1: Literature reviewed 59
Annex 2: Checklist for KII’s for farmers’ interviews 64
Annex 3. Checklist for KII’s with stakeholders 66
Annex 4: List of stakeholders’ interviewed for the study 67
Annex 5: Participants of consultation workshop 69
Annex 6: Stakeholders’ map for the study 70
Annex 7: Sustainable Rice Platform Standard 73

List of Tables
Table 1: Inventory of GHG emissions (in MT - CO2 equivalent). Source: GoP 2016 22
Table 2: Key opportunities and gaps in national / provincial policies for GHG mitigation in agriculture 28
Table 3: Why should stakeholders adopt or encourage the SRP Standard? 46
Table 4: Key barriers identified by farmers in adopting water saving technologies 53
Table 5: Which technologies are most favoured by farmers 53

List of Figures
Figure 1: Pakistan rice statistics (area and yield) – 2019 11
Figure 2: Global methane emission by sectors (2015) 13
Figure 3: Regional trends in methane emission (million metric tonnes of methane) 14
Figure 4: How does AWD work? 15
Figure 5: Relative weighting per theme in SRP Standard 16
Figure 6: Sample size by contractual status 17
Figure 7: Sample size by provinces 18
Figure 8: Sample size by gender 18
Figure 9: Sample size by land holding and area under rice (acres) 18
Figure 10: Type of stakeholders interviewed 19
Figure 11. Emissions from various sectors. Source: GoP 2010 22
Figure 12: Pakistan rice statistics: Area against yield (2019) 44
Figure 13: Source of Irrigation - average (%) 50
Figure 14: Source of irrigation by province (%) 51
Figure 15: Awareness on water saving technology (average %) 51
Figure 16: Awareness on water saving technology 52
Figure 17: Use of water saving technologies for cultivating rice (%) 52
Figure 18: Use of water saving technologies for cultivating rice 52
Figure 19. Entry points for SLCP interventions 55
Figure 20. Indicative SLCP Packages and Interventions 56
Figure 21. Potential barriers to be considered in rice sector and future interventions 57
Acronyms

AWD  Alternate Wetting and Drying
AFOLU  Agriculture, Forestry and Other Land-Use
CCAC  Climate and Clean Air initiative
CO2  Carbon Dioxide
COP  Conference of Parties
CH4  Methane
CO  Carbon Monoxide
CSA  Climate Smart Agriculture
DSR  Direct Seeded Rice
FAO  Food and Agriculture Organization
GCISC  Global Change Impact Studies Centre
GHG  Green House Gas
GOP  Government of Punjab
UNEP  United Nations Environment Programme
SLCPs  Short-Lived Climate Pollutants
NDCs  National Determined Contributions
SRP  Sustainable Rice Platform
IPPU  Industrial Processes and Product Use
IRRI  International Rice Research Institute
PhilRice  Philippines Rice Research Institute
MoCC  Ministry of Climate Change
MoNFSR  Ministry of National Food Security and Research
NAMA  Nationally Appropriate Mitigation Activities
NCCP  National Climate Change Policy
N2O  Nitrous Oxide
NWP  National Water Policy
OFWM  On-Farm Water Management
SDC  Swiss Agency for Development and Cooperation
SDG  Sustainable Development Goals
PKR  Pakistani Rupees
RPL  Rice Partner Limited
SIAPEP  Sindh Irrigated Agriculture Productivity Enhancement Project
KP-IAP  Khyber Pakhtunkhwa Irrigated Agriculture Improvement Project
MPGs  Modality Procedures and Guidelines
UNFCCC  United Nations Framework Convention to Climate Change
Rice is the second most important export commodity of Pakistan. Pakistan’s crops area under rice is increasing. It contributes 3.1% of value added in agriculture and 0.6% in the Gross Domestic Product. During 2019-20, rice cropped area of 7.5 million acres (3.034 million hectare) increased by 8.0% compared to 6.94 million acres (2.810 million hectares) during 2018-19. The production increased by 2.9% to 7.410 million tons, against 7.202 million tones driven in part by higher domestic prices and availability of inputs on subsidized rates. In 2019, Pakistan earned $1.2 billion by exporting rice.

The United Nations Framework Convention on Climate Change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response on climate change. The United Nations Environment Programme is the leading global environmental agency in promoting coherent implementation of the environmental dimension of sustainable development within the United Nations system. The United Nations Environment Programme is implementing a project funded by the Climate and Clean Air initiative, entitled, “Increasing the Ambition for Agricultural Climate Action to Reduce Short-Lived Climate Pollutants” by transforming the rice sector in Pakistan and Thailand. The Short-Lived Climate Pollutants initiative will support national governments enhancing policy implementation and establishing ambitious targets to reduce Short-Lived Climate Pollutants by fostering sustainable rice management as well as building capacity of multi-stakeholders. Drawing on best practice examples across the region under the leadership of UNEP in close collaboration with the Sustainable Rice Platform, the Short-Lived Climate Pollutants initiative aims to support the ambitions of the government by capacity building and upscaling, e.g., through establishing a project for Nationally Appropriate Mitigation Activities in Pakistan.

This scoping study commissioned by Climate and Clean Air initiative aimed to discover lessons learned and explore entry points for cooperation with other projects in the country. The study was conducted in 82 revenue villages from 17 districts in four provinces. In total 168 farmers were randomly selected for interviews. This sample included 44% farmers contracted by different rice export companies (mainly Punjab and Sindh). Around forty stakeholder institutions and key informant experts were also interviewed.

The stakeholders confirmed that the overall interest and governance regime and actors’ engagement on climate change and water sector strategies has generally improved in Pakistan. However, currently climate change mitigation is not a priority within agriculture sector of the country. There is a strong narrative on adaptation to climate change or resilient agriculture systems, but not in a systemic way. Research on evidence on low or high emission processes is lacking. There are no clear actors on mitigation within the agriculture sector. Capacities on climate smart agriculture are limited. Farmers and agriculture services are occupied with production and trade issues but are increasingly aware of increasing demands for standards on agricultural products in the face of global obligations towards changing climate.

A large proportion of farmers expressed their awareness on issues like climate change, water scarcity and need for improved water efficiency. They are confronted with several challenges in the rice value chain. Water efficient rice production is important for farmers since they are constrained for water,
especially at the tail ends. Many farmers advocated for Alternate Wetting and Drying and other suitable techniques for water saving with improved economics of rice crop. Those who have applied direct seeding technique, demand an effective solution for profuse weed growth. They also highlighted the need for well-designed schematic training programme for the farmers on rice / crop agronomy, irrigation management and safe harvest management. Improved technology for crop residue management has become more essential than before due to strict law enforcement. In summary, farmers are ready for switching their production methods to sustainable rice cultivation, however, in their view, a price incentive will help fast adoption of improved technology and save public goods (such as water, clean air).

Based on stakeholders’ interviews and socio-economic survey with farmers, it is evident that the best entry points for Short-Lived Climate Pollutants interventions are those which are embedded in the current national narrative and thus are easier to propel interest and motivation among stakeholders. Short-Lived Climate Pollutants intervention ideas may capitalize on the current readiness on ground such as policy spaces in favour of water productivity, mitigation and adaptation, rising enthusiasm for improved water management and efficiency, already available experience on use of Alternate Wetting and Drying tubes and the matter of smog which caught attention in recent years. The indicative intervention packages leading to removal of Short-Lived Climate Pollutants thus include:

1. Technology development and transfer to reduce emission from agriculture
2. Capacity development among stakeholders in SRP and related knowledge fields
3. Technical assistance for data management (ICT, MRV)
4. Develop financial mechanism to support SLCP packages
5. Research and development on support areas leading to mitigation

For the proposed packages to be successful, it is important to think of present and potential barriers in advance, which may be complex and not for a single project to address; yet will help making interventions most relevant and less liable to failure. A few guiding principles may be helpful in this regard:

1. It is important to follow an integrated approach for mitigation and adaptation. A pure mitigation focus (e.g. removal of Short-Lived Climate Pollutants) cannot achieve results.
2. Follow a landscape approach (farming system approach). This entails that rice does not grow in isolation. A farming system has livestock (which has a large contribution in emissions) and farming practices for and other crops which jointly contribute to GHG balance sheet.
3. Develop Nationally Appropriate Mitigation Activities and financing strategies for rice sector with easy-to-follow obligations and more accountability for stakeholders (certainly with adaptation co-benefits).
4. Harness SRP’s potential as an inclusive, comprehensive, and already tested entry point.
5. The concept needs to be flexible. New openings may emerge to support intervention packages and must be included.
6. Do not shy to engage actors which are labeled as more difficult and little ready for a change – for example middlemen or arhtees, money lenders, big farmers etc.
7. It is essential to follow a multi-partner and multi-stakeholders’ approach. Federal and provincial ministries, the rice millers, technology developers, communication technology, media - have to be on board for lending their respective strengths.
1. Background

The United Nations Framework Convention on Climate Change states that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions (UNFCCC, 1992). The Framework further stated, "each of these Parties shall adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs... Cooperation and actions for limiting emissions are expected by all Parties irrespective of their share in total global emission as per capita emissions in developing countries are still relatively low".

The United Nations Environment Programme (UNEP) is the leading global environmental agency that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system and serves as an authoritative advocate for the global environment. The UNEP is implementing a project funded by the Climate and Clean Air initiative (CCAC), entitled, “Increasing the Ambition for Agricultural Climate Action to Reduce Short-Lived Climate Pollutants (SLCPs). The initiative aims to reduce SLCP by transforming the rice sector in Pakistan and Thailand. As methane emissions from rice production amount to 8.5 and 36.4 Mt CO₂-eq per year for Pakistan and Thailand, respectively, sustainable rice management will be one of the key mitigation mechanisms to achieve the Nationally Determined Contributions (NDCs). Additionally, as much as 48% of global methane emissions from paddy rice could be mitigated through wide scale adoption of water management practices such as alternate wetting and drying (AWD).

The SLCP initiative will support national governments enhancing policy implementation and establishing ambitious targets to reduce SLCP by fostering sustainable rice management as well as building capacity in a multi-stakeholder approach and assisting the private sector with decision support tools and scaling up SLCP mitigation packages at national scale.

Sustainable rice management is one of the key mitigation mechanisms to achieve the national NDCs. In Pakistan it is a priority target included in the NDCs (GoP, 2016) to implement efficient water management in rice cultivation to control release of methane from agricultural soils and to introduce low water dependence rice varieties. To achieve large-scale mitigation of SLCPs emissions from paddy rice cultivation across Pakistan, the CCAC in its first phase has planned to initiate and support a scoping study to assess feasibility of SLCP mitigation activities within the national context. The scoping study has been conducted in Pakistan by the UNEP Asia Pacific Office. This report will open the door for further deliberation on potential SLCP interventions to mitigate SLCP emissions in Pakistan.

1.1 Introduction to the scoping study and objectives

Drawing from best practice examples across the region under the leadership of UNEP in close collaboration with the Sustainable Rice Platform (SRP), the mitigation of SLCP emissions from paddy rice cultivation project aims to support the ambitions of the
government by capacity building and upscaling, e.g., through establishing a NAMA project in Pakistan. The scoping study under the CCAC project aimed to discover lessons learned and explore entry points for cooperation with other projects in the country.

The study aimed at achieving the following main objectives:

- Engage stakeholders in evaluating the technical and socio-economic potential of packages for SLCP mitigation measures and implementation capacities;
- Summarise promising approaches and SLCP mitigation packages for priority rice areas identified for Pakistan by highlighting quantified mitigation potentials and lessons learned;
- Based on lessons learned, explore entry points for cooperation with other projects in the country.

A socioeconomic assessment of the approaches and best practices was also conducted in this study considering ongoing projects in Pakistan (e.g. WAPRO in Punjab and Sindh\(^1\)). Based on the most promising SLCP mitigation packages from key rice growing environment in the country, different component technologies will be combined into SLCP packages as part of the feasibility assessment to consider potential synergies and trade-offs in implementation of new technology packages at local level. The study has been conducted in collaboration with national partners, in-country and global experts, and stakeholders from provincial and federal governments, academia, private sector, and research institution. The assessment also included policy review, interviews, and meetings with Sustainable Rice Partners (SRP) country chapter and CCAC focal points.

Data for the study has been collected from four rice producing provinces in Pakistan, namely Punjab, Sindh, Balochistan and Khyber Pakhtunkhwa, in addition to interviewing key informants belonging to various stakeholder groups in the rice production and irrigation sector. A mix of quantitative and qualitative tools were used for data collection for this study. The main tools used were secondary data through a desk review and primary data through a questionnaire survey, face to face key informant or focus group interviews, interviews using digital platforms, interviewing concerned officials and farmers, and personal observations during visits to the rice growing areas.

1.2 Rice sector in Pakistan

With 207 million people, Pakistan is the 6th most populated country of the world with 2.1% population growth rate\(^2\). Pakistan's agriculture sector plays a central role in the economy as it contributes 18.9% to the GDP and absorbs 42.3% of labour force\(^3\). Majority of the rural poor draw income from food crops, mainly rice and wheat. As per Pakistan Bureau of Statistics, the total cropped area of the country is 58.71 million acres (23.76 million hectares)\(^4\). Out of this, the five major crops i.e., wheat, cotton, rice, sugarcane, and maize are grown on an area of 42.32 million acres (17.13 million hectares). Wheat dominates the total cropped area (nearly 50%). Depending on several factors including market forces, annual area under various crops fluctuates slightly.

The Pakistan Economic Survey indicates that crops area under rice is increasing (GoP, 2020). This report stated that being a main food as well as cash crop, rice holds an important place in the economy of Pakistan. After wheat, rice is the second main staple food crop and second major exportable commodity after cotton. It contributes 3.1% of value added in agriculture and 0.6% in the GDP. During 2019-20, rice cropped area of 7.5 million acres (3.034 million hectare) increased by 8.0% compared to 6.94 million acres (2.810 million hectares) during 2018-19. The production increased by 2.9% to 7.410 million tons, against 7.202 million tons driven in part by higher domestic prices and availability of inputs on subsidized rates. In 2019, Pakistan earned $1.2 billion by exporting rice\(^5\).

Rice is cultivated in 4 provinces of Pakistan over an area of 7.494 million acres. As per data provided by the Pakistan Economic Survey (2019) and Provincial Crop Reporting Services of all four provinces in 2019, out of the total 7.494 million acres, area under rice in Punjab was 5.014 million acres, Sindh 1.916 million acres, Balochistan 0.404 million acres, and KP 0.160 million acres. From these data, it is evident that Punjab is the main producer of rice in Pakistan. Punjab also produces bulk of basmati rice, which is consumed within the country as well as exported. In 2019, out of total production of country 7.411 million tones, Punjab produced 4.144 million tones, followed by Sindh 2.577 million tones, Balochistan 0.535 million tones, and Khyber Pakhtunkhwa 0.155 million tons\(^6\) (Figure 1). Given its importance as a staple and cash crop, rice production is expected to continue and even rise in the future.

---

\(^2\)http://data.worldbank.org/country/pakistan
\(^3\)http://finance.gov.pk/survey/chapters_18/02-Agriculture.pdf
\(^4\)http://www.pbs.gov.pk/sites/default/files//tables/Table%201%20area_production_crops.pdf
\(^5\)http://www.worldstopexports.com/rice-exports-country/
\(^6\)Data received in soft from the officials of the Provincial Crop Reporting Services
1.3 Key definitional parameters in climate smart rice production

To understand the findings of the scoping study, the following section briefly presents a few definitional parameters. This is also because these concepts were frequently referred during the discussion with the stakeholders.

1.3.1 Mitigation and Adaptation

Climate change mitigation refers to technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic, and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce Green House Gas (GHG) emissions and enhance sinks (IPCC 2014) through GHG emission reduction, Carbon enhancement or sequestration or Carbon substitution. Agricultural activities can cause direct GHG emission by sources and removals by sinks and improvement of these activities offer a potential for climate change mitigation. On the other side, as agriculture competes for land-resources with other land-use options such as forestry, indirect GHG emissions or removals may be caused by agriculture, e.g., through increased deforestation caused by agricultural expansion, reduced deforestation through agricultural intensification, etc. Improved water efficiency in rice cultivation may lead to reduced emissions of methane and thus both mitigation and adaptation co-benefits are gained by using simple techniques.

Climate change adaptation refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation measures exist, e.g., anticipatory and reactive, private and public, and autonomous and planned. For instance, if we realize that the growing seasons are now different from the past, or that we have less water than what we used to get for our crops, how do we adapt our cropping practices? We may need to change varieties, farming systems or cultural practices. Water efficient production systems is a major example of adaptation in agriculture.

There is a realization that whatever we may do to reduce the GHG emissions, some changes in the climate are already in place (e.g., changes in rain patterns per region). To minimize the impacts of these changes, we need to adapt to these and forth coming impacts. Adaptation and mitigation are complementary. Particularly in the Agriculture and Forestry and Other Land-Use sectors (AFOLU), climate change adaptation and mitigation measures are often synergetic. Managing the forest and tree plantations in a sustainable manner has a positive impact on carbon stocks (mitigation) and improves ecosystem resilience and co-benefits (adaptation).

1.3.2 Short Lived Climate Pollutants (SLCPs)

Methane (CH\textsubscript{4}) emitted today lasts for about a decade on average, which is much less time than CO\textsubscript{2}. But CH\textsubscript{4} also absorbs much more energy than CO\textsubscript{2}. The net effect of the shorter lifetime and higher energy absorption is reflected in the Global Warming Potential (GWP) which is between 28-36 over 100 years. The CH\textsubscript{4} GWP also accounts for some indirect effects, such as the fact that CH\textsubscript{4} is a precursor to ozone, where ozone is itself a GHG.

Rice sector mainly emits methane. Methane is defined as a SLCP. The Climate and Clean Air (CCAC)\textsuperscript{7} website provides definition and very useful information on type of SLCPs which is produced below for information and ready reference of the readers.

SLCPs are powerful climate forcers that remain in the atmosphere for a much shorter period than carbon dioxide (CO\textsubscript{2}), yet their potential to warm the atmosphere may be many times greater. Certain SLCP are also dangerous air pollutants that have harmful effects for people, ecosystems, and agricultural productivity. The SLCP such as black carbon, methane, tropospheric ozone, and hydrofluorocarbons are the most important contributors

\textsuperscript{7}https://www.ccacoalition.org/en/content/short-lived-climate-pollutants-slcps
to the man-made global greenhouse effect after carbon dioxide, responsible for up to 45% of current global warming. If no action to reduce emissions of these pollutants is taken in the coming decades, they are expected to account for as much as half of warming caused by human activity.

Methane is a powerful greenhouse gas emitted by human activities such as leakage from natural gas systems and the raising of livestock, as well as by natural sources such as wetlands. It has a direct influence on climate, but also a number of indirect effects on human health, crop yields and the quality and productivity of vegetation through its role as an important precursor to the formation of tropospheric ozone.

Methane is a SLCP with an atmospheric lifetime of around 12 years. While its lifetime in the atmosphere is much shorter than CO$_2$, it is much more efficient at trapping radiation. Per unit of mass, the impact of methane on climate change over 20 years is 84 times greater than CO$_2$; over a 100-year period it is 28 times greater (IPCC, 2014). A selection of measures to cut methane emissions can reduce near-term warming of the climate, increase crop yields, and prevent premature deaths.

Atmospheric methane concentrations have grown because of human activities related to agriculture, including rice cultivation and ruminant livestock; coal mining; oil and gas production and distribution; biomass burning; and municipal waste landfilling. Overall, 80% methane emission contribution comes from agriculture (42%) and fossil fuels (36%) and the remaining from waste, energy, and transport (Figure 2).  

![Figure 2: Global methane emission by sector (2015)](https://www.ccacoalition.org/en/slcps/methane)

Emissions are projected to continue to increase by 2030 in business-as-usual scenario (Figure 3) unless immediate action is taken. In agriculture, rapid and large-scale implementation of improved livestock feeding strategies can reduce 20% of global methane emissions by 2030, while full implementation of intermittent aeration of continually flooded rice paddies (known as alternate wetting and drying cultivation) could reduce emission from rice production by over 30%. Emissions from coal mining and the oil and gas sector could be reduced by over 65% by preventing gas leakage during transmission and distribution, recovering, and using gas at the production stage, and by pre-mine degasification and recovery of methane during coal mining.
Methane is generally considered second to carbon dioxide in its importance to climate change. The presence of methane in the atmosphere can also affect the abundance of other greenhouse gases, such as tropospheric ozone, water vapor and carbon dioxide. Recent research suggests that the contribution of methane emissions to global warming is 25% higher than previous estimates.

Methane is a key precursor gas of the harmful air pollutant, tropospheric ozone. Globally, increased methane emissions are responsible for half of the observed rise in tropospheric ozone levels. While methane does not cause direct harm to human health or crop production, ozone is responsible for about 1 million premature respiratory deaths globally.

1.3.3 Alternate Wetting and Drying in rice cultivation

Water is a precarious and scarce resource input in rice production. Given the growing shortage of water for agricultural irrigation, the International Rice Research Institute (IRRI), together with the Philippines Rice Research Institute (PhilRice), developed water-saving technologies. One of these technologies is Alternate Wetting and Drying (AWD). AWD is a management practice in irrigated lowland rice that reduce water use by up to 30% and reduces GHG emissions by up to 50% while maintaining yields. The AWD practice is defined by periodic drying and re-flooding of the rice field.
A practical way to implement AWD without yield loss is to monitor the depth of ponded water on the field using a water tube or *pani pipe*\(^9\). Allowing the field to drain permits aeration of the soil and halts the production of methane, thus reducing the total quantity of methane released during the growing season (Figure 4).

**Figure 4: How does AWD work?**

---

**1.3.4 Sustainable Rice Platform Standard (SRP)**

The Sustainable Rice Platform (SRP) is a global multi-stakeholder alliance launched in 2011 and led by UNEP, IRRI and GIZ, comprising over 100 institutional stakeholders, including public and private sector stakeholders, research, financial institutions, and NGOs. SRP promotes resource-use efficiency and climate change resilience in rice systems (both on-farm and throughout value chains) and pursues voluntary market transformation initiatives by developing a sustainable production standards, indicators, incentive mechanisms, and outreach mechanisms to boost wide-scale adoption of sustainable best practices throughout rice value chains. SRP’s goal is to minimize environmental impacts of rice production and consumption while enhancing smallholder incomes and contributing to food security.

In 2015, the SRP launched the world’s first Standard for Sustainable Rice Cultivation, together with a set of Performance Indicators to enable benchmarking and objective comparison of sustainability of any rice system. Together, these tools could serve as a working definition for sustainable rice production. The Standards offers a normative framework that can serve as a basis for supporting claims to sustainability performance in rice supply chains. Throughout the development and revision process, stakeholders have emphasized the importance of keeping the Standard as concise and inclusive tool for practitioners to drive wide-scale adoption of climate-smart sustainable best practice among rice smallholders.

SRP released the SRP Standard (Version 2.1) in 2020, with 41 requirements structured under eight major themes (Figure 5, Annex 7).

Figure 5: Relative weighting per theme in SRP standard

Source: The SRP Standard for Sustainable Rice Cultivation (version 2.1), 2020

The SRP Performance Indicators for Sustainable Rice Cultivation allow for quantitative measurement and assessment of the sustainability impacts of adoption of recommended practices at farm level. The Performance Indicators enable implementation partners and researchers to collect benchmark data and communicate field-level outcomes in a consistent way using a set of 12 common indicators. The SRP Assurance Scheme allows rice value chain actors to demonstrate compliance with the SRP Standard, as well as impact as measured by the SRP Performance Indicators.
2. Approach and methodology for the study

The methodology entailed multiple steps. Beginning from desk review and a detailed stakeholders’ mapping, the study hinged on detailed interviews with the stakeholders and farmers. An initial table of content was developed and shared for UNEP’s feedback and was refined based on suggestions received. The data collected was analyzed using qualitative and quantitative tools and was used for elaborating the study findings. The draft study was reviewed by UNEP and feedback was incorporated to refine and finalize the study. A final draft was presented in a stakeholders’ workshop for validation and study finalization.

2.1 Desk Review

An extensive review of literature for this study was carried out (Annex 1). This includes documents of UN agencies, bilateral donors, international financing institutions, national and provincial policy documents, research papers and documents of development projects related to rice sector. The purpose of the literature review was to analyse existing information on rice cultivation practices in the country and to explore key parameters of the study.

2.2 Interviews and Focus Group Discussions

The farmers for interviews were selected from 82 revenue villages from 17 districts in four rice producing provinces. In total 168 farmers were randomly selected from purposively selected districts and villages. The purposive selection was led by significance of rice crop within farming system of the districts. Another reason for selection of districts was the presence of rice companies who are engaged with farmers on improved water productivity in rice value chain so that we can also track the difference between farmers engaged by the companies and control farmers. Thus, the interviewed farmers represented two groups (Figure 6):

![Figure 6: Sample size by Contractual status](image)

- Non-contract farmers 56%
- Contract farmers 44%
• Registered / contract farmers of Rice Partners Limited and Galaxy Rice Mills in Punjab and Sindh (44% of the sample). These two millers are the partners of SDC financed WAPRO project of Pakistan and engaged farmers in different training and supervision activities for improved water productivity in rice value chain. The registered farmers were randomly selected by enumerators for the study. Registered farmers only came from Punjab and Sindh. KP province has no contract or registered farmers.

• Control / independent rice farmers who were randomly selected for the study with no direct participation in training activities known to the enumerators (56% of the total sample).

Distribution of farmers by four rice producing provinces was as follows (Figure 7):

• Punjab: 64% (being the main ground for export basmati rice in the country) - Districts Sheikhupura, Nankana Sahib, Mandi Bahauddin, Khanewal and Gujranwala.
• Sindh: 12% - Districts Shikarpur and Jacobabad).
• Balochistan 12% - Districts Nasirabad, Jafarabad and Jhal Magsi
• Khyber Pakhtunkhwa: 12% - District DI Khan.

In total, 5% farmers interviewed were women, of which, 80% came from contract farmers (Figure 8).

Farmers interviewed owned lands in the range of less than 10 acres to 110 acres. However, 76% farmers interviewed owned less than 30 acres of land. Of these 31% owned less than 10 acres and 26% owned between 11-20 acres (Figure 9).
A checklist of questions was prepared for interviews. As a result, the following two types of tools were prepared:

1. Questionnaire for farmers / communities related to rice sector in Pakistan (Annex 2) for socio-economic assessment. Priority was given to Central Punjab which is the main rice growing area of the country.

2. Interview checklist for key informants from relevant and selected stakeholders among federal, provincial, research, donor / multilateral agencies (Annex 3). Around eighty stakeholder institutions and key informant individuals were listed of which forty-six were interviewed (Annex 4). These stakeholders came from diverse backgrounds and were interviewed individually or in focus groups. Figure 10 presents the diversity among stakeholders interviewed for the study.

![Figure 10: Type of stakeholders interviewed](image)

**Stakeholders’ consultation workshop**
A final step before finalizing the study was sharing the preliminary findings with a group of multi-stakeholders in a consultation workshop for feedback and further refinement. The comments and suggestions received from the workshop participants were incorporated in the final study. Annex 5 documents briefing note for the workshop and a list of participants.
3. National context of climate change

3.1 Agriculture and water sectors

Although Pakistan contributes proportionately little to the total carbon emissions in the world (0.8%) with 405.07 million tons CO\textsubscript{2} equivalent\textsuperscript{10} (GoP, 2016), it is considered one of the most vulnerable countries to the impacts of climate change.\textsuperscript{11} Majority of the country’s rural population depends on climate sensitive sectors and resources such as farming, livestock rearing and water\textsuperscript{12} for livelihoods. Being climate-sensitive, shifting trends of temperatures and rainfall and more frequent incidents of climatic extremes have significant impact on livelihoods that depend on land and water-based resources. Impacts of climate change are being felt in the country for the last many years with devastating floods without break. Even the regions not known for receiving monsoons (e.g., parts of southern Punjab), received heavy and prolonged summer rains resulting in floods. On the other hand, the country is experiencing dry autumns and delayed winter rains impacting wheat, country’s main staple crop.

Pakistan’s vulnerability to climate change is also compounded by lack of resources and capacities to cope with climate related risks. In addition to this, the lack of sensitivity in favour of

\textsuperscript{10}Government of Pakistan NDCs 2016
\textsuperscript{11}Germanwatch 2019
\textsuperscript{12}Despite being an agricultural country, Pakistan’s nutrition indicators are rather grim. The National Nutrition Survey (NNS) 2018 reported that four out of ten children under five years of age are stunted (40.2%) whereas 17.7% suffer from wasting. Almost one in three children underweight (28.9%) alongside a high prevalence of overweight (9.5%) in the same age group. The NNS 2018 also finds that the patterns of distribution of malnutrition among boys and girls remains the same, with boys being more affected than girls by all forms of malnutrition. The prevalence of stunting, wasting and underweight children under five years in rural areas is higher than the urban areas.
preparedness and adaptation also adds to the problem. As a result, those engaged in climate sensitive sectors continue to struggle with uncertainties in securing their livelihoods. The poverty-environment nexus makes people and ecosystems extremely vulnerable to climate change and climate variability. Lack of access to information and early forecast / warning increases this vulnerability hence people in remote locations are more disadvantaged than those having access to information.

Livestock is an important and integral component of farming in Pakistan. About 35 million people are engaged in raising 2 to 3 cattle/buffaloes and 5 to 6 sheep/goats in their backyards and are deriving 20 to 25 percent income from it. The combined population of cattle, buffalo, sheep, and goat increased from 113 million in 1998-99, to 125 million in 2002-03, depicting a total increase of 12 million heads per annum. Approximately 80% of milk is produced in rural areas, with peri-urban areas accounting for 15%, and urban areas for 5%. Annual milk production from 1998-1999 to 2007-2008 increased by an average of 3.31% per year, or by a total of almost 34% (ibid). This growth is directly proportional to the increase in human population, resulting in growing demand. The extra volumes are a result of increased herd size, and cannot be attributed to enhanced animal productivity, which reportedly remained constant.

Pakistan’s economy is water-dependent with 60% of the population directly engaged in agriculture and livestock and 80% of the country’s exports based on these sectors, including some products (mainly horticulture). Approximately 90% of surface and fresh groundwater resources are injected into agriculture. Therefore, Pakistan has a long-term interest in securing its water resources and improving efficiency in agriculture and domestic sectors. Pakistan has a geographical area of 198.68 million acres or 796,096 Km$^2$, out of which 36.59% is cultivable. Of this, 52.31 million acres is cultivated area (72.27% of the total cultivable area)$^{13}$. The irrigated area is 61% of the total cultivable land. Rice is mainly cultivated in the irrigated areas.

Land and water are the main natural and economic resources of the country, and the source of livelihood for a very large segment of the population. Substantial physical infrastructures are already in place for harvesting these resources. Water resources in Pakistan are scarce i.e., per capita availability of water has declined to 1000m$^3$, a point where Pakistan is at the verge of being included in the category of water stressed countries defined by international standards. Several sectors compete for available water (people, food production, industrial development, protecting ecosystems etc.). Realizing the alarming decline in per capita water availability, the first National Water Policy was formulated in 2018 which calls for the need to increase water use efficiency in agriculture and other sectors and states that Pakistan’s water must be a source of development, dignity, and prosperity for all citizens. Pakistan’s commitment to UN Sustainable Development Agenda 2030$^{14}$ and the Sustainable Development Goals obligates the sustainable management of water and sanitation for all, water use efficiency and integrated water resource management.

The income patterns of smallholder farmers are highly vulnerable to natural and economic shocks. Majority of the rural poor draw income from food crops, mainly rice and wheat. Wheat dominates the total cropped area occupying 40% of the total area, followed by cotton and rice, 14% and 12% respectively. Depending on the size of land holding, the poorer farmers have limited freedom of choice and decision to grow more remunerative cash crops such as sugarcane. Agricultural productivity of water is very low in Pakistan compared to other countries. In addition to this, water is Pakistan’s biggest export since most of the export depends on water-intensive crop-based commodities including textile, leather, rice, sugarcane, and others. The current patterns of agricultural and dairy production systems are not contributing to improve

$^{13}$Pakistan Burau of Statistics, 2019
$^{14}$https://sdgs.un.org/2030agenda
national nutrition and food security indicators. Seeing this, the national government promulgated National Food Security Policy to address fundamental issues of agriculture adequately feeding the nation.

3.2 Emissions from agriculture sector in Pakistan

The total emission of the country is estimated to be 405.07 Mt CO\textsubscript{2} equivalent in 2016 (Table 1). GHG emission from the Agriculture was estimated to be 38.8 % in 1994 (Figure 11) which increased to 43% in 2016 (GoP, 2016). The 2016 NDC report indicated that Agriculture sector is the second largest emitter in the country with 174.56 Mt CO\textsubscript{2} equivalent. Energy sector is the largest emitter with 185.97 Mt CO\textsubscript{2} equivalent. The 2016 NDC document also shows 123% increase in emission over the last 20 years (1994-2015). During this period, emissions have increased in all sectors of the economy, especially the energy and agriculture sectors due to economic growth. Emission in the energy sector have increased by 117% whereas in the agriculture sector it has increased by 145%.

Table 1: Inventory of GHG emissions (in MT - CO\textsubscript{2} equivalent). Source: GoP 2016

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>85.8</td>
<td>168.47</td>
<td>171.44</td>
<td>185.97</td>
</tr>
<tr>
<td>Agriculture</td>
<td>71.63</td>
<td>125.97</td>
<td>162.86</td>
<td>174.56</td>
</tr>
<tr>
<td>Industrial Processes</td>
<td>13.29</td>
<td>18.54</td>
<td>19.59</td>
<td>21.85</td>
</tr>
<tr>
<td>Land Use Change &amp; Forestry</td>
<td>6.52</td>
<td>9.29</td>
<td>9.67</td>
<td>10.39</td>
</tr>
<tr>
<td>Wastes</td>
<td>4.45</td>
<td>7.24</td>
<td>10.55</td>
<td>12.29</td>
</tr>
<tr>
<td>Total</td>
<td>181.7</td>
<td>329.51</td>
<td>374.10</td>
<td>405.07</td>
</tr>
</tbody>
</table>

The NDCs are being revised by Ministry of Climate Change as per the provisions of the Paris Agreement. The new statistics are awaited with a general prediction that emissions in all sectors would show an increasing trend. The NDCs developed in 2016 prioritized emission reduction form the agriculture sector thorough intervention in the rice sector. At practice level, however, the emission reduction from agriculture is nowhere among practical priorities. From policy decisions and financing it seems that the priorities are more inclined towards energy sector, followed by sustainable cities and then industry among higher policy narratives and resource allocation.
3.3 The Rice sector and emissions

Out of the total global production of rice, 90% is produced and consumed in Asia\textsuperscript{15}. Rice fields globally are one of the main sources of methane emission (IPCC, 1996). Based on the source of irrigation water, rice land is differentiated into four ecosystems (IRRI, 1993a): irrigated rice with full control of the water regime (51% of global rice area); rainfed rice (27%), deep water rice (10%), and upland rice (11%). Among these, the upland rice does not need flooding and therefore is not a source of methane.

In Pakistan, current emissions reported form rice are 8.5 Mt CO\textsubscript{2} eq of GHGs per year (GoP, 2016). To reduce methane emissions from rice, NDCs developed by Pakistan in 2016 suggested managing ‘water in rice cultivation to control release of methane from agricultural soils and introduce low water dependent rice varieties’ (GoP, 2016). The 2016 NDCs show that rice emits a significant 5% of the total 174.56 million tons CO\textsubscript{2} equivalent emissions from the agriculture sector.

In recent years, emissions due to burning of rice stubbles and its contribution to smog in the country, especially in Punjab province, has become a national debate. A significant amount of residue including roots, stubble and straw is left behind when rice is harvested. The amount of residue increased with the introduction of combined harvesters for rice and wheat in 1980s\textsuperscript{16}. In Pakistan wheat is cultivated after harvesting of rice. For this purpose, the farmer needs to prepare land for wheat cultivation. They usually make a fire to clean the field from rice stubbles. Pollution due to burning of rice straw is also reported from rice producing area of India (Bhadauriya, Chaudhary, Mamatha, Ray 2020). This study concluded that fire counts for burning rice residue and increasing pollution levels in Delhi have positive relation. In Pakistan, however, according to an FAO study (FAO, 2020)\textsuperscript{17}, the main sectors responsible for air pollutant emissions are power, industry, and transport which together hold 80% contribution in air pollutant emissions and aids in the formation of photochemical smog especially in Punjab province. The contribution of agriculture sector (mainly rice crop residue burning) is significant to the seasonal smog phenomenon in Punjab, although it is the third sector by emissions (20%) following transport and industrial sectors.

Updated NDCs for Pakistan are currently being prepared by the Ministry of Climate Change, Government of Pakistan. Given agriculture sector contributing significantly to the total emission, it is believed that the agriculture sector will find an important place in new NDCs and that the country’s footprint of Carbon in agriculture will be more refined in the new analysis.

There is an increasing realisation in Pakistan that rice being a high delta high emission crop, measures for sustainable production of rice is crucial, especially in wake of climate change and increasing water scarcity in the country. GHG emission from inefficient water application and SMOG may be a narrow view of looking at emissions from rice sector. These may however serve a good base for cultivating an understanding on linkages of these issues with mitigation from rice sector and to look for efficient technologies and better agronomic practices. For example, In Pakistan, use of AWD tube to increase irrigation efficiency in rice has been successful at pilot sites. However, there are challenges in upscaling such techniques. Farmers are more comfortable with puddling and traditional cultural practices than with AWD. They see risks to experiment new techniques even though use of AWD tubes have shown many benefits.

\textsuperscript{15} http://www.ricepedia.org/rice-around-the-world/asia#:~:text=More%20than%2090%25%20of%20rice%20is%20produced%20and,Other%20regions%20rely%20more%20heavily%20on%20other%20cereals
\textsuperscript{17} Remote sensing for space-time mapping of smog in Punjab and identification of the underlying causes using geographic information system (R-SMOG). Islamabad. https://doi.org/10.4060/ca6989en
There are multiple policy documents at federal and provincial levels within climate change, water and agriculture sectors that may have direct or indirect influence on Pakistan’s adaptation and mitigation interests. A quick scan is presented in the following paragraphs:

### 4.1 National policies / strategies

#### 4.1.1 National Climate Change Policy 2012 and Act 2017

Despite that Pakistan is among the lowest GHG emitter in the world, the National Climate Change Policy (NCCP) suggests mitigation measures to reduce emissions especially from the energy and agriculture sectors that contribute bulk of emission from Pakistan. The Goal of the NCCP is ‘to ensure that climate change is mainstreamed in the economically and socially vulnerable sectors of the economy and to steer Pakistan towards climate resilient development’.

Chapter 5 of the policy is on mitigation. Quoting the National GHG inventory conducted in 2008, the Policy stated that the total emissions in 2008 were 310 million tons of CO₂ equivalent. This consisted of CO₂ 54%; Methane (CH₄) 36%; Nitrous Oxide (N₂O) 9%; Carbon Monoxide (CO) 0.7%; and Non-Methane Volatile Organic Compounds 0.3%. From these figures it is evident that Methane is a major contributor to the total GHG emissions from Pakistan. In Section 5.6 the policy stated, ‘the agriculture and livestock sectors accounted for about 39% of Pakistan’s total GHG emissions in 2008. These emissions were essentially all methane (CH₄) and nitrous oxide (N₂O), 79%, and 21% respectively, and originated mainly from four enteric fermentation in cattle (all in the form of methane); 2) rice cultivation; release of nitrous oxide from agricultural soils/ nitrous fertilizer; and manure management’. To mitigate emissions the policy calls for support of the international community in technological innovations and provision of financial resources. Among others, the policy suggested the following mitigation measures:

- Promote wide-scale adaptation of better management practices for agriculture and livestock with a reduction in the use of chemical fertilizer, water, and pesticides.
- Manage water in rice paddies to control releases of methane from agricultural soils and introduce low water dependent rice varieties.
- Develop capacities of the relevant institutions to undertake appropriate mitigation actions to reduce GHG emissions from the agriculture and livestock sectors.

The national climate change policy was proceeded by the Framework for implementation of climate change 2014-2030 and climate change Act 2017. The Framework provides details on how the Climate Change Policy of the country will be implemented. As other policy document, the Framework also acknowledges decreasing and un-predictable availability of water resources in the country. For conservation of water resources, the Framework provides detailed Actions under Mitigation and Adaptation sections. In Chapter 6 on Agriculture and Livestock Mitigation, the Framework indicates increasing GHG emissions from agriculture and livestock sectors at the rate of about 3% per annum and stresses the need for containing or slowing the growth of emission. Some of the Actions suggested by the Framework to reduce emission in agriculture sector especially from rice production are:
• Develop and promote best management practices for methane and nitrogen management in agriculture and livestock sectors.
• Introduce low water dependent rice varieties.
• Develop and introduce improved water management in rice paddy to control release of methane from agriculture soils.

The Pakistan Climate Change Act was passed by the Parliament in 2017. The purpose of the Act was to ‘meet Pakistan’s obligations under international obligations relating to climate change and to provide for adaptation of comprehensive adaptation and mitigation policies, plans, programmes and other measure required to address the effects of climate change and for matters connected therewith and ancillary thereto’. The Act provided for establishment of the Pakistan Climate Change Council headed by the Prime Minister or his nominee and Pakistan Climate Change Authority. Among others, the main function of the Authority is to ‘formulate, comprehensive adaptation and mitigation policies, plans, programmes, projects and measures designed to address the effects of climate change and meet Pakistan's obligations under international conventions and agreements relating to climate change and within the framework of a national climate change policy as may be approved by the Federal Government from time to time’.

4.1.2 The National Water Policy 2018
The National Water Policy (NWP, 2018) recognises and alarms severe shortage of water in the country. The main objective of the policy is improvement of water resources and conservation in the country. Objective 2.26 of the policy is specifically on water conservation in agriculture sector and states:

- Enhancing water productivity through infrastructure development and adoption of improved technologies in a sustainable manner (objective 2.26).

The policy also recognises decreasing per capita water resources in the country and states, ‘with rapidly growing population, Pakistan is heading towards a situation of water shortage and by corollary, a threat of food insecurity. Per capita surface water availability has declined from 5,260 cubic meters per year in 1951 to around 1,000 cubic meters in 2016. This quantity
is likely to further drop to about 860 cubic meters by 2025 marking our transition from a “water stressed” to a “water scarce” country. The situation calls for rapid development and management of the country’s water resources on a war footing. The policy also recognises that the impact on water resources is inextricably linked with climate and the impending climate change scenario has serious implications for Pakistan’s water resources. The changing and unpredictable precipitation patterns may have serious consequences, including flash floods in the north and increasingly prolonged droughts in the south.

In the chapter on Irrigated Agriculture (Chapter 10), the policy promotes the concept of ‘Crop Per Drop’ and suggests a ‘National plan for implementation of improved irrigation methods and practices’. The policy also suggests ‘extensive research and development for new varieties of crops with high yields, lower water consumption and reduced GHG emissions.

4.1.3 National Food Security Policy 2019
The National Food Security Policy recognizes that food security in Pakistan is still a key challenge due to high population growth, rapid urbanization, low purchasing power, high price fluctuations, erratic food production, and inefficient food distribution systems. Food insecurity in Pakistan is primarily attributable to limited economic access of the poorest and most vulnerable to food. A key factor limiting access to food, particularly since 2007, is increase in the prices of essential food items. The policy recommends improved food availability and resilient agricultural growth, especially in water scarce and rainfed areas. It is interesting enough to note that the policy’s focus is on securing water resources for land development with multiple measures (e.g., to reduce groundwater depletion, harness rainwater potential, reduce losses) and improve water productivity in agriculture through climate smart solutions as means to improving food security.

4.1.4 The National Environment Policy 2005
The National Environment Policy 2005 aims to protect, conserve, and restore Pakistan’s environment for sustained development and to improve quality of life of citizens. This policy was amended when in 2011 the 18th Constitutional Amendment devolved Central Government’s functions to the Provinces. Federal and provincial Environment Protection Agencies are mandated to ensure an effective implementation of Environment Protection Acts (revised by the provinces). The Provincial Environment Protection Acts have a larger focus on brown environment and GHGs emission from non-agricultural sectors.

4.1 Provincial policies / strategies
4.2.1 Provincial climate change policies
Punjab Climate Change Policy (draft 2017, approval awaited) aims for climate compatible development and growth. The policy promotes Carbon resilient development through sustainable cities and other carbon resilient development measures (transport, energy, slum management) and low carbon development (which includes agriculture). Under the pillar of low carbon development, it talks about Water-Food-Energy nexus and emphasizes on wastewater recycling and management. Improved water-use practices in agriculture (including enhancing water efficiency and productivity, incentivizing use of efficient devices and techniques, rehabilitate irrigation infrastructure, removing sedimentation, constructing breeches, and upgrading the water distribution system) has been emphasised by the policy.

Khyber Pakhtunkhwa’s Climate Change Policy is a draft from 2016 (approval awaited). Its main goal is to achieve climate compatible development and green growth. Energy, transport, and industry are recognized as major GHG emitters before agriculture. The proposed emission reduction measures from agriculture include residue management, low tillage and promoting improved water management and conservation. Since Khyber Pakhtunkhwa (KP) is a forest rich
region (17% area under forests), carbon sequestration schemes are encouraged by the policy. Sindh and Balochistan provinces do not have their own policies on climate change yet, however both the provinces have a major emphasis on conservation of water resources since drought is a frequent phenomenon in these provinces. A larger focus of climate policies in these provinces may be on climate resilient agriculture than mitigation.

4.2.2 Provincial agriculture policies
The Punjab Agriculture Policy (2018) amply covers the need for water conservation and emission reduction in the agriculture sector, especially in rice. One of its goals is to ‘massively expand water conservation efforts’. In the chapter on Climate Smart and Regenerative Agriculture, the policy acknowledges increasing emissions from various sectors including from rice cultivation. The policy recommends ‘mitigation of GHG’s emissions from key and minor sources in the agriculture sector’. The policy states that ‘mitigating effects of agriculture on climate change by reducing GHG emissions can come from helping farmers adopt sustainable and climate-friendly practices and techniques.

Sindh Agriculture Policy (2018-2030) aims to achieve efficient, prosperous, and resilient agriculture and livestock sectors that can provide good incomes and decent employment to those involved in production, processing, transport, and storage; and at the same time provide safe, nutritious, and cheap food to urban and rural populations. The policy uses the term Climate Smart Agriculture; however, the larger emphasis is on climate resilient agriculture and not clearly to address mitigation and environmental issues emanating from agriculture.

KP Agriculture Policy (2015-2025) is highly diverse in its focus. It aims at enhancing sector productivity and competitiveness, supporting mechanisms for tobacco and sugarcane (as two most important cash crops of the province), improving food security and access, and improved natural resource management, climate change adaptation and disaster risk reduction. Technology development within agriculture to improve its efficiency is included in these priorities. Within the field of climate change, a larger emphasis is on climate resilience, land zoning and soil and water conservation in arid and high elevations areas “beyond watercourse lining”.

Balochistan’s Agriculture Policy (2014) has a primary objective to enhance income and employment opportunities for rural people, while at the same time halting, and eventually reversing, the rapid resource degradation taking place. The policy is high on preventing malnutrition and increasing calorie intake especially for women and children, enhancing food security, and creating incentive systems to support agriculture to be more efficient and profitable. This is obvious given the fact that Balochistan is the largest, least populous and most water scarce province where agriculture is totally dependent on rare rainfall and where extreme droughts are very frequent. The policy does not make any deliberation on this since rice cultivation is not a major crop in the province and its cultivation is limited to small, irrigated pockets of the province in the South.

4.2.3 Provincial water policies
In line with the recommendation of the National Water Policy 2018, the Punjab and KP provinces have so far developed their water strategies/policies. The Punjab Water Policy (2018) focuses on the following eight areas: (i) Balancing productivity and conservation, (ii) Balancing infrastructure development and environment, (iii) Balancing supply and demand, (iv) Enlarging stakeholders’ participation, (v) Adapting to climate change hazards, (vi) Achieving financial sustainability, (vii) Harnessing information technology, and (viii) creating knowledge. Within priority v, its focus is on better understand the local impacts of Climate Change through modelling, develop surface and groundwater storages, flood, and drought management to mitigate impacts of Climate Change, strengthening capacity of universities and research centres, and enhance collaboration.
The KP Integrated Water Resource Management Strategy was launched in 2020 with four main pillars, 12 priority areas and 100 action lines. The first pillar is sustainable water resource management by ensuring 100% WASH coverage, improving water balance (surface and ground), enhancing water productivity in agriculture, and managing watersheds. The second pillar focuses on improved water governance by addressing missing policies and improving them, structured users’ participation, improving coordination and building capacities. The third pillar is devoted to promoting public-private partnership by engaging private sector and regulation whereas the fourth pillar aims at enhanced citizens’ engagement for improved water governance.

### 4.3 Policy gap analysis

Looking at some the key policies mentioned in preceding sections, some of the key opportunities and gaps are summarized in Table 2.

<table>
<thead>
<tr>
<th>Policy / strategy</th>
<th>Mitigation</th>
<th>Adaptation</th>
<th>SLCP relevance and entry points</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Water Policy 2018</td>
<td>• Need for an extensive research on water saving technology and reduced GHG emissions</td>
<td>• Promote IWRM in the provinces • Crop per drop approaches and techniques</td>
<td>• Water use efficiency, productivity • Research</td>
</tr>
<tr>
<td>Climate Change Policy 2012 and Act 2017</td>
<td>• Manage water for reduced methane emissions. • Low external inputs in agriculture • Develop capacities in mitigation actions. • Slowing emissions from agriculture, livestock</td>
<td>• Introduce low water dependent rice varieties. • Comprehensive adaptation plans for the provinces</td>
<td>• GHG reduction targets • Rice varietal development for low water requirement • Capacity development</td>
</tr>
<tr>
<td>Nationally Determined Contributions 2015</td>
<td>• Energy efficiency, low carbon pathways • Methane emissions reduction by increased irrigation efficiency in rice production</td>
<td>• Water use efficiency • Climate resilient buildings and agriculture</td>
<td>• Water productivity in rice cultivation</td>
</tr>
<tr>
<td>National Food Security Policy 2019</td>
<td>• Sustainable agriculture models and growth</td>
<td>• Climate resilient agriculture • Water conservation in multiple uses • Reduce groundwater depletion. • Enhance rainwater harvesting potential</td>
<td>• Sustainable agriculture • Water use efficiency</td>
</tr>
<tr>
<td>Environment protection</td>
<td>• Environmental Impact Assessment of commercial projects</td>
<td>• Improved quality of lives for citizens by addressing brown environment and regulation (air, water)</td>
<td>• No direct relevance</td>
</tr>
<tr>
<td>Provincial climate change policies</td>
<td>• Water-Energy-Food nexus (Punjab) • Wastewater treatment and recycling (Punjab) • Residue management and low tillage (KP)</td>
<td>• Rehabilitate irrigation infrastructure (Punjab) • Improved water use practices (Punjab, KP)</td>
<td>• Residue management and zero / low tillage • Improved water use efficiency</td>
</tr>
<tr>
<td>Provincial Agriculture Policies</td>
<td>• Emission reduction from agriculture sector (Punjab) • Technology enhancement for improved agriculture efficiency (Punjab, KP) • Capacity development in mitigation (Punjab)</td>
<td>• Water use efficiency and productivity (Punjab, Sindh, KP) • Climate resilient agriculture (Sindh, KP) • Food security and nutrition (Sindh, Balochistan) • Capacity development (all)</td>
<td>• Emission reduction from rice • Water efficiency practices</td>
</tr>
<tr>
<td>Provincial water policies</td>
<td>• Research and collaboration to study impact of water efficiency on climate change indicators (Punjab, KP, Balochistan)</td>
<td>• Hazard management and use optimal water potential (Punjab and KP) • Water productivity (Punjab and KP) • Improved water balance (surface and ground) (Punjab, KP Balochistan)</td>
<td>• Research • Water productivity enhancement • Improved water balance</td>
</tr>
</tbody>
</table>
5. Actors’ analysis and perspectives in Pakistan’s rice sector

A detailed list of actors and their mandates related to mitigation in agriculture sector is provided in Annex 6. These include, Rice Farmers, members of the Rice Exporter Association of Pakistan, federal ministries (Food Security, Climate Change), Provincial departments (agriculture, irrigation), research actors (Pakistan Agricultural Research Council, Global Change Impact Studies Centre, provincial rice research Institutes, academia, relevant international development actors, and others. This section describes few of these actors and their perspectives important in any endeavour to decrease SLCP emission in the rice sector.

5.1 Farmers

The main stakeholder in the rice sector is farmers. The rice farmers increasingly face shortage of irrigation water. In case of canal irrigated areas, water is provided to farmer through the centuries old Warabandi system introduced by the British (Bhatti and Kijne, 1990). Warabandi is defined as “weekly rotational schedule of irrigation deliveries to farmers” (World Bank 1993). “Warabandi is a rotational method for distribution of the available water in an irrigation system by turns fixed according to a predetermined schedule (specifying the day, time, and duration) of supply of canal water to each irrigator in proportion to the size of farmer’s landholding in the outlet command” (Malhotra 1982). In the wake of shortage of water in the country, farmers are reported to face differentiated shortages (Sial, Niazi and Ali, 2018). The farmers at the head face less shortage compared to the farmers at the tail. Some farmers use illegal practices to get more water to make up for the shortages or irrigate their fields at convenience. This results in conflicts between the farmer and the irrigation authorities as well as among the farmers along head, mid and tail of the canal. Shortage of irrigation water forced farmers to adopt better irrigation and agronomic practices. Since the tail farmers face more shortages of irrigation water, they will gain more from irrigation efficient techniques and therefore are willing to adopt such techniques earlier than other fellow farmers if available and affordable (Ali, Zulfiqar and Nizami, 2019).

Since inception of Pakistan’s canal irrigation system, warabandi has been traditionally practiced as a tertiary (watercourse level) water distribution method based on rotation of water turns among the individual water users. However, with changes in social conditions, intermittent water-related conflicts among the farmers and the growing need for water led to increased official interventions in this originally farmer-managed katcha (informal) warabandi tradition, resulting in the widespread conversion of katcha warabandi practices into more rigid pacca (official/formal) warabandi schedules. The katcha warabandi is still in use in some areas of Punjab and Sindh, which is managed and controlled locally by landowners without interference from the government.

Chapter 8 covers the results of socio-economic survey conducted with the farmers in this study and will detail their perspectives on water and other related issues in rice cultivation.

5.2 Public sector duty bearers

In Pakistan, the government is organized as federal Government with several ministries; provincial Government with several technical departments; and the district authorities reporting to the provincial authorities. Most of the departments are devoted to the provinces through
the 18th Constitutional Amendment and hence there are no reporting lines between federal and provincial departments except for policy linkages (water, agriculture, climate change and industry being examples). Various thematic departments in the provinces provide services through their district setups (e.g., education, agriculture, industries, water, environment, power and so on). They have their policy and administration head offices at the provincial level. The districts are administratively subdivided into district headquarters, tehsils, and union councils. These three tiers are responsible to provide services to rural and urban citizens of the districts and where relevant, coordinate development actors. The Planning & Development Departments in the provinces serve as hubs for development planning and financing and act as coordinating agencies for other provincial thematic departments.

5.2.1 The provincial actors
The agriculture departments in the provinces are the main stakeholders mandated to support the farmers in improving production and resource efficiency. Headed by the Secretaries, the departments typically have three units which are most relevant for SLCP initiative: Extension, Research and On-Farm Water Management (OFWM) departments, all headed by respective Director Generals. The OFWMs are mandated to improve irrigation efficiency at the farm level.

Beyond the farmgate, the irrigation network is managed by the Irrigation departments of the provinces headed by Secretaries. Historically, greater emphasis of the Agriculture department (Extension and OFWM) has been on improving availability of irrigation water for farming. Development projects of the Agriculture departments include subsidized tube wells, small dams, and water ponds to harvest and store rainwater\(^\text{18}\), irrigation efficiency tools (such as precision levelling equipment) on subsidized terms and conditions. The OFWM departments have also implemented projects directed at high irrigation efficiency. The projects include drip and sprinkler irrigation, land levelling and improvement of water courses to decrease water losses\(^\text{19}\).

With increasing shortage of irrigation water, the Agriculture department is hard pressed to support the farmers in increasing irrigation efficiency. As a response, the department has initiated several projects mentioned above and is keen to support other actors that could invest in irrigation efficiency and conservation of water resources.

The Pakistan irrigation network is one of the largest contiguous networks in the world. The Indus Basin Irrigation System of Pakistan consists of three large dams, 85 small dams, 19 barrages, 12 inter-river link canals and 45 canal commands, and 700,000 tube wells (Ibrahim, 2019). An aggregate length of canals is 56,073 km. The average annual cultivated area of the country is reported to be 63.56 million acres (Ahmed, 2007; Baig et al., 2013 and Frenken, 2012). Out of which, about 75% is reported to be under irrigation. Out of this, 17.07 million acres is irrigated by canal water, 10.2 million acres by groundwater and 19.67 million acres by canal water and groundwater combined, 0.67 million acres by wastewater, 4.94 million acres by the spate irrigation, 7.9 million acres is rainfed and 3.09 million acres riverine (ibid).

The Water and Power Development Authority (WAPDA) manages big water reservoirs whereas the Irrigation department manages the vast irrigation channel network which start from the reservoir and deliver irrigation at the farmgate. The Irrigation departments are then divided into various zones headed by Chief Engineers of the respective zones. The Irrigation departments are mandated to provide adequate, equitable and reliable water for irrigation to the farmers aiming at increased agricultural productivity. The department has faced challenges to meet the demand for irrigation water due to ever increasing size of farmland coupled with deteriorated irrigation network and shortage of funds to manage the systems (GoP, 2012). The department therefore may be keen to support any efforts targeted at irrigation efficiency in the country.

\(^{18}\)Agripunjab.gov.pk
\(^{19}\)Ofwm.agripunjab.gov.pk/projects
As such this picture suggests that the responsibilities for water for agriculture are split among three actors within the province (and the fourth being the farmer). In case of water productivity in rice crops, the most relevant actor is OFWM department with a direct collaboration with the Extension department, both reporting to the same authority.

The provincial stakeholders from different interviews highlighted the following:

1. Water efficiency / improving water productivity is a topic in Punjab due to stressed canal irrigation system and groundwater. KP is joining now and is keenly looking at the best practices introduced in Punjab. In Sindh and Balochistan it is not yet a topic since surface water is available in relatively adequate quantities in rice producing area or there are other alternatives with rice such as fruit orchards.

2. Agriculture extension services are obsessed with production statistics. GHG emissions and environmental concerns are often secondary or ignored.

3. AWD tubes and DSR have been tried at reasonable scales in Punjab, on pilot scale in Sindh, and never in KP and Balochistan. There are replication challenges since the farmers are not yet confident that they will not lose their yields with AWD. There is a lot of negative advocacy from the farmers. When a farmer's field fails due to other reasons, the blame goes to the new technology.

4. While GHG is not a topic widely discussed at provincial level, stubble burning is. Therefore, a quicker entry point to reducing emissions may be by offering a solution to rice residue burning to catch the attention of policy makers (even though stubble burning contributes far less than the actual methane emission during cultivation).

5. Coordination among provincial players is weak (e.g., among agriculture, irrigation, and research) hence a joint forcefield is not created.

6. Collaboration with federal players is active when there is a federally financed project for the provinces. There is no collaboration specifically on GHG mitigation issues.

7. In KP and Balochistan, private sector is not quite present in rice value chain. In Punjab and Sindh, there is a presence of vibrant private sector and the agri-business environment is quite active. Cooperation between public and private actors however is weak.

8. All the provincial actors are open to embracing and introducing best international practices and learn.

5.2.2 Federal actors

The Ministry of Climate Change (MOCC) is the nodal institution at the federal level mandated to deal with the adaptation and mitigation issues at national level and support the provinces. The ministry is also responsible for fulfilling international obligation related to climate change. The ministry is guided by Climate Change Policy 2012 (followed by Climate Change Act 2015) and international negotiations on climate change. There is a disconnect, however, between federal and provincial levels since the implementation of this policy needs to be in the provinces where there is no dedicated actor to monitor implementation. The provinces on the other hand, have tendency to prepare their own policies. A close complementarity between federal and provincial policies is essential to ensure all energies asserting in one direction. Actions including revision of NDCs, preparation of NAMA projects, and monitoring of GHG emissions are supported by federal ministry.

In case of agriculture, the provinces are in the lead seat. The Federal Ministry of Food Security and Research is mainly a strategic player which gives policy guidelines and dwells on inter-provincial issues, whereas the provinces ensure context specific planning and implementation.

The discussion with senior stakeholders at federal level brough the following main points on table:

1. Mitigation in agriculture sector including methane emissions reduction in paddy are included in revised NDCs for Pakistan (to be completed by March 2021). The Global
Change Impacts Studies Centre (GCISC, a dedicated national research centre for climate change studies) is updating the national Greenhouse Gas Inventory for the year 2017-18 and is coordinating the NDC priorities from multiple agencies on behalf of the MOCC.

2. Agriculture financing is rather limited at MOCC from global instruments (such as GCF, GEF etc.). The MOCC houses one project on agriculture (GCF, FAO Climate Smart Agriculture) which is not yet off the ground; there is a huge space for more actions, especially for projects on mitigation with adaptation co-benefits in agriculture. Climate smart rice is a high potential area for MOCC; earlier some efforts were made but a relevant partner could not be found.

3. NDC’s narrative on climate mitigation in agriculture sector is strong. However, unfortunately implementation remained weak. This is also because the policy narratives supported by MOCC in mitigation are more dominant in energy sector. The provinces need to take the lead on mitigation actions.

4. Monitoring, Reporting and Verification (MRV) of emissions is currently weak, but has been integrated in the activities under the currently ongoing revision of NDCs.

5. Planning Commission is strongly ascribing to promote “paradoxical agriculture” in Pakistan (pure organic ridge farming). This will be a holistic package deploying production technique through good soil management, reduced carbon emission, water efficiency and no use of chemical inputs. The initiative will be financed under Climate Adaptation Resilience Fund (CARF) and will be directly steered by the Commission.

6. Unfortunately, there is a lot of alienation between ministries of Food Security and Climate Change. An interested development actor may need to mediate such institutional gaps.

7. The Ministry of Food Security feels excluded from international negotiations on Climate Change, and from international financial agreements with the donors (e.g. UN agencies). The ministry, however, fully supports that agriculture is a provincial subject and the provinces are independent to negotiate and agree on projects and programmes meant for the provinces. On the other hand, MoCC also feels that it is also not taken on board while developing programmes, discussions, agreements, and in negotiations pertaining to agriculture, food security and climate change. Thus, both the ministries need to establish a formal mechanism for decision making and coordination.

5.3 Private sector

The private sector has long suffered in Pakistan during early 2000s from insecurity, political instability, and energy crises. The situation has, however, improved over years and the private sector has dared to bring innovation and new ideas in the market by fully exploiting windows of opportunities. It represents a development partner which is little explored in relation to local economic development. The private sector still finds risks for its operation in remote rural areas except when they have large commercial incentives. An important trend in recent years is that the private sector is increasingly interested in partnering with development actors for visibility; at the same time there is an increasing growth of social enterprises which have commercial strategies to maximize improvements in financial, social, and environmental well-being alongside securing their profits. These are often small in scale and have a greater ownership within social fabric. A few private sector actors relevant in the SLCP mitigation initiatives are described below.

5.3.1 Rice export companies/millers and their association

Several national and international rice companies export basmati rice from Pakistan. In the past, rice was being exported by the Rice Export Corporation of Pakistan. In 1980s the private sector could export rice. Later, these companies formed the Rice Exporter Association of Pakistan (REAP). REAP has 675 members and significantly influences rice export policies of the country. The international market is increasingly encouraging rice which is produced on sustainable production principles. Some of the international companies, therefore, are sourcing rice through their local partners from farmers who use improved agronomical and efficient
irrigation techniques in rice cultivation. Some of these companies also support contract farmers to produce rice following SRP Standard. These companies could be very useful partners of the government and other actors in efforts directed at reducing emission from paddy rice and could serve as a role model for other companies.

The REAP is a joint forum of over 1250 rice Small and Medium Enterprises (over 600 operate in Punjab) including millers. REAP plays crucial role on negotiating market for Pakistani rice (mainly Basmati). REAP includes all rice millers which is an influential size in promoting water efficient practices in the country. Hence an improved capacity of REAP on assuring compliance with the SRP Standard and water efficiency may serve a high PUSH factor in this project. REAP’s effectiveness can trigger a better export market for Pakistani Basmati rice with water efficiency label. The members of REAP may be highly influential in promoting desired SLCP packages and give scale. REAP’s member companies which directly work with farmers (covering around 25% of Punjab’s rice area), may also raise farmers’ awareness, and support them in introducing various proven water efficient techniques.

The members of REAP shared two important points:

- REAP gave a presentation, to the ministry of commerce, on its plans to potentially double the rice export. The main focus was on increasing productivity, through better seed, farm mechanisation and resource efficiency. They reportedly asked the government to set a target making at 30% of rice production in Pakistan sustainable as per SRP Standard. This was just an initial presentation and goals will be mutually agreed.
- Increase in rice export is also the goal of the government. This is an entry point, as per REAP’s view, to promote increased productivity with efficient use of resources, especially land and water. Excess land may be used for import substitution of agriculture products, import of which creates a continuous pressure on the trade account.

The main challenge with REAP, however, is that it will be a daunting task to convince all their member companies that adoption of SLCP packages will have a positive impact on their businesses and there are no economic risks involved for the value chain in the long run. So far, a project financed by Swiss Agency for Development and Cooperation (SDC) namely Water Productivity (WAPRO) operating in Punjab has been able to motivate around 10 big millers to join SRP – this scale needs to enlarge with a greater impact.

Further views from the rice companies’ interviews are summarised as follows:

1. Galaxy Rice Mills and Rice Partners Limited (RPL) are championing water productivity in Pakistan; they do this to sustain rice supply chain and to secure long-term economic interest of the business.
2. GHG mitigation is not yet their topic, however an important selling argument for EU consumers and customers. Some traders, however, may never change since their buyers do not demand for reduced GHG emission or other standards.
3. According to all the companies interviewed (notably Atlas, Matco, Engro), Minimum Residue Level (MRL) in rice is currently a more immediate worry for exporters than GHG emission mitigation. MRL issue directly affects exports and the government’s support to deal with the issue is essential.
4. The government needs to improve awareness and capacities in applying water productivity at farms’ level as an entry point to reduce emissions at scale. Private companies directly working with farmers have acquired good technical knowledge on water efficient practices.
5. Several companies have their own R&D set up and they continue to try to improve production systems. Trust deficit between public and private and increasing international trade requirements lead private sector to establish their own R&D systems.
6. There are huge data deficits in public and private sectors. High quality research is needed to fill knowledge gaps (and the private sector may also guide on topics for further research).

7. RPL and Galaxy are pioneers in applying the SRP Standard in Pakistan and many other companies are following (notably Atlas, Matco, Engro interviewed for the study). However, scale is relatively small. How will government adopt and apply this for millions? The Government has little knowledge of the SRP Standard but is interested.

8. Private companies feel that they are not getting support from the government for what they are doing. The government has large extension wings, whereas companies are also engaged in giving services and training to the farmers.

9. Trade-based negotiations could ideally be led by the government, especially on tricky issues such as water efficiency, socially responsible behaviour, MRL, aflatoxins etc. instead of leaving the rice companies alone with the buyers; it is important that the government recognises importance of such issues constraining revenue generation and supports companies in addressing MRL issue with more technical assistance.

10. The rice companies demand state of the art, internationally accredited, high quality labs for samples tests. The current facilities are not sufficient for supporting international trade.

5.3.2 Service providers

Skilled service providers provide different services to the farmers on commercial basis. These may include machinery and hardware dealers, machine operators (such as tractor operators, land levelling experts, harvesters), agriculture input providers etc. Strengthening such SMEs is important to include in the project plans. New or improvised range of services emerges from introduction of new techniques e.g., laser land levelling equipment, AWD tubes, new germ plasm in rice from research and seed industry, agriculture inputs, hardware fixers, and spare parts. The WAPRO partners interviewed under this study observed that there is an increasing number of service providers in the market to offer paid services to the farmers (esp. in precision levelling and hardware support). More competition is resulting in reducing cost of services and quality. The SLCP packages need to be calibrated to the capital and skill needs of the service providers. Service delivery can make or break the proposed packages for enhancing water productivity and mitigation of greenhouse gases. This is also important for financial sustainability after the project period without additional donor funding.
A few reflections from the interviews are as follows:

1. Training on mechanical maintenance and precision, access to necessary spare parts, and genuine inputs with quality control are necessary for service providers to serve rice farmers. Usually, SMEs have money for a machine or two and they start providing services without any training and thus do not make optimal use of technology for efficiency.

2. Micro-credits are not easily available for SMEs to do business or build asset capital.

3. Provision of subsidised services to farmers by government may leads to SMEs running out of business (e.g., provision of 50% subsidy laser land levelling to the farmers). Instead, the government could train SMEs and provide them subsidized machinery so that this service is sustainable in the long run and is affordable for the farmers.

4. SMEs need to access information on market demand for services. They are often indecisive where to invest for service provision (what kind of machinery, technology etc. to buy for making a living).

5.3.3 Middlemen / arhtees

There is a clear distinction between rice milling companies which directly purchase rice from farmers, and middlemen or arhtees who are closely engaged with farmers. Nearly 25% rice area is supported by rice companies who source rice from the farmers directly and provide them necessary agronomic advice. Nearly 75% rice cultivation area’s outreach is directly with government. This way, arhtees have large rice area under a direct access as the only market agents for rice farmers. A general perception is that these farmers are difficult to be reached for improved or non-traditional practices. While companies can lend a hand with the government to promote good practices by providing punctual agronomic advice, financial incentives and economic evidence, the only incentive with non-contract farmers is to make their own judgement on production economy. Arhtees therefore need to be taken very seriously as an important medium to promote technology. The companies interviewed for the study believe that this is doable.

Some of the key messages include the following:

1. A general perception about arhtees is very negative; they are money lenders, exploit farmers, and are least interested in ethical practices in the value chain. While this could be partly true based on farmers’ experience, it is necessary to find a few champions among arhtees and use this channel to change things. Make them believe that this will not reduce their profit margin nor burden them with extension responsibility.

2. A starting point is to sensitize arhtees and the government; the government could go a step further and introduce obligatory standards for arhtees to offer support.

3. What exactly arhtees may do? According to the companies, arhtees could provide AWD tubes to the farmers and give advice on how to use them; brochures in Urdu with drawings can be even more helpful. Arhtees may also note down farmers’ feedback for extension workers to assess if this channel is working and to treat negative advocacy well in time.

4. Include arhtees in relevant training programmes.

5.4 Academia and research actors

At federal level, there are dedicated research institutions such as Pakistan Agriculture Research Council (PARC), National Agriculture Research Centre (NARC), and Global Change Impact Studies Centre (GCISC) to uptake topics of national significance and offer solutions. At provincial level, there are provincial research bodies including for instance, the Kala Shah Kaku Rice Research Institute in Punjab, Dokri Rice Research Institute in Sindh, and research wings with the provincial agriculture departments. Dokri and Kala Shah Kaku are especially assigned the task of rice varietal development. In total 11 varieties have so far been registered by Dokri and 27 by Kala Shah Kaku. Federal research institutions (such as PARC rice research centre) have a job to evaluate rice varieties produced by provincial research stations and present to seed council
for approval. Smaller rice provinces (KP and Balochistan) do not have their own rice research centres, but they may benefit from work conducted in Punjab, Sindh and at federal level.

At the same time there are several universities with faculties and research programmes in different fields of agriculture including irrigation agronomy and water. The stakeholders have indicated several aspects of rice value chain needing research and validation. These include crop-water requirements, water efficient techniques, their impact on economics of value chain, and GHG emissions mitigation. At the same time, there is a high potential to share already available knowledge at a large scale for giving boost to replication. The universities may play a crucial role in both the areas in close collaboration with national and international research and academic community.

The main take homes from stakeholders’ discussion are as follows:

1. Governance regime and actors’ engagement on climate change and water sector strategies has generally improved. There is a strong narrative on adaptation to climate change or resilient agriculture systems – yet not in a systemic way
2. A focus on mitigation is generally missing in Pakistan’s research agenda, except in case of energy and recently to some extent in forestry.
3. There are no drought resistant varieties in rice specifically for DSR / AWD conditions. This came out as a common concern from public, private, research actors.
4. Agriculture bureau of statistics annually publishes details on each crop. These statistics, however, do not track adoption to new technology. There is no segregation between puddled, DSR or AWD rice. Without this segregation, it is difficult to monitor adoption rate and impact of technique and technology.
5. Farmers’ main concern is economic viability of crops they produce. Researchers often fail to produce convincing comparative examples from different practices. In addition, farmers are annoyed due to weeds in DSR and thus stick to puddled rice. Effective solution to weeds problem can help improving adoption rate.
6. Due to weak MRV systems for GHG tracking, no agency can tell with confidence if GHG emission mitigation targets set were met or not. Emission measurement technology is expensive.
7. Research agenda in public sector mostly include high efficiency irrigation techniques, their impact, new varieties etc. A larger interest is in climate resilient agriculture.
8. Except at GCISC, there is no focus on GHG mitigation aspects in agriculture research in Pakistan; GCISC does not have stake in the field with primary research; however, it is an important hub for information on GHG inventory and make use of data provided by the provinces. Provincial collaboration with GCISC needs to be strengthened.
9. Most of public research is supply driven and does not adequately benefit from farmers’ feedback and experiences.

5.5 International development actors

These may include international donors in Pakistan, bilateral NGOs and international research institutions supporting thematic areas relevant to SLCP related actions (e.g., water efficiency, improved water governance, water infrastructure and distribution, water & climate relevant polices, value chain development, and skill development). International development actors are also increasingly interested in partnering with private sector for promoting socially and economically viable businesses. Promotion of green technology has been more successful through private sector engagement and thus new types of consortia are emerging with public-private and international actors with complimentary knowledge sets. At the same time, many international development actors are changing their position and funding levels viz a viz COVID-19 outbreak and other factors, internal or external. However, all the international actors contacted for this study welcomed the ideas of mitigating SLCP from agriculture and showed interest in the topic.

Key points discussed during interviews are as follows:
1. It is important to recognize that rice and cotton value chains have a complex actors’ map engaging multiple actors and interests.
2. The agriculture and water sectors are victim of poor inter-agency coordination, data management, and sharing.
3. Water efficiency in agriculture has not been optimally achieved despite availability of techniques, good economy, and years of investment. GHG mitigation sounds a far-fetched issue under the current pressures that actors are managing to address.
4. There are good policies, but implementation of policies has face challenges. Pakistan is blessed with competent human resources; due to institutional failure they do not perform as expected.
5. The ingredients of SRP concept are aligned with the policy priorities of the government; therefore, promoting the SRP Standard stands a good change if policy makers are sensitized about its benefits. The SRP Standard needs to be introduced and adopted by the government as the officially preferred standard for exporting rice. The Punjab government is taking interest. There needs to be a neutral facilitator like BCI in cotton.
6. The NDC's claim that Pakistan emits only 0.84% of global GHG emissions, provides an excuse for some for not taking mitigation seriously. The new with updated figures and pledges of the government for mitigation targets, may facilitate serious discussion on mitigation.
7. There is no dearth of funds for large infrastructure. There is a need for investment in water sector for interventions that do not require brick and mortar.
8. Currently there are a few good examples in water efficient agriculture (e.g., by Better Cotton Initiative in cotton (BCI) and by WAPRO in rice), but upscaling is a challenge without collective action of the private sector and the government.
9. WAPRO is a good example worth upscaling including introduction of AWD technique in Pakistan. An additional layer with AWD could be mitigation co-benefits. There is a need for validating economics of different techniques.

20The 0.84% figure is anyway not comparable to global emissions or other countries because each country is sharing emission levels calculated from different years (since they are not bound by UNFCCC to share emission level from each year) and following multiple guidelines.
6. Actors’ participatory initiatives in the field

In response to recent national and international discussions on resource efficiency, some actors have initiated projects on climate smart agriculture in general and specifically on irrigation efficiency. Few projects indicted by stakeholders are summarised in this chapter.

6.1 Water Productivity in Commercial Agriculture (WAPRO)
The WAPRO project jointly funded by the Global Programme Food Security (GPFS) of the Swiss Agency for Development and Cooperation (SDC) and international companies is being implemented in seven districts of Punjab. Rice Partner Limited (rice miller, the local sourcing partner of MARS Foods) and Galaxy Rice Mills (rice miller, the local sourcing partner of Westmill) are partners in implementing WAPRO. WAPRO is based on Push, Pull and Policy components. The Push component supports rice farmers in adopting water efficient and other improved agronomic techniques following the SRP Standard. Water efficient techniques include introduction of AWD tubes, DSR and laser land levelling. The Pull component supports farmers in marketing rice produced with the SRP Standard. The Policy components is to study, document and disseminate best practices through research studies, workshops, and seminars especially for the policy makers. The Policy component facilitates dialogue among important stakeholders especially the farmers, policy makers and the market players.

6.2 Prime Minister’s initiative on productivity enhancement of rice
Financed by federal government, this interprovincial initiative operates in Islamabad, Punjab, Sindh, KP and Balochistan. It has started in 2019 and will conclude in 2024. The initiative’s core areas include (i) Coordinated research to develop rice varieties for climate resilient, high yielding, short duration, insect pest and disease resistant as well as crop production and protection technologies (ii) Popularize agricultural machinery, seed of improved varieties and fertilizer use for rice by providing subsidies and making demonstrations (iii) Demonstrate appropriate & mechanized production technologies for rice planting, water saving and harvesting etc. and (iv) Mobilization of multidisciplinary research & extension based scientific resources using print and electronic media, field demonstrations and field meetings etc. to improve rice production. This initiative aims to double average paddy yield for basmati and coarse rice through reducing yield gaps and increasing productivity and profitability through multifarious activities to compete at international market. Practically, all rice related agencies in Pakistan are involved in this project including PARC (coordinator) and provincial agriculture departments.

6.3 Transforming Indus Basin with Climate Resilient Agriculture & Water Management
Briefly known as Climate Smart Agriculture (CSA), this project aims at transforming agriculture in the Indus Basin by increasing resilience among the most vulnerable farmers and strengthening government capacity to support communities to adapt. Pakistan’s vulnerability is linked with its arid to semi-arid climate, as well as its high dependency on a single river system along snow and glacial meltwater for its agricultural water supply. This project will develop the country’s capacity to use the information it needs to adapt to the impacts of climate change on
agriculture and water management by putting in place state-of-the-art technology. It will build farmers’ climate resilience through skills, knowledge, and technology enhancement activities. It will also create a wider enabling environment for continuous adaptation. This project has an estimated lifespan of 20 years. CSA is a project financed by Green Climate Fund (GCF) and will be implemented initially in eight cotton dominated districts of Punjab including Lodhran, Khanewal, Muzaffargarh, Multan, DG Khan and three districts in Sindh.

6.4 Initiatives to improve irrigation infrastructure.

The Punjab Irrigated Agriculture Productivity Improvement Project (PIPIP) was designed to maximize productivity of available water by adopting a complete OFWM technological package for minimizing water losses at various levels of tertiary conveyance network and improving its application efficiency at the farm level. The PIPIP foresees an integrated development approach, envisages upgrading / developing unimproved and partially improved watercourses/irrigation schemes, promoting high efficiency water conserving technologies such as sprinkler/drip irrigation systems, laser land levelling, capacity building of all stakeholders, and undertaking action research for acquisition, indigenization, and pilot testing of improved water management interventions to suit the local conditions. The project has been sponsored by the Government of the Punjab and World Bank through Agriculture department and is being implemented since 2012 throughout Punjab.

The Sindh Irrigated Agriculture Productivity Enhancement Project (SIAPEP) is a World Bank funded Project. SIAPEP (2015-2021) aims to improve irrigation water management at tertiary and field levels in Sindh. The project supports efficient management of scarce water resources and improve tertiary and field level structures where water losses are highest together with promotion of high efficiency irrigation system and improved irrigation agronomy. This way, the project is designed to augment adaptation under different climate change scenarios in water stressed Sindh. The project’s core components include promoting drip irrigation system, water courses lining, laser land levelling and kitchen gardening.

The Khyber Pakhtunkhwa Irrigated Agriculture Improvement Project (KP-IAIP) is a 6-year long project jointly funded by the World Bank and farmers. The project has just begun in the field and is implemented by the OFWM directorate of the Agriculture department. The project will cover all thirty-four districts of KP including seven newly merged districts from erstwhile federally administered tribal areas. The project will work on both canal and non-canal irrigation systems and the activities include lining of canal and non-canal command area watercourses, harvesting of spring water into water storage tanks, capacity building and high efficiency irrigation system.

In Balochistan, World Bank has financed Balochistan Integrated Water Resources Management and Development project to strengthen provincial government capacity for water resources monitoring and management and to improve community-based water management for targeted irrigation schemes in Balochistan. This project comprises three components. The first component, institutions, capacity and information will support a gradual transition to IWRM approaches in Balochistan in line with the existing IWRM policy. It will support institutional restructuring, professional development, installation and operation of hydro-meteorological systems, and establishment of multi-agency river basin information systems that provide public access to all available hydrometeorological data for the two project basins (Nari and Porali) basins with community mobilization and participation.

6.5 Lessons learned from different initiatives

- It is easier to motivate famers if technology is easily available and affordable. Imported technology is expensive and complicated to operate for the farmers.
- The idea to harmonize monitoring systems in the rice sector (as it has been done in cot-
ton) is not feasible because in cotton farmers are organized in learning groups and in rice as contractual farmers; this is the reason that monitoring adoption rate in rice is not as easy as in other crops.

- Participation of the government line departments in the project activities is very useful to promote mutual ownership by Government and project support actors, and further replication of practices at large scale. The Government is leading water efficiency management agenda in agriculture.

- AWD tubs have proven very successful. For now, however these are not readily available in the local market. Upgradation of AWD tubes with sensors (to alerting farmers on cell phone for irrigating the field) will motivate farmers at large scale to adopt this technology.

- DSR results in more weeds. However, this method is still being practiced and is very effective in term of water saving. Therefore, effective methods for reducing weed need to be worked out.

- Use of Mechanical transplanters as an alternate to manual transplanting proved to be very useful in terms of number of plants per unit area (almost doubled), labour cost, and water savings. This must be promoted. Farmers are fast shifting from manual transplanting practices to DSR and mechanical transplanters.

- Rice millers are directly approaching farmers instead of through arhtees. This trend is contributing to change arhtees’ behaviour towards farmers. Rice millers directly sourcing rice from farmers also ensure good production standards and quality of purchased rice.

- Evidence sharing regarding economics of irrigation efficiency has a positive impact on behavioural change of the farmers.

- Rice value chain is complex involving multiple actors. Multi-stakeholder meetings prove meaningful linkages among actors.
7. Stakeholders’ perspective - Issues that need to be addressed

Under the study, the stakeholders were asked about their future, and what do they think is important for future of Pakistan in terms of enhancing mitigation pathway to addressing climate change. Most of their views describe a bigger picture, which may be then downscaled by UNEP for the actual intended objective of reaching the climate smart rice in the country. The stakeholders’ discussion is documented in this chapter:

7.1 Lack of research and evidence on low emission progress

Currently, none of the sectors (especially agriculture) in Pakistan have clear GHG emission reduction targets. No evidence could be found on NDC tracking since 2015. Talking to stakeholders, no agency could tell with confidence about NDC compliance since there are no monitoring tools. No agency has proper and consistent MRV systems. The statistics provided by the provinces are also not sensitive to monitoring low emission pathways. For instance, one example relevant to rice is that of AWD and DSR application. The GSISC requested provinces to precisely inform them on area under AWD/DSR practices so that they could calculate methane reduction using emission factors from other countries in the region. However, this could not be done since there were no segregated datasets on rice produced by conventional or non-conventional methods. The scientists depend on the government’s statistics reports on agriculture to calculate progress on emissions reduction. Any flaws at this level may lead to wrong calculations and interpretation. Therefore, an important step is to align statistical reporting to the needs of GHG emission MRV in the country.

A strong and methodologically reliable research is extremely important for decision making and finding right pathways of interventions. A rice relevant example came from FAO’s recent study on SMOG conducted at the request of the provincial government (FAO, 2020). The study demonstrated that it is not wise to place all the blame on rice stubble burning, which has 20% contribution to smog. This research was important since the earlier narrative took away the responsibility from other contributors to Smog. On the other hand, it also validated the urgency to control stubble burning and find solutions for alternate technology, even if with incentives.

The primary emission factors are not available in Pakistan. Most of data come from south Asian regional countries with agricultural practices like Pakistan. The IPCC methodology supports this. However, with the introduction of the Modality Procedures and Guidelines (MPGs) for the transparency framework for action and support under Paris Agreement\(^2\), parties need to submit their first biennial transparency reports and national inventory reports by 31 December 2024. A Common Reporting Format is being negotiated. In 2023 Pakistan will enter Global Stocktaking, which is a five-yearly review of the impact of countries’ climate change actions under the Paris Agreement. All this requires that Pakistan must eventually switch to submitting annual GHG inventories. The GCISC under the Third National Communication, is planning to support the MOCC to prepare inventories from 1999-2020 as per the 2006 guidelines of IPCC. Sooner than later, Pakistan needs to create its own strong capacities to conduct reliable GHG emissions inventories by source and removal by sinks. There is a need for a precise system of inventory with a data management and communication mechanism which has minimum drudgery for the experts involved remains important.

\(^2\)https://unfccc.int/sites/default/files/resource/i23_0.pdf
7.2 Improved governance regime and actors’ engagement

The biggest achievement of the Paris Agreement is that it reflects a global consensus that climate change is real and urgently needs to be addressed by all states, industrialised and developing. To fulfil expectations of the global community, it is important to build trust at the national level. Trust will be cultivated through political and legal accountability and making domestic mechanisms strong, ambitious, and responsive to the global demand. Parties to the United Nations Framework Convention to Climate Change (UNFCCC) recognize that if domestic governance is not accountable, ethical, and transparent, public trust will continue to erode and national interest to adopt climate solutions for a greater impact will dwindle. Therefore, it is essential that national-level implementation processes engage both the likely winners and the potential losers of this transformation. Policies need to be both ‘green’ and ‘just’, including concrete measures in core revenue generation sectors in the countries (e.g., agriculture in case of Pakistan).

Similarly, the issue of climate justice and rights has emerged as a very important domain within national commitments and climate governance. Countries like Pakistan recognize the importance of adaptation and loss and damage and strongly focus on these in present and future negotiations. If other human development issues are not attended adequately, the discussion on mitigation may be completely side-lined. Multi-stakeholders need to be brought together and convinced that there are clear overlaps between mitigation pathways and social and economic well-being of the nation.

All the stakeholders interviewed unanimously urged for a multi-stakeholder approach. The role of businesses, districts, provincial and federal governments, civil society organisations, academia, researchers and think tanks – everyone’s commitment is important. The private sector has never been more active in Pakistan with their climate commitments than now, even when many of them may not label this. There are clear examples, though at small scale, of complimentary relationship between agri-business viability and climate change adaptation and mitigation. One of the stakeholders indicated that many emerging economies see climate change as a major barrier and threat to their economic development. Individual businesses relying on agricultural supply chains see this even more clearly and ominously, as explained by national rice companies, and thus are ready to take steps in the right direction.

Based on the discussion with government officials, it seems that climate governance now, is limited to ticking timelines on national commitments. The provinces are little involved in taking the pressure on meeting national commitments and managing institutional governance to meet ambitious goals. However, the way government is managing revision of the NDCs, reflects a high commitment to bring multiple stakeholders on board. There are four main groups to manage GHG inventories in the country as per 2006 IPCC guidelines and prepare NDCs:

- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture, Forestry and Other Land Use (AFOLU)
- Waste

All these sectors and subsectors are managed by working groups from multiple stakeholders:

1. **Working Group on Energy.** Ministry of Energy/ NEECA.
   National Electric Power Regulatory Authority
   Hydrocarbon Development Institute
   Provincial departments (energy, transport)

2. **Working Group on Agriculture and adaptation**
   Ministry of National Food Security and Research/ NARC
   Global Change Impact Studies Centre
   Provincial agriculture departments

3. **Working Group on Industrial Processes**
   Ministry of Industries Production
   Provincial industry departments

4. **Working Group on Land Use Change & Forestry and adaptation**
   Ministry of Climate Change
   Provincial forest departments

5. **Working Group on Waste**
   Ministry of Climate Change- Environment Wing
   Ministry of Industries & Production
   Lahore & Rawalpindi waste management company

On a perpetual basis however, there is a need to identify sectors / subsectors, targets and improve accountability of all the actors and institutions. Two steps may be useful in this regard:

1. The working groups identified for NDCs may be notified and made permanent with a change of roles for a longer-term climate governance and tracking. This will be very helpful in the new reporting modality.

2. More stakeholders (especially from civil society, industry, and academia) be brought into these groups. This will further improve monitoring mechanism for the future and encourage necessary overlaps between humanitarian / livelihoods needs and mitigation.

**7.2.1 Readiness among actors within agriculture sector**

The 2006 IPCC guidelines to manage GHG inventories identify AFOLU into following subcategories:

- Aggregate sources and non- CO\textsubscript{2} emissions from land
  - Emissions from biomass burning
  - Liming
  - Urea application
  - Direct NO\textsubscript{2} emissions from manure management
  - Rice cultivation

23[https://www.ipcc-nggip.iges.or.jp/support/Primer_2006GLs.pdf](https://www.ipcc-nggip.iges.or.jp/support/Primer_2006GLs.pdf)
• Harvested wooded products
• Others

Thus, rice biomass and livestock are clearly integrated in these categories and it merely about gearing our existing energies in a proper direction.

The national context and narrative are always inclined to agricultural productivity enhancement at all costs. None of the sectors (especially agriculture) have GHG reduction targets. In a country like Pakistan with 88th position among 107 global countries on hunger index24 over 40% stunting25 and 38.8%26 population living under multi-dimensional poverty, the discussion around mitigation is not an easy task. Most of the stakeholders feel occupied by other pressures around revenue generation, production targets and human development needs. They are also faced with limited capacity on this issue. A more useful approach may be to introduce mitigation methodologies with adaptation co-benefits. This is highly applicable for rice. Farmers need to recognize that they can acquire same or higher yield (or a non-significant loss) with different method, with less water, less emission, and less cost. Until the farmers see an economic benefit, they will not adopt better and sustainable technologies. The stakeholders believed that all of them jointly need to take farmers into confidence (public, private, research actors) and giving non-contradictory messages is the key.

What is the most plausible entry point for mainstreaming mitigation in agricultural sectoral priorities? The stakeholders clearly identified water as a red thread to this discussion! "We assert our energies on water efficiency because water is in short supplies and is affecting our production. Not because we believe that more can be produced with less water even when we have enough water. The case will, however, prove when farmer has enough water, yet he chooses to apply water efficient methods". A senior stakeholder from Government of Punjab. He referred to a graph on rice statistics from Pakistan where Punjab’s yield is lower when compared to Sindh, Balochistan and KP, despite that the irrigation regime in Punjab is more liberal when compared to other provinces (Figure 12).

There are voices that farmers will not go for water efficient production due to our preaching on mitigation co-benefits. The farmers will go for it for their economic viability. Therefore, an entry point to this debate is that we prove that farmers are providing water in excess to crop needs – and less is better may also lead to other benefits.

Figure 12: Pakistan rice statistics: Area against yield (2019)

<table>
<thead>
<tr>
<th>Area (mill acres)</th>
<th>Yield (mill tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Punjab</td>
<td></td>
</tr>
<tr>
<td>Sindh</td>
<td></td>
</tr>
<tr>
<td>Balochistan</td>
<td></td>
</tr>
<tr>
<td>KP</td>
<td></td>
</tr>
</tbody>
</table>

24https://www.globalhungerindex.org/pakistan.html
25National Nutrition Survey, Pakistan 2018
26file:///C:/Users/Dr.%20Arjumand%20Nizami/Downloads/Multidimensional%20Poverty%20in%20Pakistan%20(2).pdf
The stakeholders reported that in Pakistan several break throughs have been made in the livestock sector. There are few global solutions, for example feed rationing, which have proven successful also in Pakistan. However, there are no tools to monitor emission reduction and report. Agriculture has a long way to go in mitigation and adaptation. Actors in Pakistan pursue climate resilient agriculture which is too basic and that too is still weak and not systemic. Future projects therefore must focus on reducing methane emissions (including livestock and rice) in a farming system development approach so that capacities created are relevant for the whole sector.

7.2.2 Capacities in climate smart agriculture
All the stakeholders emphasised that water efficiency in agriculture is the most relevant and practical entry point to reduce GHG emissions from rice. A direct approach to GHG mitigation may scare actors’ interest since there is no capacity on the subject in public and private sectors yet. When the entry point is as straight as promoting AWD – all the challenges around AWD application may be integrated into a well-articulated extension programme through the tools like farmer field schools.

One of the highest priority capacity building area is research. Research institutions have limited capacity to deal with GHG emissions and mitigation issues in agriculture. The stakeholders believe that training alone or gadgets only is not a solution. Having said this, research needs to be equipped with necessary equipment but also an excellence to deploy them in the right places in a right manner. The private companies indicated the need to also have state of the art labs in the government research facilities to increase quality standards and demand for Pakistani rice.

The need for varietal research is another priority area indicated by several stakeholders. In the absence of drought resistant and early maturity varieties, farmers are reluctant to use transplanted rice varieties under AWD or DSR conditions. Special varieties which suite drought conditions or have less water requirement are essential for promoting water efficiency and low emissions agenda.

Another capacity building area is to provide technical assistance to the farmers on sustainable rice production chain with less water, improved soil fertility management and better moisture retention. The farmers may also need a few simple gadgets to monitor their progress (e.g., AWD tubes with sensors, mobile apps etc.).

A proposal from stakeholders is to hold conferences for different stakeholders on different relevant topics. As a starting point, a conference dedicated to the SRP Standard for policy advocacy is important to bring multiple arguments together. Sustainable Rice Platform is a UN embedded initiative. The governments need to know this and offer support in promoting standards promoted by SRP. Cross learning between Better Cotton Initiative and SRP is also important since Better Cotton stands at an advanced stage and SRP may need to reach at the same level where both government and companies feel the need to ensure compliance of the SRP Standard.

7.2.3 The SRP Standard needs to be promoted
There is an increasing pressure from the export market, especially in EU (Mars, Harba27, Vee Tee Rice, VSR Rice, Westmill etc.), to produce rice with sustainable practices. The rice export companies interviewed believe that the SRP Standard is becoming more and more obligatory

27 80,000 tons (8-10 sourcing agents and millers in Pakistan)
from EU customers. The millers in Pakistan who trade rice to EU are around 30-35. Of them, around 30% are SRP registered. As a low hanging fruit, an objective pathway is to promote the SRP Standard and integrate the GHG emission reduction agenda within SRP frame.

One of the most frequent messages from the stakeholders was to invest in awareness raising of farmers as well as government in favour practices promoted by SRP. However, most of them suggested that this is not just about preaching. It is about presenting some convincing facts and figures (especially economics of water use efficiency in rice through AWD / DSR). Both the farmers and private companies are interested in viable businesses. Farmers are clever and know what is good for their business. Companies believe that the growing awareness among private sector shows that the market will search for SRP farmers when international demand rises. The government is interested in revenue generation and manage already stressed water resources. All these interests can be brought together for creating successful collaborative models.

For the farmers, the most convincing argument is the increased production with same or less amount of water using precision land levelling, AWD and DSR techniques. The government is aware of the SRP Standard and is interested to know more. The narrative from SRP facilitators (such as WAPRO partners), however, needs to be adapted. Instead to beginning by presenting an exhaustive list of 41 key requirement under the SRP Standard in the beginning, it is necessary to make the pillars more prominent and match these with already existing policy narratives of the government so that they see a reason to embrace SRP with interest. Table 3 shows minimum incentives attached with the SRP Standard for the government and farmers:

Table 3: Why should stakeholders adopt or encourage the SRP Standard?

<table>
<thead>
<tr>
<th>Farmers’ incentives to comply with the SRP Standard</th>
<th>Government’s incentive to encourage the SRP Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Advisory services from SRP member companies / extension agents at the doorstep</td>
<td>• Export enhancement, growing EU demand for SRP rice.</td>
</tr>
<tr>
<td>• There is an increasing demand for SRP (even when regular rice market drops), market security.</td>
<td>• Production is environment and resource friendly (less water, inputs)</td>
</tr>
<tr>
<td>• Better economics of yield with water productivity (but proven by economic analysis and studies).</td>
<td>• Reduced GHG emission</td>
</tr>
<tr>
<td>• Sustainability of rice value chain</td>
<td>• Domestic and export production will increase</td>
</tr>
<tr>
<td></td>
<td>• Other intangible benefits and moral support (SDGs, climate change related policy obligations)</td>
</tr>
</tbody>
</table>

Another view is about accreditation or certification. When mass number of farmers (contract or free) begin to follow the SRP Standard, there needs to be a system of minimum verification or accreditation to verify the claim that the farmers do apply best standards practices. This is to raise SRP’s standard from voluntary to relative obligatory. The SRP compliant companies suggest that they need several supply chain members on their side – this will lead to more clients for the farmers, a great pull for the SRP Standard and a greater policy case for the government. The WAPRO project is making efforts in this direction. Till the government is ready to play a role of an enabler and facilitator to promote SRP, it is necessary to have a neutral facilitator in the country also mandated to train interested parties.

The practitioners and extension workers believed that it is important to involve extension agents (public and private) in a stepwise extensive training for a greater sustainability. Verbally, everyone within rice value chain who knows SRP and observes results from WAPRO partner companies, appreciates the effectiveness of the SRP Standard (of which water productivity is the most important and prominent pillar). However, these are endorsed into a policy document, no success in uptake of SRP is expected in the long run. Field replication from one farmer to
the other cannot guarantee upscaling. Farmers continue to fall back into their comfort zone of traditional practices.

7.2.4 Diagnose and plan for addressing existing research gaps

The stakeholders report lack of diagnostic analysis in agriculture technology development. At times technology fails due to other factors, however a negative advocacy kills the entire case for addressing the problem and take remedial actions. The researchers engaged in this study hinted a few priority areas requiring research:

**Varietal development:**
There is a need for drought resistant varieties in Pakistan which may have a good export value (e.g., Basmati rice varieties) and which perform better in AWD and DSR conditions. As a welcome news, the development of drought resistant varieties for DSR is in process and may be expected soon from rice research institutes. Variety development takes years – but it is still worth the time investment. Variety development process is constrained by access to reliable genetic resource. The public rice research actors need to buy germ plasm and lines from reliable sources with desired genes in priority areas. IRRI used to supply these for free in the past. However, now since Pakistan is no more a member of IRRI, and perhaps the policies have changed on both sides, this free access has been blocked.

**MRV reporting:**
There is a need to improve MRV system and discover an automated system for regular progress of emissions reduction by source. The researchers also felt a huge gap in research and monitoring facilities. A simple equipment such as methano-meter is not available in the provinces and at PARC to monitor methane. Country’s own emission references levels are important for the future. Another recommendation is to regularly provide field evidence of adaptation and mitigation from the provinces so that MOCC may include this in their reporting.

**International collaboration:**
It is also important to bring international development agencies on board to support research and development activities in evaluation, analysis and developing technology packages for improving water use efficiency, monitor water resources, and reduce GHG gases in Pakistan.

**Further research on different aspects of AWD / DSR:**
Research on the challenges associated with alternate irrigation regimes including AWD tubes and DSR is still inadequate in Pakistan. These are water efficient methodologies that need to be further refined and adapted to Pakistan’s conditions. In addition, it is very important to study economics of these methods to convince farmers and enhance adoption rate.

**Reliable, accredited, internationally recognized labs:**
A very genuine demand from private sector is to enhance quality and reliability of agriculture research laboratories. The private sector requires access to labs. The labs need to be upgraded and accredited to the international standards required by most clients so that the companies do not have to take their samples abroad for analysing MRL, aflatoxin or other tests.

7.2.5 Policy issues

The private sector is concerned about future sustainability of rice value chain. There are also fears whether the government will permit rice cultivation in the long run or not. There is an ample space for policy dialogue to achieve a win-win position to sustain rice value chain with improved water use efficiency. Several policy issues need to be gripped from the top decision-making level. For instance, the system only talks about adaptation and does not focus on reducing emission and mitigating climate change effects.
The most important policy element in rice value chain is public-private partnership and collaboration. Interviews with rice companies were eye opening. Companies are promoting sustainable rice production, introducing water use efficiency, struggling to find their way through preventing MRL, and taking farmers into confidence on good standards. In a highly forward-looking manner, the message from the companies was that the private sector must stay ahead of government to ensure water use efficiency in rice for sustaining supply chain. The government is highly occupied with introducing structural efficiency in irrigation system. To companies, improvement in conveyance system should not be a disincentive to promote water productivity and behavioral change to use less water even when it is amply available.

Several stakeholders commented on provision of subsidized technology by the government to encourage adoption by farmers. It works for some time; however, it is necessary to withdraw subsidy when there is enough demand and encourage market forces to take over. A continuous subsidy may be counter-productive since the scale may only be achieved through the market. The government as a regulator may support through skill development, pricing, import subsidy, and low-bracket taxation.

The interconnectedness among multiple issues can be an opportunity. There are two topics as an example. SMOG is a big policy issue at the moment and gains hype during rice harvesting weeks and later during winter. This is an opportunity to introduce improved harvesting and seeding techniques, motivate policy makers to subsidize combined harvesters, happy seeders etc. reduce residue burning and thus reduce temporal emissions. At the same time, the stubble may be sold, rice fields’ readiness of wheat may be quickened and at the end of the day, it will be a win-win and cost-effective solution. Water efficient rice production is another such lead. It addresses sustainability of rice value chain, reduces supply-demand deficit for water, increases yield and reduces GHG emissions from rice. The stakeholders suggest defining SLCP packages around such issues for multi-actor engagement.

Research, validation, and knowledge management remain important to enhance motivation of late adapters. Public sector researchers and stakeholders felt a significant lack of fiscal space in their work. Sensitization of policy makers and decision-makers is essential for them to see the value in certain investments. There is a continuous disconnect among various actors and organizations (e.g., federal, and provincial, research and field etc.). There are various parliamentary committees and tens of actors in agriculture who have no joint forum to discuss issues and acquire understanding on innovative concepts. Climate change, reducing emissions, adaptation and sustainable agriculture are some of the least known topics among agriculture actors. Flow of information from one actor to the other is hardly mediated.

Pakistan needs to prepare itself for 2023 when the country will be asked to report mitigation compliance. There are no mechanisms of reporting from provinces to the federal. There are needs for creating reliable MRV mechanism or tools for data. Pakistan specific software-based technology is needed which can generate automated GHG emission data. Several standards which were voluntary in the past, may become obligatory as pressure on resources increases. Institutional and capital investors will look for green economy not only in the international trade but also local market.

7.2.6 Views of stakeholders concerning cornerstones of the project strategy

- **An institutional set up for a potential UNEP project** is suggested to be a consortium-based set up for the project with multiple institutional strengths (research being just one). Engaging multiple stakeholders from the beginning is important. The private sector offers an access to their corporate farmers, several thousands of acres under sustainable rice value chain practice and knowledge base on SRP, access to partnership alliances and corporate social responsibility.
• **Take major millers on board**, who are directly working with farmers. The examples include RPL, Engro, Atlas, Galaxy, Matco etc. These millers are already championing best practices in rice cultivation through the farmers and are proponents of the SRP Standard. They may create a push and pull effect to promote good standards. The private companies are of the view that if private sector in rice wishes to sustain supply chain and stay in business, there is no harm to give a small premium to the farmer for a longer-term benefit. This mindset of the companies is very encouraging. A possible future project may take this financial contribution into account and in return enhance visibility of these companies as an incentive.

• **Arhtees can act as a push to promote water productivity** as suggested by rice millers. The opportunity is that the arhtees are very close to the farmers. Farmer would listen to arhtees because they serve as the cash machine and the only market strategy of the farmers. Arhtees will need to first internalize that by promoting AWD, their profit will not reduce. Farmers’ volume will also not reduce (perhaps increase). They may be given training, education on results from economic research, and AWD tubes for distribution to support the agenda.

• **The project must not shy of engaging big farmers** since they are influencers in the value chain and smaller farmers try to copy from them. Workshops, training, capacity building and dialogues within the provinces engaging all types of farmers is essential. It is at farmers’ level where readiness level will improve for better practices and reduced GHG emissions. Low hanging fruits, e.g., making intermittent irrigation more common, is the easiest way to reduce emissions because farmers feel the impact of water stress and will be easier to convince on this agenda.

• **A pilot project is very important to build a stronger base for a national project.** The key elements of a pilot project may include capacity building of extension services (public and private), demonstrating technology, conducting economic comparison studies, and by creating a culture of awareness from farmers to consumers. The interventions of the provincial OFWM departments on water efficiency may serve a great departure point in the project.
In total 168 rice growing farmers were interviewed in four provinces. Their average land holding was 27 acres (minimum 2 to 110 acres maximum) and 21 acres under rice (minimum 2 to maximum 98 acres). An inventory of interviewed farmers’ farm assets illustrated that a farm commonly has one tractor, a trolley, and a spray pump. An average ownership of rotavator, disc machine, combined harvester, thresher, and stubble chopper is nearly 11% at national level (with scattered ownership of these machines).

Use of farm manure:
An average number of cattle held by the farmers is 8 (highest in Balochistan with an average 14 and the lowest in KP with an average 5 heads). As per farmers’ response, 59% of animal dung is used as farm-yard manure, followed by fuel for self-use (26%).

Source of irrigation:
Major source of irrigation is tube well with share of 34%, followed by combination of both irrigation sources i.e., canal and tube well (33%) whereas 33% farmers exclusively use canal irrigation (Figure 13). This suggests that reliance on canal irrigation is secondary to the tube wells and thus water saving techniques may have a direct impact on saving costs since canal water is highly subsidised.

Canal is major source of irrigation in Balochistan (90%), Sindh (80%) and KP (62%) whereas tube well holds substantial share as irrigation source in Punjab (52%). A large segment of farmers in Punjab reported using both irrigation water sources followed by KP (Figure 14).

The difference in case of contract and non-contract farmers is significant. Contract farmers are using tube well as their main source of irrigation (63%) or combination of tube well and canal water. Non-contract farmers are mostly inclined towards canal water as the main source of
irrigation, 55% of the non-contract farmers are using canal as source of irrigation.

**Figure 14: Source of irrigation by province (%)**

<table>
<thead>
<tr>
<th>Province</th>
<th>Canal</th>
<th>Tube well</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>KP</td>
<td>62%</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Punjab</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Sindh</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Balochistan</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Awareness of weather changing patterns:**

Awareness on changing patterns of weather is profound with 93% farmers (Sindh 100%, Punjab 93%, KP 90% and Balochistan 85%). The farmers shared the following examples of issues in crops with changing weather patterns:

- Yields drop due to lodging, pest attack, shriveled grain (locust or other pests)
- Rise in temperature affects crop at flowering stage
- Black grains due to heavy / torrential rain or untimely rain
- Sowing and harvesting time has noticeably changed

Awareness regarding GHG emissions is limited. Only 17% farmers in Pakistan express awareness of GHG emissions from rice sector (mainly in Punjab). All the contract farmers are aware of weather changing patterns (100%) whereas 89% of non-contract farmers are aware of weather changing patterns. However, the difference of knowledge among contract and non-contract farmers regarding GHGs are significant. Only 7% of non-contract farmers are aware of GHG emissions from rice; conversely, 27% of contract farmers are aware of GHG emissions from rice.

**Water saving technologies: Awareness, utilization, and satisfaction:**

At country level, 61% farmers expressed awareness of water saving technologies (**Figure 15**). Of these, Punjab leads with 66% farmers expressing knowledge of water saving techniques in agriculture and that rice cultivation is feasible with water saving, followed by Sindh (55%), KP (24%) and Balochistan with 14% (**Figure 16**).
The difference among contract and non-contract farmers is significant; 86% of the contract farmers are aware of water saving technologies as oppose to 39% farmers among non-contract farmers.

In total, 43% of the farmers are utilizing these techniques (Figure 17). Of these 90% are in Punjab and 10% in Sindh. None of the farmers reported having used water saving techniques and technologies. The difference between contract and non-contract is important here. A large percentage of non-contract farmers (89%) have not used water conservation technologies. Conversely, 80% of contract farmers have used these technologies to reduce water demand in rice cultivation (Figure 18).

72% of farmers using these technologies reported their satisfaction with technologies they are using (71% in Punjab and 86% in Sindh). When asked which technology were they using, mainly precision land levelling through laser technology was mentioned by all the farmers (including 15% non-contract farmers). Use of AWD tubes was mentioned by 73% of contract farmers. No other farmers reported using AWD technique, which suggests that companies have a large influence on promoting AWD tube technology for saving water. In Punjab and Sindh, farmers
observed 22% and 14% water being conserved, respectively. Four major benefits were reported by the farmers using improved and water saving technology:

- High yield and quality of crop despite reduced irrigation
- Less water consumed.
- Cost saving due to reduced tube well hours.
- Reduced need for labour and hassle

**Key barriers in adopting water saving technologies:**
Three major problems were highlighted by the farmers i.e., high cost of technology (45%), lack of awareness about different technologies (45%), and non-availability of technologies (43%). 55% of contract and 45% of non-contract farmers assume that non-availability is one of the major problems in adoption of water conservation technologies. Poor quality and effectiveness of these technologies were reported as major hurdles in adoption primarily reported by limited number of farmers. In KP, 76% farmers recorded lack of awareness being a major barrier followed by the issue of access to water saving technology (52%) and cost (33%). A similar trend was noted in Sindh and Balochistan.

**Table 4: Key barriers identified by farmers in adopting water saving technologies**

<table>
<thead>
<tr>
<th>Data source</th>
<th>Non-availability</th>
<th>Low quality</th>
<th>Lack of awareness</th>
<th>High cost</th>
<th>Ineffectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>43%</td>
<td>5%</td>
<td>45%</td>
<td>45%</td>
<td>2%</td>
</tr>
<tr>
<td>KP</td>
<td>52%</td>
<td>10%</td>
<td>76%</td>
<td>33%</td>
<td>10%</td>
</tr>
<tr>
<td>Punjab</td>
<td>39%</td>
<td>5%</td>
<td>31%</td>
<td>48%</td>
<td>0%</td>
</tr>
<tr>
<td>Sindh</td>
<td>45%</td>
<td>0%</td>
<td>45%</td>
<td>40%</td>
<td>10%</td>
</tr>
<tr>
<td>Balochistan</td>
<td>55%</td>
<td>5%</td>
<td>85%</td>
<td>50%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Majority of users of water saving technology at national level paid for water saving techniques (57%). Free technologies are observed only in Punjab (55%, especially among contract farmers). No free technology beneficiary farmers were found in KP, Sindh and Balochistan.

**Which technologies suit the farmers best:**
At national level, precision land levelling is said to be most suited by 61% farmers, followed by DSR and AWD tubes (14 and 15%). In KP, 95% farmers voted in favour of precision land levelling and 24% favoured DSR. With a similar trend in Sindh, precision land levelling is most voted (55%) followed by DSR and AWD (5% each). In Punjab, the most popular technology is precision land levelling (61%), followed by AWD tubes (20%) and DSR (16%). In Balochistan farmers vote for precision land levelling (30%) followed by DSR (10%) and AWD tubes (5%).

**Table 5: Which technologies are most favoured by farmers**

<table>
<thead>
<tr>
<th>Data source</th>
<th>Laser</th>
<th>Raised bed</th>
<th>Zero tillage</th>
<th>DSR</th>
<th>AWD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
<td>61%</td>
<td>0%</td>
<td>0%</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>KP</td>
<td>95%</td>
<td>0%</td>
<td>0%</td>
<td>24%</td>
<td>0%</td>
</tr>
<tr>
<td>Punjab</td>
<td>61%</td>
<td>0%</td>
<td>0%</td>
<td>16%</td>
<td>20%</td>
</tr>
<tr>
<td>Sindh</td>
<td>55%</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Balochistan</td>
<td>30%</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
<td>5%</td>
</tr>
</tbody>
</table>

There are differences among contract and non-contract farmers. AWD tubes and DSR are endorsed by 86% and 65% of contact farmers when compared to only 14% and 35% of non-contact farmers. Laser land levelling is endorsed by contract and non-contract farmers by 59% and 41% respectively. At national level, 63% of farmers presume that using water saving techniques will improve their socio-economic conditions. Farmers with a perception that water conservation
technologies will have no impact on socio-economic status are 45% in Sindh, 38% in Punjab, 23% in KP and 25% in Balochistan. More contract farmers (77%) than non-contract farmers (56%) believe that water efficient rice cultivation makes a positive difference to their livelihoods.

Farmers motivating other fellow farmers for using water efficient technologies: 80% farmers in Pakistan are optimistic toward motivating other fellow farmers for using new technologies, especially for switching rice cultivation to water efficient regime (90%, 75%, 80% and 90% in KP, Sindh and Punjab and Balochistan respectively). These include 85% of contract farmers. In total 10% farmers reported high adoption of water efficient techniques among fellow farmers followed by 29% medium and 30% reported low adoption of water efficient techniques.

Farmers in all the provinces showed positive response and interest in motivating other farmers. 72% farmers in Punjab reported that their fellow farmers (friends, relatives) are already adopting water saving techniques of different types (of which the most frequent ones are laser land levelling, followed by AWD tubes, DSR and mechanical transplanter). Other three provinces have also reported adoption at different levels and strengths.

Recommendation for a future project by the farmers: The farmers were asked what they would wish to see in a project on rice in future?

- Teach best crop management techniques (12%)
- Training of farmers but not one-time; it must be a series and continuous training (16%)
- Research on improved seed and commercialization (18%)
- Awareness raising of farmers on technology and adequate advisory (21%)
- Improved access to technology and advice (27%)
- Subsidy to the farmers in water saving technology (31%)
- Knowledge about economics of technology (37%)
- Cost effectiveness of technology (38%)
- Expert service providers to immediately help in technical issues (41%)

SLCP interventions preferred by the farmers: The answer to this question was derived through multiple questions asked from farmers. Following priorities were indicated:

1. Help farmers in applying AWD and other suitable techniques for water saving – with improved economics of rice crop.
2. Improve access to water at tail ends to make irrigation more reliable. For this, implement strict water saving measures at head and mid of the canal system.
3. Well-designed schematic training programme for the farmers on rice / crop agronomy, irrigation management and safe harvest management.
4. Support farmers in preventing open burning of rice residue (and other agricultural waste) and prepare fields for agriculture.
5. Solve weeds issue from DSR / AWD for encouraging faster adoption – herbicides is an additional economic load on the farmers to sustain value chain.
6. Make service provision within rice value chain cost effective and readily accessible.
7. Regulate prices offered by companies and arhtees, especially for the farmers who follow water efficient or new technologies.
9. Proposed intervention packages in SLCP

Based on stakeholders’ interviews and socio-economic survey with farmers, it is evident that the best entry points for SLCP interventions are those which are embedded in the current national narrative and thus are easier to propel interest and motivation among stakeholders. SLCP intervention may capitalize on the current readiness on ground (Figure 19):

1. The current policy spaces for innovation regarding sustainable rice standard / SRP
   a. Policy dialogue on mitigation potential and solutions in agriculture
   b. Strengthen MRV, reference emission levels, and prepare for new regime of MRV reporting post 2023
   c. Special support, green loans and tariff support for “green” rice

2. Rising enthusiasm for improved water management, conservation, water productivity in agriculture
   a. Varietal research and development to improve drought tolerance
   b. Research and international collaboration to address and remove barriers
   c. Awareness raising on low emission and SRP rice for local and global markets

3. A critical mass of farmers and pilot sites with a high success rate on use of AWD tubes to increase irrigation efficiency in rice
   a. Address challenges reported by the farmers for upscaling AWD
   b. Awareness raising of farmers on sustainable production practices
   c. Engaging farmers on the most important issues they face

4. The matter of smog during rice harvesting season in autumn / early winter
   a. Technology development for easy removal of residual waste
   b. Ideas for converting crop residues to useful material (e.g. biochar)

Figure 19. Entry points for SLCP interventions
Indicative intervention packages leading to mitigation of SLCPs are as follows (Figure 20):

1. Technology development and transfer to reduce emission from agriculture
2. Capacity development among stakeholders in SRP and related knowledge fields
3. Technical assistance for data management (ICT, MRV)
4. Develop financial mechanism to support SLCP packages
5. Research and development on support areas leading to mitigation

**Figure 20. Indicative SLCP Packages and Interventions**

<table>
<thead>
<tr>
<th>Technology development and transfer</th>
<th>Capacity development</th>
<th>Technical Assistance for data management</th>
<th>Develop financial mechanism</th>
<th>Research and development</th>
</tr>
</thead>
</table>
| • Provide low emission and sustainable rice technology  
  ✔ Water efficiency  
  ✔ Harvest/Post Harvest processes  
  ✔ Fertility management  
  ✔ Others  
  • Develop appropriate technology | • Increase awareness of climate change on rice sector (government, farmers, and other stakeholders)  
  • Training on SRP Standard  
  • Use and application of technology | • MRV strengthening and reporting system  
  • Develop ICT to help the officials and other stakeholders  
  ✔ M&E system to monitor SRP Standard & Performance indicator  
  ✔ Market access | • Develop Financial Model to help farmers access crop financial/ incentives and crop insurance  
  • Green loans for mitigation in agriculture | • Variety development and patent rights  
  • Scope for mitigation in agriculture and solutions  
  • Economics of technology solutions |
10. Barriers in application of SLCP packages

For the proposed SLCP packages to be successful, it is important to think of present and potential barriers in advance. The following chart is a result of socio-economic survey and interviews with the stakeholders (Figure 21).

**Figure 21. Potential barriers to be considered in rice sector and future interventions**

<table>
<thead>
<tr>
<th>Technology development and transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>• High cost of technology</td>
</tr>
<tr>
<td>• Lack of awareness about different technologies</td>
</tr>
<tr>
<td>• Availability of technologies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technological adoption (farmers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Water supply through canals is short of demand</td>
</tr>
<tr>
<td>• There are up stream-downstream tension</td>
</tr>
<tr>
<td>• A larger reliance on groundwater (cost high)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production/target driven mindset and strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Subsidized technology support-no exits strategy</td>
</tr>
<tr>
<td>• Upscaling challenges</td>
</tr>
<tr>
<td>• Low risk handling ability within the system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lack of awareness on Climate Change and its impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limited adaptation choices</td>
</tr>
<tr>
<td>• Mitigation is missing in strategies</td>
</tr>
<tr>
<td>• Capacities to support farmers are low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Private sector’s motivation is low</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lack of engagement by government</td>
</tr>
<tr>
<td>• Feel somehow left alone with export and negotiation issues</td>
</tr>
<tr>
<td>• Cost of production is increasing</td>
</tr>
</tbody>
</table>

While these barriers are complex and not for a single project to address, a few guiding principles may be helpful to ensure that none of the barriers is missed out during planning stage so that the plan remains achievable, realistic and relevant in given ground realities:

1. It is important to follow an integrated approach for mitigation and adaptation. A pure mitigation focus (e.g. removal of SLCP) cannot achieve results. There are always adaptation co-benefits which are necessary to be considered. Thus may create interest and motivation among local players including farmers.

2. Follow a landscape approach (farming system approach). This entails that rice does
not grow in isolation. A farming system has livestock (which has a large contribution in emissions) and farming practices for and other crops which jointly contribute to GHG balance sheet.

3. Develop rice NAMA concepts and financing strategies for rice sector with easy-to-follow obligations and more accountability for stakeholders (certainly with adaptation co-benefits).

4. Harness SRP’s potential as an inclusive, comprehensive, and already tested entry point.

5. The concept needs to be flexible. New openings may emerge to support rice NAMA. Check where the pulse is already running high (like in case of water, smog, global trade targets that are highly demanding for standards).

6. Do not shy to engage actors which are labeled as more difficult and little ready for a change – for example middlemen or arhtees, money lenders, big farmers etc.

7. It is essential to follow a multi-partner and multi-stakeholders’ approach. Federal and provincial ministries, the rice millers, technology developers, communication technology, media - have to be on board for lending their respective strengths.
ANNEXES
Annex 1: Literature reviewed


27. GoP. (2016). Pakistan’s Intended Nationally Determined Contribution (Pak-INDC). Retrieved December 23, 2019, from https://www4.unfccc.int/sites/ndcstaging/Published-


Annex 2: Checklist for KII for farmers’ interviews

### General

<table>
<thead>
<tr>
<th>Date</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of interviewer</td>
<td></td>
</tr>
<tr>
<td>Name of villages/tehsil/district</td>
<td></td>
</tr>
<tr>
<td>Name of Farmer/contact number</td>
<td></td>
</tr>
<tr>
<td>Location of farm (head/middle/tail)</td>
<td></td>
</tr>
<tr>
<td>Total land size (acre)</td>
<td></td>
</tr>
<tr>
<td>Under rice (acre)</td>
<td></td>
</tr>
</tbody>
</table>

### Farm Assets (to assess socio-economic level of the farmer)

<table>
<thead>
<tr>
<th>Assets</th>
<th>Own</th>
<th>Rented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land size for cultivation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage with rice cultivation during summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tractor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disc/Rotavator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill machine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined Harvester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thresher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trolley</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spray Pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stubble chopper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of animals by type (numbers)</td>
<td>Cattle</td>
<td>Small ruminants</td>
</tr>
<tr>
<td>How do you use animal dung?</td>
<td>Fuel for self-use (%)</td>
<td>Farm manure for own use (%)</td>
</tr>
<tr>
<td>Other assets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sources of irrigation

<table>
<thead>
<tr>
<th>What is the source of irrigation i) Canal ii) Tube well iii) Any other (specify)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>If canal, rotational turn of irrigation (weekly, fortnightly, others)</td>
<td></td>
</tr>
<tr>
<td>How much is the canal water allocation for rice (hrs / acre)</td>
<td></td>
</tr>
<tr>
<td>If irrigation is also done through tube well, type of energy source being uses (diesel, electricity, solar, others)</td>
<td></td>
</tr>
</tbody>
</table>
### Time taken to Irrigation 1 acre by tube well

### Total Irrigation Ratio Canal: Tub well (e.g., 80: 20)

### Cost of irrigation 1 acre through tube well

### Farmer Awareness and Knowledge

<table>
<thead>
<tr>
<th>Question</th>
<th>YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you aware of changing weather pattern such as temperature and rainfall?</td>
<td></td>
</tr>
<tr>
<td>How were you affected by these changes in recent months / years?</td>
<td></td>
</tr>
<tr>
<td>Are you aware of green-house gases from rice sector?</td>
<td></td>
</tr>
<tr>
<td>Are you aware of any water saving Technologies?</td>
<td></td>
</tr>
<tr>
<td><strong>If YES:</strong></td>
<td></td>
</tr>
<tr>
<td>Have you ever used any such technology for rice?</td>
<td></td>
</tr>
<tr>
<td>Name of technology:</td>
<td></td>
</tr>
<tr>
<td>Major benefits which you perceive</td>
<td></td>
</tr>
<tr>
<td>Are you satisfied with technology?</td>
<td></td>
</tr>
<tr>
<td>Name of the organization who introduced this technology i) Govt. ii) University / Research iii) NGO iv) Other</td>
<td></td>
</tr>
<tr>
<td>Was this technology provided for free or you have paid for it?</td>
<td></td>
</tr>
<tr>
<td>If paid, how much did you pay Rs.</td>
<td></td>
</tr>
<tr>
<td>How much irrigation water was saved using that Technology (number of irrigations reduced OR % reduced)?</td>
<td></td>
</tr>
<tr>
<td>Roughly, the cost of irrigation saved due to use of technology (Rs/acre)?</td>
<td></td>
</tr>
<tr>
<td>Are your fellow farmers (relatives, friends, neighbors) using water efficient technologies?</td>
<td>NO Low Medium High</td>
</tr>
<tr>
<td>Do you discuss use of new technology with your fellow farmers (relatives, friends, neighbors)?</td>
<td></td>
</tr>
</tbody>
</table>

### Future Options / Course of Action

<table>
<thead>
<tr>
<th>Question</th>
<th>YES / NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the major problems in adoption of water saving technologies?</td>
<td></td>
</tr>
<tr>
<td>(Availability, Quality, Lack of Awareness, High Cost, Ineffectiveness of such technologies, Others)</td>
<td></td>
</tr>
<tr>
<td>How to address those problems? Please share recommendations and priorities?</td>
<td></td>
</tr>
<tr>
<td>Which improved water saving technologies best suit your area (Laser, Raised beds, Zero tillage, DSR, AWD, others)</td>
<td></td>
</tr>
<tr>
<td>Why?</td>
<td></td>
</tr>
<tr>
<td>Do you think your socio-economic status would improve if you adopted improved technology?</td>
<td>YES / NO</td>
</tr>
<tr>
<td>If yes, how do you think your socio-economic status will improve?</td>
<td></td>
</tr>
<tr>
<td>Do you think as an individual farmer you can contribute to motivate other farmers to use new technology?</td>
<td></td>
</tr>
</tbody>
</table>
Annex 3. Checklist for KIIIs with stakeholders

1. Sustainable rice management will be one of the key mitigation mechanisms to achieve the NDCs. What are the key policy measures that the government has taken to reduce GHG emissions in the agriculture sector in compliance to NDCs?

2. Has the government launched any major / pilot programme in the country to reduce GHG emission in the rice and/or cotton sectors?

3. What step the government has taken to reduce Short-Lived Climate Pollutants ("SLCPs") emission from the rice sector?

4. Who are the key players including donors contributing to the government’s efforts in mitigating GHG emission in the rice sector?

5. Is the government currently partnering with any development/conservation actors to increase irrigation efficiency in the country?

6. What are the key challenges that the government is facing in addressing irrigation efficiency and reduction of GHG emissions?

7. What are the gaps in implementing programme on irrigation efficiency and reduction of GHG emissions (policy gaps, capacities, knowledge gaps, access to technology)?

8. What is the coordination mechanism between the federal government and the provinces to implement international obligations / commitments on reduction of GHG emission?

9. Any major/minor studies that the government has conducted or is planning to conduct in relation to irrigation efficiency/reduction of GHGs?

10. Area where international development agencies can support the government in implementation of key policies/strategies pertaining to emission reduction in rice sector?

11. What are the methane emission reduction targets of the government from the rice sector in coming years?

12. Has the government introduced any incentive system for the rice farmers to ensure water efficiency or reduce GHG emission?

13. What are the challenges in the irrigation systems that needs to be addressed to attain reduced emission in the Agriculture sector?

14. Is the government providing any incentive to the private sector to facilitate technology development that is necessary for promotion of water efficient rice production?

15. What are the government’s plans to promote public –private partnership on improved standards in export value chain such as rice (e.g., compliance to the Sustainable Rice Platform Standard)?

16. What are the government’s plans to promote public –private partnership on improving irrigation efficiency and technology development (e.g., AWD, laser technology)?

17. What role the government envisages for the private sector, especially the international rice buyers, in promoting water efficient rice?

18. Any recommendations for a future project / programmes in terms of scope and entry points?
Annex 4: List of stakeholders’ interviewed for the study

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malik Amin Aslam</td>
<td>Ministry of Climate Change</td>
<td>Special Assistant to the Prime Minister on Climate Change</td>
</tr>
<tr>
<td>Ms. Naheed Shah Durani</td>
<td>Ministry of Climate Change</td>
<td>Federal Secretary</td>
</tr>
<tr>
<td>Irfan Tariq</td>
<td>Ministry of Climate Change</td>
<td>DG Environment</td>
</tr>
<tr>
<td>Hadiqa Jamshed</td>
<td>Ministry of Climate Change</td>
<td>Focal person NDC Secretariat</td>
</tr>
<tr>
<td>Mr. Ahsanullah Khan Kundi</td>
<td>Ministry of Climate Change</td>
<td>Climate Finance Unit</td>
</tr>
<tr>
<td>Rao Irshad Ali Khan</td>
<td>Indus River System Authority, (IRSA)</td>
<td>Chairman</td>
</tr>
<tr>
<td>Dr Muhammad Yousaf</td>
<td>Pakistan Agriculture Research Council / National Agriculture Research Centre (PARC / NARC)</td>
<td>National Coordinator Rice</td>
</tr>
<tr>
<td>Dr. Bashir Ahmad</td>
<td>Water Resources Institute, Pakistan Agriculture Research Council (PARC / NARC)</td>
<td>Director</td>
</tr>
<tr>
<td>Dr. Muhammad Ashraf</td>
<td>Pakistan Council for Research on Water Resources (PCRWR)</td>
<td>Chairman</td>
</tr>
<tr>
<td>Dr. Naveed Iqbal</td>
<td>Pakistan Council for Research on Water Resources (PCRWR)</td>
<td>Deputy Director (GIS/RS) / Hydrologist</td>
</tr>
<tr>
<td>Dr. Arif Goheer</td>
<td>Global Change Impacts Studies Centre</td>
<td>Head Agriculture &amp; Coordination</td>
</tr>
<tr>
<td>Dr. Nihal Uddin Mari</td>
<td>Sindh Agriculture department</td>
<td>Director Sugarcane Research Institute</td>
</tr>
<tr>
<td>Dr. Aziz Khakwani</td>
<td>Agriculture Research Institute</td>
<td>Director</td>
</tr>
<tr>
<td>Chaudhry Rafique</td>
<td>Rice Research Institute Kalasha Kaku</td>
<td>Director</td>
</tr>
<tr>
<td>Dr. Abid Mahmood</td>
<td>Punjab Agriculture Research Board (PARB)</td>
<td>CEO</td>
</tr>
<tr>
<td>Dr. Hamid Jalil</td>
<td>Planning Commission. Planning, Development &amp; Special Initiatives</td>
<td>Member Food Security and CC</td>
</tr>
<tr>
<td>Jawad Rabbani</td>
<td>Planning Commission. Planning, Development &amp; Special Initiatives</td>
<td>Scientific Officer</td>
</tr>
<tr>
<td>Faisal Baloch</td>
<td>Planning Commission. Planning, Development &amp; Special Initiatives</td>
<td>Deputy Chief Planning</td>
</tr>
<tr>
<td>Syed Anwar-ul-Hassan Bukhari</td>
<td>Ministry of Food Security and Research</td>
<td>Additional Secretary</td>
</tr>
<tr>
<td>Dr. Javed Humayun</td>
<td>Ministry of Food Security and Research</td>
<td>Senior Joint Secretary</td>
</tr>
<tr>
<td>Dr. Syed Waseem-ul-Hassan</td>
<td>Ministry of Food Security and Research</td>
<td>Food Security Commissioner</td>
</tr>
<tr>
<td>Shahid Tarer</td>
<td>Galaxy Rice Mills</td>
<td>MD</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Organization</td>
</tr>
<tr>
<td>---</td>
<td>---------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>23</td>
<td>Imran Sheikh</td>
<td>Galaxy Rice Mills</td>
</tr>
<tr>
<td>24</td>
<td>Ali Tariq</td>
<td>Rice Partners' Ltd.</td>
</tr>
<tr>
<td>25</td>
<td>Zafar Iqbal</td>
<td>Rice Partners' Ltd.</td>
</tr>
<tr>
<td>26</td>
<td>Hafiz Ghulam Jelani</td>
<td>Matco Foods</td>
</tr>
<tr>
<td>27</td>
<td>Hafiz Muhammad Ismail</td>
<td>Rice Partners' Ltd.</td>
</tr>
<tr>
<td>28</td>
<td>Mumtaz Ahmad</td>
<td>Engro Fert Sheikhupura</td>
</tr>
<tr>
<td>29</td>
<td>Umair Ijaz</td>
<td>Engro Eximp Sheikhupura</td>
</tr>
<tr>
<td>30</td>
<td>Malik Akram</td>
<td>On Farm Water Management, Agriculture department Punjab</td>
</tr>
<tr>
<td>31</td>
<td>Dr. Muhammad Anjum Ali Buttar</td>
<td>Agriculture Extension Punjab</td>
</tr>
<tr>
<td>32</td>
<td>Gulam Zakir Sial</td>
<td>Irrigation Research Institute Punjab</td>
</tr>
<tr>
<td>33</td>
<td>Behram Jan</td>
<td>On Farm Water Management, Agriculture department KP</td>
</tr>
<tr>
<td>34</td>
<td>Mr. Abdul Rahim Soom- ro</td>
<td>Sindh Agriculture department</td>
</tr>
<tr>
<td>35</td>
<td>Riaz Dayo</td>
<td>Sindh Agriculture department</td>
</tr>
<tr>
<td>36</td>
<td>Naimatullah Chahar</td>
<td>Sindh Agriculture department</td>
</tr>
<tr>
<td>37</td>
<td>Dr. Mahmood Ahmad</td>
<td>Water Informatics &amp; Technology(WIT) Lahore University of Management Sciences (LUMS)</td>
</tr>
<tr>
<td>38</td>
<td>Dr. Muhammad Zulfiqar</td>
<td>University of Agriculture Peshawar</td>
</tr>
<tr>
<td>39</td>
<td>Dr. Kausar Abdullah</td>
<td>FC College Lahore</td>
</tr>
<tr>
<td>40</td>
<td>David Potter</td>
<td>DFID / FCDO Pakistan</td>
</tr>
<tr>
<td>41</td>
<td>Dr. Muhammad Shafiq</td>
<td>Better Cotton Initiative</td>
</tr>
<tr>
<td>42</td>
<td>Shahrulkhan Khan</td>
<td>Helvetas</td>
</tr>
<tr>
<td>43</td>
<td>Mr. Munawar Khan Khattak</td>
<td>Helvetas</td>
</tr>
<tr>
<td>44</td>
<td>Dr. Jawad Ali</td>
<td>Helvetas</td>
</tr>
<tr>
<td>45</td>
<td>Dr. Zahoob Bazai</td>
<td>University of Balochistan</td>
</tr>
<tr>
<td>46</td>
<td>Tanveer Channa</td>
<td>Agriculture department Balochistan</td>
</tr>
</tbody>
</table>
### Annex 5: Participants of consultation workshop

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Organization</th>
<th>Designation</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Makiko Yashiro</td>
<td>United Nations Environment Programme (UNEP)</td>
<td>Programme Officer Ecosystems Division, Asia &amp; Pacific Office</td>
<td></td>
</tr>
<tr>
<td>Arjumand Nizami</td>
<td>UNEP / Helvetas</td>
<td>Consultant Scoping Study</td>
<td></td>
</tr>
<tr>
<td>William Wyn Ellis</td>
<td>Sustainable Rice Platform (SRP)</td>
<td>Executive Director</td>
<td></td>
</tr>
<tr>
<td>Marie-yon Struecker</td>
<td>United Nations Environment Programme (UNEP)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zafar Iqbal</td>
<td>Rice Partners’ Ltd.</td>
<td>Manager Sustainability WAPRO</td>
<td>Private sector</td>
</tr>
<tr>
<td>Shahrukh Khan</td>
<td>Helvetas</td>
<td>National Coordinator WAPRO</td>
<td>International / donor financed initiatives</td>
</tr>
<tr>
<td>Mumtaz Ahmad</td>
<td>Engro Fert Sheikhupura</td>
<td>R&amp;D Manager</td>
<td>Private sector</td>
</tr>
<tr>
<td>Imran Sheikh</td>
<td>Galaxy Rice Mills</td>
<td>MD</td>
<td>Private sector</td>
</tr>
<tr>
<td>Dr. Muhammad An-jum Ali Buttar</td>
<td>Agriculture Extension Punjab</td>
<td>Director General</td>
<td>Punjab provincial government</td>
</tr>
<tr>
<td>Dr. Jawad Ali</td>
<td>Helvetas</td>
<td>Dy. Country Director</td>
<td>International / donor financed initiatives</td>
</tr>
<tr>
<td>Imran Sheikh</td>
<td>Galaxy Rice Mills</td>
<td>Manager Sustainability WAPRO</td>
<td>Private sector</td>
</tr>
<tr>
<td>Dr. Arif Goheer</td>
<td>Global Change Impacts Studies Centre</td>
<td>Head Agriculture &amp; Coordination</td>
<td>Research institution, Federal Government</td>
</tr>
<tr>
<td>Hafiz Muhammad Ismail</td>
<td>Atlas Foods</td>
<td>Project Manger</td>
<td>Private sector</td>
</tr>
<tr>
<td>Shahid Tarer</td>
<td>Galaxy Rice Mills</td>
<td>Managing Director</td>
<td>Private sector</td>
</tr>
<tr>
<td>Ali Tariq</td>
<td>Rice Partners’ Ltd.</td>
<td>Managing Director</td>
<td>Private sector</td>
</tr>
<tr>
<td>Dr. Nihal Uddin Mari</td>
<td>Sindh Agriculture department</td>
<td>Director</td>
<td>Sindh Provincial Government</td>
</tr>
<tr>
<td>Bilal Ashraf</td>
<td>Galaxy Rice Mills</td>
<td>Data specialist</td>
<td>Private sector</td>
</tr>
<tr>
<td>Hafsa Yamin</td>
<td>Galaxy Rice Mills</td>
<td>Community mobilization</td>
<td>Private sector</td>
</tr>
<tr>
<td>ahmadnawaz2006</td>
<td>Agriculture Research Institute</td>
<td>Director</td>
<td>Research institution, Provincial Government KP</td>
</tr>
<tr>
<td>Behram Jan</td>
<td>On Farm Water Management, Agriculture Dpt.</td>
<td>Director</td>
<td>Provincial Government KP</td>
</tr>
</tbody>
</table>
## Annex 6: Stakeholders’ map for the study

<table>
<thead>
<tr>
<th>Name of the organization</th>
<th>Mandate</th>
<th>CC related Mandate</th>
<th>CC related Capacities / Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers</td>
<td>Cultivate lands</td>
<td>Follow water efficient agriculture</td>
<td>Adopt and stay consistent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Participate in training activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Share knowledge with fellow farmers</td>
<td></td>
</tr>
<tr>
<td>Federal stakeholders</td>
<td></td>
<td>Focal point CC; UNFCCC, Focal Point IPCC, DNA. Support on climate finance</td>
<td></td>
</tr>
<tr>
<td>Ministry of Climate Change (MoCC)</td>
<td>- Environment, Focal point Multilateral Environment / Climate Change Agreements, international negotiations and climate financing instruments</td>
<td>- National Communication to UNFCCC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Main actors on CC Policy (both mitigation and adaptation)</td>
<td>- Mitigation, Adaptation policies / strategies and programmes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Updating Nationally Determined Commitment (NDC)</td>
<td></td>
</tr>
<tr>
<td>Ministry of Water Resources</td>
<td>- Policy and regulations related to water and power.</td>
<td>Efficient use of water resources, water resource monitoring, equitable water distribution among provinces</td>
<td>National Water Policy and Charter have important dimensions on climate change (including crop per drop, water productivity etc.)</td>
</tr>
<tr>
<td>Planning Commission of Pakistan</td>
<td>- National level planning</td>
<td>- The environment section has a focal person on CC for development of project with national significance;</td>
<td>Inter-province coordination / PSDP development</td>
</tr>
<tr>
<td></td>
<td>- Approval of projects (above Rs. 40 million and/or projects with above 25% foreign exchange)</td>
<td>- House of special initiatives of PM on Green Pakistan</td>
<td>Strong senior staff with technical understanding and financial powers for development interventions</td>
</tr>
<tr>
<td></td>
<td>- A key player to influence development sector policies and dialogues</td>
<td>- Fan of paradoxical agriculture</td>
<td></td>
</tr>
<tr>
<td>Ministry of Food Security and Research</td>
<td>- Act at policy level on inter-provincial food security issues; import of food and supply regulation</td>
<td>Interested but delegate such responsibilities to the provinces where actual work is implemented</td>
<td>Food security magistracy and powers; experts on multiple sectors in agriculture and food trade</td>
</tr>
<tr>
<td></td>
<td>- Policies and regulations for food and agricultural security</td>
<td></td>
<td>National policy on Food Security with strong elements on resource efficient food production systems.</td>
</tr>
<tr>
<td>Pakistan Agricultural Research Council (PARC)</td>
<td>Under the Ministry of Food and agriculture, conduct/coordinate research on agriculture at national level (with a large network to coordinate agricultural research in the provinces)</td>
<td>Rice research center</td>
<td>Strong technical experts in agriculture including CC adaptation research.</td>
</tr>
<tr>
<td>National Agricultural Research Centre (NARC)</td>
<td></td>
<td>Multi research programmes with direct and indirect relevance to climate change</td>
<td>Projects on drought resistant varieties, introduction of alternate crops, pest and disease control, genetic improvements, water harvesting and modern irrigation techniques that might have relevance to CC adaptation</td>
</tr>
<tr>
<td>Pakistan Meteorological Department (PMD)</td>
<td>- Scientific meteorological services throughout Pakistan; weather forecast and monitoring.</td>
<td>- Strong role in disaster preparedness (early warning systems).</td>
<td>Trained staff in model-based research; weather forecasting, early warning systems (floods, drought, cyclone etc.)</td>
</tr>
<tr>
<td></td>
<td>- Maintains records of historical data on various climatic parameters.</td>
<td>- Conduct CC related research (including modeling) in collaboration with GCISC.</td>
<td>Conduct, CC research and scenarios</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Participate in policy dialogue at national/international levels.</td>
<td>Install and manage automated weather stations</td>
</tr>
</tbody>
</table>
| **Global Change Impact Studies Centre (GCISC)** | Operating under the MOCC as independent entity. Conducting modeling-based research on climate change and its impact on agriculture and water resources. On this basis, mitigation and adaptation strategies will be developed. | The only CC related research center in public sector in Pakistan with capacity to conduct GHG assessment and reporting (core scientific staff) | - Implemented capacity enhancement project on CC modeling as well as research by core team.  
- Secretariat to PM committee on CC  
- Lead NDC development |

| **Pakistan Council of Research on Water Resources (PCRWR)** | - Research on water Resources in Pakistan (especially groundwater)  
- Strong collaboration in the provinces – open for knowledge collaboration, influence on policy and research | Technical experts have direct interest in and relevance to CC adaptation. Specialized in groundwater issues | - Research on water Resources and its relationship with CC.  
- Conduct modeling-based research on water, relevant for CC (including in Punjab).  
- Initiatives on water harvesting  
- Research on groundwater depletion and their causes |

| **National rice mills / companies** | Punjab / Sindh / KP based companies | Small / medium scale private sector actors engaged with farmers | Sourcing agents of rice – few have own agronomist to guide farmers |

### Provincial stakeholders (a larger focus on Punjab)

| **Provincial Agricultural departments** | - Development of provincial agricultural priorities, policies  
- An important actor on any dimension of discussion in rice sector | Policy development Manage agricultural extension and livestock departments | Water efficiency is mostly high on agenda |

| **Agricultural Extension Department** | - Under the Provincial Agriculture department, serve for technology transfer and farmer advice,  
- An important partner for outreach to the farmers (may be engaged in field survey) | Provide advice to farmers. Agricultural offices up to the level of Union Council with human resource | - Field staff often have no capacity on climate change.  
- Large focus on crop productivity enhancement  
- Engaged in technology transfer on water efficient / water productive techniques |

| **Provincial Agriculture Research** | - Under the provincial agriculture departments  
- An active partner to be involved in future to study the impact of low emission techniques in agriculture | - Coordinate agricultural research with research stations at important agricultural regions.  
- Indirect link with climate change in research interventions Development of new crop varieties and Research trials on crop management practices |

| **Provincial Irrigation departments** | - Responsible to manage irrigation system at macro level  
- Influence narrative of water efficient agriculture | Control Organisation for irrigation resource | Concerned with increasing pressure on irrigation system – huge infrastructural management capacity and funds |

### Multi-lateral / bilateral international stakeholders

| **Asian Development Bank (ADB)** | - Main donors for development projects (including large infrastructure projects)  
- Investment and Reforms in Energy and Infrastructure | Multi-sectoral development actors Strong policy influence | - Important entities for international climate change financing instruments (GEF, GCF)  
- Policy influencing |

| **IFAD** | - Rural Poverty Alleviation through empowering poor rural women and men to achieve higher incomes and improved food security.  
- Enhance access to productive assets, skills, services.  
- To strengthen the capacity of the rural poor | Climate risk mainstreaming in infrastructure projects  
Distant from agriculture at the moment (more focus on rural livelihoods) | No specific project. Generally, the environmental safeguards guidelines are weak |
| **UN Food and Agricultural Organization (FAO)** | Fighting hunger; expanded focus to DRR, emergency response  
- An important player on climate smart agriculture | Improve productivity of food crops; Agriculture based livelihoods; Securing livelihoods | Entity and Core implementer of Climate Smart Agriculture project (GCF) |
| **UNIDO clean tech program for SMEs** | The Global Cleantech Innovation Programme Pakistan is part of a global programme funded by GEF and implemented by UNIDO. Its mandate is to support inclusive and sustainable industrial development by fostering innovation and entrepreneurship ecosystems. | Promote affordable and scalable solutions enabling partners to leapfrog to cleaner, resilient economies.  
- Contributing to GHG emissions reductions, the technology innovations fostered  
- Improved water efficiency, soil protection, and waste beneficiation. | Funds clean-tech startups focusing on renewable energy, energy efficiency, water efficiency, waste-to-energy, and green buildings.  
- Comprehensive and extensive programme of mentoring, training, access to investors, judging and showcasing opportunities. |
| **UNDP** | Sectoral Development, advocacy, capacity building, facilitation in policy development  
- Environment and Climate Change department | CC taken as cross sectoral in various programme.  
- UNDP focal point for CC  
- Important role in influencing CC narrative and priorities in the country | Entity for international climate change financing instrument (GEF, GCF)  
- Projects on CC mitigation, Environment, Adaptation and disaster management. |
| **World Bank (WB)** | Economic governance  
- Human development and social protection; Infrastructure to support growth.  
- Security and reducing the risk of conflict | Multi-sectoral development actors  
- Strong policy influence on improved / efficient water infrastructure through big programmes | Entity for global CC financing instruments (GEF, GCF).  
- Environmental safeguards.  
- REDD+ focus (forestry sector)  
- High policy influence in Pakistan |
| **Department for International Development (DFID) UK** | Poverty reduction through health and education, governance, and livelihoods. Environment, climate change, food security and water governance | Water governance with an accent of climate change | Water, climate change, resilience building |
| **European Union (EU)** | Poverty reduction, notably through assistance in rural development and NRM as well as education and human resources development, environment, and civil society dialogue | Support to tapping hydrological resources in Pakistan for promoting rural access to energy | Energy and DRR |

### Academia

| **FC College** | Deliver education. Conduct research (especially within students programmes) | Climate change mitigation / adaptation may not be their direct purview; however important to understand their engagement in technological / thematic research relevant to climate change directly or indirectly | Agriculture research focusing on resource efficiency and reducing GHG emissions |
| **University of Engineering and Technology Punjab** |  |  | Engagement in useful appropriate technology |
| **Lahore University of Management Sciences** |  |  | - Engagement in useful appropriate technology |
| **KP Agricultural University, Peshawar** |  |  | - Research in economics of technology  
- Climate Change Centre; research on water saving technology |
| **Tandojam Agricultural University** |  |  | Research on water saving technology |
| **University of Agriculture Faisalabad** |  |  | GHG monitoring research programme. |
Annex 7: Sustainable Rice Platform Standard

Figure 1. Themes and Requirements in the SRP Standard for Sustainable Rice Cultivation

<table>
<thead>
<tr>
<th>FARM MANAGEMENT</th>
<th>PREPLANTING</th>
<th>WATER USE</th>
<th>NUTRIENT MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Crop calendar</td>
<td>• Heavy metals</td>
<td>• Water management</td>
<td>• Nutrient management (organic and/or inorganic)</td>
</tr>
<tr>
<td>• Record keeping</td>
<td>• Soil salinity</td>
<td>• Irrigation system at community level</td>
<td>• Organic fertilizer choice</td>
</tr>
<tr>
<td>• Training</td>
<td>• Land conversion and biodiversity</td>
<td>• Inbound water quality</td>
<td>• Inorganic fertilizer choice</td>
</tr>
<tr>
<td></td>
<td>• Invasive species</td>
<td>• Groundwater extraction</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Leveling</td>
<td>• Drainage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pure seed quality</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTEGRATED PEST MANAGEMENT</th>
<th>HARVEST AND POSTHARVEST</th>
<th>HEALTH AND SAFETY</th>
<th>LABOR RIGHTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Weeds</td>
<td>• Timing of harvest</td>
<td>• Safety instructions</td>
<td>• Child labor</td>
</tr>
<tr>
<td>• Insects</td>
<td>• Harvest equipment</td>
<td>• Tools and equipment</td>
<td>• Hazardous work</td>
</tr>
<tr>
<td>• Diseases</td>
<td>• Drying time</td>
<td>• Training of pesticide applicators</td>
<td>• Education</td>
</tr>
<tr>
<td>• Molluscs</td>
<td>• Rice storage</td>
<td>• Personal protective equipment</td>
<td>• Forced labor</td>
</tr>
<tr>
<td>• Rodents</td>
<td>• Rice straw</td>
<td>• Washing and changing</td>
<td>• Discrimination</td>
</tr>
<tr>
<td>• Birds</td>
<td></td>
<td>• Applicator restrictions</td>
<td>• Freedom of association</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Re-entry time</td>
<td>• Wages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pesticide and chemical storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Pesticide disposal</td>
<td></td>
</tr>
</tbody>
</table>

Source:
COUNTRY REPORT
SCOPING STUDY CLIMATE SMART RICE
PAKISTAN

Promoting Global Best Practices and Scaling of Low Emissions Technologies by Engaging the Private and Public Sectors in the Paddy Rice Sector

April 2021