

Rethinking Perceptions

Agriculture, Water and Energy Scenario in South Asia

CUTS International

#1616

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CUTS Centre for International Trade, Economics & Environment

Abbreviations

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
APMC	Agricultural Produce Market Committee
AWD	Alternate Wetting and Drying
BBIN	Bangladesh, Bhutan, India and Nepal
BDO	Block Development Officer
CFMG	Community Forest Management Group
CRRID	Centre for Research in Rural and Industrial Development
CSOs	Civil Society Organisations
CUTS	Consumer Unity & Trust Society
DAP	Di Ammonium Phosphate
DFAT	Department of Foreign Affairs and Trade
DM	District Magistrate
EGP	Eastern Gangetic Plain
ES	Environment Service
FAO	Food and Agriculture Organisation
FPC	Farmer Producer Company
FPO	Farmer Producer Organisation
FYM	Farm Yard Manure
GDP	Gross Domestic Product
HDI	Human Development Index
HH	Household
HYV	High Yielding Variety
IEG	Institute of Economic Growth
IFAD	International Fund for Agriculture Development
IGS	Indian Grameen Services
INR	Indian Rupee
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ISIC	International Standard Industrial Classification
JFMC	Joint Forest Management Committee
KII	Key Informant Interview
MIAMA	Marketing Infrastructure & Agricultural Marketing Reforms Act
MSP	Minimum Support Price

MW	Mega Watt
NEFORD	Nand Education Foundation for Rural Development
NGO	Non-Governmental Organisation
NPAs	Non-Performing Assets
NPK	Nitrogen Phosphorus Potassium
PACS	Primary Agricultural Cooperative Society
PES	Payment for Environmental Services
RE	Renewable Energy
RGVN	Rashtriya Grameen Vikas Nidhi
SAARC	South Asian Association for Regional Cooperation
SADKN	South Asian Disaster Knowledge Network
SAFIR	South Asia Forum for Infrastructure Regulation
SAFTA	South Asian Free Trade Area
SAWTEE	South Asia Watch on Trade, Economics & Environment
SDG	Sustainable Development Goal
SDIP	Sustainable Development Investment Portfolio
SDPI	Sustainable Development Policy Institute
SFAC	Small Farmers' Agri Business Consortium
SHG	Self Help Group
SNV	Netherland's Development Organisation
SPS	Sanitary and Phytosanitary
SRI	System of Rice Intensification
TBWS	Transboundary Water Sharing
TV	Television
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
US$	US Dollar
VAB	Value added at basic prices
WFP	World Food Programme
WUA	Water User Association
WWAP	World Water Assessment Programme

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Foreword

South Asia, with its 1.7 billion population, faces numerous challenges. These include extreme poverty, poor infrastructure and governance, and detrimental effects of climate change. Fortunately much of the region is connected through three key river basins, namely the Indus, Ganges and Brahmaputra.

Food security is fundamental to sustaining the growth of diverse societies of South Asia. Thus, enabling good agriculture practices in small farms, which dominate the region, that can adapt to unforeseen circumstances and connecting farmers to markets through local community initiatives, national and sub-national policies, and trans-boundary cooperation can help build a sustainable agriculture production environment.

As regional and global markets become more inter-connected, it is paramount for farmers to gain greater and more direct access to sellers and buyers while striving to diversify crops in order to respond to the potentially challenging effects of both trade liberalisation and climate change.

However, given the poor water management, particularly irrigation systems, agriculture structures will be unable to sustain the needed capacity for securing food in South Asia region. South Asian countries are moving closer together in various ways and as the river basins of the region cross borders the effort for trans-boundary cooperation on water will become even more necessary. Furthermore, renewable and cost effective energy supplies can spark the required provision for small farmers to meet their food and water demands while supporting their livelihoods and those of their communities.

Therefore, an understanding of ground realities is vital to effectively and sustainably address the multifaceted challenges of food, water and energy security in South Asia. This study is an attempt to do so by documenting the perceptions of the relevant stakeholders on these issues. The recommendations are derived from the key stakeholders namely small farmers, national and local government officials, private industry representatives, and civil society organisations.

The key message is that through suitable policies and practices coupled with effective coordination between governments, private sector and non-state actors, both nationally and sub-regionally/regionally, the resources provided by these grand rivers hold the potential to alleviate the negative impacts of climate change on food-water-energy security nexus in South Asia and find sustainable solutions for future generations.

I am sure that the study will be useful in designing national, sub-regional and regional policies for addressing future challenges of food-water-energy security nexus in South Asia.

I congratulate CUTS International and its partners for such a useful contribution on food-water-energy security nexus in South Asia.

Pramod Kumar Joshi
Director, South Asia
International Food Policy Research Institute

Preface

River basins have always been the integral part of civilisation and development of any region and South Asia is no exception. The mighty rivers of Indus, Ganges and Brahmaputra have sustained the food production systems, supported several hundred millions of people residing in these basins and also have played a prominent role in defining the political economy of the region. Increases in economic growth, urbanisation and population explosion have resulted in the depletion of natural resources, mainly land and water. Degraded natural resources and the advent of climate change have raised threats to the food, water and energy security of the region. Access to electricity is another grave issue where more than half a billion people still live in the dark. The vast hydro potential of the rivers remain untapped owing to hydro diplomacy and water sharing challenges.

Characterised by small land holdings and poor supply and value chains, agriculture sustains more than half of the work force in South Asia. Improved technologies, mechanisation and irrigation can provide a boost to the agricultural sector. Thus, to address the challenges related to food, water and energy security, it is important to understand the linkages between this trio of resources of the region. This is also very much in tune with the United Nations' SDGs that seeks to prepare a 'Road to Dignity' by 2030.

In this context, CUTS International conducted this study across the river basins of Indus, Ganges and Brahmaputra in South Asia focussing on perceptions of farm households and other relevant stakeholders on pre-identified issues related to agriculture, water and energy. The study was undertaken under the aegis of Sustainable Development Investment Portfolio (SDIP), a regional programme for South Asia designed by the Department of Foreign Affairs and Trade, Australia.

Being a portfolio partner of SDIP, CUTS International works towards the goal of increased water, food and energy security in South Asia by bringing in grass root insights to meso and macro levels of governance and advocating policy reforms in these three domains. This study was conducted in 24 locations spread over five countries in South Asia viz. Bangladesh, Bhutan, India, Nepal and Pakistan, with the support of CUTS' strategic partners under SDIP.

The findings presented in this report provided for a basin wise analysis of the quantitative and qualitative data gathered from household survey and key informant interviews. Significant trends were observed in the agriculture sector, which highlight the dominance of private sector in the input industry, lack of awareness about sustainable agricultural practices, imbalanced use of fertiliser and high dependence on traders and middlemen. Depleting ground water table was a major concern raised during interviews. Across the three basins, the responses from upper riparian locations on transboundary water sharing were not in favour of water sharing whereas downstream dwellers completely agreed to the same. This implies the dependency of downstream population on upper riparian regions for water resources.

Attempts were also made to record the general perceptions on climate change and capture the perceptions of female respondents in every household; thus, bringing in the vital gender dimension into the discussion. The findings and discussions lead to conclusions and recommendations that would generate wider deliberations across five countries through advocacy efforts of CUTS and its partners. We hope that this work would serve as a benchmark for all development professionals working in the space of agriculture, water and energy security in South Asia.

I thank Department of Foreign Affairs and Trade (DFAT), Australian Government for supporting this and all the strategic partners *viz*, Centre for Research in Rural and Industrial Development (CRRID), Punjab, Indian Grameen Services (IGS) BASIX, Bihar, Nand Educational Foundation for Rural Development (NEFORD), Uttar Pradesh, Rashtriya Gramin Vikas Nidhi (RGVN), Assam, SNV Netherlands Development Organisation, Bhutan, South Asia Watch on Trade, Economics & Environment (SAWTEE), Nepal, Sustainable Development Policy Institute (SDPI), Pakistan and Unnayan Shamannay (US), Bangladesh for conducting the survey and supporting CUTS in conducting the key informant interviews in all locations. Without this support it would have been impossible to complete this work within the stipulated time. I also thank my colleagues at CUTS for putting their sincere effort to bring this report to fruition.

As we continue uniting the advocacy voices in agriculture, water and energy in the Indus, Ganges and Brahmaputra basins, we hope to achieve comprehensive and specific milestones based on this report.

Bipul Chatterjee
Executive Director
CUTS International

Executive Summary

In 2014, South Asia, with its population of 1.7 billion, had experienced 6.9 per cent growth in its gross domestic product. In 2012, its poverty headcount ratio was 18.8 per cent (as per US$1.90 a day) and Human Development Index (HDI) of 0.607 in 2014. Estimates for 2014-16 suggest that close to 281 million people are undernourished in the region but the number has started to decline with a 56 per cent reduction overall.

Given these development challenges, South Asia is blessed with three resourceful Himalayan Rivers – the Indus, Ganges and Brahmaputra, which sustain agricultural production and livelihoods of millions. However, reduced water flow, over exploitation of ground water, erratic rainfall and increased water contamination has delineated it as water scarce region.

Keeping this in mind, the DFAT, Australian Government has developed a regional programme titled "Sustainable Development Investment Portfolio"(SDIP) targeting the river basins of Indus, Ganges and Brahmaputra encompassing Bangladesh, Bhutan, India, Nepal and Pakistan. The programme aims to contribute to increased water, food and energy security in South Asia to facilitate economic growth and improve livelihoods, targeting the poorest and most vulnerable, particularly women and girls.

CUTS International is one of the portfolio partners of this programme and acts as a facilitator and works towards enhancing the value of SDIP by linking its interventions with key actors (other partner organisations) and stakeholders from micro to meso level through local and regional networks. In order to create a base for its advocacy initiative, CUTS International has entered into partnership with eight civil society organisations along the three rivers basins.

Therefore, keeping the food-water-energy security nexus of South Asia in mind, the perception survey, on which the report is based on, was carried out to provide a baseline for further research and advocacy activities under the SDIP platform. The study was conducted in 24 locations across 11 sample sites in five countries viz., Bangladesh, Bhutan, India, Nepal and Pakistan, with approximately 840 respondents selected by stratified sampling and close to 150 key informant interviews by applying a semi-structured questionnaire. The questionnaire was divided into two parts – part A was gender neutral and part B was meant to be specifically answered by female members of a household.

The highest mean age of the respondents was observed in Uttar Pradesh (51.06) and the lowest was in Bhutan (40.11). The minimum age was closer to late and early 20s and the maximum age was closer to late and early 70s. Across the sample size, higher land ownership among males was observed as compared to female ownership, except in Bhutan where almost equal ownership was among male and female land owners (approximately 36 per cent). Across the sample size, highest numbers of responses were recorded under agricultural sources of income. This was followed by non-agricultural and then in-service/salaried job sources of income.

The agriculture profile across the sample sites yielded some interesting results. In the Indus basin, close to 75 to 86 per cent of farmers reported water logging in the soil followed by other issues like sandy texture, declining fertility and lack of essential nutrients like zinc, magnesium and potassium. Regarding the type of seeds used for cultivation, predominance of hybrid and high yielding variety (HYV) seed were evident. The emerging role of privately owned seed shops was evident in

all the three basins. In Bangladesh and India, a serious problem with regard to making variety rice seeds available and accessible to farmers was noticed.

On closer investigation, it was observed that quite often the farmer buys seeds directly from private shops in Bangladesh and hence might not be even aware that the seeds were originally procured from across the border. Among the chemical fertilisers, Urea and DAP (Di Ammonium Phosphate) were used by maximum number of respondents across all three basins. The data clearly indicate the imbalance in fertiliser use with negligence in applying farm yard manure (FYM) in most of the locations. This also underlines the observations on soil problems where declining soil fertility was suggested in the 'other' category by many respondents.

Regarding the type of agricultural practices, most of the respondents from Indus and Ganges basins reported chemical farming. The survey revealed that higher proportion of respondents relies on traditional knowledge for information on agricultural practices across all the three basins. With respect to market access for farm produce, it can be seen that farmers in the Indus basin recorded significantly higher percentage of marketable surplus being sold at the market. Significant number of responses in West Bengal showed that traders from across the border come and collect it from the farm, which again indicated cross-border informal trade of agricultural produce.

Data on institutional participation shows that Pakistan lacks a strong institutional framework, while institutions across Ganges and Brahmaputra basins showed strong linkages with cooperative societies, non-governmental organisations (NGOs) and self-help groups (SHGs). These institutions also extended help in terms of credit, agricultural inputs and other related aspects. In Pakistan, higher proportion of respondents depended on local money lenders followed by nationalised banks for buying agricultural inputs. With respect to the machinery owned by farm households, the farmers in the Indus basin owned a range of machinery (pump sets, tractors and tillers) while in Ganges and Brahmaputra, pump sets were the most commonly reported machinery. Fertilisers, irrigation and labour were seen as costly components across the three basins.

The water related issues in the survey concentrated mainly on trans-boundary aspects and access to irrigation water. High water scarcity in farms was observed for less than three months across most of the sites. Similarly, across the sample sites, canal irrigation and flood irrigation was a common practice for usage of irrigation water. With this regard, rain harvesting structures and dams were a prominent source of water conservation and storage across the three basins.

Water sharing perception and related variables yielded interesting trends. The influence of location on the upper and lower riparian sides of a basin directly influenced the willingness to share water.

While respondents of a lower riparian basin were willing to share water respondents of an upper riparian basin were not favourable to the idea due to water-sharing related issues. Across the sample sites, most of the respondents agreed that their concerns related to water sharing were not raised at any meeting or forum. Most of the respondents also agreed that water sharing issues were not relevant to them, but a sizeable number of responses were recorded under issues like release of dam water without warning and conflicts related to water sharing.

The variables related to the energy scenario indicate a strong trend in promoting renewable energy sources. Even though a large part of the sample sites reported fossil fuels as the source of energy for agriculture related purposes, successful cases of renewable energy (solar and hydro grids) were reported for non-farming purposes. Private companies were the key supplier of renewable energy equipment in the Indus basin, and government and non-governmental sources in the Ganges and Brahmaputra basins. The data shows that community based approach to promote renewable energy was quite successful across the basins.

Across the sample sites, climate change and related weather patterns have shown a strong influence on agricultural practices too. Maximum responses were observed for unseasonal rainfall and incidences of terminal heat stress. This also seemed to influence the choice of stress tolerant seeds and climate resilient agricultural practices used by farmers in the Ganges basin.

The survey had a separate section to be answered only by women members of the households. A considerable footprint of female-oriented agriculture was observed across the basins with maximum favourable responses found in the Brahmaputra basin. The data reveals that women across the basins are mostly engaged in household work and farming activities. Across the basins, it was found that female respondents have not availed any formal loan from banks in their own name. Their source of credit was usually cooperative societies, non-governmental organisations and self-help groups. Specific decision making skills were also categorically tied to their institutional membership and ability to access credit since financial independency was a prominent factor in decision making.

Key Recommendations (Refer Chapter 10 for Details)

- Promote knowledge sharing of sustainable agricultural practices among South Asian countries
- Promote regional agricultural value chains among South Asian countries
- Assimilate transboundary water aspects into national level discussions
- Support renewable energy and energy grid models among South Asian countries
- Integrate women farmers in agriculture and water related policy decisions

The survey results have led to key recommendations, which are dependent on site-specific data. Access to agricultural inputs and markets to promote local trade and infrastructure building came out as the key result in agriculture. Trans-boundary water sharing and issues related to access of irrigation water seems to be a core problem across the five countries. Addressing regional energy security issues by incorporating solutions like the generation of renewable energy and establishment of hydro grids is also a prominent solution. While it has been firmly acknowledged that women empowerment needs to be looked at as an entity in itself, mainstreaming gender issues in the national policies on food, water and energy might offer some respite for the female farmers.

Overall, it was observed that across the domains of agriculture, water and energy; the stakeholders expect the government to initiate key reforms. In the absence of active recognition from various government bodies, alternative arrangements comprising of community-based organisations, NGOs and SHGs will have to take up region-specific advocacy for policy and practice changes to address future challenges to food, water and energy security in South Asia. The study concludes that state and non-state actors need to combine their efforts to convert advocacy messages into sustainable solutions.

1
Context

Over the past decade South Asia has achieved commendable progress in poverty eradication and human development with consistent economic growth. South Asia's population of 1.7bn had a Gross Domestic Product (GDP) growth of 6.9 per cent in 2014, poverty headcount ration of 18.8 per cent (US$1.90 a day) in 2012, and Human Development index (HDI) of 0.607 in 2014. Estimates for 2014-16 suggest that close to 281 million people are undernourished in the region but the number has started to decline with a 56 per cent reduction overall (FAO, IFAD & WFP 2015). In addition, half a billion people in the region have no access to electricity.

Mounting population, depleting natural resources and climate changes have threatened the food production systems in the region. South Asia is blessed with resourceful Himalayan Rivers – the Indus, Ganges and Brahmaputra, which sustain agricultural production and livelihoods of millions. However, reduced water flow, over exploitation of ground water, erratic rainfall and increased water contamination has delineated the region as water scarce. Thus, taking a closer look at the intrinsic linkages amongst the three vital resources of water, energy and food, it is evident that these resources are crucial for South Asia to attain the goals of sustainable development.

Given the trans-boundary nature of the Himalayan Rivers, upstream-downstream dynamics are often sparked between the political boundaries making water an issue of contention. The massive potential of hydroelectricity in Nepal and Bhutan can serve as a boon to the energy starved population in the sub-continent provided there is a policy framework for basin-wide water management and energy cooperation at regional and national-levels.

Agriculture plays a significant role in South Asian economy; the region is a leading producer of cereals mainly rice, wheat and maize. Apart from these staples, a wide range of horticultural crops and cash crops are characteristic to the region. Nevertheless, many South Asian countries are net food importers. Shrinking land and water resources have put greater pressure on national governments to increase agricultural production per unit land area and the water consumed. The region is known for its small and marginal land holdings, landless agricultural labourers and share croppers, which have resulted in poor investment, mechanisation and lower farm incomes. With similar cropping patterns and food consumption existing across international borders there is great scope for developing regional value chains. But this has not been realised fully because of low production, poor infrastructure for post-harvest management, trade barriers and lack of forward and backward linkages.

The Himalayan river basins of Indus, Ganges and Brahmaputra are shared by multiple South Asian countries, with some overlap (Table 1) (FAO 2011, Nepal and Shreshta 2015). The existing geopolitics and its repercussions have led to mistrust among these countries hindering trans-boundary cooperation in water, energy and trade, which has implications on the region's economic development.

Table 1: Basic Characteristics for Indus, Ganges and Brahmaputra River Basins					
Basin	*Total area (km^2)*	*Countries included*	*Area of country in basin (km^2)*	*As % of total area of basin*	*As % of total area of country*
Indus	1,120,000				
Home to ~ 180 million people, the Indus is 3,180 km in length, with its mouth at the Arabian Sea, with an average discharge of 5,533 m^3/sec per annum. Runoff in Upper Indus is from glacial melt 41%, snow melt 21%, rainfall 27%.		Pakistan	520,000	47	65
		India	440,000	39	14
		China	88,000	8	1
		Afghanistan	72,000	6	11
Ganges	1,087,300				
Home to ~ 410 million people, the Ganges is 2,515 km in length, with its mouth at the Bay of Bengal, with an average discharge of 12,037 m^3/sec per annum. Runoff in Upper Ganges is mostly rainfall 66% with melt water ~20%.		India	860,000	79	26
		China	33,500	3	.3
		Nepal	147,500	14	100
		Bangladesh	46,300	4	32
Brahmaputra	543,400				
Home to ~ 120 million people, the Brahmaputra is 2,840 km in length, with its mouth at the Bay of Bengal, with an average discharge of 21,261 m^3/sec per annum. Rainfall in upper Brahmaputra is mostly rainfall 59% with melt water ~25%.		India	195,000	36	6
		China	270,900	50	3
		Bangladesh	39,100	7	27
		Bhutan	38,400	7	100

Keeping this in view, the DFAT has developed a regional programme for South Asia, the 'SDIP targeting five countries in the river basins of Indus, Ganges and Brahmaputra encompassing Pakistan, India, Nepal, Bhutan and Bangladesh. The programme aims to achieve increased water, food and energy security in South Asia to facilitate economic growth and improve livelihoods, targeting the poorest and most vulnerable, particularly women and girls. The objectives of SDIP are:

- Confident and cooperative decision-making across jurisdictional borders for the effective and equitable management of shared water resources
- Increased access to and cooperation on energy
- Increased agricultural productivity and farm incomes through the adoption of more efficient and sustainable agricultural practices and better developed value-added market chains

CUTS International is one of the portfolio partners of this programme and acts as a facilitator and works towards enhancing the value of SDIP by linking its interventions with key actors (other partner organisations) and stakeholders from micro to meso-level through local and regional networks. In order to create a base for its advocacy initiative, CUTS International has entered into partnership with eight organisations along the three river basins.

Figure 1: CUTS SDIP Partners across the Basins

Table 2: CUTS SDIP Partnership Portfolio across the Basins		
River Basins	**Country partners**	**Indian partners**
Indus	(i) Sustainable Development Policy Institute (SDPI), Pakistan	(ii) Centre for Research in Rural and Industrial Development (CRRID), Punjab
Ganges	(iii) South Asia Watch on Trade, Economics and Environment (SAWTEE), Nepal	(iv) Nand Educational Foundation for Rural Development (NEFORD), Uttar Pradesh (v) Indian Grameen Services (IGS) BASIX, Bihar
Brahmaputra	(vi) Unnayan Shamannay (US), Bangladesh	(vii) Rashtriya Gramin Vikas Nidhi (RGVN), Assam (viii) SNV Netherlands Development Organisation, Bhutan

The main objective of developing this partnership was to:

- expand and deepen the geographical outreach of CUTS
- tap in the knowledge and expertise of partners in the three domains of SDIP viz., agriculture, water and energy
- create a network of Civil Society Organisations (CSOs) across the three basins and
- act as change agent and advocate for policy changes

Keeping the agriculture, water and energy nexus in mind, the perception survey on which the report is based , was carried out to provide a baseline for CUTS research and advocacy activities under the SDIP platform. It primarily focussed on the perceptions of farm households and other stakeholders on pre-identified issues related to agriculture, water and energy. From a regional perspective also, the exercise was one of its kinds covering the domains of agriculture, water, energy, gender and climate change across a total of five countries and nine identified specific regional pockets in a total of 24 locations. This report captures the findings of the mentioned detail perception study exercise that was conducted by CUTS with the support of its partners. The results of the study have enabled to accentuate the advocacy strategy of CUTS International to achieve the SDIP goals and objectives.

2
Rationale

Instances like the "Southeast Asia Growth Triangle model" have shown that developmental models, which keep specific regional pockets as the focus, have shown economic progress (Dubey, Baral and Sobhan 2000). The developmental challenges in South Asia are peppered with inter-connected issues in agriculture, water and energy. Previous solutions of looking at the resources in singularity have been less effective due to the inter-connected and trans-boundary nature of these three key resources as well as their management. For example, increasing agricultural production and farm incomes would be possible in case of assured availability and access to irrigation services. But assured access to groundwater has also led to exploitation of water tables across the three basins. Typical example is that of Indus basin where higher production was realized with assured irrigation facilities and supporting policies like free electricity in Punjab leading to depletion of ground water.

The Gangetic basin is highly productive and contributes to the food security of the region, but there is marked distinction between the Western and Eastern counterparts. Intensive crop production is followed in the Upper Gangetic Plain, whereas in the Middle and Lower Gangetic plain (referred as the Eastern Gangetic Plain), agricultural production is at subsistence levels. The current irrigation practices would not support production of cash and water intensive crops for trade purposes. In Brahmaputra basin, alternate models of micro and mini hydroelectric (hydels) power plants are being promoted to meet power requirements. All of these instances indicate that the nexus is interdependent across South Asia and yet distinctly positioned because of sensitive regional politics.

A closer look into the SDIP goals clearly connects it with the United Nations Sustainable Development Goals in general and the second, sixth and seventh goals in particular.[1] The linkage between SDIP initiatives and Sustainable Development Goals should also be viewed in the context of climate change, which is going to have serious implications with regard to agricultural productivity and water. South Asia is expected to face more droughts and cyclones as per the predictions of Inter-governmental Panel on Climate Change (IPCC). Changing patterns of rainfall and melting snow and ice are altering freshwater systems, affecting the quantity and quality of water available in many regions, including South Asia (IPCC 2014).

Increasing urbanisation and population has put pressure on agricultural land thereby threatening the food security of the region, which will also affect food prices in the coming years. Thus, climate change is to play a significant role in determining food and water security in the region.

In spite of the steady economic growth of the region, regional integration has not been realised to the fullest in South Asia due to numerous factors including extensive sensitive list of tradable goods, persistence of restrictive non-tariff barriers, poor infrastructure, and mistrust prevailing among South Asian Association for Regional Cooperation (SAARC) member countries. The historical incidents which paved way for partition and birth of new countries, wide disparity between India and its neighbouring countries (with respect to power, size and natural resources) and internal politics between opposition parties within countries have sown seeds of hatred, fear and mistrust

among South Asian countries. The failure of SAARC in bringing regional integration has been a topic of concern in the developmental agenda of South Asian countries.

At the same time, South Asian Free Trade Area (SAFTA) has made some progress in opening up the region for facilitating trade. For instance, India has a strategic benefit due to its geographic location compared to its landlocked neighbours. Being a vast country blessed with natural resources, India has a comparative advantage over its neighbours in terms of agricultural production, water resources, energy access and connectivity. For example, regional and bilateral initiatives like Bangladesh Bhutan India Nepal (BBIN) and Indo-Bangla agreements on trade and economic diplomacy have shown success.

The Land Boundary Agreement (Ministry of External Affairs, GoI 2015) and the BBIN Motor Vehicles Agreement (Prime Minister's Office, GoI 2015) are other landmark agreements, which have redefined the political confluence and trust in eastern South Asia. These initiatives have helped start mirror discussions for the use of inland water ways for trade and transport between India and Bangladesh. The tripartite protocol between India, Nepal and Bangladesh facilitated by International Rice Research Institute (IRRI) promotes sharing rice varieties released in one country to be used by the other countries.

The SAARC Seed Bank also has mandated the cross-border sharing of essential crop varieties and germplasm for reducing food insecurity in the SAARC region. Another such instant is in the field of energy cooperation which was the focus at the 5th SAARC Energy Ministers Meeting in Oct., 2014 where the SAARC Framework Agreement for Energy Cooperation was finalised. The agreement will facilitate development of a South Asian Association for Regional Cooperation Market of Electricity (SAME) and will help in inking Power Trade Agreement (PTA) among SAARC countries. The meeting had also called for a strong political investment among the member countries to move past political disagreements and come together for a common cause. It also has provision for joint varietal release and evaluation. All these developments underline the continued need for regional cooperation for securing the food, water and energy in South Asia.

3
Review of Literature

Enabling Agriculture

South Asia's food security concern will exacerbate in the coming years owing to global environmental changes and poor supply chain infrastructures. The Indo Gangetic Plain plays a significant role in assuring food security in the region as it contributes the lion's share with respect to rice and wheat production. Unlike the western counterpart, the Eastern Gangetic Plains (EGP), which is the home to 300 million people is characterised by low agricultural productivity, poor infrastructure, diminishing size of farm holdings and frequent climate vagaries resulting in poor household income leading to greater levels of poverty. Though rice and wheat are the predominant crops, maize, sugarcane, cotton, pulses and jute are also grown in the region. National mean yields of all three cereals in South Asia are below global averages (except for maize in Bangladesh) and yield gaps of 50 per cent or more exist in all the three crops. The reasons for low national average is attributed to rain fed agriculture (poor water management), low adoption of High Yielding Varieties and hybrids, small farm holdings which restrict the use of technology and degrading soil quality.

Table 3 shows that agriculture is a significant contributor to the GDP of countries lying in Himalayan river basins. About half of the workforce in each South Asian country is engaged in this sector. But the productivity scenario shows that the region lags much behind the global average. Among the listed countries, only Bangladesh recorded higher cereal yield per hectare (4357kg/ha) than the global average (3851kg/ha). In the recent years, Bangladesh has increased the area under irrigation and HYV and hybrids and strengthened extension services but still it is a net importer

Table 3: Agriculture and Allied Indicators across Sample Countries

Sample Countries	Agricultural land (% of land area)[2]	Agriculture, value added (% of GDP)[3]	Employment in agriculture (% of total employment)[4]	Cereal yield (kg per hectare)[5]	Fertiliser consumption (kilograms per hectare of arable land)[6]
Pakistan	47.06 (2013)	25.03 (2014)	43.50 (2014)	2722.20 (2013)	135.25 (2013)
Nepal	28.74 (2013)	33.69 (2014)	66.50 (2013)	2569.65 (2013)	57.72 (2013)
India	60.63 (2013)	17.83 (2014)	49.70 (2013)	2961.61 (2013)	157.52 (2013)
Bhutan	13.63 (2013)	17.74 (2014)	56.29 (2013)	2941.65 (2013)	15.18 (2013)
Bangladesh	69.97 (2013)	16.11 (2014)	47.50 (2010)	4357.34 (2013)	208.66 (2013)
World aggregate	37.70 (2013)	3.1 (2013)	19.80 (2010)	3851.30 (2013)	119.90 (2013)

Source: World Development Indicators (Accessed on March 12, '16 at http://databank.worldbank.org/)

owing to the growing demand. This indicates that there is a great scope for South Asian countries for improving the agricultural production in the region by better management practices and services.

Further, production increases of the last 50 years achieved in the Indo-Gangetic belt is at significant cost to the natural resource base (degraded soils and ecosystem impacts, including habitat fragmentation threatening biodiversity) as well as the global environment (Vethaiya, Adhya and Ladha 2012). It is also interesting to note that management practices and technologies are available in the irrigation command areas where these problems are more common, but their adoption is constrained due to lack of appropriate institutional arrangements (P. Aggarwal, P. Joshi and J. Ingram, et al. 2004).

Food wastage, mostly of cereals, is of paramount concern in South Asia. Against the food wastage at the consumption level in developed countries, food wastage in developing countries (about 40 per cent) is at the supply chain-level, which includes storage, transportation, cold storage and post-harvest management (FAO 2015). The region is yet to exploit fully the prospective of high value crops and diversified farming, though it possesses immense potential for the same. Home to many unexploited fruits like mango, *karonda*, litchi, *jamun* (java plum), the processing industry has not yet developed for these crops, especially in the Eastern Gangetic Plain mainly because of the lack of investment and interest shown by private players (Vidyadharan, et al. 2016). There is a shift in food consumption pattern in the region towards high value crops and meat due to increase in per capita income. However, this inclination towards diversification, which also fetches a market for the produce within the region, has to be supported through adequate policies.

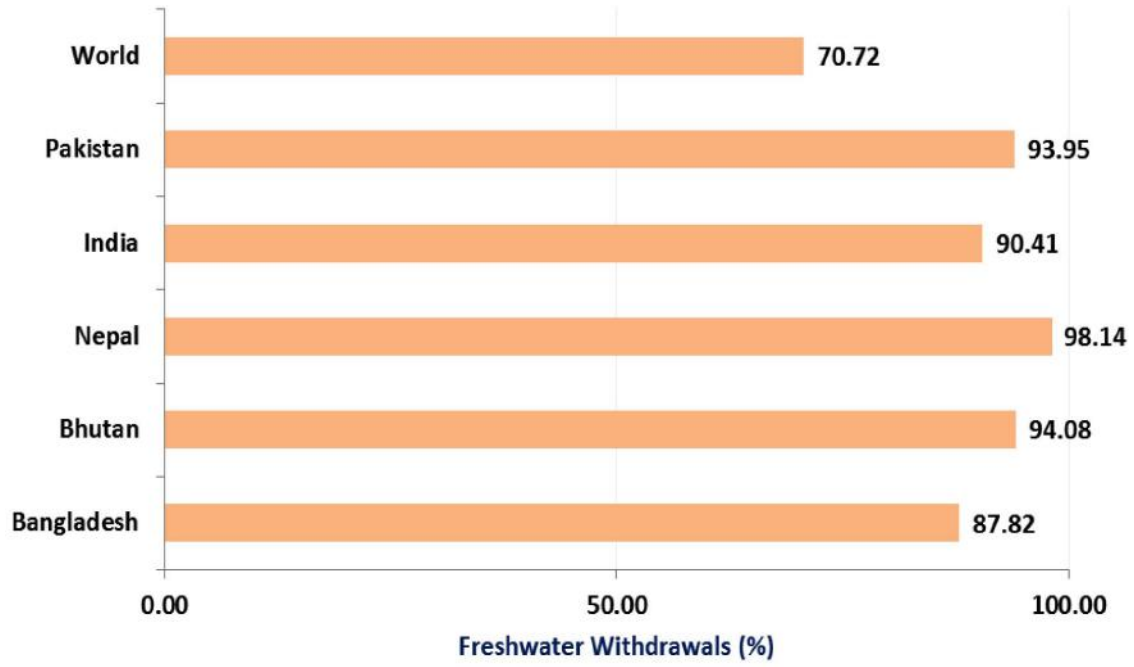
Increase in farm incomes in small holdings is possible only when farmers realise better price for their produce. Access to markets, market information and poor market infrastructure are the constraints faced by small and marginal farmers in South Asia. Even in regulated markets of India, market facilities and infrastructure are weak and farmers rely on middlemen or traders because of poor connectivity. At the regional-level also there are different factors that restrict trade in agricultural commodities across borders. Trade of agricultural commodities require testing and verification for safety and protection of human beings, plants and animals. Various Sanitary and Phyto-Sanitary (SPS) measures, which act as NTBs are laboratory testing, chemical level testing, plant quarantine requirements, pre-shipment certification, compliance with measures preventing food adulteration, biosecurity, hygiene and sanitary permits, need to be simplified (CUTS International 2016).

Water Cooperation

Historically, the development of cooperation among South Asian countries particularly Bangladesh, India, Nepal and Pakistan with respect to the Indus and the Ganges-Brahmaputra-Meghna river basins has been a cause of tension, apprehension and ongoing disputes. Given the atmosphere of mistrust, 'upstream-downstream' syndrome, 'unequal' partnerships, lack of definitive international laws, regional principles or enforceable global conventions, a number of conflicts have erupted in South Asia on trans-border water issues (Actionaid India 2015). The Indus Water Treaty and the Ganges Treaty being the two important treaties of the kind in the region are mainly about allocation of water between partner countries.

Looking at the Ganges treaty, Farakka Barrage, 17 km (11 miles) upstream from the Bangladesh border in India, has been the key source of disputes between India and Bangladesh over the Ganges River. The downstream effects of the Ganges water diversion include reduced surface water and ground water, increased ground and surface salinity, agricultural loss, adverse effects on ecosystems, changes in river morphology, declining fisheries, etc. (Khan 1996, Mizanur 2006). The increased salinity has led to closing down of several industries and also destroyed farm land and created thousands of landless farmers. Loss of forest resource and fish yield has also affected the livelihoods of dependent population (Kawser and Samad 2015).

Figure 2: Annual Freshwater Withdrawals in Agriculture (Percent of Total Freshwater Withdrawal) in 2013



Regarding the Indus Water Treaty, approximately 80.52 per cent of the volume of water in the Indus basin was allocated to Pakistan and 19.48 per cent was allocated to India (Brar and Gill 2015). Both the countries have become water stressed and have to seek solutions through improving water use efficiency and sharing of water efficient knowledge, technology and development pattern – with a perspective of give and take. Between India and Nepal, the latter being the upper riparian country is more concerned about the inundation and backwater effects of the hydro related projects proposed by India, considering quite often promises are not kept. The main issues pertain to potential benefit from these projects regarding flood control, irrigation and power generation (Khalid 2008).

Figure 2 shows the annual freshwater withdrawals in agriculture for the world and the sample countries in this report (FAO 2016). The data shows that all the five countries have higher freshwater withdrawals than the world average of 70.72 per cent with the highest being in Nepal (98.14 per cent) and Bhutan (94.08 per cent). When it comes to ground water, in India, it is an immovable property associated with land. Under the federal system of governance, state governments are responsible for management of water resources. Similarly, after the constitutional amendment in Pakistan, agriculture and water are provincial subjects.

In case of Nepal, Central Government is given the right to conserve water resource and prepare policies and criteria regarding the multiple use of water resource. Non-performance of big irrigation projects are mostly due to siltation of reservoirs and canals, lack of regular and proper repair and maintenance of the irrigation infrastructure, inadequate allocation of resources for repair and maintenance, water intensive crops in the head reaches, water logging and salinisation, and diversion of water for non-irrigation uses has increased the dependency on ground water use for irrigation (Vidyadharan, et al. 2016, Thakkar 2010).

Rain-fed agriculture in South Asia is by and large influenced by monsoons and taking into account of the uncertainty in rainfall affecting surface water, ground water withdrawal is expected to continue. At the same time prolonged dry spell will also dry up wells threatening water tables. Since ground water irrigation is related to energy consumption, sustainable groundwater management

can lead to long-term cost and energy savings (WWAP 2014). Proper water management practices, which include crop need based irrigation, micro-irrigation techniques; dry seeding etc. would increase the water use efficiency and also conserve water. Scientific evidence shows that Alternate Wetting and Drying (AWD) irrigation of rice transplanted into puddled soil reduced water use by 25 per cent with little impact on yield (Gathala, et al. 2011).

Renewing Energy

Among the South Asian countries, India (90085mt; 39tcf) and Pakistan (17550mt; 33tcf) have major energy resource endowments of coal and natural gas while Bhutan (30000 MW) and Nepal (42000 MW) have vast hydropower potential in relation to their size (Jha and Mishra 2014). However, the energy consumption in South Asia has increased over the past couple of decades owing to population growth, industrialisation, economic growth and urbanisation. As reported by the FAO, the food sector currently accounts for about 30 per cent of the world's total end-use energy consumption, and that more than 70 per cent of that energy is used beyond the farm gate (FAO 2011).

The increased reliance of developing nations on fossil fuel imports for the generation of electricity is neither climate-friendly nor economical. Furthermore, South Asia has immense potential of renewable energy; tapping the renewable energy sources through regional cooperation and knowledge sharing is vital to its energy security (CUTS International 2015).

As stated by many scholars, the energy deficiency situation in South Asia can be overcome through regional energy cooperation as well as optimal utilisation of available resources, such as river waters in the high Himalayas, wind energy along coasts, natural gas and other hydrocarbons (Kurian and C. 2015, B. K. Singh 2013, CUTS International 2015). Affordability, investment and scalability remain a concern with off grid renewable energy models. Though predominantly public investment played a major role in building water and energy infrastructure, the size of future investment required for both domains means that a major recourse to private finance will be essential (WWAP 2014).

Nexus of Food, Water and Energy

There exist intrinsic linkages between the three pillars of water, energy and food with each influencing the availability of other. Water is essential for agricultural production and hydropower is one of the most promising renewable energy. Many of the big hydro projects in South Asia are multipurpose, e.g. for energy generation and irrigation (Golam 2014). With the advent of climate change and variations in monsoons, crop productions in rain-fed agricultural areas are likely to be adversely affected. Also, irrigated agriculture in South Asia is becoming increasingly dependent on ground water resources (Barker and Molle 2004).

Increased extraction of groundwater for food production has consequently increased the demand for energy and lowered the groundwater table in many parts of the South Asian region (Lele, Klousia-Marquis and Goswami 2013, Golam 2014). Populist policies of free electricity have contributed to over exploitation of ground water resources in North West India. Where electricity is not heavily subsidised, farmers resort to diesel pump sets.

However, it was noticed that subsidising energy, in the form of fossil fuels, has benefited smallholder farmers in Bangladesh without over-exploiting water resources unlike the energy subsidies in the form of cheap electricity in the drier parts of India, which have had detrimental effects on groundwater levels. Power consumption for tube-well irrigation is expected to be double by 2023 escalating the cost to farmers for maintaining pump infrastructure and replacing failed pumps. Moreover, the intrusion of saline groundwater into fresh groundwater aquifers has forced irrigation to be restricted to 1-10 meters below the groundwater table (Weert, Gun and Reckman 2009).

Considering that, the breadbaskets of the Indo-Gangetic plain provide sustenance to whole of South Asia; resource efficiency and comprehensive policy support is required for sustaining the nexus of food, water and energy in South Asia (P. Aggarwal, P. Joshi, et al. 2004). Any efforts to improve the efficient use of water would have implications in energy saving as well. This includes modernisation of existing canal irrigation systems to improve services and use knowledge-based precision irrigation. Small, mobile diesel engines that are demountable and can be used for a range of applications, including powering pumps for irrigation, have increased food production and economic returns to farmers (Steele 2011).

Vagaries of Climate Change

The IPCC's Fifth Assessment Report states that South Asia will experience rise in temperature, floods, heat waves, sea level rise by the mid-21st century and all of this will have serious implications on livelihood, health and food security of the people in the region (IPCC 2014). Rice, the most important staple of the region, is highly vulnerable in the northern part of South Asia, but changes in climate might boost wheat production in parts of Pakistan where warmer temperatures would make it possible to grow at least two crops per year of wheat and maize in mountainous areas. The report also warns that there will be yield reduction of wheat in the Indo Gangetic region if proper management practices are not adopted. Climate-related declines in food productivity will impact livelihoods as well as the rate of exports, increasing poverty levels. For example, the report points out that these factors would cause a net increase in poverty of 15 per cent in Bangladesh by 2030.

South Asia's vulnerability to climate change is more in focus currently because it directly interacts with the farm landholdings and food security of the rural poor. Since 2013, few landmark food reforms have also acknowledged the impact of climate change on food insecurity among the poor of South Asia (IFPRI 2015). Given that the sub-continent depends on the seasonal monsoons for its cropping preferences, the erratic rainfall also has been a major cause of crop failures. Women and children who are the most vulnerable bear the largest brunt of climate shocks because they are more susceptible to the after effects like malnutrition, migration, displacement etc. of climate disasters like drought, flood, landslide and earthquake (Kapoor 2011).

The UN has estimated that a person living in the Asia-Pacific is 3.2 times more likely to be affected by natural disaster than a person in Africa, 5.5 times more likely than a person in Latin America and the Caribbean, almost nine times more likely than a person living in North America, and 67 times more likely than a person living in Europe. Quite often susceptible communities are not well prepared to mitigate natural disasters due to climate change because of poor infrastructure for warning in the countries. Recent advances have been made in addressing early warning and alerts for disaster management by South Asian Disaster Knowledge Network (SADKN).

Gender Gap

South Asian agriculture is predominantly resistant to large scale mechanisation due to its subsistence type of farming methods. This has also encouraged the requirement of labour for activities like sowing, transplanting, weeding and harvesting which are characterised by a limited economic value for the work performed and low wages. Humans provide close to 30 per cent of the power required for land preparation in South Asia (FAO 2015). In addition to this, the rise of Female Headed Households (FHHs) due to male migration has also increased the female workforce to close to 43 per cent in the agricultural labour force (FAO 2015). Along with farm labour, women also participate in domestic activities, resulting in women working longer hours than men. Despite the pivotal role that women have in agriculture, their due participation goes unrecognised because they rarely have a chance to exercise their economic rights.

One key inhibitor to this has been observed to be the access of women to credit and loan facilities. Statistically, it has been found that women are 20 per cent less likely than men to have an account at a formal financial institution (Fletschner and Kenney 2011, Demirguc-Kunt, et al. 2015). In South Asia, lack of financial education and absence of accessible finance outlets are the two main inhibitors for women to acquire economic empowerment. These issues are common due to limitations in mobility given their patriarchal conservative societies.

Only 14 per cent of landowning rural households are owned by women in Nepal whereas in Bangladesh and Pakistan, the land holdings of male-headed households are more than twice the size of the holdings of female-headed households. Most women, however, engage in subsistence farming, and are "trapped in low productivity cycles" (Agarwal 2012 and Agarwal 2014).

Women's insecure tenure rights mean that they are sometimes forced to work on less productive land and are excluded from agricultural training. In addition, less predictable rainfall, more frequent floods and droughts and more crop failures mean that greater investments are needed in technology and fertilisers, to name a few, for women in agriculture (UN Women 2014).

Interesting cases of share-cropping (*bataiya*) by women in Eastern Gangetic Plain have been observed in a study conducted under the aegis of ACIAR (Lahiri-Dutt 2014). Women who have received some degree of education were reluctant to do agricultural work and hence hired labour and entered into share cropping. They take other women households land on share or give out their own to others, if unable or unwilling to farm themselves. Gender-based division of labour exists in all farm practices; for example, in rice farming, ploughing is traditionally a task for men, and in jute cropping, cutting the stalks is a task for men, whereas women ret the stems (Kapoor 2011).

Women farmers are very often key players in many of the interventions of grassroot NGOs because women farmers are more responsive than men farmers and achieve greater success. In such cases, women farmers are not only recipients of knowledge, skills and technologies but are also mobilisers, decision-makers and risk-takers (Kapoor 2011). Mainstreaming of gender in the policy discourse on climate change and adaptation strategies can address gender disparity in agriculture.

4
Sampling Methodology & Characteristics

Building on the SDIP partnership with DFAT, CUTS International had conducted field research to identify the key problems related to food, water and energy security as observed by the different stakeholders in these locations. To begin with, CUTS carried out a quick diagnostic study by interviewing key informants across the sectors of agriculture, water and energy (CUTS International 2015). The diagnostic study enabled to identify the challenges, possible solutions and the expectations of different stakeholders from state and non-state actors to enhance agricultural production, water and energy security.

Based on the key findings of the diagnostic study, a detailed perception study was conducted with farm households and other key stakeholders located in the Indus, Ganges and Brahmaputra basins. The study aimed to capture the perception of various stakeholders on pre-identified issues within the domain of agriculture, water and energy and also their expectations from state and non-state actors to address the challenges in the three domains.

The objectives of the perception study were to:

- build on the findings of diagnostic study by mapping the perceptions of various stakeholders on pre-identified issues within the domain of agriculture, water and energy;
- capture the expectations of stakeholders from state and non-state actors to address the challenges in the three domains;
- identify the policy gaps and streamline the advocacy strategy of CUTS under SDIP; and
- encourage policy discourse and knowledge dissemination on the mentioned topics across South Asia.

Sampling Procedure

The study was conducted in 24 locations in 11 sample sites across five countries viz., Pakistan, India, Nepal, Bhutan and Bangladesh. The study covered two districts (or the equivalent administrative unit) in each location. The criteria for selection of district were as follows:

- One of the two districts in each location should be close to the national/state border
- Preferably one of the districts should be located on the upper riparian and another on the lower riparian
- Districts (and thus sample households) should ideally have a mix of social stratifications, representing different classes, tribes, minorities etc.
- Districts (and sample households) should also adequately represent small and marginal farmers (with less than 5 acres of land)
- Districts with experience of in/out migration are desirable
- Districts with considerable presence of female farmers are desirable (the idea is to have at least 20 per cent female respondents)

Figure 3: Location of Sample Sites across the Three Basins

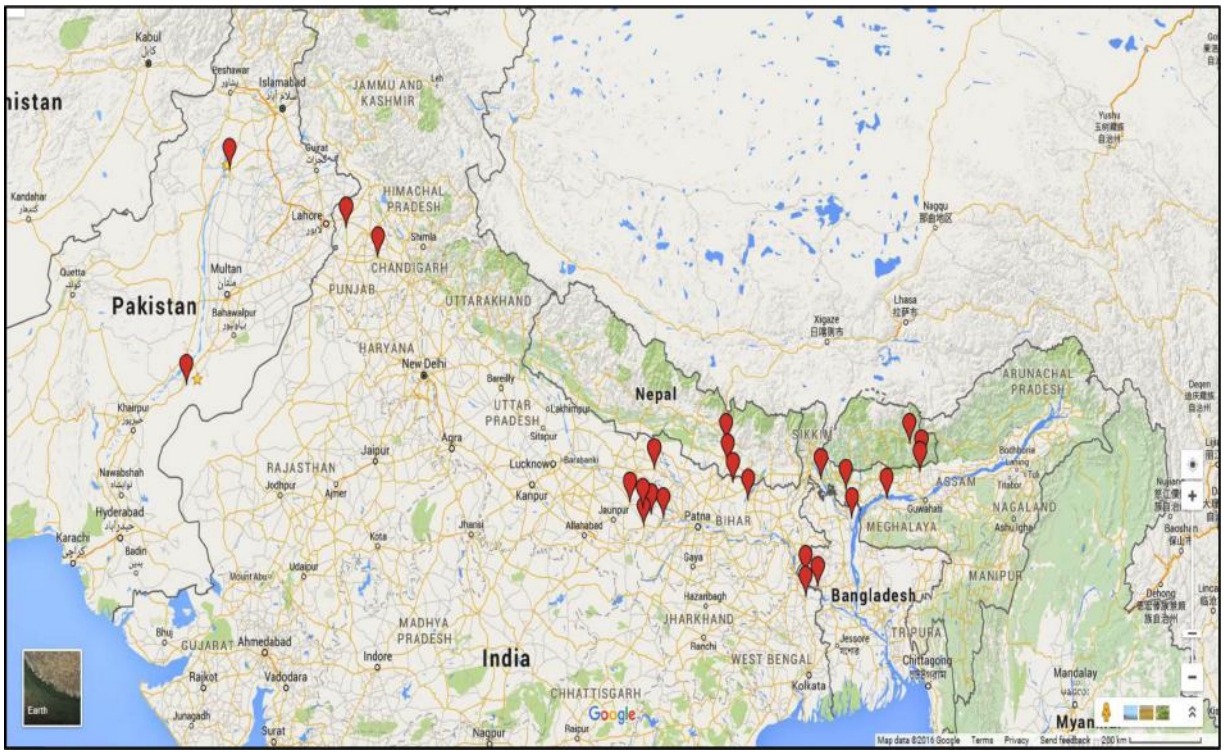


Figure 4: Location of Sample Sites in the Indus Basin

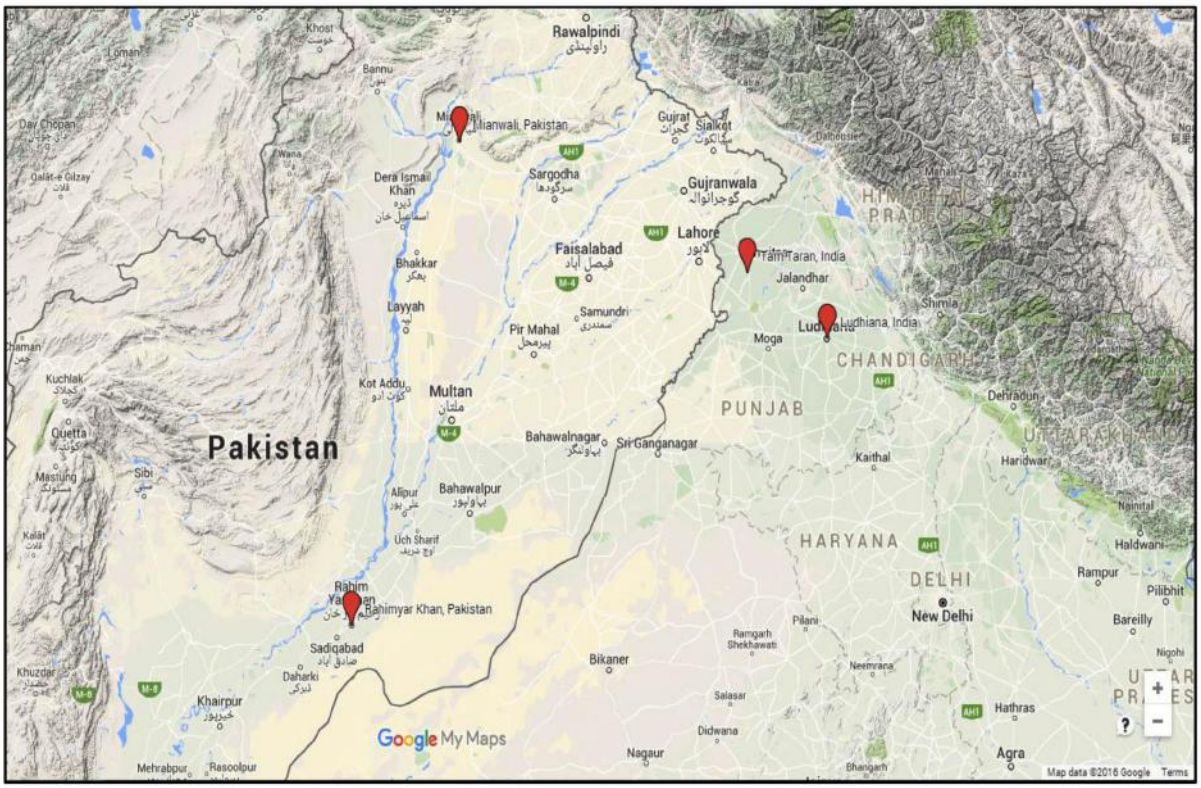


Figure 5: Location of the Sample Sites in the Ganges Basin

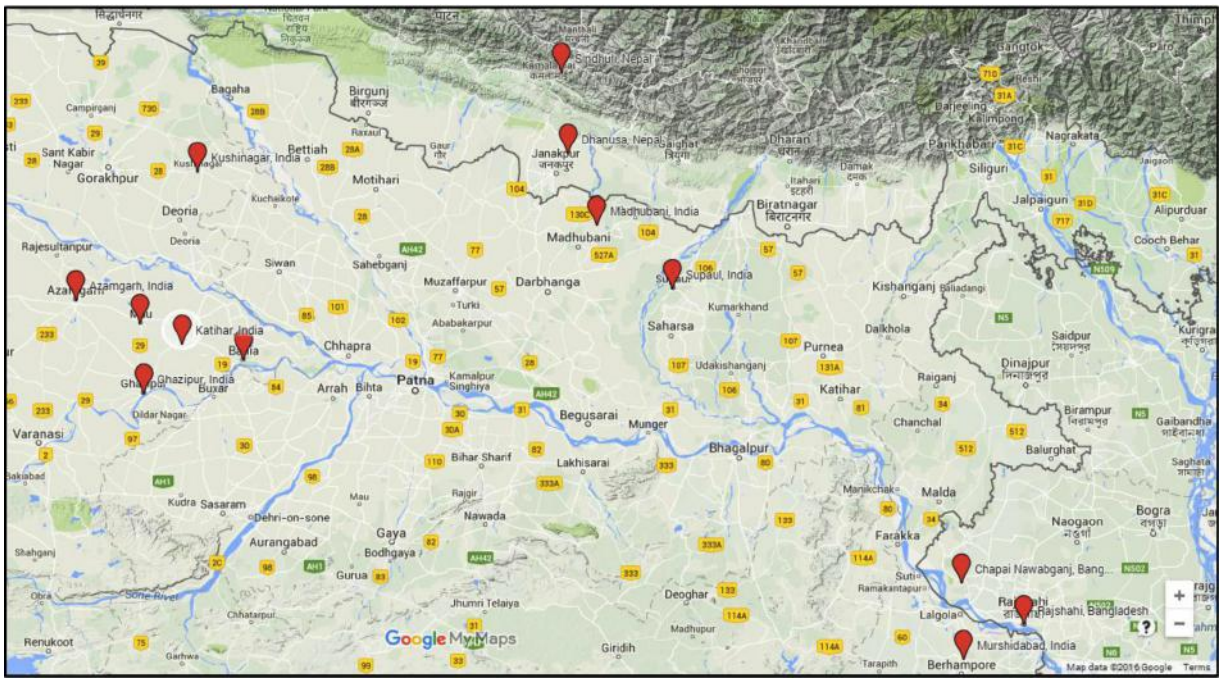
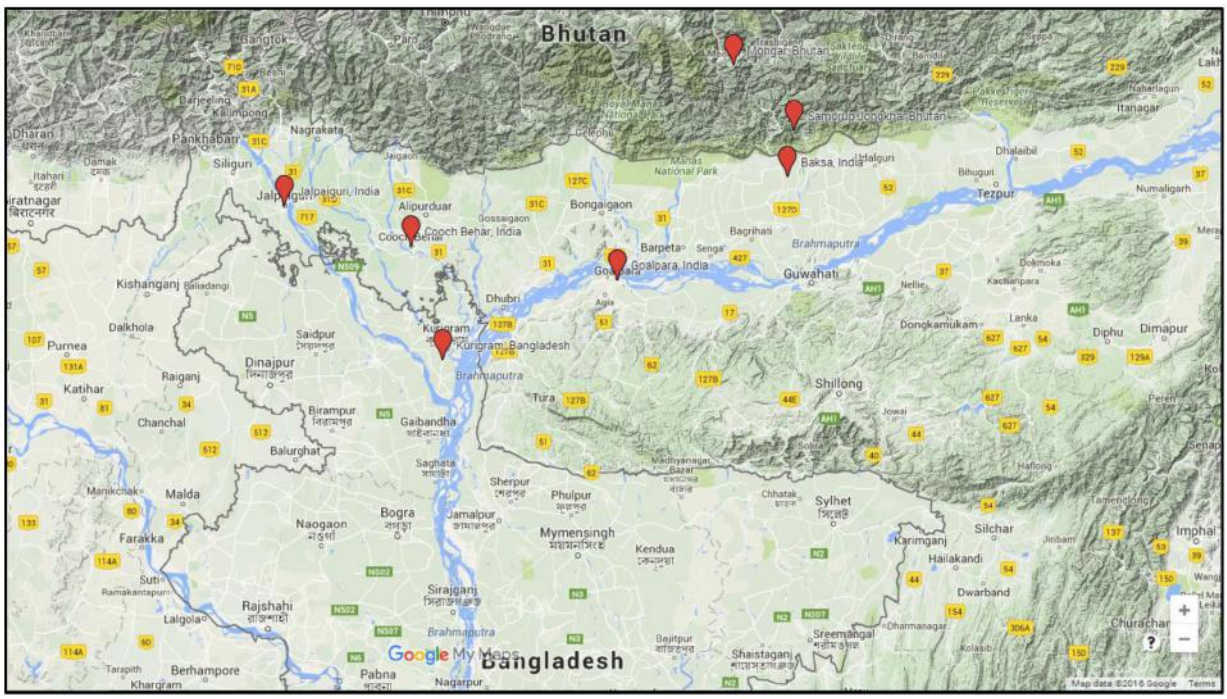


Figure 6: Location of the Sample Sites in the Brahmaputra Basin



The basic survey unit was the farm, and for each farm surveyed, the perception of the head of the household was recorded as responses. In the absence of the head of the household, the member who would have maximum information about farming data was chosen as the respondent. The perception survey questionnaire was divided in two parts – Part A and Part B. Part A was comprised of gender neutral and farm specific questions and Part B comprised of gender specific questions targeted at the female members of the households. Desk research and field scoping prior to the survey had suggested that the farm profile is different across the 24 locations; hence an unbiased profiling of the farms and farmers was carried out to understand the impacts or influences on the responses.

A summary of some of the main profiling characteristics of the farms, farmers and their households are given in the succeeding sessions. The total sample size allocated for each sample site was 100 respondents. Out of 100, 80 respondents were allocated for household questionnaire surveys; the rest 20 comprised of other stakeholders who were covered through semi-structured interviews. Table 4 provides details of the sample stratification:

The perception survey was conducted as planned across a total of five countries and eleven sample sites and a total of 24 locations. A total of 846 respondents administered the survey instrument and their responses were collected to create an overall baseline database for this project. The spread of the sample across the countries and pockets is given in Table 5.

A total of 846 responses were collected across the three basins with approximately 9 per cent responses from each survey pocket. The responses from Bangladesh and West Bengal consist of responses from both Ganges and Brahmaputra basin. The detailed distribution of respondents has been given in Annexure 1.

Table 4: Details of Sample Stratification

Methodology	**Sample Stratification**
Open-ended Interviews	• Regional and Bilateral Agencies • National Leaders/Policy Makers • Sub-national Leaders/Policy Makers

Semi-structured Interviews	• Government Officials
	  ◦ District (DM + water, energy, agriculture departments)
	  ◦ Block (BDO + water, energy, agriculture departments)
	• Local Governments
	  ◦ *Panchayats*
	  ◦ Village Heads
	• Civil Society Organisations or CSOs (At least one CSO with a focus on each of the 3 domains)
	• Media
	• Private Players
	  ◦ Agri input traders
	  ◦ Agri output traders
	  ◦ Water/energy service supplier
	• Collaborative Structures
	  ◦ Farmer producer groups
	  ◦ SHGs
	• Academicians/researchers

Questionnaire Survey	• Farmer Households

Limitations to the Study

Due to the diverse and extensive nature of the survey, following limitations were encountered during the progress of the survey:

(i) Due to the earthquakes in Nepal and Bihar during April 2015, the survey was delayed substantially by almost six months.

(ii) The fuel blockade followed by Madhesi agitation in Nepal during September, 2015-January 2016 prevented the movement of the team for survey purposes.

(iii) The local *Panchayat* elections in Uttar Pradesh and state elections in Bihar during October 2015 delayed the later part of the survey.

(iv) Local agitations in Punjab during October 2015 delayed a significant portion of the survey.

(v) The coinciding time frames of numerous local and regional festivals from August-November 2015 across the five countries caused the scheduling of interviews with government officials and other key informants to be tedious.

(vi) Since the survey was spread across 24 locations in 5 countries, the entire exercise was logistically resource consuming. Quite often, coinciding of the survey with the cropping season was difficult, because each of the locations had varied time and season zone. The compilation and data analysis of each of the 24 datasets involved multiple back and forth with local partners and hence was quite time-consuming.

Table 5: Distribution of Respondents across the Sample Sites

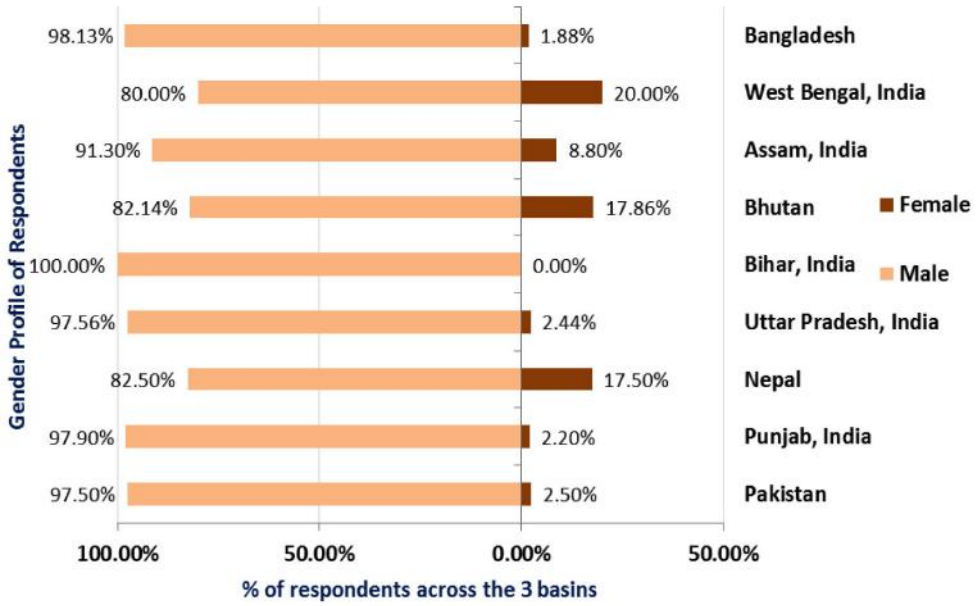
Basin	Sample Site	Districts	Riparian Location	Total no. of respondents in sample site	% of respondents in sample site	% of respondents in basin
Indus	1. Pakistan	1. Mianwali	Upper	80	9.46	20.45
		2. Rahim Yar Khan	Lower			
	2. Punjab, India	3. Ludhiana	Lower	93	10.99	
		4. Tarn Taran	Upper			
Ganges	3. Nepal	5. Dhanusha	Lower	98	11.58	50.71
		6. Sindhuli	Upper			
	4. Uttar Pradesh, India	7. Ajamgarh	Upper	82	9.69	
		8. Ballia	Upper			
		9. Gazipur	Upper			
		10. Kushinagar	Lower			
		11. Mau	Lower			
	5. Bihar, India	12. Katihar	Upper	89	10.52	
		13. Madhubani	Lower			
		14. Supaul	Lower			
	6. West Bengal, India	15. Murshidabad	Lower	40	4.73	
	7. Bangladesh	16. Chapai Nawabganj	Upper	120	14.18	
		17. Rajshahi	Lower			
Brahmaputra	8. Bhutan	18. Mongar	Upper	84	9.93	28.84
		19. Samdrup Jongkhar	Lower			
	9. Assam, India	20. Baksa	Upper	80	9.46	
		21. Goalpara	Lower			
	10. West Bengal, India	22. Coochbehar	Upper	40	4.73	
		23. Jalpaiguri	Upper			
	11. Bangladesh	24. Kurigram	Upper	40	4.73	
	Total			846	100.00	100.00

Gender Profile

Figure 7 shows the gender profile of respondents for each state. Since the questionnaire was divided into two parts – gender neutral and gender specific questions, the variables had interesting results based on the respondents. For gender neutral questions, across the locations, a similar trend was observed where the percentage of male respondents was higher than female respondents with the exception of Bihar where there were no female respondents.

However, in Nepal, Bhutan and West Bengal, close to 17-20 per cent of the respondents were also female for the gender neutral questions, so essentially the entire questionnaire was answered by females in these cases. This information indicates that the female respondents had awareness about key questions involving key farm activities, which have been described in detail in the succeeding sections.

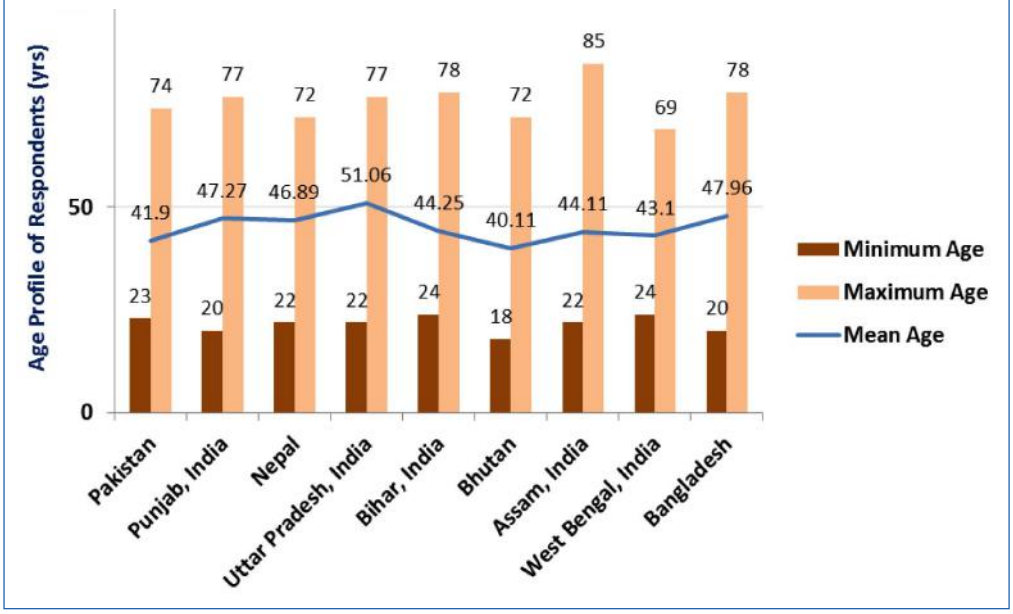
Figure 7: Gender Profile of Respondents



Age Profile

The age profile of respondents (Figure 8) revealed expected conclusions as observed in the desk research and field scoping studies. The highest mean age was seen in Uttar Pradesh (51.06) and the lowest was seen in Bhutan (40.11). The minimum age was closer to late and early 20s and the maximum age was closer to late and early 70s. This concurs with the estimate that the age bracket of the respondents is in a generous spread between the ages 20-70. This age spread is critical to the adoption of key messages under SDIP since it would ensure sustained participation and involvement from the beneficiaries.

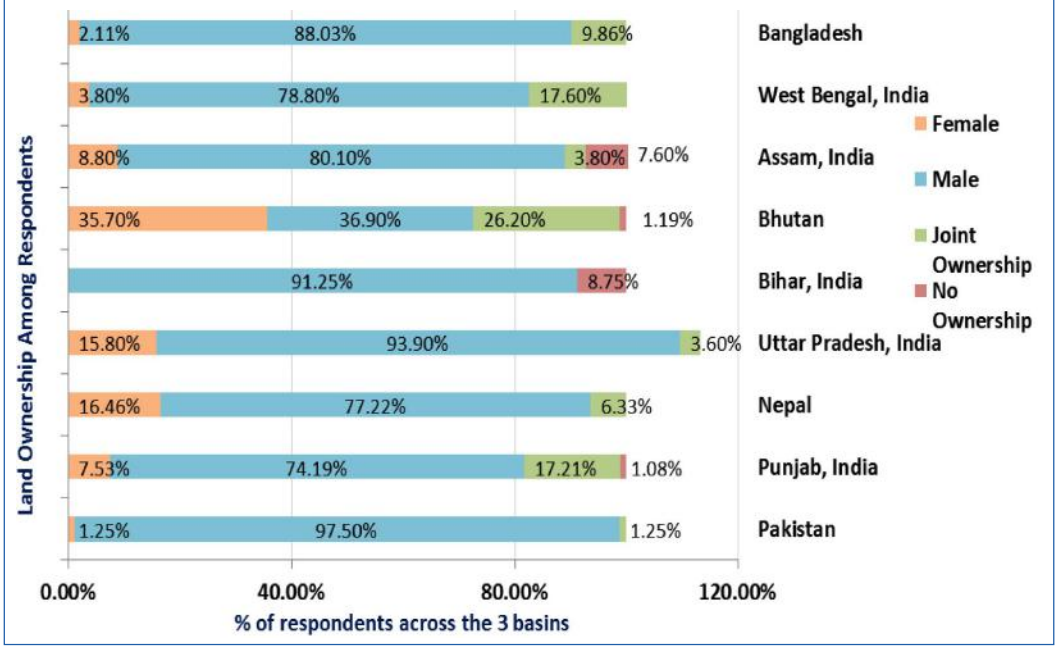
Figure 8: Age Profile of Respondents



Land Ownership Status

Since land entitlements are directly linked to numerous social benefits, the survey also comprised questions on ownership of the farm land. The question also specified that if the man and woman of the HH own separate land units then both male and female options should be ticked and if the same land unit was in registered in both of their name, then joint ownership has to be chosen. The responses came back from the field with another option which was 'no ownership' (Figure 9). This option was observed in Punjab (1.08 per cent), Bihar (8.75 per cent), Bhutan (1.19 per cent) and Assam (7.60 per cent). Across the sample size, higher land ownership among males was observed as compared to female ownership, except Bhutan where almost equal ownership was seen among male and female land owners (≈36 per cent).

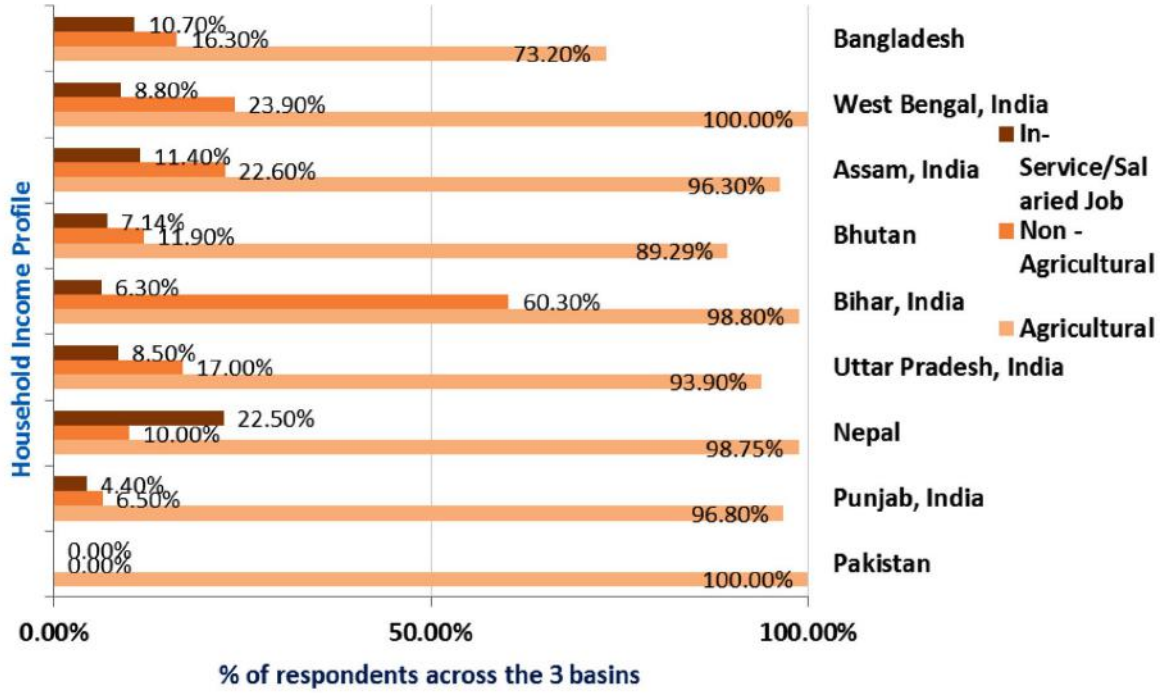
Figure 9: Land Ownership among Respondents



Household Income Profile

Figure 10 shows the primary source of income for the respondents covered under the study. The highest source of income was observed under agriculture in Pakistan and West Bengal (100 per cent). The lowest percentage of respondents was recorded under in-service/salaried jobs in Punjab (4.40 per cent). Across the sample size, highest numbers of responses were recorded under agricultural sources of income. This was followed by non-agricultural and then in-service/salaried job sources of income. This supports the conclusions from the desk research and field scoping studies, which suggest that farm based income is a major source of income in the five countries covered under the study.

Figure 10: Household Income Profile of Respondents



5
Agriculture Profile and its Characteristics

The agriculture scenario for majority of the sample sites taken under the study was more or less similar. The variables related to cropping pattern and access to agricultural inputs showed drastic variations basin wise. However, across the sample sites common issues of credit access, government aided support and improvement in subsidy disbursement were observed. A more detailed variable wise discussion has been given in the sections below.

Soil Characteristics

Figure 11 shows the type of soil problems observed in the 11 survey sites in the last three years from the date of this survey. The three year timeframe was chosen to emphasise whether farmers are aware of any visible changes in the soil rather than an attempt to capture a technical soil problem. The three year timeframe also assured that the farmer would have had the farmland in possession for at least three years, hence would have more reliable knowledge about the soil variations in the farm.

The data shows that across the sample site, majority of the respondents did not report any visible changes in the soil. In the Indus basin, maximum number of farmers reported water logging in the soil followed by other issues like sandy texture, declining fertility and lack of essential nutrients like zinc, magnesium and potassium. In Ganges basin, water logging and salinity were the main issues for farmers. Similarly, in Brahmaputra basin, the biggest issue was water logging followed by acidity in the soil.

Seed Characteristics

Regarding the type of seeds used for cultivation (Figure 12), predominance of hybrid and HYV seed was evident as reported by respectively 32.3 per cent and 97.8 per cent of the respondents in the Indus basin of India. However, in Pakistan, use of traditional varieties (53.8 per cent was leading followed by HYV and hybrid varieties. In Ganges, varied responses were recorded across different states of India, Nepal and Bangladesh, which clearly indicates that farmers rely on different kinds of seeds for cultivation.

As observed in Nepal, traditional varieties, hybrid and HYV were used by 91.3 per cent, 56.3 per cent and 30.10 per cent of the farmers, respectively. A closer look at the data reveals that farmers use simultaneously traditional varieties for cereal food crops and hybrids and HYVs for vegetable crops. It is interesting to note that 65.9 per cent of the respondents in Uttar Pradesh cultivated stress tolerant varieties. This could be attributed to the popularisation of stress tolerant varieties and short duration varieties by NEFORD in the districts where the survey was conducted. In Bihar, the maximum number of the respondents were in favour of traditional varieties (82.5 per cent) followed by hybrid (41.4 per cent).

Figure 11: Type of Soil Problems Observed in the last three years

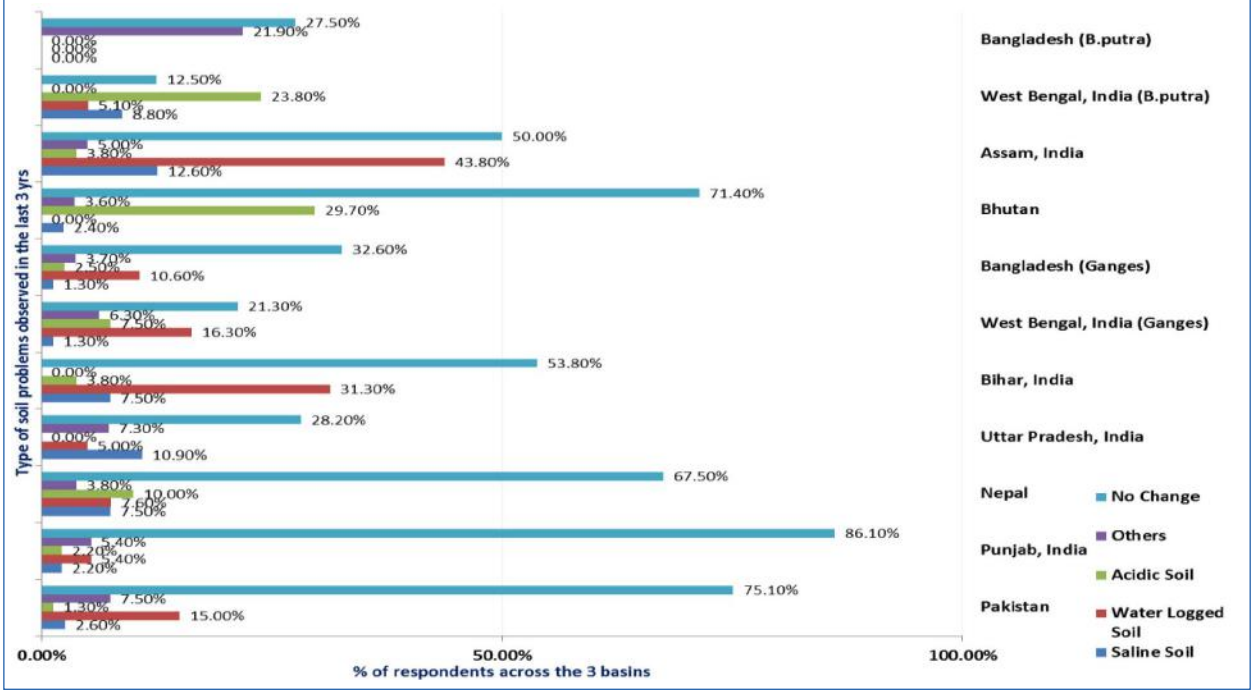
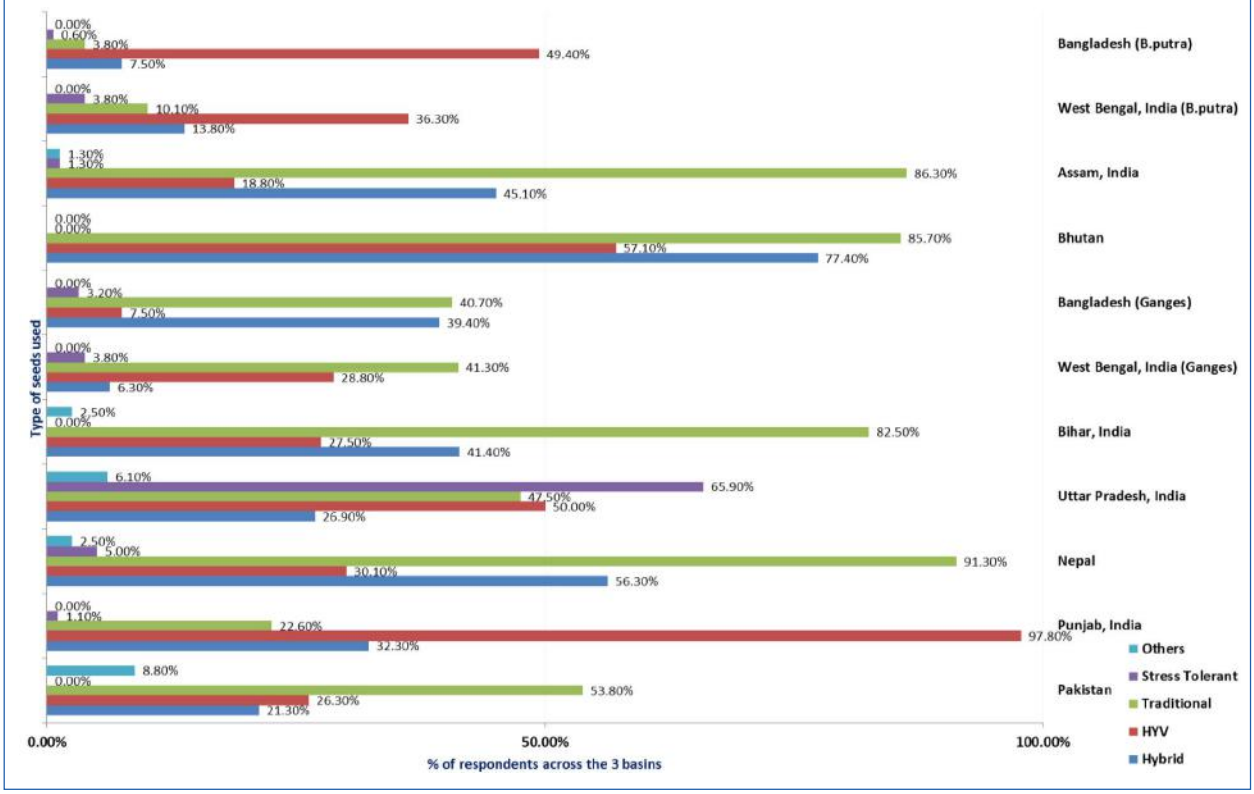


Figure 12: Type of Seed Varieties



The share of traditional variety users in West Bengal and Bangladesh was almost equal (41.3 and 40.7 per cent), which was followed by hybrids (39.4 per cent) in Bangladesh and HYV (28.8 per cent) in West Bengal.

With regard to Brahmaputra basin, higher proportion of traditional varieties use was recorded in Bhutan and Assam (85.7 and 86.3 per cent respectively) whereas in West Bengal and Bangladesh the respondents using HYV dominated with 36.3 and 49.4 per cent, respectively.

Table 6 reflects the source of seeds used by the respondents across the three basins. The emerging role of privately owned seed shops in the seed industry is evident in all the three basins. In Pakistan, 71.3 per cent of respondents used own seeds for cultivation whereas 42.5 per cent bought seeds from privately owned seed shops.

However, in Punjab, the maximum respondents depended on privately owned shops for seeds (91.4 per cent) followed by own seeds (60.2 per cent) and government shops (39.8 per cent). This is in tune with the responses on type of seeds (Figure 12), which show that in Punjab farmers prefer to use HYV seeds which are usually sold over the counter at private seed shops.

In the Ganges basin, except for the state of Uttar Pradesh, high proportion of respondents were dependent on privately owned seed shops in Nepal (83.8 per cent), Bihar (88.8 per cent) and West Bengal (32.5 per cent). Respondents using own seeds dominated in Bangladesh (43.2 per cent) and Uttar Pradesh (65.5 per cent). It was also noted that a substantial proportion (21.9 per cent) of respondents in Uttar Pradesh obtained seeds from 'other' category, which comprised of the stress tolerant and short duration varieties distributed by NEFORD. It was also observed that in the Ganges basin of Bangladesh, 26.9 per cent of the respondents received their seeds from private contractors. This might have influenced their choice of type of seeds (Figure 12). Increasing popularity of hybrid varieties have enabled private sector to secure their position in seed market.

The data of Brahmaputra basin reveals that in Bhutan and Assam respectively, 72.6 per cent and 77.6 per cent of the respondents used own seeds. The reliance on seed banks was considerable in the state of Assam (58.8 per cent) where significant portions of the population are tribal communities.

The demographics of the survey locations in Assam indicate that 34.8 per cent and 22.9 per cent of the population in Baksa and Gopalpura villages respectively belonged to tribal community. This also signifies the popularity of seed banks with indigenous people cultivating traditional varieties. Private seeds shops constituted the major source of seeds in West Bengal (45 per cent) and Bangladesh (46.9 per cent).

Table 6: Source of the Seeds (%)

Basin	Sample Sites	Own seeds	Family members	Neighbours	Seed Banks	Privately owned seed shops	From traders/ suppliers across the border	Government seed shops	Provided by contractor	Others
Indus	1. Pakistan	71.30	1.30	1.30	0.00	42.50	0.00	13.80	1.30	0.00
	2. Punjab, India	60.20	1.10	5.40	9.70	91.40	2.20	39.80	7.60	2.20
Ganges	3. Nepal	71.30	5.00	6.30	10.00	83.80	2.50	1.30	0.00	2.50
	4. Uttar Pradesh, India	65.50	4.90	34.10	2.40	48.90	0.00	45.10	0.00	21.90
	5. Bihar, India	57.70	0.00	1.30	1.30	88.80	0.00	0.00	0.00	1.30
	6. West Bengal	18.80	1.30	6.30	12.50	32.50	1.30	10.00	0.00	0.00
	7. Bangladesh	43.20	1.30	0.00	0.00	27.50	0.00	1.20	26.90	0.00
Brahmaputra	8. Bhutan	72.60	13.10	51.20	0.00	58.30	0.00	23.80	0.00	46.40
	9. Assam, India	77.60	0.00	55.00	58.80	57.60	0.00	52.50	0.00	2.60
	10. West Bengal	5.00	8.80	8.80	5.00	45.00	3.80	2.50	2.60	0.00
	11. Bangladesh	20.00	1.30	1.90	0.00	46.90	0.00	19.40	0.00	0.00

It is also evident from the data that seeds have also been procured by respondents from sources across the international borders in the border states of Punjab (2.20 per cent), Nepal (2.5 per cent) and West Bengal (5.1 per cent), mainly through traders. An absence of traders/suppliers across the border for seeds was prominently noticed given that Indo-Bangla seed trade is high. On closer investigation, it was observed that quite often the farmer buys the seeds directly from the private shops in Bangladesh and hence might not be even aware that the seed was originally procured from across the border.

Fertiliser Characteristics

Figure 13 displays the type of fertiliser used across the three basins. Among the chemical fertilisers urea and DAP (Di Ammonium Phosphate) were used by maximum number of respondents in the Indus, Ganges and Brahmaputra basins. More than 90 per cent of the respondents reported the use of urea in Pakistan (96.3 per cent), Punjab, (100 per cent), Nepal (92.5 per cent), Uttar Pradesh (98.8 per cent), Bihar (98.8 per cent) and West Bengal (Brahmaputra) (90.10 per cent). Even in a pro-organic country like Bhutan, 26.2 per cent of respondents used urea. The data also revealed that above 60 per cent of the respondents in Punjab (65.7 per cent), Uttar Pradesh (63.3 per cent), and West Bengal (Brahmaputra) (61.3 per cent) used a NPK dosage of complex fertilisers.

With regard to organic manure, the use of Farm Yard Manure (FYM) was recorded by 79.6 per cent of the respondents in Punjab whereas across the border in Pakistan it was limited to 1.30 per cent. In the Ganges basin, Uttar Pradesh (57.4 per cent) and Nepal (53.8 per cent) were leading in terms of FYM use.

In the Brahmaputra basin, all the respondents in Bhutan used Farm Yard Manure (FYM) for crops and in Bangladesh 42.5 per cent used FYM. Considerable proportion of respondents reported application of bio fertilisers (mostly phosphorus bacteria) in the state of Punjab (19.4 per cent), Nepal (31.3 per cent), Assam (17.60 per cent) and West Bengal (Brahmaputra basin) (38.8 per cent).

The data clearly indicates the imbalance in fertiliser use across the basins with negligence in applying FYM in most of the locations. Application of organic manures like FYM, compost etc. not only supplies nutrients but also improves physical properties of the soil like bulk density, porosity and water holding capacity. This also underlines the observations on soil problems (Figure 11) where declining soil fertility was suggested in the 'other' category by respondents across the basins.

Figure 13: Type of Fertilisers

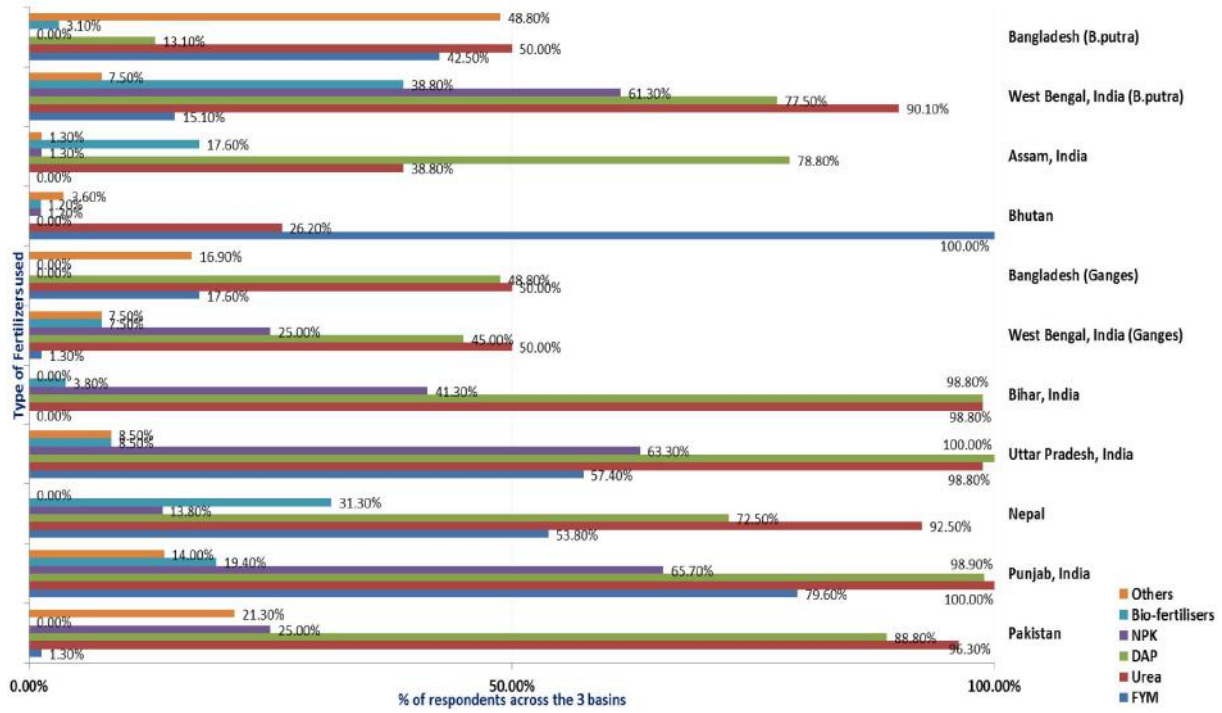
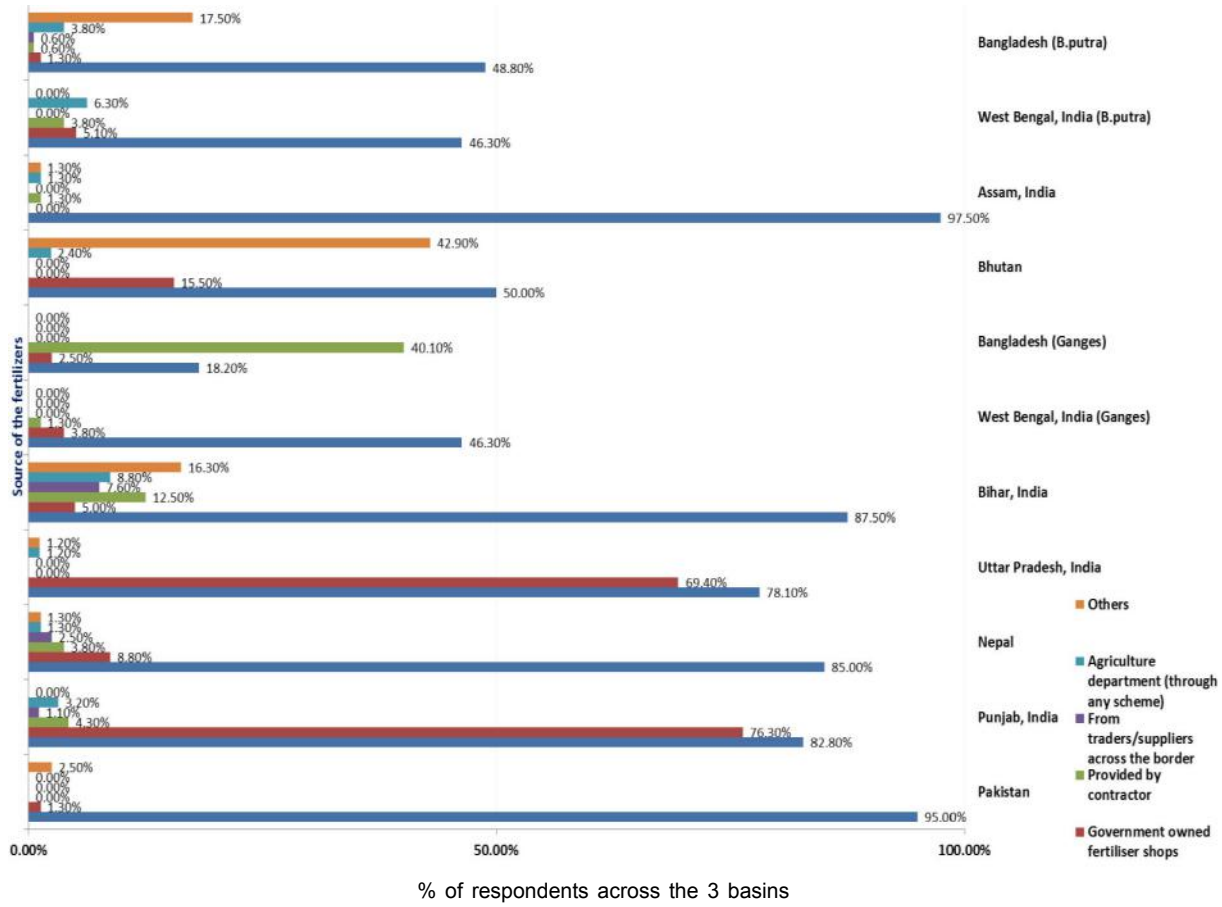


Figure 14: Source of Fertilisers



The data given above shows the source from which fertilisers are purchased by farmers. In the Indus basin privately owned fertiliser shops were found to be the major source (95 per cent in Pakistan and 82.8 per cent in Punjab) for procuring fertilisers. A similar trend was noticed throughout the locations in Ganges and Brahmaputra basins too. Dependency on government owned fertiliser shops by a substantial proportion of respondents was observed only in Punjab (76.3 per cent), Uttar Pradesh (69.4 per cent), and Bhutan (15.5 per cent).

It was noted that in the Ganges basin of Bangladesh, close to 40 per cent of the respondents reported that the fertilisers are provided by private contractors, which is similar to their source of seeds (Figure 14) also. However, involvement of contract farming as a source of fertiliser was also observed with 12.5 per cent of the respondents in Bihar (Katihar village) whereas no respondents claimed to get seeds from the contractors (Figure 12). The data from Ganges basin also confirms cross-border trade of fertilisers as responded by 7.6 per cent of respondents from Bihar and 2.5 per cent in Nepal.

Agricultural Practices

Regarding the type of agricultural practices, most of the respondents from Indus and Ganges basins reported chemical farming (Table 7 and 8). While the proportion of farmers following chemical farming was much higher in Punjab (95.70 per cent) compared to Pakistan (53.8 per cent), in Pakistan an integrated approach for nutrient management and pest management was recorded by 40.1 per cent and 45 per cent of respondents, respectively. The practice of laser levelling was adopted by 37.5 per cent of the respondents in Pakistan and 86 per cent in Punjab. It was also noted that crop diversification was absent in Pakistan and in Punjab; it was 5.4 per cent.

Chemical farming dominated in the survey locations in Ganges basin except West Bengal where only 25 per cent of households practised the same and 33.1 per cent adopted zero tillage. Dry sowing (89 per cent) and cultivation of stress tolerant varieties (74.4 per cent) were reported in the survey locations of Uttar Pradesh, which is in tune with the data of Table 6 where 21 per cent of the respondents used seeds distributed by NEFORD. Higher proportion of respondents in Nepal (45.6 per cent) and Uttar Pradesh (14.60 per cent) adopted soil reclamation practices; salinity was the major soil problem recorded in Nepal and Uttar Pradesh (7.5 per cent and 10.9 per cent, respectively as per Figure 11). Except in Bihar, furrow irrigation method was followed in all other locations of Ganges basin viz., Nepal (6.3 per cent), Uttar Pradesh (17 per cent), West Bengal (38.8 per cent) and Bangladesh (48.1 per cent).

Results from Brahmaputra basin indicate that respondents followed organic farming, with a maximum of 96.4 per cent in Bhutan. This is contradictory because 26.2 per cent respondents claimed that they use urea (Figure 13) as fertiliser. Field discussions show that informal trade of urea from India accounts for the availability and use of urea in Bhutan in limited scale the practices of zero tillage and laser levelling are not popular in this basin. This could be due to undulating

topography in the region (Table 7 and 8). 13.1 per cent of the respondents from Bhutan reported practicing soil reclamation practices, which supports the data from Figure 11, which reveals that Bhutan experiences soil acidity (29.7 per cent). Regarding irrigation practices, 36.90 per cent of respondents in Bhutan followed sprinkler irrigation while in West Bengal 17.50 per cent followed drip irrigation.

Considerable proportion of respondents practice mixed cropping in Pakistan (47.5 per cent), Uttar Pradesh (40.2 per cent), Bihar (85.2 per cent) and Bhutan 95.2 per cent). With regard to crop diversification, maximum number was noticed in Bhutan (58.3 per cent) followed by Uttar Pradesh (17.1 per cent). This data indicates that Bhutan adopts sustainable agricultural practices in higher proportion compared to other locations surveyed.

The data given in Table 9 reveals that higher proportion of respondents rely on traditional knowledge for information on agricultural practices across all the basins. In the Indus basin of Pakistan, 52.5 per cent depend on traditional knowledge whereas 38.8 per cent rely on extension officers from the agricultural department. In Punjab, (India) it was found that the respondents relied on multiple sources for information viz. traditional knowledge (88.2 per cent), progressive farmers (48.40 per cent), newspaper and agricultural university (45.2 per cent each), extension officers and radio (38.7 per cent each). This diversity in sources of information explains the popularity of sustainable agricultural practices like laser levelling, mulching and zero tillage in Punjab.

In the Ganges basin, very few respondents reported extension department as their source of information, the maximum number being 17.1 per cent in Uttar Pradesh. NGOs were found to play an important role in this basin with 15 per cent in Nepal, 42.7 per cent in Uttar Pradesh and 18.8 per cent in Bihar. Progressive farmers also served as source of information in Nepal (36.3 per cent) and Uttar Pradesh (39.1 per cent).

The contribution of extension officers and agricultural department in Brahmaputra basin was quite significant (92.8 per cent) in Bhutan and Bangladesh (36.9 per cent) compared to the Indian states of Assam and West Bengal. Progressive farmers remained as a reliable source in this basin as well. In Assam 6.3 per cent of the respondents said that they acquired information about sustainable agricultural practices from migrants from Bangladesh. Bhutanese also depend on radio and television for technical information.

Table 7: Type of Agricultural Practices Followed (%)

Basin	Sample Sites	Organic farming (pesticide/ chemical free)	Chemical farming	Integrated approach	Mulching	Zero tillage	IPM	Laser levelling	Drip irrigation	Sprinkler irrigation	Furrow irrigation
Indus	1. Pakistan	10.00	53.80	40.10	0.00	0.00	45.00	37.50	1.30	0.00	1.30
	2. Punjab, India	4.30	95.70	5.40	54.90	6.50	11.90	86.00	1.10	3.30	2.20
Ganges	3. Nepal	28.80	92.60	3.80	32.50	42.50	0.00	2.50	0.00	0.00	6.30
	4. Uttar Pradesh, India	6.10	95.20	4.90	1.20	3.60	0.00	0.00	0.00	0.00	17.00
	5. Bihar, India	7.60	83.80	1.30	1.30	0.00	1.30	0.00	1.30	0.00	0.00
	6. West Bengal	3.80	25.00	25.00	3.80	18.80	0.00	28.80	1.30	1.30	38.80
	7. Bangladesh	3.80	46.30	3.20	0.60	33.10	6.20	0.00	5.60	0.00	48.10
Brahmaputra	8. Bhutan	96.40	0.00	34.60	97.60	0.00	31.00	0.00	0.00	36.90	2.40
	9. Assam, India	35.10	0.00	20.00	1.30	0.00	11.30	1.30	6.30	0.00	1.30
	10. West Bengal	11.40	10.00	38.80	5.00	6.30	2.50	6.30	17.50	7.60	16.30
	11. Bangladesh	18.20	43.10	0.60	3.10	0.00	40.60	0.00	0.00	0.00	0.00

Table 8: Type of Agricultural Practices Followed (Contin...) (%)												
Basin	Sample Sites	SRI	Soil testing varieties	Dry sowing	Stress tolerant	Crop diversifi-cation	Soil reclam-ation	Community nurseries	Vermi-culture	Composting cropping	Mixed	Others
Indus	1. Pakistan	0.00	8.80	100	2.60	0.00	0.00	0.00	0.00	0.00	47.5	13.8
	2. Punjab, India	0.00	15.0	1.10	0.00	5.40	2.20	0.00	0.00	2.20	4.40	3.20
Ganges	3. Nepal	18.8	6.30	0.00	0.00	1.30	45.6	0.00	0.00	46.3	2.60	0.00
	4. Uttar Pradesh, India	0.00	6.10	89.0	74.4	17.1	14.6	1.20	0.00	2.40	40.2	2.40
	5. Bihar, India	1.30	0.00	0.00	2.50	1.30	1.30	20.0	30.0	40.1	58.6	27.4
	6. West Bengal	2.50	0.00	18.8	23.8	8.80	1.30	3.80	0.00	5.00	0.00	0.00
	7. Bangladesh	0.00	0.60	19.4	1.30	15.0	5.10	0.00	0.60	13.1	1.90	0.60
Brahmaputra	8. Bhutan	2.40	0.00	38.1	1.20	58.3	13.1	0.00	0.00	14.3	95.2	3.60
	9. Assam, India	33.8	7.60	1.30	1.30	7.50	2.00	1.30	0.00	3.80	12.5	13.8
	10. West Bengal	0.00	0.00	0.00	1.30	5.00	0.00	0.00	7.50	13.8	8.80	0.00
	11. Bangladesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.10	0.00	0.00

Table 9: Source of Information about the Agricultural Practices (%)										
Basin	Sample Sites	Traditional knowledge	Government department/ extension officer	Agricultural university	NGO	Progressive farmers	Migrants from other state/country/ province	Newspaper/ Magazine	Radio	Others
Indus	1. Pakistan	52.50	38.80	2.60	1.30	1.30	0.00	1.30	0.00	1.30
	2. Punjab, India	88.20	38.70	45.20	1.10	48.40	2.20	45.20	38.70	3.20
Ganges	3. Nepal	76.30	0.00	0.00	15.00	36.30	2.50	0.00	1.30	1.30
	4. Uttar Pradesh, India	68.30	17.10	2.40	42.70	39.10	0.00	33.00	15.80	2.40
	5. Bihar, India	62.60	3.90	7.50	18.80	1.30	0.00	30.10	0.00	5.20
	6. West Bengal	41.30	3.80	0.00	0.00	12.50	0.00	3.80	10.00	8.80
	7. Bangladesh	46.30	3.80	0.00	1.90	42.50	0.00	0.00	1.90	6.90
Brahmaputra	8. Bhutan	94.10	92.80	0.00	8.30	28.60	0.00	0.00	40.40	15.40
	9. Assam, India	91.30	3.80	0.00	28.80	16.30	6.30	2.50	0.00	0.00
	10. West Bengal	33.80	6.30	6.30	13.80	40.00	0.00	2.60	7.60	0.00
	11. Bangladesh	21.90	36.90	0.60	1.90	23.80	0.00	0.00	0.00	0.00

Market Access for Farm Produce

Marketable surplus is the key element, which decides the farmer's income. Figure 15 shows the data on marketable surplus as reported by the respondents in the three river basins. It can be seen that Indus basin farmers recorded significantly higher percentage of marketable surplus being sold at the market with 93.8 per cent in Pakistan and 97.9 per cent in Punjab. In the Ganges basin, nearly half of the respondents in Nepal (45 per cent), Uttar Pradesh (51.3 per cent), Bihar (45.1 per cent), West Bengal (47.5 per cent) and Bangladesh (43.10 per cent) reported that they sell their excess produce after household consumption.

The survey locations in Brahmaputra basin showed varied results, in this regard. In Bhutan, 91.6 per cent of the sample size responded that they do not sell their produce in the market, which implies that in Bhutan farming is significantly at subsistence level. The proportion of responses in favour of selling excess produce was 81.3 per cent in Assam, 48.8 per cent in West Bengal and 46.9 per cent in Bangladesh.

Figure 15: Selling Excess Produce after HH Consumption

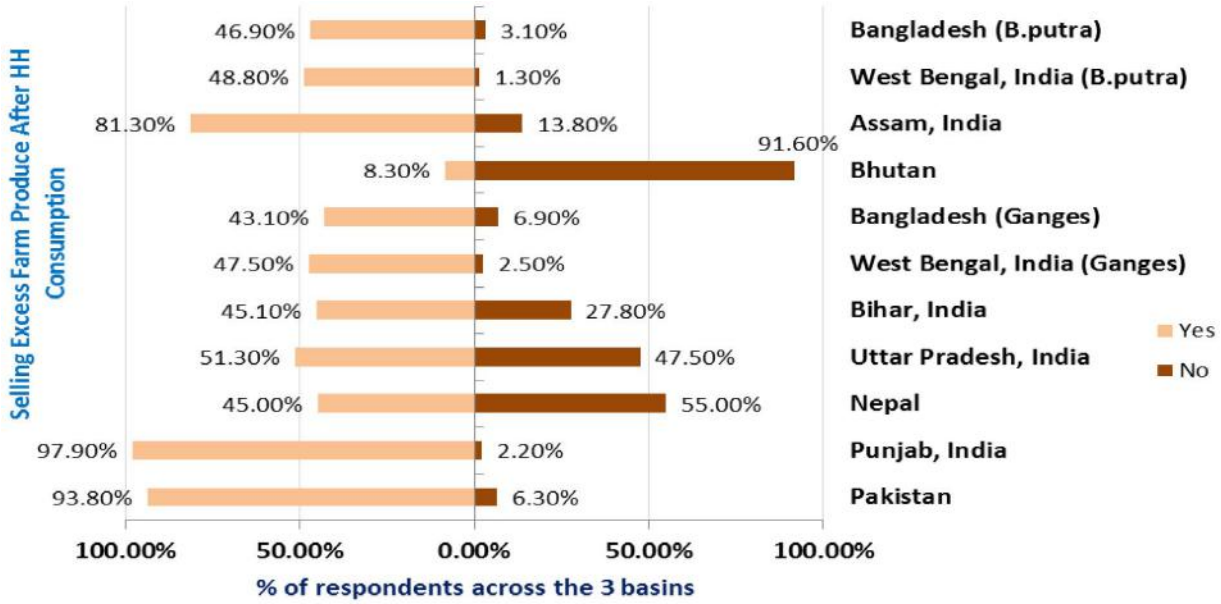


Table 10 and Figure 16 and 17 are related to access to the market and connectivity. In the Indus basin, the data from Pakistan (Table 10) showed that the traders play a vital role in marketing. 45 per cent of the respondents mentioned that the trader comes and collects the produce from the farm while 63.8 per cent said that they take their farm produce to trader's collection centre. In Punjab, varied responses were recorded wherein 90.3 per cent took their produce to traders, 56 per cent sold to the government procurement centres and 16.1 per cent have their own stall in the market.

With respect to the Ganges basin, close to 30 per cent of respondents in Nepal reported farm gate as the selling point, which supported the data of more than 93 per cent respondents reporting nearby markets with a mean distance of 1.55 km. The dominance of traders in the market scenario was well evident in the states of Uttar Pradesh, Bihar and West Bengal where the produce was either collected from the farm (28.2 per cent, 3.8 per cent and 40 per cent respectively) or taken to

Table 10: Points for Sale of Excess Produce (%)

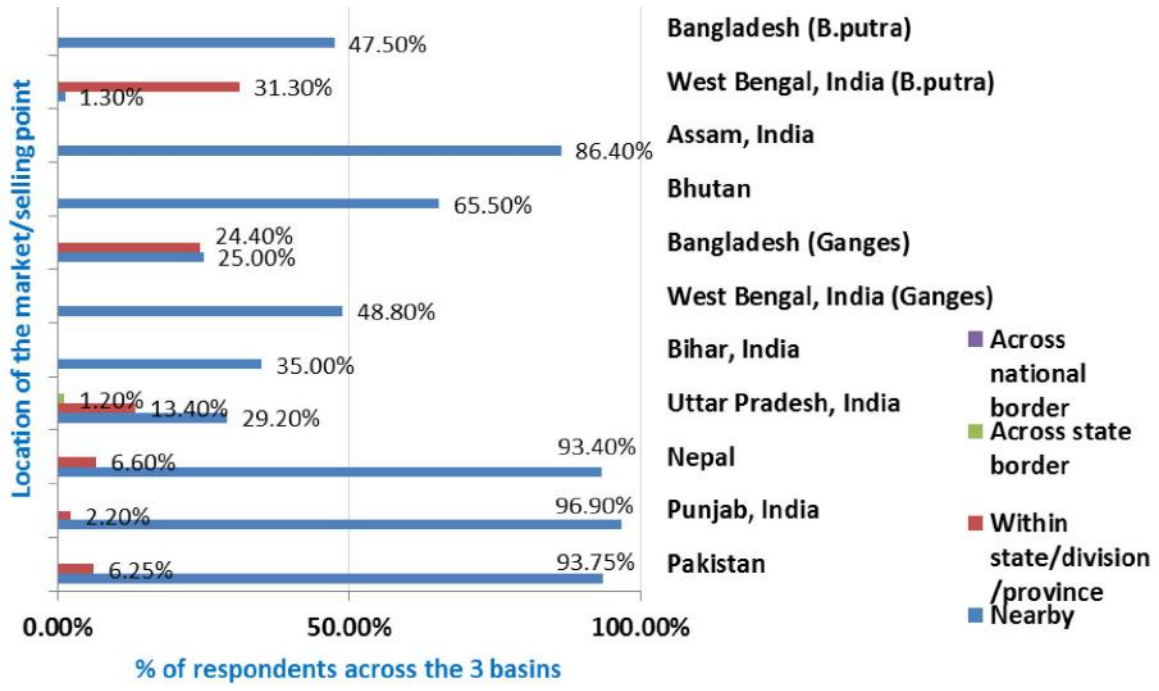
Basin	Sample Sites	At farm gate	At own stall in the market	Traders come and collect it from the farm	Traders from across the border come and collect it from the farm	Go to the traders' collection Centre	Government procurement centre	Contract farming	Others
Indus	1. Pakistan	1.30	2.50	45.00	2.60	63.80	2.50	0.00	7.50
	2. Punjab, India	1.10	16.10	2.20	0.00	90.30	56.00	0.00	3.30
Ganges	3. Nepal	28.80	5.10	13.80	5.00	3.80	0.00	0.00	0.00
	4. Uttar Pradesh, India	9.70	0.00	28.20	0.00	18.30	15.80	0.00	6.00
	5. Bihar, India	13.80	2.50	3.80	7.50	30.00	36.30	2.50	45.20
	6. West Bengal	6.30	8.80	40.00	50.00	30.00	2.50	0.00	1.30
	7. Bangladesh	0.60	1.30	1.20	0.60	16.90	0.60	0.00	15.70
Brahmaputra	8. Bhutan	54.80	44.10	9.50	1.20	2.40	0.00	11.90	22.70
	9. Assam, India	40.00	13.80	53.80	0.00	0.00	2.50	0.00	17.50
	10. West Bengal	11.30	16.40	72.60	98.80	58.80	5.10	1.30	1.30
	11. Bangladesh	1.30	0.00	10.60	0.00	46.90	3.10	0.00	0.00

the collection centre (18.3 per cent, 30 per cent and 30 per cent respectively). Nepal, Bihar and West Bengal also reported that traders from across the border to collect the agricultural produce (5 per cent, 7.5 and 50 per cent respectively).

About the Indian states in the basin, considerable proportion of government procurement was observed only in Bihar (36.3 per cent) followed by Uttar Pradesh (15.8 per cent), which underlines the fact that the bulk of the procurement takes place from the states of Indus basin viz, Punjab and Haryana ignoring other states. Government procurement in Bihar has increased in past couple of years owing to the role of Primary Agricultural Cooperative Societies (PACS) in procurement as evident from the Key Informant Interviews (KII). Location of market in the Ganges basin was mostly nearby farm but in the Indian states of Uttar Pradesh, Bihar and West Bengal, it ranged up to 27 km with a mean distance of 7.45 km.

Bhutan stood apart in the Brahmaputra basin, with considerable proportion of respondents selling their produce at farm gate (54.8 per cent) and at their own stall in the market (44.1 per cent); the mean distance of the market was 5.73 km. However in the Indian states of Assam and West Bengal and in Bangladesh, the involvement of traders was clear from the data. Though in Assam 40 per cent of respondents sold their agricultural produce at farm gate, 53.8 per cent reported that trader collected it from farm.

Figure 16: Location for Selling the Excess Produce



In West Bengal 72.6 per cent of the sample size reported that a trader collects the produce from the farm and 58.8 per cent took it to the collection centre where the mean distance of market was 8.05 km. Significant number of responses (98.8 per cent) in West Bengal showed that traders from across the border come and collect it from the farm, which again indicated cross-border trade of agricultural produce.

Figure 17: Distance of the Market/Selling Point from the Farm (km)

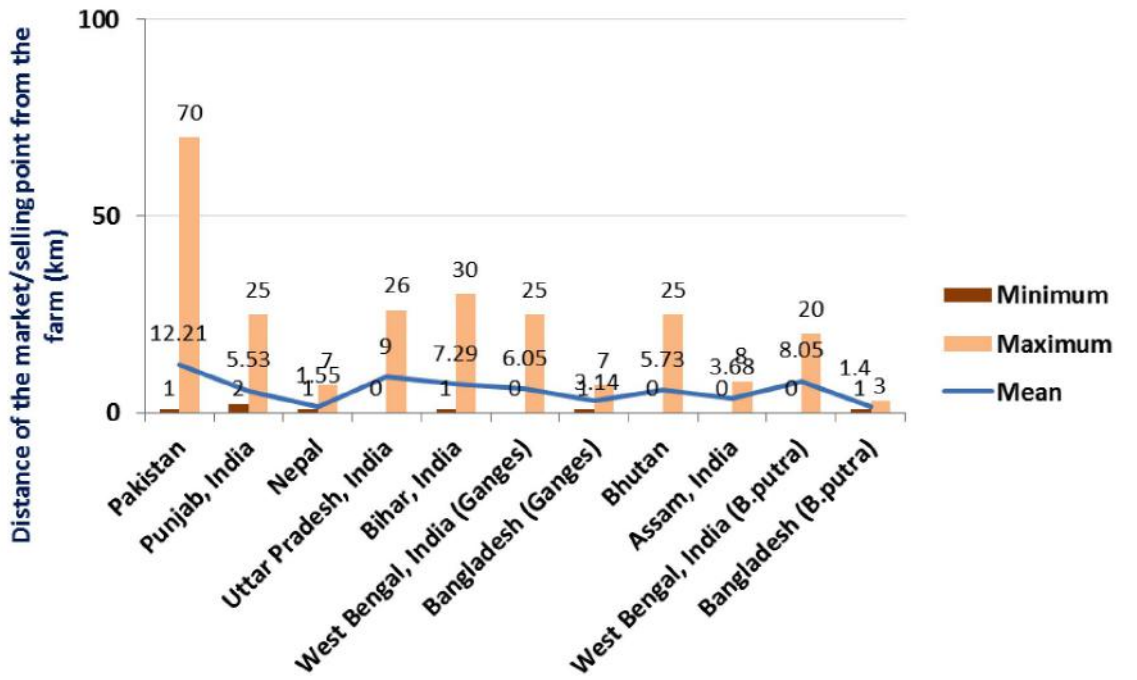
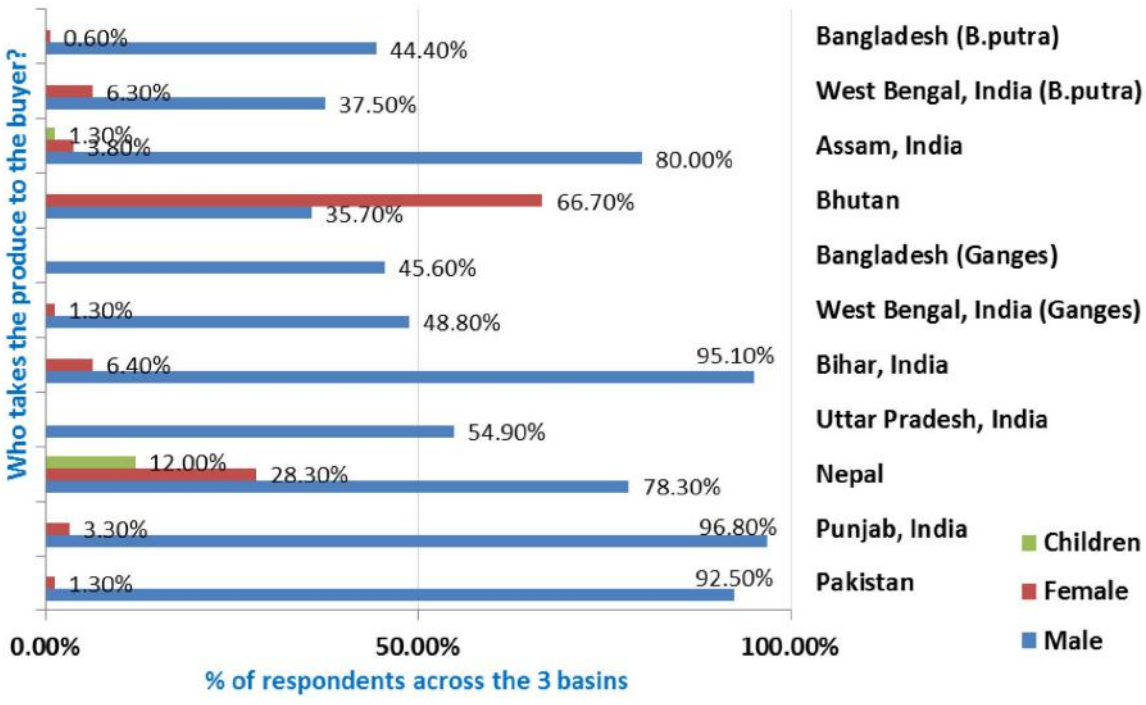


Figure 18: Who Takes the Produce to the Buyer?



The location of markets (Figure 16) in Pakistan was nearby (93.75 per cent) and within the province (6.25 per cent) with a mean distance of 12.21 km from the farm (Figure 17) and ranged up to 70 km. In Punjab also, the market was located nearby within a mean distance of 5.53 km.

Figure 18 comprises interesting data about who takes the produce to the buyer. Male dominance is quite evident in the Indus basin of Pakistan and Punjab, where significant proportion of the respondents (92.5 per cent and 96.8 per cent) revealed that the responsibility stays with the male. When it comes to Ganges basin, 28.3 per cent of the responses from Nepal show that female also take produce to the buyer. Selling produce was also the responsibility of male, mostly in Uttar Pradesh (54.9 per cent), Bihar (95.1 per cent), West Bengal (48.8 per cent) and Bangladesh (45.6 per cent), where traders used to play a significant role either by collecting from the farm or procuring it from the collection centres.

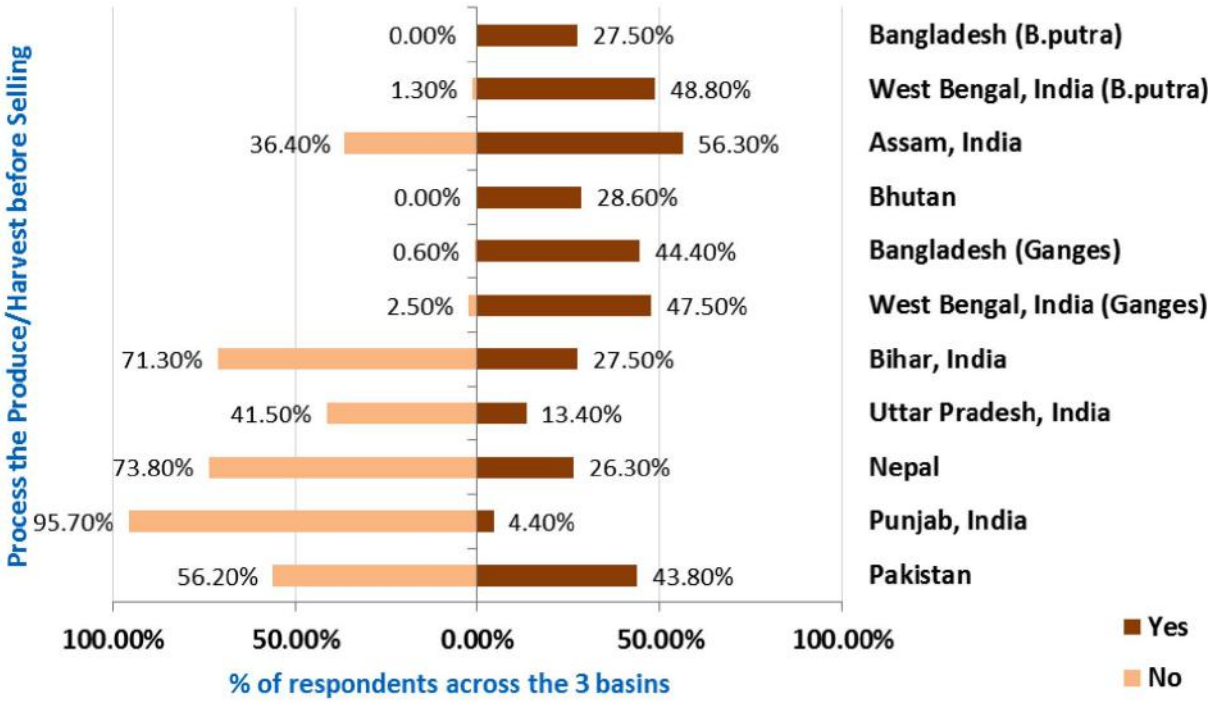
The trend was more or less similar in Brahmaputra basin, although in Bhutan, an exception of 66.7 per cent of the respondents acknowledged that the female takes produce to the seller. It should also be noted that in Bhutan, the selling point was located either at farm gate or a market nearby (the mean distance being 5.73 km), which is easily accessible to women. Matrilineal heritage and ownership of productive assets have created a more or less gender equity status in Bhutan wherein females manage the home and farms and spare men's tasks.

Only Assam (1.3 per cent) and Nepal (12 per cent) reported the involvement of children in taking the produce to the buyer. This could be possible due to the low mean distance to markets (1-3 km), which might be considered safe for children to move around.

Processing of the Produce

Figure 19 and Table 11 and 12 display the responses to questions on processing and value addition of the agricultural produce. 95.7 per cent of the responses from Punjab and 56.2 per cent in Pakistan indicate that they do not undertake any kind of processing. Cleaning was the only value addition carried out in Pakistan. Out of the total sample size, 45 per cent of the respondents claimed that it was done by male and 42.5 per cent by female.

Figure 19: Do You Process the Produce/Harvest before Selling?



Higher proportion of positive responses in Ganges basin with regard to processing was recorded in West Bengal (47.5 per cent) and Bangladesh (44.4 per cent), followed by Bihar (27.5 per cent) and Nepal (26.3 per cent). In Nepal, male and female participation in processing was observed mostly in milling and cleaning.

However, in West Bengal, male and female participation was observed in milling, cleaning and grading but processing, labelling and packaging was mostly performed by men. Similarly, in Bangladesh, male and female participation was observed in cleaning, grading and processing and on an average 13.73 per cent of the responses stated child's participation in these activities.

In Brahmaputra basin, positive responses on processing were noted in Bhutan (28.6 per cent), Assam (56.3 per cent), West Bengal (48.8 per cent) and Bangladesh (27.5 per cent). Interestingly, the data of Bhutan showed that both male and female were engaged in all stages of value addition, i.e. milling, cleaning, grading, processing, labelling and packaging. While in Assam, cleaning was found to be the major activity under value addition in which male (55.5 per cent of the respondents)

Table 11: Details of the Value Addition of the Produce before Selling (%)

Basin	Sample Sites	Milling			Cleaning			Grading		
		Male	Female	Children	Male	Female	Children	Male	Female	Children
Indus	1. Pakistan	0.00	0.00	0.00	45.00	42.50	0.00	1.30	1.30	0.00
	2. Punjab, India	0.00	0.00	0.00	0.00	1.10	1.10	3.30	2.20	3.30
Ganges	3. Nepal	23.80	17.50	6.30	22.50	20.00	0.00	5.10	8.80	0.00
	4. Uttar Pradesh, India	32.90	4.90	6.00	31.70	33.00	8.40	1.20	1.20	1.20
	5. Bihar, India	0.00	0.00	0.00	0.00	1.30	0.00	16.30	16.30	0.00
	6. West Bengal	30.00	26.30	2.50	38.80	35.00	1.30	35.00	26.30	7.50
	7. Bangladesh	2.60	0.60	0.00	45.70	40.70	18.10	43.80	41.90	11.90
Brahmaputra	8. Bhutan	14.30	13.10	0.00	51.20	86.90	3.60	39.30	60.70	0.00
	9. Assam, India	6.30	1.30	0.00	55.00	10.10	0.00	12.50	2.50	0.00
	10. West Bengal	36.30	32.60	1.30	17.60	47.60	12.60	17.60	43.80	2.60
	11. Bangladesh	0.00	0.00	0.00	47.50	47.50	7.50	0.60	0.60	0.00

Table 12: Details of the Value Addition of the Produce before Selling (Contin...) (%)

Basin	Sample Sites	Processing			Labelling			Packaging		
		Male	Female	Children	Male	Female	Children	Male	Female	Children
Indus	1.Pakistan	1.30	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2.Punjab, India	1.10	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00
Ganges	3.Nepal	11.30	10.00	0.00	0.00	1.30	0.00	1.30	0.00	0.00
	4.Uttar Pradesh, India	1.20	1.20	0.00	0.00	0.00	0.00	21.90	14.60	4.80
	5.Bihar, India	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6.West Bengal	20.00	3.80	1.30	18.80	3.80	0.00	28.80	13.80	3.80
	7.Bangladesh	23.70	15.70	11.20	0.60	0.60	0.00	0.00	0.00	0.00
Brahmaputra	8.Bhutan	28.60	35.70	0.00	14.30	17.90	0.00	36.90	51.20	3.60
	9.Assam, India	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10.West Bengal	15.10	43.80	6.30	17.50	40.00	3.80	16.30	36.30	6.30
	11.Bangladesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

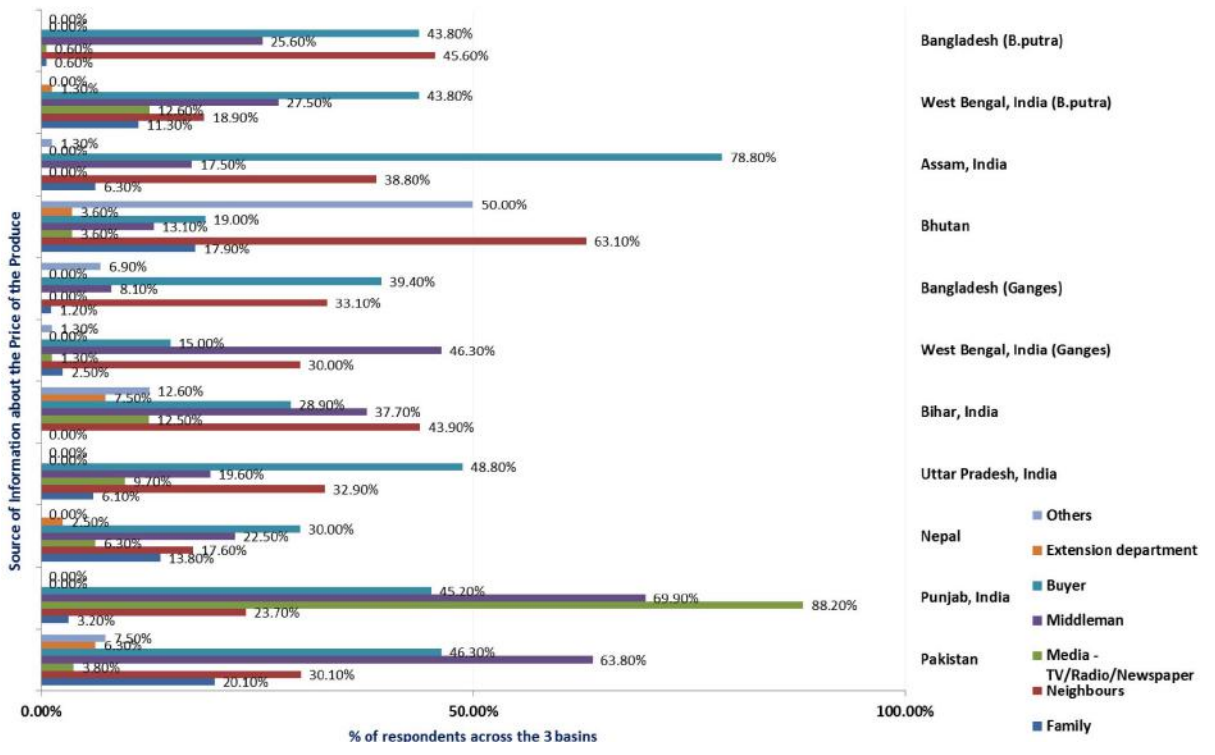
and female (10.1 per cent) participated. Though the responses from West Bengal indicated positive responses in all stages of processing, higher proportion of female involvement was seen in cleaning (47.6 per cent), grading (43.8 per cent) and processing (43.80 per cent), labelling (40 per cent) and packaging (36.3 per cent). In Bangladesh, except cleaning which showed equal male and female (47.5 per cent) and child participation (7.5 per cent), none of the activities under processing/value addition was undertaken.

Source of Information about Price of Produce

Small farmers in rural areas are often not aware of the market prices and hence are dependent on the middlemen and are unable to realise maximum price for their produce. Figure 20 shows the data related to the source of information of farmers about market price. In the Indus basin of Pakistan, it is evident that middlemen (63.8 per cent) and buyers (46 per cent) constituted the major source of information based on responses. But in Punjab, 88.2 per cent of the respondents highlighted the role of media as their source of information. This was closely followed by middlemen (69.9 per cent) and buyers (45.2 per cent).

Market information was found lacking in the Ganges basin, in general, where higher proportions of respondents were in favour of middlemen and buyers followed by neighbours in Nepal, Uttar Pradesh, Bihar and West Bengal. In the Brahmaputra basin, dominance of middlemen, buyers and neighbours were observed as the source of market information in West Bengal and Bangladesh. However, in Bhutan, the respondents mostly relied on their neighbours and other sources like local market, traders/vendors.

Figure 20: Source of Information on the Price of the Produce



Institutional Participation

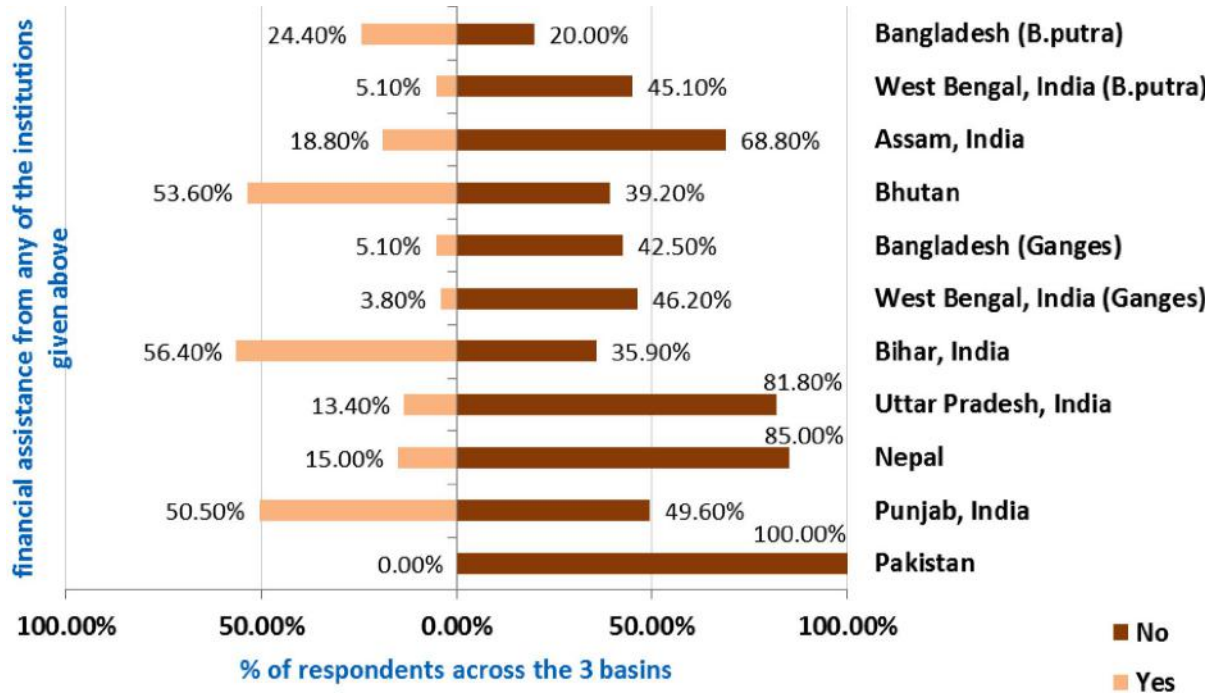
The data in Table 13 shows the institutional membership of the respondents. It reveals that farmers are not organised in Pakistan with 86.3 per cent citing no membership and only 13.8 per cent responded that they are part of SHGs. However, across the border, 68.9 per cent of the respondents in Punjab claimed to be the part of a cooperative society. In the Ganges basin, varied responses were recorded across the survey locations.

In Nepal, cooperative society and Joint Forest Management Committee (JFMC) (also named as Community Forestry User Group in Nepal) and SHGs formed the main institutions as reported by 16.3 per cent, 13.8 per cent and 11.3 per cent of the sample size, respectively. While cooperative society (36.6 per cent) and NGOs (18.3 per cent) were found to be the major institutions in Uttar

Table 13: Institutional Membership (%)

Basin	Sample Sites	FPOs	Cooperative society	SHGs	NGOs	JFMCs	WUAs	Others	None
Indus	1.Pakistan	0.00	0.00	13.80	0.00	0.00	0.00	0.00	86.30
	2.Punjab, India	4.30	68.90	3.30	0.00	0.00	2.20	1.10	30.10
Ganges	3.Nepal	7.50	16.30	11.30	0.00	13.80	5.10	1.30	26.30
	4.Uttar Pradesh, India	0.00	36.60	6.10	18.30	0.00	0.00	2.40	14.60
	5.Bihar, India	1.30	2.60	0.00	0.00	0.00	0.00	2.60	0.00
	6.West Bengal	1.30	0.00	5.00	0.00	0.00	1.30	0.00	42.50
	7.Bangladesh	0.00	0.00	0.00	5.00	0.00	1.30	0.00	41.90
Brahmaputra	8.Bhutan	1.20	76.10	0.00	0.00	0.00	4.80	0.00	10.70
	9.Assam, India	3.80	1.30	23.80	1.30	0.00	5.00	1.30	66.30
	10.West Bengal	18.80	1.30	7.60	2.60	0.00	0.00	0.00	26.30
	11.Bangladesh	9.40	2.50	0.00	18.80	0.00	0.00	1.90	20.60

Figure 21: Financial Assistance from any of the Institutions (given above)



Pradesh, the data from the states of Bihar and West Bengal and in Bangladesh lacked the evidence of institutional capacity.

With respect to Brahmaputra basin, the maximum numbers of responses were recorded with cooperative societies in Bhutan (76.1 per cent), SHGs in Assam (23.8 per cent) and Farmer Producer Organisations (FPOs) in West Bengal (18.8 per cent). In Bangladesh, FPOs and NGOs were the main institutions as reported by 9.4 per cent and 18.8 per cent of the sample size, respectively.

The responses on the support rendered by various institutions for financial assistance have been displayed in Figure 21. In line with the responses on institutional membership, Pakistan did not record any support whereas in Punjab, 50.5 per cent of the respondents received financial assistance. The percentage of respondents who agreed to have received financial assistance in Nepal, Uttar Pradesh, Bihar and West Bengal was 15 per cent, 13.4 per cent, 56.4 per cent and 3.8 per cent, respectively. The maximum number of respondents who availed financial assistance was recorded in Bhutan (53.60 per cent), followed by Bangladesh (24.4 per cent) and Assam (18.8 per cent) in the Brahmaputra basin.

Sources of Agricultural Finance

Table 14 shows the data regarding the source of agricultural finance in Indus basin. It is clear that in Pakistan, higher proportion of respondents depended on local money lenders (25 per cent) followed by nationalised banks (12.5 per cent) that too for agricultural inputs.

Agricultural machinery was the other component for which 7.5 per cent of the respondents accessed finance from nationalised banks. The data from Punjab reveals that multiple sources of finance were relied upon in the survey locations. Agricultural inputs and machinery were the two main categories for which credit was availed. Local money lenders emerged as the most dominant source with 78.5 per cent, 48.4 per cent and 52.7 per cent responses for agricultural inputs, livestock/poultry enterprise and machineries, respectively. Cooperative banks and nationalised banks were found to be the other major sources of credit. Dependency on friends and family was also observed to the some extent. Predominance of non-institutional credit was highlighted during the KII, as well.

Table 14: Source of Agricultural Finance in the Indus Basin (%)

Sample Sites	Institution	Agriculture inputs	Livestock/ Fisheries/ Poultry	Machinery (tractor, harvester etc.)	Water harvesting structures	Renewable energy sources
Pakistan	Nationalised Bank	12.50	1.25	7.50	0.00	0.00
	Local money lender	25.00	0.00	1.30	0.00	0.00
	Friends	3.90	0.00	1.30	0.00	0.00
	Family/Relatives	2.50	0.00	0.00	0.00	0.00
Punjab	Nationalised Bank	46.20	29.00	30.10	8.70	1.10
	Cooperative Bank	69.90	37.70	44.10	9.70	2.20
	Private Bank	9.70	6.40	6.40	3.30	2.20
	Local money lender	78.50	48.40	52.70	17.20	5.40
	SHGs	1.10	1.10	1.10	1.10	1.10
	NGOs	1.10	1.10	1.10	1.10	1.10
	Friends	16.20	4.30	5.40	3.30	1.10
	Family/Relatives	31.20	12.90	9.70	4.40	4.40

Table 15: Source of Agricultural Finance in the Ganges Basin (%)						
Sample Sites	**Institution**	**Agriculture inputs**	**Livestock/ Fisheries/ Poultry**	**Machinery (tractor, harvester etc.)**	**Water harvesting structures**	**Renewable energy sources**
Nepal	Cooperative Bank	2.50	3.80	3.80	0.00	0.00
	Private Bank	2.50	3.80	3.80	0.00	0.00
	Local money lender	2.50	3.80	3.80	0.00	0.00
	SHGs	1.60	4.70	0.00	0.00	2.50
	NGOs	3.80	3.80	0.00	0.00	2.50
	Friends	3.80	3.80	0.00	0.00	2.50
	Family/Relatives	3.80	3.80	0.00	0.00	2.50
Uttar Pradesh	Nationalised Bank	34.10	0.00	1.20	0.00	0.00
	Cooperative Bank	12.20	0.00	0.00	0.00	0.00
	Local money lenders	36.60	0.00	0.00	0.00	0.00
	Friends	57.30	1.20	12.20	2.40	0.00
	Family/Relatives	64.70	8.50	8.50	0.00	0.00
Bihar	Nationalised Bank	55.10	11.30	37.70	0.00	0.00
	Private Bank	25.00	30.00	1.30	0.00	0.00
	Local money lenders	5.10	0.00	2.60	0.00	0.00
	Friends	13.80	16.30	12.50	0.00	0.00
	Family/Relatives	52.60	0.00	1.30	0.00	0.00
West Bengal	Local money lenders	22.50	5.00	3.80	5.00	3.80
	Friends	8.80	0.00	1.30	0.00	0.00
	Family/Relatives	18.80	5.00	5.00	7.50	5.00
Bangladesh	NGOs	6.30	0.60	5.10	6.30	0.00
	Friends	8.20	0.60	6.90	6.90	0.00
	Family/Relatives	45.00	17.50	38.70	43.20	0.60

Regarding the source of credit in the Ganges basin (Table 15), it was interesting to find that the respondents from Nepal did not avail a great amount of credit for farming related operations. NGOs, friends and family formed the major sources of credit for agricultural inputs and livestock/ poultry (3.8 per cent each). Cooperative banks, private banks and money lenders were the other sources, which were being depended upon for agricultural inputs (3.8 per cent each), livestock/ poultry (3.8 per cent each), and machinery (3.8 per cent each).

In Uttar Pradesh, it was found that credit services were availed mostly for the purchase of agricultural inputs. Higher proportion of respondents opted for family and relatives (64.7 per cent) as their source of credit, followed by friends (57.3 per cent), local money lenders(36.6 per cent) and nationalised bank (34.1 per cent). However, in Bihar, it was realised that nationalised banks were the major source of credit (55.10 per cent) for agricultural inputs followed by family/relatives (52.6 per cent) and private banks (25 per cent). Livestock and machineries were other categories for which credit was availed.

Similar results were found in West Bengal and Bangladesh where family/relatives were the key source of credit for agricultural inputs as reported by 18.8 per cent and 45 per cent, respectively. Further, the data revealed that family was also the source for livestock/fisheries/poultry (17.5 per cent), machinery (38.7 per cent) and water harvesting structures (43.2 per cent). But in West Bengal,

Table 16: Source of Agricultural Finance in the Brahmaputra Basin (%)						
Sample Sites	**Institution**	**Agriculture inputs**	**Livestock/ Fisheries/ Poultry**	**Machinery (tractor, harvester etc.)**	**Water harvesting structures**	**Renewable energy sources**
Bhutan	Nationalised Bank	10.70	21.50	15.50	0.00	3.60
	Cooperative Bank	2.40	4.80	2.40	0.00	0.00
	Local money lenders	2.40	3.60	3.60	0.00	0.00
	Friends	2.40	2.40	2.40	0.00	0.00
	Family/Relatives	0.00	1.20	3.60	0.00	1.20
Assam	Nationalised Bank	10.00	1.30	2.60	0.00	0.00
	Cooperative Bank	5.00	2.50	3.80	0.00	0.00
	Private Bank	2.50	0.00	1.30	0.00	0.00
	Local money lenders	26.30	21.30	17.50	1.30	0.00
	SHGs	20.00	11.30	11.30	2.50	1.30
	NGOs	2.50	1.30	1.30	0.00	0.00
	Friends	8.80	10.00	3.80	0.00	0.00
	Family/Relatives	8.80	7.50	5.00	0.00	0.00
West Bengal	Nationalised Bank	15.00	5.10	7.50	2.50	0.00
	Cooperative Bank	10.00	3.80	3.80	1.30	0.00
	Local money lenders	2.50	3.80	0.00	0.00	0.00
	SHGs	2.60	1.30	3.80	0.00	0.00
	NGOs	1.30	1.30	2.60	0.00	0.00
	Friends	11.30	5.10	7.60	0.00	0.00
	Family/Relatives	6.30	1.30	3.80	0.00	0.00
Bangladesh	Nationalised Bank	2.50	0.00	1.30	4.40	0.00
	NGOs	13.80	0.00	3.80	18.80	0.00
	Friends	6.30	0.00	4.40	6.90	0.00
	Family/Relatives	7.50	0.00	6.30	10.00	0.00

the purpose of credit was mostly to buy agricultural inputs for the current crop for which they were dependent on local money lenders (22.5 per cent) and family (18.8 per cent).

The survey results clearly indicate the necessity of credit services for farmers, the demand being highest for purchasing agricultural inputs and machineries.

Table 16 shows the source of agricultural finance in the survey locations of Brahmaputra basin. Unlike the Ganges basin, the respondents relied on multiple financial sources for farming operations. Nationalised banks were found to be the major source of finance in Bhutan as reported by 10.7 per cent, 21.5 per cent and 15.5 per cent of the respondents for agriculture inputs, livestock/fisheries/ poultry and machinery, respectively. In Assam, where there were a considerable proportion of tribal and socially excluded communities, it was noted that local money lenders (26.3 per cent) and SHGs (20 per cent) were mostly being depended upon for purchasing agricultural inputs, allied enterprises and machinery. In West Bengal, 15 per cent of the respondents availed credit from nationalised bank for agricultural inputs, 5.1 per cent for allied enterprises and 7.5 per cent for buying machinery. This was followed by friends and cooperative banks. But in Bangladesh, NGOs emerged as the main source of credit services for agricultural inputs (13.8 per cent) and water harvesting structures (18.8 per cent).

Agro-machinery

With respect to the machinery owned by farm households, the data given in Figure 22 indicates that the Indus basin farmers own a range of machineries; pump sets, tractors and tillers being owned by the highest proportion of respondents in Punjab (77.5 per cent, 65.6 per cent and 57 per cent) and Pakistan (21.3 per cent, 31.3 per cent and 26.3 per cent). However, in the Ganges basin, pump sets constituted the main category of machinery owned as reported by respondents in Uttar Pradesh (45.1 per cent), Bihar (46.5 per cent) and West Bengal (23.8 per cent).

Moreover, considerable proportion of farmers in Uttar Pradesh also owned tractors (20.7 per cent), tillers (19.5 per cent) and threshers (20.7 per cent). The proportion of respondents who owned machinery was meagre in Nepal where just 3.8 per cent of the sample size claimed to own a tractor and tiller. This could be attributed to the undulating terrain and small farm holdings in Bhutan. In West Bengal also, pump sets were found to be the most commonly owned machinery by 23.8 per cent of the respondents. In Bangladesh, threshers were found to be the machinery owned by maximum respondents (46.9 per cent).

Similarly, pump sets were the most widely used machinery in the Brahmaputra basin with 13.8 per cent in Assam, 17.5 per cent in West Bengal and 13.8 per cent in Bangladesh. It is to be noted that in Bhutan, machineries were mostly used for processing (28.6 per cent of the respondents owned cornflakes and potato chips making machineries, flour mills, dryers etc.) rather than farm machineries like tractors and pump sets.

Figure 23 summarises the type of rented machineries used by farm households. It can be noticed in the Indus basin that heavy and costly machineries like harvesters and threshers are mostly hired, as evident from Pakistan (65 per cent and 70 per cent, respectively) and Punjab (78.5 per cent and 61.3 per cent respectively). 68.8 per cent of the respondents from Pakistan and 32.3 per cent from Punjab also hired tractors.

Figure 22: Type of Owned Agricultural Machineries

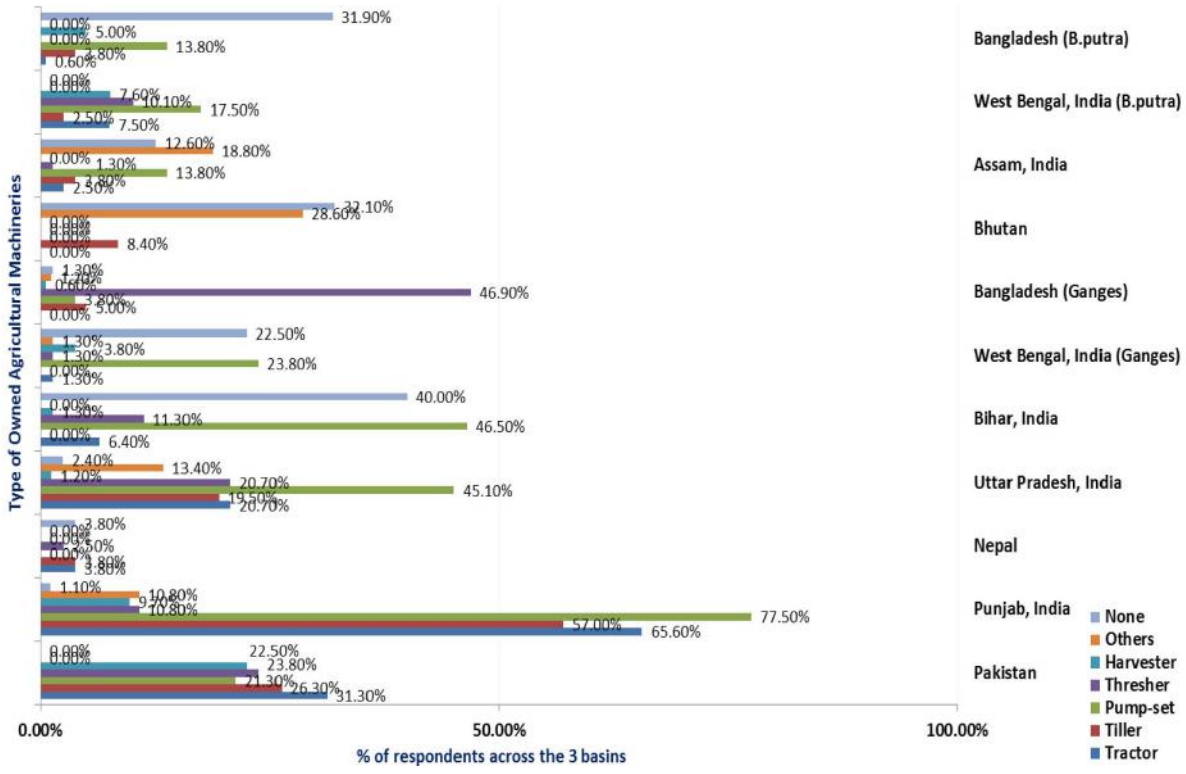
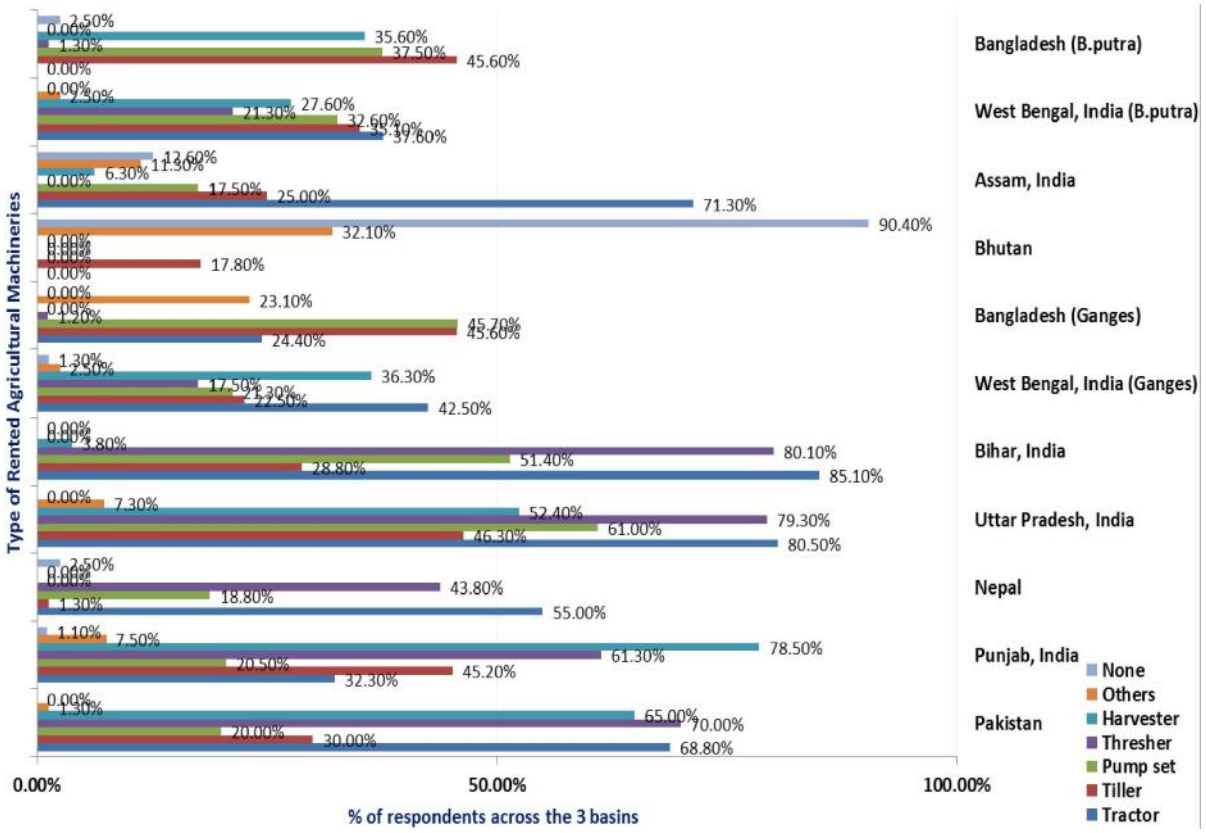


Figure 23: Type of Rented Agricultural Machineries



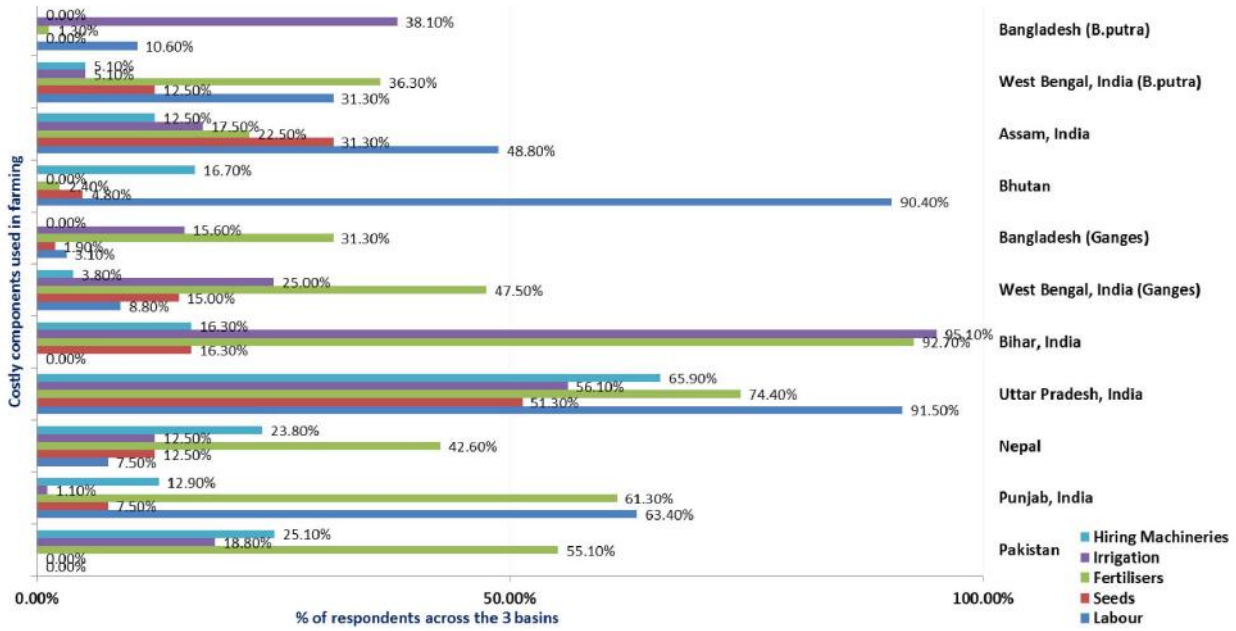
The resource poor farmers in Nepal (Ganges basin) hired tractors, pump sets and threshers as reported by 55 per cent, 18.8 per cent and 43.8 per cent, respectively. Similar trends were observed in Uttar Pradesh, Bihar, West Bengal and Bangladesh, where significant proportion of the sample size hired various machineries like tractors, tillers and pump sets.

In Brahmaputra basin, the data from Bhutan shows that 17.8 per cent of the respondents hire tillers while 32.1 per cent use processing machineries like corn flakes and potato chips machineries, flour mills etc. on rent. Higher proportion of respondents in Assam hired tractors (71.3 per cent) than tillers (25 per cent) and pump sets (17.5 per cent). Tillers and harvesters comprised of the machineries, which are mostly hired in Bangladesh as per the response of the survey. However, in neighbouring West Bengal, the responses showed that they hire all categories of machines viz., tractor (37.6 per cent), tiller (35.1 per cent), pump sets (32.6 per cent), thresher (21.3 per cent) and harvester (27.6 per cent).

Costly Component in Farming

Figure 24 shows that varied responses on costly components of farming were recorded across the survey locations. Fertilisers and labour were seen as costly components in the Indus basin. Fertilisers were found to be the costliest component in Nepal (42.6 per cent) followed by seeds and irrigation (12.5 per cent). Higher proportion of respondents in Uttar Pradesh suggested labour (91.5 per cent) and fertilisers (74.4 per cent) as costlier components whereas in Bihar, irrigation was recorded as the most expensive component (95.10 per cent) followed by fertilisers (92.7 per cent). Figure 24 supports this fact as 51.4 per cent of the respondents opined that they hire irrigation pump sets. In Bihar small farmers rely on diesel pump sets, which again add to the cost of irrigation.

Figure 24: Costly Components in Farming



Even in West Bengal and Bangladesh, fertilisers were the costliest component in agriculture, followed by irrigation.

Maximum number of responses from Bhutan (90.4 per cent) shows that labour is the costliest component followed by hiring machinery (16.7 per cent). Labour was found to be the costlier component in Assam (48.8 per cent), West Bengal (31.3 per cent) and Bangladesh (10.6 per cent) as well. Conversely, the data from Assam is marked with higher proportion of responses in other components like seeds (31.3 per cent), fertilisers (22.5) and irrigation (17.5 per cent).

Taking per cent into account, the fact that the respondents from Assam included socially excluded communities, it was noted that increasing cost of cultivation with respect to all the components is of serious concern. It is also surprising to note that just 1.3 per cent of the responses from Bangladesh showed that fertilisers are costly, wherein 38.1 per cent found irrigation as the most expensive component. The increased cost of labour in Brahmaputra basin could be due to the out migration of agricultural labourers. This, coupled with poor mechanisation, might have created a greater demand for farm labour.

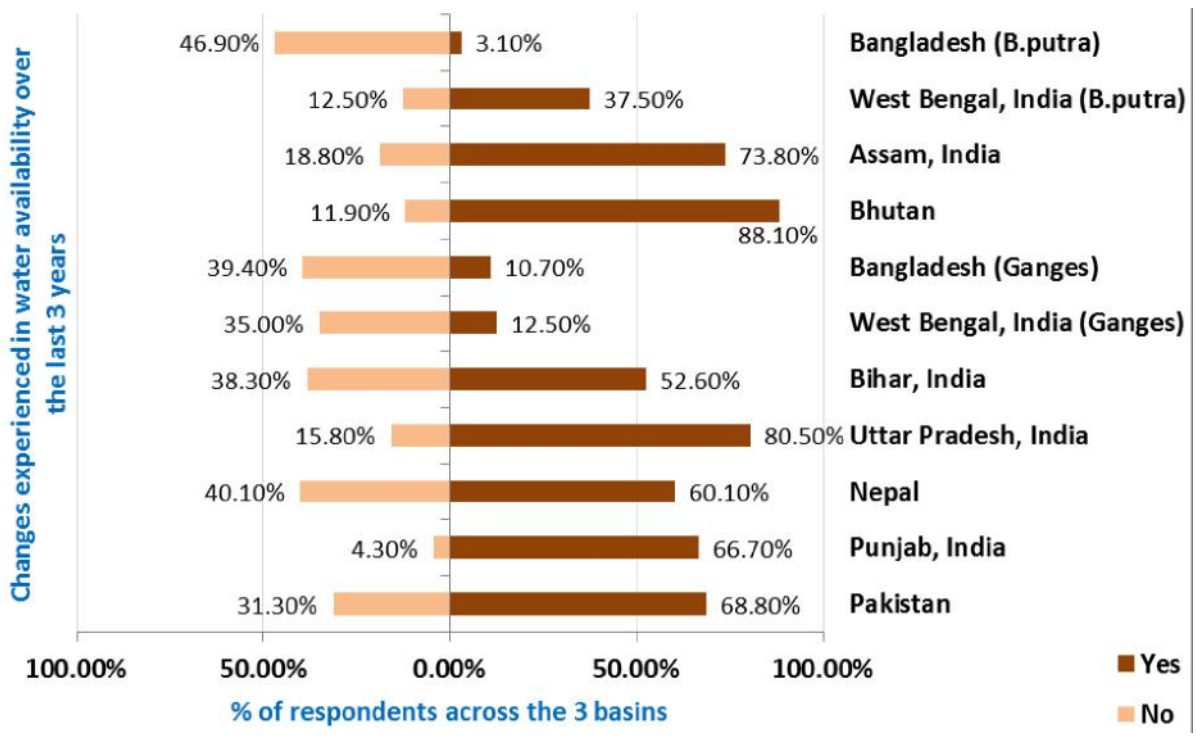
6
Water Profile and its Characteristics

South Asia, the land of the mighty Himalayan rivers also experiences water scarcity mostly due to the uneven distribution resulting in floods and droughts. Transboundary flow of rivers and prevailing scarcity has made water an issue of contention among South Asian countries. Variation in rainfall and over exploitation of ground water has aggravated water scarcity. This study is exclusively concentrated on the transboundary aspect of South Asian water at both farm and riparian levels. Diversion of water by upper riparian affects the downstream water flow and availability. The farm level data has already shown extensive scarcity issues for off-season cropping. The riparian water issues primarily comprised of water sharing and access. The following sections have captured the ground insights on these issues.

Water Availability

Figure 25 shows the changes experienced in the water availability over the past three years in the farms across the three basins. The time frame of three years was chosen to stress on the urgency of the water situation in the farms. Across the three basins, majority of the respondents agreed to

Figure 25: Changes Experienced in Water Availability over the Past Three Years

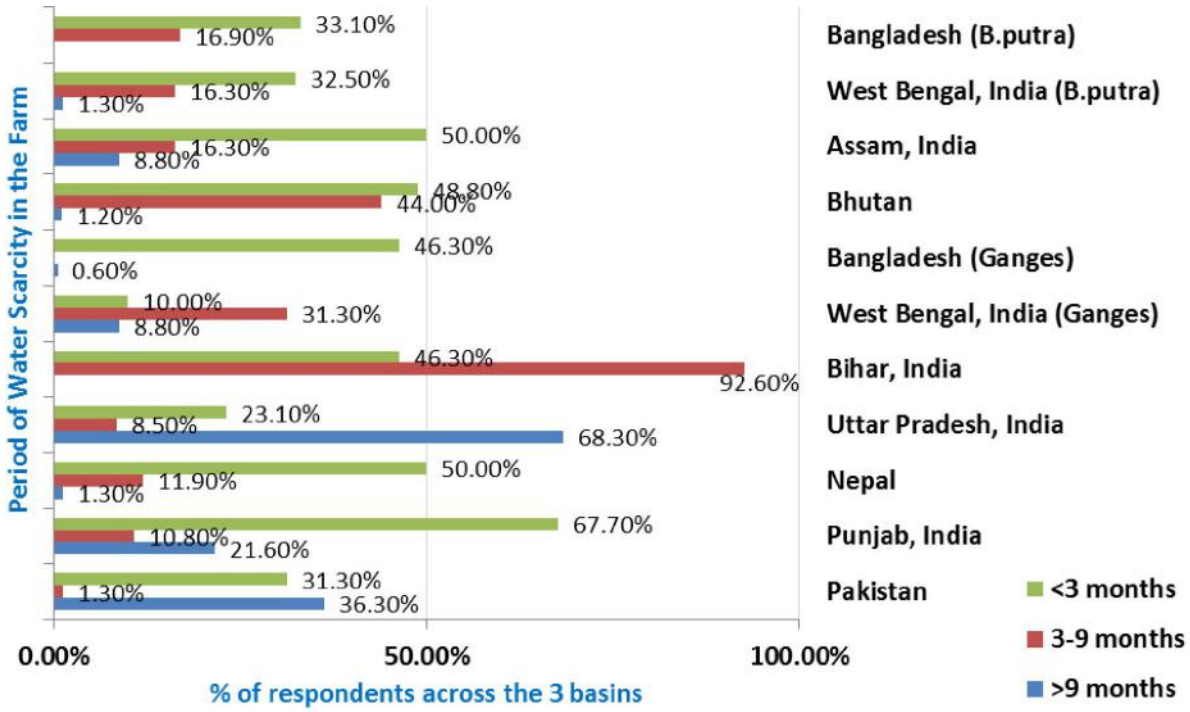


have experienced changes in water availability over the past three years. Exceptions were observed in West Bengal (35.00 per cent) and Bangladesh (39.40 per cent) in the Ganges basin and Bangladesh (46.90 per cent) in the Brahmaputra basin. This could be a case of perception since both the sites experience extreme patterns of flood and drought.

Water Scarcity

The water scarcity situation across the basins was diverse in nature (Figure 26). High water scarcity was observed for less than three months across most of the sites. This could be due to two scenarios. In one scenario, since respondents take more than one crop consecutively in the year, hence the requirement of water might extend beyond three months. The second scenario is a derivative of the first scenario where keeping aside the nine months of cropping season in the site, respondents might have experienced water scarcity for approximately three or less than three months. High water scarcity was also observed for more than nine months in Pakistan (36.30 per cent) and Uttar Pradesh (68.30 per cent). Bihar (92.60 per cent) and West Bengal (31.30 per cent) in the Ganges basin showed high water scarcity between three to nine months in the year.

Figure 26: Period of Water Scarcity in the Farm



Type of Irrigation

The types of irrigation used differ across the sample sites. Table 17 and 18 shows that in Pakistan, canal system (70 per cent) and other sources of irrigation (83.8 per cent) like tube well and turbine operated irrigation systems were the main types of irrigation on farm. About 55 per cent of the respondents in Nepal, 59.50 per cent in Bhutan and 53.80 per cent in Assam also reported using canal irrigation.

In Punjab, 91.40 per cent of the respondents reported using flood irrigation method. In Uttar Pradesh, high numbers were recorded in sub-surface (63.40 per cent) and flood irrigation (59.80 per cent). A similar trend was observed in the sample sites of West Bengal in the Ganges basin too.

Flood irrigation was found to be a common practise in Bihar (96.30 per cent). The Bangladesh sites in the Ganges basin showed that a majority of the respondents preferred basin (50 per cent) followed by lift (48.80 per cent) and furrow (45.10 per cent) irrigation. Similar to the Ganges basin side, close to 50 per cent of the respondents in the Bangladesh sites in the Brahmaputra basin also preferred using lift irrigation.

In Brahmaputra basin, West Bengal showed nominal but steady responses in drip (15.10 per cent), sprinkler (15 per cent), furrow (13.80 per cent) and flood (12.50 per cent) irrigation.

Table 17: Types of Irrigation used in the Farm (%)

Basin	Sample Sites	Drip	Sprinkler	Sub-surface	Basin	Furrow
Indus	1. Pakistan	1.30	0.00	0.00	0.00	1.30
	2. Punjab, India	1.10	1.10	0.00	0.00	3.30
Ganges	3. Nepal	0.00	0.00	0.00	18.80	1.30
	4. Uttar Pradesh, India	0.00	1.20	63.40	0.00	12.20
	5. Bihar, India	0.00	0.00	0.00	0.00	0.00
	6. West Bengal	0.00	0.00	13.80	10.00	36.30
	7. Bangladesh	13.10	0.00	0.60	50.00	45.10
Brahmaputra	8. Bhutan	1.20	36.90	2.40	0.00	1.20
	9. Assam, India	0.00	0.00	0.00	3.80	0.00
	10. West Bengal	15.10	15.00	1.30	8.80	13.80
	11. Bangladesh	0.00	0.00	24.40	0.00	0.00

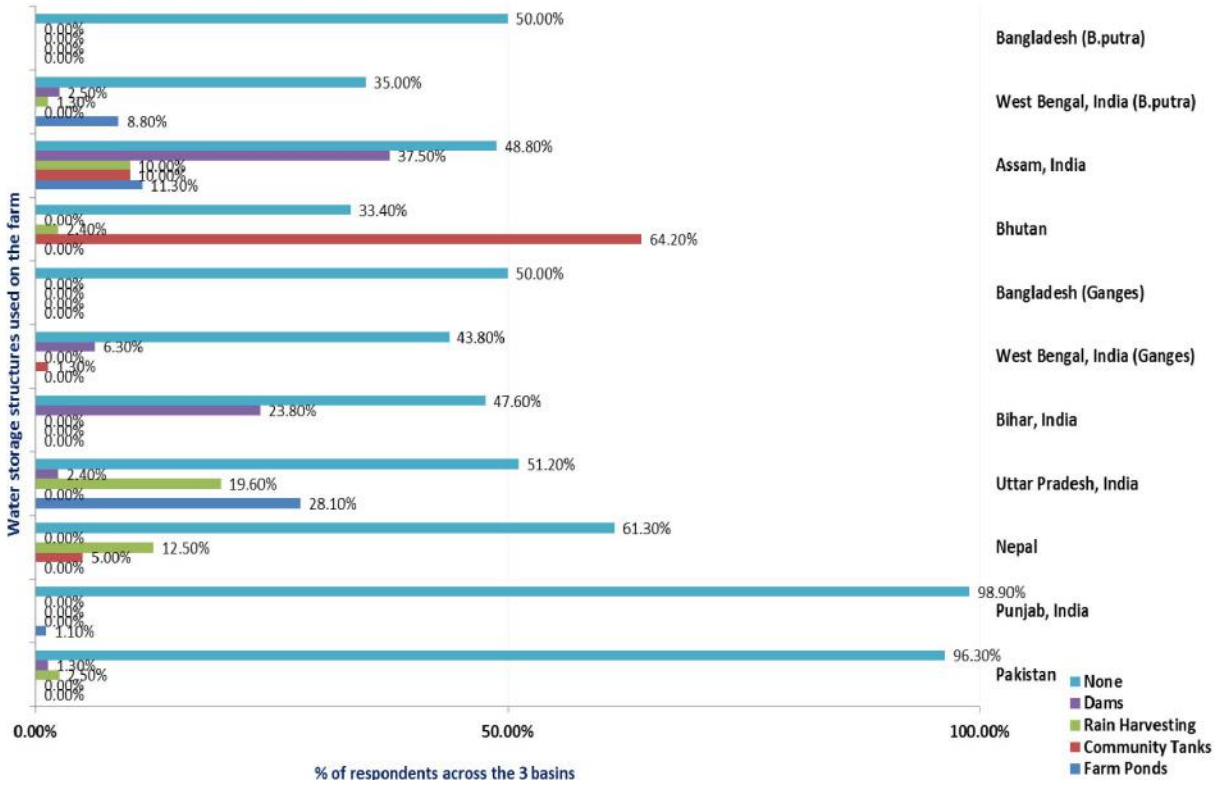
Table 18: Types of Irrigation used in the Farm (Contin...) (%)

Basin	Sample Sites	Flood	Gravity Flow	Lift	Canal	Others
Indus	1. Pakistan	0.00	0.00	0.00	70.00	83.80
	2. Punjab, India	91.40	7.50	0.00	13.00	5.40
Ganges	3. Nepal	5.00	17.50	7.60	55.00	0.00
	4. Uttar Pradesh, India	59.80	0.00	0.00	3.70	1.20
	5. Bihar, India	96.30	0.00	0.00	0.00	0.00
	6. West Bengal	27.50	20.00	0.00	11.30	1.30
	7. Bangladesh	1.20	0.00	48.80	0.00	0.00
Brahmaputra	8. Bhutan	17.90	0.00	0.00	59.50	13.10
	9. Assam, India	8.80	0.00	13.80	53.80	11.30
	10. West Bengal	12.50	3.80	0.00	5.10	1.30
	11. Bangladesh	0.00	0.00	50.00	0.60	0.00

Water Storage Structures

Figure 27 shows that the majority of the respondents did not have any storage structures for water conservation on the farm. This could be supported with the trends observed in Figure 26 which explains the water scarcity in the farms for more than three months. Coincidentally, rain harvesting structures and dams were a prominent source of water conservation and storage across the three basins. Across the sample sites, maximum responses were recorded for community tanks in Bhutan (64.20 per cent) followed by dams in Assam (37.50 per cent) and farm ponds in Uttar Pradesh (28.10 per cent), which also indicates the efficiency of different institutional initiatives in the survey sites.

Figure 27: Water Storage Structures used on the Farm



Water Sharing Status

Figure 28 shows interesting results about the perception of respondents for water sharing between neighbouring states and countries. High number of respondents from Pakistan (98.80 per cent), Nepal (67.60 per cent), Uttar Pradesh (52.40 per cent), Bihar (77.60 per cent), Bhutan (96.40 per cent), Assam (42.50 per cent) and Brahmaputra basin (30.60 per cent) completely agreed with the notion of sharing water. However, maximum respondents in Punjab (54.90 per cent), West Bengal in Ganges basin (41.30 per cent) and Brahmaputra (22.50 per cent) basin completely disagreed at the idea of sharing of water. This also directly indicates the influence of location on the upper and lower riparian sides of the basin on the willingness to share water. While respondents on the lower riparian are willing for water sharing but respondents on the upper riparian are not favourable to the idea.

Water Sharing Forums

Across the sample sites, most of the respondents agreed that their concerns related to water sharing were not raised at any meeting or forum (Figure 29). Exceptions were seen in Uttar Pradesh (75.70 per cent), Bangladesh in Ganges (47.50 per cent) and Brahmaputra (49.40 per cent) basins and Bhutan (60.70 per cent), where the concerns had been raised. This also indicates the presence of a suitable forum to raise the issues related to water conflicts at the local-level.

Figure 30 displays the key stakeholders, which organise such meetings and forums to address water sharing issues. Majority of the sample sites reported that the concerns were raised at the local government or the *panchayat*-level. An exception was seen in Uttar Pradesh, where 18.30 per cent of the respondents reported that the national and state government had organised meetings where their concerns about water sharing had been raised.

Figure 28: Perception about Water Sharing between Neighbouring States/Countries

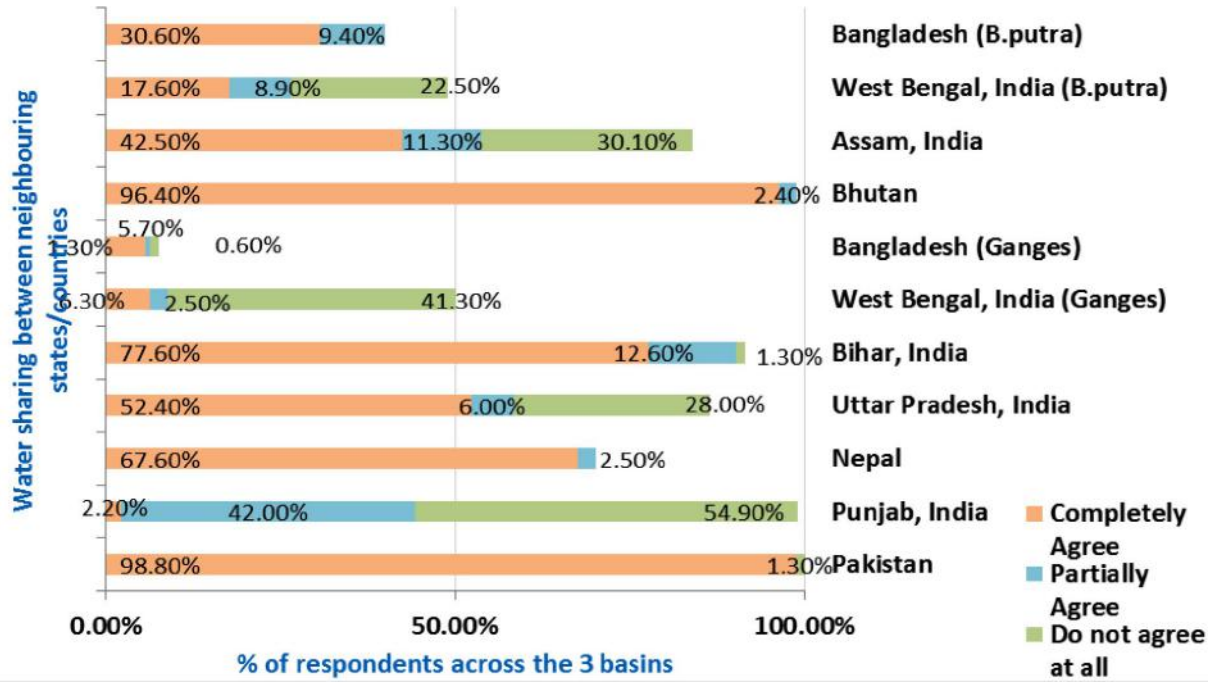
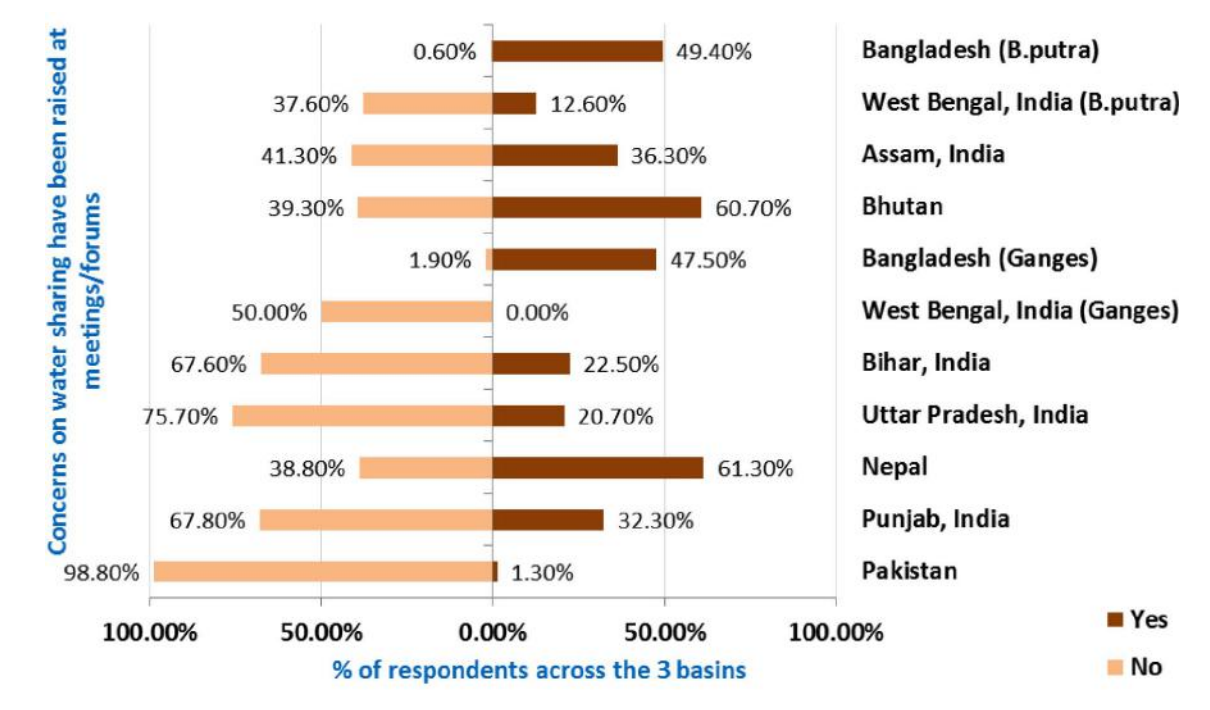


Figure 29: Concerns Raised at Any Meeting/Forum for Water Sharing



Issues with Water Sharing

Figure 31 shows the responses from the survey under some of the issues that might arise out of water sharing across the three basins. Across the sample sites, water scarcity during crop season was a dominant issue. But, most of the respondents also agreed that water sharing issues were not relevant for them, probably, because they were not affected by any issues related to water sharing

or had not observed any change in water availability as they rely mostly on ground water resources. Nevertheless, a sizeable number of responses were recorded under issues like release of dam water without warning and conflicts related to water sharing.

Figure 30: Organisers of Water Forums/Meetings

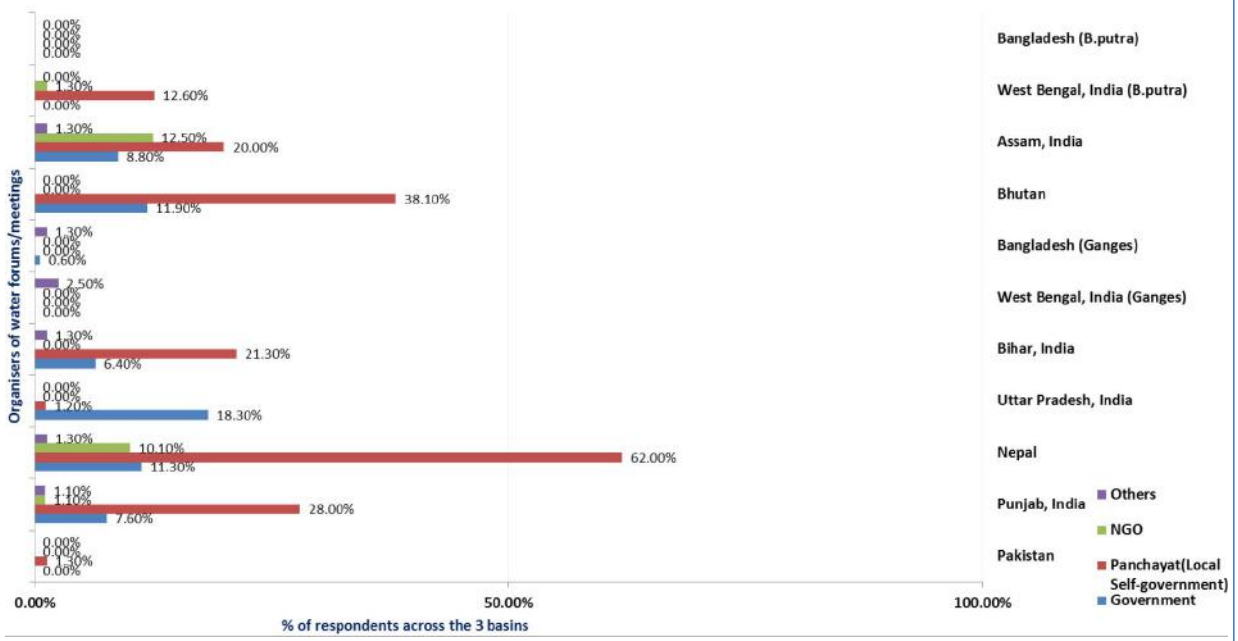
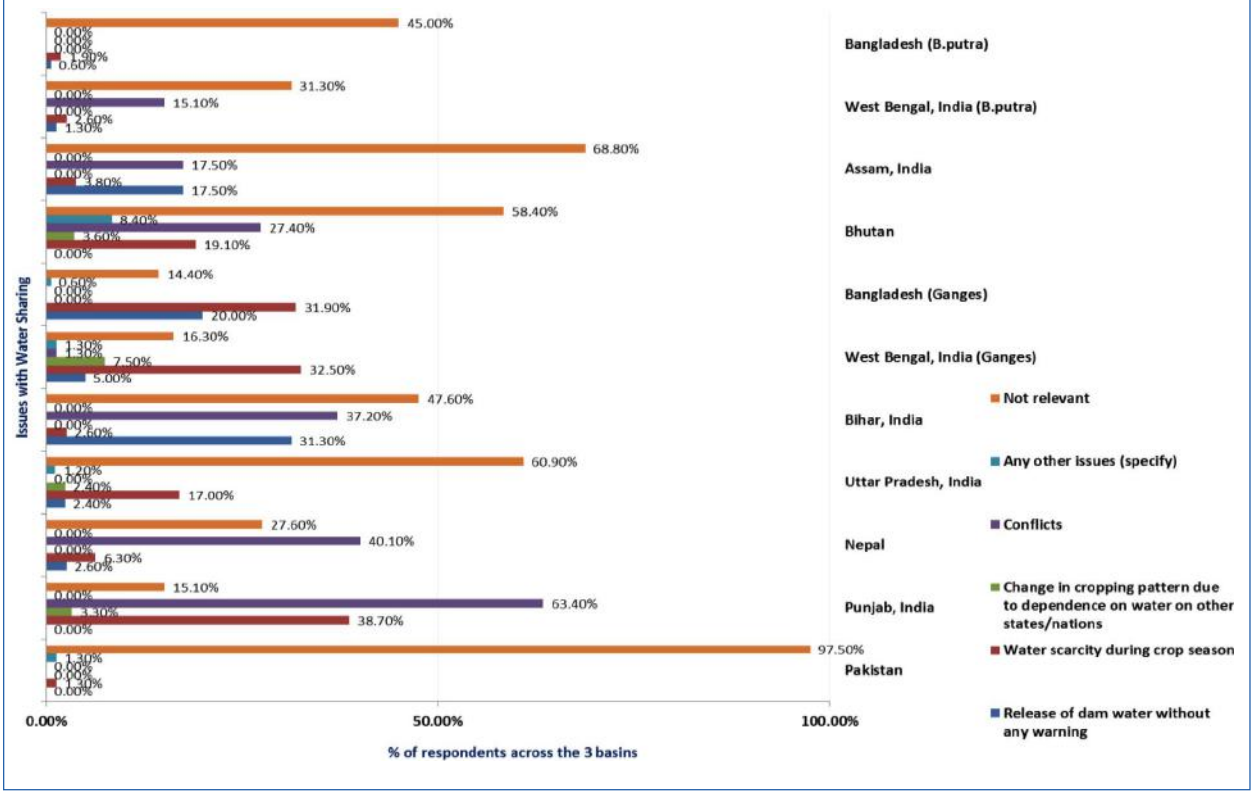


Figure 31: Issues with Water Sharing



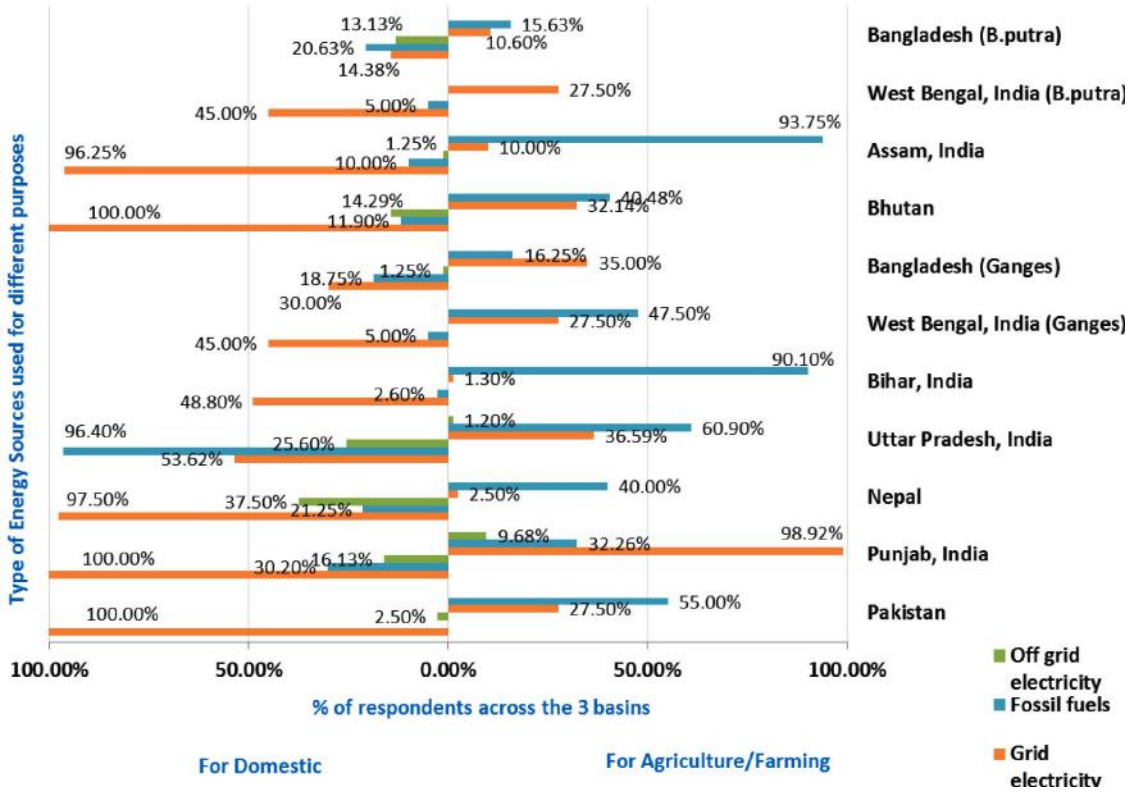
7
Energy Profile and its Characteristics

The energy security in South Asia is a persistent crisis owing to the imbalance between demand and supply. In this context, it was interesting to see alternative sources of energy being used for farming as well as non-farming purposes. The survey results reveal that considerable footprint has been observed in terms of renewable energy as a substitute for fossil fuel sources of energy. The following sections elaborate the key variables enumerated on field for understanding the trend in the energy scenario across five countries.

Types of Energy Sources Used

Figure 32 shows the sources of energy used for domestic and farming purposes across the survey locations. It can be seen that grid connected electricity was the main source of energy in Pakistan, Punjab, Nepal, Bhutan and Assam (irrespective of the source-whether it is from hydropower stations or thermal). Fossil fuels, under the purview of this survey included petrol, diesel and kerosene.

Figure 32: Type of Energy Sources Used for Domestic and Farming Purposes



Considerable proportion of respondents in Uttar Pradesh (96.4 per cent), Punjab (30.2 per cent), Nepal (21.25 per cent) and Bangladesh (Brahmaputra) (20.63 per cent) depended on fossil fuels for energy. Off grid energy source was mostly relied upon in Ganges and Brahmaputra basins (37.5 per cent and 25.6 per cent of respondents in Nepal and Uttar Pradesh, respectively; whereas 14.29 per cent and 13.13 per cent in Bhutan and in the Brahmaputra basin of Bangladesh).

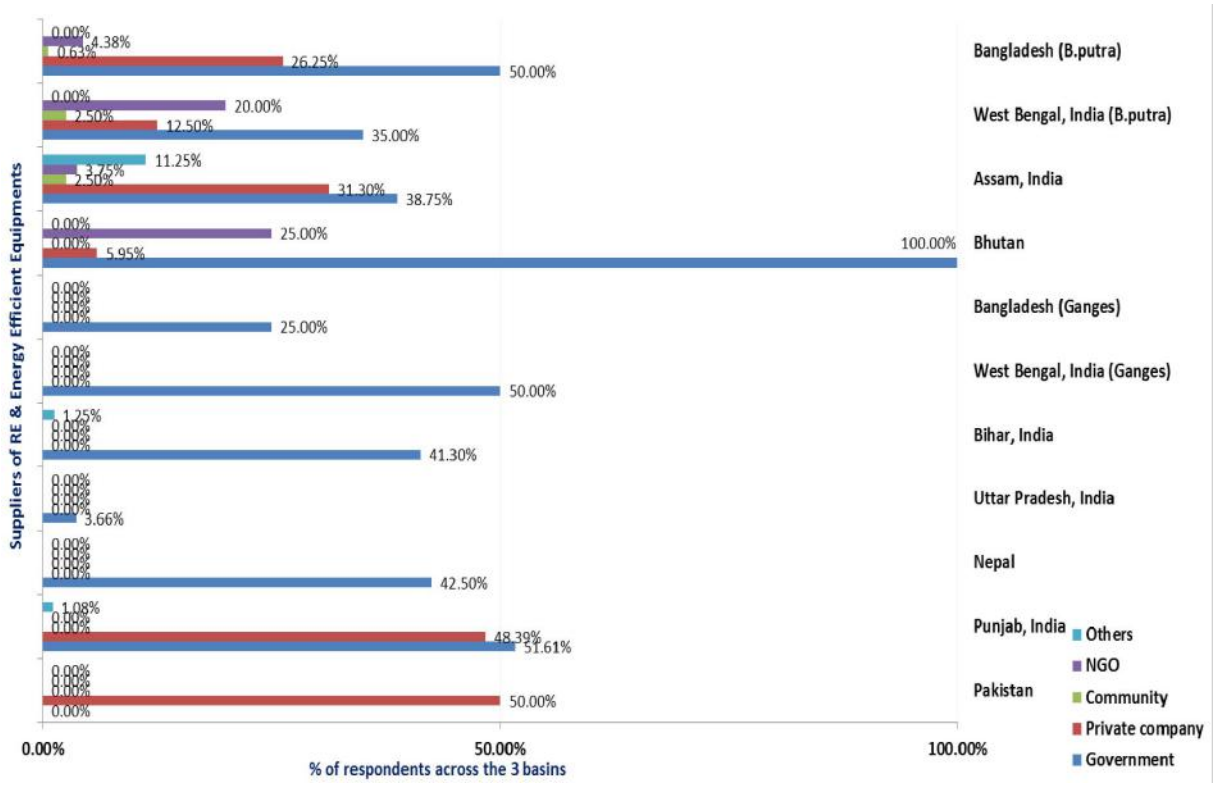
With regard to the source of energy for agricultural purposes (Figure 32), it was observed in the Indus basin that the dependency on grid connected electricity was 27.5 per cent of the sample size in Pakistan and 98.92 per cent in Punjab. Grid connected electricity for agricultural purposes was found to be heavily subsidised in Punjab, which accounts for the higher response.

However, in the Ganges basin, except Bangladesh, fossil fuels were found to be the most important source of energy for farming. Similarly in Brahmaputra basin, except West Bengal, majority of the responses in other locations were skewed towards fossil fuel usage. Predominance of diesel pump-sets in these basins explains the situation. Poor grid connectivity, unreliable supply and relatively high cost have made farmers dependant on diesel pump-sets. It is also interesting to note that off grid sources were not utilised for agricultural purposes. Nevertheless, in Punjab, 9.68 per cent of respondents depended on off grid sources.

Suppliers of Renewable Energy

The renewable energy sources discussed here includes off grid connection of solar, wind, biogas and mini/micro hydels of which the responses were mostly for solar and biogas energy sources. Figure 33 shows that private companies were the key supplier of renewable energy equipment in Punjab and Pakistan as reported by 48.39 per cent and 50 per cent of the respondents, respectively. However, 51.61 per cent of respondents in Punjab also depended on the government.

Figure 33: Suppliers of Renewable Energy and Energy Efficient Equipment

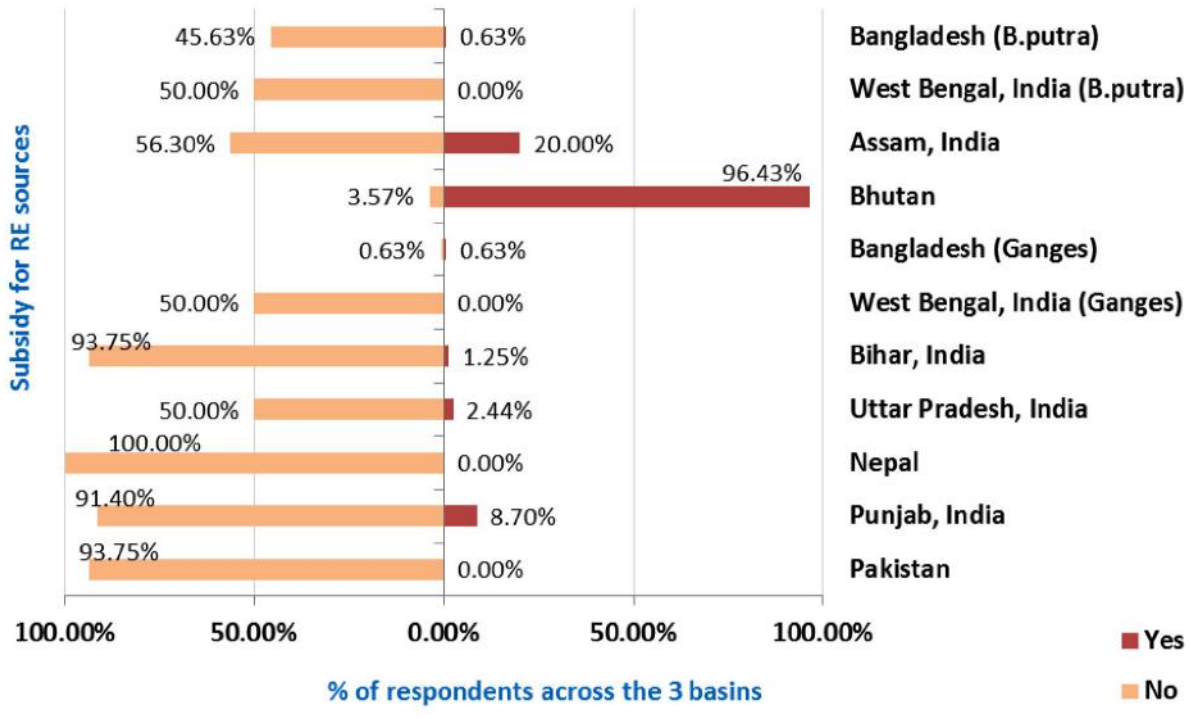


In the Ganges basin, higher proportion of respondents in Nepal (42.5 per cent), Bihar (41.3 per cent), West Bengal (50.0 per cent) and Bangladesh (25 per cent) relied on government sources for their supply. Higher proportion of respondents depended on the government for supply of energy efficient equipment in Brahmaputra basin. Presence of private suppliers was acknowledged by 31.3 per cent of the respondents in Assam and 26.25 per cent in Bangladesh and 12.5 per cent in West Bengal. The role of NGOs in supplying energy efficient equipment was acknowledged by respondents in Bhutan (25 per cent) and West Bengal (20 per cent).

Subsidy for Renewable Energy Sources

Figure 34 reveals that except in Bhutan (96.43 per cent) and Assam (20 per cent), where respondents claimed to have availed subsidies for renewable energy (RE) equipment, no significant response in this regard was observed in most of the locations. The subsidies for purchasing RE

Figure 34: Subsidy for Renewable Energy Sources

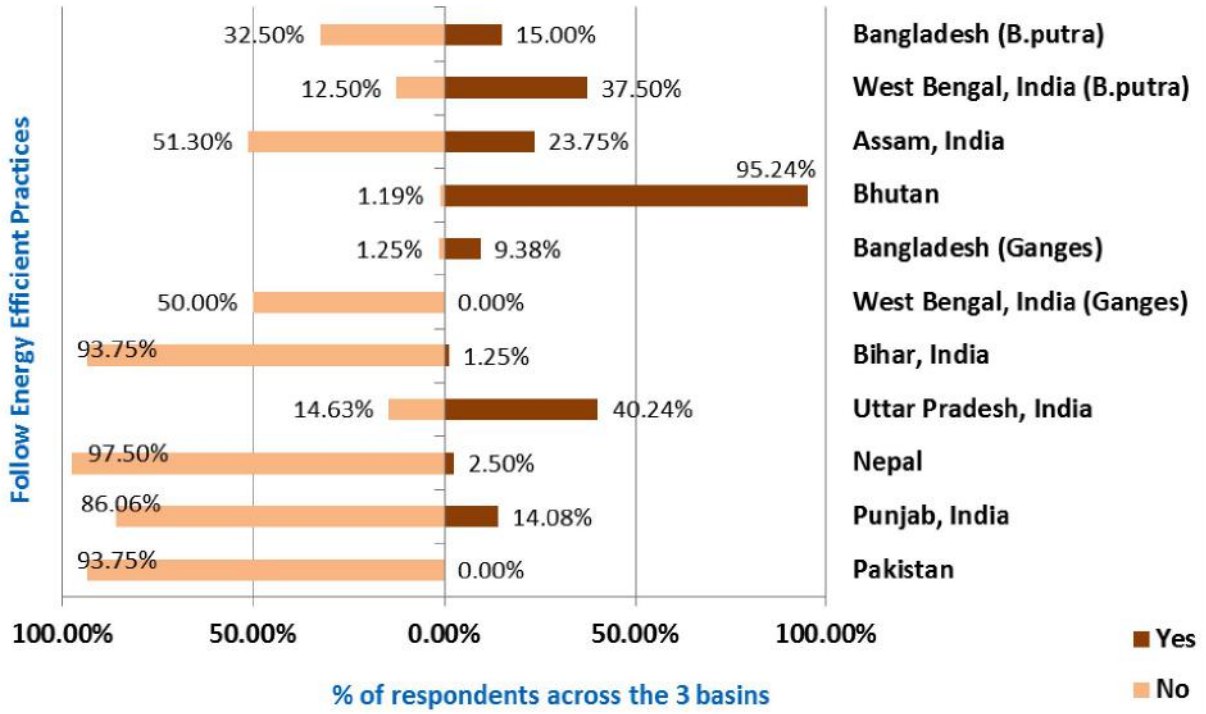


equipments were mostly provided by government and NGOs. In another sense, where there was direct intervention of government or NGOs in promoting RE technology, people have adopted it. This also indicates the need for awareness generation and support to popularise RE technology.

Energy Efficient Practices

Energy efficiency aims to reduce the amount of energy used to provide products and services and minimise wastage. Commonly used energy efficient equipments are LED bulbs, Compact Fluorescent Lamps (CFL), improved stoves, appliances with energy rating labels etc. The data given in Figure 35 shows that considerable proportion of respondents from Bhutan (95.24 per cent), Uttar Pradesh (40.24 per cent), West Bengal (37.5 per cent) and Assam (23.75 per cent) followed energy efficient practices. Negative responses from other locations underline the necessity of creating awareness about such practices at grassroots-level.

Figure 35: Do you Follow any Energy Efficient Practices?



Community Based Approach to Promote Renewable Energy

Rather than sporadic and isolated promotion of RE technology within a village or community, an intervention wherein most of the households in a community/village benefits would set an example and can cause behavioural change in nearby communities. In this regard, the survey tried to identify if community based approaches to promote RE are being adopted across the basins. Figure 36 shows the presence of a community based approach for promoting RE sources across the sample sites. Majority of the survey sites did not have any such mechanism in place with the exception of some sites in the Brahmaputra basin. Bhutan (96.3 per cent) followed by Assam (43.7 per cent) and West Bengal (25 per cent) showed positive responses.

As given in Figure 37, a community based approach for promoting RE received significant responses from Brahmaputra basin, with Bhutan (96.39 per cent), Assam (43.75 per cent) and West Bengal (25 per cent). In most cases, the community based approach was initiated by government authorities as reported by respondents in Bhutan (79.76 per cent) and Assam (33.75 per cent). This

was followed by NGOs with 32.15 per cent in Bhutan, 8.75 per cent in Assam and 18.75 per cent in West Bengal.

The responses from Bhutan and Assam were mostly on subsidised biogas plants supplied by government while NGOs also played a role in promoting renewable energy through solar and biogas based initiatives.

Figure 36: Presence of Community-based Approach to Promote Renewable Energy

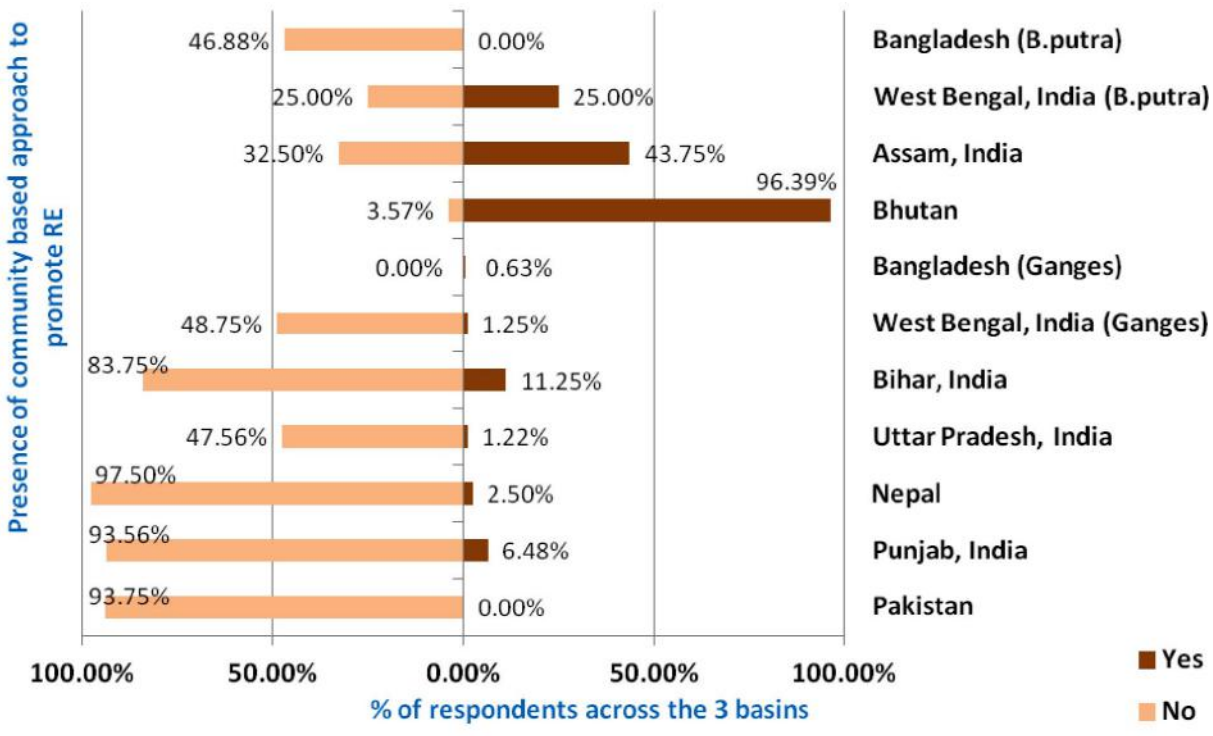
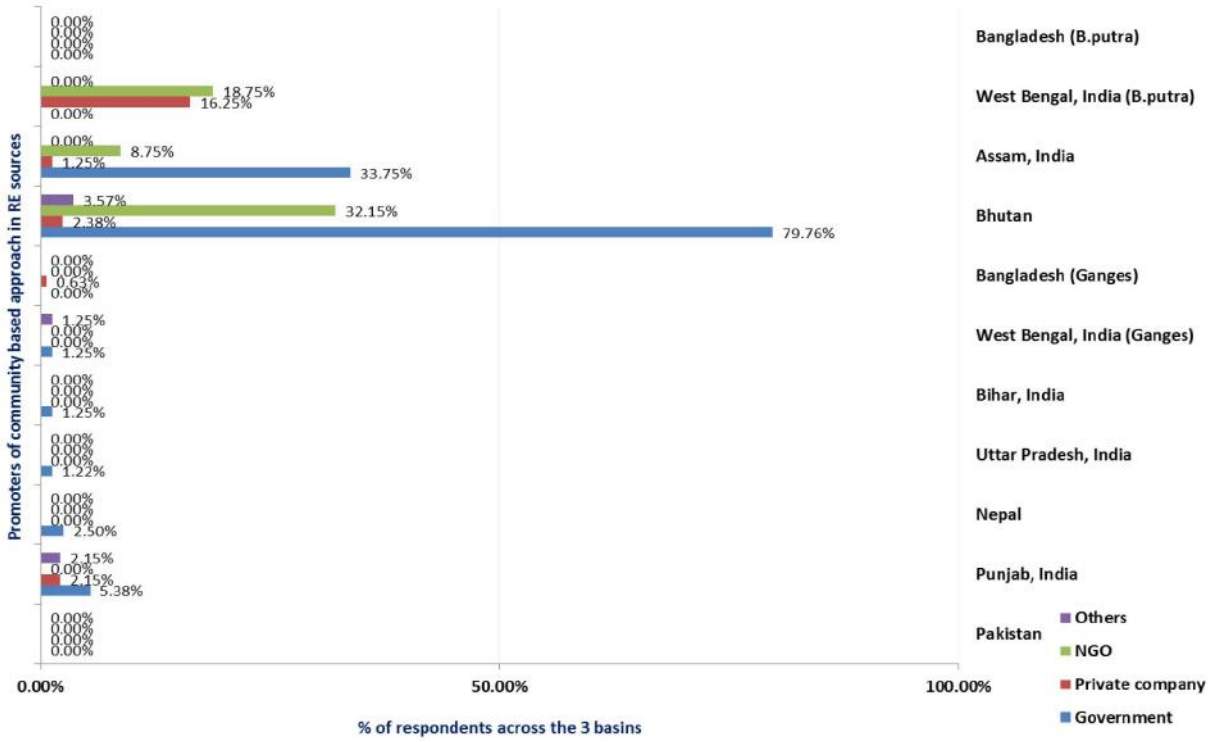


Figure 37: Promoters of Community Based Approach in Renewable Energy Sources



8
Climate Change and its Characteristics

Climate change has significant influence in determining the food, energy and water security of any region. South Asia has been experiencing increasing weather abnormalities or extreme events in recent past. Given that adaptation strategies are to be developed to meet local requirements, it is necessary to understand the manifestations of weather aberrations at local level. Hence the survey focused on observed changes in key climatic variations like rainfall, frost, stress and drought to understand the effect of these environmental systems on agriculture and water. The following sections delineate the trends observed in the data relevant to climate change.

Weather Patterns

Table 19 and 20 shows the observed climate variability over the past three years Unseasonal rainfall received maximum responses of 45 per cent in Pakistan (Indus Basin), likely accounted for by the increase in number of rainy days and high intensity short duration rainfall as reported by 41.3 per cent and 37.5 per cent of the respondents.

Maximum responses (89.2 per cent) were observed with unseasonal rainfall even in Punjab (India) but consecutively, decrease in number of rainy days (51.6 per cent) and delay in the onset of monsoon (78.5 per cent) was also recorded. Considerable proportion of responses in the Ganges basin (Nepal, Uttar Pradesh, Bihar and West Bengal) illustrated delay in the onset of monsoon and decrease in number of rainy days. Nepal, Uttar Pradesh and West Bengal also experienced early withdrawal of monsoon. However, increased incidences of terminal heat stress were realised in Uttar Pradesh (79.30 per cent), Bihar (30.10 per cent), West Bengal (32.50 per cent) and Bangladesh (41.90 per cent).

Table 19: Type of Weather Patterns Observed in the Past three years (%)

Basin	Sample Sites	Delayed onset of monsoon	Early monsoon withdrawal	Increasing number of rainy days	Decreasing number of rainy days
Indus	1. Pakistan	0.00	0.00	41.30	8.80
	2. Punjab, India	78.50	17.30	23.70	51.60
Ganges	3. Nepal	42.60	30.10	7.60	41.30
	4. Uttar Pradesh, India	98.70	64.60	4.80	97.60
	5. Bihar, India	62.50	0.00	11.30	76.30
	6. West Bengal, India	43.80	35.00	7.50	31.30
	7. Bangladesh	4.40	11.30	11.30	8.80
Brahmaputra	8. Bhutan	46.40	19.10	78.60	50.00
	9. Assam, India	31.30	12.50	10.00	11.30
	10. West Bengal, India	25.10	15.10	3.80	17.60
	11. Bangladesh	28.80	10.60	10.60	8.80

Table 20: Type of Weather Patterns Observed in the past three years (Contin...) (%)						
Basin	**Sample Sites**	**High rainfall intensity in short duration**	**Unseasonal rainfall**	**Stress on crop due to increased temp.**	**Frost**	**Others**
Indus	1. Pakistan	37.50	45.00	25.00	0.00	0.00
	2. Punjab, India	21.50	89.20	9.70	27.90	0.00
Ganges	3. Nepal	25.10	41.30	5.00	5.00	0.00
	4. Uttar Pradesh, India	52.40	73.20	79.30	41.50	9.70
	5. Bihar, India	10.00	30.10	30.10	0.00	0.00
	6. West Bengal, India	15.00	25.00	32.50	0.00	1.30
	7. Bangladesh	3.70	3.70	41.90	0.00	0.00
Brahmaputra	8. Bhutan	38.10	38.10	28.50	9.50	4.80
	9. Assam, India	56.30	56.30	1.30	0.00	0.00
	10. West Bengal, India	13.80	28.80	40.00	0.00	0.00
	11. Bangladesh	0.00	0.00	3.80	0.00	0.00

Furthermore, mixed responses were recorded in Brahmaputra basin with regard to climate change. Contradictorily, both increase and decrease in number of rainy days were observed by 78.6 and 50 per cent of respondents in Bhutan, which implies that over the past three years, there was variation in rainfall distribution. Wider variability was observed in Mongar district of Bhutan, where 42.9 per cent respondents said that there was an increase in rainy days where as 20.2 per cent opined a decrease in rainy days.

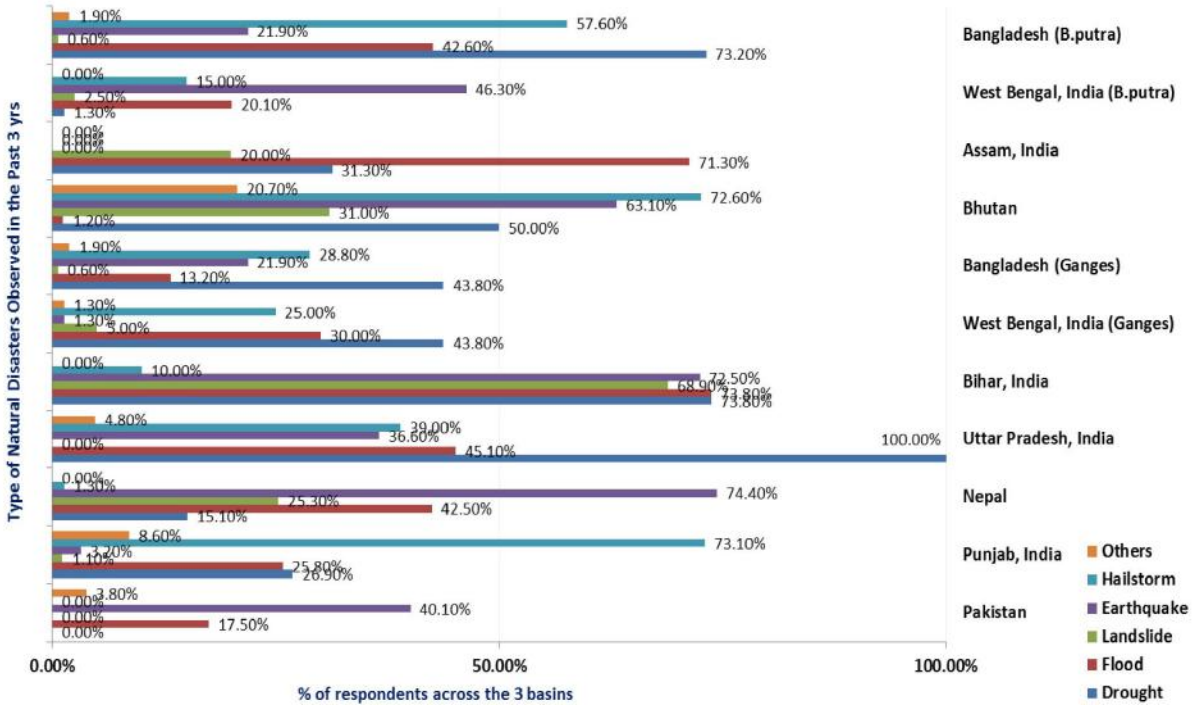
Unseasonal rainfall and high intensity rainfall were reported by 56.3 per cent of the respondents in Assam whereas terminal heat stress and delay in the onset of monsoon were the key issues identified by 40 per cent and 25 per cent of respondents, respectively in West Bengal. Delay in the onset of monsoon was also a significant problem in Bangladesh.

Natural Disasters

Looking at the type of natural disasters observed in the Indus- Ganges- Brahmaputra basins, it can be seen that earthquakes emerged as the major disaster in Pakistan, Nepal, Bihar and West Bengal, which aligns with the recent tremors experienced in these locations last year (Figure 38). Incidence of hailstorm dominated in Punjab (India) with 73.1 per cent of responses. This also confirms the occurrence of frost as reported by 27.9 per cent of respondents in the state. Further, in the Ganges basin drought was the most important natural disaster by a considerable proportion of respondents. Bihar appeared as the state worse hit by different types of disasters namely drought (73.8 per cent), flood (73.8 per cent) and earthquake (72.5 per cent).

Being located in the mountainous terrain, Bhutan experienced hailstorms (72.6 per cent) and earthquakes (63.1 per cent). In Assam, a maximum number of responses were shown for floods (71.3 per cent) whereas in West Bengal higher responses were noted for earthquakes (46.3 per cent). Incidences of drought (73.2 per cent), hailstorm (57.6 per cent) and flood (42.60 per cent) were observed in Bangladesh.

Figure 38: Type of Natural Disasters Observed in the Past three years



Flood Warning

With regard to the information about the occurrence of floods (Table 21), it was interesting to note that in Pakistan despite 17.5 per cent respondents reporting the occurrence of floods, no responses were recorded with any of the sources listed. However, 25 per cent of the respondents said that they received no warning. On the contrary, in Punjab, television, radio and newspaper were the common sources of information for such warnings.

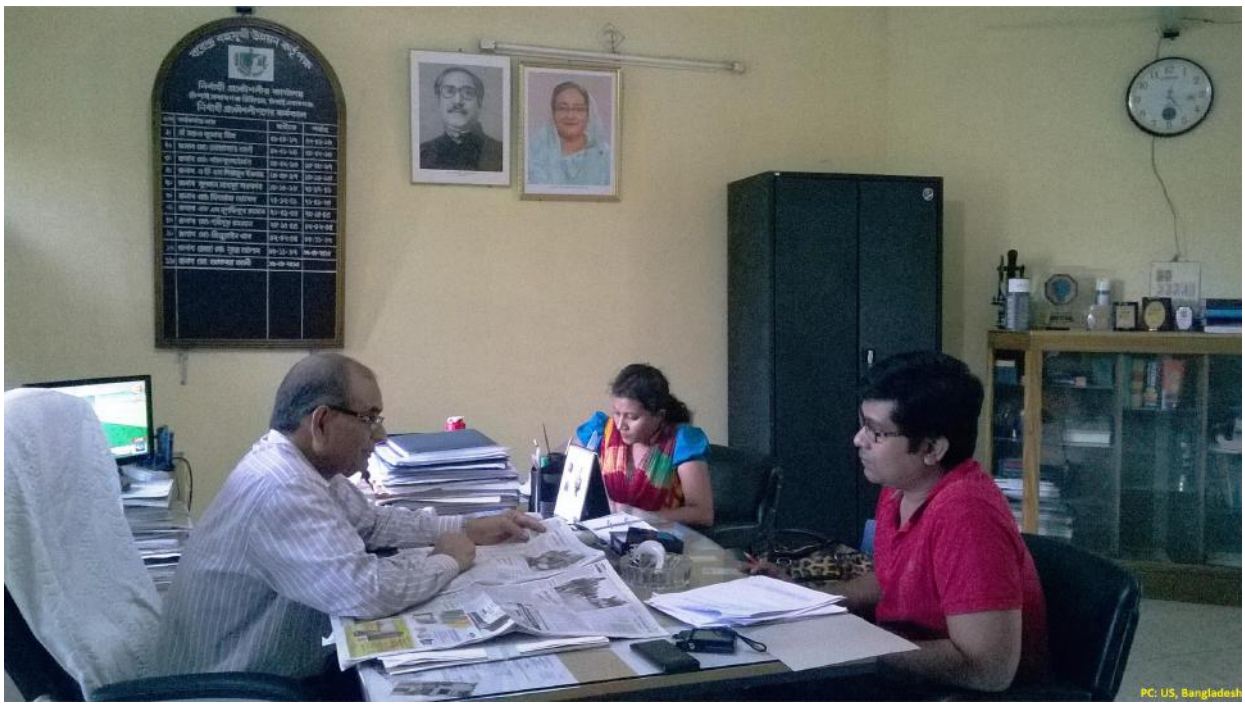
In the Ganges basin, it is to be noted that 48.8 per cent respondents said that they receive no warning while 21.3 per cent said that they rely on neighbours and elderly people in the village for information. Television, radio, newspaper and traditional knowledge were found to be the sources of warning in Uttar Pradesh and Bihar. In West Bengal, 31.3 per cent of the respondents said that they did not receive any warning, but 23.8 per cent respondents depended on traditional means of

Table 21: Sources of Warning in Case of Flood (%)

Basin	Sample Sites	Government	Neighbours/Village elders	TV	Radio
Indus	1. Pakistan	0.00	0.00	0.00	0.00
	2. Punjab, India	4.30	26.90	86.10	81.70
Ganges	3. Nepal	0.00	21.30	2.50	0.00
	4. Uttar Pradesh, India	46.40	6.00	34.20	26.80
	5. Bihar, India	0.00	2.60	23.80	23.80
	6. West Bengal, India	0.00	2.50	2.50	2.50
	7. Bangladesh	0.00	20.10	38.80	5.10
Brahmaputra	8. Bhutan	95.20	0.00	3.60	9.50
	9. Assam, India	2.50	55.00	0.00	2.50
	10. West Bengal, India	15.00	10.10	42.60	40.10
	11. Bangladesh	0.00	0.00	18.80	0.60

Table 22: Sources of Warning in Case of Flood (Contin...) (%)					
Basin	**Sample Sites**	**News papers**	**Traditional knowledge**	**Others, specify**	**No warning**
Indus	1. Pakistan	0.00	0.00	0.00	25.00
	2. Punjab, India	64.50	0.00	2.20	5.40
Ganges	3. Nepal	0.00	2.50	1.30	48.80
	4. Uttar Pradesh, India	37.90	1.20	2.40	4.90
	5. Bihar, India	8.80	26.30	0.00	22.60
	6. West Bengal, India	3.80	23.80	2.50	31.30
	7. Bangladesh	3.20	25.60	0.60	5.70
Brahmaputra	8. Bhutan	0.00	0.00	0.00	0.00
	9. Assam, India	1.30	67.60	0.00	16.30
	10. West Bengal, India	13.80	6.30	0.00	3.80
	11. Bangladesh	0.00	0.60	0.00	10.00

information. Television, neighbours and traditional information means were mostly relied upon by the respondents in Bangladesh.



9
Gender Gap and its Characteristics

A conscious attempt was made to record the female farmer and stakeholder voice in this survey. This effort stems from the field learning that though women's contribution to agricultural production is acknowledged, they do not benefit from agricultural incentives and innovations. At the core of the issues lies the solution of looking at women empowerment in agriculture as an entity in its own. Key factors like access to credit and productive assets and active participation in local level institutions influenced the bargaining power of women stakeholders dramatically. The following sections consist of variables which were categorically targeted only to women respondents of the second part of the questionnaire.

Occupation

The data in the Table 23 reveals that women across the basins are mostly engaged in household work and farming activities. A conscious effort was made to record household work as an occupation, rather than it being just an additional duty of the female member of the HH. So, it can be seen that in the Indus basin, household work was the main occupation of women as noted by 93.8 per cent of respondents in Pakistan and 76.4 per cent in Punjab. The proportion of women engaged in farming was lesser in Punjab (16.1 per cent) as compared to Pakistan (38.1 per cent).

The data from Ganges basin shows that the proportion of women engaged in farming was highest in West Bengal (40 per cent). In the Sindhuli region of Nepal, 83.9 per cent of women were involved in collecting forest produce whereas in the states of Uttar Pradesh and Bihar, 20.70 per cent and

Table 23: Occupation of Women Respondents (%)

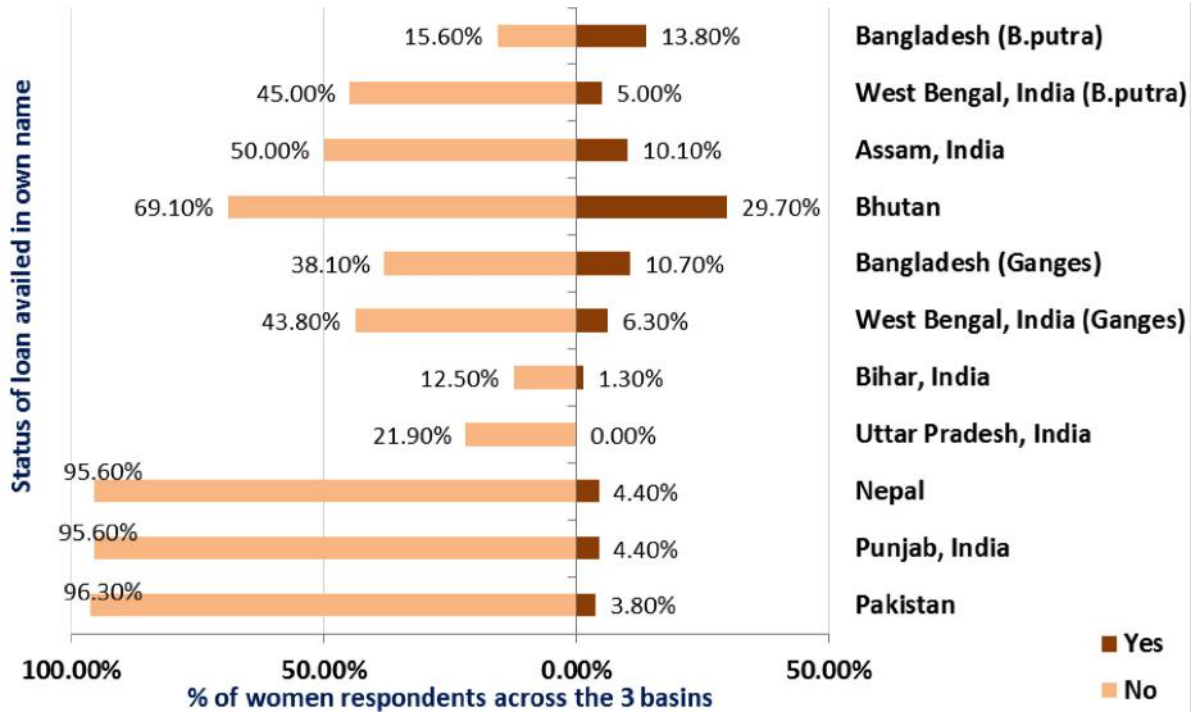
Basin	Sample Sites	Farming (own land)	Farming (leased land)	Non-Farming	In-Service/ Salaried Job	Agricultural labour	Collecting forest produce	House-hold work	Others
Indus	1. Pakistan	38.80	0.00	0.00	0.00	0.00	43.80	93.80	0.00
	2. Punjab, India	16.10	3.30	3.20	5.40	7.50	0.00	76.40	23.70
Ganges	3. Nepal	16.10	3.30	3.20	5.40	7.50	83.90	76.40	0.00
	4. Uttar Pradesh, India	15.80	0.00	0.00	0.00	20.70	0.00	47.50	0.00
	5. Bihar, India	1.30	0.00	1.30	0.00	18.80	0.00	20.00	0.00
	6. West Bengal, India	41.30	1.30	0.00	1.30	1.30	7.50	42.50	12.50
	7. Bangladesh	6.30	1.90	0.00	0.00	6.30	0.00	48.80	0.00
Brahmaputra	8. Bhutan	96.40	3.60	9.60	1.20	48.80	48.80	94.00	4.80
	9. Assam, India	41.30	11.30	5.00	1.30	3.80	1.30	47.50	11.30
	10. West Bengal, India	16.30	1.30	0.00	0.00	2.50	5.10	13.80	0.00
	11. Bangladesh	1.90	0.00	0.00	0.00	0.00	0.00	29.40	0.00

8.8 per cent of the women respondents worked as agricultural labourers, respectively. Farming in own land and household work dominated the responses from Brahmaputra basin. In Assam, 11.3 per cent of female respondents did farming in leased land. In Bhutan, 48.8 per cent of female respondents were engaged in collecting forest produce and also worked as agricultural labour.

Credit Situation

Across the river basins, it was found that female respondents have not availed any loan in their own name (Figure 39). More than 95 per cent negative responses were recorded in the Indus basin in this regard, whereas in Ganges basin 10.70 per cent of respondents claimed to have availed credit in Bangladesh. However, in Brahmaputra basin, considerable proportion of respondents from Bhutan (29.70 per cent), Assam (10.10 per cent), and Bangladesh (13.8 per cent) availed loan on their behalf.

Figure 39: Status of Credit Availed by Women Respondents



Sources of Credit

The data in the Table 24 shows that the source of credit of maximum female respondents in Bhutan (29.7 per cent) was nationalised bank whereas in Bangladesh, 14.40 per cent of the respondents relied on NGOs for credit. It is important to note that though none of the female respondents in Uttar Pradesh availed loans, 74.4 per cent and 26.8 per cent of the respondents said that they depend on friends and families/relatives for money, respectively. A similar response was observed with Bihar, where 10.10 per cent of female responses depended on families/relatives as a source of credit.

Table 24: Sources of Credit for Women Respondents (%)									
Basin	Sample Sites	Nationalised Bank	Cooperative Bank	Private Bank	Local Money Lender	Self Help Group	Non-Governmental Organisation	Friends	Family/ Relatives
Indus	1. Pakistan	1.30	0.00	0.00	0.00	0.00	0.00	1.30	2.50
	2. Punjab, India	5.40	2.20	0.00	0.00	0.00	0.00	0.00	1.10
Ganges	3. Nepal	5.40	2.20	0.00	0.00	0.00	0.00	0.00	1.10
	4. Uttar Pradesh, India	0.00	0.00	0.00	4.90	0.00	1.20	74.4	26.8
	5. Bihar, India	1.30	0.00	0.00	5.10	0.00	0.00	1.30	10.1
	6. West Bengal, India	1.30	0.00	1.30	1.30	2.50	1.30	0.00	0.00
	7. Bangladesh	0.00	0.00	5.10	0.60	0.00	7.50	0.00	0.00
Brahmaputra	8. Bhutan	29.7	3.60	0.00	0.00	0.00	0.00	0.00	1.20
	9. Assam, India	1.30	2.50	1.30	2.50	0.00	0.00	0.00	2.50
	10. West Bengal, India	1.30	0.00	0.00	0.00	2.50	0.00	2.50	1.30
	11. Bangladesh	0.00	0.00	0.00	0.00	0.00	14.4	0.00	0.00

Access to Technology and Information

Table 25 pertains to access to technology by female respondents. The data reveals that use of agricultural machinery was reported by females in West Bengal, India (26.30 per cent) and Bangladesh (15 per cent) in the Ganges basin while few responses were recorded in the Indus basin in this regard. Assam dominated in Brahmaputra basin with respect to use of agricultural machineries by females (58.8 per cent), followed by West Bengal (10.10 per cent).

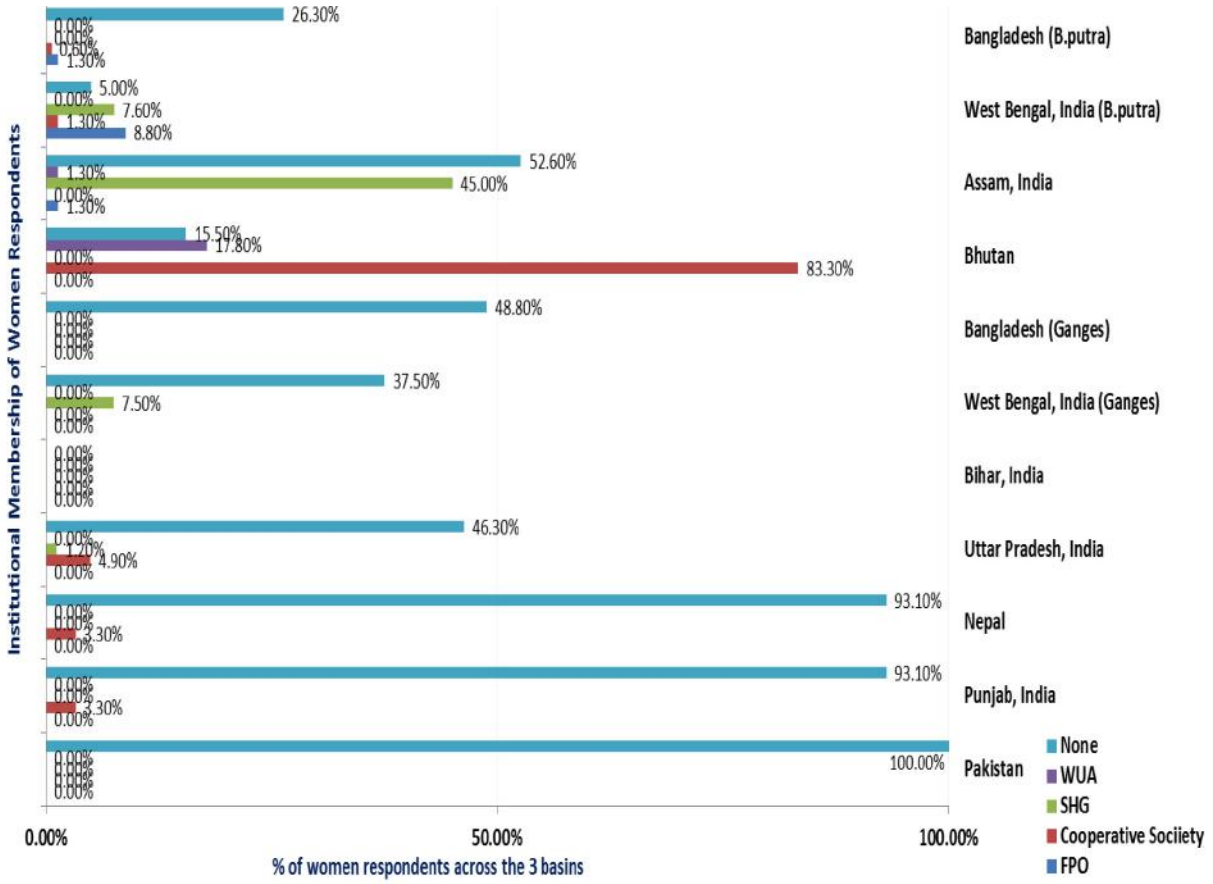
For considering future action on capacity building, very few female responses were obtained in favour of attending training programmes in the Indus and Ganges basins. But considerable proportion of responses in this respect was observed in the Brahmaputra basin, in general and Bhutan (61.9 per cent) and Assam (46.30 per cent) in particular. It can be noted that 90.4 per cent and 45.10 per cent of the female respondents in Bhutan and Assam respectively were in contact with extension officers, which might have led to increased female participation in these locations.

Table 25: Access to Technology and Information by Women Respondents (%)							
Basin	Sample Sites	Do you use any machinery in agricultural operations?		Have you attended any training in agriculture?		Have you been in contact with any extension officer?	
		No	Yes	No	Yes	No	Yes
Indus	1. Pakistan	97.50	2.50	100.0	0.00	97.50	0.00
	2. Punjab, India	98.90	1.10	98.90	1.10	98.90	1.10
Ganges	3. Nepal	98.90	1.10	98.90	1.10	98.90	1.10
	4. Uttar Pradesh, India	51.20	0.00	50.00	2.40	47.50	2.40
	5. Bihar, India	18.80	1.30	20.10	0.00	10.00	0.00
	6. West Bengal, India	23.80	26.30	50.00	0.00	48.80	1.30
	7. Bangladesh	34.40	15.00	50.00	0.00	48.10	0.00
Brahmaputra	8. Bhutan	89.30	9.50	38.10	61.90	4.80	90.40
	9. Assam, India	34.00	58.80	57.50	46.30	48.80	45.10
	10. West Bengal, India	40.10	10.10	45.10	5.10	46.30	3.80
	11. Bangladesh	49.40	6.00	49.40	0.60	49.40	0.60

Institutional Membership

Regarding membership in various institutions, the data shows that the respondents from Indus basin did not report any membership asked in the questionnaire except for few in Punjab, who were associated with cooperative societies (Figure 40). Nevertheless, in the Ganges basin, some of the respondents were part of cooperative societies from Uttar Pradesh (4.9 per cent) and Nepal (3.3 per cent). In West Bengal, it was found that 7.5 per cent of the respondents were member of SHGs. In the Brahmaputra basin, cooperative society was the main institution where 83.3 per cent of the respondents from Bhutan had membership. This was followed by SHGs in which 45 per cent of the respondents from Assam had membership.

Figure 40: Institutional Membership of Women Respondents



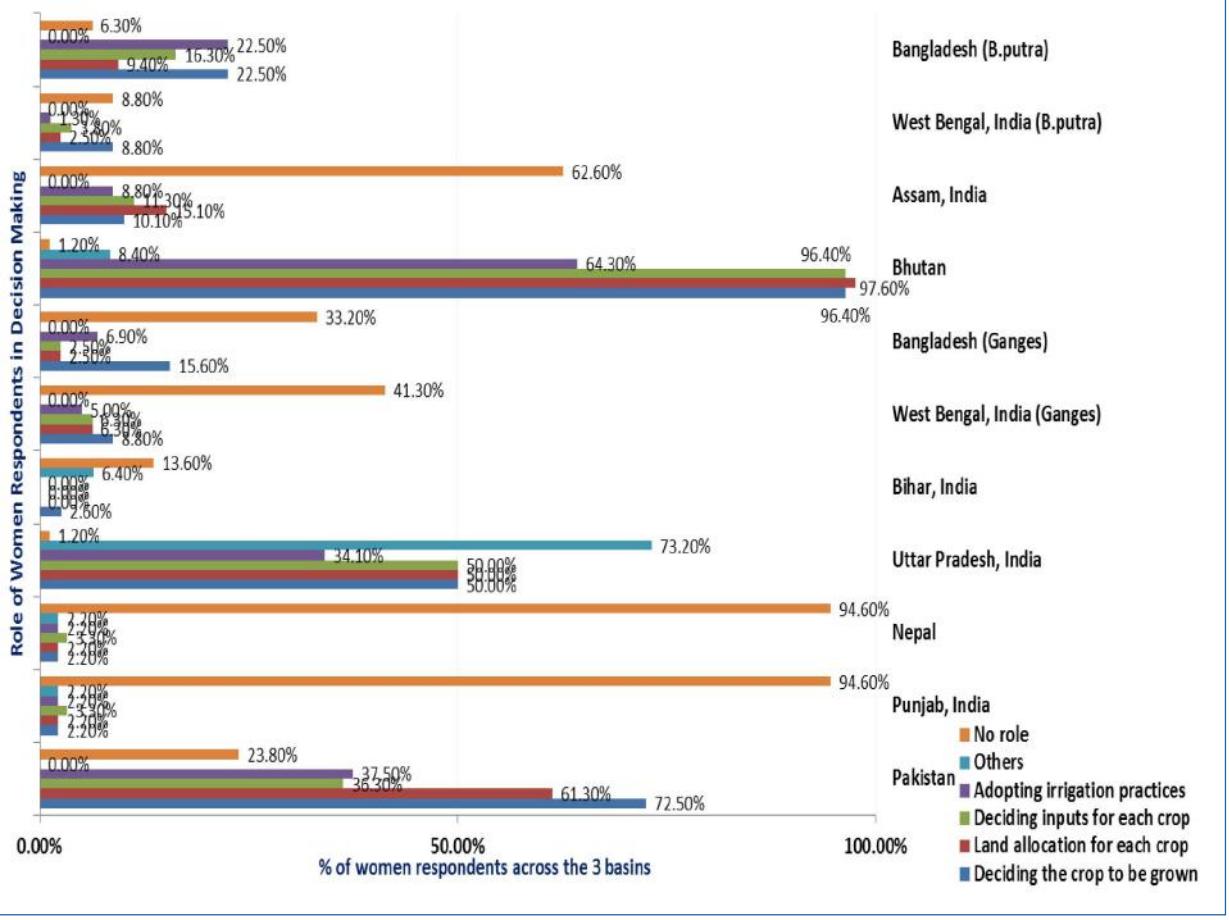
Decision Making

The data from Indus basin (Figure 41), especially from Punjab, India, clearly indicated male dominance where 94.6 per cent of the respondents said that they have no role in decision making. Socio-economic factors, lack of land ownership and increased mechanisation in farm operations might have attributed to limited role of women in decision making in Punjab. But in Pakistan, considerable proportion of respondents claimed that they play a role in decisions on crops, allocating land and deciding inputs and irrigation practices. Barring Uttar Pradesh, all other locations in the Ganges basin showed limited response of females in decision making.

In Uttar Pradesh, 50 per cent of the female respondents claimed to have a role in deciding on crops, area and inputs. In the Brahmaputra basin, significantly higher number of female respondents in Bhutan had a role in deciding on crops, area, inputs and irrigation practices. In other Brahmaputra locations (i.e. Assam and West Bengal), women were also found to have a role in decision making

but in limited proportions. However, 22.5 per cent of the female respondents in Bangladesh claimed that they had a role in deciding on crops and irrigation practices.

Figure 41: Role of Women Respondents in Decision Making



10
Field Insights and Recommendations

The data trends described in detail in the previous chapters reveal that each of the datasets cannot be looked at singularly. The survey revealed that majority of the variables taken as indicators in agriculture had significant domino effect on water, energy and gender too. The unique scenario where specific issues in agriculture, water and energy could not be compartmentalised has led to the discussions in this chapter.

Access to Agricultural Inputs

The data has revealed that at various sample sites, the key factors, which determine farm income and productivity, are inputs (fertilisers and seeds), irrigation, credit and market access. The maximum responses shown under sources of seed and fertilisers and the selling points for the produce have been collated in Figure 42 to better understand the key factors.

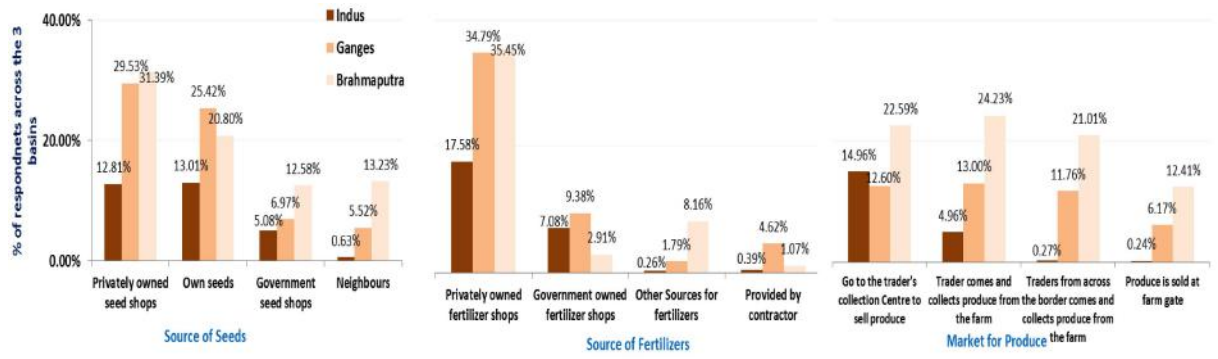
When it comes to inputs, Figure 42 below depicts that the private sector had a large share in the seed and fertiliser industry across the three basins. As evident from Figure 12, more farmers rely on hybrid seeds even in countries like Nepal and Bhutan where subsistence level of farming exists and even in Bangladesh and India (particularly Assam and Bihar), which justifies a higher role of private sector involvement in Brahmaputra and Ganges (31.39 per cent and 29.53 per cent of the total sample size).

However, field interactions with respondents in Nepal have revealed that due to open border between India and Nepal, farmers can easily get the seeds from India, i.e. from Indian farmers (following traditional seed exchange system) and from Indian traders. Such seed might not be formally registered in Nepal. This percentage response also includes, among others, those farmers who get seeds from Indian seed shops and the agents of such shops who operate in Nepal and bring the seed informally. In contrast, the KIIs with farmers in Mianwali and Rahimyar Khan Districts in Pakistan have revealed that in most cases, seed purchasing is done by the land lord/big farmer of the area and small farmers purchase it from them.

Box 1: Indo-Nepal Border Trade

The cross-border trade at the Indo-Nepal border is a cause of prominent discussions in hindsight of the Nepal Fuel Blockade. With regard to cash crops like vegetables, traders complain that if there is low production in Indian side, no NTBs are faced by Nepalese producers and vice versa. Similarly, gap exists between promises of central government and treatment of custom officials and state governments in Nepal.

Figure 42: Markets for Input and Produce



With regard to fertilisers, 87.82 per cent of the total sample size across the basins claimed to have depended on privately owned fertiliser shops. Here also, Brahmaputra region recorded maximum responses (35.45 per cent) closely followed by Ganges (34.79 per cent). Relatively higher responses in Ganges and Indus basin were in favour of government-owned fertiliser shops, which can be attributed to the positive responses in Uttar Pradesh and Punjab (Figure 14). Farmers are aware that if they used the recommended dose of high quality fertilisers, it would increase their crop yield; however farmers are not using such fertilisers due to the high cost factor. Further, the problem of low quality fertiliser was highlighted by farmers in Pakistan, Bangladesh and Assam.

Cases of high cost of fertilisers and seeds have been reported across the three basins and more sporadically for the Pakistani farmers too. During KIIs, the officials from agricultural department of Rahimyar Khan District (Pakistan) also elaborated on how government's uneven subsidy schemes have caused the farmers to use high quality and expensive fertilisers in the year 2007-08. Although, the seed and fertiliser industry is dominated by the private sector, KIIs have revealed that the expectations of farmers for the supply of good quality seeds and fertilisers are still associated with the government.

Box 2: Competitive Agricultural Markets in Punjab

"Sugarcane, Basmati and Kinnow are good alternatives for traditional crops, but dearth of processing units (which have now been shut down due to state government negligence) make them vulnerable to market"

- Jagmohan Singh, General Secretary, Bharatiya Kisan Union leader, Punjab, India.

"When Turkey and Israel can sell tomatoes at a high price in international market, why can't India"? said an official, Agricultural Department, Punjab.

The challenge is to make Indian agriculture products competitive in the international market. Fruits, such as litchi and banana could not be exported because of inferior quality. Even Indian *Basmati* rice is not able to compete in international market.

The mandated price of seeds and micronutrients like zinc, boron etc. in the private market are inundated with regional price fluctuations. In this scenario, interactions with stakeholders have revealed that farmers are willing to go the extra mile of paying more as long as the government assures them of the quality seeds and fertilisers.

The survey results also brought to light the imbalanced use of fertilisers (Figure 13) across the basins, wherein urea and DAP were found as the most widely used form of fertilisers. South Asia's share in the world consumption of nitrogen, phosphate and potash is 19.8 per cent, 18.4 per cent and 9.1 per cent respectively.[7] Owing to the current subsidy regime in India, urea alone occupies 58.8 per cent of the total

fertiliser consumed in the country. Decontrol of phosphate and potash fertilisers have led to steep increases in their prices and a drop in their usage.

The subsidised urea also flows to neighbouring countries like Nepal and Bangladesh through the porous borders and informal channels.[8] The interviews and survey findings emphasise the expectations of farmers from the government to assure timely supply of quality inputs at affordable prices. It also calls for re-orienting the incentives so as to ensure efficient use of quality inputs to realise higher yields.

Box 3: Market driven Crops in Pakistan

The Rahimyar Khan district of Pakistan was traditionally known for cotton cultivation, but due to low price of cotton and the development of sugar mills in nearby areas, now farmers have shifted to sugarcane cultivation. Farmers in this region claim that their produce is of superior quality in terms of sugar content and hence demand higher support price from government.

Access to Markets

Market access to inputs and produce has long been associated with reducing the drudgery of subsistence farmers. Since input requirement and produce sale for small holder farming is localised in quantity and scale, the market indicators covered in the study revealed interesting trends. Figure 42 also exhibits the key selling points for the produce/harvest by the respondents across the three basins.

With regard to access to the market, it was found that Brahmaputra basin recorded maximum responses (24.23 per cent) out of total sample size where a trader comes and collects the produce from a farm, which shows that small farm holdings have poor access to markets for direct selling and depends on traders. A significant amount of cross-border trade of produce was observed in the Ganges and Brahmaputra basin of West Bengal (Figure 16), which has attributed to responses in the figure above with respect to trade across borders. This would substantiate the current discourse on cross-border trade through formal and informal traders who work along with national and state-level governments too.

Box 4: Reform APMCs in Bihar

Interview with a representative of an agribusiness firm in Bihar revealed that there are issues related to transportation and timely delivery of products in the market because of traffic regulation in the no entry zone of Patna and the resulting high traffic jams. There is a lack of proper infrastructure and basic facilities in the *mandi*. "Agricultural Produce Market Committee (APMC) should be there as it gives facilities, legal cover, and guarantee of money and trade security", he said. Farmers should be made aware about quality of the produce. Those who have availed subsidy for establishing cold storage do not know how to operate it optimally and efficiently and end up paying heavy electricity bills.

Assured market for any crop plays a decisive role in determining the cropping pattern in a locality. The dominance of rice and wheat in Punjab, India is primarily due to the Minimum Support Price (MSP) and government procurement of these commodities. Recently, to promote maize as an alternate crop, the government of Punjab raised its MSP but could not generate a market until procurement was initiated. Interestingly, traders play a role even in government procurement as was evident in the interviews of farmers in Punjab and Bihar. This is obvious from the trend shown in Figure 42 too. The procurement of rice and wheat in India is primarily from the states of Punjab and Haryana neglecting other rice producing states of eastern India. More than 80 to 90 per cent of total market arrivals of wheat in Punjab and Haryana are picked up by government agencies at minimum support prices, which also explain the power dynamics of policy making (Vidyadharan, et al. 2016).

Box 5: Market Regulation in India

Agricultural markets in India are regulated by State Governments by the Agricultural Produce Market Committee APMC Act. The monopoly of government regulated wholesale markets has prevented development of a competitive marketing system in the country, providing no help to farmers in direct marketing, organised retailing, a smooth raw material supply to agro-processing industries or adoption of innovative marketing system and technologies. Hence, the Union Government came up with a Model APMC Act in 2003 (MIAMA 2015) (Department of Agriculture & Cooperation, Ministry of Agriculture 2015) which had provisions for direct marketing, contract farming and private market yards. However, the regulatory regime is different in different states of the country and the state also imposes taxes on inter-state transport of agricultural produce.

If the market regulation is in favour of private investment, this could definitely take a leap. Uttar Pradesh has not adopted the Model Act yet whereas Bihar, which has repealed the Act, has not attracted private investment. Also, since the government is not collecting taxes through market committees (*Mandi parishads*), there is little investment by the public sector in building infrastructure and basic facilities. Hence, across the basin, the enabling environment for market regulation differs widely. Also, since the government is not collecting taxes through market committees (*Mandi parishads*), there is little investment by the public sector in building infrastructure and basic facilities.

Since 2013, government procurement of produce in Bihar has been through PACS. PACS have gradually been picking up speed in terms of membership as well as commodity turnover. However, field interactions have revealed that the landless farmers and sharecroppers are unable to produce a land possession certificate which is an eligibility criterion for government procurement. Another problem is the high moisture content of farmer produce for which traders pay farmers less. Poor quality of produce is also the reason for the low interest shown by private players in direct purchasing. But, in states with government interference, solutions have been encouraged. For instance, in Punjab, the marketing board has set up maize dryers in order to comply with MSP standards.[9]

Poor market infrastructure, lack of storage and processing units and absence of supporting auxiliary units were some of the main reasons for weak supply and value chains across the three basins. Small holdings, low quantity and quality of produce restrict the scope for private investment in the region.

Box 6: Credit for Women in Pakistan

Quite often female farmers face difficulty in getting loans sanctioned because in most cases land is the name of the male head of the family.

Interviews with farmers in Rahimyar Khan, Pakistan revealed that if the land owner is a female, the bank will demand the pass book of the male representative of the family to be on the safer side, so that the loan can be easily recovered from her family.

Farmers, if organised either as producer companies or as cooperatives and linked with service providers and markets can make a difference in this setup. Data trends in the study reveal a similar situation exists in countries like Pakistan, Nepal, Bhutan and Bangladesh where agricultural products are not competitive enough in the international market. The need for producing good quality agricultural commodities and strengthening regional value chains was highlighted in KIIs conducted in these countries. There is a huge market potential within South Asia and strengthening of agricultural value chains would facilitate trade within the region. This necessitates elimination of non-tariff trade barriers, harmonisation of standards and better regional connectivity, including improvements in infrastructure.

Given that the survey has clearly indicated that cross-border trade is prevalent in agricultural produce and harvest, it is pertinent to discuss local solutions like Border *haats*[10] to promote market access. For farmers, dwelling near the international border areas of India and Bangladesh market access is a serious problem.

Though there is a demand on each side of border, political boundaries hinder any formal business. In such areas, border *haats* have shown a lot of promise towards economic development of border communities building trust and formalising trade. Visits to border *haats* have provided an understanding of the volume of trade and increased demand from both sides of the border for more *haats*, commodities and open *haat* days to enhance trade and strengthen the regional value chain.

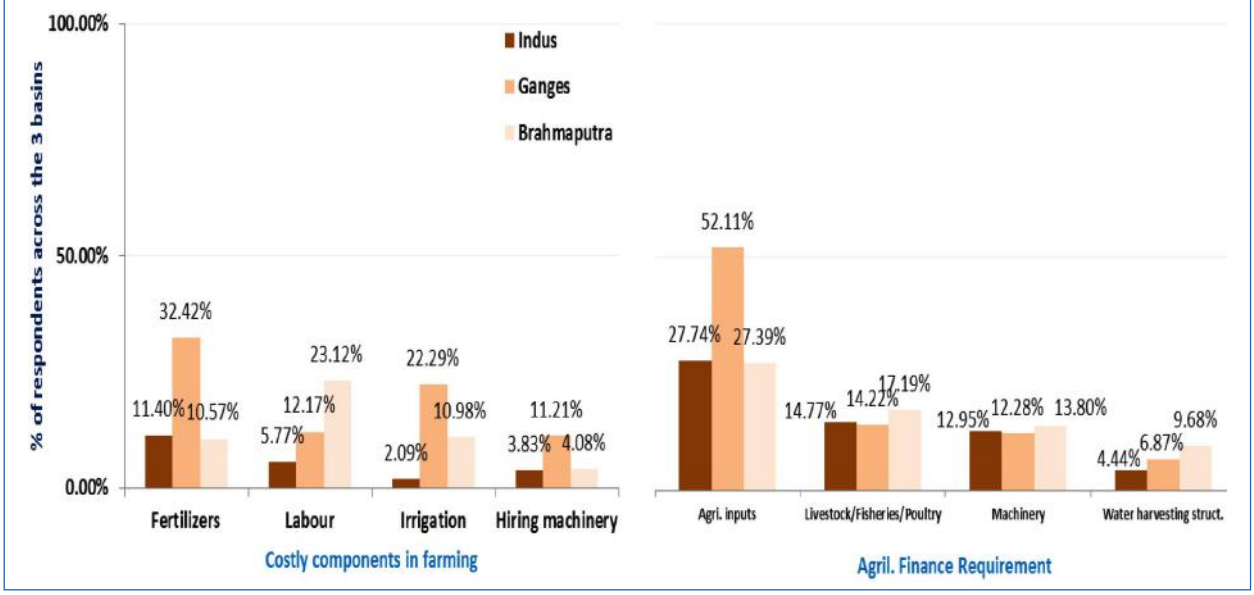
Box 7: Zimidara Farm Solutions

Zimidara Farm Solutions is a new venture in Punjab, which provides machinery banks (at Patiala and Muktsar) and extension services in collaboration with Department of Agriculture, Punjab and Punjab Agricultural University, which has shown remarkable results in 10-20 villages. "There is a registered change in farmer practices; they do not burn paddy straw, they have sold their machinery and use custom hiring", said an official in Department of Agriculture, Punjab. Such initiatives can reduce the cost of cultivation; lessen the burden of loan and interest while purchasing machineries and increase yields.

Access to Credit and Other Services

The survey results indicate that farmers avail credit mostly for purchasing agricultural inputs during the cropping season. Figure 43 illustrates the top responses received for the costliest components of farming and the component for which agricultural finance is taken for. Of these, higher responses were observed with regard to agricultural inputs across the three basins; the maximum value being noted in the Ganges basin (52.11 per cent). Thus, if we look at the economics of cultivation, it was found that fertilisers and irrigation cost more in the Ganges basin whereas labour was the expensive input in Brahmaputra basin. The low cost of irrigation in the Indus basin can be attributed to the free electricity in Punjab, India.

Figure 43: Costly Components and Credit Requirements



Box 8: Extension Service Centres in Nepal

In Nepal, NGOs basically provide extension services to the vegetable farming, not food crop farming. Another case is that in recent times, there were a number of extension service centres in some districts. But, during armed conflict, they were all brought and absorbed into the main district offices. Even now when the conflicts have subsided, the extension centres have yet not been re-established.

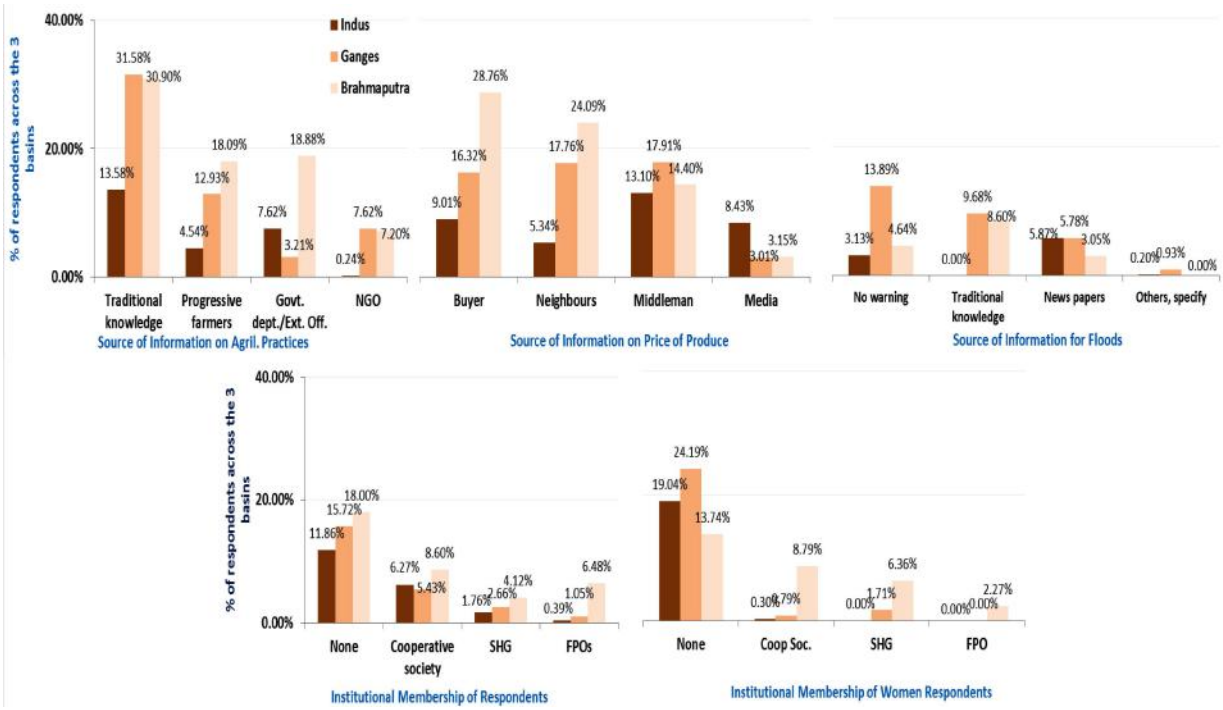
Family/relatives and local moneylenders constituted the source of credit of small and marginal farmers as evident from the Table 24. Getting credit from banks was cited as the most important challenge by farmers in Assam. In Punjab, farmers rely on multiple sources of credit at the same time. Thus, if the farmer repays a money lender, he is unable to pay the bank, which causes non-performing asset[11] in his name and cuts off his subsidy at his accounts in the nationalised banks. Non-productive use of loans to meet social obligations is also a common phenomenon in Punjab.

The use of agricultural machinery in farming is quite popular in Punjab. Costly machineries are available on rental basis and there are also agro-machinery service centres. Size of farm holding, high cost of machineries, lack of technical expertise of farmers and absence of service centres are the main hindrances for mechanisation in the Eastern Gangetic and Brahmaputra basin. Creation of machine banks by private firms was found to be successful in Punjab and can be replicated in other parts of the region.

Institution and Services

With regard to the source of information about agricultural practices, the figure above indicates that across the three basins, farmers mostly depend on traditional knowledge with a higher proportion of responses being recorded in Ganges and Brahmaputra basins. The role of extension officers in knowledge dissemination was found high in Brahmaputra basin, followed by Indus (Figure 44).

Figure 44: Successful Institutions and Services Provided by them



Extension services in Ganges basin was reported to be poor by farmers even during interviews. Information about the price of produce was mostly obtained from neighbours in Brahmaputra basin, whereas in Ganges and Indus farmers mostly depended on middle-men.

Traditional knowledge emerged as the main source of warning about the occurrence of floods in the flood prone areas of Ganges and Brahmaputra basin, followed by newspapers. But in Indus basin, newspapers were found to be the important source of information. The figure also displays the most common type of institutions across the basins; higher responses were recorded with cooperative societies followed by SHGs in the three basins with Brahmaputra basin leading. The female responses also confirm that cooperative societies are most common in Brahmaputra basin followed by SHGs. Compared to the overall sample; very few female responses in Indus basin confirmed their membership in any kind of institutions.

The study reveals that fertilisers are the costliest component in South Asian agriculture wherein private sector has a dominant share in market. There is imbalance in use of fertilisers across the basins owing to skewed fertiliser prices. Also, there is a great demand for timely supply of quality inputs including seeds and fertilisers. This calls for a relook into the current fertiliser policies in South Asian countries, in general and India, in particular because there is illegal trade of subsidised fertilisers from India to neighbouring countries. Both forward and backward linkages are crucial for a farmer to enter into profitable business; in this sense, it is important to reform market and strengthen institutional capacities of small and marginal farmers by organising them as Farmer Producer Organisations or Companies. Often, low quality produce is the reason for the non- interest shown by private players in direct procurement. Hence farmers are to be sensitised to ensure the quality of produce to meet the national and international standards which would foster the regional agricultural value chain. Emphasis should also be laid on improving market infrastructure and connectivity.

Box 9: Farmer Producer Organisations

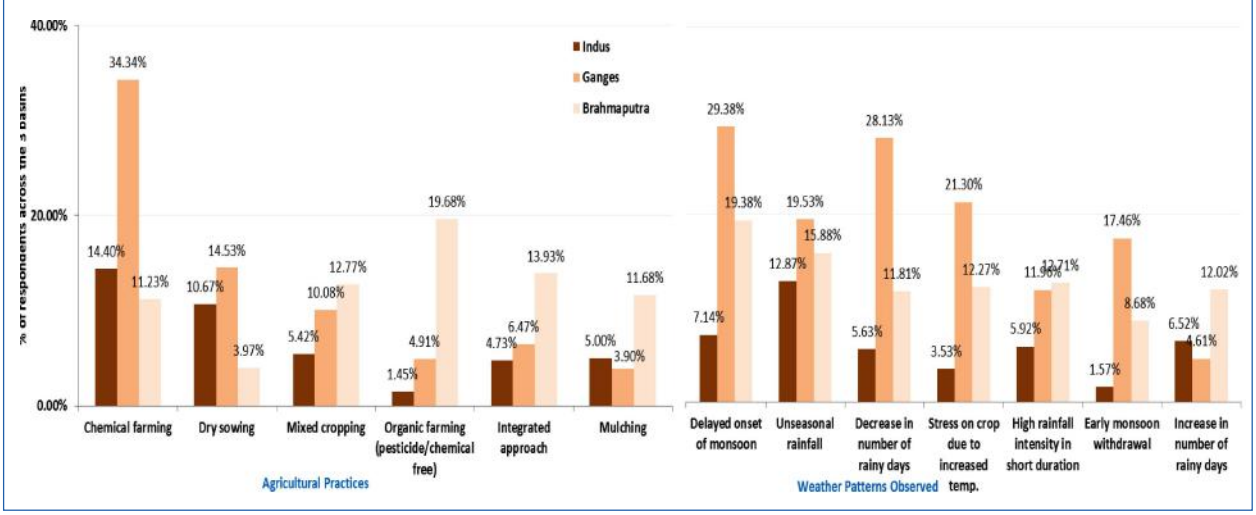
In India, there is a policy provision where farmers can organise and register themselves as Farmer Producer Companies/Organisations (FPOs). The "Small Farmers Agribusiness Consortium (SFAC) has been constituted with the objective of building efficient linkages between the producers and the consumers for expanding employment opportunities and increasing the rural income through better marketing of agricultural products. Under this, the FPOs are linked to technology as well as to the markets in association with private, corporate or cooperative sector and if necessary, by providing backward and forward linkages. As of now 570 FPOs are registered in India.

As part of the perception study, CUTS interviewed FPOs in the states of Bihar, Uttar Pradesh, West Bengal and Assam. The interviews revealed that most of the registered FPOs are still lagging behind in terms of institutional capacity, access to credit and services. The Resource Institutions that have facilitated the formation of FPOs backed out after the creation of FPOs as they have support from the government only for a period of two years. The FPO representatives and the Resource Institution opined that they need hand holding support for at least five years. Further, women representation is not mandatory on the board of directors of FPOs. But to avail the benefit of the Equity Grant Fund,[12] at least one women board member is mandatory. Many of FPOs have no female members on their board of directors. Only a few FPOs with entrepreneurial skills have developed business models. Most of the FPOs are not benefitting from government schemes[13].

Climate Change and Adaptation

The Indus-Ganges-Brahmaputra river basin is the most productive belt of South Asia and contributes significantly to the region's food security. The survey results show that this particular area is also vulnerable to climate change, increased incidences of unseasonal rainfall, variation in monsoon pattern (delay in the onset, early withdrawal and change in the number of rainy days), heat stress and frost have been observed in varying degrees across the three basins. Figure 45 shows the widely observed forms of climate vagaries and prominent agricultural practices followed by the respondents across the basins. Though chemical farming is a prominent practise across all the basins, it was not considered by farmers in the context of climate change. The discussion among farmers was composed of direct interventions in the agricultural practices which help to combat climate change.

Figure 45: Prominent Weather Patterns and Agricultural Practices



It can be seen that delays in the onset of monsoon was the most widely observed climate variability over the last three years with higher responses from Ganges basin (29.38 per cent), followed by Brahmaputra (19.38 per cent). The Ganges basin was found to be most vulnerable to climate change as higher responses related to early withdrawal of monsoon, heat stress and decrease in number of rainy days was recorded. High intensity short duration rainfall and increase in number of rainy days was found in higher proportion in Brahmaputra basin whereas the Indus basin received maximum responses in relation to unseasonal rainfall.

Box 10: Erratic Rainfall in Pakistan

"*Unseasonal rainfall during the harvest season of wheat costs too much.*"

- Khalid Mehmood Khan
Vice President Kisan Welfare, Ittehad, Mianwali district, Pakistan

The KIIs conducted as part of the study also support the survey findings. In response to delays in the onset of monsoons and decrease in number of rainy days farmers in Uttar Pradesh (India) are demanding short duration/drought tolerant seed varieties. Ironically, the farmers in Brahmaputra basin faced both floods and droughts. In light of this, it is inevitable to increase the adaptive capacity of farmers and build their resilience through climate smart agricultural practices and resource conservation supported with adequate policies so as to secure their incomes.

Figure 45 also displays prevalent agricultural practices across the basins. A challenge found was that the majority of these practices, for example, mulching, integrated approach, and mix cropping, might not be equipped to adapt to the threatening climatic trends found in the survey and KIIs. Sustainable agriculture practices, such as direct seeding of rice, cultivation of drought tolerant varieties, zero tilling of wheat and double transplanting of rice (*Sanda* method) was found as an excellent solution to the challenges arising from delayed monsoon in the Eastern Gangetic plain (Singh and Singh 2013).

Certain areas did, however, receive higher responses of more sustainable practices, such as the Ganges basin with regard to dry sowing. Maximum responses related to mixed cropping was noted in Brahmaputra basin, which is in agreement with the widely accepted fact that mixed cropping is mostly associated with subsistence farming. Similarly, chemical free farming was practised by 19.68 per cent of the total sample size in Brahmaputra basin (mainly attributed to Bhutan) as against 1.45 per cent in the Indus basin.

These findings indicate that most of the small farm holdings covered under the survey is not following sustainable agricultural practices to address the challenging weather patterns also observed by respondents. It was also found that local NGOs like NEFORD, RGVN and SNV play a significant role in the cases where there was adoption of sustainable practices. The need for strengthening extension services by government functionaries to create awareness and technology dissemination was emphasised by farmers in the Ganges and Brahmaputra basins.

Box 11: Metering of Irrigation in Bangladesh

The irrigation project of Barind Multipurpose Development Authority (BMDA) at Godagari Upazila of Rajshahi district has an innovative metering system for pumping of irrigation water. The authority reserve the river water in a canal and the farmers take the water as per their requirement by using a prepaid card with this prepaid meter. After the specific time of the farmer, the machine gets shut down automatically.

Pre-paid Water Meter at Barind Multipurpose Development Authority (BMDA), Rajshahi
PC: US, Bangladesh

Water Access & Availability

Figure 46 given below shows the scenario of on farm water availability across the basins. It can be seen that higher responses for water scarcity for a period of three months was observed in Brahmaputra basin followed by Ganges and Indus basins, respectively, but responses for water shortage for three-nine months was found to be higher in Ganges basin followed by Brahmaputra and Indus. Severe water deficit for more than months was noted in Ganges and Indus basin with limited responses. Among the irrigation practices, flood irrigation and canal irrigation dominated in Ganges and Indus basins while in Brahmaputra, canal irrigation and lift irrigation was found popular. Furrow irrigation and sub-surface irrigation were also practised in Ganges basin as displayed in Figure 46.

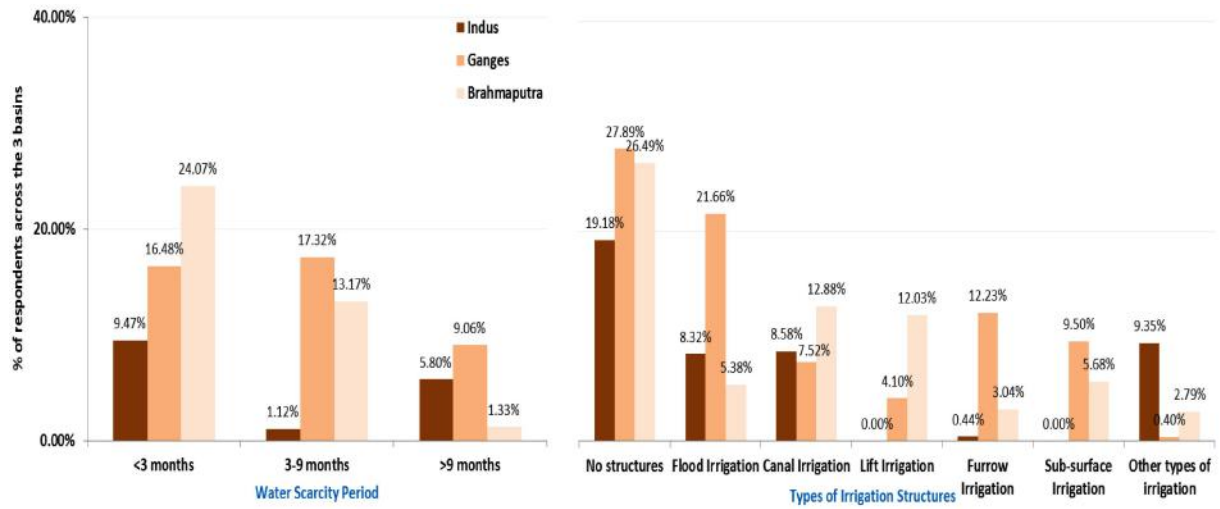
Box 12: Paddy distress in Punjab

"Paddy is main culprit in Punjab for distressing water resources"

"The first, second and third challenge for agriculture in Punjab is water" – Officials, Dept. of Agril., Punjab

The data on water availability shows that Ganges and Brahmaputra basin experiences water scarcity on farm for short to medium duration of 0-3 months. There is a lot of wastage in flood irrigation, which is the common practice in Ganges belt. This means that proper water management and need based application of water can prolong the water availability in this basin. The data on water conservation structures reveal that not much significance is given for water conservation in three basins. Lift irrigation is mostly done from water bodies like rivers and ponds in Brahmaputra basin. Drying of these water bodies could be the reason for extended water scarcity in the Brahmaputra basin.

Figure 46: Water Access and Availability



Known for its well-developed canal system of irrigation, Indus basin is the most productive region of South Asia. Rice and wheat are the chief crops grown in this region, which plays a key role in determining region's food security. The region also experiences severe depletion of ground water resources owing to the cultivation of water intensive crops. The survey data (Figure 11) reveals that water logging and declining soil fertility are the major soil problems faced by the farmers in the Indus basin.

Owing to the poor efficiency and improper maintenance of canal irrigation system, ground water resources have become the common source for irrigation. New technologies like laser levelling, tensiometers, irrigation scheduling and micro irrigation saves water and may be helpful in long run in increasing the ground water-level. The enactment of Punjab Preservation of Subsoil Water Act

Box 13: Case of Chure Destruction in Nepal

The Chure mountain range, one of the youngest and most vulnerable ranges situated between the middle hills and the *Terai* of Nepal, has been greatly affected by the prospect of trade between Nepal and India. One of the main causes for destruction of the Chure is the mining of sand, stone and gravel in the region, mainly for export to India.

The main challenges faced by the people are devastation being caused in the Chure, regular floods in Kamala and its tributaries, use of high amount of chemicals in the farm land and deposition of garbage in the rivers. Due to the young age of the mountains and the steep slopes, the conglomerates and sandstones that make up the region are easily erodible; and the rivers originating in Chure carry high volume of silt. This could have had significantly affected, among others, water resources in Nepal and also India, because as water flows from the higher belt in Nepal to the lower belt in India, effects on water resources in Nepal could have an impact on water resources also in India.

2009 has provided for prohibition of sowing nursery of paddy and transplanting paddy before the notified dates in the state.[14] This also has resulted in saving of water and electricity, which would otherwise have been used for nursery preparation and transplanting of paddy in the peak summer month of May.

More or less similar cropping pattern exists in the district of Rahimyar Khan, Pakistan where farmers have shifted from growing cotton and wheat towards water intensive crops like sugarcane and rice. Here also, lack of proper maintenance of the canal system has led to unsatisfactory service and there is no inter-provincial consensus on development strategy over the equitable distribution of water. Consequently, ground water exploitation has happened in this part of the basin as well.

Field interactions reveal that cultivation of water guzzling crops is a trend even in Ganges basin. Apart from the traditionally irrigated crops like rice and wheat, crops like mint and banana are becoming popular in eastern Uttar Pradesh. Though canal water is supplied free of cost in the state of Uttar Pradesh there is increasing dependency on ground water source for irrigation especially during summers. In addition to this, unreliable power supply and relatively high tariff has made diesel pumpsets popular.

Box 14: Case of PES in Bhutan

SNV, Bhutan has established a Payment for Environmental Services (PES) on protecting the drinking water source for four companies and other water users in Pasakha area under Sampheling geog of Chukha Dzongkhag in Bhutan. The environmental service (ES) is the protection of the drinking water source at Devithan at the bottom of Burkhey village. The ES providers are the Burkhey Community Forest Management Group (CFMG) consisting of 25 households from Burkhey village. The ES buyers are the 4 companies (Tashi Beverages Ltd. – Coca Cola, Bhutan Board Products Ltd, Druk Cement, and Majur Oxygen and Gases) and 2 private water users.

The focus of the project is catchment protection for a water source that 4 major companies rely on, including a number of other water users.

Irrigation facilities in Brahmaputra basin is poor compared to Ganges and Indus. In Bhutan, there is little possibility of development of large irrigation schemes due to the geographical conditions. Only two large-scale systems have been developed by the Government in recent years: the Taklai Irrigation scheme[15] and the Gaylegphug Lift Irrigation scheme[16]. The Taklai irrigation system was devastated by flash floods during 2010 was rebuilt and inaugurated on April 2015 with Japanese aid. Dongs, are the traditional canals in Bhutan originating from the hills and flowing down to the plains. This system was relied upon heavily during earlier days but now many of the Dongs are unsuitable or

blocked. Dong users' associations are also almost defunct bodies. Though this basin experiences flash floods quite often there is water scarcity during winter and summer months.

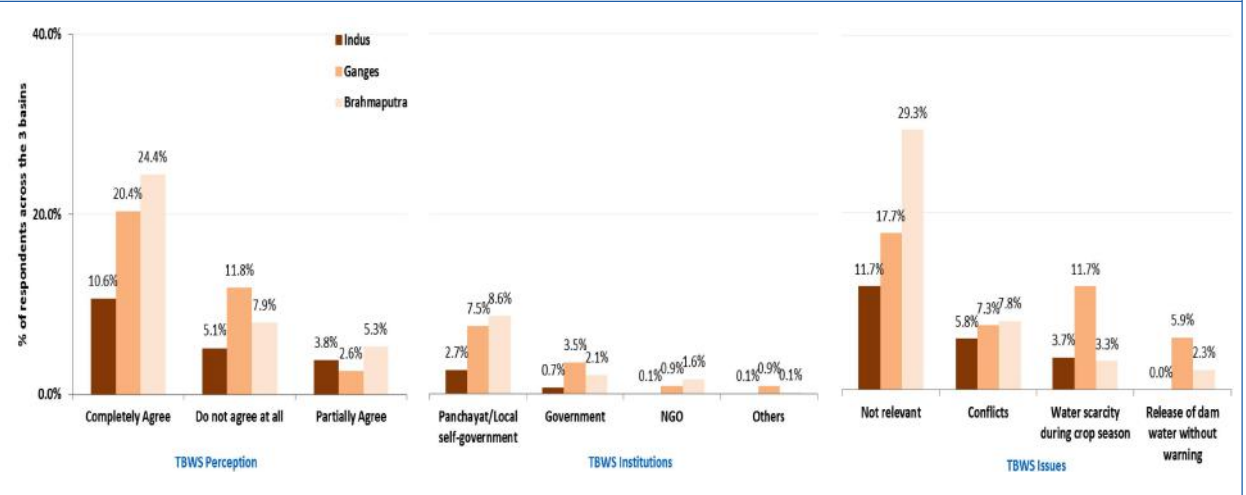
Apart from crop diversification and new technologies of irrigation water harvesting and ground water recharge are the other practical solution to this crisis. Water experts in Punjab say that there is a possibility that deep water aquifers can be recharged from elsewhere like the Himalayas. It should be kept in mind that aquifers may be linked and severe depletion on one part will affect the availability on the other side. Poor quality of ground water also makes it unfit for drinking. While indiscriminate use of fertilisers and pesticides has been the reason for ground water pollution in the Indus basin, arsenic and iron toxicity is found in the Eastern Gangetic Plain and Brahmaputra basin, which is attributed to industries in the upper riparian side. The presence of iron and other metal in ground water in Koshi region has also been the cause of skin diseases and other ailments among the villagers.

Transboundary Water Concerns

Figure 47 exhibits the perceptions of respondents on transboundary water sharing (TBWS) and issues related to it. The data indicates that higher proportion of respondents of the total sample size completely agree with sharing water. The survey results in Figure 28 shows that the respondents lower riparian countries completely agree with water sharing irrespective of the basin. The negative responses with respect to water sharing were observed in Punjab (Indus basin upper riparian), West Bengal (Ganges and Brahmaputra upper basin) and Assam (Brahmaputra upper basin). Except some responses in Uttar Pradesh, Bangladesh and Bhutan where complaints regarding water sharing across boundaries were raised at the level of local governments and *panchayats*, mostly respondents refrained from raising issues in any forum or meeting. In very few cases these concerns were raised at government-level that too in Ganges (Uttar Pradesh, Nepal and Bihar) and Brahmaputra basins (Assam and Bhutan).

Limited instances of conflicts were reported mostly in Brahmaputra (Bhutan Assam and West Bengal) followed by Ganges (Uttar Pradesh Nepal and Bihar) and Indus basin (Punjab). Water scarcity during crop season was the most widely observed effect of water sharing with highest responses in Ganges basin (Murshidabad in West Bengal and Chappai nawabganj and Rajshahi in Bangladesh). The downstream effects of the Ganges water diversion include reduced surface water and ground water and agricultural loss as reported by Khan (1996). Discussion with farmers in Chapai Nawabganj (Bangladesh) also confirmed this. Issues related to releasing water without warning was found in the lower riparian locations of Ganges (Bihar and Bangladesh) and

Figure 47: Status of Trans-boundary Water Sharing



Box 15: Farmer's Views on Ganges Water Treaty

Md. Humayun Ali (54) is a farmer of Tahirpur village of Shibgonj Upazila, which is situated in Chapainawabganj district in Bangladesh. Generally, rice, wheat, corn, jute, maskalai (black gram) etc. are the prime agricultural products of this area. Among these, rice production needs the largest amount of water. According to him, prior to 1990 and signing of the Ganges Water Treaty in 1996, he got necessary water from either river or shallow tube well for cultivating agricultural crops. But he claims that the availability of water has decreased in comparison with the past as the river Padma is getting sediment gradually. In addition to his opinions about the treaty, he also confirms that he is thinking of alternative professions to agriculture as it is getting more expensive gradually due to the shortage of water.

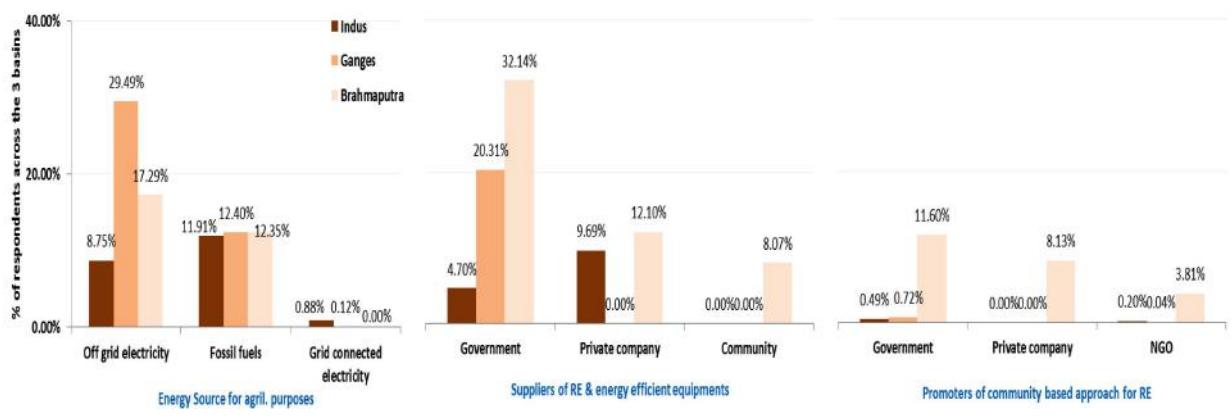
Brahmaputra (Assam). Floods in Koshi river have caused mistrust between Nepal and Bihar, India. The dam in Kurichuriver in Bhutan constructed for power production has increased the vulnerability to Lower Assam, especially the Baksa district. Water released from the dam gushes down the plains of Assam and causes floods in Lower Assam. Every year, lives are lost and thousands of hectares of arable land destroyed.

In the Ganges-Brahmaputra River basin (Bangladesh, Bhutan, China, India and Nepal), the Zangmu Dam in Tibet, a run-of-the-river facility slated for completion in 2015, as well as the recent approval of three more Brahmaputra dams as part of China's 12th Five Year Plan, are raising concerns over downstream effects in India and Bangladesh (WWAP 2014). Interaction with farmers in Baksa district revealed that as irrigation system is very poor villagers have to go every week to the nearest state Bhutan for bringing water for their paddy fields but sometimes Bhutan does not allow for taking water from them. The field interactions reveal that canals and waterways, originating in Bhutan, should be preserved and re-activated by both the countries – India and Bhutan – as they bring benefits to both.

Addressing Energy Issues

Energy crisis in South Asia has been a persistent crisis; all South Asian countries are facing social and political pressure to make energy accessible to all at affordable prices. The demand has been mounting to meet the requirements for domestic, industrial and agricultural purposes. The survey results have shown that for domestic purposes respondents mostly relied on grid connected electricity whereas for agricultural purposes, use of fossil fuels dominated in South Asia. Figure 48 below shows that Ganges and Brahmaputra basins largely depend on fossil fuels for agricultural purposes.

Figure 48: Status of Renewable Energy



Proportion of respondents using grid electricity was more or less equal in all the basins (ranged from 11.91 per cent to 12.4 per cent); but the data in Figure 32 indicated that Indus basin was ahead of other basins in this respect (98. 92 per cent of respondents in Punjab and Pakistan 55 per cent in Pakistan). The smaller sample size in Indus basin might have accounted for at par usage with other basins in the figure below. Higher response in Punjab is attributed to heavily subsidised electricity in the state.

Higher power subsidies in Punjab have led to overconsumption of water, resulting in reduction of underground water reserves, which in turn necessitates the use of higher capacity pump set consuming more power. It is believed that introduction of metering and charging of electricity system can motivate farmers to use water and electricity efficiently (Bala 2015)[17]. Withdrawal of populist policy of free electricity is politically challenging but restricting the subsidy to small and marginal farmers, optimising the subsidy based on irrigation requirement, metering and incentivising lower consumption are some options, which can be resorted to.

Unreliable power supply and higher tariffs in the Ganges and Brahmaputra basins have paved way for the popularisation of diesel pumpsets. Recently, the state governments in India have started promoting solar irrigation pumpsets supported with subsidies but higher cost is a major constraint for marginal farmer. Subsidising energy in the form of fossil fuels in Bangladesh has benefited smallholder farmers without over-exploiting water resources unlike the energy subsidies in the form of cheap electricity in the drier parts of India. In fact, this has enabled the development of market for cheap efficient pumpsets for small farmers (WWAP, 2014).

Insufficient generation is the prime reason for energy starvation in South Asia. Inefficiencies in transmission and distribution, limited private participation and lack of regional cooperation have also worsened the situation. Though grid connection exists between India-Nepal, India-Bangladesh and India-Bhutan, Pakistan is out of the frame. Grid connectivity with Pakistan would benefit both the countries. At the same time, there is also a need to explore other renewable sources of energy like mini hydro, solar, wind and biogas. Figure 48 shows that renewable energy initiative is much more prevalent in Brahmaputra basin. As per the survey responses, private sector is the major supplier in Brahmaputra followed by Indus basin.

The private sector is more involved in selling electricity appliances. Considerable responses on community based initiatives facilitated by Government and private sector was observed in Brahmaputra basin. NGOs are more involved in raising awareness and promoting the replacement of firewood by alternative energy sources, electricity, and improved traditional cooking stoves.

Field level interactions in Nepal and Assam have revealed that local people wait for the support of International NGOs to have solar equipment offered at lower prices or even freely, or are ready to wait for years for grid connection by government. In such cases, private players find it difficult to generate a market for their products. There is also a need to develop proper value chains for renewable source of energy.

Often, after delivery services are not available in case of solar products. According to former representatives of local bodies in Nepal, the government offers an opportunity for individual entrepreneurs and community user groups to buy electricity in bulk from the Nepal Electricity Authority and manage the distribution through a community entity.

With respect to solar based energy solutions, India has comparative advantage in the region and there is great scope for regional cooperation in terms of technology and trade. Lack of adequate power supply has limited industrialisation in eastern South Asia. Illegal connections, power theft and low voltage during peak hours are also quite common. Many villages in India near Bhutan border are not electrified till date and people go to neighbouring villages to charge their torch, cell phones etc. by paying some amount. It was also noticed that there is a widespread dissent towards large hydro projects in North-East India owing to environmental concerns however people welcome small and mini hydro projects.

Being the largest country in the region with vast resources, India can initiate the trust building processes between the South Asian countries. Tapping the hydropower potential of Nepal and Bhutan and marketing electricity as a tradable commodity, would change the energy scarce scenario in South Asia. Lack of data on water sharing and financial outlays for developing infrastructure has hindered cross border energy trade. Political differences among the countries and populist policies for political gains have adversely affected real time investment. The recent SAARC agreement on energy cooperation (2015) is a major leap in this direction. It is also essential to bring private players on board and convincing that there is no risk in investment. Regional agencies like SAFIR or SAARC Energy Centre could be assigned with new mandates, additional resources and influence. All countries covered in the study are endowed with significant amount of renewable resources, which is yet to be tapped. There is potential synergy between the countries, where India is manufacturer of the technology and other countries offer a potential market. Moreover, countries especially India, Nepal and Bangladesh, have significant experience in RE business models, which makes a case for cross-country learning for better and faster deployment of RE.

Mainstreaming Gender

Figure 49 given below shows the occupation and activities in which women are mostly engaged. Across the three basins, it can be seen that women are mostly engaged in household work. With regard to farming in own land, Brahmaputra basin recorded higher responses followed by Ganges and Indus. Limited responses were also noted in Brahmaputra and Ganges basins where women worked as agricultural labour. Apart from household work farming women were also engaged in collecting forest produce; higher responses in this regard were observed in Ganges followed by Brahmaputra and Indus.

Brahmaputra basin recorded higher responses followed by Ganges basin wherein women were responsible for taking the produce to market. Very few responses were noted in Indus basin in this regard. Across the basins, it was also found that cleaning was the major activity related to post harvest management in which women were involved, higher responses being recorded in Brahmaputra followed by Ganges and Indus. Women were also involved in processing, milling, grading, packaging and labelling mainly in Brahmaputra and Ganges basin but little responses were observed in Indus basin regarding this. Women in Indus basin are not involved in post-harvest management due to cultural restrictions as was evident in Pakistan and Punjab. Gender inclusion in agriculture of Punjab

Figure 49: Occupation and Other Main Activities by Women

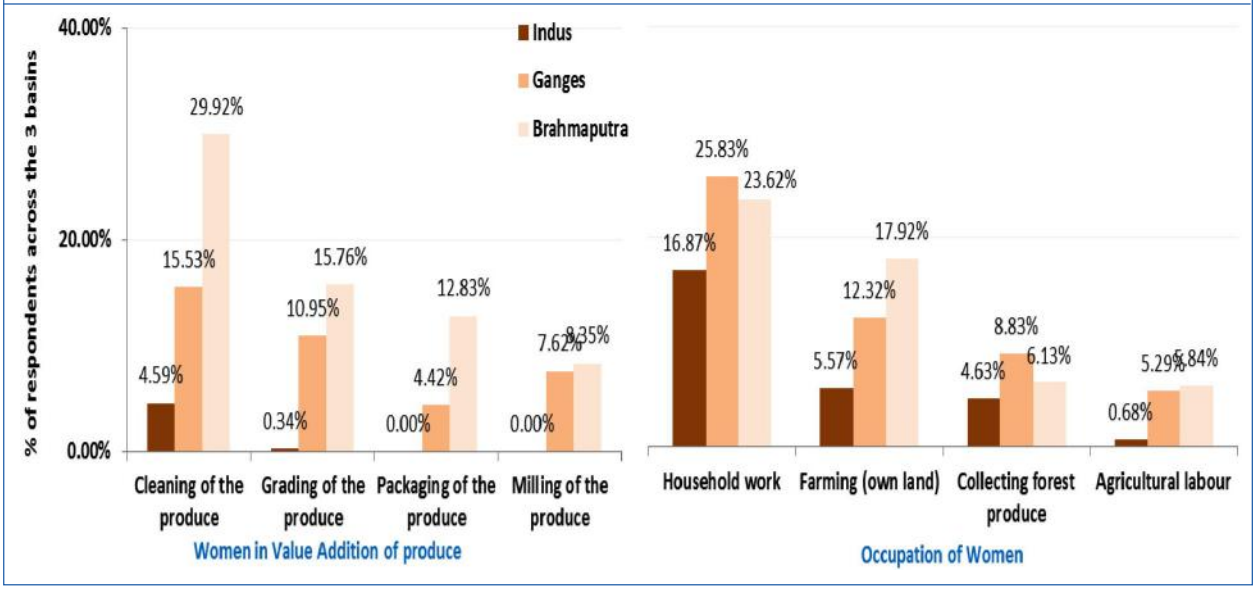


Figure 50: Factors Influencing Decision Making among Women

is negligible because most of the operations are mechanised including sowing, transplanting and harvesting which eliminates much participation of women.

With respect to land ownership of women, Brahmaputra basin recorded maximum responses (5.08 per cent) followed by Ganges (3.2 per cent). The sample population in Assam comprised of tribal community which are matriarchal in nature. The data from Assam and Bhutan attributed the higher responses in Brahmaputra basin. Similar trend was noticed in case of joint ownership. Regarding the source of loan, the category of friends followed by families and relatives dominated in the Ganges basin whereas in the Brahmaputra basin, nationalised bank (Bhutan and Assam) and NGOs (Bangladesh) were found to be the main sources of loan. Very few responses in Indus basin availed loan from nationalised bank (0.63 per cent) followed by family/relatives (0.36 per cent).

The results in Figure 50 also indicate that the females in Brahmaputra basin had a significant role in decision making followed by Ganges and Indus basins whether it is about deciding the crop to be grown, inputs, area of allocation, and adoption of irrigation practices.

Interestingly, considerable proportion of respondents in Ganges (20.66 per cent), Indus (11.12 per cent) and Brahmaputra (9.93 per cent) also reported to have no role in decision making. However, in Ganges basin of Nepal, women played role in other decision making like deciding how much of the produce to be sold to middlemen/trader. This has to be seen with an angle of household food security. As in Nepal farming is mostly at subsistence level and they sell produce after meeting their household requirements. In this context, women decide how much to be sold and how much to be kept for household purposes.

It was also revealed that women's participation is increasing in social activities. They are seen participating in cooperatives, forest user groups, self-help groups etc. The respondents argued that female participation was more effective than male participation in such organisations. In particular,

Box 16: Women Farmers of Assam

Survey locations in Assam were dominated with tribal population of Bodos and Rabhas in which women are very active in agriculture but they are also worst affected. *"We do all the farming activities except ploughing"* says a female farmer in Assam. Women in this area also own assets such as domestic animals, particularly cows, goats and pigs. In the absence of fodder it becomes very difficult to raise animals. This affects the livelihood of women in the area. Since the villages are not electrified, women also face the problem of movement in dark. Bus stops are unlit and there are no street lights affecting the safe movement of women. The district also faces a great problem of trafficking of the girl child. It is envisaged that provision of basic facilities and infrastructure can prevent such undesired movement.

Box 17: Decision Making of Women in Nepal

Women actually carry out the day-to-day household chores, while male members work the fields. However, with an increasing absence of males from a significant number of households in the lower basin due to migration women are being compelled to take their place, conducting almost all farmland activities in the as well. Yet, it is important to note that women are not consulted or invited while taking critical decisions among the *Madheshi* community in the lower parts of the basin. But, women's participation in decision making is high among the *Majhi* community. This is an example where social and cultural differences decide women's role in a society.

– Krishna Hari Ghimire, Civil Society Leader, Sindhuli, (Nepal)

decision of cooperatives to make investment and lend to farmers have been proved to be better and moe appropriate when female members are involved in making such decisions.

Considering the increasing role of women in agriculture, there is a need to mainstream gender in policies. As pointed out in the survey, women still do not have access to technology, training, credit and other services while farming is mostly done by them. Women are mainly responsible for food and nutritional security of the households; as such the concept of diversified farming by including crops of nutritional value and allied enterprises of livestock, poultry would work well with them. Building institutional capacity, developing gender friendly technologies and machineries, developing entrepreneur skills, providing credit without collaterals, all would reinforce their social and economic status in the society.

Recommendations

The survey has provided key learnings in the domain of agriculture, water and energy for the Indus-Ganges-Brahmaputra basins. The key findings are an indication that data trends combined with field insights will provide solutions for countering issues related to the domains. Based on the previous chapters, an attempt was done to conclude the essence of the findings and create a space for policy discussions and deliberations. These have been enumerated in the following sections.

a) Agriculture

1. Climate resilient agricultural practices need to be promoted in each state/ province/ location to build resilience of the farming community. Several programs have been initiated by agriculture departments, NGOs and universities to address this. Nevertheless, this has been a fragmented approach with a lack of convergence/ coordination among line departments, populist policies and bureaucratic hurdles that have hindered realisation of sustainable agriculture outcomes. **Hence, it is important to scale up successful and sustainable practices suited to each agro-climatic situation. This could be done by means of pilot demonstrations under various flagship programmes and schemes.**
2. Extension services rendered by the government departments play a significant role in creating awareness about new technologies and practices. However, across the basin, it was found that there is a need to strengthen extension services, since government bodies are the only players. Majority of the gaps in extension services calls for qualitative commitment from government officials. Since government extension functionaries have a wider outreach, **capacity building and retention of extension staff on resource efficient technologies and practices is essential so that they can deliver better outputs at field level. Further, local NGOs were found to have an important role in promoting good agricultural practices at local level, which could be used as a resource for improving government extension services.**

3. Private sector has a bulk share in the seed and fertiliser industry. Hybrids and HYV are becoming increasingly popular with farmers given the context of climate change impacts. There is also a demand for stress tolerant (drought/heat/saline/flood tolerant) and short duration varieties. Hence, relevant government and private seed associations should **popularise the use of stress tolerant varieties through schemes and ensure timely supply of stress tolerant varieties.**
4. Fertiliser use is often influenced by decades-old government policies. Heavily subsidised fertilisers/cheap fertilisers are used indiscriminately irrespective of the nutrient status of the soil. The recommended dose of fertilisers is not being applied to save cost – resulting in imbalanced nutrition. Nitrogenous fertilisers are widely used across the basins with little attention to potassium. Fertiliser application should be based on soil test analysis. The use of **soil health cards should be popularised**. There is also a need to **reorient incentives under the current fertiliser policy in India towards more balanced use of fertilisers.**
5. Market infrastructure, connectivity and access are crucial for the farmers to realise better prices for their produce. Assured markets influence the cropping pattern of a region. For instance, in Indian context, market-based incentives include the Minimum Support Prices and government aided procurement. **This kind of support if extended to hardy/ climate resilient crops would enable diversification in cropping patterns and procurement.**
6. In a government regulated market system, such as in India, direct purchase/contract farming would eliminate middlemen. Such mechanisms would succeed if a value chain for the crop processing is established. **Polices should also focus on increasing private investment in market development and agro processing units. State should reform the current regulatory regime to invite private participation and attract investments.**
7. It is also important to develop the institutional capacity of farmers and strengthen linkages between service providers, market players and farmers through collaborative structures. **FPOs and cooperatives SHGs are the successful models that could be piloted and expanded across the three basins.**
8. Trade operations at border points would facilitate cross-border agricultural input-output trade and improvement in the local economy. **Reducing non-tariff trade barriers would promote regional value chains and boost the regional economy. Promoting cross border regional trade with multiple mode of transport would improve regional connectivity and ensure a steady flow of income for the farmers and other stakeholders like seed and agro-commodity traders.**

b) Water

1. Poor maintenance of surface/canal irrigation systems have resulted in increasing use of ground water resources. Farmers in the head end divert water from canal leaving the tail end farmers deprived of water. The irregularities in the supply and volume of water available in canals have led to over dependence on ground water. Cost recovery mechanisms like metering and pricing would enable proper maintenance of the canal systems and would also lead to more judicious use of water. Hence, **revival of canal irrigation systems** through investment, maintenance and reinforcing, the Water User Associations would reduce the dependency on ground water.
2. Traditional systems of irrigation like dongs are suitable to local topography and require minimal capital for maintenance and upkeep. Given that, these systems are currently declining and not functioning properly, **traditional systems like Dongs need to be revived** in Brahmaputra basin Bhutan and Assam.
3. Irrigation water efficiency can be achieved by improvement in related practices on the farms. Popularising **technological solutions like laser levelling, tensiometers, alternate wet and drying and micro irrigation** for efficient water use through government programmes would increase the water use efficiency.
4. An absence of prominent trends in water conservation and a lack of incentives for constructing water conservation structures were observed across the three basins. **Incentivising farm water harvesting/conservation and clubbing it with irrigation subsidies** would develop a practice of water conservation. For instance, merging subsidises for micro irrigation with solar pumpsets /energy efficient pumpsets or a conditional clause of water harvesting structures like farm ponds for pumpset subsidies would conserve water.
5. Aquifer mapping and groundwater recharge is essential to stabilise groundwater-levels. It is important to note that aquifers are linked and severe depletion in one end would affect the water availability in another. Hence, it is vital to **integrate groundwater resources to the on-going regional debate** on surface water sharing and management. Unavailability of accurate data on groundwater availability, withdrawal and aquifer recharge has been a serious constraint to regulate and manage groundwater usage. A proper **database on ground water resources would facilitate identifying critical areas** and see the possibility of recharging it from multiple locations.
6. The upstream-downstream dynamics needs are to be considered in transboundary water sharing. **Minimal water flow in each cropping season needs to be assured** to take care of lower riparian areas.
7. The concept of Payment for Environment Services (PES) has shown success for drinking water purposes. This can be extended as **pilot projects for hydro-power generation and energy production through mini and micro grids and** could be replicated for the management of water streams with the involvement of the local community.

c) Energy

1. Subsidised electricity for agricultural purposes has led to over consumption and increased the burden of state administrations. **Restricting subsidy to small and marginal farmers, optimising the subsidy based on irrigation requirement, metering of electricity consumption and incentivising low consumption** would reduce the consumption and enhance energy use efficiency.
2. Successful models of alternate energy have been recorded in different basins, for example solar, biogas, rice husk, and mini/micro hydels. **Knowledge and experience sharing of various renewable energy business models within and across borders** would enhance wider adoption.

3. India has a comparative advantage with respect to renewable energy technology, thus **India should lead in harnessing RE markets in South Asia and facilitating RE technology transfer and trade** for greater use of renewable energy technology.
4. India has established energy grid infrastructures with Nepal, Bangladesh and Bhutan but not with Pakistan. **Indo-Pak grid connection** would facilitate a platform for a South Asia grid and energy trading.
5. Regional cooperation in energy trade can be envisaged only in the absence of mistrust among member countries. **Building trust among the governments and other important stakeholders through inclusive and sustained dialogues** at multiple-levels is essential.
6. South Asia has a dedicated network of regional agencies to steer intra-regional dialogue, coordinate initiatives but it lacks contemporary institutional memory of engagements and outcomes. Regional agencies like **SAFIR or SAARC Energy Centre could be reassigned with new mandates,** additional resources and influence.
7. Owing to low financial incentives and political uncertainties in South Asia, private sector participation has been limited across the region. Presence of private sector investment is inevitable in the development of adequate generation and transmission infrastructures. Hence, **favourable policies should be compiled for increasing the ease of doing business** in South Asian countries for energy companies.

11
Way Forward

The topics elaborated in the above sections can be by no means achieved in a day. Dominance of small farm holdings, similar food production systems and transboundary rivers in South Asia give a common angle to the issues related to agriculture, water and energy security across the survey sites. Some of the recommendations listed above also demand behavioural change in farmers.

Changing perceptions would bring a behavioural change, too. Though various players like government, private players, CSOs and INGOs are present in the development space of this region and it was observed that local NGOs and community leaders can influence the local people. Absorbing grassroots insights through local NGOs and taking them ahead as case scenarios should be the norm. CSOs and media will play a crucial role in this while upholding public interest and welfare. Moreover, media could also play a key role in changing perceptions, particularly in the case of sensitive issues like transboundary water sharing. The study also highlighted that public expectations are mostly with the state/government. Given that agriculture and water are state subjects, the strategies of policy advocacy should target stakeholders at local, sub-national, national and regional-levels. To identify the diverse views of the South Asian developmental challenges, we need to bring the discussion from the ground levels. These learnings need to be absorbed into higher level discussions.

Based on the key recommendations and learnings from the perception survey this report is based on, CUTS International has finalised its advocacy voice under SDIP. The recommendations will be represented at the national and regional levels by utilising the extensive profile of CUTS's strategic partners. This would require close follow-up with change agents and prominent stakeholders in the policy regulation sphere. Changes at local, subnational-levels are achievable and can bring transformation in resource use pattern in long run. As far as regional cooperation is concerned, trust building process should continue for the benefit of whole region. To promote the willingness and participation of relevant government bodies, there is a need to create a policy dialogue space. Regional agencies could play a significant role in this. To make the change happen, it is important to start with the low hanging areas that create the spark and then maintain the momentum continuously over the years.

Annexure 1
Sample Characteristics of Respondents across the Sample Sites

A.1.1: Sample Distribution in Pakistan (%)			
Villages	Districts		Total
	Mianwali	Rahim Yar Khan	
Bhairan	1.25	0.00	1.25
Chak -3/4	6.25	0.00	6.25
Chak 64	0.00	10.00	10.00
Chak-106 B	0.00	12.50	12.50
Chak-5-6	6.25	0.00	6.25
Chak-87A	0.00	3.75	3.75
Chak-88 A	0.00	3.75	3.75
Dhok Ali Khan	3.75	0.00	3.75
Dhok Miani	6.25	0.00	6.25
Head Pakka	6.25	0.00	6.25
Isa Khel	3.75	0.00	3.75
Moun Mubarak	0.00	2.50	2.50
Shah Da Khou	0.00	17.50	17.50
Trag	2.50	0.00	2.50
Wanda Jhalandar Wala	13.75	0.00	13.75
Total	50.00	50.00	100.00

A.1.2: Sample Distribution in Punjab, India (%)			
Villages	Districts		Total
	Ludhiana	Tarn Taran	
Cholla Sahib	8.60	17.20	25.80
Kalsian Khurd	0.00	29.03	29.03
Madhpur	21.51	0.00	21.51
Saholi	23.66	0.00	23.66
Total	53.76	46.23	100.00

A.1.3: Sample Distribution in Nepal (%)			
Villages	Districts		Total
	Dhanusha	Sindhuli	
Ganeshman Charnath Municipality (Badha Sagar)	1.25	0.00	1.25
Ganeshman Charnath Municipality (Badha Sagar)	1.25	0.00	1.25
Ganieshman Charnath Municipality (Chisapani)	1.25	0.00	1.25
Ganeshman Charnath Municipality	3.75	0.00	3.75
Ganeshman Charnath Municipality	6.25	0.00	6.25
Harshai VDC (Ward No 05)	0.00	1.25	1.25
Harshai VDC (Ward No 07)	0.00	1.25	1.25
Harshai VDC (Ward No 05)	0.00	6.25	6.25
Harshai VDC (Ward No 07)	0.00	3.75	3.75
Harine VDC (Hathmund)	5.00	0.00	5.00
Inarwa VDC (ward No: 1)	1.25	0.00	1.25
Inarwa VDC (Ward No 2)	2.50	0.00	2.50
Inarwa VDC (Kamalpur)	2.50	0.00	2.50
Raghunathpur VDC (Kiratpur)	5.00	0.00	5.00
Hansapur Kathpula VDC (Malhaniya)	2.50	0.00	2.50
Hansapur Kathpula VDC (Malhiniya)	1.25	0.00	1.25
Singhyahi Maidan VDC	1.25	0.00	1.25
Singhyahi Maidan VDC	1.25	0.00	1.25
Paterwa VDC (Ward No-09)	1.25	0.00	1.25
Raghunathpur VDC	2.50	0.00	2.50
Raghunathpur VDC (Ward No 4)	2.50	0.00	2.50
Ranibas VDC (Ward No 01)	0.00	5.00	5.00
Ranibas VDC (Ward No 02)	0.00	7.50	7.50
Raghunathpur VDC	1.25	0.00	1.25
Kamalamai Municipality (Ward No 10 Sisneri)	0.00	12.50	12.50
Harine VDC (Sona Para)	1.25	0.00	1.25
Harine VDC (Sona para)	1.25	0.00	1.25
Harine VDC (Tariya)	2.50	0.00	2.50
Kamalamai Municipality (Ward No 10 Bhiman)	0.00	2.50	2.50
Kamalamai Municipality (Ward No 14 Bhiman14)	0.00	10.00	10.00
Total	50.00	50.00	100.00

A.1.4: Sample Distribution in Uttar Pradesh, India (%)						
Villages	**Districts**					**Total**
	Ajamgarh	**Ballia**	**Gazipur**	**Kushinagar**	**Mau**	
Amwadigar	0.00	0.00	0.00	7.32	0.00	7.32
Bijpatwa	0.00	0.00	0.00	7.32	0.00	7.32
Jagalipatti	0.00	0.00	0.00	6.10	0.00	6.10
Javahi Dayal (Chayan Patti)	0.00	0.00	0.00	7.32	0.00	7.32
Kasonndra	0.00	6.10	0.00	0.00	0.00	6.10
Makhmelpur	0.00	0.00	0.00	0.00	17.07	17.07
Piparaghat	0.00	0.00	0.00	7.32	0.00	7.32
Rakawa Jagalipatti	0.00	0.00	0.00	1.22	0.00	1.22
Rampurbarhan (Laxmipur)	0.00	0.00	0.00	4.88	0.00	4.88
Rampurbarhan (Prorahi)	0.00	0.00	0.00	2.44	0.00	2.44
Tajopur	0.00	0.00	8.54	0.00	4.88	13.41
Tiwaripur	12.20	0.00	0.00	0.00	0.00	12.20
Virawat Konhavalia	0.00	0.00	0.00	7.32	0.00	7.32
Total	12.20	6.10	8.54	51.22	21.95	100.00

A.1.5: Sample Distribution in Bihar, India (%)				
Villages	Districts			Total
	Katihar	Madhubani	Supaul	
Armara	6.25	0.00	0.00	6.25
Babuari	0.00	2.50	0.00	2.50
Bathnaha	0.00	0.00	8.75	8.75
Bayana	3.75	0.00	0.00	3.75
Chhtahi	0.00	2.50	0.00	2.50
Dagmara	0.00	0.00	7.50	7.50
Dagwara(Ward7)	0.00	0.00	1.25	1.25
Dumariya Bisanpur	2.50	0.00	0.00	2.50
Haripur	0.00	0.00	1.25	1.25
Jalhipatti	0.00	2.50	0.00	2.50
Jay Nagar	12.50	0.00	0.00	12.50
Kajara Tola	7.50	0.00	0.00	7.50
Kasmalpur	0.00	0.00	6.25	6.25
Kaua Badi	2.50	0.00	0.00	2.50
Kharkhadiya	1.25	0.00	0.00	1.25
Kunoli	0.00	0.00	7.50	7.50
Laxmania	0.00	2.50	0.00	2.50
Mahadev Math	0.00	1.25	1.25	2.50
Mansahi	1.25	0.00	0.00	1.25
Narehdrapur	0.00	2.50	0.00	2.50
Neur	0.00	1.25	0.00	1.25
Rajpur	0.00	0.00	6.25	6.25
Ratan Sara	0.00	2.50	0.00	2.50
Rauahi	0.00	1.25	0.00	1.25
Rouahi	0.00	1.25	0.00	1.25
Sishoni	0.00	0.00	1.25	1.25
Theho	0.00	0.00	1.25	1.25
Total	37.50	20.00	42.50	100.00

A.1.6: Sample Distribution in Bhutan (%)			
Villages	Districts		Total
	Mongar	Samdrup Jongkhar	
Barpang	3.57	0.00	3.57
Beldangra	0.00	8.33	8.33
Dungkharling	0.00	2.38	2.38
Gangjuk	2.38	0.00	2.38
Khibrak	1.19	0.00	1.19
Metothang	0.00	4.76	4.76
Phosorong	11.90	0.00	11.90
Raling	0.00	10.71	10.71
Redaza	7.14	0.00	7.14
Rekhey	0.00	25.00	25.00
Thridangbi	21.43	0.00	21.43
Yakgang	1.19	0.00	1.19
Total	48.81	51.19	100.00

A.1.7: Sample Distribution in Assam, India (%)			
Villages	Districts		Total
	Baksa	Goalpara	
Balachara	0.00	2.50	2.50
Bhelakhama	0.00	3.75	3.75
Bhelakhamar	0.00	8.75	8.75
Bujruk Manikpur	0.00	3.75	3.75
Bujrukmanikpur	0.00	3.75	3.75
Dhaigaon	0.00	5.00	5.00
Gopinathpur	6.25	0.00	6.25
Hatiduba	3.75	0.00	3.75
Jogeshpur	5.00	0.00	5.00
Mesguri	3.75	0.00	3.75
N K Angarkata	3.75	0.00	3.75
N K Darranagar	2.50	0.00	2.50
Nayapara	0.00	5.00	5.00
No-1 Kalipur	2.50	0.00	2.50
No-1 Simliguri	3.75	0.00	3.75
No-2 Kalipur	5.00	0.00	5.00
Paikam Pt 2	0.00	2.50	2.50
Plesguri	1.25	0.00	1.25
Pukhuripar	8.75	0.00	8.75
Salbari	1.25	0.00	1.25
Sardarpara	0.00	5.00	5.00
Shashipur	2.50	0.00	2.50
Sutradharpara	0.00	1.25	1.25
Tukura P.3	0.00	1.25	1.25
Tukura Part 2	0.00	1.25	1.25
Tukura Part 3	0.00	6.25	6.25
Total	50.00	50.00	100.00

A.1.8: Sample Distribution in West Bengal, India (%)				
Villages	**Districts**			**Total**
	Coochbehar	**Jalpaiguri**	**Murshidabad**	
Bhagaban-Gola	0.00	0.00	27.50	27.50
Bhagatpur Tea Garden	0.00	12.50	0.00	12.50
Bhojaripara	7.50	0.00	0.00	7.50
Dewanaganj	1.25	0.00	0.00	1.25
Dubrakhali	0.00	0.00	2.50	2.50
Eliashpur	0.00	0.00	13.75	13.75
Ganeshpur	0.00	0.00	2.50	2.50
Gosanimari	2.50	0.00	0.00	2.50
Milanpally	0.00	10.00	0.00	10.00
Oodlabari, Gajoldoba	0.00	5.00	0.00	5.00
Ransagar	0.00	0.00	3.75	3.75
Takibari	0.00	2.50	0.00	2.50
Tattaram, Paschim Hemkumari	3.75	0.00	0.00	3.75
Ulladabri	0.00	5.00	0.00	5.00
Total	15.00	35.00	50.00	100.00

A.1.9: Sample Distribution in Bangladesh (%)				
Villages	**Districts**			**Total**
	Chapai Nawabganj	**Kurigram**	**Rajshahi**	
Uzirpur	0.63	0.00	0.00	0.63
Anantapur	0.00	12.50	0.00	12.50
Atrashia	0.63	0.00	0.00	0.63
Babu Pur (Bissas Para)	0.63	0.00	0.00	0.63
Bramhottor	0.00	17.50	0.00	17.50
Chakpara	0.00	0.00	5.00	5.00
Chokpara	0.00	0.00	0.63	0.63
Chokpara	0.00	0.00	1.88	1.88
Damudiar	8.13	0.00	0.00	8.13
Dompuli	0.00	0.00	0.63	0.63
Fazilpur	0.00	0.00	1.25	1.25
Forajipara	0.00	7.50	0.00	7.50
Hatia Bhobesh	0.00	12.50	0.00	12.50
Hatpukur	0.00	0.00	1.25	1.25
Jahanabad	0.00	0.00	0.63	0.63
Jatgosaidash	0.00	0.00	0.63	0.63
Jotgosaidas	0.00	0.00	2.50	2.50
Kuthipara	0.00	0.00	0.63	0.63
Lalbag	0.00	0.00	0.63	0.63
Paromanonodopur	0.00	0.00	0.63	0.63
Sarangpur	0.00	0.00	6.25	6.25
Sultangonj	0.00	0.00	0.63	0.63
Uttar Uzirpur	5.00	0.00	0.00	5.00
Uttar Uzirpur (House Nagar)	2.50	0.00	0.00	2.50
Uzirpur	3.75	0.00	0.00	3.75
Uzirpur (Balur Hat)	0.63	0.00	0.00	0.63
Uzirpur (Dakat Para)	0.63	0.00	0.00	0.63
Uzirpur (Joardar Para)	1.88	0.00	0.00	1.88
Uzirpur (Majhi Para)	0.63	0.00	0.00	0.63
Vogmontopur	0.00	0.00	1.25	1.25
Vomkuli	0.00	0.00	0.63	0.63
Total	25.00	50.00	25.00	100.00

Annexure 2
Socio-Economic Details of the Respondents

A.2.1. Education Profile

The education profile of respondents is given in the Table A.2.1. It shows that overall high responses were observed in the primary school and illiterate categories. Low responses were observed in the graduate or above and diploma/certificate categories. Some interesting cases were observed in the education profile of respondents. For example, Bhutan showed the highest percentage (46.50 per cent) in illiterate respondents, but it also showed the highest response (40.48 per cent) overall as well as in primary schooling, which included non-formal and monastery education. Such informal education systems are quite often not quantifiable for mainstream research purposes, since their impact on the respondents goes quite often well beyond the graduate education.

High numbers of graduates were recorded in Uttar Pradesh (21.95 per cent) and Bihar (22.50 per cent) but this is not a significant-level of literacy in India itself. These cases indicate that the formal education system followed across the five countries might not be a significant measurement of assessing the demographic profile of the respondents.

Table: A.2.1: Education Profile of Respondents (%)

Sample Site	Graduate or Above	Diploma/ Certificate	Higher Secondary (Class 12)	High School (Class 10)	Middle School (Class 6-8)	Primary (Class 1-5)	Illiterate
1. Pakistan	5.00	0.00	6.25	20.00	18.75	20.00	30.00
2. Punjab, India	5.38	4.28	16.13	29.08	18.25	10.75	16.18
3. Nepal	0.00	0.00	7.50	13.75	12.50	33.75	32.50
4. Uttar Pradesh, India	21.95	0.00	15.85	19.51	15.85	12.20	14.63
5. Bihar, India	22.50	0.00	7.50	25.15	15.15	21.35	8.80
6. Bhutan	0.00	0.00	2.40	7.20	3.57	40.48*	46.50
7. Assam, India	2.50	0.00	7.55	16.25	15.05	40.10	18.90
8. West Bengal, India	17.60	1.25	13.75	12.50	10.00	41.30	3.75
9. Bangladesh	5.00	0.63	6.25	8.13	16.25	35.00	28.75

**Includes Non-formal and Monastery Education*

A.2.2. Social Profile

Table A.2.2 shows the profile of respondents based on the social categories, which mirror the caste and religion categories, also. Majority of the respondents across the sample size were in the general category. It is interesting to note that the category of Scheduled Caste was captured only in India (34.75 per cent) and Pakistan (11.25 per cent). Another noteworthy case is that most of the respondents in the general category in Bangladesh (93.13 per cent) were from the Muslim community

Table A.2.2: Social Profile of Respondents (%)						
Sample Site	General	Scheduled Caste	Tribal Community	Backward Caste	Religious Minority	Other Minority
1. Pakistan	81.25	11.25	7.50	0.00	0.00	0.00
2. Punjab, India	83.87	1.08	0.00	4.31	0.00	0.00
3. Nepal	61.25	0.00	26.25	12.50	0.00	0.00
4. Uttar Pradesh, India	37.80	7.32	1.22	53.66	0.00	0.00
5. Bihar, India	7.60	12.60	25.00	55.10	0.00	0.00
6. Bhutan	100.00	0.00	0.00	0.00	0.00	0.00
7. Assam, India	6.25	0.00	12.55	41.30	37.50	2.55
8. West Bengal, India	30.05	13.75	0.00	0.00	33.75	22.55
9. Bangladesh	93.13	0.00	6.88	0.00	0.00	0.00

which is classified as a minority community in India. This indicates that a one size fits all description of social and caste structure might not be suitable across the five countries.

Substantial percentages of respondents in the tribal communities were captured in Nepal (26.25 per cent) and Bihar (25 per cent). Similarly close to half of the respondents in Uttar Pradesh (53.66 per cent), Bihar (55.10 per cent) and Assam (41.30 per cent) were from the backward caste. This concurs with the conclusion from the desk research and field scoping studies that minorities and backward caste are more vulnerable to the vagaries of agriculture, water and energy.

A.2.3. Family Profile

The family profile of the respondents was also captured to understand the household dynamics across each of the locations. Table A.2.3 shows the mean number, the minimum number and the maximum number of adult male, female and children in the family. The highest mean number of adult male in the HH was recorded in Bihar (≈8) followed by Uttar Pradesh (≈4) and the lowest were recorded in Bhutan ≈2). The highest mean number of adult female in the HH was recorded in Uttar Pradesh (≈3) followed by Nepal (≈3) and the lowest were recorded in Punjab, Pakistan and West Bengal (≈2). The highest mean number of children in the HH was recorded in Uttar Pradesh (≈5) followed by Bihar and Pakistan (≈3) and the lowest were recorded in West Bengal (≈1).

This indicates that the highest mean number of children in the HH was higher than that of females, but almost half of that of males. The minimum number of males, females and children in the HHs across the five countries varied between null and one. Except, Uttar Pradesh and Bihar, all the other locations have maximum number of males, females and children varying between five and 10. Uttar Pradesh showed high numbers of male members of 17, female members of 12 and children of 12. Bihar also showed high number of male members of 26 and children of 16. This could be possible because of high intensity of joint family cases in these two Indian states.

Table A.2.3: Family Profile of Respondents				
Sample Size	**Characteristic**	**No. of adult male in the family**	**No. of adult female in the family**	**No. of children in the family**
1. Pakistan	Mean	2.41	1.93	3.00
	Minimum	0	1	0
	Maximum	9	6	8
2. Punjab, India	Mean	2.45	1.97	1.71
	Minimum	1	0	0
	Maximum	7	7	12
3. Nepal	Mean	2.96	2.85	2.55
	Minimum	1	1	0
	Maximum	7	6	9
4. Uttar Pradesh, India	Mean	4.29	3.38	4.75
	Minimum	1	1	1
	Maximum	17	12	14
5. Bihar, India	Mean	8.28	2.51	3.44
	Minimum	0	0	0
	Maximum	26	7	16
6. Bhutan	Mean	1.94	2.12	2.71
	Minimum	1	1	0
	Maximum	5	5	6
7. Assam, India	Mean	2.24	2.08	1.82
	Minimum	1	1	0
	Maximum	7	5	5
8. West Bengal, India	Mean	2.14	1.80	1.53
	Minimum	1	1	0
	Maximum	6	5	10
9. Bangladesh	Mean	2.17	2.04	2.25
	Minimum	1	1	1
	Maximum	6	6	8

A.2.4. Family Labour Profile

The sample was also surveyed to analyse the manual labour engaged from each HH (Table A.2.4). Across all the sample pockets, Uttar Pradesh had the highest mean number of males (≈3), female (≈3) and children (≈3) as family labour. Overall, it was evident that the mean difference between the number of female family labour to male family labour was quite low, ranging from highest in Punjab (1.33) to Nepal (0.04). In Bhutan, the mean number of female labour was higher than male labour (-0.04). This indicates that female members of the HHs across all the sample locations are equal stakeholders in farming and agriculture related activities.

Table A.2.4: Family Labour Profile of Respondents				
Sample Size	**Characteristic**	**No. of male in family labour**	**No. of female in family labour**	**No. of children in family labour**
1. Pakistan	Mean	2.20	1.05	0.19
	Minimum	0	0	0
	Maximum	6	6	4
2. Punjab, India	Mean	1.75	0.42	0.05
	Minimum	0	0	0
	Maximum	5	3	3
3. Nepal	Mean	2.61	2.57	0.34
	Minimum	1	0	0
	Maximum	5	6	5
4. Uttar Pradesh, India	Mean	3.14	2.68	3.00
	Minimum	1	1	1
	Maximum	12	5	7
5. Bihar, India	Mean	1.92	0.00	0.00
	Minimum	0	0	0
	Maximum	5	0	0
6. Bhutan	Mean	1.31	1.36	0.03
	Minimum	1	1	0
	Maximum	3	3	1
7. Assam, India	Mean	1.97	1.27	0.61
	Minimum	1	0	0
	Maximum	5	4	4
8. West Bengal, India	Mean	1.66	0.75	0.05
	Minimum	1	0	0
	Maximum	6	2	1
9. Bangladesh	Mean	1.80	1.07	1.00
	Minimum	1	1	1
	Maximum	5	2	1

Annexure 3
Demographic Information on the Sample Sites

Sample Site	Basin	Sample Site	Area (sq. km.)	Population	Population density (per sq. km.)	Sex Ratio	Literacy Rate
1.Pakistan	Indus	1. Mianwali	5840.00	1056620 (1998)	180.90 (1998)	100.8 (males per 100 females)(1998)	42.8% (1998)
		2. Rahim Yar Khan	11880.00	3141053 (1998)	264.40 (1998)	108.80 (males per 100 females) (1998)	33.1% (1998)
2.Punjab, India		3. Ludhiana	3767.00	3487881 (2011)	975 (2011)	869 (females per 1000 males) (2011)	82.5% (2011)
		4. Tarn Taran	2414.00	1120070 (2011)	460 (2011)	898 (females per 1000 males) (2011)	69.4% (2011)
3.Nepal	Ganges	5. Dhanusha	1180.00	754777 (2011)	640 (2011)	100.60 (males per 100 females) (2011)	50.4% (2011)
		6. Sindhuli	2491.00	296192 (2011)	119 (2011)	92.2 (males per 100 females) (2011)	60.5% (2011)
4.Uttar Pradesh, India		7. Ajamgarh	4054.00	4613913 (2011)	1139 (2011)	1019 (females per 1000 males) (2011)	72.69% (2011)
		8. Ballia	1981.00	3223642 (2011)	1081 (2011)	933 (females per 1000 males) (2011)	73.82% (2011)
		9. Gazipur	3384.00	3622727 (2011)	1100 (2011)	951 (females per 1000 males) (2011)	74.27% (2011)
		10. Kushinagar	2873.00	3560830 (2011)	1200 (2011)	955 (females per 1000 males) (2011)	67.66 (2011)
		11. Mau	1713.00	2205170 (2011)	1300 (2011)	978 (females per 1000 males) (2011)	75.16% (2011)
5.Bihar, India		12. Katihar	3056.00	3068149 (2011)	1000 (2011)	916 (females per 1000 males) (2011)	53.56% (2011)
		13. Madhubani	3501.00	4476044 (2011)	1279 (2011)	925 (females per 1000 males) (2011)	43.35% (2011)
		14. Supaul	2410.00	2228397 (2011)	919 (2011)	925 (females per 1000 males) (2011)	59.65% (2011)
6.Bhutan	Brahma putra	15. Mongar	1940.00	37069 (2005)	22.6 (2005)	101.7 (males per 100 females) (2005)	50.2% (2005)
		16. Samdrup Jongkhar	1877.00	33889 (2005)	18.1 (2005)	106.1 (males per 100 females) (2005)	54.5% (2005)
7.Assam, India		17. Baksa	2457.00	950075 (2011)	387 (2011)	967 (females per 1000 males) (2011)	70.53% (2011)
		18. Goalpara	1824.00	1008959 (2011)	550 (2011)	962 (females per 1000 males) (2011)	68.67% (2011)
8.West Bengal, India		19. Coochbehar	3387.00	2822780 (2011)	833 (2011)	942 (females per 1000 males) (2011)	75.49% (2011)
		20. Jalpaiguri	3044.00	3869675 (2011)	1300 (2011)	954 (females per 1000 males) (2011)	84.79% (2011)
	Ganges	21. Murshidabad	5324.00	7102430 (2011)	1334 (2011)	957 (females per 1000 males) (2011)	67.53% (2011)
9.Bangladesh		22. Chapai Nawabganj	1702.00	1647521 (2011)	970 (2011)	97 (males per 100 females) (2011)	55.09% (2011)
		23. Rajshahi	2407.00	2595197 (2011)	1100 (2011)	102 (males per 100 females) (2011)	30.61% (2011)
	Brahma putra	24. Kurigram	2296.00	2069273 (2011)	900 (2011)	95 (males per 100 females) (2011)	22.3% (2011)

Bibliography

Actionaid India. *Blues Beyond Boundaries.* Natural Resource Knowledge Activist Hub (NR-KA HUB), Actionaid India, 2015.

ADB & UNCTAD. *Quantification of Benefits from Economic Cooperation in South Asia.* Macmillan India Ltd., 2008.

Agarwal, Bina. "Food Sovereignty, Food Security & Democratic Choice: Critical Contradictions, Difficult Conciliations." *The Journal of Peasant Studies* 41, no. 6 (2014): 1247-1268.

Agarwal, Bina. *IEG Working Paper No. 320: Food Security, Productivity & Gender Inequality.* Delhi: Institute of Economic Growth (IEG), 2012.

Aggarwal, P. K. , P. K. Joshi, J. S. I. Ingram, and Raj K. Gupta. "Adapting food systems of the Indo-Gangetic plains to global environmental change: key information needs to improve policy formulation." *Environmental Science & Policy*, 2004: 487-498.

Aggarwal, P. K., P. K. Joshi, J. S. I. Ingram, and R. K. Gupta. "Adapting food systems of the Indo-Gangetic plains to global environmental change: key information needs to improve policy formulation." *Environmental Science & Policy* 7, no. 6 (2004): 487–498.

Aggarwal, "Adapting food systems of the Indo-Gangetic plains to global environmental change: key information needs to improve policy formulation." *Environmental Science & Policy*, 2004: 487-498.

Aggarwal, P. K., P. K. Joshi, J.S.I. Ingram, and R. K. Gupta. "Adapting Food Systems of the Indo-Gangetic Plains to Global Environmental Change: Key information needs to improve policy formulation." *Environmental Science & Policy* 7, no. 6 (2004): 487-498.

Barker, Randolph, and François Molle. *Evolution of irrigation in South and Southeast Asia.* Colombo, Sri Lanka: Comprehensive Assessment Secretariat, IWMI, 2004, Comprehensive Assessment Research Report 5.

BBIN Motor Vehicles Agreement. *Prime Minister's Office, GoI.* June 10, 2015. http://pmindia.gov.in/en/news_updates/bangladesh-bhutan-india-and-nepal-bbin-motor-vehicle-agreement/ (accessed August 8, 2015).

Brar, Jaswinder Singh, and Sucha Singh Gill. "Remodeling Water Use in Indian Punjab for." 2015. http://www.cuts-citee.org/SDIP/pdf/Policy_Brief_on_Water-Remodelling_Water_Use_in_Indian_Punjab_for_Efficiency_and_Sustainability.pdf.

CUTS International. *Assessment of Bangladesh-India Trade Potentiality: Need for Cross Border Transport Facilitation & Mutual Recognition of Standards*. 2016.

CUTS International. "Mainstreaming Sustainable Development - A Quick Diagnostic of Key Challenges & Opportunities for Water, Energy & Food Security in South Asia." 2015.

Demirguc-Kunt, Asli, Leora Klapper, Dorothe Singer, and Peter Van Oudheusden. *The Global Findex Database 2014: Measuring Financial Inclusion around the World*. Policy Research Working Paper 7255, Washington, DC: World Bank, 2015.

Department of Agriculture & Cooperation, Ministry of Agriculture. *Marketing Infrastructure & Agricultural Marketing Reforms (MIAMA)*. 2015. http://www.google.com/url?q=http%3A%2F%2Fagmarknet.nic.in%2Famrscheme%2Fmodelact.htm&sa=D&sntz=1&usg=AFQjCNGevXBsHH6zb7Jc1fVejR5qg6VSeA.

Dubey, Muchkund, Lok Raj Baral, and Rehman Sobhan, . *South Asian Growth Quadrangle: Framework for Multifaceted Cooperation*. New Delhi: Macmillan, 2000.

Food and Agriculture Organisation of the UN (FAO). *FAO Statistics*. 2016.

FAO. "Ganges-Brahmaputra-Meghna Basin." 2011.

FAO. "Global Initiative on Food Loss & Waste Reduction." 2015.

FAO. "Issue Paper: Energy-Smart Food for People & Climate." 2011.

FAO. *Men & Women in Agriculture: Closing the Gap*. Rome, 2015.

FAO. *New Partnership to Promote Sustainable Mechanization of Agriculture*. Rome, October 2, 2015.

FAO, IFAD & WFP. *The State of Food Insecurity in the World 2015 - Meeting the 2015 international hunger targets: taking stock of uneven progress*. Rome: FAO, 2015.

Fletschner, Diana, and Lisa Kenney. *Rural Women's Access to Financial Services*. FAO, 2011.

Gathala, Mahesh K., et al. "Tillage & Crop Establishment Affects Sustainability of South Asian Rice–Wheat System." *Agronomy Journal* (The American Society of Agronomy, Inc.) 103, no. 4 (2011): 961-971.

Golam, Rasul. "Food, Water & Energy Security in South Asia: A Nexus Perspective from the Hindu Kush Himalayan Region." *Environmental Science & Policy* 39 (2014): 35-48.

International Food Policy Research Institute (IFPRI). *Global Food Policy Report*. International Food Policy Research Institute, 2015.

Intergovernmental Panel on Climate Change (IPCC). "Agriculture, Forestry and Other Land Use (AFOLU). In: Climate Change 2014: Mitigation of Climate Change." *Contribution of Working Group III to the Fifth Assessment Report of the* IPCC. 2014. https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_chapter11.pdf (accessed September 24, 2015).

IPCC. "Climate Change 2014: Impacts,Adaptation, and Vulnerability." Cambridge University Press. 2014. https://ipcc-wg2.gov/AR5/images/uploads/WG2AR5_SPM_FINAL.pdf.

Jha, Ram Kumar, and Akshat Mishra. *Sustainable Development in South Asia: Need for Cooperation in Food-Water-Energy Security*. CUTS International, 2014.

Kapoor, Aditi. *Policy Brief: Why Women Matter: The Gender Dimension of Climate Change Adaptation Policies*. Alternative Futures, 2011.

Kawser, Abul Mohammad, and Abdus Md. Samad. "Political history of Farakka Barrage and its effects on environment in Bangladesh." *Bandung: Journal of Global South* 2:16 (2015).

Khalid, Iram. "Trans-Boundary Water Sharing Issues: A Case of South Asia." *Journal of Political Studies* 1, no. 2 (2008): 79-96.

Khan, Tauhidul Anwar. "Management and Sharing of the Ganges." *Natural Resources Journal* 36 (1996): 455-479.

Kurian, Anju Lis, and Vinodan C. "Quest for Energy Security: New Trends in India-China Relations." *International Journal of Management and Social Science Research Review* 1, no. 15 (2015): 284-288.

Lahiri-Dutt, Kuntala. *Experiencing & Coping with Change: Women-headed Farming Households in the Eastern Gangetic Plains*. ACIAR Technical Reports No. 83, Australian Centre for International Agricultural Research (ACIAR), 2014, 66.

Lele, U., M. Klousia-Marquis, and S. Goswami. "Good Governance for Food, Water & Energy Security." *Aquatic Procedia* 1 (2013): 44-63.

Ministry of External Affairs, GoI. "Modalities for Implementation of India - Bangladesh Land Boundary Agreement." 2015.

Mizanur, Rahaman Muhammad. "The Ganges Water Conflict: A Comparative Analysis of 1977 Agreement & 1996 Treaty." *Asteriskos* 1/2 (2006): 195-208.

"Modalities for Implementation of India - Bangladesh Land Boundary Agreement." *Ministry of External Affairs, GoI*. June 6, 2015. http://mea.gov.in/Uploads/PublicationDocs/25354_scan0006.pdf (accessed August 8, 2015).

"Memorandum of Understanding by National Seed Association of India & Bangladesh Seed Association." *CUTS CITEE*. April 30, 2015. http://www.cuts-citee.org/RISTE/pdf/MoU_between_Seeds_Associations_of_India_and_Bangladesh.pdf (accessed August 8, 2015).

Nepal, Santosh, and Arun Bhakta Shreshta. "Impact of climate change on the hydrological regime of the Indus, Ganges and Brahmaputra river basins: a review of the literature." *International Journal of Water Resources Development* 31, no. 2 (2015): 201-218.

Prime Minister's Office, GoI. "BBIN Motor Vehicles Agreement." June 10, 2015. http://pmindia.gov.in/en/news_updates/bangladesh-bhutan-india-and-nepal-bbin-motor-vehicle-agreement/ (accessed August 8, 2015).

South Asian Disaster Knowledge Network (SADKN). *Themes & Issues: Technological - Early Warnings*. SADKN. 2016.

Singh, Bhupendra Kumar. "South Asia Energy Security: Challenges & opportunities." *Energy Policy* 63 (2013): 458-468.

Singh, Ram Kathin, and Rama Kanth Singh. *NEFORD's Adaptation Strategy to Climate Change: A farm level practical approach*. Lucknow: NEFORD, 2013.

Steele, P. E. *Agro-Mechanization & the Information Services Provided by FAOSTAT*. FAO, 2011.

Thakkar, Himanshu. "India's Tryst with The Big Irrigation Projects." *South Asia Network on Dams, Rivers & People (SANDRP)*. 2010. http://sandrp.in/irrigation/Failure_of_Big_Irrigation_Projects_and_Rainfed_Agriculture_0510.pdf.

UN Women. "The World Survey on the Role of Women in Development: Gender Equality & Sustainable Development." 2014.

Vethaiya, Balasubramanian, Tapan Kumar Adhya, and Jagdish K. Ladha. "Enhancing Eco-Efficiency in the Intensive Cereal-Based Systems of the Indo-Gangetic Plains." 2012. http://ciat.cgiar.org/wp-content/uploads/2012/12/chapter_7_eco_efficiency.pdf.

Vidyadharan, Veena, Ram Kumar Jha, Akshat Mishra, Sucharita Bhattacharjee, Prithviraj Nath, and Ashwini Kumar Swain. *Agricultural Production & the Water-Energy-Food Security Nexus in the Indus, Ganges & Brahmaputra Basins of South Asia*. Islamabad: Sustainable Development Policy Institute (SDPI), 2016, 227-247.

Weert, Frank van, Jac van der Gun, and Josef Reckman. *Global Overview of Saline Groundwater Occurrence & Genesis*. Utrecht: International Groundwater Resources Assessment Centre (IGRAC), 2009.

World Water Assessment Programme (WWAP). *The United Nations World Water Development Report 2014: Water & Energy*. WWAP United Nations , Paris: UNESCO, 2014.

WWAP. *The United Nations World Water Development Report: Managing Water under Uncertainity & Risk*. World Water Assessment Programme, Paris: UNESCO, 2012.

Endnotes

1 SDG 2: Food – End hunger, achieve food security and improved nutrition and promote sustainable agriculture. SDG 6: Water – Ensure availability and sustainable management of water and sanitation for all. SDG 7: Energy – ensure access to affordable reliable, sustainable modern energy for all.

2 Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.

3 Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the International Standard Industrial Classification (ISIC), revision 3. Note: For VAB countries, gross value added at factor cost is used as the denominator.

4 Employment is defined as persons of working age who were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period or not at work due to temporary absence from a job, or to working-time arrangement. The agriculture sector consists of activities in agriculture, hunting, forestry and fishing, in accordance with division 1 (ISIC 2) or categories A-B (ISIC 3) or category A (ISIC 4).

5 Cereal yield, measured as kilograms per hectare of harvested land, includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Production data on cereals relate to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded. The FAO allocates production data to the calendar year in which the bulk of the harvest took place. Most of a crop harvested near the end of a year will be used in the following year.

6 Fertiliser consumption measures the quantity of plant nutrients used per unit of arable land. Fertiliser products cover nitrogenous, potash, and phosphate fertilisers (including ground rock phosphate). Traditional nutrients – animal and plant manures – are not included. For the purpose of data dissemination, FAO has adopted the concept of a calendar year (January to December). Some countries compile fertiliser data on a calendar year basis, while others are on a split-year basis. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded.

7 *http://www.fao.org/3/a-i4324e.pdf*

8 *http://www.cuts-citee.org/SDIP/pdf/Agricultural_Input_Trade_and_Food_Security_in_South_Asia.pdf*

9 Due to the moisture content, middlemen deducted INR 300-400 from MSP before paying farmers

10 Local markets constructed along the border are open a few days a week to facilitate trade between small scale industries and farmers. These markets are prevalent in Ind0-Bangla and Indo-Nepal borders.

11 A non- performing asset is defined as a credit facility in respect of which the interest and /or installment of Bond finance principal has remained 'past due' for a specified period of time. NPA is used by financial institutions that refer to loans that are in jeopardy of default.

12 The Equity Grant Fund enables "eligible FPCs to receive a grant equivalent to about to the equity contribution of their shareholder members in the FPC, thus enhancing the overall capital base of the FPC. Also, the eligibility criteria for the Equity Grant Fund states that there should be adequate representation from member farmers and minimum one woman member.

13 'Policy & processes Guidelines for farmer Producer Organisations' states that the "formation and development of FPOs will be actively encouraged and supported by the Central and State Governments and their agencies, using financial resources from various centrally sponsored and State-funded schemes in the agriculture sector agencies".

14 Government of Punjab 2009, *The Punjab Preservation of Subsoil Water Act, 2009*, Department of Legal and Legislative Affairs, Punjab Govt Gaz. (Extra), 28 April 2009, viewed 23 January 2015, <*http://agripb.gov.in/abt_deptt/pdf/Pb%20preservation%20of%20Subsoil%20Act,2009.pdf*>

15 Taklai irrigation system was built in 1980s but flash floods in the year 2004 and 2010 completely destroyed its infrastructure. With consent and approval from the Japanese government, the rehabilitation project under grant scheme was commissioned in October 2013 (Gurung 2015)

16 Gaylegphug Lift Irrigation scheme construction was undertaken by the Royal Government of Bhutan in the year 1977-78 (Subba 2015).

17 Bala, R. 2015, Policies Intervention for Groundwater Governance in Gujarat and Politics?, *International Research Journal of Social Sciences,* vol. 4, no. 1, January, pp. 55-58.

About CUTS

With its headquarter in Jaipur, India; Regional Centres, in Lusaka, Nairobi, Accra and Hanoi; and an International Centre in Geneva, CUTS International has three verticals: Trade, Regulations and Governance. Through policy- and action-research, advocacy, networking and capacity building, it has established its relevance and impact in several policy-making areas and among the larger development community.

CUTS Centre for International Trade, Economics & Environment

Mission

Pursuing economic equity and social justice within and across borders by persuading governments and empowering people

Goals

Enable and empower representatives of the civil society, from developing countries in particular, to articulate and advocate on the relevant issues at the appropriate fora	Create a questioning society through empowerment of civil society representatives thus ensuring transparency and accountability in the system	Promote equity between and among the developed and developing countries through well-argued research and advocacy on the emerging and relevant issues

About the Study

CUTS International is a portfolio partner of the Sustainable Development Investment Portfolio (SDIP), a regional programme for South Asia developed by Department of Foreign Affairs and Trade (DFAT), Australian Government. The SDIP seeks to improve transboundary water resource management, increase access to energy and energy connectivity, and improve agricultural productivity and farm incomes. SDIP focuses on a sub-region of South Asia defined by three major Himalayan river basins-the Indus, Ganges and Brahmaputra-covering north-east Pakistan, northern India, Bangladesh, Nepal and Bhutan

Under SDIP, CUTS International has extended its network across the 3 basins to facilitate and work towards interventions in policy research and advocacy. This report is a compilation of a perception study spanning across five countries and twenty four locations in South Asia. The study covers the transboundary aspects of agriculture, water and energy and the collective diffusion impact on gender. The study had identified the constraints for promoting policy integration and proposes bullet points to attain economic and regional growth among South Asian countries.

For details, please visit: http://www.cuts-citee.org/SDIP/

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