REPORT

RAINFALL, FOOD SECURITY AND HUMAN MOBILITY

CASE STUDY: INDIA

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No. 4 I November 2012

This report should be cited as:

Murali, Janakaraj, and Tamer Afifi (2012).
"Where the Rain Falls" project. Case study: India.
Results from Janjgir-Champa District, Chhattisgarh State.
Report No. 4. Bonn: United Nations University
Institute for Environment and Human Security (UNU-EHS).

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UNITED NATIONS UNIVERSITY
INSTITUTE FOR ENVIRONMENT AND HUMAN SECURITY
(UNU-EHS)

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″Where the Rain Falls″ Project
Case study: India

Results from Janjgir-Champa District, Chhattisgarh State

Authors: Janakaraj Murali and Tamer Afifi

Acknowledgements

At the outset we are thankful to all of the individuals and households in the villages of Akalteri, Banahil, Jullan Pakaria and Silli who have participated enthusiastically in the survey. We are also grateful to all the experts who shared their knowledge and experience about rainfall variation and its impact on life and the livelihoods of people in the Janjgir Champa district of Chhattisgarh.

We owe many thanks to Dr. Koko Warner (United Nations University Institute for Environment and Human Security – UNU-EHS), the Scientific Director of the project; to Mr. Kevin Henry (CARE), project coordinator; and Ms. Aurélie Ceinos (CARE), project officer, for their support before, during and after the field research.

Moreover, we would like to thank Mr. Bruce Ravesloot from the CARE Poverty, Environment and Climate Change Network (PECCN) for reviewing and helping improve this report. Many thanks as well to the peer reviewers of the report Dr. A. K. Singh, Deputy Director General, Natural Resource Management, Indian Council of Agricultural Research (ICAR); Dr. B. Venkateswarlu, Director of the Central Research Institute for Dryland Agriculture (ICAR); Dr. Murari Lal, Chairman, Climate, Energy and Sustainable Development Analysis Centre; and Mr. Shirish Sinha, Senior Thematic Advisor, Climate Change, Embassy of Switzerland in India, for their valuable suggestions and constructive comments.

We are duty-bound to thank our institutions – the United Nations University Institute for Environment and Human Security (UNU-EHS) and The Energy and Resources Institute (TERI), especially Dr. R .K .Pachauri, Director General, for providing all the support needed to complete the report. The donors, AXA Group and the John D. and Catherine T. MacArthur Foundation, also deserve special mention for their generous funding support.

We would like to express our sincere appreciation and gratitude to Mr. Magesh Nagarajan (UNU-EHS) for his tremendous efforts and time allocation in statistical guidance and data analysis. We also thank the CARE India country office colleagues, Ms. Mousumi Barua, Ms. Maya Nair, Ms. Prerna and CARE Chhattisgarh office staff, Mr. Sathish Kumar, Mr. Dilip Sarvate, Mr. Sandeepta Biswal and their colleagues for their enthusiastic support from beginning to end. We would like to extend our thanks to Mr. Ravi Muthusamy for creating and following up on the data entry mask, as well as to Ms. Sophia Zielke and Ms. Verena Rossow (both at UNU-EHS) for their enormous support in literature and data-related work. Mr. Davide Marino and Mr. Sabu Chittilappilly (both at UNU-EHS) also deserve our thanks for their engagement in the work in its early stages.

We would also like to thank Mr. Charles Ehrhart (CARE) for his work in the preparatory and early phases of this project and Ms. Delphine Pinault (CARE) for her inputs and comments on the research protocol for this project. We would like to extend our thanks to the following colleagues at UNU-EHS: Mr. Matthew Mullins for administrative support and Ms. Thérèse Rosenfeld for support in the preparation of fieldwork.

Furthermore, it was a great pleasure working with our national junior researchers, field assistants and volunteers, Mr. Tapas Das, Mr. Reji S. Kuruvilla, Mr. Manish Ranjan, Mr. Manoj Kumar Satpathy, Mr. Amitabh Tiwari, Mr. Deepak Sharad Hate, Ms. Mittu Hendry and Ms. Susila, who all worked diligently to

complete the PRA exercises, the household survey in the field and produced quality outputs. Our special thanks go to Ms. Julie K. Maldonado, PhD in Anthropology candidate, American University, Washington DC, as well as Mr. Philip Maldonado, Professional Environmental Engineer, Virginia Tech, for their active involvement in the fieldwork and for carrying out a high quality photo and video documentation of events as well as enriching the report with valuable quotes and photos from the field.

We are grateful to the UNU-EHS communications team, namely Alice Fišer, Andrea Wendeler and Katharina Brach for their valuable work in publishing the case study reports.

Last but not least, we would like to thank Ms. Kimberly Bennett (CARE "Where the Rain Falls" communications coordinator) for editing this report.

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Abbreviations and acronyms

BCM	*Billion Cubic Meter*
BPL	*Below Poverty Line*
CBO	*Community-Based Organization*
CO	*Country Office*
CRIDA	*Central Research Institute for Dryland Agriculture*
EACH-FOR	*Environmental Change and Forced Migration Scenarios*
FAO	*Food and Agriculture Organization of the United Nations*
FGD	*Focus Group Discussion*
GAIN	*Global Adaptation Index*
GDP	*Gross Domestic Product*
GHI	*Global Hunger Index*
IFPRI	*International Food Policy Research Institute*
IGAU	*Indira Gandhi Agricultural University*
IMD	*Indian Meteorological Department*
IMF	*International Monetary Fund*
IPCC	*Intergovernmental Panel on Climate Change*
KII	*Key Informant Interviews*
MGNREGA	*Mahatma Gandhi National Rural Employment Guarantee Act*
MSP	*Minimum Support Price*
NABARD	*National Bank for Agriculture and Rural Development*
NAP	*National Agriculture Policy*
NAPCC	*National Action Plan on Climate Change*
NGO	*Non-Governmental Organization*
NSS	*National Sample Survey*
OBC	*Other Backward Class*
PDS	*Public Distribution System*
PHC	*Primary Health Centre*
PRA	*Participatory Research Approach*
PRI	*Panchayat Raj Institutions*
SC	*Scheduled Caste*
SHG	*Self Help Group*
SPSS	*Statistical Package for the Social Sciences*
SRI	*System of Rice Intensification*
SSA	*Sub-Saharan Africa*
ST	*Scheduled Tribe*

Glossary

Anganwadi	*Government-run crèche and nutrition improvement centre*
Kharif crops	*Crops which are sown in the rainy season and harvested in the autumn season (monsoon crops)*
Kolapa	*A term referring to the flood irrigation from canal water*
Panchayat	*Institutions of local self-government*
Rabi crops	*Crops sown in the winter season and harvested in the spring season (winter crops)*
Ration shop	*Public distribution system where food grains are sold at a subsidized price to poor families*
Talab	*Village pond*

Executive summary

The overall goal of this study is to understand and present the relationship between changing weather patterns, food security and human mobility in India. This report presents the findings of research undertaken in four villages in the Janjgir Champa district of Chhattisgarh State, India. The research, carried out by a multidisciplinary team led by the United Nations University Institute for Environment and Human Security (UNU-EHS), Bonn, Germany, in collaboration with CARE International, uses a variety of methods to document the trends and impacts of rainfall variations on the livelihoods and food security of local communities in the research villages. It also studies the causes and patterns of human migration as a major coping mechanism against rainfall variability.

The research uses both qualitative and quantitative methods to capture the voices of communities on how and to what extent the rainfall variations are impacting their livelihoods in the study area. It tests the hypothesis that human migration has been a major coping mechanism against climate variability. The analysis establishes aberrations in rainfall patterns in terms of delays, shifting seasons and erratic rain in the study area. The findings confirm that there is a coordination mechanism that exists between rainfall changes and livelihood/food security of largely agrarian communities. Due to single annual harvest/rice monoculture and non-availability of water for a second crop, marginal farmers and farm labourers are left with very few options in finding enough employment in the vicinity of their villages. The findings also convey that migration is one of the strategies that mainly small farmers and farm labourers head to in response to rainfall variations/climatic changes.

Less rain causes drought, a lower pond level and a decline in the ground water. This has its implications for the food security of humans and the crops, but also for the survival of the cattle, which again feeds into the livelihoods of the communities of the research site. Some people cope with the situation by seeking external help from families and institutions, reducing food consumption and expenditure or trying to increase their income on the spot without leaving their villages. However, a considerable proportion of them leave their villages, seeking new livelihood alternatives or at least attempting to increase their income through work (mainly brick making and construction) in other towns/cities. Even the people who stay and borrow from others might still opt for migration in order to be able to generate income that partly repays their loans.

The answer to the question "Who migrates?" is clearly the small, marginal farmers and landless agricultural labourers who suffer most from food shortage associated with the rainfall variability. People very often migrate in families. In cases where the children accompany their parents in the migration process and are not left behind in the villages to be taken care of by the grandparents and other relatives, the quality of education suffers and school dropouts are not unusual.

The general circumstances under which people would use migration as an adaptation strategy in response to rainfall variability and food insecurity in the research site are the following:

- Relying on monoculture throughout the year with no diversification;
- Unequal distribution of the canal water among the farmers;
- Unequal distribution of the canal water between the farmers on the one hand and the new coal-based power plants on the other;

- The deteriorating level of pond maintenance, leading to more water pollution and other related problems;
- The continuous, rapid population growth and the inheritance system, which have their implications on the minimum land requirement for cultivation and exacerbate all the problems related to rainfall variability and water shortage;
- No improvement in the financial situation of the farmers due to the shortage of water from all sources, regular disease and pest invasion, which all have their implications on food and livelihood security;
- No proper interventions from the institutions that the communities rely on regarding food security, but also other institutions that provide them with necessary services;
- The power plants not absorbing excess labour during the lean agricultural seasons in the research site;
- The strong informal contractors/mediators network facilitating the migration process to other towns/cities;
- The pull factors in other cities that represent improved and alternative livelihoods for the communities.

Such findings are essential for informing policy decisions by ensuring that marginal farmers and their climate-driven risks are addressed in policy design. Issue-specific recommendations are made for policy and programme reforms by incorporating migration issues into adaptation planning in response to likely long-term climate change impacts.

Section 1: Introduction

1.1 Background and rationale

Changing weather patterns, including less predictable seasons and increasingly erratic rainfall, is one of the most important but least understood impacts of global climate change. Long-term and seasonal weather patterns are critical to the viability of many natural resource-dependent livelihoods. For example, the onset and duration of rainy seasons; the quantity of rainfall; its variability and even intra-seasonal rainfall shape farmers' decisions about sowing and harvesting, as well as the success or failure of their crops. Therefore, it is of great concern that many small landholding farmers and pastoralists report marked changes in the timing, quality and quantity of rainfall. Their observations are striking for several reasons, including geographic scope and the consistency of described changes. Climate change is worsening the odds of longstanding risks, such as heat stress, insufficient or too much rain at crucial moments in the plant cycle, in addition to pests and diseases. These interact with a range of escalating stresses on rural livelihoods, that is, land pressure, soil erosion, deforestation and depleted water resources that would exist regardless of climate change (Iglesias et al., 2007). Their cumulative impact on food security can be devastating and are already affecting human migration patterns in various ways.

Climate change affects nearly all aspects of food security, from production and availability, to the stability of food supplies, access to food and food utilization. This relationship has already been documented in South Africa, Central America and South Asia. However, the situation is likely to worsen in parts of the world that already experience high levels of food insecurity.

When local livelihoods are under stress, people often try to move either short-term or permanently in "search of greener pastures". This could either represent part of a successful strategy for adapting to the impacts of climate change, or it could be the last resort. This research helps clarify the circumstances under which mobility can play a role in managing climate change-related risks, as well as identify the kinds of interventions that can best support *in-situ* adaptation despite increasingly erratic weather patterns.

1.2 Goals and objectives of the research

The overall goal of this research is to enhance the capacity of governments and civil society organizations at all levels, as well as the private sector, to better understand and effectively address the relationship between changing weather patterns, food security and human mobility in the world's most vulnerable countries. Its specific objectives are to understand:

- rainfall variability and its patterns and their impact on people and their livelihoods;
- the most important mechanisms and institutions which support people to safeguard their food security;
- migration as a coping mechanism and the major variables affecting migration.

1.3 Structure of the report

The report is organized into 10 sections. Given the study objectives presented above, section one sets the context for the case study by exploring the rainfall variability-human food security-social vulnerability nexus and describes the issues currently affecting India, and Chhattisgarh State in particular. In section two, a brief account of some of the literature available on the subject is presented primarily to gain an understanding of the key issues connected to the research. Section three introduces the methodology applied and the process followed in the case study. The survey tool is then described and an overview of the experimental design process is given. Then a description of the stated preference survey design process for India and Chhattisgarh is provided, highlighting local factors influencing the study design and its implementation. Also, the limitations and constraints faced by this research are presented. This is followed in section four by a detailed description and rationale for choosing each of the study sites (both the base village and the satellite villages) in terms of the socio-economic profile.

The main findings are expounded in sections five to eight. In section five, particular attention is given to the results across study villages on the rainfall patterns/variability and particular events related to rainfall in the past 30 years. In section six, livelihood impacts and food security patterns in the base camp and satellite villages are presented. Section seven deals with the migration component of the study by mainly addressing the main factors that lead to migration, and all the circumstances surrounding this issue in the research villages. Section eight presents the analysis of the main findings regarding the interrelation between rainfall variability, food and livelihood security and human mobility in the research villages. A summary of the research findings and conclusions are provided in section nine. Finally, several policy relevant findings are then discussed and presented in section ten as "Reflections for policymakers". This section also offers some recommendations in terms of the future actions required at various levels to build a robust adaptation response to rainfall variations and other climatic-related events in the region.

1.4 Profile of case study country – India

India is the seventh largest country in the world with an area of 3,287,263 km^2. The Indian peninsula is separated from mainland Asia by the Himalayas. The country is surrounded by the Bay of Bengal in the east, the Arabian Sea in the west, and the Indian Ocean to the south. The mainland extends between 8°4′ N to

37°6′ N latitude and 68°7′ E to 97°25′ E longitude. It measures about 3,214 km from north to south between the extreme latitudes and about 2,933 km from east to west between the extreme longitudes. It has a land frontier of about 15,200 km. The total length of the coastline of the mainland, Lakshadweep Islands and Andaman & Nicobar Islands is 7,516.6 km (Government of India, 2005). According to the recent population census (Government of India, 2011), India has 1,210,193,422 residents living in the country, thus making it the second most populous country in the world. Overall, the literacy rate in the country in 2011 was recorded as 74.04 per cent. About 65.46 per cent females and 82.14 per cent males were found to be literate (Government of India, 2011).

In addition to challenges related to poverty and the need for more economic development, India is facing many environmental and social challenges related to global climate change. The massive retreat of glaciers in the Himalayas, erratic monsoons and an inundation of low-lying coastal areas and islands are threatening the lives and livelihoods of millions of people. According to the Global Adaptation Index (2010), India is one of the most disaster-exposed countries in the world with an estimated 60 per cent of the country being prone to earthquakes and 70 per cent to floods (UNDP, 2011).

India is blessed with a variety of climatic regions, ranging from tropical in the south to temperate in the north. Four major climatic groupings predominate the Indian sub-continent, into which six climatic zones are defined on the basis of temperature and precipitation (Heitzman and Worden, 1996). They are: alpine, humid subtropical, tropical wet dry, tropical wet, semi-arid and arid. The monsoons are a striking feature of India, with the country very often swept by the seasonal rain-bearing clouds moving across the entire Asian continent, which makes most of the rainfall occur within only a few months across the country. All the Indian agro-climatic zones are associated with various monsoons and their respective timings and amplitude. The main monsoons with the natural maximum precipitation occur in the following seasons and geographic locations: in winter in the northwest; in summer across the broad centre and on the west coast, and in October and November on the eastern peninsula and Sri Lanka (Stein, 2010). Regarding rainfall variability during each monsoon season, it is evident that there is a large spatial and intraseasonal variability of the monsoon rainfall across the country (Krishnamurthy and Shukla, 2000). When analysing the rainfall in India for the period 1901 to 1970, Krishnamurthy and Shukla conclude that there is "considerable variability in the spatial patterns of the rainfall anomalies over India on both daily and seasonal timescales".

Although the Indian economy witnessed more than 7.5 per cent GDP growth each year in the last decade, the growth has not been sufficiently inclusive. Poverty levels were found to be high in seven states (Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh) and are compounded by insecurity and the risk of conflicts. The percentage of poor among Scheduled Castes and Scheduled Tribes remains high in these states.

The food security concerns in India have always urged the policymakers to foster production of food grains. However, the gains from traditional crops, especially food grains, are limited and "the future sources of agricultural growth lie in the high value sector (viz. horticulture, livestock, and marines)" (Gulati, 2009).

Dev and Sharma (2010) state that India's malnutrition levels are almost double those of many countries in Africa. India is ranked 96 out of 119 countries in the Global Hunger Index (GHI) developed by the International Food Policy Research Institute (IFPRI) in 2006. In terms of child malnutrition, India is ranked 117 among 119 countries and "the prevalence of child malnutrition in India declined by six percentage points (from 53 per cent to 47 per cent during 1992–1998) and then stagnated,

reaching 46 per cent in 2005–2006 (only 0.6 per cent decline during 1998–2005)" (Pathak and Singh, 2011).

Like many countries in the world, people do migrate in India for various environmental, social, economic and political reasons. In the last decade, India has witnessed large-scale mobility of people due to the opening up of new frontiers of employment and opportunities. Mostly urban areas started growing on a rapid scale with new infrastructure and construction being added every day. The cross-border movement of people, from rural to urban, from one state to another state, and in some cases international migration, has increased substantially. While the current status on migration is awaited from government sources, the 2001 National Census enumerated 30 per cent of the population or 314 million people were migrants in the country. Of these migrants by last residence, 268 million (85 per cent) were intrastate migrants, (those who migrated within the state), while 41 million (13 per cent) were interstate migrants and 5.1 million (1.6 per cent) migrated from outside of the country.

Deshingkar and Akter (2009) emphasize, however, that census data does not always account for either short-term or circular migration, which usually represents most of the internal migration in India, and which in turn is the type of migration that is usually associated with climatic problems (farmers and herders). Moreover, the census only reports the main reason for migration without listing the secondary reasons that might be related to climatic factors. It is estimated that net rural-urban migration (14.3 million) contributed up to one-fifth of urban growth during the period 1991–2001 (Bhagat and Mohanty, 2009).

Figure 1: Map showing the location of Chhattisgarh and Janjgir Champa district. Source: Verena Rossow (2012).

1.5 Profile of Chhattisgarh State and Janjgir Champa district

This research was carried out in the Chhattisgarh State in India (see Figure 1). Chhattisgarh was formed on 1 November 2000 by carving out 16 districts of undivided Madhya Pradesh State, which now has 18 districts. Chhattisgarh lies between 17°47' to 24°06' N latitude and 80°15'to 84°24' E longitude. The state measures 640 km from north to south and 336 km from east to west with a total area of 135,194 km^2. It constitutes 4.1 per cent land area of the country, thus making it the ninth largest state in India. Chhattisgarh shares its borders with six neighbouring states. Physiographically, the state is divided into three zones,

namely: the Chhattisgarh plains, Bastar plateau and Northern hills. The soil is shallow in the upper regions with less developed features and is highly eroded in nature. Down the slope, the soil has more developed features.

Hydrologically, the state is covered by four drainage systems, namely Mahanadi, Godavari, Ganga and Narmada (Joshi and Verma, 2004). According to the Forest Survey of India (2009), Chhattisgarh has 59,772 km^2 of forest, which is 44.21 per cent of the total geographical area of the state. Chhattisgarh is very rich in mineral wealth – it is endowed with all major minerals. The state also has mega industries such as steel, coal-based power generation, mining, aluminium and cement production. The latest Population Census (Government of India, 2011) revealed that the state has 25,540,196 residents, of which 12,827,915 are male and 12,712,281 are female. Compared to the previous census in 2001, the state has registered a 22.59 per cent increase in population in one decade. The population of Chhattisgarh is 71.04 per cent literate, with a male literacy rate of 81.45 per cent and a female literacy rate of 60.59 per cent. The state has the largest tribal population in central India, which exhibits diversity in origin, socio-cultural history, dialect, livelihood and level of engagement with mainstream society. They are concentrated in the north-east and the southern parts of the state. Chhattisgarh was one of the states with the highest child malnutrition rates in 1992–1993. Although the situation has improved in other states, child malnutrition rates in Chhattisgarh continued to be above 50 per cent, even in the past decade (Pathak and Singh, 2011).

Janjgir Champa district, where the research was carried out, is a relatively new district bifurcated from the undivided Bilaspur district. According to the 2011 Census Report, Janjgir Champa has 15 small towns and 892 villages. The district has a total population of 1,620,632 with 816,057 males and 804,575 females. The district registered a population growth of 23.01 per cent in the last decade. Janjgir Champa registered a 73.70 per cent literacy rate in the recent census study.

Section 2: Literature review

2.1 Impacts of climate change in India and Chhattisgarh

The extent to which rainfall, temperature patterns and the intensity of extreme weather events will be altered by climate change remains uncertain, although there is growing evidence that future climate change is likely to increase the temporal and spatial variability of temperature and precipitation in many regions (IPCC, 2007). Lonergan (1998) estimates that India's climate could become warmer under the conditions of increased atmospheric CO_2. Climate change projections made up to the year 2100 for India indicate an overall increase in temperature by 2 to 4 °C, with no substantial change in precipitation (Kavikumar, 2010). However, different regions are expected to experience variations in the amount of rainfall; according to a study carried out by Bhagat and Mohanty (2009) based on rainfall trends from 1901–2004, a significant increase in rainfall is likely to occur in West Bengal, Central India, coastal regions, south-western Andhra Pradesh and Central Tamil Nadu. A significant decreasing trend was observed in the central part of Jammu and Kashmir, northern Madhya Pradesh, central and western parts of Uttar Pradesh, and northern and central parts of Chhattisgarh (Rao et al., 2009). The 4x4 Assessment Report by the Ministry of Environment and Forests (MoEF) (Kulkarni et al., 2010) provides information about the monsoon rain, temperatures and extreme events in the past as well as plausible scenarios for the future in all India. The mean annual minimum temperature has significantly increased by 0.27 °C per 100 years during the period 1901–2007. The number of heavy rainfall events is increasing almost over the entire landmass of the country. Moreover, the frequency and intensity of extreme events defined as one-day maximum precipitation shows an increasing trend everywhere except some northern parts of the

country. A 10 per cent increase in the monsoon rainfall over central and peninsular India is projected in the 2030s. In addition, a 1.5-2 °C warming in the annual mean temperature over the Indian landmass is projected, while winter (Nov – Feb) and spring (Mar – Apr – May) seasons show relatively higher warming (Kulkarni et al., 2010).

In Chhattisgarh, analysis of the rainfall data shows that blocks in the central part of the state, adjoining Janjgir Champa, Raipur and Bilaspur, experience low average annual and average seasonal rainfall (Gupta, 2002). These changes are likely to have adverse impacts on India's fresh water resources, agriculture and livestock, forests and wildlife, coastal and marine ecosystems and on human health. In India, climate change impacts will add additional stress on ecological and socio-economic systems which are already facing tremendous pressures due to rapid economic development activities, such as urbanization and industrialization.

2.2 Rainfall variation and its impact on agriculture and livelihoods

Agriculture is a major constituent in the Indian economy. India's small and marginal farmers account for 80 per cent of the overall farmers in the country and they own less than 2 hectares (ha) of land on average. In other words, the land provides livelihood security for 65 per cent of the people, and the small farmers provide food security for 1 billion people (Shiva, 2007). India occupies the first position among the countries that practice rain-fed agriculture, both in terms of extent and value of production. A large part of Indian agriculture depends on monsoons. Out of an estimated 140.3 million ha net cultivated area in India, 79.44 million ha (57 per cent) is rain-fed (CRIDA, 1997). Rain-fed agriculture contributes the production of 91 per cent of coarse cereals, 91 per cent of pulses, 80 per cent of oil seeds and 65 per cent of cotton in the country (Bhagat and Mohanty, 2009). On the other hand, India receives 4,000 billion cubic metres (BCM) of rainwater annually and nearly 1,600 BCM falls on agricultural land. About 240 BCM equivalent rainwater is available for harvesting in small-scale storages. Regions with up to 1,000 mm rainfall potentially produce 114 BCM run-offs, and nearly one-quarter of annual rainfall is received before or after the cropping season (Sharma et al., 2010).

There has been a noticeable change in the extreme rainfall events that occurred over India in the past (Guhathakurta and Rajeevan, 2008; Guhathakurta et al., 2011; Rupa Kumar et al., 2002). The rainfall pattern dictates regional and national economic disaster management and hydrological planning for the country; it has complex linkages with agricultural production and rural-urban migrations. The Indian summer monsoon/rainfall (June to September) is very crucial for economic development, disaster management and hydrological planning for the country (Guhathakurta and Rajeevan, 2008).

Various initiatives on the research and policy front indicate that the climate change impact on agriculture has received considerable attention in India as they are closely linked to the food security and poverty levels of the vast majority of the population. With the growing evidence of climate change since the late 1990s, an increasing emphasis was put on studying the impact of climate change on Indian agriculture (Kumar and Parikh, 2001; Lal et al., 1998; Mall et al., 2006). It was found that wheat yields could decrease between 28 and 68 per cent in the next one or two decades (by 2032) without considering the CO_2 fertilization effects, and would range between +4 and -34 per cent after considering CO_2 fertilization effects (Rao and Sinha, 1994). According to Saseendran et al. (2000), for every one degree rise in temperature there would be a 6 per cent decline in the rice yield. Mall et al. (2006) through their research provide evidence of a significant drop in yields of important cereal crops such as rice and wheat under climate change conditions. Methods adopted to study the impact of climate change on agriculture in India are largely site-specific, based on research being carried out in farm fields (Kelkar and Bhadwal, 2007).

A number of modelling studies based on future climate change scenarios, with a focus on the vulnerability of rice and wheat yields, have been carried out for India. According to the latest results of the crop simulation modelling studies published in the Fourth Assessment Report (AR4) (IPCC, 2007), the drop in yields of non-irrigated wheat and rice in India will be significant: a temperature increase beyond 2.5 °C would incur a loss in farm-level net revenue of between 9 and 25 per cent. Net cereal production in India is projected to decline at least between 4 and 10 per cent by the end of this century under the most conservative climate change scenario (Lal, 2007, cited in IPCC, 2007).

Most parts of Central India show a decreasing trend in frequency of rainy days. A decrease in intensity and frequency of extreme rainfall was observed over Chhattisgarh, Jharkhand and some parts of Northern India (Guhathakurta et al., 2011). After analysing the long-term rainfall records of about 58 stations in Chhattisgarh, it was found that the rainfall patterns were changing in the state in the order of 35 per cent in some localities to as low as 5 per cent in other locations (Sastri, 2009). Chhattisgarh receives an average annual rainfall of 1,300 mm. Although this amount is quite sufficient for growing rice crops, erratic distribution of rainfall, frequent dry spells and heavy rainfall at times cause failure and adversely affect the economic conditions for the farmers (Sastri, 2009). Due to changes in rainfall pattern during the Kharif season (crops which are sown in the rainy season and harvested in the autumn season, or monsoon crops) and temperature variations in the Rabi season (crops sown in the winter and harvested in the spring, or winter crops), changes in the crops and crop rotations have been observed in Chhattisgarh. For example, the cultivated area under rice in the state is decreasing continuously. Because of the decreasing rainfall pattern, rice farming is failing in fragile ecosystems, for example upland areas. Similarly, during the Rabi season, the area of wheat is showing a decreasing trend (Sastri, 2009).

2.3 Livelihood support mechanism and food security

In Chhattisgarh, paddy is the main crop grown in about 3.7 million ha, covering 77 per cent of the net sown area. Only about 20 per cent of the area is under irrigation, and the rest is under rain-fed conditions. Due to changes in rainfall patterns and shifts in the monsoon in terms of delayed onset, farmers in Chhattisgarh have adopted various measures. The farmers used to grow long duration, tall varieties of rice that flower in mid-October and mature by mid-November. As a consequence of decreasing rainfall trends, especially in October, the long duration varieties started failing and since the early 2000s farmers began taking early or medium-duration rice varieties (Sastri, 2009). Many agricultural extension workers have suggested that instead of providing blanket recommendations for agricultural adaptations, farmers need to be advised based on location, crop and climate conditions. Increased yields mean increased net profits, which can be achieved only through the adoption of improved and recommended practices.

According to the Food and Agriculture Organization of the United Nations (FAO, 1996), food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. Food insecurity exists when any such factors are missing. Based on the above definition, it is difficult to claim that all the small and marginal farmers in the state have adequate food security. The poverty alleviation strategy of the federal and provincial governments revolves around strengthening natural resource development and the promotion of off-farm income generation activities such as the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA) implemented in rural areas. Another major intervention by the government across many states is the supply of rice and wheat at a highly subsidized cost to the families living below the poverty line. This ensured food security to some extent.

Recognizing the challenges of global climate change for India's economic growth, the Government of India has brought out the National Action Plan on Climate Change (NAPCC), which was prepared by the Prime Minister's Council on Climate Change and released in June 2008. The NAPCC identified eight national missions and proposed to institutionalize them through the respective ministries. The National Mission for Sustainable Agriculture is one of the eight missions identified to combat the impact of climate change on agriculture. The implementation of the Plan was through appropriate institutional mechanisms which include public private partnerships and civil society engagement. Other focal areas promote the understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation across the country.

For adaptation to climate change in agriculture, the Ministry of Agriculture of the Government of India took several steps, including the development of new genotypes (of both plant and cattle), development of new land use systems, enhancement of value-added weather management services, and the development of a compendium of indigenous traditional knowledge for its utilization. The National Policy for Farmers of the Ministry of Agriculture (2007) adequately addresses the importance of adaptation in agriculture.

2.4 Mobility and migration as a coping and adaptation strategy against rainfall variations

Migration is a worldwide phenomenon happening due to a number of factors such as economic, socio-political, cultural and environmental changes. The factors underlying migration are often complex. For some communities, migration is a tradition. In other regions, people migrate for improved livelihood opportunities. Forced migration is different from other types of migration occurring, due to opportunities arising from new economic developments. There are an estimated 80 million seasonal migrants in India. More than 1.2 million interstate migrant workers work in the agricultural sector. Brick kilns provide temporary employment to around 1 million seasonal migrant workers. Various construction works of roads, railways, buildings, dams, canals, etc. employ nearly 2 million interstate migrants. Around 4.5 million interstate migrant workers work for temporary periods in different sectors (Salve, 2009).

In addition, large numbers of seasonal migrants work in the urban informal manufacturing, construction services and transport sectors as casual labourers. In general, adult males are the primary migrants. However, whole families also migrate every year with or without children. Women usually migrate to accompany the males but also to generate income for the households. Nevertheless, several other micro surveys have noted that, as with the migration of single males, single females are also increasingly moving in search of jobs (Mitra, 2003). These migrants undertake unskilled, hard and risky jobs in the unorganized/informal sector, such as construction sites, brick kilns, shops and small-scale industries. Caste-kinship bonds and other kinds of village networks help rural jobseekers to arrange such urban-based jobs (Banerjee, 1986).

A study examining migration rates in the state of Rajasthan during drought periods reported important changes in occupation patterns. A severe drought in 2002–2003 forced 80 per cent of the farmers to quit the fields and join the labour force, both at relief sites and in the regular economy (Rathore, 2004). According to the Population Census carried out in 2001, migration into large cities was significant during 1991–2001, with Greater Mumbai drawing about 2.49 million migrants, Delhi about 2.11 million migrants, and Chennai about 0.43 million migrants, to name just the largest three urban destinations in the country. Besides this decadal count, there is no verified census of rural-urban movement, particularly the seasonal migrations, but the Population Census and the National Sample Survey (NSS) use definitions of migration that are not employment-related. These are changes in birthplace and in the last usual place of residence. Moreover,

they provide only the main reason for migration and do not focus on secondary reasons, which are often work-related, particularly in the case of women. In addition, they count only migrant population and not flows which are actually more important for policy intervention. Finally, they seriously under-estimate categories of work that employ migrant workers (Anon., 2010).

There are strong links between failure of rainfall and poor natural resource management (NRM) on the one hand, and unemployment in rural areas on the other. These strong links are causing and accelerating the migration issue in many rural areas of India. According to Desarda (1987), drought is not entirely caused by nature but also by the failure of the system to properly plan and use the land and water resources. Desarda further emphatically stresses that the water resources in India are colossal but seasonal, regionally distributed and very compressive in nature. However, the problem of chronic under-employment in rural areas was essentially due to the failure of seasons and lack of resources (Gadgil, 1972).

Poverty is directly related to the existence of unemployment, under-employment and low productivity (NIRD, 1984). Part of agriculture is a seasonal occupation, which cannot provide job opportunities for everyone all year round (Powar, 1983). In the absence of irrigation facilities permitting multiple cropping, monsoon agriculture imposes on the majority of the rural labour force an extended period of seasonal unemployment (Myradal, 1970). This helplessness makes the unemployed labourers leave their village homes and swell the already over-populated areas, not only in India but also in other parts of the developing and developed countries, whose agricultural labourers are shifting to the industrial sector (ILO, 1960).

In Chhattisgarh, seasonal migration in search of wage labour is very common in many districts. Most of them are landless farm labourers and some are marginal landholders who grow one crop of rice in a year. After one season of agriculture employment, landless labourers choose seasonal migration due to lack of productive assets or availability of alternative employment options in the villages. People who belong to Most Backward Castes (MBC), Scheduled Castes (SC) and Scheduled Tribes (ST) migrate in large numbers. It is ironic that Chhattisgarh, known as the rice bowl of India, pushed food-insecure farmers out of their villages due to a lack of alternatives. The state has the lowest percentage of irrigated land (16 per cent), which clearly shows that families cannot sustain themselves on rainfall-dependent agriculture (Anon., 2008). Figure 2 shows the cultivable area under irrigation in Chhattisgarh.

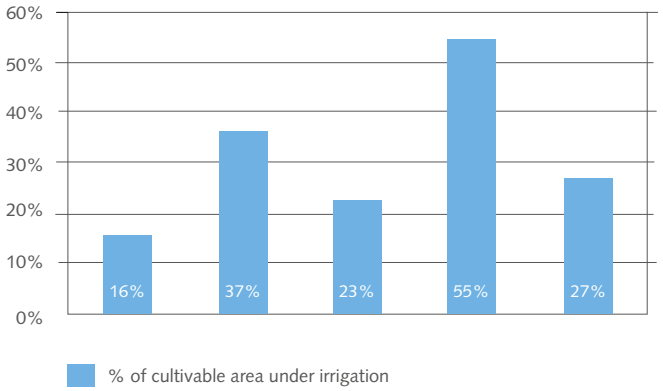


Figure 2: Cultivable area under irrigation.
Source: Mobile Crèches Report (Anon., 2008).

Section 3: Methodology

3.1 Research design and process

The goals and objectives of this policy-oriented research, as indicated in the introductory section, are to study and understand the rainfall variability impacts on food security, livelihood security and mobility/migration among people particularly vulnerable to the impacts of climate change. The study essentially addresses the three pillars of sustainability: economic (agriculture and livelihood); environmental (rainfall and climate); and social (poverty and migration). Guided by the theoretical framework, the study contemplates various stages and processes to be adopted in the research (see Rademacher-Schulz et al., 2012 for a general methodological overview).

The detailed literature review presented in section two serves as the foundation to formulate the aim, objectives and research questions for the study. The research uses inductive and deductive approaches to help narrow down the focus from theory to practice and from global to local. This approach also helps demonstrate familiarity with a related body of knowledge, establishing credibility, showing the path of prior research and how the current study is linked, integrated and summarized. The Rainfalls project is a significant second generation approach to help fill these policy relevant knowledge gaps after previous studies contributed to the building of a research agenda for investigating the complex relationships between environmental factors and migration (e.g., Afifi, 2011; Afifi and Jäger, 2010; Afifi and Warner, 2008; Foresight, 2011; Milan et al., 2011; Piguet, 2008, 2010; Renaud et al., 2007, 2011; Stal and Warner, 2009; Warner, 2010, 2011; Warner and Laczko, 2008; Warner et al., 2009).

3.2 Research methods

The following methods were used to study the current links between rainfall variability, food security and migration:

- Participatory Research Approach (PRA);
- Structured interviews/Household survey;
- Semi-structured interviews with experts.

For the rainfall research in India, the set of PRA tools demonstrated in Table 1 were used for obtaining information from the participants. Since the information to be collected using each PRA tool was linked one to another, it was decided to sequence the PRA tools. Moreover, to maintain the continuity and flow of information, it was decided to conduct all the PRAs with the same group/community. However, to obtain divergent views and opinions on various aspects of rainfall variation, livelihood conditions, migration, status of women, concerns of under-privileged sections, it was decided to form three groups in each village to provide fair chances for all sections of the community to voice their views. Table 1 also provides the sequence and details of PRA sessions held in the base camp, Table 2 provides the PRA sessions conducted in the satellite villages, and Table 3 shows the group composition of the PRA sessions.

Regarding the household survey, Table 4 provides the village-wise breakdown of household surveys conducted and latitude and longitude coordinates.

S. No.	PRA tool	Output envisaged	No. of PRA sessions conducted
1	Focus group discussion	General profile of village, rainfall patterns, changes/variations in rainfall, livelihood profile, migration patterns.	1
2	Transect walk	Village resource map capturing key areas such as residential areas, agricultural land, local institutions.	1
3	Seasonality calendar	A matrix of major seasonal variations (drought, flood, monsoon, summer, winter), agricultural activities (sowing, harvesting times), food security (plenty of food, shortage of food), migration (seasonal, long duration) etc., captured on a paper chart.	3
4	Timeline on important events and rainfall & trend analysis	1) Major events listed and chronologically arranged on a paper chart; 2) A graph where key rainfall and harvest-related events were temporally plotted.	3
5	Livelihood risk ranking and Venn diagram on food security and support services	1) Direct livelihood risks are identified, prioritized based on their severity. Frequency of each risk's occurrence in a year is captured and coping strategies are identified and listed for each risk. Everything arranged on a paper chart; 2) Venn diagram on food security and village support services.	3
6	Mobility map on migration and Venn diagram on migration support services	1) Names of places/cities/towns of migration are identified. Purpose, number of migrants, choice of destination, kind of jobs, cost of migration, remittance amount and mode need to be captured. All of the destinations are arranged on a paper chart where most influential destinations were placed closer to the village and least influential villages were kept away from the village. A discussion on reverse migration and notes are taken;	3

S. No.	PRA tool	Output envisaged	No. of PRA sessions conducted
6	Mobility map on migration and Venn diagram on migration support services	2) Venn diagram on institutions/companies, their contractors, agents, family members, friends and other networks influencing the community to take the migration decision, and the cards are arranged on a chart based on the levels of influence.	3
7	Impact diagram on rainfall variability and food security including ranking coping strategies	1) Major rainfall-related impact is identified and participants are probed to provide sequences of possible events based on the severity, and the likely events are captured and interlinked; 2) Coping strategies are listed and ranked based on the comfort levels (most severe, moderate, less severe) of respondents, on a paper chart.	3
8	FGD on future strategies for adaptation	Future strategies of youth in a village are captured for each question and notes are arranged accordingly.	3

Table 1: Sequence of Participatory Research Approach tools, expected outputs and number of sessions held in the base camp. Source: Authors.

S. No.	PRA tool	Output envisaged	No. of PRA sessions conducted
1	Focus group discussion	General profile of village, rainfall patterns, changes/variations in rainfall, livelihood profile, migration patterns.	3
2	Transect walk	Village resource map capturing key areas such as residential areas, agricultural land, local institutions.	3
3	Seasonality calendar	A matrix of major seasonal variations (drought, flood, monsoon, summer, winter), agricultural activities (sowing, harvesting times), food security (plenty of food, shortage of food), migration (seasonal, long duration) etc., captured on a paper chart.	9
4	Livelihood risk ranking and Venn diagram on food security and support services	1) Direct livelihood risks are identified, prioritized based on their severity. Frequency of each risk's occurrence in a year is captured and coping strategies are identified and listed for each risk. Arrange everything on a paper chart; 2) Venn diagram on food security and village support services.	9
5	Mobility map on migration and Venn diagram on migration support services	Names of places/cities/towns of migration are identified. Purpose, number of migrants, choice of destination, kind of jobs, cost of migration, remittance amount and mode need to be captured. All of the destinations are arranged on a paper chart where most influential destinations were placed closer to the village and least influential villages were kept away from the village. A discussion on reverse migration, and notes are taken.	9

Table 2: Sequence of Participatory Research Approach tools, expected outputs and number of sessions held in satellite villages. Source: Authors.

Group No.	Profile of participants	Gender	No. of participants in each session
1	Farmers, local traders, school teacher, ward member from upper caste, panchayat secretary	Male and female	10–15
2	Farm labourers, ward member from SC/ST, BPL card holders, landless people, person without own house/assets	Male and female	10–15
3	Farmers, non-farmers, traders, Anganwadi worker, widow, spinster, family member of migrant worker, migrant, etc.	Only female	10–15

Table 3: Group composition of the Participatory Research Approach sessions. Source: Authors.

S. No.	Name of village	Household IDs provided	No. of households covered	No. of total households	Lat, long Coordinates
1	Jullan Pakaria	07/03/052 to 07/03/138	87	688	N – 21.55.30 E – 82.26.21
2	Akalteri	07/01/001 to 07/01/021	21	152	N – 21.56.42 E – 82.39.16
3	Banahil	07/04/139 to 07/04/180	42	326	N – 21.57.16 E – 82.25.22
4	Silli	07/02/022 to 07/02/051	30	233	N – 21.55.12 E – 82.27.6
		Total	180	1399	

Table 4: Details of village-wise household survey conducted. Source: Household survey.

In the semi-structured interviews, the team attempted to gain more insight into the three main variables of the study in Chhattisgarh, and more specifically in Janjgir. It was important to link the PRA session and the household survey results together and then link both to the expert interviews by informing the experts about the very preliminary research outcomes on the ground and seeking their feedback, in order to get a full picture. In some cases, the information was complemented and confirmed by the experts, and in others the team received contradicting information and had to balance between the various points of view. The experts who were interviewed were part of various institutions. A list is provided in Annex I.

3.3 Data sources, sampling and distribution

General information related to the Janjgir Champa district, socio-economic profile of villages, irrigation facilities and village maps was collected, interpreted and verified with the help of key informants as well as through personal observations. Temperature and rainfall data, population details, settlement patterns and occupations were obtained from published literature and from various government departments and academic institutions. Rainfall changes, livelihoods and migration details were obtained through FGDs, the household survey and semi-structured interviews with the key experts. The rainfall research aimed at representative sampling to arrive at more robust conclusions. Due to the non-availability of detailed household level information, the simple random sampling for the household survey was used. Simple random sampling was applied to select the households and ensure that adequate representative households participated in the research. In accordance with one of the selection criteria, Special attention was assigned to SC and ST respondents/ households during PRA sessions and the household survey. A total of 53 PRA sessions and 181 household surveys were conducted in 4 identified villages.

3.4 Pre-testing and validation

After pre-testing the household survey questionnaire in the field, major observations and feedback collected by the junior researchers were discussed during the research methodology orientation workshop. Necessary corrections were carried out in the questionnaire without compromising the overall design and structure. The questionnaire was also modified according to the Indian case. An example was to reformulate some questions in a culturally sensitive way without having to change the message of the question. Moreover, the caste issues were included in the questionnaire.

3.5 Data analysis

The collected data went through a process of comprehending or establishing the adequacy of information and synthesizing this to describe typical patterns or trends performed once data were coded into usable categories. The PRA outputs and semi-structured interviews with the experts were interpreted and compared to comprehend different patterns. Rainfall data collected from the Agro-meteorological department of the Indira Gandhi Agricultural University (2010) was analysed. Various kinds of evaluation of the data and results were aimed at answering research questions in terms of response rate, quantum of discrete measures and the relationships among different variables.

3.6 Research limitations and difficulties

Like any other research, this study also faced many limitations. A key underlying factor is the role of interdisciplinary data collection, where methods have been used from both environmental and social sciences. Limitations faced by the research can be categorized into methodological shortcomings and physical difficulties, some of which are the following:

- Lack of sufficient baseline data was one of the limitations faced by the research. The baseline data could have been useful to compare the results of PRA for triangulation and validation;

- Lack of sufficient time for pilot testing and fieldwork was also a major limitation which led to the team being totally exhausted towards the completion of the survey. Only part of the questionnaire was pre-tested;

- The case study region and sites were selected/finalized based on limited information available due to various constraints. For example, census data, voters lists and other detailed information that is specific to the site, was not made available;

- Considering India's vast geographical area and number of agro-climatic zones, the scope of the current study and its results could not be extrapolated/interpreted beyond a limit;

- In the absence of household data, only simple random sampling was possible in selecting the households for administering the questionnaire;

- Due to the requirements of maintaining uniformity of the research design, PRA tools and household questionnaire across the case study countries, a lack of customization of research tools was considered to be a limitation;

- In the household survey, sometimes respondents did not give a clear answer, which made the interviewer drop the respective question. In other cases, respondents gave two answers where the question required only one answer. Therefore, in some exceptional cases in this report, adding up percentages in a table might give a sum of slightly less or more than 100 per cent.

Since the number of participants of each PRA session was larger than anticipated:

- The different backgrounds of the participants of each group were quite diverse, and therefore the researchers had to make sure that everyone was communicating and expressing themselves, as each one could be representing a different point of view/interest. This sometimes led to physical fights among the participants;

- Quite often, one or two people fully dominated the discussion (e.g., one dominant male towards females, or even a female who has a special – political – status in the village towards villagers). One or two researchers made sure to engage such participants in side discussions, so that the flow of the main discussion could proceed with as many as possible being represented;

- Within the PRA sessions, there were some dropouts and people who joined later, which made it difficult to capture who was really in the session for the whole duration and whether every session really had a good balance and representation from the perspective of age, activity and gender;

- Getting the PRA groups together (in time) was very often a challenge, due to their daily responsibilities, especially in the field;

- Finding returned migrants was also a considerable challenge in some communities;

- Most of the sites relied to a large extent on canal irrigation rather than rainfall, but the team made sure to know from the participants – among others – to what extent the canal solved the problems they were suffering from in the times when they only relied on rainfall (to give a reference to the main variable the team was dealing with), etc.;

- The speed of the PRA sessions was quite diverse, depending on the education level of the participants, which led to the junior researchers not finishing their sessions at the same time;

- Some members of the team were received with high expectations and scepticism from the participants;

- Arranging expert interviews was an important limitation, partly due to their limited availability;

- The village maps were not provided timely due to the multi-responsibilities of some of the team members (e.g., arranging the expert interviews) and the time limitation;

- Due to the workload on the junior researchers, the team had to seek the assistance of other people to enter the quantitative data. The lack of communication between both teams due to the time constraint and the geographical distance was a challenge, especially since the team that entered the data had not mastered the English language and the research team's English language skills were also limited. This had its implications not only for filling in the questionnaires but also for data entry, especially with regard to open questions;

- The language among the communities was an additional challenge, since in some villages the Chhattisgari language was spoken with a very strong dialect, and so the researchers had to triangulate in order to get most of the information.

There might be other limitations in the research. Some respondents during the household survey may not have disclosed their exact family income and exaggerated their expenses to gain sympathy. To minimize the negative impact of the limitations, the research team was sufficiently oriented to use proxy indicators to obtain the true information. Triangulation was also carried out to improve the reliability and validity of this research. Overall, these limitations were all pre-considered and mitigated to a considerable extent through suitable modifications/consideration in methodological design and application.

Section 4: Introduction to the case study area

4.1 Site selection

After an extensive secondary data analysis of the impacts of climate change, particularly rainfall variation on livelihoods, food security and migration, the study decided to focus on India as one of the case studies of the project. In selecting the study region/district within India, the criteria listed in Table 5 were considered.

From Table 5 we see that, out of the three districts, Janjgir qualified for most of the criteria, compared to the two other proposed districts.

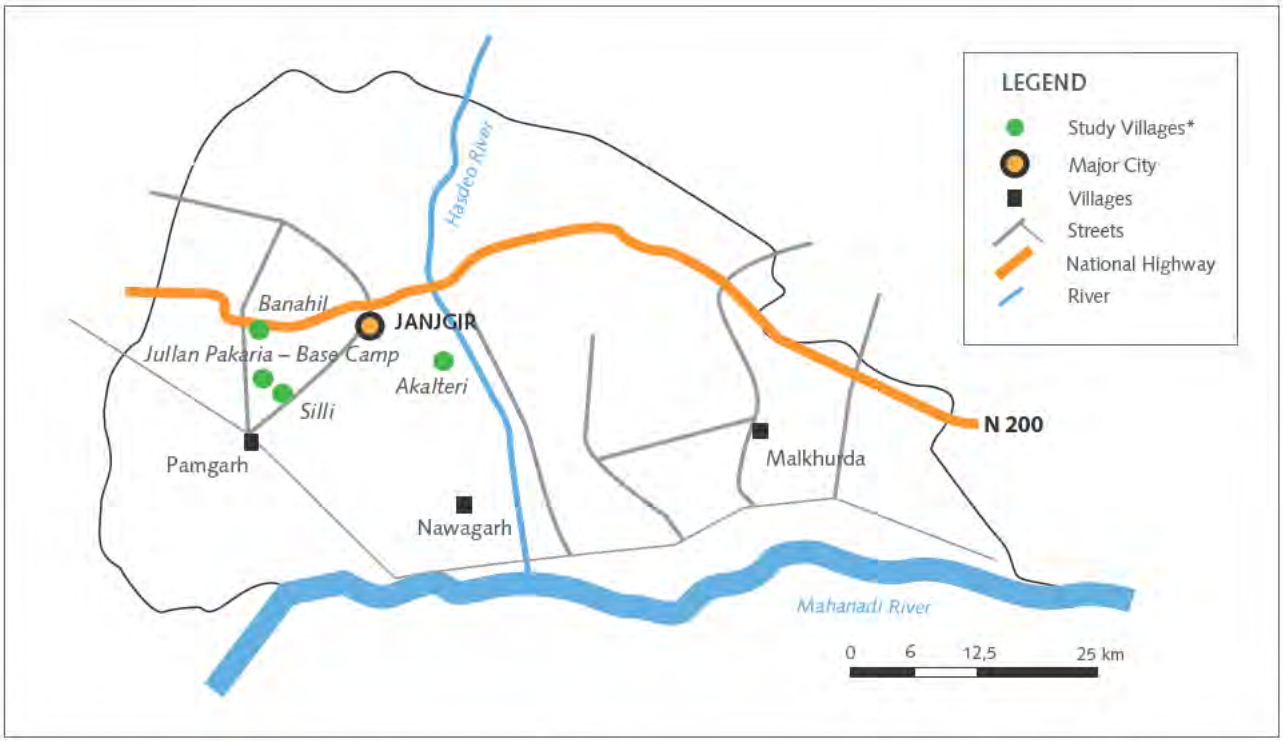
The rich body of literature suggested that Janjgir Champa District of Chhattisgarh State in Central India is an ideal site for the detailed research. Although the district is not entirely rainfall dependent for agriculture and other livelihoods, the rainfall trends, poverty and migration levels qualify Janjgir Champa district as one of the potential sites for detailed research. From various studies and informal discussions, other potential districts, such as Mahasamud and Sarguja, were to be investigated for this study. However, a number of factors, such as rapid industrialization, conflicts of interest among the local people and governments on land acquisition for industrial development, presence of irrigation facilities, and possibilities of mobilizing logistical support for the field study, guided the team to consider Janjgir Champa district as the final study area.

In Janjgir Champa district, nine villages were considered when selecting the base camp and satellite villages. In order to identify an ideal base camp, a combination of induction, deduction and case study approaches were used.

District/Criteria	Proposed site 1 (CEE1) **Janjgir**	Proposed site 2 Korba	Proposed site 3 Sidhi
Less predictable seasons (changes in beginning or end of agricultural season) over last 10 to 15 years	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Sensitivity of local livelihoods (e.g., rain-fed agriculture or pastoralism) to changing rainfall patterns	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Typical levels of poverty and food insecurity	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Purported linkage between changing rainfall patterns, food security and human mobility	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Practical criteria			
Less than one full day's travel from CARE CO (this may include air travel)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Accommodation for field team can be arranged in focus community (this could entail homestays with villagers, tents, etc.)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Complementarity of site with planned or existing CARE programmes	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)

District/Criteria	Proposed site 1 (CEE1) **Janjgir**	Proposed site 2 Korba	Proposed site 3 Sidhi
Timing – no irreconcilable conflict with agricultural calendars, etc. (assume research will take place in July or mid-September)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
[CO defined criteria]			
Has good functional relations with counterparts	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
Has monitoring & evaluation officer in other CARE project within the research area	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)	1 2 3 4 (poor fit) (good fit)
TOTAL "points"	37	28	26
Longitude/latitude	Longitude: Latitude:	82.55401611328125 22.001628438498244	

Table 5: District selection criteria. Source: Own compilation done by CARE India in 2011.



* The location of the villages in the map is based on approximate values, based on the assumptions of the researchers.

Figure 3: Location of study villages.
Source: Verena Rossow (2012).

A set of seven important indicators was used to rank the potential study sites in order to choose the most appropriate one (see Table 6). From the matrix, Jullan Pakaria emerged as the base camp for the case study. One of the main reasons the team choose this village as the base camp was the fact that it has the largest population compared with the other villages, and also it offers a broad range of diversities across its population. Other satellite villages selected were Akalteri, Banahil and Silli (see Figure 3).

Name of potential villages/indicators for ranking	% families below poverty line (BPL)	% families dependent on agricultural labour as primary livelihood	No. of livestock	% hand pumps against households	% SC and ST	% families possess motor bike	Violence against women	Suitability ranking by team after field visit
Jullan Pakaria	68	95	800	4	26	11	Yes	1
Banahil	77	17	500	6	63	10	No	2
Silli	79	77	25	6	39	8	Yes	3
Akalteri	32	86	90	5	4	1	Yes	4
Soti	36	74	130	7	27	10	Yes	5
Pacheda	0	57	480	12	54	10	No	6
Jogi Petta	15	83	298	1	55	8	Yes	7
Hathnegra	26	60	1180	3	69	25	No	8
Kanei	16	89	132	4	67	9	No	9

Table 6: Ranking and evaluation of potential sites to select the base camp and satellite villages. Source: Own compilation done by CARE India in 2011.

4.2 Socio-demographic profile of surveyed community

In addition to the PRA sessions, a total of 180 households were administered with the questionnaire survey in four villages of Janjgir Champa. Table 7 provides some socio-demographic details of the households covered in the survey. From the household survey, it is found that 79 per cent of households belong to the other backward class (OBC)[1]. SC households comprised of 9.4 per cent and ST comprised of 7.5 per cent. A meagre 3.3 per cent of respondents belong to the general category. The survey revealed that 75 out of 180 households surveyed were migrants, which makes up 41.7 per cent of the total households. Both Silli and Jullan Pakaria showed a higher percentage of households with migrants (66.7 per cent and 42.53 per cent, respectively). The average number of migrants per household was measured lowest at Banahil (2.4) and highest number of migrants per household seen among the respondents in Akalteri satellite village (3.6).

Table 8 presents the landholding pattern of respondents in the research area. In terms of the number of landless households, Banahil stood high at 36 per cent, followed by Silli (27 per cent), Akalteri (24 per cent) and Jullan Pakaria (18 per cent). The average landless households for all the villages were recorded at 24.4 per cent. Among the respondents, the average landholding across the study area was recorded at 0.91 hectares. A high proportion of small landholdings of less than or equal to 0.4 hectares of land were recorded in Banahil (50 per cent), followed by Silli (47 per cent) and Jullan Pakaria (33 per cent). Ownership of very large areas of land (2.04 hectares and above) was recorded, the highest in Akalteri (10 per cent), followed by Jullan Pakaria (7 per cent) and Banahil (5 per cent). Figure 4 provides the evidence for monoculture of rice from the respondents. Also, 97 per cent of farmers stated that they only grow paddy rice as a mono-crop/ monoculture.

1 The *Other Backward Class* is a term used by the Government of India (http://www.india.gov.in/) for castes that are economically and socially disadvantaged. The Scheduled Castes, also known as the Dalit, and the Scheduled Tribes are two groupings of historically disadvantaged people that are given express recognition in the Constitution of India.

4.3 Challenges in the site selection

There were some challenges associated with the site selection. Firstly, the team discovered that most villages that could be in the scope of the study within the Janjgir district are largely dependent on irrigated agriculture, and therefore the team tried to prioritize the village that relies the most on rain-fed agriculture compared to the rest of the villages, as a base village, which was not an easy task. Secondly, the Banahil village was at the beginning a good candidate for the base village, given its relatively high poverty rate and greater dependency on rain-fed agriculture. However, the CARE experts suggested not to take Banahil as a base village due to the high rate of alcohol consumption as well as its closeness to the main road, which could have had implications on the research process. Thirdly, the village Akalteri was a complete outlier from the criteria that the team used in selecting the villages (see Table 1). However, it was a good exercise to have the opportunity to run a comparison between Akalteri and the other three villages.

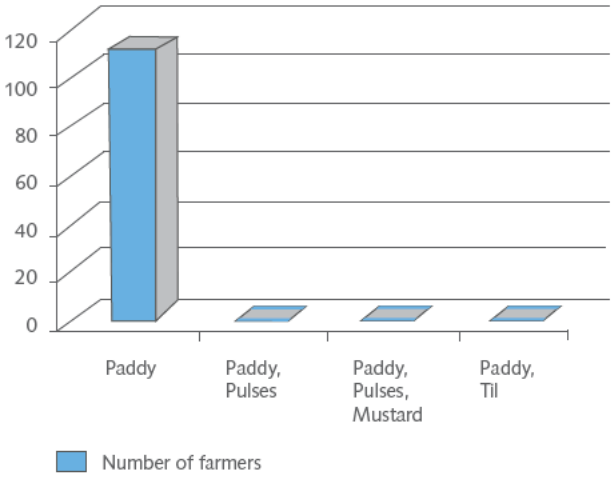


Figure 4: Type of crops cultivated by farmers in the study villages. Source: Household survey.

Name of village	Akalteri	Silli	Jullan Pakaria	Banahil	Total
Household samples collected	21	30	87	42	180
Interviewee's gender					
Male	20	26	66	35	147
Female	1	4	21	7	33
Ethnicity of households					
General	1	3	1	1	6 (3.3%)
OBC	19	22	66	36	143 (79.4%)
SC	0	4	11	2	17 (9.4%)
ST	0	1	9	3	13 (7.2%)
Unspecified	1	0	0	0	1 (0.56%)
Family size: Range (average)	4–24 (8.5)	1–15 (5.8)	2–24 (6.9)	2–10 (5.7)	1–24 (6.6)
Number of households with migrants	5 (23.8%)	20 (66.7%)	37 (42.53%)	13 (30.95%)	75 (41.7%)
Average number of migrants per household	3.6	2.9	2.8	2.4	2.8

Table 7: Socio-demographic profile of surveyed community in Janjgir Champa. Source: Household survey.

Name of the village	Akalteri	Silli	Jullan Pakaria	Banahil	Total
No. of landless households	5 (24%)	8 (27%)	16 (18%)	15 (36%)	44 (24%)
Land holding per household in hectares – Range	0.30 to 2.4	0.04 to 2.73	0.02 to 6.47	0.07 to 3.24	0.02 to 6.47
Average land owned in hectares	1.3	0.64	1.11	0.59	0.91
No. of households in each land holding category:					
Small landowners (≤ 0.4 hectares)	2 (10%)	14 (47%)	28 (33%)	21 (50%)	65 (36%)
Medium landowners (0.41 to 0.8 hectares)	4 (19%)	5 (17%)	12 (14%)	2 (5%)	23 (13%)
Large land ownership (0.81 to 2 hectares)	8 (38%)	2 (7%)	24 (28%)	2 (5%)	36 (20%)
Very large land ownership (≥ 2.04 hectares)	2 (10%)	1 (3%)	6 (7%)	2 (5%)	11 (6%)
Total no. of households (including landless)	21	30	86	42	179[2]

Table 8: Land ownership of households in Janjgir – Champa district. Source: Household survey.

2 One household head did not provide information regarding land holding.

Section 5: Climate variability

This section discusses the rainfall patterns and variability in the research site, based on the findings of the research team in the field.

The expert interviews revealed that the average annual rainfall in Janjgir Champa is 1229.4 mm. The rainfall pattern clearly indicates the dominance of south-west monsoon rainfall accounting for more than 90 per cent of the annual rainfall between July and September. The average rainfall for August is 387.8 mm, which is the highest and contributes 31.55 per cent of annual rainfall in the region. The July rainfall is slightly lower and contributes about 31 per cent of the annual rainfall. July and August rainfall are almost similar, and they contribute 62 per cent of total annual rainfall. The average south-west monsoon rainfall (>1,100 mm) contributes more than 90 per cent of the annual rainfall. The contribution of pre-monsoon and post-monsoon rainfall annually is less than 10 per cent, only 3.59 per cent of which was recorded during January to May. The linear trend shows slight decreases in the average annual rainfall pattern for the 30-year period from 1981; the significance can be accurately calculated with a larger set of data over a 100-year period. Figures 5 and 6 show average and comparison of annual and monsoon rainfall in Janjgir 1981–2010 with a clear peak in 1994 and a slightly decreasing overall trend in rainfall.

The Meteorological department data concludes that the monsoon generally begins in June and ends in October. Rainfall patterns and variability for Janjgir Champa regions for the 30-year period have been analysed and interpreted in detail and the results are presented in section 8.

The agro-meteorology department reported a reduction in the total number of rainy days from 65 to 56 in the past few years[3]. On the other hand, scientists at the Indira Gandhi Agricultural University have also confirmed the delayed onset of monsoon (seven days of delay); instead of starting around 10 June, now the monsoon rain begins around 17 June.

One other challenge mentioned in the expert interviews (agriculture extension officer) was that the groundwater table has decreased below 250 feet across the district. This complicates the availability of a water supply to villages during the peak summer period when most of the hand pumps go dry.

Due to the erratic rainfall, the ponds that the village inhabitants use for partial irrigation, but also for feeding their animals with water and for bathing and other similar activities, dry out more frequently. In general, the ponds are not taken care of by the communities and are polluted by human and animal waste. In addition, the duckweed herb grows on the surface, which hinders accessibility to the water. The experts mention that there is an increased need to sustain this water source from the communities' perspective, given the low level of water caused by erratic rainfall.

The seasonality calendar PRA sessions carried out across the four villages revealed that the changing weather and rainfall patterns have been affecting the livelihoods of the PRA participants. Instances including delayed onset of monsoon and erratic rainfall were discussed and reported (see Table 9). They were able to relate to this with the village festivals and other events very well.

This exercise also shed some light on the key seasons and the timing of various agricultural activities, such as preparing fields for cultivation, sowing and replanting, weed control and tending operations, harvesting, availability of water in the irrigation canals

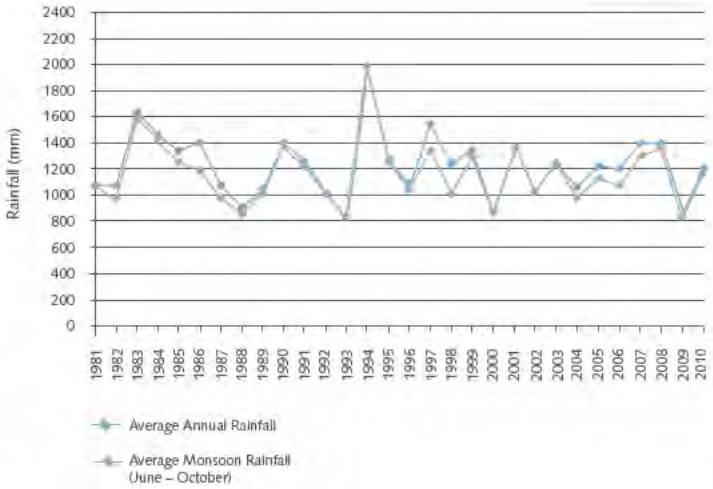


Figure 5: Average annual and monsoon rainfall in Janjgir (1981–2010). Source: Field survey analysis.

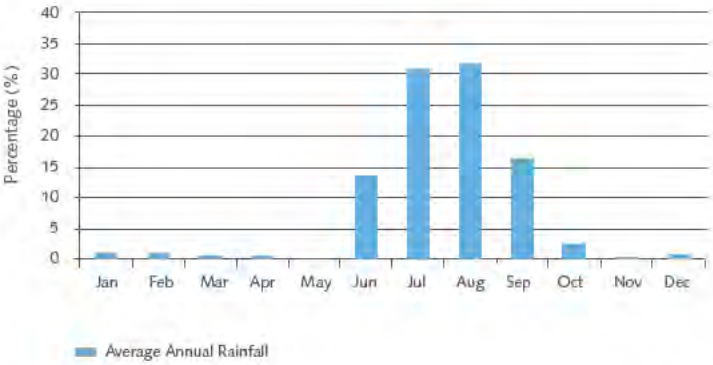


Figure 6: Comparison of annual rainfall and monsoon pattern in Janjgir Champa from 1981–2010. Source: Field survey analysis.

3 Since the information is based on personal interview, the precise number of years was not mentioned explicitly.

and periods of migration. Although the participants of the PRA sessions have captured the summer and winter seasons correctly, there were interesting discussions and rich debates on the exact timings of the rainy seasons/monsoons. While the base camp Jullan Pakaria conveyed the onset of the monsoon as the middle of June, the Silli village seasonality calendar stated that July is the starting time of the monsoon. Both Jullan Pakaria and Akalteri observed that the monsoon ends mid-October, whereas the Banahil calendar suggests September, and Silli village conveyed that monsoon rain extended to the end of October. The seasonality calendars and the discussions conveyed that there were disagreements in predicting the timings of onset and completion of monsoon rainfall across all the villages.

Reduction in the number of rainy days in a year was conveyed by few groups across four villages. Furthermore, it was stated by the PRA participants that the El Niño phenomenon[4] is driving the probability of a more or less intense rainy season with increased likelihood of droughts in Chhattisgarh. Less intense winter and heavy summer temperatures over the past decade was also reported in the expert interviews. In addition, it was mentioned that the water used from the canal built in 1986 provides irrigation to at least one crop in the Kharif season. Some PRA participants reported that the land in the upper command area receives sufficient water, whereas the land at the tail end of the canal does not receive sufficient water for the crops. As much as 84 per cent of the farmland in this area receives canal water for irrigation. Only 16 per cent of the agricultural land in the region is irrigated by wells and tube wells. Presently, water from the Bongo dam is provided to 247,000 ha of farmland through canals for Kharif crops from July to September. About 40,000 ha of land receive water for Rabi crops from January to March. Seasonal changes and rainfall patterns will determine water availability in the dam for Rabi crops and the extent farmlands to be irrigated. However, a general complaint in the PRA session was about the distribution of the canal water. Many participants mentioned that the water in the canal is not enough and that they believed that the government is biased against farmers towards the new power plants when distributing the water. This information was not accepted by most of the experts who recommend the farmers make the best use of the available water and land by diversifying their production throughout the year instead of using a monoculture system (mainly paddy rice).

Table 9 provides the major seasons and activities of communities in the survey villages in a calendar year.

Table 10 shows the perception of climatic changes among the interviewed household heads/representatives of the study. Out of 180 interviewees, the majority has not observed any floods over the past three decades (1981–2010). However, almost one-third of the interviewees reported that the droughts and dry spells have increased (in total 62 interviewees, 11 of whom even believe that the droughts and dry spells are currently a lot more than before). More interviewees reported their observation of increasing extreme weather events (a total of 68 out of 180). Since the research was done in four separate villages, and since most of the agriculture is irrigated in the research sites, the contradicting answers could be due to the fact that the dry spells do not directly impact on farmers who receive relatively regular amounts of water from the canals.

Table 11 summarizes the rainfall changes observed by the household heads/representatives of the research site. From the table and interviews it is clear that a high number of the households (107 out of 180) have been suffering from shorter rainy seasons.

Gaurelal Kasyap, a 48-year old farmer in the Akalteri village stated: "The rain is not like before. It is 8 to 10 days less than before. In the past, rain started in June and stayed till July/August. Now it starts in July and ends in August. The ending time of the rain has not changed, it is just the start".

4 El Niño is defined by prolonged differences in the Pacific Ocean surface temperatures when compared with the average value. Warming or cooling of at least 0.50 °C averaged over the east-central tropical Pacific Ocean. Typically this anomaly happens at irregular intervals of two to seven years and lasts nine months to two years.

Picture 1: Manish Ranjan, junior researcher of the project, interviewing Gaurelal Kasyap. Source: Julie K. Maldonado.

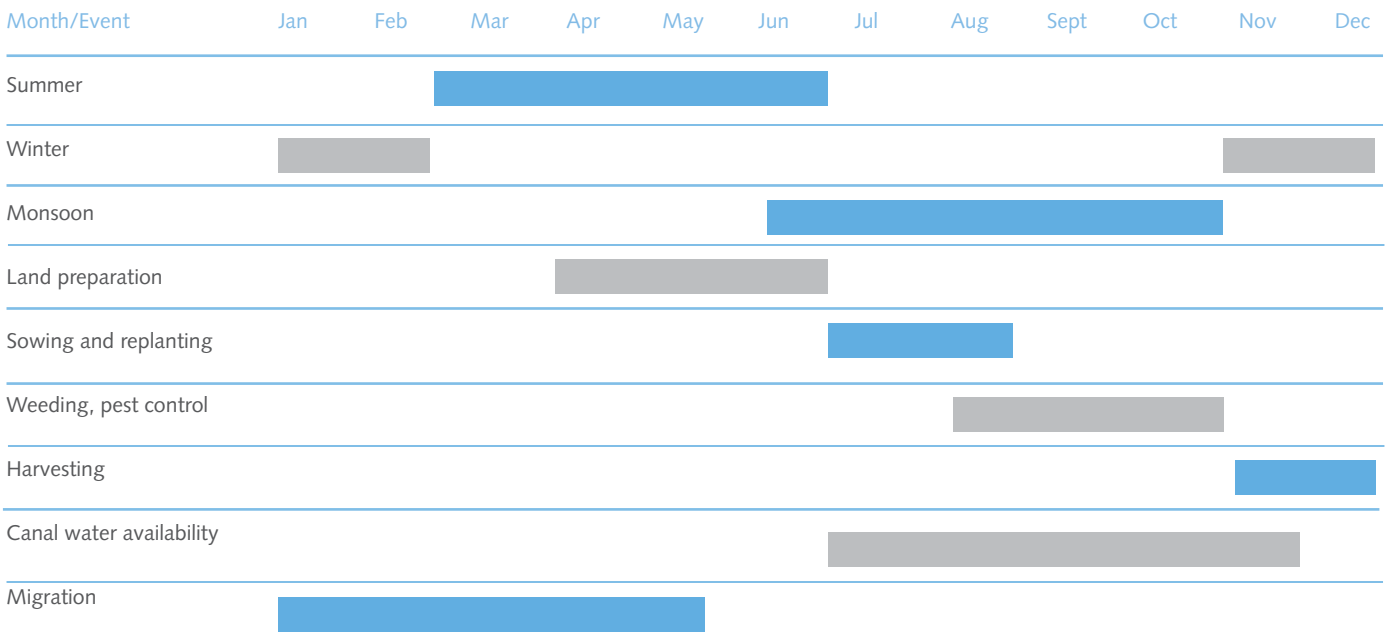


Table 9: Consolidated seasonality calendar of study area.
Source: PRA sessions.

	More drought/dry spells?	More flood?	More heavy rain?	More extreme weather events?
Yes, a lot more	11	1	11	13
Yes, more	51	12	49	55
Same as before	24	20	14	28
No, less than before	4	3	31	7
Not existed at all	76	105	66	70
Not applicable	10	33	4	3
Don't know				
No response	4	6	5	4
Total	180	180	180	180

Table 10: Perception of climatic changes in the households.
Source: Household survey.

Rainfall change	Yes
Longer rainy seasons	12
Shorter rainy seasons	107
More rain	43
Longer dry spells	22
Shorter dry spells	21
More dry spells	28

Table 11: Rainfall changes observed by the households[5]. Source: Household survey.

5 The sum of the observations is more than 180 (number of households interviewed), as multiple options were allowed in answering this question, meaning that one household could have observed more than one rainfall change.

Section 6: Livelihood and food security

The major livelihood activity for communities living in this region is agriculture. Hence, the livelihood concerns and risk factors that emerged out of the PRA sessions revolved around agriculture and the challenges of its sustainability. From discussions with both community members and experts, it is evident that agriculture is going through a tough phase. Although the yield has gone up since 2000, and reported regionally and nationally as an achievement, it does not capture the complex dynamics involved between farmers, farm labourers, farming practices and more importantly the cost of productivity. Some of the key challenges of agriculture in Chhattisgarh in general and in the study area in particular, according to both the experts interviewed and the PRA participants, are: delayed monsoons/seasons; single annual harvest; recurrent crop diseases; input-intensive unsustainable agriculture; labour shortage during peak harvesting seasons; and poor support price for the producer. Monoculture of rice has been practiced in the region for hundreds of years for cultural and traditional reasons, which include food consumption habits, soil conditions and flood irrigation patterns forcing farmers to go for rice cropping.

According to the Agriculture Department in Janjgir, the average paddy yield has increased since the early 1990s from 8–10 quintals per 0.405 hectares to 40–45 quintals per 0.405 hectares due to the irrigation facilities. The government purchases the paddy rice from the farmers through procurement centres situated across the state. According to the varieties, farmers get Rs 1,200/quintal for fine grain and Rs 1,000/quintal for the bigger

size grains, as minimum support price (MSP). The government also provides seeds and fertilizers at a subsidized price to farmers to encourage agricultural development and increase productivity in the state.

Within the PRA sessions, farmers and farm labourers identified the livelihood risks and ranked them according to the severity levels. They were asked to provide the frequency and intensity of their occurrences and possible coping mechanisms they adopt when encountered with such risks. Results of livelihood risk ranking suggested that rainfall-related risks such as delayed rainfall and shifting seasons were classified as major risks, particularly in Akalteri and Silli. Other major risks identified by them were linked to crop productivity, landholding patterns, crop diseases, less/no employment after the crop season, and shortcomings in other support services provided by the government. In the PRA sessions in the base camp Jullan Pakaria and the satellite village Banahil in particular, the participants identified pollution and rapid industrialization as important livelihood risks. They fear that their agricultural land could be forcefully acquired for industrialization as it had happened in nearby villages. Many of the livelihood risks were linked to each other and were looped. Even one or two successive crop failures could be devastating to the community, which is already fragile and in the grip of poverty and uncertainty. Tables 12, 13, 14 and 15 provide village-wise livelihood risk ranking, frequency of occurrence and coping mechanisms.

Severity ranking	Details of risk	Frequency of occurrence	Current coping mechanism
1	Poverty/less food	December to June	Working with big farmers and moving out of the village in search of employment
2	Less landholding	Throughout the year	Selling the land, working on other farmers' land and moving away in search of other livelihoods
3	Eligible families are not given BPL cards	Throughout the year	Getting support from neighbours and relatives. Borrowing money to buy food grains
4	Inflation and price rises	Last few years	Getting support from neighbours and relatives. Borrowing money to buy food grains
5	Less earning members and more elderly people to support at home	Throughout the year	Women forced to go for work within and outside the village
6	Less/no work	Six months in a year (January to June)	Working with big farmers and moving out of the village in search of employment
7	Increasing cost of agricultural inputs	June to October every year	Borrowing money from moneylender and involving family members in farm work
8	Crop diseases	July to October	Application of more pesticides
9	Recurrent illness of earning members	Many times in a year	Borrowing money from moneylender, women members forced to work on the farms

Table 12: Livelihood risks and coping strategies of communities in Jullan Pakaria base camp. Source: PRA sessions.

Severity ranking	Details of risk	Frequency of occurrence	Current coping mechanism
1	Less rain and delayed rain	Every year	Shifting to less-expensive food to make up for the loss/less profit from agriculture
2	Crop disease	July to October	Application of more pesticides
3	Agricultural produce always fetch less price	Every year	Buying less-expensive food Judicious spending to meet household requirements
4	Flood due to sudden rain during harvesting time	November and December	Shifting to less-expensive food to make up for the loss/less profit from agriculture
5	Poor healthcare facilities	Throughout the year	Travelling long distance and spending more money to get healthcare support
6	Less water in the canal	Throughout the year	Depending on bore well water and rain for irrigation
7	Fertilizers and pesticides are expensive	Every year	Borrowing money from moneylenders and available loans from relatives and friends
8	Less/no work	Six months in a year (January to June)	Working with big farmers and moving out of the village in search of employment
9	Less food/no food	Six months in a year (January to June)	Migrating to cities and towns in search of employment

Table 13: Livelihood risks and coping strategies of communities in Akalteri. Source: PRA sessions.

Severity ranking	Details of risk	Frequency of occurrence	Current coping mechanism
1	Poverty	Throughout the year	Borrowing money from others
2	Pollution	Throughout the year	No coping mechanism, adjusted to live in the polluted surroundings
3	Inadequate rainfall	Monsoon	Using canal water for irrigation
4	Crop disease	July to October	Application of more pesticides
5	Eligible families are not given BPL cards	Throughout the year	Getting support from neighbours and relatives. Borrow money to buy food grains
6	Inadequate fresh water supply	3 months (March, April and May)	Nearby industry supply fresh water in tanker lorries
7	Alcoholism	Throughout the year	Women taking the responsibility of meeting household expenses (saving money and keeping it out of reach of men)
8	Delayed payments from government for MGNREGA work	Throughout the year	Getting support from neighbours and relatives. Borrowing money to buy food grains
9	Increasing cost of agricultural inputs	June to October every year	Borrowing money from moneylender and involving family members in farm work
10	Less landholding	Throughout the year	Selling the land, working on other farmers' land and moving away in search of other livelihoods

Table 14: Livelihood risks and coping strategies of communities in Banahil. Source: PRA sessions.

Severity ranking	Details of risk	Frequency of occurrence	Current coping mechanism
1	Changing rainfall/ delayed monsoon	Every year	Shift to less-expensive food to make up for the loss/less profit from agriculture
2	Less/no work	Six months in a year (January to June)	Working with big farmers and moving out of the village in search of employment
3	Less wages	Throughout the year	Adjust to live with less money Request/demand increase in wages
4	Agricultural produce always fetches less price	Every year	Buy less-expensive food Judicious spending to meet household requirements
5	Landlessness and shortage of food	September and October every year (just before harvest)	Borrow money from moneylender and involve family members in farm work
6	Increasing cost of agricultural inputs	June to October every year	Borrow money from moneylender and involve family members in farm work
7	Crop diseases	July to October every year	Use pesticides and borrow money to buy more pesticides
8	Delayed payments from government for MGNREGA work	Throughout the year	Get support from neighbours and relatives Borrow money to buy food grains
9	Eligible families are not given BPL cards	Throughout the year	Get support from neighbours and relatives Borrow money to buy food grains
10	Alcoholism	Throughout the year	Women taking the responsibility of meeting household expenses (saving money and keeping it out of reach of men)

Table 15: Livelihood risks and coping strategies of communities in Silli. Source: PRA sessions.

The Venn diagram (see Figure 7) constructed by the participants of PRA sessions revealed their access to food security in the study sites. Participants guided by the PRA facilitators listed individuals as well as institutions as their most reliable direct and indirect food security sources existing in and around their villages. Across the base camp and the satellite villages, communities informed that local institutions, such as village Panchayat offices (institutions of self-government elected by people every five years, which governs village level developments), Anganwadi centres (crèche/mid-day meal and nutrition programme to pre-school children in a village), ration shop (fair price public distribution system) and post office, could be considered the key institutions impacting their food security. In addition, MGNREGA has been pointed out as one of the important livelihood and food security mechanisms across the villages. The Act ensures a minimum of 100 days of wage employment to at least one member in each family in a year. To avoid misappropriation of funds and to ensure that the wages are paid to all labourers, government has organized wage payment to all workers through village post offices. Hence, people consider post offices as one of the local institutions ensuring food security, even though they do not provide them directly with the food.

The next set of institutions listed as important by the PRA participants contribute to resolving problems – if any – related to food security; the District Collector who is the administrative head of a district ensures and facilitates all aspects of governance issues within a district comes first among this category. According to the participants, he decides on the water sharing in the canal among villages and redresses disputes related to water sharing, issue of job cards under MGNREGA and BPL cards that bring them jobs, and food grain at a subsidized price. The rice mill nearby helps them dehusk the paddy grains; the schools provide their children with a mid-day meal in addition to education; through the banks they receive the remittances; and the police station helps them to resolve theft-related conflicts. The shops and the court in Janjgir town were other institutions listed by the participants, which contribute to their food security, but to a limited extent.

From both the PRA sessions and expert interviews it has become increasingly clear that current coping mechanisms, such as the BPL assistance programme, the MGNREGA providing guaranteed employment to poor families, have not always worked as expected due to various operational and implementation constraints. The Agriculture Department's intervention programmes, such as System of Rice Intensification (SRI) to reduce water usage for rice cultivation, soil and moisture conservation measures, promotion of multi-cropping and seed treatment to avoid crop diseases, have not created a big impact among farmers, which contradicts with statements given by the expert interviewed in the Agriculture Department in Janjgir.

In order to find out the main sources of income in the research villages, the questionnaires classified the households according to the main economic activity currently and more than 10 years ago (pre-2001). From Table 16 it is clear that the majority of the household's main income comes from agricultural activities, followed by labour work for others. For the second category, the change was not large (from 109 to 122 households) for the past 10 years. However, the number of labourers increased considerably (from 63 to 96 households), an increase of around 52 per cent. This could be due to the fact that the population is growing, and the land is limited, forcing people to seek working for others, as their own land has less capacity to absorb more workers from the same households.

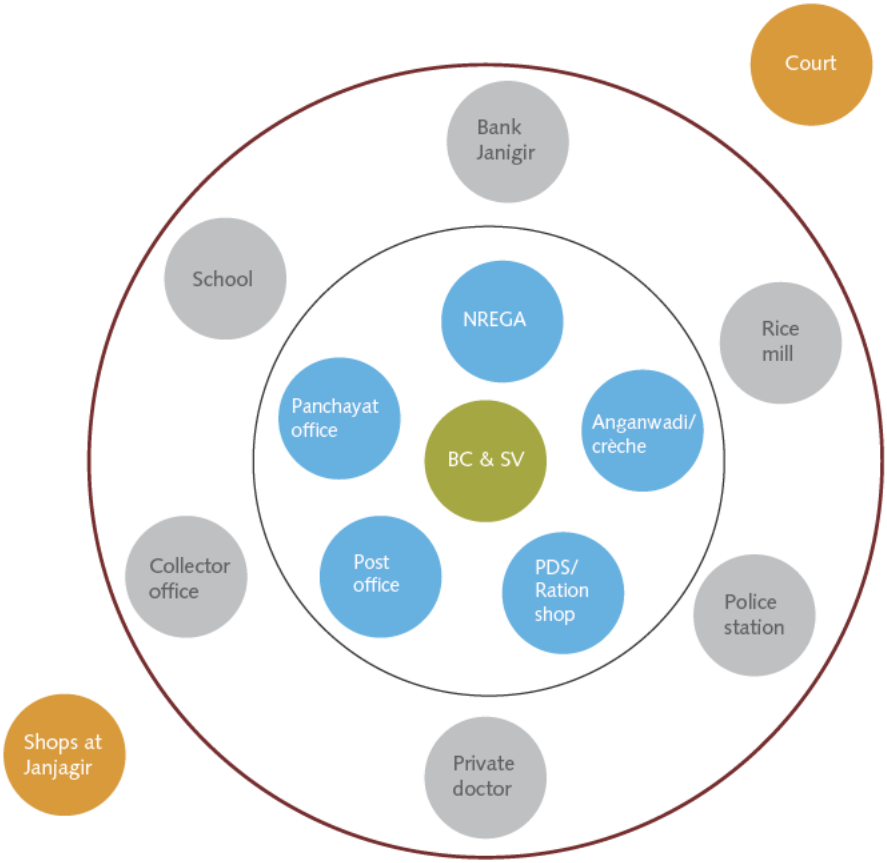


Figure 7: Consolidated Venn diagram on access to food security depicting key institutions and organizations.
Source: PRA sessions.

Current economic activity		Economic activity since pre-2001	
Agriculture	122	Agriculture	109
Labourer	96	Labourer	63
Farm labourer	25	Migrant labourer	10
Daily labourer	14	Business	8
Migrant labourer	14	Daily labourer	8
Business	9	Salaried job	6
Salaried job	6	Farm labourer	4
Driver	3	Remittance	4
Remittance	3	Cattle rearing	2
Tractor driver	3	Sheep rearing	2
Retail trade	3	Barber	2
Cattle rearing	2	Brick making	1
Cook	2	Car mechanic	1
Cycle shop	2	Driver	1
Worker in mining	2	Husband´s salary	1
NREGA	2	Potter	1
Pension	2	Tailor	1
Service	2	Construction worker	1
Mason	2	Cycle shop	1
Barber	1	Mason	1
Clerk	1	Education	1
Construction labourer	1	Tractor driver	1

Table 16: Main economic activities of the village households' members. Source: PRA sessions.

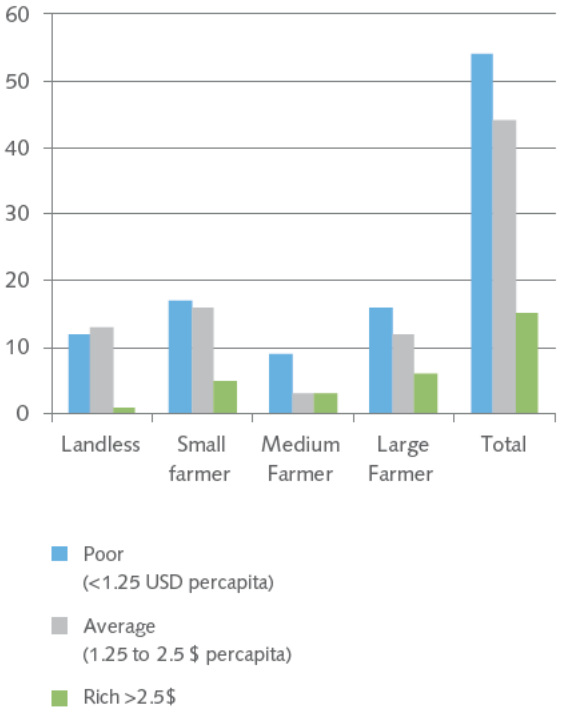


Figure 8: Wealth ranking across the various classifications of the farmers. Source: Household survey.

The study breaks down the farmers into four categories: large-scale farmers, medium-scale farmers, small-scale farmers and the landless who seek to work for others (see Figure 9). In the household survey, a question was raised about the peak of the food shortage for the four categories due to a decline in own production and also due to lack of income. Figures 10 and 11 show that the peak months of food shortage in total are September and October, just before the harvest starts in November (which can be seen in the seasonality calendar, see Table 9). The small farmers suffer most during these two months, followed by the landless. The interpretation for this could be the fact that the small farmers still need to cover fixed costs as landowners, whereas the entirely landless receive their wage without having to pay further expenses. When the harvest season starts, the food shortage is still considerable but less than in the two peak months, which is an indicator that the harvest gives the four categories of farmers some relief from the previous period.

Table 17 presents various coping and adaptation mechanisms used by the community. About 26 per cent of respondents look for external help and 15.6 per cent opt for migration as a coping mechanism. Nearly 40 per cent of respondents said that they make adjustments in expenses and food consumption to cope with the situation. Only 10 per cent said that they sell assets to manage the situation.

An important factor that has its implications in terms of food shortage/insecurity for the research site is the rapid population growth accompanied by the traditional heritage system; when the household head owns a piece of land, the land is divided among the kids after s/he dies, which has a negative impact on the productivity of the land and the average consumption of the family members, since the resources of the land are limited. This creates stress among the families and can lead to conflicts as a consequence.

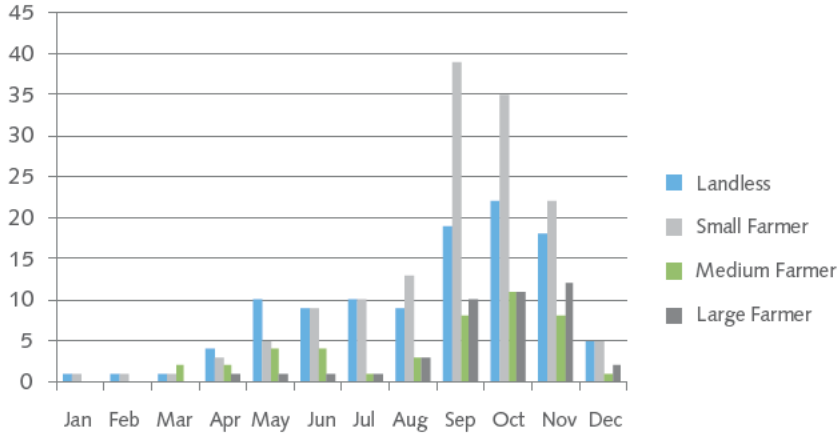


Figure 9: Food shortages (from own production) by month.
Source: Household survey.

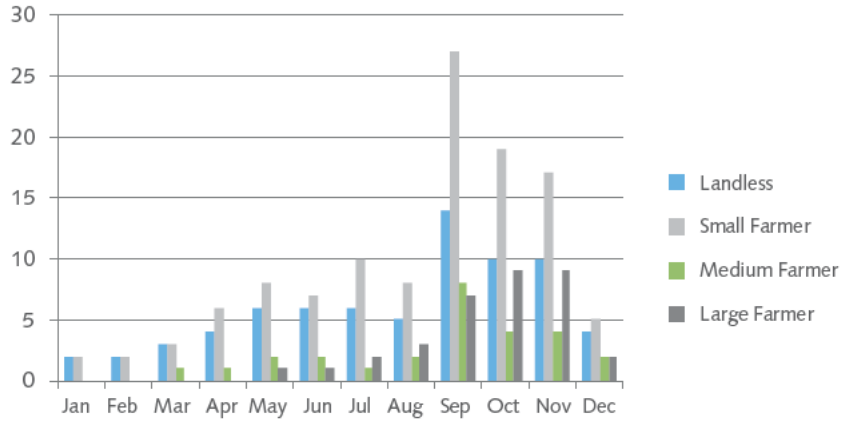


Figure 10: Food shortages (due to lack of income) by month.
Source: Household survey.

	Responses		
Coping and adaptation strategy	Number of households	Per cent %	Percentage of cases
Modify food production	31	12.1	23.1
Reduce food consumption	42	16.4	31.3
Increase income	14	5.5	10.4
Selling assets	29	11.3	21.6
Migration of members	40	15.6	29.9
Reduce expenditure	33	12.9	24.6
External help	68	26.2	50
Total	257[6]	100	

Table 17: Coping and adaptation strategies used by communities to survive food shortages. Source: Household survey.

6 The total number does not go in line with the total number of interviewed households, since there were multi-option answers.

Section 7: Migration and human mobility patterns

There is no reliable official data available about migrants in each village in any of the government departments or private agencies. However, a practice existed in previous times, according to which migrants would have to inform/register with the village Panchayat President before leaving the village. Since this rule is not enforced, it is difficult to find sufficient corresponding numbers or information. Furthermore, complicated labour contract registration rules discourage labour contractors from registering their activities. Thus, they do not disclose the number of people they hire or the exact details and destinations of employees, which makes things complicated.

In general, government officials tend to deny drought-related migration. This could be due to the fear that it could result in a bad remark on their drought relief programmes and other anti-poverty programmes. It might also be viewed as failure of the government mechanism; therefore government agencies heavily underreport migration. This is also confirmed in the literature on earlier studies carried out in the same region by Joshi and Verma (2004).

Based on information collected from the PRA sessions, despite irrigation facilities in the study area, a large number of small and marginal farmers and landless agricultural labourers had limited working days in a year. This is due to the fact that agriculture is vastly dominated by one season and the farmers are stranded

idle after the paddy rice is harvested. Hence, household earnings among landless labourers are very little and insufficient to have a marginal level of subsistence. The small and marginal farmers with limited agricultural productivity due to rainfall changes end up in debt and are therefore subject to migration, in order to seek new income possibilities. On the other hand, there is a labour demand for construction and brick making in other towns/cities, which offers higher wages, availability of loans/advance payment from labour contractors/employers and advance motivation from labour contractors. Therefore, cities/towns are attractive to young migrants from the study area. The information in Table 18 is extracted from the household survey and confirms that, within the research sample, it is mostly the landless and small farmers who migrate.

Land category	Monthly income in Rs/cap/	Economic migrants	Educational migrants
Landless	467.52	20	
Small farmer	533.26	34	
Medium farmer	474.83	12	1
Large farmer	646.89	7	1
Total		73	3

Table 18: Number of migrants among the various classifications of farmers. Source: Household survey.

The PRA sessions and household survey show (see Table 19) that the majority of migration is seasonal. Planned seasonal migration is extended to several months in a year. According to the PRA participants, migration increases when rainfall becomes erratic. The vast majority of migrants are economics migrants and only very few migrate for education, as can be seen from Table 19.

Based on the PRA sessions and the household survey (see the seasonality calendar, Table 9), migration begins in December/January every year, depending on the harvest of the paddy crop. The migrants choose their destinations based on the type of work and skills required. Figure 11 shows the gender distribution of the migrants within the households in the research. The males make up 62 per cent compared to the females 38 per cent.

38 % Female *62 % Male*

Figure 11: Gender distribution of migrants. Source: Household survey.

From the PRA sessions, the research team learned that it is very common for people to migrate in families, which has its negative implications on the quality of education, as there are several

Indicators	Akalteri	Silli	Jullan Pakaria	Banahil	Total
Households with migration experience	5	20	37	13	75
Total number of migrants	18	58	105	31	212
Economic migrants	16	48	97	25	186
Educational migrants	2	2	0	0	4
Gender of migrants					
Male	15	35	61	20	131
Female	3	23	44	11	81
Average age of migrants	23.5	16.3	22.9	22.5	21.3
Education level of migrants	6.1	6.9	6.1	4.47	5.9
Marital status of migrants					
Single	3	11	20	7	41
Married	15	40	69	24	148
Others	0	2	3	0	5
Type of migration					
Seasonal	13	50	52	23	138
Temporal	5	6	41	8	60
Migration status					
Current	7	36	62	17	122
Returned	11	22	41	14	88

Table 19: Classification of migrants in the research site.
Source: Household survey.

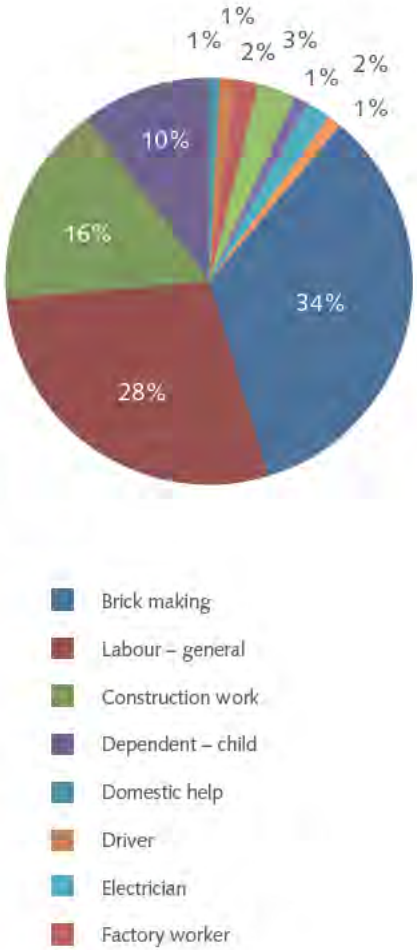


Figure 12: Type of employment of migrant workers. Source: Household survey.

months where the kids have no access to schools. In the worst cases, there are complete dropouts from schools. In general, education is quite neglected in the villages visited by the research team. For example, while running the PRA sessions and the household surveys, the team noticed that there were children of school age who were either helping their parents in the farms or playing around, and the field research mostly took place on working days.

The majority of the migrants are landless labourers and the migration rate is less among the people with greater landholding which indicates that, in general, people are attached to their own land, and would migrate only as an option and not a priority. Accordingly, the rate of migration among SCs and STs was found to be high compared to other social groups/communities.

Many of the PRA participants mentioned that when they leave for other towns/cities, they work mostly in brick kilns, followed by construction work, and few said that they work in shops and industries as unskilled labour. Figure 12 shows in detail the type of employment the household survey respondents choose when deciding their destination.

During the PRA sessions it was indicated that the migration process in the research area is largely informal; employers approach labour contractors/mediators with their requirements. The contractors visit the villages to search for workers. Based on the convincing skills, wages and the amount of advance money employers are willing to pay, the migration decision is taken mutually. Then a contract is informally agreed upon between the contractors and potential migrants. In most cases, the informal agreement is fully adhered to/complied with by the migrants. Past experience will decide the destination of migrants from the second year onwards. In some cases, the father/elderly in the family who had made permanent contact with the employer or labour contractor also facilitates the migration process of their own family members or relatives and neighbours.

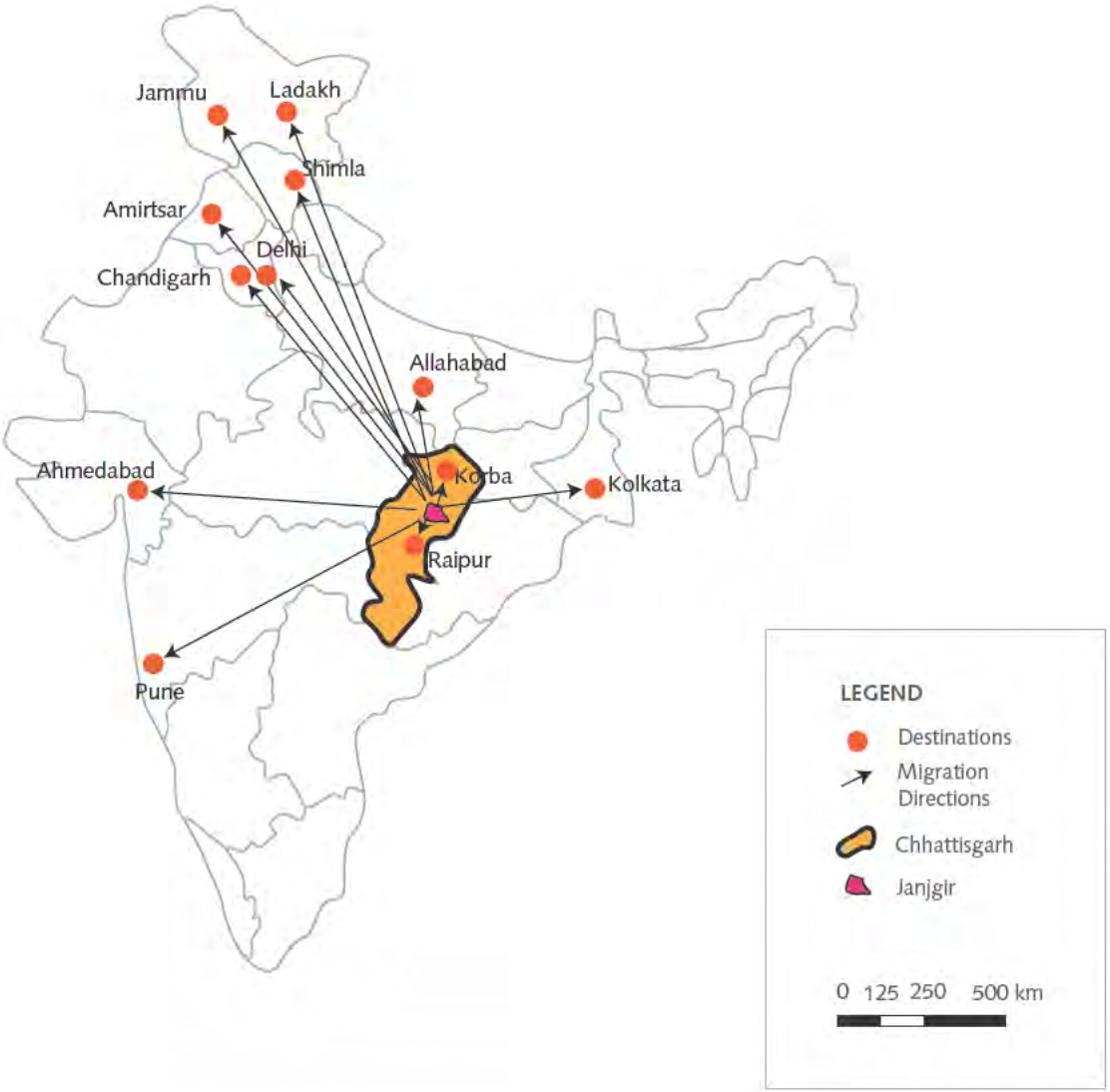


Figure 13: Map showing the cities/towns where migrants from all the study villages go for alternative livelihoods.
Source: Household survey and PRA sessions.

The migration from the study area is not only high in volume but also directed towards diverse destinations spread across India. Except for the southern states, migrants spread far and wide within the country and move to Jammu and Ladak, Kolkata and the north-eastern states. Figure 13 shows the cities and towns where migrant workers go for alternative livelihoods. Respondents from all the study villages stated that they start their migration in December/January and return in May/June.

Remittance plays an important role in the research area; according to the PRA participants, a range of options is used by migrants to send remittances to their families and relatives, such as bank transfers, sending the money through relatives and friends, or saving the money until they return home and then providing families and friends with the money. Nevertheless, there are also people who stay in their destinations and search for semi-permanent housing. The conditions under which this group of migrants live are hard. For example, the semi-skilled migrants, such as brick kiln and construction workers, stay in sheet houses and in barracks. Social and other interactions of migrants are largely restricted to fellow migrants from their village or nearby villages only. Respondents also reported poor sanitation conditions.

New challenges are emerging in the study area as a result of the rapid expansion of activities such as large-scale mining, industrialization and encouraging coal-fired thermal power plants in huge numbers (29 proposals have been approved to start coal-fired thermal power plants in the Janjgir Champa district alone). The rapid phase of development will leave huge footprints on the socio-economic settings of the communities and their livelihoods. Many farmers in the study villages were approached by companies/their agents to sell their land to proposed power plants and other industrial projects. Without any clear plans/support for investing/utilizing the financial compensation they receive, they will find it difficult to secure their livelihoods in the long run once the money is exhausted. Communities' genuine concerns about rapid industrialization, such as forceful acquisition of farmland, large-scale exploitation of water resources or impact of pollution on agriculture and human health care, need to be addressed empathetically.

There are several impacts of the power plants on migration; since the power plants require skilled labour rather than the labour available in the study villages, the farmers in the said villages are not accepted in the plants that in turn "import" workers from other regions. This means that the in-migration of "external workers" for the power plants has an overcrowding effect on the local farmers, competing with them over the resources. Moreover, the lost opportunity of the local farmers who are not absorbed by the power plants increases the probability of them migrating to other regions. This was a general complaint by the PRA participants.

Section 8: Linking rainfall variability, food security and migration

This section connects the three main variables together, namely rainfall variability, livelihood/food insecurity and migration/human displacement, based on the findings of the study in the research site.

From the outcomes above, there is a clear link between the three variables. Nevertheless, other intervening demographic, historical/cultural, institutional, social and economic factors influence the dynamics between these variables and they should not be overlooked in the research.

Seasonal shifts are definitely an issue in the research site. Although a large proportion of land is irrigated by canal water, rainfall still has an impact on the availability of the canal water, in the water ponds, in the water wells and on rain-fed agriculture.

People complain about the shortage of canal water (which leads to shortage in food production), referring to unfair distribution in favour of the power plants. However, the District Collector denies the information and refers responsibility for the shortage in food production to the monoculture system. Here we see two institutional (Collector) and historical/cultural (single annual rice harvest) factors intervening in the relationship between water availability and food insecurity.

Moreover, the water level in the ponds is negatively affected by the erratic rainfall. Although the water in the pond is not a main source for irrigation, it does have a daily influence on people's livelihoods, especially as it is an important water source for their cattle and also represents an important place for community daily activities. Again, there are other factors intervening in the accessibility by people to the pond water in addition to the rainfall; the ponds are extremely polluted (due to human and animal waste, an important social factor) and the duckweed herb (natural factor) is a huge challenge for the people.

There is a very direct relationship between erratic rainfalls on the one hand and rain-fed agriculture and the wells water on the other. There is also a direct impact of rainfall variability on food and livelihood security in that context, even though rain-fed agriculture is not dominant in the research site.

Table 20, which is based on the household survey, conveys the community perception of the changing rainfall impact on food production. As many as 42 per cent of respondents said that rainfall changes did affect food production a lot. Also, 31 per cent said that it affects their food production to a lesser extent. In total, 73 per cent of respondents' food production is affected by rainfall in one way or another.

Does changing rainfall affect your food production?		Frequency	%
Valid	Yes, a lot	74	42
	Yes, but only little	54	31
	No, it does not affect us	42	24
	Not applicable	7	4
	Total	177	100

Table 20: Community perception about rainfall impact on food production. Source: Household survey.

Less water for agriculture means less productivity and greater crop failure which in turn also leads to less fodder for livestock. Crop damage and less productivity do not only lead to food insecurity but also result in less employment for marginal farmers and farm labourers. Associated impacts such as health risks to humans and livestock are imminent. Two essential demographic and cultural factors that intervene in creating food insecurity are the rapid population growth (which leads to pressure on the limited land) and the heritage system that divides the land into small pieces, leading to less productivity, and hence more food insecurity.

All the problems mentioned above push marginal farmers and farm labourers to seek alternative options in urban centres across India for non-agricultural work such as brick making and construction work. Once again, an economic factor intervenes, which is the pull factor in the receiving areas. Once people take the decision to leave, they definitely seek better livelihoods and more income sources that compensate for them leaving their land – and in some few cases their families, even if temporarily.

The impact diagram (see Figure 14) resulting from the PRA sessions gives more detailed and interesting insights into the current and future scenarios in the communities' perception; three scenarios were highlighted as follows:

- Less rain leads to drought, which has negative implications for human beings, the cattle and the crops, but at the same time negative implications for job opportunities, as the farms cannot absorb any labour. For all these reasons, people either migrate directly, in order to seek new jobs and livelihood opportunities, or try to resist by staying in the village. People who stay fill the gap by borrowing from other individuals or institutions, but in order to be able to repay their loans, they end up migrating, seeking new sources of income. Therefore, migration is in both cases the final resort.

- Due to the deteriorating rainfall, the ponds and small lakes the people rely on in their daily lives (drinking water, feeding animals, some agricultural activities, etc.) are drying out. This has a negative impact on the livelihoods of the people, and serves as one of the important reasons that make people leave the villages or regions, seeking better opportunities.

- An important result of the erratic rain is the decline of the groundwater that is used by the farmers in their daily lives, leading to livelihood stress, and in turn to human displacement.

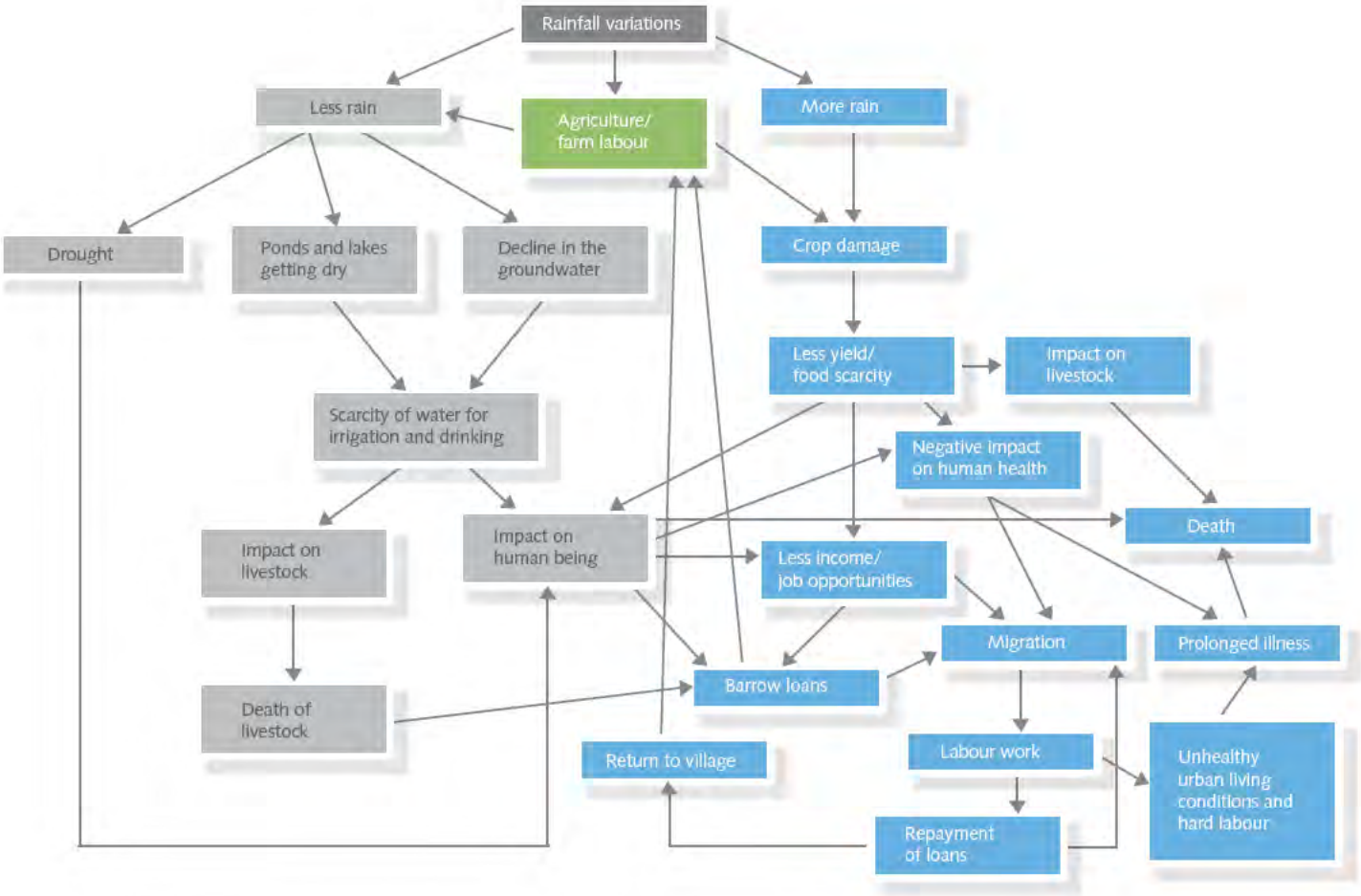


Figure 14: Impact diagram of local community against rainfall variations. Source: PRA sessions.

In order to validate the PRA and household survey results, one-to-one interviews with individuals in the community were conducted.

Kamala-bai Kashyap, a 31-year old lady in the Akalteri village shares her experience of rainfall shortage, food insecurity and migration as follows:

"Rainfall is a big problem for my family and for the whole village; we are facing less crop yielding and are therefore using most of the paddy crop for food consumption. Once we have a surplus, we will sell it. In the summer, we fetch water from a far distance. To overcome this problem, I cannot migrate in search of work, because I have very small children who need someone to take care of them. I can only do my best in farming and labour work here in the village to feed my children. I am running a mere 'bread and butter' life."

This indicates that people would rather like to stay in their home villages and that migration is very often only the last resort for them.

Picture 2: Kamala-bai in a PRA session in Akalteri.
Source: PRA session in Akalteri.

Harprasad Kuree, a 27-year old farmer in Silli says:

"For agriculture, we depend on rain. This year we have more rain. Due to good crop, this year no more villagers will migrate. However, earlier more people out-migrated. And if there is no rain, the crop is affected and for earning money we will have to out-migrate."

Shivnaryan Kevant, a 25-year old farmer from the same village, mentions:

"Ten years back, rainfall was good, but now it has changed. Therefore, there is no demand for our work. I have to go to other states for a better livelihood. I am going to Panjab for brick making. However, I keep my children with my parents in the village for them to be able to go to school. If rainfall is good, I will stay here. Otherwise I have to move."

From the outcomes above, it is found that it is mainly the small, marginal farmers and landless agricultural labourers with limited working days a year who suffer most during the two months of peak food shortage, namely September and October, just before the harvest starts in November. When the harvest season starts, the food shortage is still considerable but less than in the two peak months, which is an indicator that the harvest gives the farmers a relief from the previous period.

The small farmers and landless agricultural labourers are the ones who migrate due to rainfall variability and associated food insecurity. The males make up 62 per cent of the migrants compared to the females, 38 per cent. The vast majority of the total migrants consist of economic migrants, seeking new sources of income and better alternative livelihoods in other areas, compensating for the loss they have in terms of livelihood and food security.

Picture 3: Harprasad Kuree with his family.
Source: Interview in Silli.

The migration rate decreases the more the people possess their own land, which means that migration becomes higher among the SCs and STs who live under the worst conditions compared to the rest of the communities. Very often people migrate in families, which has its negative implications on the quality of education and leads in many cases to dropping out of school.

The general circumstances under which these groups would use migration as an adaptation strategy in response to rainfall variability and food insecurity are as follows:

1. Relying on a single annual harvest/monoculture throughout the year with no diversification. This makes people too dependent on one single crop, which in itself could be subject to diseases (such as the disease that successively hit the paddy rice) and make them more exposed, vulnerable and threatened by food insecurity.

2. Unequal distribution of the canal water among the farmers, especially against the ones with land or working on land at the tail of the canal, making them the first to suffer from water shortage and the last to benefit from its availability; and hence, the challenges of generating the income or even securing food availability for themselves and their families.

3. Unequal distribution of the canal water between the farmers on the one hand and the new power plants on the other, which creates mistrust among the farmers who believe that they are under-privileged under the government schemes in favour of the power plants.

4. The level of maintenance of the ponds is deteriorating, leading to more water pollution and other related problems with no proper intervention by the communities – who do contribute to the pond pollution – or the government, which amplifies the livelihood problems, especially in association with cattle survival.

5. The continuous rapid population growth and the heritage system which have implications in terms of land availability and exacerbating all the problems related to rainfall variability and water shortage, especially that they negatively impact on the productivity of the land and lead in turn to more food shortage and insecurity.

6. No improvement of the farmers' financial situation due to the shortage of rainwater, canal water, pond water and wells water, which again has implications in terms of food and livelihood security, forcing them to seek alternative income sources and livelihoods elsewhere.

7. No proper intervention from the institutions that the communities rely on regarding food security but also other institutions that provide them with the necessary services and indirectly contribute to their food security, such as the National Rural Employment Guarantee Act and the Agriculture Department's intervention programmes.

8. The power plants not absorbing the excess labour in the research site but "importing external labour" instead, which limits the job opportunities of farmers and agricultural labourers who need to generate new income as a consequence of rainfall variability and associated food shortage. Also as a consequence, the overcrowding effect and competition for resources.

9. The contractors/mediators facilitating the migration process to other towns/cities, whose availability and support play a big role in the migration decision of the farmers.

10. The pull factors in other cities that represent improved and alternative livelihoods for the communities, especially the brick making and construction sector that absorb unskilled labour, in addition to the higher living standards that the migrants expect but do not always find when they move away.

Section 9:
Summary and conclusions

The analysis presented in the previous sections establishes the aberrations in rainfall patterns in terms of delays, shifting seasons and erratic rain in the study area. High input costs and inadequate support prices for the produce, recurrent crop diseases and less landholding have rendered agriculture a non-remunerative venture for smallholders in the study area, regardless of canal irrigation. Vulnerable communities in the study area face significant risks without adequate opportunities and safeguards. As a result, some of them are migrating to far places in search of better/alternative livelihoods. Some people have opted for migration as a major coping mechanism for traditional and cultural reasons. However, when people migrate, they do not necessarily find the best environment for them in the destination areas, which create new challenges for them and their families.

Although the farmers use various coping practices, their efforts to minimize the loss or maximize the profit from agriculture remain very low. Except for the use of a few hybrid seed varieties, their coping mechanisms have not resulted in minimizing the input cost or reducing the loss. As a result, the poor are being pushed towards more poverty and indebtedness. Sharing water from the canal is going to be a growing problem and possible source of conflict, given the rapid growth of industry and its water needs. The existing response mechanisms, such as the improved agriculture practices, MGNREGA, granting BPL status and associated benefits, need thorough investigation and review in order to improve their governance and reach.

When the research was done, a virtual debate came up between the communities on the one hand and the experts and officials on the other. Regarding food insecurity, the communities blame the officials for not being fair in distributing the canal water, but the officials blame the communities for relying on historical and traditional habits in respect to monoculture.

According to the communities interviewed, less rain causes drought, a lower pond level and a decline in the groundwater. This has its implications on the food security of humans and on the crops, but also on the survival of the cattle, which again feeds into the livelihoods of the communities of the research site. Some people cope with the situation by seeking external help from families and institutions, reducing food consumption and expenditure or trying to increase their income on the spot without leaving their villages. However, a considerable number of people leave their villages, seeking new livelihood alternatives or at least attempting to increase their income through work (mainly brick making and construction) in other towns/cities. Even the people who stay and borrow from others might still opt for migration in order to be able to generate income that partly repays their loans.

Other factors push further the migration decision, such as the weak level of pond maintenance, the population growth and heritage system that decreases the productivity of the land, as well as the role of the contractors/mediators who help people leave for other places.

It is usually the small, marginal farmers and landless agricultural labourers who suffer the most from food shortage associated with rainfall variability and it is also they who migrate. In contrast to the typical scenario where males migrate and leave the women behind, it was found that in the research area people mostly migrate in families. When children are left behind, usually the grandparents or other relatives are responsible for them in the absence of the parents. However, the children often accompany their parents, which affects their education.

Section 10: Reflections for policymakers

The India case study of the "Rainfalls" project represents an effort to strengthen the knowledge base on rainfall variation and its implications on livelihoods, food security and migration of people in Chhattisgarh, particularly in the Janjgir district. This study is anticipated to supplement future efforts in this direction. Some of the key recommendations that emerged out of this study are summarized as follows:

1. The state action plan to combat climate change currently under preparation should address the life and livelihood challenges of small and marginal farmers and landless farm labourers affected by rainfall variation and its associated impacts. Appropriate adaptation actions when implemented will considerably reduce the cost of climate change impacts in the future.

2. Existing irrigation canal systems need to be maintained and managed in such a way as to make sufficient water available to local farmers even in the tail end of the canal in a reliable way, so that a minimal volume of water is wasted.

3. Introducing a new irrigation system that relies on tubes rather than open canals would help maintain more water and protect it from evaporation or being exposed to all other types of water wastage.

4. Greater transparency is required in water sharing to ensure that poor communities and farmers get their fair share of water versus the power plants.

5. Major and minor irrigation ponds in the villages need to be regularly de-silted and co-managed with the complete participation of the local communities. This needs further efforts from local government and the NGOs. In this case, raising awareness (schools and regular visits) is crucial for the communities to be able to understand the high potential benefits they can gain from doing such activities.

6. As a measure to promote more sustainable, productive and profitable smallholder agriculture in the district, improved agricultural systems and practices that use water resources efficiently, such as the SRI, could also be explored for their suitability in the Janjgir Champa district.

7. At the community level, traditional agricultural practices that withstood over time and were largely based on micro-climatic conditions need to be revived and fostered. The local government needs to be encouraged not only to provide the communities with modern practices, but also to work with them and give them guidance and technical support during a transitional period. Such efforts can be supported by the engagement of NGOs that have already dealt with the communities, so that trust is created and more effective outcomes are reached.

8. Improvements in technology are needed in terms of developing new crop varieties which are of short duration and high yielding as well as drought tolerant, and need to be made available to farmers (Chhattisgarh once used more than 23,000 rice varieties). However, this is a long-term strategy that has to consider historical and cultural factors deeply rooted in the communities and associated with traditional consumption habits. Therefore, again, raising awareness is an essential factor that should be incorporated in the educational system.

9. Increasing food production during the *Rabi* season, particularly pulses, and reversing the general trend towards mono-crop/monoculture of paddy rice; improved pest management, including the use of low-cost integrated pest management techniques; competitive support prices for the produce and improved agricultural extension services to reach poor farmers with appropriate and timely advice (including weather information) would improve the livelihood conditions of farmers and help them stay in the villages. This could have its positive implications on the women not left behind, the elderly not carrying too much burden of raising the children, and the children not having to suffer from low quality education or becoming complete dropouts from school.

10. Increased number of small landholdings as a result of inheritance is a major issue faced by many farmers in the Janjgir Champa district which affects the viability and profitability of farming. This could be tackled through the initiation of community farming or cooperative farming where 10 to 20 small farmers could join together and increase the viability and profitability of farming. NGOs can take a lead in experimenting with this with support from government.

11. An independent and detailed enumeration on migration in Chhattisgarh needs to be conducted in order to have region-specific and issue-specific intervention plans for people choosing migration as a primary coping mechanism against the impact of rainfall/climate change. The International Organization for Migration might be a good source for such a data base.

12. Short-term and medium-term measures to protect the income and welfare of migrants in their workplace/urban centres, specific policies on safety, better living and sanitation facilities protection of migrants from violence as well as the need to be ensured by making reforms in labour laws and strictly implementing them.

13. With appropriate government policies and regulations, new companies commencing their operations in Janjgir Champa could be directed to support the vulnerable communities through proper CSR programmes. In addition to traditional corporate social responsibility activities, more responsible behaviour and increased regulation is probably needed, with regard to controlling air and water pollution, exploiting groundwater resources, and ensuring safe working conditions. Here, the role of NGOs should be emphasized, as they do deal already with the communities.

14. Both the National and State Government must ensure better and improved governance of programme implementation, focusing on marginal and poor people in the target areas: schemes such as issuance of BPL cards, providing rations to eligible families, payment of a retirement pension and providing job cards and jobs under MGNREGA. These measures will go a long way in supporting the livelihoods of a vast number of people who are affected by rainfall variation, who live on the brink of poverty and struggle between survival and existence. The success of better governance could influence their decision (not) to migrate in a big way.

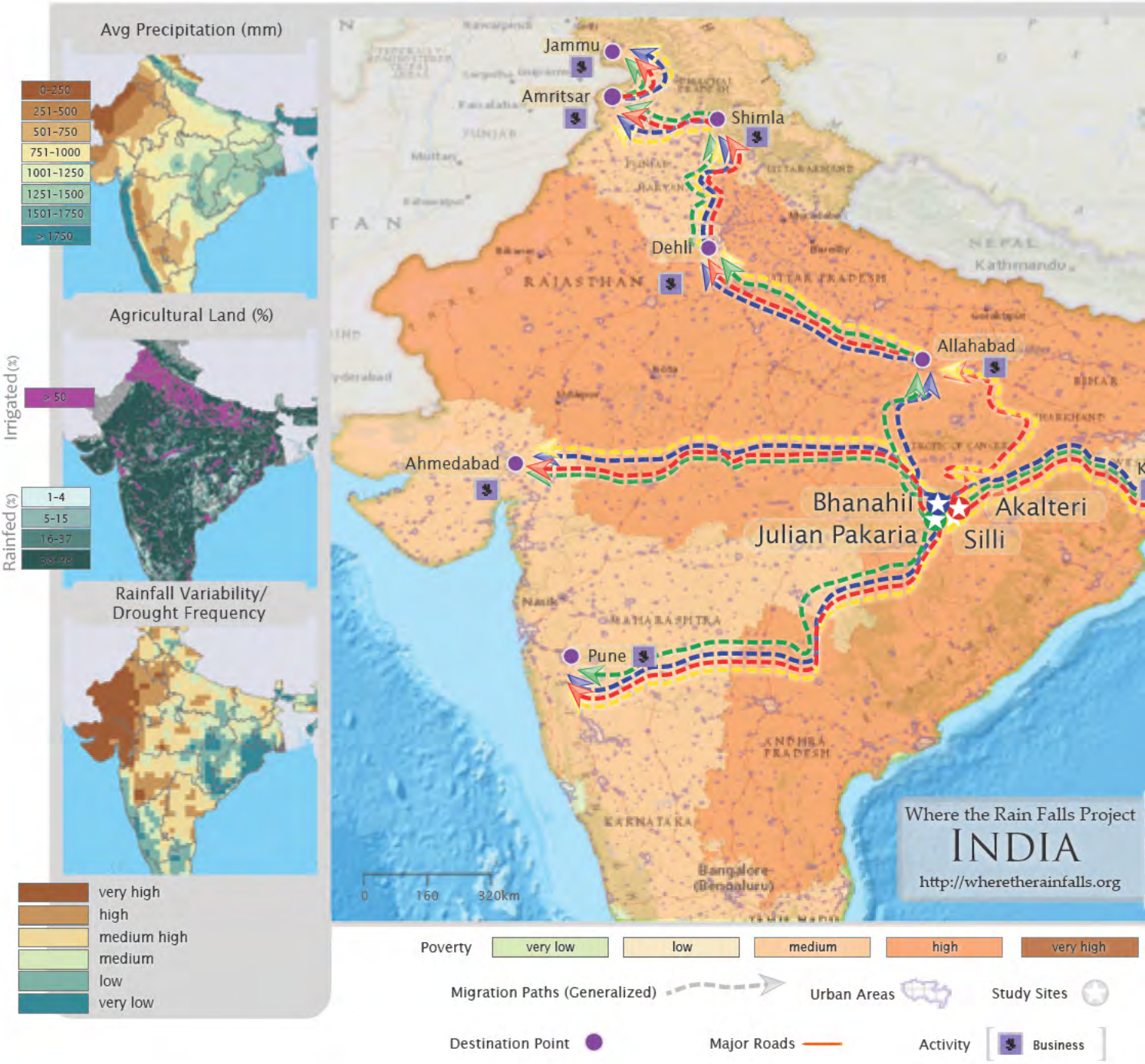
Annex I:
List of experts and institutions interviewed in Chhattisgarh

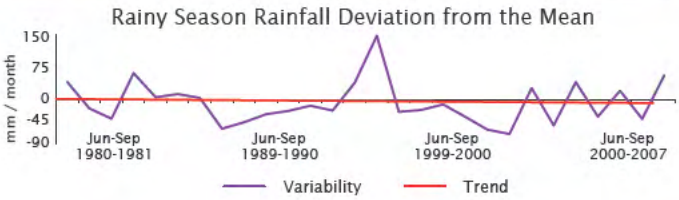
S. No.	Name of the expert and designation	Institution
1	Dr. Brijesh Mishra IAS District Collector	District Collectorate Janjgir Champa District Chhattisgarh – 495668
2	Mr. Srivastav Executive Engineer Irrigation	Department of Water Resources Office of the Executive Engineer – Irrigation Janjgir Champa District Chhattisgarh – 495668
3	Mr. D. L. Rathore, Agriculture Development Officer	Office of the Deputy Director for Agriculture Janjgir Champa District Chhattisgarh – 495668
4	Mr. Ashok Shrisikar, Assistant General Manager	Assistant General Manager District Development, National Bank for Agriculture and Rural Development (NABARD) Janjgir Champa District, Chhattisgarh – 495668
5	Dr. Khan, Head of Department Department of Geology and Water Resources	Pandit Ravi Shankar Shukla University Raipur Chhattisgarh – 492010
6	Dr. S. K. Pande Associate Professor Department of Geology and Water Resources	

S. No.	Name of the expert and designation	Institution
7	Professor Arun Kumar Department of Anthropology	
8	Dr. J. S. Urkurkar Director Directorate of Extension Services	Indira Gandhi Agricultural University Krishak Nagar Raipur Chhattisgarh – 492006
9	Dr. Ganguly Entomologist and Senior Scientist Directorate of Extension Services	
10	Dr. A.S. R. A. S. Sastri Professor and Head Department of Agrometeorology	

Annex II:
National research team composition

Mr. Tapas Das
Ms. Mittu Hendry
Mr. Reji S. Kuruvilla
Dr. Janakaraj Murali
Mr. Manish Ranjan
Mr. Manoj Kumar Satpathy
Mr. Deepak Sharad Hate
Ms. Susila
Mr. Amitabh Tiwari


Avg Precipitation (mm)
0-250
251-500
501-750
751-1000
1001-1250
1251-1500
1501-1750
> 1750
Agricultural Land (%)
Irrigated (%)
> 50
Rainfed (%)
1-4
5-15
16-37
Rainfall Variability/
Drought Frequency
very high
high
medium high
medium
low
very low
Jammu
Amritsar
Shimla
Dehli
Allahabad
Ahmedabad
Bhanahil
Akalteri
Julian Pakaria
Silli
Pune
RAJASTHAN
MAHARASHTRA
KARNATAKA
ANDHRA PRADESH
NEPAL
Kathmandu
Bangalore (Bengaluru)
0
160
320km
Where the Rain Falls Project
INDIA
http://whereterainfalls.org
Poverty
very low
low
medium
high
very high
Migration Paths (Generalized)
Urban Areas
Study Sites
Destination Point
Major Roads
Activity
Business



Annex III

This map shows the location, landscape, average precipitation, agricultural land and drought frequency of the research sites. It also demonstrates the main destinations of the migrants of the research villages, based on consolidated information collected from the focus group discussions and the household survey.

Note: The maps (and associated rainfall variability graphs) produced for each case study report were developed using data sets from multiple sources. Each map provides the location of each research site along with contextual data on rainfall amounts and variability, poverty and agriculture. For a full list of sources please see chapter 9.2 of the Where the Rain Falls Global Policy Report (Warner et al., 2012).

Source: CIESIN (2012).

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Picture credits:
Julie K. Maldonado, cover/page 78, page 4/5, 22/23, 28, 36, 38/39, 44, 48/49, 50, 53, 54, 58/59, 61/62, 72, 74/75; 86, 88/89, 92/93 and 102/103; Amelia Andrews/CARE, page 16/17, 82; Valenda Campbell/CARE, page 68.

Imprint

United Nations University
Institute for Environment and Human Security (UNU-EHS)

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Tel.: + 49-228-815-0200, Fax: + 49-228-815-0299
e-mail: info@ehs.unu.edu

Design: Andrea Wendeler
Copy-editing: WordLink
Proofreading: Katharina Brach
Print: DCM Druck Center Meckenheim GmbH
Print run: 500

ISSN: 2304-0459
e-ISSN: 2304-0467
ISBN: 978-3-939923-78-7
e-ISBN: 978-3-939923-79-4

WHERE the RAIN FALLS

The Where the Rain Falls Project investigates how changes in rainfall interact with societies. The project provides a more nuanced understanding of the links between changing rainfall patterns, food and livelihood security, as well as migration in eight case study countries:

Bangladesh: Kurigram District, Rangpur Division
Ghana: Nadowli District, Upper West Region
Guatemala: Cabricán Municipality, Quetzaltenango Department
India: Janjgir-Champa District, Chhattisgarh State
Peru: Huancayo District, Junín Region
Tanzania: Same District, Kilimanjaro Region
Thailand: Thung Hua Chang District, Northern Thailand
Viet Nam: Dong Thap Province, Thap Muoi District.

Changing weather patterns are already causing weather extremes, including droughts and flooding, leading to food insecurity and displacement of people. Research results will help climate change policy and its implementation with important practical aspects to tackle poverty, protecting the most vulnerable people.

The full project findings – a research protocol, eight case study reports and a synthesis report for policymakers – are available at *www.wheretherainfalls.org*.