Food Security Atlas of
Rural Bihar

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Maps not to scale.

CONTENTS

FOREWORD

The right to food is basically about freedom from hunger. Hunger in its narrow sense can be understood as the inability to have even two square meals a day, while in a much boarder sense it includes nutrition along with three other important entitlements viz., the access to clean water, health care and elementary education. The Right to Food derives from the larger human right of access to an adequate standard of living as spelt out in the Universal Declaration of Human Rights (UDHR), 1948, which clearly states that all human beings, regardless of their race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status, have the right to adequate food and the right to be free from hunger. In the context of the Indian sub-continent, inspite of the significant progress that has been made in food production and sufficiency over the last six decades, a fairly large proportion of the population still has to deal with food uncertainties on a daily basis.

This Food Security Atlas for Bihar 2018 extensively documents the prevailing food and nutrition security scenario in the state with focus on first, the nature and dynamics of the food security situation at the state and district levels; second, identifying the highly food insecure regions; third, pinpointing the policy interventions required for addressing and improving food security in the identified regions; and fourth, comparing the food security status using a food security index for the time periods 2008-09 and 2016-17. The dimensions and determinants of food security in Bihar along with the calculations of various Food Security Indices are carried out using data from various secondary sources including the NSS and the NFHS datasets. Food security at the district level is estimated and the districts with the lowest levels of food security are identified by laying focus on the three basic components of food security viz., availability, access and absorption/utilization of food. These three elements of food security are measured via eleven indicators, shortfalls in which manifest as outcomes such as high morbidity and mortality and low BMIs.

Using the input and outcomes indicators approach to estimating the Food Security Index, the study identifies 17 districts that are either severely or extremely food insecure and need specific and concerted policy attention. Over the period 2008-09 and 2016-17, the study finds a change in the ranking of districts in terms of food security with some improving and some others worsening their food security status. An attempt is also made to assess the status and impact of various government interventions to address food security in the state.

This study is a part of the research initiative 'System of Promoting Appropriate National Dynamism for Agriculture and Nutrition (SPANDAN) implemented by the Indira Gandhi Institute of Development Research (IGIDR) with support from a grant of Bill and Melinda Gates Foundation. This study has been done by the Institute for Human Development (IHD), Delhi. The study, in our view, will help in devising policies and strategies with regard to food security and nutrition in rural Bihar. It will also be of interest to all other stakeholders concerned with the issue of improving food and nutrition security.

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List of Abbreviations

AAY	Antyodaya Anna Yojana
ADI	Average Daily Intake
AHS	Annual Health Survey
ARWSP	Accelerated Rural Water Supply Programme
ASA	Above State Average
BMI	Body Mass Index
BSA	Below State Average
CED	Chronic Energy Deficiency
DFID	Department for International Development
DW	Drinking Water
EIS	Extremely Insecure
FAO	Food and Agricultural Organization
FLR	Female Literacy Rate
FNS	Food and Nutrition Security
FSI	Food Security Index
FSO	Food Security Outcome
GHI	Global Hunger Index
GSDP	Gross State Development Product
HDI	Human Development Index
HSD	High Speed Diesel
ICDP	Integrated Cereal Development Programme
ICDS	Integrated Child Development Services
IFAD	International Fund For Agricultural Development
IFPRI	International Food Policy Research Institute
IMR	Infant Mortality Rate
ISOPOM	Integrated Scheme on Pulses, Oilseeds and Maize
JLG	Joint Liability Groups
KMO	Kaiser-Meyer-Olkin

LFP	Labour Force Participation Rate
MDG	Millennium Development Goal
MDM	Mid Day Meals
MFIs	Microfinance Institutions
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MIS	Moderately Insecure
MMR	Maternal Mortality ratio
MPCE	Monthly Per Capita Consumption Expenditure
MS	Moderately Secure
MSM	Mean Standardization Method
MSSRF	MS Swaminathan Research Foundation
NAGLA	Non Agricultural labourer
NAMI	Normalized Adult Malnutrition Index
NBJK	Nav Bharat Jagriti Kendra
NCEUS	National Commission for Enterprises in the Unorganised Sector
NCMI	Normalized Child Malnutrition Index
NFHS	National Family Health Survey
NFSA	National Food Security Act
NFSM	National Food Security Mission
NGO	Non Government Organization
NIA	Net Irrigated Area
NRDWP	National Rural Drinking Water Programme
NSS	National Sample Survey
NSSO	National Sample Survey Organization
OBC	Other Backward Caste
PCA	Principal Component Analysis
PCI	Per Capita Income
PCVAO	Per capita Value of Agricultural Output
PDS	Public Distribution System

PHC	Primary Health Centre
PHI	Poverty and Hunger Index
PMGSY	Pradhan Mantri Gram Sadak Yojana
PRI	Panchayati Raj Institutions
RDA	Recommended Dietary Allowance
REM	Range Equalization Method
RWAP	Ratio of Working Age Population
S	Secured
SBL	SHG Bank Linkage
SDG	Sustainable Development Goal
SECC	Socio-Economic And Caste Census
SHG	Self Help Group
SIS	Severely Insecure
SOFI	State of Food Insecurity
SRS	Sample Registration System
ST	Scheduled tribes
SUN	Scaling - Up Nutrition
TPDS	Targeted Public Distribution System
U5MR	Under five mortality rate
UDHR	Universal Declaration of Human Rights
UNDP	United Nation Development programme
UNICEF	United Nations International Children's Emergency Fun
WFP	World Food Programme
WFS	World Food Summit
WHO	World Health Organization

EXECUTIVE SUMMARY

Bihar is one of the most economically backward states of the country with lowest per capita income and the highest incidence of poverty. A large proportion of its population (89 percent) resides in rural areas where agriculture and related activities are the main source of livelihood. Keeping the high dependence on agriculture as its focus, the Institute for Human Development (IHD) had prepared a Food Security Atlas of Rural Bihar with support from World Food Programme (WFP) in 2008-09. The Report had identified 12 districts as either severely or extremely food insecure. The present report revisits the issue of food security in Bihar with the primary focus of identifying the extremely food insecure districts with main objectives of :

- Analyzing the nature and dynamics of the food security situation at district level in Bihar.

- Identifying the most food insecure regions.

- Carrying out inter-district comparisons in terms of a food security index for the period 2008-09 to 2016-17

- Bringing forth appropriate policy interventions to tackle the issue in the highly food insecure regions of the state.

Food security is dependent, in the first place, on the availability of food In the absence of adequate purchasing power, the access of households to food gets curtailed even if physical availability exists. Thus, access to food is the second most important determinant of food security. However, even in the presence of these two determinants, unless adequate health status prevails, the bodily absorption of food as well as its nutritional impact suffers. Thus, the third basic component of food security is absorption or utilization of food . These three imperative components of food security are measured using eleven indicators, taken to comprise the inputs into food security. Over the long run, inadequate food security in terms of these factors results in harmful outcomes such as morbidity, high mortality rates and low BMIs. It needs to be kept in mind that given the long lag involved between inputs and perceived benefits in terms of outcomes, there can be a deviation between the overall input and outcome indices used to measure food security.

Methodology

The study broadly adopts two methods to estimate the index value for food security i.e. (1) Max-Min (Range Equalization Method, REM) adopted by UNDP and (2) the Mean standardization Method. Further, the Principal Components Analysis (PCA) is used to study the importance of various variables in explaining the food security status of the districts. The Food and Nutrition Security (FNS), a composite index of food security is calculated and it covers the three dimensions of availability, access and utilization of food. One of the objectives of estimating the district level FNS indicator is to show the district's position in the various dimensions of food and nutrition security considered. Another important dimension of food security is food stability but this indicator could not be used in calculating the final FNS index as district level data for the same was not available. Further, based on the index values, the districts have been categorized into five groups: extremely insecure, severely insecure, moderately insecure, moderately secure, and secure.

Status of Districts of Bihar

In terms of food availability index, the study identifies Jamui, Madhubani , Dharbhanga , Purnia and Kishanganj as the extremely insecure districts in Bihar. On the other hand, Rohtas, Aurangabad, Jehanabad and Sheikhpura are identified as the food secure districts. Five moderately food secure districts include Gopalganj, Begusarai, Pashchim Champaran, Bhojpur and Sheohar.

In terms of the food access index, Purnia, Pashchim Champaran, Banka, Gaya, Katihar, Araria, Aurangabad, Sheikhpura and Sitamarhi fall in the two lowest categories (severely insecure and extremely food insecure). Only three districts viz., Patna, Saran and Vaishali are food secure.

In terms of food utilization index, Arwal is the most secure district while Jamui is the least secure district.

Further, the food secure group comprises 5 districts, followed by 13 districts in the moderately secure group, 9 districts in the moderately insecure group, 8 districts in the severely insecure group, and 3 districts in the extremely insecure group in terms of the outcome index. The three most food insecure districts are Sheikhpura, Sitamarhi and Purnia. Hence these districts need special targeted policies to improve food security outcomes.

In terms of overall food security index, five districts are identified as extremely insecure namely, Jamui, Banka, Purnia, Araria and Katihar. Five districts which are severely insecure are Gaya, Kishanganj, Dharbhanga, Supaul and Paschim Champaran. These districts need urgent attention in terms of improvements in the food security input indicators. On the other hand, the most food secure districts are Jehanabad, Patna, Rohtas, Vaishali, Arwal, Siwan and Bhojpur.

Priority Districts

The districts in the two lowest categories, that is, the extremely and severely food insecure need to be prioritized for developmental interventions for enhancing food security. A total of 17 districts, (8 from North Bihar and 9 from from Central Bihar) are identified as priority districts. The districts which fall under the food insecure category for both the input and output approach are identified as alarming districts. These districts include Jamui, Araria, Gaya and Purnia. Other priority districts which need special attention include Supaul, Darbhanga Pashchim Champaran, Katihar, Banka, Sheikhpura, Patna, Sitamarhi, Nalanda, Nawada, Madhepura, Arungadabad and Arwal. These districts are insured in either input or output approach.

Comparison of the Food Security Index between 2008-09 and 2016-17

- The South, South East and North East parts of Bihar (Purba Champaran, Darbhanga , Sheohar, Bhagalpur Sitamarhi, Sheikhpura) were moderately food insecure in both the time periods being considered.

- Districts like Mungar, Bagalpur and Nawda from the south and south east regions; Saharsa and Madhepura from the north east region and Nalanda from the centre south region, were moderately food secured in 2008-09 but transitioned to being moderately food insecure in 2016-17.

Policy Implications and the Way forward

- The study finds that the female literacy rate, the ratio of working age population, prevalence of diarrhoea in the 2 weeks preceding the survey, access to toilet facilities, the percentage nonagricultural labourers and the proportion of net irrigated area to net sown area emerge as the important policy variables for the overall food security of the state.

- To improve the food security scenario in the most insecure districts, the state government and policy makers need to put into place direct or indirect policy instruments or adopt special welfare programmes for the target groups such as SC/ ST or dependent people.

- An IHD study on Public Programs, Social Safety Nets and Food Security in Rural Bihar (2016) found that BPL households never availed of anywhere near their allowance of 15 kg of rice and 10 kg of wheat per month. Further, high levels of exclusion and inclusion errors in providing BPL and APL cards existed. Inclusion errors were higher for SC households compared to STs, OBCs and others. The exclusion error was also high among the SC households compared to other social groups. Further, the exclusion error was relatively high in Central Bihar compared to Northern Bihar (NSSO 68th round).

- The NREGA is a powerful means of providing income and hence access to food security. Nearly 70 per cent of the income generated from this employment programme is spent on food in Bihar, pointing towards its key role in providing food security in Bihar (IHD Bihar Survey, 2016). Further, while the proportion of SCs being provided employment is much higher in the case of Bihar than for India as a whole, the reverse is the case for women and STs.

- When we consider the National Food Security Mission (NFSM), an important point to remember is that it primarily addresses the food availability dimension of food security, but ignores the access to food dimension. Moreover, it covers a very limited number of Special Category Districts.

- The Mid-day Meal Scheme is an important means of enhancing food security in the state. The IHD Bihar survey (2016) analysed the perception of households on the performance of the MDM schemes and found that more than sixty percent of the beneficiaries mentioned that the food quality was average and more than one third of the beneficiaries found the food quality to be good. More than half of the parents reported that the MDM food accounted for more than half the food that children consumed.

- In terms of rural road connectivity, the proportion of villages connected by roads in Bihar is well below the all- India figure. The progress in providing rural connectivity under the PMGSY has been lower in Bihar as compared to the All-India level. Whilst connecting villages to main roads, it needs to be borne in mind that simply provisioning link roads cannot achieve the objective unless the through roads already exist. Thus, the construction of link roads needs to be appropriately coordinated with the provisioning of through roads in the state.

In order to improve the food security of the poorest districts in Bihar, it is important to improve the food security policy variables along with other food security intervention programme. The state also has an important role in improving the welfare development programmes of the districts

INTRODUCTION

Attaining food security is a matter of prime importance for India, a country where the Planning Commission (2011-12) pegs more than 25 percent of the population as poor with 25.7 percent for rural and 13.7 percent for the urban population as being below the poverty line. As many as half of the children under 5 also suffer from malnourishment which has been persistent over the last three decades. The right to food is about freedom from hunger. While the narrow meaning of hunger can be understood to imply not being able to have even two square meals a day, its broader import would also include under nutrition which comes hand in hand with the three other important entitlements of access to clean water, health care and elementary education. The concept of right to food derives from the larger human right of access to an adequate standard of living as spelt out in the Universal Declaration of Human Rights (UDHR), 1948 which clearly states that all human beings, regardless of their race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status have the right to adequate food and the right to be free from hunger.

Access to adequate food and proper nutrition is one of humanity's basic needs. In spite of the significant progress that India has made in food production and sufficiency over the last sixty years, a fairly large proportion of the population still has to deal with uncertainties in food security on a daily basis. FAO, (2018) states that, "The absolute number of undernourished people, i.e. those facing chronic food deprivation, has increased to nearly 821 million in 2017, from around 804 million in 2016." Malnourishment creates a vicious circle such that without regular and adequate food intakes, an

individual is not able to lead a healthy and active life. The ideology of food security has been evolving over the last few decades with academics, policy makers and Non Governmental Organisation (NGO) activists contributing substantially to the debate on what really constitutes food security, its various determinants, its beneficial effects and how it can be ensured at the global, nation, state, region, household and individual levels. In the year 2000, as a Millennium Development Goal (United Nations, 2008), the world communities pledged to cut

the number of the world's hungry people to half by the year 2015. The Sustainable Development Goal 2 (SDG 2) focuses explicitly on food by seeking to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture", while multiple other goals also relate to the challenges in the food system. The SDG 1 focuses on poverty reduction, where agriculture and food have a key role to play.

India is home to the largest undernourished population in the world. The State of Food Insecurity in the World, 2018 (SOFI) explicitly states that India is home to the highest number of undernourished people on Earth. The country tops the list with an estimated 194.6 million people surpassing China's 138.8 million. There has however been a significant reduction in the proportion of undernourished people in India by 36 per cent from 1990-92 to 2014-16. While its smaller neighbor, Nepal has achieved both the Millennium Development Goal target of halving the prevalence of undernourishment by 2015 and the World Food Summit (WFS) targets, India has failed miserably on both fronts. The number of undernourished in India was 210.1 million in 1990-92, 189.9 million in 2010-12 and 194.6 million in 2014-16.

Among the developing nations, India's achievements in reducing poverty and hunger are impressive, but there is more that needs to be done to see a hunger-free India. Various studies show that social groups like the scheduled castes and scheduled tribes, children and women are mainly affected by malnutrition and starvation in different parts of the country (Desai et al, 2009, Ackerson et al, 2008).

The Atlas of Sustainability of Food Security by Vepa S S *et al* (2004) studied the food security at the sub-state level for eight states in India, undertaking a district level analysis of food security based on a range of indicators including availability, access and utilization. The report identified the districts which were insecure in terms of the various food security indicators considered.

The Institute for Human Development (IHD), Delhi had prepared a Food Security Atlas of rural Bihar with support from World Food Programme (WFP) in 2008-09. This Food and Nutritional Security Atlas for Bihar aims to update the previous exercise undertaken at the district level. It extensively documents the prevailing food and nutrition security scenario in Bihar keeping the following underlying objectives as the focus:

- To analyze the nature and dynamics of the food security situation at district level in Bihar

- To identify the regions which are most affected by food insecurity in Bihar

- To compare the status of the districts in terms of food security index between 2008-9 and 2016-2017

- To suggest policy interventions appropriate to improving food security for those regions in Bihar

1.1 Conceptual framework

The concept of food security saw its origin in the mid 1970s, when the global food crisis was at centre stage (FAO, 2003) and at its outset this was confined to the supply side aspect of the problem only. Therefore, the main focus at the time was on food availability and the stability in prices of various food products at the national as well as international levels.

The initial definition of food security thus reflected the global concerns of the World Food Summit, 1974, defining food security as, "Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices". Sen (1981) has highlighted that food security is not just about food production and agriculture related activities but it is also influenced by economic and social structures. The most recent definitions of food security are multifaceted and go well beyond economics and physical availability to include social, health and nutritional determinants as well. The World Food Summit of 1996 adopted a more complex definition to include these aspects: "Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life". This definition has been further amended by the FAO in 2001 to stress the significance and importance of the social aspects to food security: "Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." This widely accepted definition points to the dimensions of food security as shown on the facing page (Figure 1.1).

Food security is thus a deeper and more multi-dimensional concept that has been conventionally thought of. It goes well beyond production, availability, and demand for food. Food insecurity is determined by various factors such as the domestic production of food, imports and exports of food, purchasing power, people's to access food as well as factors that influence the absorption of food in the body.

"A person is considered nutrition secure when she or he has a nutritionally adequate diet and the food consumed is biologically utilized such that adequate

Figure 1.1: **Dimensions of Food Security**

Utilization: Utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met.

Food Availability: availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid)

Stability: To be food secure, a population, household or individual must have access to adequate food at all times. Refers to both the availability and access dimensions of food security

Food Access: Access by individuals to adequate resources entitlements) for acquiring appropriate foods for a nutritious dietfor a nutritious diet

FOOD SECURITY

performance is maintained in growth, resisting or recovering from disease, pregnancy, lactation and physical work." (Frankenberger et al. 1997 , p.1). As per the Road Map for Scaling - Up Nutrition (2010)[1], nutritional security can be successfully achieved when a secured access to an appropriately nutritious diet is coupled with a sanitary environment and adequate health care services so as to ensure a healthy and active life for all household members.

Taken together, food and nutrition security lays emphasis on the complementarity and overlaps between the two concepts and therefore can be seen as a state where 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. Weingärtner (2010) states food and nutrition security to be a condition under which adequate food (quantity, quality, safety, socio-cultural acceptability) is available

and accessible for and satisfactorily utilized by all individuals at all times to live a healthy and happy life. The term food and nutrition security has wider usage as it intergrates both goals into one.

1. 2 LITERATURE REVIEW ▪

1.2.1 Status of Food Security in India

In India, chronic food inadequacy at the national, regional and household levels has remained widespread and persistent amongst the poor segments of the population with poverty and the inability to purchase adequate food perpetuating under nutrition and micronutrient deficiencies. Further, nearly 40 percent of the world's food-insecure population was resident in India (Shapouri *et al* 2009). While there is overwhelming evidence to show that in both developed and developing counries, a very large share

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1 *The Scaling - Up Nutrition (SUN) is a collaborative process that began in 2009 with the development of the Scale Up Nutrition Framework. The framework was developed by a group of stakeholders from governments, donor agencies, the civil society, the research community, the private sector, intergovernmental organizations, and development banks. The goal of the Road Map for SUN is to reduce hunger and under-nutrition and contribute to the achievement of all the Millennium Development Goals, particularly MDG 1 which aimed at halving poverty and hunger by the year 2015.*

of the population does not have adequate access to food, quantifying the extent of the problem continues to remain problematic (e g, Barrett 2010; Nord *et al* 2007). A review of the progress towards food security in India using various indicators such as per capita food grain availability assessed at the national level, access to food grains at the household level as assessed by the hunger rate, health as assessed by infant and under five mortality, and nutrition as assessed by under five underweights and low BMIs in adults shows that on the basis of food production and household access to food, India has fared well. For the U5MR India compares well with developing countries with a similar health profile, and in terms of the proportion of underweight children in the under five category, India fares poorly with rates comparable to that of Sub-Saharan Africa. About a sixth Indian preschool children reported low BMIs for age (Ramachandran, 2013).

According to the State of Food Insecurity Report, nearly one billion people across the nation are estimated to be under nourished of which developing nations account for 98 percent (FAO 2010). In 2010, India ranked 66 among 88 countries for the Global Hunger Index (GHI). (von Grebmer et al. 2010, Menon *et al.* 2009).

In a detailed study of malnutrition in India, Gulati *et al*, 2012, classified the various Indian states based on two indices of malnutrition namely, the Normalized Adult Malnutrition Index (NAMI) and the Normalized Child Malnutrition Index (NCMI). They found that all the eastern states fell in the top two categories of malnutrition, with Bihar faring the worst among them. A similar study conducted by the MS Swaminathan Research Foundation (MSSRF, 2008) classified various Indian states based on a composite index of food insecurity using seven indicators[2] and found that the eastern states such as Chhattisgarh and Jharkhand fell in the category of 'very high' food insecurity,

while Bihar and Odisha were classified as 'high' food insecurity. West Bengal was relatively better off with moderate levels of food insecurity. Such levels of food insecurity and malnutrition prevalent in the eastern part of India reflects the inability of government sponsored measures to alleviate food deficiency in the poverty ridden pockets and show that the programmes have actually not reached the target beneficiary population.

Rahman (2015) studied the role of consumer food subsidies in improving nutritional intake and diet quality by evaluating the expansion of coverage of government food assistance programs in the hunger prone state of Odisha. He found that after the interventions, the proportion of households consuming below the recommended dietary allowance of calories, fats and proteins had declined significantly. Examining the possible beneficial outcomes of greater consumer subsidies or implicit income transfers to BPL households due to changes in the PDS from it being a universal scheme to it becoming a targeted scheme, Kochar (2005) finds that in 1997, greater wheat subsidies to BPL households did not lead to any improvements in the overall calorie intakes. In an evaluation of the impact of the transition from universal to a targeted PDS on nutritional intakes using nationally representative data for the period 1993-94 and 2009-10, Kaushal and Muchomba (2013) found that increase in income resulting from the food price subsidy had no impact on calorie, protein and fat intake in poor households in rural India. Over time, a variety of criticisms have been brought against the functioning of the PDS ranging from cost ineffectiveness, its marginal impacts and leakages (Swaminathan, 2001, 2003; Radhakrishna and Rao, 1993). The performance of the Public Distribution System (PDS) has not been very successful in states like Bihar, Odisha, Jharkhand

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2 *The seven indicators used for constructing the food insecurity index in the study are (i) percentage of women with any anaemia, (ii) percentage of women with CED, (iii) percentage of children with any anaemia, (iv) percentage of stunted children under three, (v) percentage of population consuming less than 1890 Kcal of energy per day, (vi) percentage of households without access to safe drinking water and (vii) percentage of households without toilet within premises*

etc., due to reportedly high prevalence of targeting errors (errors of exclusion and inclusion) and the unauthorized diversion of PDS food grains (Khera, 2011a; 2011b). Kaushal and Muchomba (2011) study whether improvements in the PDS have led to greater consumption of nutrients. They find no significant relationship between higher nutritional intake and PDS participation. PDS system in Bihar was also too bad and had no impact on rural poverty (Drèze and Khera 2013). The main reason for the poor performance was corruption and mis-governance. The authors have found that people's awareness of their entitlements was much higher than it used to be (Drèze and Khera 2015). Krishnamurthy *et al.* (2013) on the other hand report improvements in the PDS delivery system in Chhattisgarh which led to higher nutrient intakes and improvements in diet quality.

1.2.2 Approaches to Food Security: Cross Country Experiences

Sustained progress towards improved food security for the populace continues to be a serious issue across the globe. Countries that have made resonable progress in reducing hunger include Latin America as well as the Eastern and South-Eastern regions of Asia, as they have have all achieved the Millennium Development Goal (MDG) 1 hunger target. On the other hand, Central Africa and Western Asia seem to be moving away from the hunger targets, with a higher proportion of undernourished in the population now than in 1990-92. The countries which have achieved the MDG 1 hunger target have done so as a consequence of stable political conditions and good economic growth that have been accompanied by sound social protection policies targeted towards vulnerable population groups. On the other hand, the countries that have failed to achieve MDG 1 goal have had to deal with natural and human-induced disasters or political instability that have prevented the protection of vulnerable population groups and the promotion of income opportunities for all. Further, in many cases, the benefits of economic growth have failed to reach

the poor, due to lack of effective social protection and income redistribution policies (FAO 2015).

The cross country experience of Mexico, Brazil, Nigeria and Malaysia suggests that supporting smallholder farming could be one of the most effective ways to alleviate poverty and hunger at the household level and to improve food security at the local, regional and national levels.

Investments and differential public policies aimed at increasing technological, financial and marketing support to small-holder farmers could immensely improve the productivity of small farmers thereby raising their livelihoods and contributing to overall food security (Sharma and Gulati, 2012).

Increases and subsequent fluctuations in food prices have tended to put millions of people at risk of becoming food insecure and being pushed into poverty across the globe (IFPRI *et al.* 2009, DFID 2009, UN 2008 and Ivanic and Martin 2008a). The poorest households spend nearly four-fifths of their incomes on food and remain the most vulnerable to sharp rises in the prices of staple food items. Some studies suggest that the sharp rise in food prices could increase poverty in many developing countries (Chaudhry and A. Chaudhry 2008, Ivanic and Martin, 2008b; and Wodon and Zaman, 2008).

1.2.3 Existing Food and Nutrition Security Indicators

There are numerous indicators of food and nutrition security at the global, national, household and individual level and these are elaborated upon below

■ **Undernourishment**

   The FAO's measure of food deprivation (undernourishment) reflects the proportion of population with per capita dietary energy consumption below the standard minimum energy requirements. The FAO indicator comprises three parameters namely the mean quantity of calories available for human consumption, the inequality in access to calories among the population, and

the mean minimum amount of calories required by the population (de Haen et al. 2011). However, estimates based on the mean quantity of calories are found to be unsatisfactory (Svedberg 2000). First, the calorie availability is a poor predictor of nutritional development, mortality and productivity. Second, the cut -off point estimated by aggregating sex and age specific minimum dietary requirements has been critically debated as it could result in a large underestimation of under-nutrition (Dasgupta 1993, Svedberg 2002).

■ **The Global Hunger Index (GHI)**

The Global Hunger Index, designed by the International Food Policy Research Institute (IFPRI), captures the multidimensionality of food insecurity. The index is constructed by equally

weighing three indicators viz., the proportion of the population who are food energy deficient i.e. the FAO undernourishment indicator (based on dietary energy supply); the proportion of children (lesser than age five) who are underweight,; and the under-five mortality rate (Wiesmann 2006). Although, the GHI provides unique insights by combining three aspects of hunger, the three elements of hunger are found to be correlated, raising the issue of double counting by its critics (Masset 2011).

■ **The Poverty and Hunger Index (PHI)**

The Poverty and Hunger Index, isused as one of the instruments for achieving the Millennium Development Goals. The proportion of the population living on less than a dollar per day, the poverty gap, the share of the poorest quintile in national income or consumption, the prevalence of children underweight, and the proportion of undernourished population calculated by the FAO are the various indicators that go into its calculation (Gentilini and Webb, 2008). The statistical methodology for calculating the PHI follows the UNDP's Human Development Index (HDI) (Gentilini and Webb 2008). A limitation of this index is that the correlation between

poverty and hunger is not always high which then decreases the redundancy between the elements. On the other hand, the correlation between the poverty rate and the poverty gap indicators is very high (close to one), suggesting that these indicators are redundant (Gentilini and Webb 2008). There are also data concerns in the calculations of this index as the data is derived from national data sets raising apprehensions on the quality and datedness of the same (Masset 2011).

■ **Anthropometric Indicators**

While the three indicators discussed above focus on measuring nutrition at the the macro level, anthropometric indicators such as stunting (low height-for-age), underweight (low weight-for-age), and wasting (low weight-for-height) measure nutritional out comes at the individual level.

Low weight-for-height, also known as wasting, captures short-term substantial weight loss resulting from health problems or acute food shortage in food intakes. Wasting is strongly associated with child mortality. Stunting reflects low height-for-age and is an indicator of chronic malnutrition. Stunted children fail to reach their potential cognitive and physical development. Underweight reflects low weight - for- age and results from the combination of short -term weight loss and long -term growth problems. All these indicators are calculated by comparing weight and height of a child with a reference population of well-nourished and healthy children (Shetty 2003).

Nutritional outcomes are influenced by factors well beyond the mere availability of and accessibility to food and include interactions between food losses, intra-household food distribution, individual health and activity levels etc. Svedberg (2011) points out the advantages of anthropometric indicators stressing that they directly reflect the imbalances between energy intakes and expenditures. Poor anthropometric outcomes are found to be associated with

higher morbidity and mortality by Deaton and Dreze 2009. Anthropometric data are usually collected from househohold surveys including demographic and health surveys. They can be disaggregated by region thereby facilitating spatial analysis. Also, anthropometric norms for children under five years of age are universal given that in that age range, the genetic potential growth for children is usually uniform (Svedberg, 2011).

Anthropometric measures could be subject to measurement errors including technical errors of measurement wherein the exact age of children is sometimes not known. Further, for nutritional outcomes at the macro level, anthropometric indicators are generally expressed as percentages of prevalence, i.e. frequencies (e.g. the prevalence of underweight in children). The reference cut- off points can be based on statistical, risk of dysfunction and prescriptive criteria may vary from country to country (Pelletier 2008). Anthropometric indicators are mostly available for all countries although the data series are not uniform in some countries since the data for such indicators is not collected annually.

- **Household Diet Diversity**

    Two indicators of food insecurity proposed by Smith and Subandoro (2007) that measure Dietary Diversity: First: a diet diversity measure constructed by classifying food into 7 categories (cereals, roots and tubers; pulses and legumes; dairy products; meats, fish, seafood and eggs; oils and fats; fruits; vegetables) and then summing up the number of different food categories that are consumed by the household during the reference period. Second: the share of calories from staple foods as a proportion of total calorie intake at the household which captures food security through diet diversity.

    The motivation behind such an approach is that poor households can be expected to have a high marginal utility of calories thereby choosing a diet that provides them as many calories as are possible

within their budget constraints. Therefore, it can be expected that as the household budget increases, they would tend to substitute relatively more expensive foods in terms of the calories they provide but have additional attributes such as good taste (D'Souza and Jolliffe, 2010). Hoddinott and Yohannes (2002) elaborate on why diet diversity scores are meaningful indicators of food and nutrition security. First, these scores correlate with measures of food consumption and are a good measure of household food access and caloric availability. Second, variety varied diet can be associated with a number of improved outcomes, particularly birth weight (Rao et al. 2001), child anthropometric status (Hatloy et al. 1998), improved hemoglobin concentration (Bhargava et al. 2001), reduced risk of mortality from cardiovascular disease (Kant et al. 1995) and incidence of hypertension (Miller et al. 1992). Third, diet diversity scores can be collected through household surveys and can be used to examine food and nutritional security at the individual and intra-household levels.

1.3 THE STUDY METHODOLOGY

The FNS is a composite index covering three dimensions of food security viz., access, availability and utilization to food. In this study, a Food and Nutrition Security (FNS) index was calculated for the state of Bihar at the district level, only for rural areas. In our analysis of the index, a district with a high FNS index value is considered relatively more food secure than the districts woth a lower FNS index value. Two measures were used to calculate the index viz., (1) the Range Equalisation Method (REM, max-min method) as adopted by UNDP (2010) and (2) the mean standardization method (MSM). The Principal Components Method was further used to calculate the overall food and nutrition security index. One of the objectives of calculating the district FNS was to show the district's position vis-à-vis other districts in terms of the various dimensions of food and nutrition security. Another important dimension of the FNS

index is stability which could not considered while calculating the final FNS index as district level data was not available for the same.

Methodology I: Range Equalization (RE)/ Max-Min Approach

Under the max-min approach an index was constructed for each variable under consideration by applying the following general Range Equalization Method formula adopted by UNDP.

$$\text{Variable Index} = \frac{(X_i\text{-min X})}{(\text{Max X-Min X})}$$

where X_i: Value of the variable
min X: Minimum value of X in the scaling
max X: Maximum value of X in the scaling

In undertaking the scaling procedure, desirable norms were adopted for each indicator. In some cases, the scaling of indicators was self-selected, while for some others there was an element of value judgment.

Construction of a Food and Nutrition Security Radar

Different indicators included in the FNS were scaled and normalized to take a value between 0 and 1. The scaled least achievement corresponded to zero, while the best achievement corresponded to 1.

After calculating the index for each variable, each dimension of the index was calculated by taking the average of each variable index. The composite food and nutrition security index (FNSI) was then derived by averaging the three dimensions.

Methodology 2: Mean Standardization Method (MSM)

In this method the index value of each variable was constructed by dividing the actual value of the variable by its mean value.

$$\text{Variable Index} = \frac{X^i}{X}$$

Each dimension index was calculated by adding the index value of each variable. Further, the overall FNSI index was derived by adding all the index values of the variables.

Methodology 3: Principal Component Analysis (PCA)

The PCA is a data reduction technique. Sometimes there is found a high correlation between variables. In such cases, it is useful to transform the original data set into a new set of uncorrelated variables called principal components. It is quite likely that the first few components account for most of the variability in the original data set. The PCA can be applied either to the original values of variables or to the normalized values of the variables. In general, normalization can be done using three methods, (1) deviation of the variables from their respective means (i.e. $X - \overline{X}$) (2) dividing the actual values of the variables by their respective means; and (3) deviation of value of a variable from the mean which is then divided by standard deviation {i.e. $(X - \overline{X})/\sigma$}. The second method has been used for our calculations. In the PCA analysis the first component explained most of the variance.

The Food Security Outcome Index

To crosscheck the validity of the FNS for its availability, access and absorption components, we used the Food Security Outcome (FSO) index. The nutritional status of an individual can be considered as the outcome of food and nutrition security. Although the intake of food is not the only factor that affects nutritional status, it is definitely the prime one. The food security outcome index calculated here is based on two child-related variables: the under-five mortality rate (U5MR) and child underweight (weight for age -2SD). These two variables were collected from Annual Health Survey. The district level FSO index was calculated using the Range Equalization Methodology and the Mean Standardization Method. Finally, we investigated for a correlation between the food and nutrition

security index and the food security outcome index.

Finally, all the districts of Bihar were grouped into five broad categories i.e highly secure, secure, moderately secure, insecure and highly insecure on the basis of the composite FSO and FNS indices.

1.4 Structure of the Report

This report is an effort to chalk out a district level profile of food security in Bihar as well as to compare the status of food security in its districts across two time perods (2008-09 and 2016- 17). Chapter 2 provides an overview of the state in terms of basic economic indicators such as education, health, employment and physical infrastructure. Chapter 3 presents the food

availability, access and utilization indices as well as a composite index of food security outcomes. Chapter 4 analyses the overall food security input index (FSI) which is a composite index of the factors that are critical for food security in Bihar. It identifies the priority districts as well as compares food security in the districts of Bihar between 2008-09 and 2016-17. Chapter 5 deals with the revised food security index and the status of the districts. Chapter 6 discusses strategies for action that emerge from the anlysis of food security in the state and suggests policy initiatives and interventions that could be put into place in the highly food insecure districts of the state. Chapter 7 wraps up the report with the final conclusions of the study.

BIHAR: A PROFILE

2.1 BACKGROUND OF THE BIHAR ECONOMY ■

Bihar is located in the eastern part of the country (between 83°-30' to 88°-00' longitude). It is an entirely land–locked state, although an outlet to the sea through the port of Kolkata is not far away. Bihar lies mid-way between the humid West Bengal in the east and the sub humid Uttar Pradesh in the west which provides it with a transitional position in terms of climate, economy and culture. It is bound by Nepal in the north and by Jharkhand in the south. The Bihar plain is divided into two unequal halves by the river Ganga which flows through its middle from west to east. Bihar was bifurcated in November 2000 and the state of Jharkhand was carved out from it. The state covers an area of 94,163 sq. km, which accounts for approximately 2.86 percent of the total landmass of the country, supporting more than 8 percent of population. The state is organized into nine administrative divisions with 38 districts and 101 sub-divisions. There are 534 development blocks, 8,471 Gram Panchayats and 45,103 villages. A total of 9 urban agglomerations and 130 towns comprise the state. A major part of the state falls in the fertile Indo-Gangetic region and a large portion of the state experiences repeated floods. As per the Census 2011, Bihar had a population of 10.41 crores, an increase from 8.30 Crore in 2001 (Census figure). The total population growth in this decade was 25.42 percent while in the previous decade it was 28.43 percent. The population of Bihar was 8.60 percent of that of India in 2011 (8.07 percen in 2001). The population density of the state has also increased from 881 in 2001 to 1106 per square kilometer in 2011, against an all-India population density of 382 persons per square kilometer in 2011. Almost 89 percent of the population in Bihar lives in rural areas in 2011.

2.2 BASIC ECONOMIC INDICATORS ■

During the decade 2004-5 to 2013-14, Bihar experienced a period of consistent growth. The Gross State Domestic Product (GSDP) of Bihar was 9.32 on a compound annual growth rate (CGAR) basis compared to all India figures (7.59) (Table 2.1) during this decade. More recent figures for 2011-12 to 2015-16 show the growth rate of GSDP in Bihar to be 7.6 percent (2011- 12 base price). This growth rate is higher than the growth rate of 6.8 percent for the Indian economy.

In spite of a high growth phase, Bihar ranks at the bottom of the per capita income (PCI) table for the country. In 2004-05, the per capita income of Bihar was 32.77 percent of the all-India average. In 2013-14, its share went up to 38.66 percent. In 2015-16 the PCI of Bihar was Rs 26,801 which was 34.61 percent of All India figure. With sustained growth, the gap in per capita incomes between Bihar and the All-India figures was bridged by about 6.09 percentage points over a 10 years period (Table 2.2).

As is evident from Table 2.3, for the period 2005-06 and 2013-14, the annual average growth rate of GSDP of Bihar was 10.13 percent, well above the all India figure of 7.61. The primary sector grew at 5.33 percent, which was above all India average indicating a comparative advantage for Bihar in terms of its agricultural and allied activities. In the case of industry and the services sector also, Bihar's annual average growth rate was above all the all India average.

Table 2.1:	Compound growth rate (%) GSDP 2004-05 to 2013-14
Bihar	9.32
All India	7.59

Source: Author's calculation from Handbook of Statistics on Indian Economy-RBI various years

Table 2.2: Per capita Income of Bihar and India (Rupees)

	Bihar	India	Share of Bihar in All India PCI
2004-05	7914	24143	32.77
2013-14	15506	39904	38.86
2015-16 (2011-12 base)	26801	77435	34.61

Source: Ministry of Statistics and Programme Implementation, Government of India

Over the period 2004-5 and 2014-15, the share of agriculture and allied sectors in GSDP declined in Bihar from 32 percent in 2004-05 to 23 percent in 2014-15 (Figure 2.1). On the other hand, the share of the services sector increased from 55 percent in 2004-05 to 60 percent in2014-15. The contribution of the industrial sector to GSDP was 18 percent in 2014-15 showing an increase of 4 percentage points over 2004-05

Figure 2.1: Sectoral Composition of GSDP in Bihar, 2004-05 to 2014-15
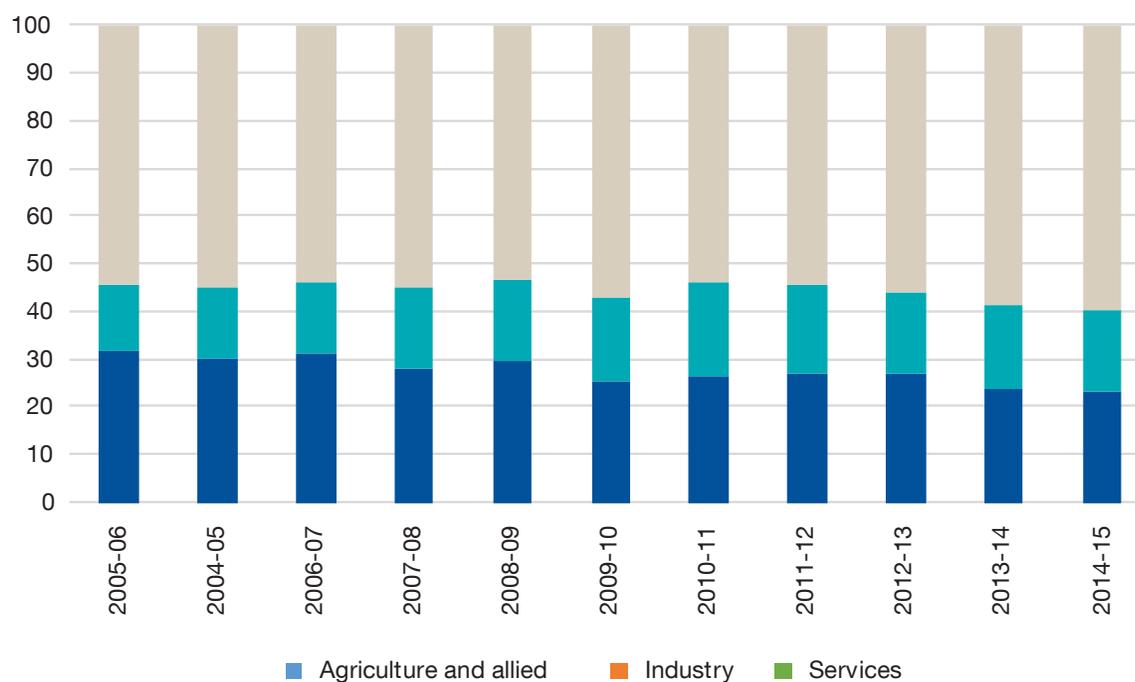
Source: Ministry of Statistics and programme Implementation, Government of India

Table 2.3: **Annual Average Growth rate of Bihar and India (2005-06 to 2013-14)**

	Bihar	All India
Primary	5.33	3.97
Secondary	13.07	6.87
Tertiary	12	9.07
GSDP	10.13	7.61

Source: Planning Commission, Government of India

The improvements in Bihar's economic growth are primarily due to a considerable rise in the growth rate of registered manufacturing, construction, banking and insurance and transport/storage/ and communication sectors which have exhibited more than 15 per cent growth rates. However, the growth rate of agriculture and Agriculture/Animal Husbandry has been only 6.02 percent (Table A2.1).

The agricultural sector which is the source of livelihood for a majority of the inhabitants of the state, suffers from low productivity and appears to be unable to supply any growth impetus to the state's economy. While the total geographical area of the state is 93.60 lakh hectares, around 6.64 percent of this area is under forest cover. The net sown area of the state is 60 percent of its geographical area which is much higher than all India average of 42 percent. The gross cropped area is 78.82 lakh hectares. The cropping intensity of the state is 1.44 (Economic Survey of Bihar, 2016). Cropping pattern in dominated by cereals. Rice-wheat cropping system occupies more than 70 percent of the gross cropped area. Pulses occupy around 7 percent of the gross cropped area.

The agricultural economy of the State is dependent on the monsoon and is characterized by low irrigation potential, massive soil degradation coupled with fragmented and low productivity and small and scattered farm holdings. There are about 1.61 crore farm holdings of which 91 percent are marginal holdings of size less than 1 hectare. More than 91 percent of all holdings in Bihar fall in the category of marginal holdings with farm size less than 1 hectare (Economic Survey of Bihar, 2016).

2.3 SOCIO ECONOMIC STRUCTURE

Poverty

Poverty estimates for 2011-12 show the incidence of both rural and urban poverty to be considerably higher in Bihar than for India as a whole. While in 1993-94, the gap in rural poverty between India and Bihar was 12.2 percentage points vis-à-vis urban poverty at 12.9 percentage point, in 2011-12, this gap had been reversed with the gap between All India figures and poverty being higher for urban poverty (17.53 percentage points) vis-à-vis rural poverty (8.36 percentage points) (Table 2.4). It can be seen that the decline in both urban and rural poverty in Bihar was higher (-13.47 and -28.24) than at All-India level (-24.4 and – 18.1 respectively) during 1993-94 and 2011-12 (Table 2.4). The incidence of poverty among the scheduled castes and scheduled tribes was also higher in Bihar than at the all India level in 2013- 14 (Table 2.5).

Table 2.4: **Incidence of Poverty in Bihar and India**

	Year	Bihar	India	Gap
Rural Poverty		62.3	50.1	12.2
Urban Poverty	1993-94	44.7	31.8	12.9
Total		60.5	45.3	15.2

	Year	Bihar	India	Gap
Rural Poverty		55.7	41.8	13.9
Urban Poverty	2004-05	43.7	25.7	18
Total		54.4	37.2	17.2
Rural Poverty		34.06	25.7	8.36
Urban Poverty	2011-12	31.23	13.70	17.53
Total		33.74	21.92	11.82
Rural poverty change	2011-12-1993-94	-28.24	-24.4	
Urban poverty change	2011-12-2004-05	-13.47	-18.1	

Source: Planning Commission, Government of India 2013

Table 2.5: **Incidence of Poverty in Rural Bihar and Rural India by Social group**

	SC	ST	All
Bihar	51.7	59.3	34.4
All India	31.5	45.3	25.4

Source: Panagariya (2013-14)

Literacy rates

The literacy rate for Bihar was 47 per cent and 61.8 per cent in 2001 and 2011, respectively vis- à-vis 64.83 per cent and 74 per cent for India as a whole. However, the increase in literacy rate in Bihar was 17.9 percentage points over the period 2001 to 2011, compared to an increase of 10.9 percentage points for the country. With respect to female literacy, (which has a large bearing on food security), the figure for Bihar was 51.50 per cent in 2011 vis-à-vis 65.46 per cent for India as a whole (Table 2.6).

Table 2.6: **Literacy rates in Bihar and India, 2001 and 2011**

	Year	Bihar	India
Male Literacy rates		59.68	75.26
Female Literacy rates	2001	33.12	53.67
Total		47	64.83
Male Literacy rates		71.2	82.14
Female Literacy rates	2011	51.50	65.46
Total		61.80	74

Source: Census 2001 and 2011

Health indicators

Over the last decade, Bihar has shown significant improvements in some of the health indicators over the two NFHS Rounds viz., NFHS-3 (2005-06) and NFHS-4 (2015-16) as well as in subsequent years as shown by data from the more recent rounds of the Sample Registration Survey (SRS) and the Annual

Health Survey (AHS). The Infant Mortality Rate (IMR) has registered the sharpest fall in the state over the last decade (Figure 2.2). The IMR for Bihar has shown a decline from 56 in 2008 to 47 in 2015 whereas during the same period the IMR for All- India decreased from 53 to 37.

While most of the reduction in infant deaths can be contributed to reductions in post-neonatal death rates, neonatal deaths are being focused primarily. The Maternal Mortality Ratio (MMR) for Bihar has also registered a decline (261 in 2007-09 to 200 in 2011-13) yet it remains much higher than the national average

Figure 2.2: Infant Mortality Rate, Bihar and India, 2008-2015
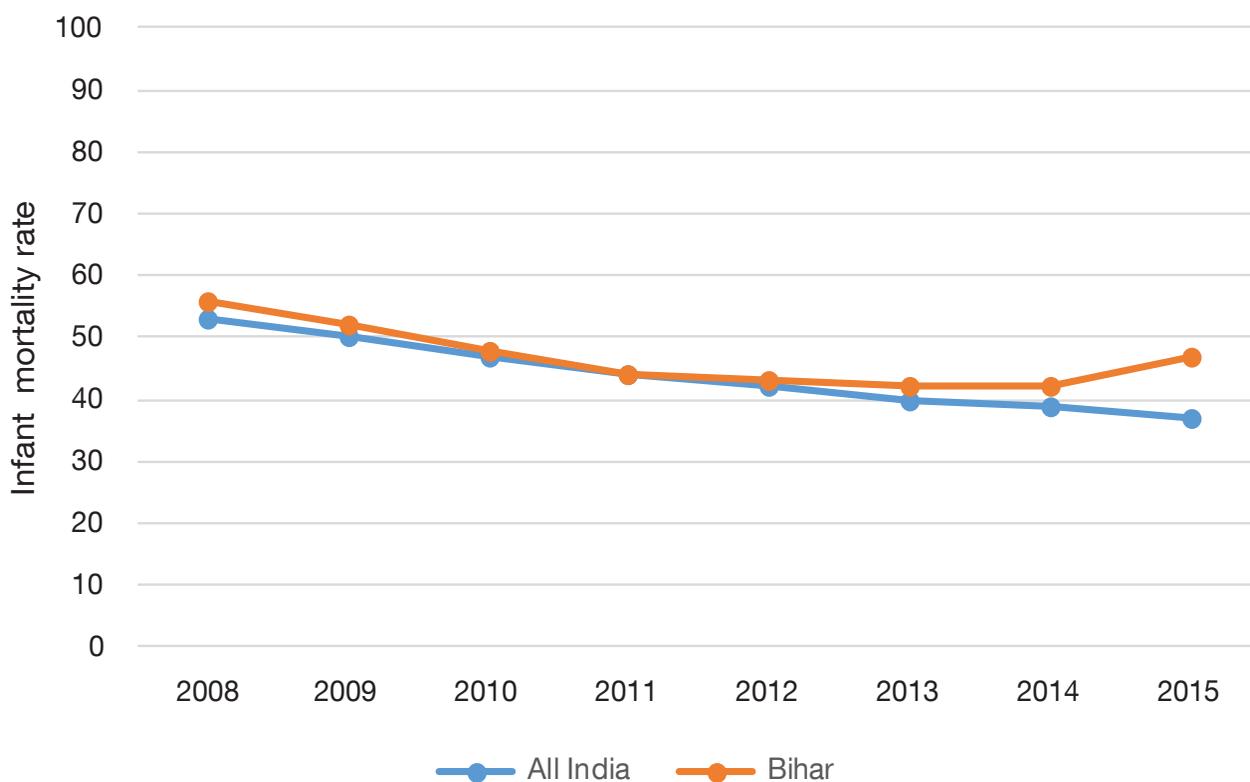
Source: SRS various reports

of 167 (SRS, 2011-13). SRS figures also reveal a high fertility rate for Bihar at 3.4 in 2013 as compared to 2.3 for India as a whole.

The health and hutrition status of women and children in Bihar, when studied using NFHS data for the decade 2005-06 and 2015-16 reveals a marginally worsening IMR and U5MR for the state (Table 2.7). The proportion of children suffering from stunting, wasting and underweight has shown a decrease over the decade which is a positive sign. The proportions of

anaemic children and women has also shown a decline over the decade under consideration, nevertheless, approximately two-thirds of the child and adult female population is reported as anaemic which is a worrying sign as a health indicator. A third of the births in the state are not in institutions and a third of the child population (12-23 months) is not fully immunized. Despite there being imporvements in all these indicators over the decade under study, the fact remains that these health related indicators have still

Table 2.7: **Health and Nutrition Status among Women and Children, 2005-06 and 2015-16**

Indicators	2015-16			2005-06		
	Urban	Rural	Total	Urban	Rural	Total
Infant mortality rate	66	34	49	NA	NA	48
Under5-mortality rate	84	40	60	NA	NA	58
Mothers who had at least 4 antenatal care visits (%)	26.3	13	14.4	36.2	14.5	16.9
Mothers who consumed iron folic acid for 100 days or more when they were pregnant (%)	12.3	9.4	9.7	NA	NA	6.3
Mothers who had full antenatal care (%)	6.6	3	3.3	NA	NA	4.2
Institutional births (%)	74.3	62.7	63.8	47.7	18.6	22
Children age 12-23 months fully immunized (BCG, measles, and 3 doses each of polio and DPT) (%)	59.7	61.9	61.7	45.6	31.1	32.8
Children under age 3 years breastfed within one hour of birth (%)	41.8	34.2	34.9	6	3.8	4
Children under 5 years who are stunted (height-for-age) (%)	39.8	49.3	48.3	NA	NA	55.6
Children under 5 years who are wasted (weight-for-height) (%)	21.3	20.8	20.8	NA	NA	27.1
Children under 5 years who are underweight (weight-for-age) (%)	37.5	44.6	43.9	NA	NA	55.9
Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)	22.2	31.8	30.4	25.1	45.9	43
Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	58.8	64	63.5	NA	NA	78
All women age 15-49 years who are anaemic (%)	58.7	60.5	60.3	NA	NA	67.4

Source: NFHS 2005-06 and 2015-16

ground to cover for Bihar to be considered as doing well on the health and nutrition indicators front.

Using selected health and nutrition indicatros at the district level from NFHS data, we have classified the districts into the best and worst categories and the data is presented in Table 2.8 below. The worst off districts mainly are in the north-eastern regions of Bihar and include Dharbhanga, Supaul, Madhepura, Araria, Kishanganj, Purnia, Katihar and Saharsa. Some of the districts from South and South East region

Table 2.8: Highest and Lowest five Districts in Terms of Health and Nutrition Indicators, 2015-16

Status	District	Institutional births (%)	District	Children age 12-23 months fully immunized	District	Children under 5 years who are stunted (height-for-age)12 (%)	District	Children under 5 years who are wasted (weight-for-height)12 (%)	District	Children under 5 years who are underweight (weight-for-age)12 (%)	District	Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2)14 (%)	District	Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	District	All women age 15-49 years who are anaemic (%)
Best 5 districts	Buxar	81.2	Arwal	74.9	Purnia	53.9	Sheohar	15.3	Gopalganj	30.2	Saran	24.3	Aurangabad	54.5	Buxar	51.7
	Munger	81.5	Rohtas	75.6	Jehanabad	54.7	Siwan	15.3	Siwan	32.2	Bhojpur	24.7	Muzaffarpur	55.0	Muzaffarpur	52.5
	Rohtas	82.1	Saharsa	78.2	Kaimur (Bhabua)	55.0	Vaishali	15.5	Saran	40.3	Siwan	25.0	Purba Champaran	56.8	Saran	52.7
	Jehanabad	82.7	Aurangabad	78.3	Nalanda	55.7	Sitamarhi	15.7	Samastipur	40.4	Gopalganj	25.3	Nawada	58.5	Purba Champaran	53.6
	Patna	82.7	Begusarai	80.1	Sitamarhi	58.1	Gopalganj	16.7	Begusarai	40.7	Buxar	25.4	Saran	59.4	Aurangabad	53.9
Worst 5 districts	Sitamarhi	37.9	Pashchim Champaran	30.4	Gopalganj	36.0	Gaya	26.6	Madhepura	50.0	Gaya	37.4	Saharsa	69.0	Banka	66.7
	Kishanganj	41.7	Madhubani	50.3	Siwan	38.2	Patna	27.2	Nalanda	50.0	Jamui	37.9	Banka	70.0	Kishanganj	66.7
	Darbhanga	46.9	Purba Champaran	51.3	Bhojpur	44.3	Sheikhpura	28.9	Sheikhpura	52.0	Supaul	38.6	Darbhanga	70.0	Araria	67.4
	Purba Champaran	47.0	Araria	53.0	Begusarai	44.6	Jamui	29.1	Arwal	53.8	Purnia	39.9	Bhagalpur	71.0	Supaul	68.2
	Katihar	49.1	Darbhanga	54.0	Saharsa	44.8	Arwal	29.2	Gaya	54.0	Araria	40.0	Supaul	72.5	Purnia	69.0

such as Jamui, Banka, Gaya, Arwal, Sheikhpura and Bhaagalpur are also find a place in this category. The best performing districts mostly belong to the West and South West region and are Buxar, Bhojpur, Rohtas, Kaimur, Aurangabad, and in the North West region such as Gopalganj, Siwan, Saran, Vaishali.

Table 2.9: **Status of Nutritional Intake in Rural Bihar and India**

	Bihar		India	
	2004-05	**2011-12**	**2004-05**	**2011-12**
Per capita per day intake of calories (kcal)	2049	2242	2047	2233
Per capita per day intake of proteins (gm)	57.8	62.9	57.0	60.7
% given vitamin A supplements in last 6 months (children< 5 yrs)	30.7	62.7	20.4	59.1

Source: NSS 61st and 68th rounds and NFHS III and IV

Table 2.9 presents comparative data on calorie and protein intakes for rural Bihar and India. In terms of intake of calories, proteins and vitamins, rural Bihar lies above than all-India average. In terms of vitamins also rural Bihar lies above the All-India averages.

Access to safe drinking water and sanitation is an important indicator of the socio-economic status of a household and is also fundamental to the health of its members. Safe drinking water is essential for child survival. Bihar has done rather well in terms of proportions of rural and urban habitations with safe sources of drinking water including piped water supply, tube wells and closed wells. The percentage of households having access to safe drinking water was 86.6 percent in 2001 which increased to 94 percent

Table 2.10: **Households with Access to Toilet Facility in Bihar (Percentage)**

Districts	Toilet Rural Bihar	District	Toilet Rural Bihar
Kishanganj	7.1	Sitamarhi	19.6
Araria	7.3	Sheohar	20.9
Purnia	9.5	Buxar	21.2
Supaul	9.9	Siwan	21.2
Banka	11.8	Bhojpur	21.8
Madhepura	12.2	Rohtas	22.1
Pashchim Champaran	12.4	Darbhanga	22.1
Jamui	12.7	Khagaria	22.9
Saharsa	13.7	Muzaffarpur	22.9
Katihar	13.8	Jehanabad	23.3

Districts	Toilet Rural Bihar	District	Toilet Rural Bihar
Kaimur (Bhabua)	15.3	Arwal	23.6
Purba Champaran	16.2	Nalanda	24.2
Gaya	17.3	Sheikhpura	25.9
Samastipur	17.9	Vaishali	26.1
Madhubani	18.2	Begusarai	26.8
Aurangabad	18.3	Bhagalpur	26.8
Nawada	18.3	Munger	27.0
Saran	19.0	Lakhisarai	28.1
Gopalganj	19.0	Patna	28.7
Bihar	23.1		

Source: Census of India, 2011

in 2011 with this indicator marking 94 percent in both rural and urban areas in 2011. Where Bihar falls behind is in the provisioning and access to sanitation facilities. In 2011, only a fifth (23.1 percent) of the households had toilet facilities within the household.

Districts such as Patna, Lakhisarai and Munger reported the highest proportions of households with access to toilet facilities within the household while Kishanganj, Araria and Purnia were at the bottom of the list (Table 2.10).

Table 2.11: **Rural Household Access to Facilities that Relates to Health in Bihar, 2011**

Basic Amenities	Percentage
Dilapidated house	7.4
unsafe water	5.6
main source of lighting kerosene	88.4
Fuel cooking-firewood	35.5
Open defecation	71.3
No bathing facility	66.3
No drainage facility	61.1

Source: Census 2011

Tables 2.11 explains the access to different amenities of rural households in Bihar for 2011, that are directly or indirectly related to health.. The nutrition insecurity of households is directly linked to water and sanitation related variables. Kerosene and firewood are the major sources of lighting and cooking for a large proportion of households. The open defacation indicator is cause for worry as 71 percent of the households report the same. More than sixty percent of rural households do not have bathing or drainage facilities.

Table 2.12: Employment structure in Bihar and India (%)

	Bihar		India	
	2004-05	**2011-12**	**2004-05**	**2011-12**
Agriculture, forestry & fishing	73.4	62.37	58.5	48.9
Mining & quarrying	0.1	0.08	0.57	0.54
Primary	73.5	62.45	59.07	49.44
Manufacturing	6.15	5.72	11.73	12.6
Electricity	0.08	0.03	0.27	0.52
Construction	2.89	10.18	5.57	10.6
Secondary	9.12	15.93	17.57	23.72
Trade, hotels & restaurants	9.5	10.58	10.24	10.96
Transport, storage & communication	2.6	2.94	3.83	4.83
Finance, real estate & business	0.6	1.14	1.55	2.32
Pub admn, edu, health & others	4.69	6.95	7.74	8.75
Tertiary	17.39	21.61	23.36	26.86

Note: Total Workforce based on the Usual Principal and Subsidiary Status.

Source: NSS, Various Rounds

Employment Status

The labour force participation rate in Bihar is low primarily due to lower participation rate of women. In the NSS 68th round, the LFP rate (usual status, principal and subsidiary) in 2011-12 in Bihar was 28.3 percent (Female: 5.7, male: 48.2). In rural areas, workers were mostly self employed (51.8 percent) and 44 percent were casual labourers. Only 4 percent of workers were engaged in regular wage work. In Bihar, a bulk of the workforce was engaged in the primary sector (62.45 percent) as against the all India level average of 49.44 percent in 2011-12. However, compared to 2004-05, dependence on the primary sector is seen to have declined in Bihar. On the other hand, employment in the secondary and tertiary sectors is observed to have increased in 20011-12 as compared to 2004-05.

Yet, Bihar lags behind the All-India average in terms of employment in the secondary and tertiary sectors (Table 2.12).

2.4 Physical Infrastructure Roads ■

A sound infrastructural base is key for economic development. The availability of adequate infrastructure not only promotes rapid industrialization, but also improves the quality of life of the people. The transportation network is one of the primary factors that promotes development.

However, the state still continues to remain far behind other states in terms of road length per lakh of population. In 2012-13, Bihar reported only 190 kms. of road length per lakh of population, as against 358

for all-India. In terms of road density, Bihar has 210 kms. of road length per 100 sq.kms., ahead of other states, except Kerala and West Bengal (Basic Road Statistics of India, 2012-13).

Power

Economic growth depends upon the availability of adequate, reliable and quality power at a competitive rate. It is key for accelerating economic growth, generation of employment, elimination of poverty and human development. The per capita power consumption in Bihar is 144 kilo watt hour, 85 percent lower than the all-India average of 927 kwh. Only 26 percent of rural households are electrifiedwhich is a very low proportion when compared to the other states. Bihar faces a power deficit (the difference between peak demand and electricity supplied) of 19 percent (Economic Survey of Bihar, 2016). In Bihar, while 90-99 percent villages are electrified, only 16.4 percent of households use electricity as their primary source of lighting.

Irrigation

Irrigation potential is key for agricultural development in the state. The irrigation potential for the state is 117 lakh hectares. Out of the Gross cropped area of 78.82 lakh ha., the area under assured irrigation is about 45.60 lakh hectares. Tube wells are the major source of irrigation with 63 percent (28.3 lakh hectare) of the area under assured irrigation. The area under

canal irrigation was 13.7 lakh hectares (30 percent) (Economic Survey of Bihar, 2016)..

Drinking Water Supply and Sanitation

Regular supply of and easy access to safe drinking water and sanitation are critical for healthy living. The state government is solely responsible for the provisioning of clean drinking water and sanitation to improve the health status of the population. According to the 2011 census, the proportion of households having no latrines in the country were 53.1 percent, compared to

63.6 percent in 2001. In Bihar, 76.9 percent of households were found to have no latrines in 2011, compared to 80.8 percent households in 2001. This decadal increase of only 3.9 percentage point is very small and is a matter of concern the for state's policy makers.

Bihar has done well in terms of coverage of rural and urban habitations with safe sources of drinking water, including piped water supply, tube wells and shallow wells. In Bihar, the coverage of households using tap water, tube well water and well water was 58.8 percent in 1991 86.2 percent in 2001, and this increased to 4.0 percent in 2011.

The overview of the Bihar economy presented in this chapter indicates low per capita incomes, high malnutrition levels and high mortality among children. Food insecurities in Bihar continue to persist notwithstanding recent achievements in poverty reduction and improvements in a few social indicators.

APPENDIX

Table A2.1: Appendix Table

	2005-06 to 2013-14
Agriculture/Animal Husbandry	6.02
Forestry / Logging	-1.95
Fishing	6.45
Mining/Quarrying	5.77
Sub-Total (Primary)	**5.33**
Manufacturing	7
Registered Manufacturing	19.31
Unregistered Manufacturing	3.38
Construction	16.58
Electricity/ Water Supply/ Gas	7.97
Sub-Total (Secondary)	**13.07**
Transport / Storage /Communication	15.08
Railways	3.91
Other Transport	12.17
Storage	9.38
Communication	25.38
Trade	13.13
Banking / Insurance	17.70
Real Estate	9.69
Public Administration	8.28
Other Services	8.70
Total Tertiary Sector	**12**
Total GSDP	**10.52**

Source: Ministry of Statistics and programme Implementation, Government of India

THE DIMENSIONS AND DETERMINANTS OF FOOD AND NUTRITION SECURITY IN BIHAR

Food security is the ability of a household to command food (its food entitlements as a result of its livelihood activities coupled with any other non-livelihood-based entitlements.) The effective demand for food, which is a combination of food consumed via self production and food purchased, when insufficient, requires various forms of interventions to ensure food security of households. In rural areas, agricultural production is a main component of livelihoods and earnings of households, leading to food security. We have calculated the food and nutritional security index for Bihar by taking into consideration 11 variables under the three main dimensions of food security viz., food availability, access and utilization (Table 3.1).

Table 3.1: Choice of Indicators used to Analyse Food and Nutrition Security in Bihar

Name of Variable	Ref. Year	Source
(a) Availability		
1. Proportion of net irrigated area to net sown area	2012-13	Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi
2. Per capita value of agricultural output	2011-12 to 2013-14	Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi
3. Percentage of inhabited villages having access to paved roads.	2011	Census of India 2011
(b) Access		
1. Percentage of agricultural labour to total workers.	2011	Census of India 2011
2. Proportion of ST and SC population to total population (Rural)	2011	Census of India 2011
3. Ratio of working age Population (Rural)	2011	Census of India 2011
4. Monthly per capita consumption expenditure (inequality adjusted)	2011-12	68th NSS round 2011-12

Name of Variable	Ref. Year	Source
5. Rural casual wage rate	2011-12	68th NSS round 2011-12
6. Female literacy rate (7+) (Rural)	2011	Census of India 2011
(c) Utilization		
1. Percentage of households having access to safe drinking water.	2011	Census of India 2011
2. Percentage of inhabited villages having access to Primary health centre in Rural Areas within 5 km range	2011	Census of India 2011
Outcome indicator		
1. % of children underweight (0-5 years) under 2SD	2015-16	NFHS 4, 2015-16
2. BMI among women	2015-16	NFHS 4, 2015-16

3.1 FOOD AVAILABILITY

The availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid) is important for ensuring food and nutrition security of a country's populace. Cereal and pulses are staple foodsthatcannot be perfectly substituted. For the poor classes, food grains are the cheapest source of energy and hence indispensable. In our analysis, the following indicators have been used to determine the magnitude of food availability in the districts of Bihar.

3.1.1 Per Capita Value of Agricultural Output

Agricultural output is a useful indicator to study the availability of food. Since agricultural output is dependent on the climate, it is advisable to take an average of three to five years' data for agricultural production to account for the variability in production. Further, in order to account for variations in the population across districts, we have used the per capita value of agricultural production. The position of each district between the triennium ending at two average years 2002-05 and 2012-15 is presented in Table 3.2.

A district wise analysis of the value of agricultural output (rupees) using the triennium average of 2012-13 to 2014-15 indicates that in comparison to Bihar state as a whole (Rs. 804), Rohtas (Rs. 1816.8), Pashchim Champaran (Rs. 1512), Kaimur (Rs 1492.5) and Aurangabad (1492.5) were the four districts with highest value of agricultural output. On the the other hand Jamui (Rs 292.1), Gajapati (Rs. 482), Dharbhanga (Rs. 366.7) and Madhubani (Rs. 367.9) were the three districts with the lowest value of agricultural output. The per capita value of agricultural output over the period 2002-05 to 2012-15 marked some changes. The value of agricultural output in districts of Aurangabad, Banka, Begusarai, Bhagalpur, Bhojpur, and Katihar marked an increase over the period under consideration whereas in the rest of the districts the value remained either the same or decreased (Map 3.1).

Table 3.2: **Per Capita Value of Agricultural Output (in Rs.)**

District	2012-15		2002-05	
	Percentage	**Rank**	**Percentage**	**Rank**
Araria	1198.4	7	1420	2
Arwal	718.7	21	738	18
Aurangabad	1425.6	4	1103	9
Banka	895.6	17	658	22
Begusarai	642.9	25	508	32
Bhagalpur	657.3	24	543	26
Bhojpur	988.4	12	895	13
Buxar	1243.0	6	1372	5
Darbhanga	366.7	37	358	37
Gaya	471.6	32	510	31
Gopalganj	950.7	15	944	12
Jamui	292.1	38	277	38
Jehanabad	1149.5	8	738	19
Kaimur (Bhabua)	1492.5	3	1409	3
Katihar	1368.2	5	1160	7
Khagaria	689.9	23	804	14
Kishanganj	1047.8	9	1166	6
Lakhisarai	951.5	14	526	28
Madhepura	1024.8	11	1073	10
Madhubani	367.9	36	423	36
Munger	470.4	33	472	34
Muzaffarpur	579.1	29	525	29
Nalanda	824.9	19	765	17
Nawada	592.6	28	646	23
Pashchim Champaran	1512.0	2	1448	1
Patna	555.4	30	715	20
Purba Champaran	691.5	22	675	21
Purnia	881.1	18	1133	8
Rohtas	1816.8	1	1404	4
Saharsa	1035.4	10	609	24

| | 2012-15 | | 2002-05 | |
District	Percentage	Rank	Percentage	Rank
Samastipur	555.3	31	537	27
Saran	464.3	34	524	30
Sheikhpura	933.4	16	804	15
Sheohar	774.5	20	582	25
Sitamarhi	601.1	27	433	35
Siwan	620.3	26	773	16
Supaul	957.7	13	1005	11
Vaishali	443.4	35	485	33
Bihar	804.0		485	

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India

Map 3.1: **Per capita value of Agricultural Output Bihar**

Legend:
- > 1513
- 1208 – 1512
- 903 – 1207
- 598 – 902
- < 597

Bihar Average = 849
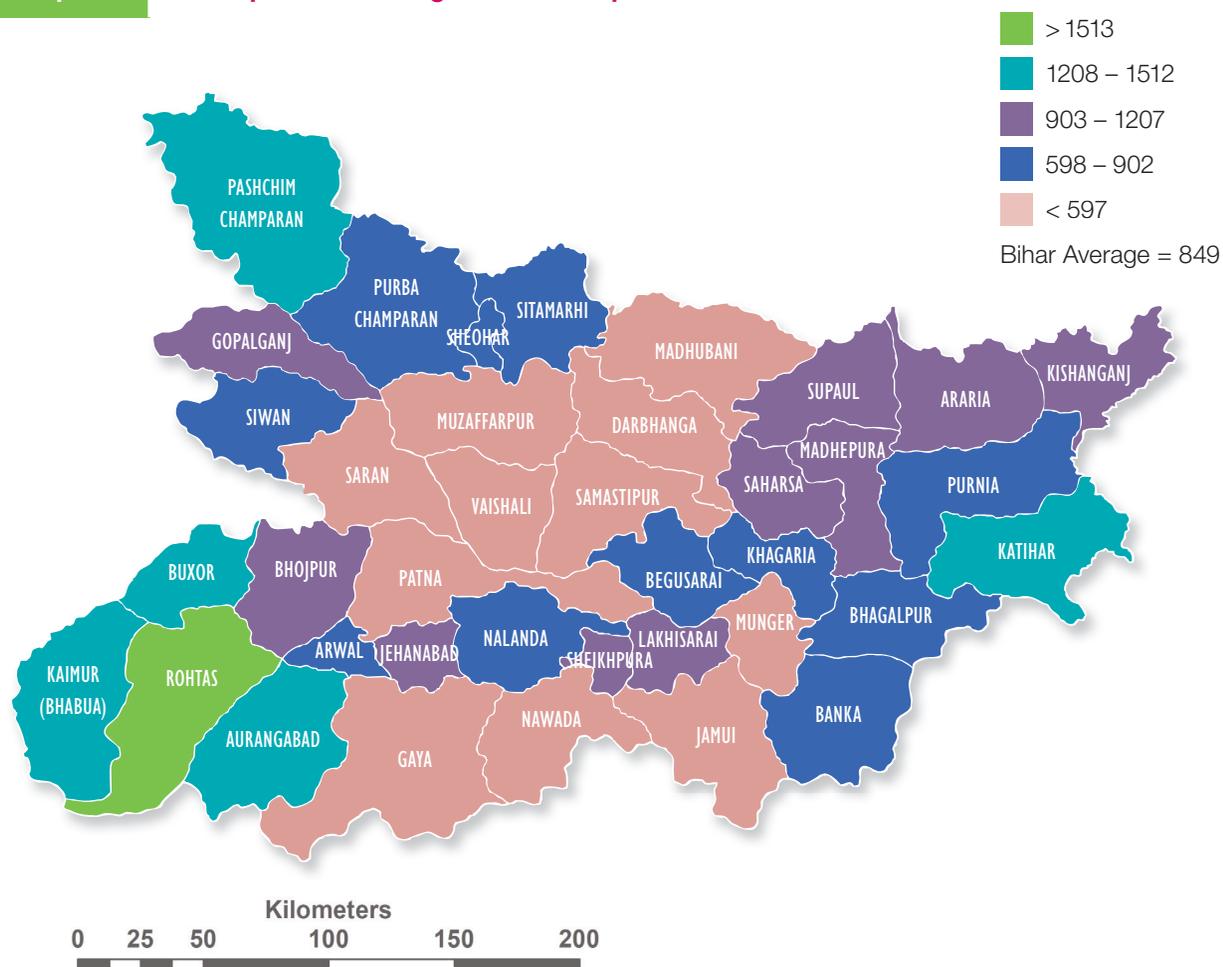
3.1.2   Net Irrigated Area to Net Sown Area

Improvements in irrigation facilities help in stabilizing agricultural production and reduces variations in incomes by mitigating the impact of drought.

The extent/intensity of irrigation available in the state can be estimated by the ratio of the net area irrigated to the net sown area. Table 3.3 presents the position of districts in Bihar for the proportion of net irrigated area to net sown area for the period 2001-02 to 2012-13.

Table 3.3:   **Percentage of Net Irrigated Area to Net Sown Area**

District	2012-13		2001-02	
	Percentage	Rank	Percentage	Rank
Sitamarhi	74.9	4	31.0	31
Siwan	62.0	17	47.7	14
Supaul	38.4	33	30.9	32
Vaishali	53.6	25	38.5	23
Araria	39.8	32	23.4	37
Arwal	64.7	13	64.3	8
Aurangabad	96.3	2	72.8	2
Banka	72.5	7	55.5	11
Begusarai	61.1	18	44.4	16
Bhagalpur	37.3	34	29.3	33
Bhojpur	58.7	19	67.3	4
Buxar	62.7	16	73.1	1
Darbhanga	45.7	28	25.7	35
Gaya	73.6	5	64.5	6
Gopalganj	65.3	11	42.9	17
Jamui	47.2	27	34.6	25
Jehanabad	100.8	1	64.3	7
Kaimur (Bhabua)	64.9	12	67.3	3
Katihar	34.8	35	32.3	30
Khagaria	73.2	6	53.7	12
Kishanganj	18.6	38	11.0	38

| | 2012-13 | | 2001-02 | |
District	Percentage	Rank	Percentage	Rank
Lakhisarai	71.6	9	46.0	15
Madhepura	44.4	30	42.9	18
Madhubani	32.3	36	25.5	36
Munger	54.4	24	42.4	20
Muzaffarpur	56.2	23	32.7	28
Nalanda	75.5	3	57.8	10
Nawada	58.1	20	64.0	9
Pashchim Champaran	63.5	15	32.7	29
Patna	45.3	29	50.5	13
Purba Champaran	43.6	31	39.3	22
Purnia	31.7	37	34.9	24
Rohtas	72.2	8	66.9	5
Saharsa	51.5	26	32.9	27
Samastipur	64.7	14	33.2	26
Saran	56.4	22	42.7	19
Sheikhpura	56.7	21	42.1	21
Sheohar	70.3	10	26.1	34
Bihar	56.5		44.39	

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India

The extent of irrigation in Bihar was 56.5 in 2012-13. Regional variations are also observed in irrigation patterns with Kishanganj reporting the lowest irrigation extent (18.6 percent). Some districts like Purnia, Katihar and Madhubani had just over a thirty as the proportion of net irrigated area to net sown area in 2012-13. Compared to 2001-02, the intensity of irrigation is seen to have increased in Bihar (from 44.39 percent to 56.5 percent in 2012-13). In some districts such has Bhojpur, Kaimur, Nawada and Purnia, the intensity of irrigation showed a decline in the period under consideration. Jehanabad had 100 percent irrigation intensity in 2012-13 followed by Aurangabad (96 percent) (Map 3.2).

Map 3.2:   **Proportion of Net Irrigated Area to Net Sown Area, Bihar 2012-13**

Legend:
- > 84.5
- 68.0 – 84.4
- 51.6 – 67.9
- 35.1 – 51.5
- < 35

Bihar Average = 57.8
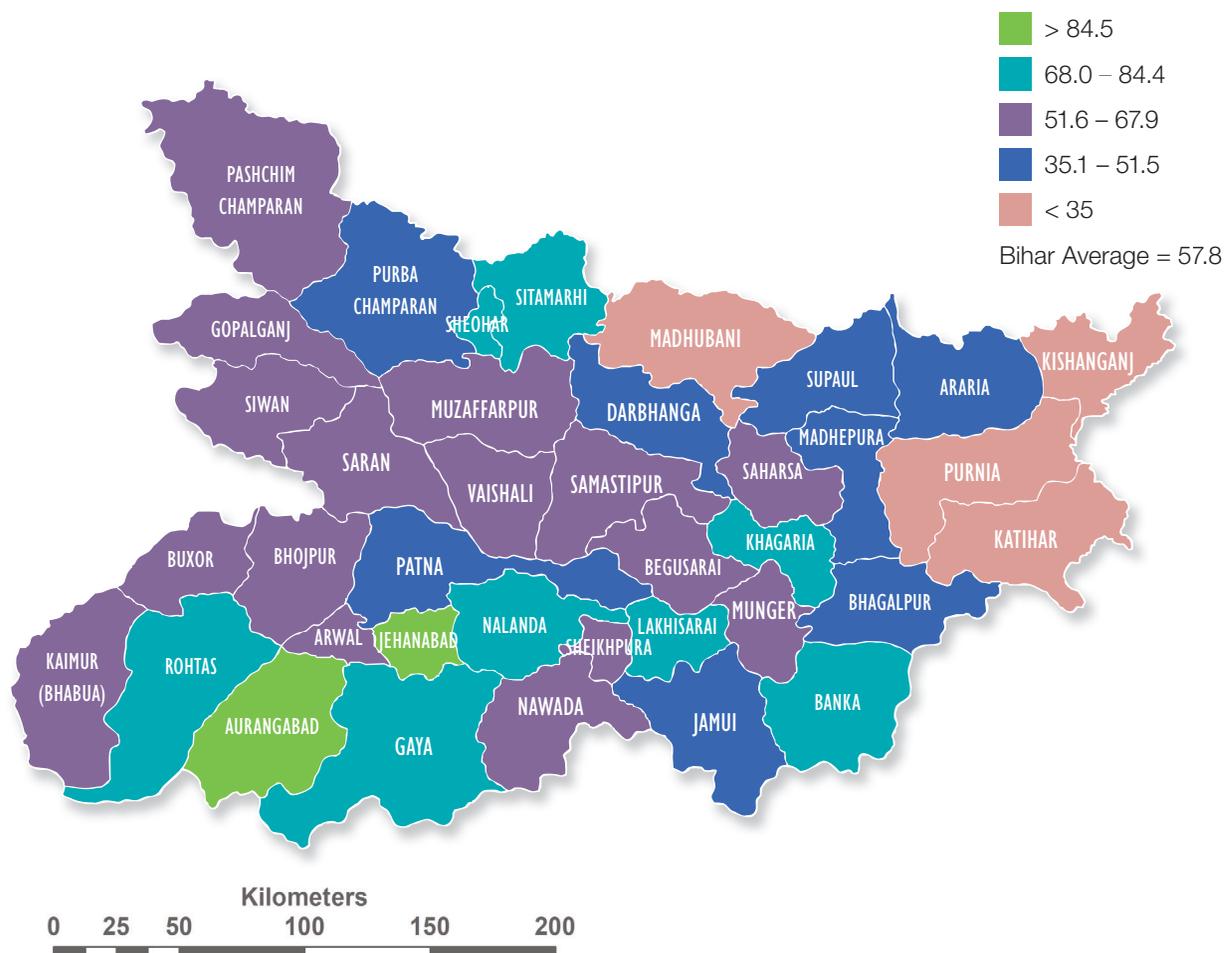
3.1.3   Access to Paved Roads

Roads in rural areas act as feeder roads, serving areas where agriculture is the predominant occupation, providing outlets to urban market centres. These roads also play a significant role in opening up backward areas and accelerating socio-economic development. Table 3.4 presents District ranks for the two Census years of 2001 and 2011 in terms of percentage of villages having access to paved roads.

Table 3.4:   **Percentage of Villages having Access to Paved Roads**

District	2011		2001	
	Percentage	**Rank**	**Percentage**	**Rank**
Araria	68.44	32	35.28	29
Arwal	95.65	2	36.46	24

District	2011		2001	
	Percentage	Rank	Percentage	Rank
Aurangabad	63.2	34	25.61	34
Banka	22.15	38	22.03	38
Begusarai	70.61	29	62.93	3
Bhagalpur	82.71	19	50.17	7
Bhojpur	77.73	25	46.75	8
Buxar	59.88	35	30.33	31
Darbhanga	83.72	18	45.89	10
Gaya	57.49	36	27.04	32
Gopalganj	81.65	20	40.28	18
Jamui	55.06	37	23.67	37
Jehanabad	94.09	5	36.46	24
Kaimur (Bhabua)	74.12	27	35.71	27
Katihar	64.55	33	25.3	35
Khagaria	87.35	13	52.28	6
Kishanganj	91.39	9	25.07	36
Lakhisarai	90.61	11	35.33	28
Madhepura	91.32	10	43.32	14
Madhubani	79.81	23	52.91	5
Munger	85.02	16	64.21	2
Muzaffarpur	87.14	14	44.6	12
Nalanda	86.64	15	39.8	19
Nawada	79.9	22	37.89	23
Pashchim Champaran	83.74	17	33.93	30
Patna	70.25	30	40.5	17
Purba Champaran	94.17	4	38.58	22
Purnia	76.64	26	26.06	33
Rohtas	79.5	24	43.89	13
Saharsa	71.91	28	42.6	16
Samastipur	91.76	8	57.23	4
Saran	94.33	3	39.05	21

	2011		2001	
District	Percentage	Rank	Percentage	Rank
Sheikhpura	93.87	6	66.03	1
Sheohar	99.48	1	36.17	26
Sitamarhi	80.07	21	43.22	15
Siwan	88.43	12	39.2	20
Supaul	68.44	31	45.9	9
Vaishali	92.26	7	45.05	11
Total	76.1		40.4	

Source: Census 2001 & 2011

Map 3.3: **Percentage of Inhabited Villages Having Access to Paved Roads, Bihar**

> 84.1
68.7 – 84.0
53.2 – 68.6
37.8 – 53.1
< 37.7
Bihar Average = 79.3
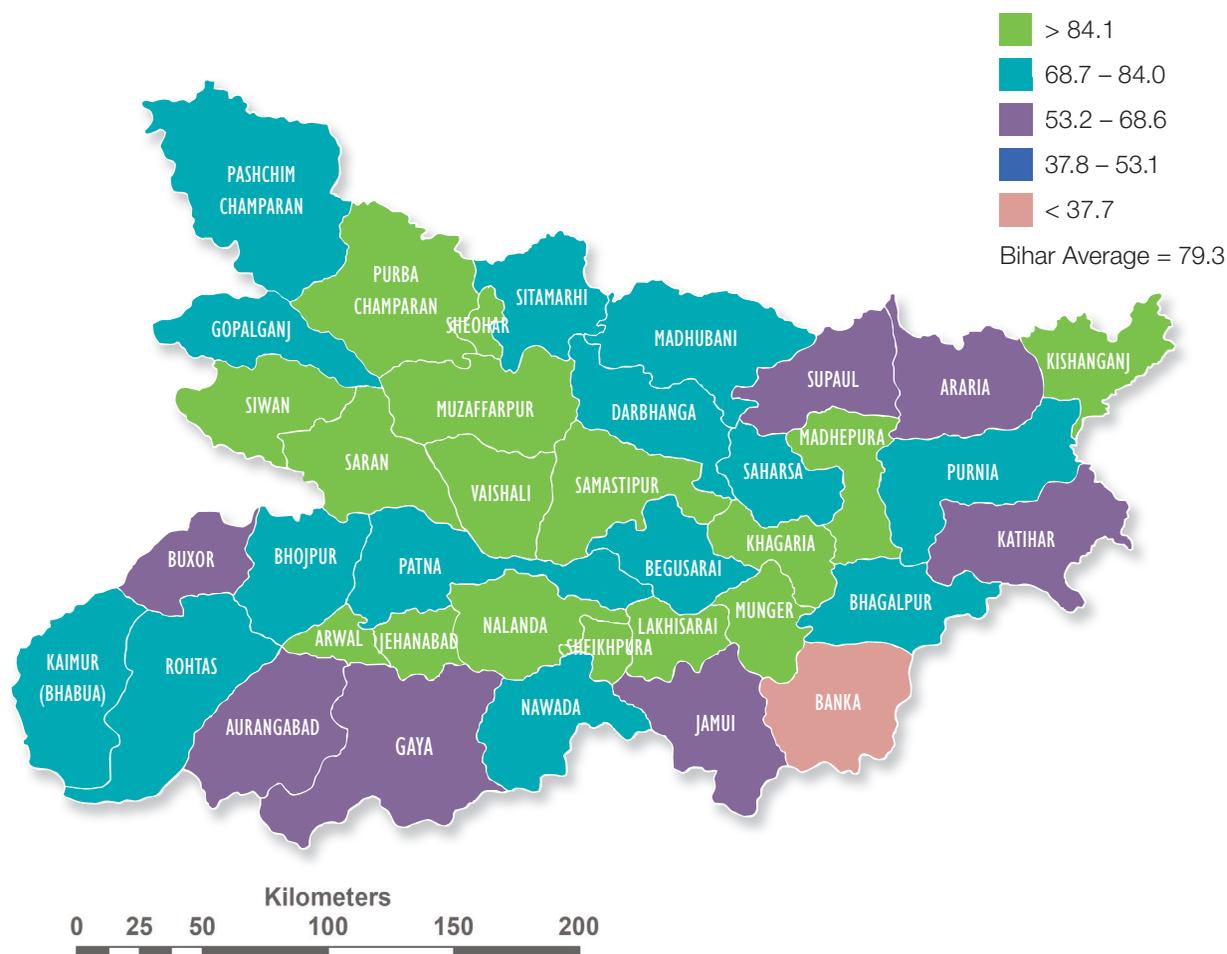
Most of the districts in Bihar are seen to have good rural connectivity, with an average of more then 70 percent of villages having access to paved roads. The exception are Banka (22.15 percent), Buxar (59.88 percent), Gaya (57 percent) and Jamui (55 percent). The districts that have shown a stark improvement in the access to roads for villages over the decade 2001-2011 are Kishanganj, Sheohar, Arwal, Jehandabad, Purba Champaran, Lakhisarai, Saran and Purnia (Map 3.3) (more than 50 percentage points).

3.1.4   The Food Availability Index

Using the two techniques of Range Equalisation and Mean Standardisation, we have calculated the Food Availability Index for the various districts in Bihar and present the same in Tables 3.5.1 and Table 3.5.2 below. The food availability index using the Range Equalisation Method shows districts such as Jamui,

Madhubani and Banka as the extremely food availability insecure. The Mean Standardisation Method calculated food availability index finds districts such as Jamui, Madhubani, Darbhanga, Patna and Bhagalpur the extremely insecure districts in terms of food availability. Both methods throw up approximately twelve districts as extremely food insecure in terms of availability and call for urgent policy attention Rohtas, Aurangabad and Jehanabad on the other hand come up as highly food availability secure districts using the Range Equalisation Method and the same districts in addition to Paschim Champaran are also on top using the Mean Standardisation Method. The moderately food secure diatricts (Using the range equalization method) include Sheikhpura, Nalanda, Sheohar, Lakhisarai, Kaimur (Bhabua) and Paschim Champaran of which only three come in the same category using the mean Standardisation method viz., Sheohar, Lakhisarai and Kaimur (Bhabua) (Maps 3.4a and 3.4b).

| Table 3.5.1: | Status of Districts in Food Availability Index 2016-17 (RE) |

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.258	Patna	0.373	Muzaffarpur	0.496	Sheikhpura	0.604	Aurangabad	0.740
Madhubani	0.321	Darbhanga	0.392	Purba Champaran	0.499	Nalanda	0.625	Rohtas	0.798
Banka	0.351	Gaya	0.415	Saran	0.502	Sheohar	0.649	Jehanabad	0.831
		Bhagalpur	0.417	Saharsa	0.510	Lakhisarai	0.654		
		Purnia	0.417	Siwan	0.533	Kaimur (Bhabua)	0.674		
		Supaul	0.425	Samastipur	0.544	Pashchim Champaran	0.714		
		Munger	0.455	Sitamarhi	0.546				
		Begusarai	0.458	Buxar	0.549				
		Kishanganj	0.464	Bhojpur	0.555				
		Nawada	0.475	Madhepura	0.563				
		Vaishali	0.477	Khagaria	0.590				
		Araria	0.484	Gopalganj	0.590				
		Katihar	0.484	Arwal	0.597				

Map 3.4a : **Food Availability Index Bihar (Range Equalization Method) 2016-17**

Legend:
- < 0.35 — Extreme Insecure
- 0.35 – 0.48 — Severe Insecure
- 0.48 – 0.59 — Moderate Insecure
- 0.59 – 0.71 — Moderately Secure
- > 0.71 — Secure

Bihar Average = 0.498
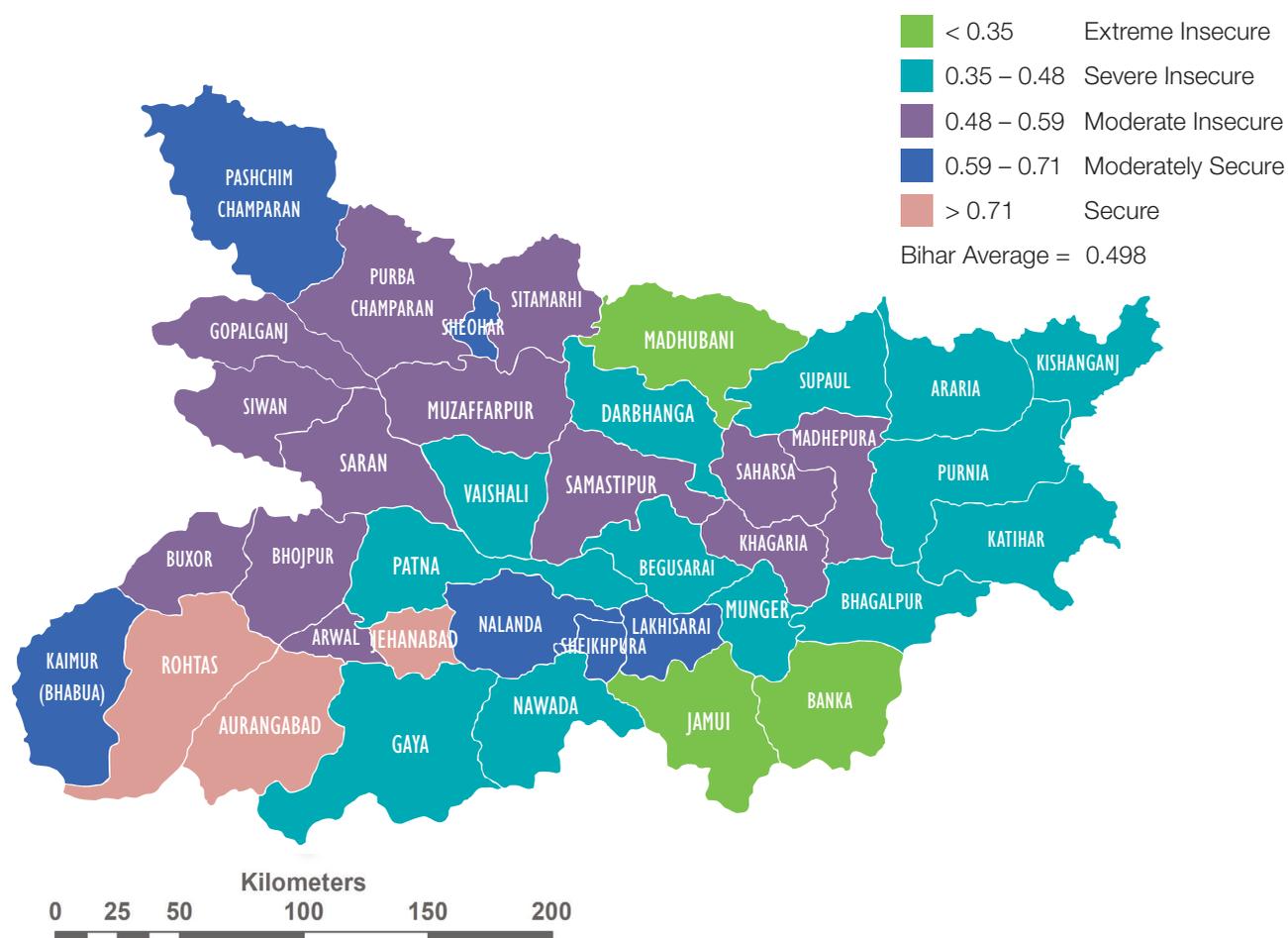
Table 3.5.2: **Status of Districts in Food Availability Index 2016-17 (MS)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	1.855	Bhagalpur	2.463	Siwan	2.919	Sheohar	3.384	Pashchim Champaran	3.936
Madhubani	1.998	Purnia	2.553	Samastipur	2.93	Lakhisarai	3.504	Aurangabad	4.143
Darbhanga	2.279	Gaya	2.555	Araria	2.964	Kaimur (Bhabua)	3.816	Jehanabad	4.285
Patna	2.325	Munger	2.568	Sitamarhi	3.015			Rohtas	4.392
		Banka	2.59	Saharsa	3.018				
		Vaishali	2.613	Katihar	3.028				

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
		Supaul	2.656	Madhepura	3.127				
		Begusarai	2.705	Bhojpur	3.161				
		Kishanganj	2.708	Arwal	3.172				
		Nawada	2.711	Khagaria	3.182				
		Saran	2.713	Sheikhpura	3.264				
		Muzaffarpur	2.754	Gopalganj	3.28				
		Purba Champaran	2.757	Buxar	3.305				
				Nalanda	3.372				

Map 3.4b: **Food Availability Index Bihar (Mean Standarization Method) 2016-17**

< 2.36	Extreme Insecure
2.36 – 2.87	Severe Insecure
2.87 – 3.37	Moderate Insecure
3.37 – 3.88	Moderately Secure
> 3.88	Secure

Bihar Average = 2.88
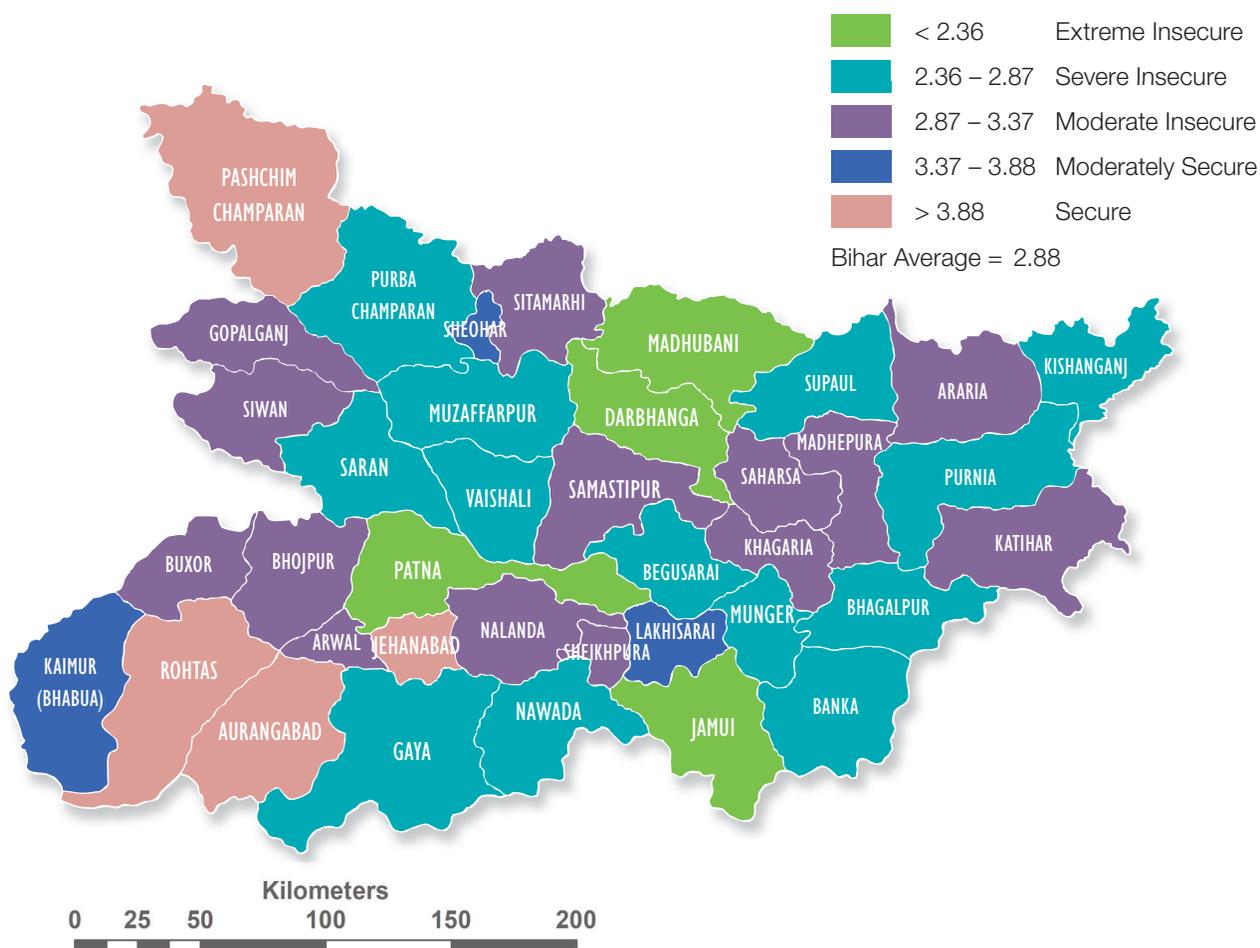
3.2 FOOD ACCESS ■

The critical significance of access to food has been imprinted by Sen's description of the Bengal famine, where people went hungry and starved, not because food was not available, but because they could not afford it (Sen, 1981). Sen linked the issue of food access to a person's 'entitlements'. Broadly, entitlements refer to the bundle of goods and services a person can acquire, based on his or her endowments such as wealth and assets, skills, knowledge, status and so on. Thus, the availability of food is important to food security but is not enough as food needs to also be affordable and people should be able to access it. Access to food is therefore tied up with people's capacity to buy, their earnings, livelihoods and other socio-economic factors. In addition, the access to food depends both on the availability of economic opportunities as well as the social inclusion of the population in availing those opportunities. To calculate the access to food index, we have taken into consideration six important variables

viz., the proportion of agricultural labour, proportion of SC/ST population, ratio of working age population, monthly per capita consumption expenditure, and the rural casual wage rate.

3.2.1   Proportion of agricultural labourers to total workers

Agricultural labourers are characterized by extremely poor physical and human capital and also the highest poverty levels (NCEUS, 2007). Thus, it can be expected that the proportion of agricultural labourers would be negatively related to food security, i.e., the more the agricultural labourers in a district, the worse will be the food security situation. Agriculture provides the major source of livelihoods and incomes for a large number of districts and the involvement of households in agriculture is more in the form of casual labour. Table 3.6 presents district rankings in terms of the proportion of agricultural to total workers in Bihar for the two Census years 2001 and 2011.

Table 3.6: **Percentage of Agricultural Labourers to Total Workers**

District	2011		2001	
	Percentage	Rank	Percentage	Rank
Araria	66.9	35	64.69	36
Arwal	62.5	29	46.16	14
Aurangabad	54	18	43.98	10
Banka	60.7	28	52.21	23
Begusarai	51.2	10	49.43	20
Bhagalpur	56.7	22	54.42	26
Bhojpur	48.5	5	42.87	8
Buxar	50	7	42.67	7
Darbhanga	56.3	21	54.31	25
Gaya	51.7	11	47.45	17
Gopalganj	48	3	41.1	4

| District | 2011 | | 2001 | |
	Percentage	Rank	Percentage	Rank
Jamui	47.2	2	33.57	1
Jehanabad	52.2	13	46.16	15
Kaimur (Bhabua)	53.8	17	49.47	21
Katihar	70.5	37	64.31	35
Khagaria	60.1	27	56.23	29
Kishanganj	65.2	34	61.03	33
Lakhisarai	52.7	14	45.88	13
Madhepura	63.8	32	57.37	32
Madhubani	58.5	25	53.64	24
Munger	56.7	23	51.03	22
Muzaffarpur	53.7	16	48.9	19
Nalanda	56	20	45.8	12
Nawada	51.1	9	41.74	5
Pashchim Champaran	70.9	38	65.4	37
Patna	52	12	46.94	16
Purba Champaran	63.1	30	56.66	30
Purnia	69.3	36	66.31	38
Rohtas	48.2	4	42.33	6
Saharsa	57.5	24	54.69	27
Samastipur	55.1	19	48.58	18
Saran	50.1	8	39.36	3
Sheikhpura	52.7	15	44.82	11
Sheohar	63.5	31	62.2	34
Sitamarhi	59.1	26	57.3	31
Siwan	42.1	1	35.05	2
Supaul	64.6	33	55.87	28
Vaishali	49.2	6	42.87	9
Bihar	56.9		51.05	

Source: Census 2001 &2011

Map 3.5 :   **Percentage of Agricultural Labour to Total Workers, Bihar districts, 2011**

> 65.2

59.5 – 65.1

53.7 – 59.4

48.0 – 53.6

< 47.9

Bihar Average = 56.5
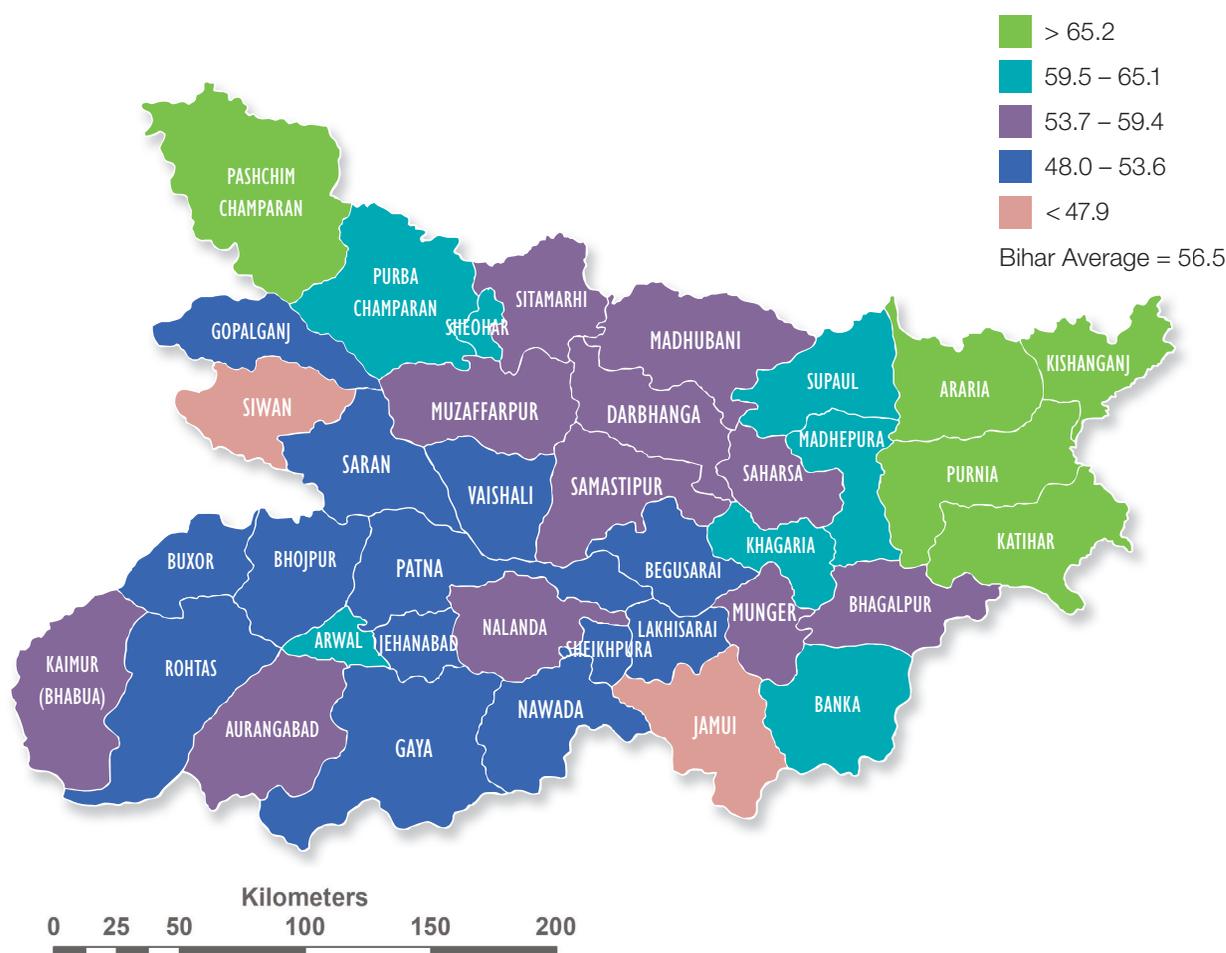
The proportion of agricultural labourers is seen to be high in Paschim Champaran and Katihar (more that seventy percent) in 2011. From the Census data presented in Table 3.6 it is also evident that over the decade 2001-2011, the proportion of agricultural labourers to total workers increased in all the districts of Bihar. Map 3.5 shows the position of the districts in 2011 for the same indicator.

3.2.2   Social groups – scheduled castes and scheduled tribes

Almost 18 percent of the total population in Bihar comprises the social groups of scheduled castes and scheduled tribes, which is almost comparable to the All India level. The higher the levels of SC and ST population within a district, the more food insecure it is likely to be. The indicator used for depicting food and nutrition security is percentage of non SC/ST population in the district. Census data for the proportions of scheduled castes and scheduled tribes in the population of Bihar's districts is presented in Table 3.7 for 2001 and 2011 and mapped for districts in 2011 in Map 3.6. The proportion of SC/ST population is more than 20 percent in Gaya, Nawada, Kaimur, wArungabad, Nalanda, Jamui, Paschim Camparan, Sheikhpura, Vaishali, Rohtas, Jehanabad, Arwal and Patna.

Table 3.7 : **Percentage of SC/ST Population to Total Population in Bihar**

District	2011		2001	
	Percentage	**Rank**	**Percentage**	**Rank**
Araria	15.3	12	15.3	14
Arwal	20.37	27	19.3	27
Aurangabad	25.36	35	24.5	35
Banka	16.83	18	17.3	23
Begusarai	15.5	13	14.8	10
Bhagalpur	13.75	6	13.9	8
Bhojpur	17.08	22	16.6	17
Buxar	16.95	19	15.2	13
Darbhanga	16.12	14	16	16
Gaya	33.26	38	32.6	38
Gopalganj	15.16	10	12.8	5
Jamui	22.39	33	22.9	34
Jehanabad	20.67	28	19.3	28
Kaimur (Bhabua)	26.75	36	25.4	37
Katihar	14.49	7	14.8	11
Khagaria	15.27	11	14.9	12
Kishanganj	10.25	1	10	1
Lakhisarai	17.07	21	17.4	24
Madhepura	18.23	24	18	25
Madhubani	13.32	5	13.7	7
Munger	17.04	20	16.7	20
Muzaffarpur	16.48	16	16.6	18
Nalanda	22.99	34	21.6	33
Nawada	27.05	37	25.3	36
Pashchim Champaran	21.75	32	16.6	19
Patna	20.05	26	19.7	29
Purba Champaran	13.3	4	13.6	6
Purnia	16.43	15	17.1	21
Rohtas	21.23	29	20.7	30
Saharsa	17.79	23	17.1	22

	2011		2001	
District	Percentage	Rank	Percentage	Rank
Samastipur	18.98	25	18.8	26
Saran	13.17	3	12.4	4
Sheikhpura	21.57	31	20.7	31
Sheohar	14.84	9	14.4	9
Sitamarhi	12.1	2	12	2
Siwan	14.59	8	12.2	3
Supaul	16.65	17	15.6	15
Vaishali	21.45	30	21	32
Bihar	17.99		17.4	

Source: Census 2001&2011

Map 3.6 : **Proportion of ST and SC Population to Total Population (Rural), Bihar districts, 2011**

Legend:
- > 28.8
- 24.2 – 28.7
- 19.5 – 24.1
- 14.9 – 19.4
- < 14.8

Bihar Average = 18.2
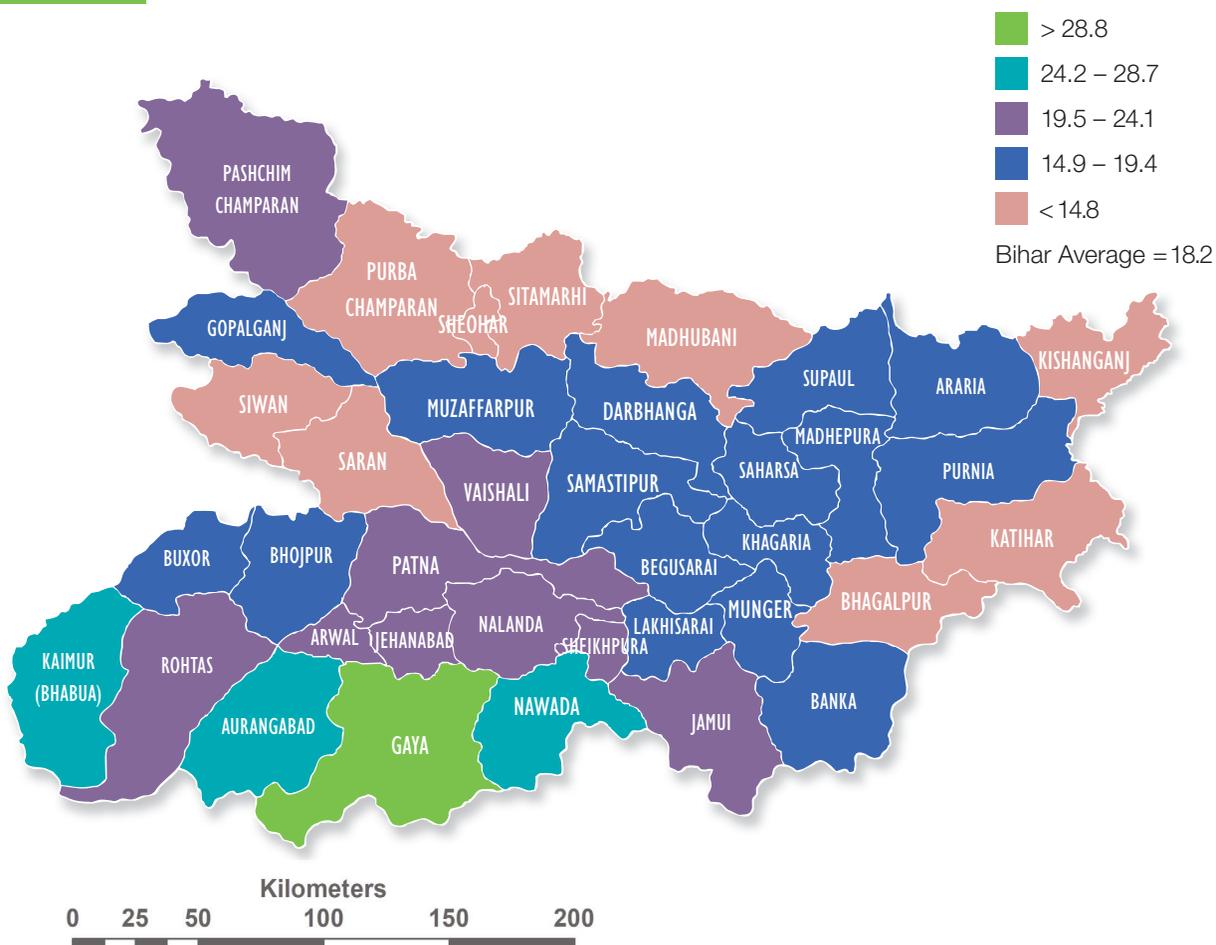
3.2.3 Working age Population (Rural)

The proportion of working age population has varied implications for the food security situation in a region. The working age ratio is the ratio between the working population (15–59 years) and the dependent population (less than 15 years and more than 59 years of age). The demographic transition from high fertility and high mortality to low fertility and low mortality has several phases. With development, fertility rates

| Table 3.8 : | Proportion of Working Age Population to Dependent Population by District in Bihar, 2001 and 2011 |

	2011		2001	
District	**Non dependency ratio**	**Rank**	**Non dependency ratio**	**Rank**
Araria	1.01	33	1.01	31
Arwal	1.07	14	1.09	3
Aurangabad	1.08	13	1.07	7
Banka	1.10	5	1.06	8
Begusarai	1.06	22	1.03	23
Bhagalpur	1.07	15	1.03	21
Bhojpur	1.14	1	1.05	14
Buxar	1.09	8	1.04	19
Darbhanga	1.06	18	1.03	24
Gaya	1.03	25	1.04	18
Gopalganj	1.06	21	0.97	36
Jamui	1.12	4	1.09	2
Jehanabad	1.09	11	1.09	3
Kaimur (Bhabua)	1.04	24	1.02	27
Katihar	1.02	27	0.97	35
Khagaria	1.00	36	1.00	34
Kishanganj	1.02	30	1.01	29
Lakhisarai	1.06	20	1.00	33
Madhepura	1.02	28	1.03	25
Madhubani	1.09	10	1.06	10
Munger	1.14	2	1.09	1
Muzaffarpur	1.09	9	1.05	15
Nalanda	1.07	16	1.08	6
Nawada	1.10	6	1.04	16
Pashchim Champaran	1.02	29	1.05	12
Patna	1.09	7	1.09	5
Purba Champaran	1.00	35	1.03	22
Purnia	1.00	37	1.01	32

	2011		2001	
District	**Non dependency ratio**	**Rank**	**Non dependency ratio**	**Rank**
Rohtas	1.12	3	1.06	9
Saharsa	1.01	34	1.03	20
Samastipur	1.05	23	1.01	30
Saran	1.06	19	0.95	37
Sheikhpura	1.01	31	1.03	26
Sheohar	0.99	38	1.06	11
Sitamarhi	1.01	32	1.05	13
Siwan	1.08	12	0.94	38
Supaul	1.02	26	1.04	17
Vaishali	1.06	17	1.02	28
Total	1.10		1.03	

Source: Census 2001 & 2011

Map 3.7 : **Proportion of Working Age Population to Dependent Population (Rural) Bihar 2011**
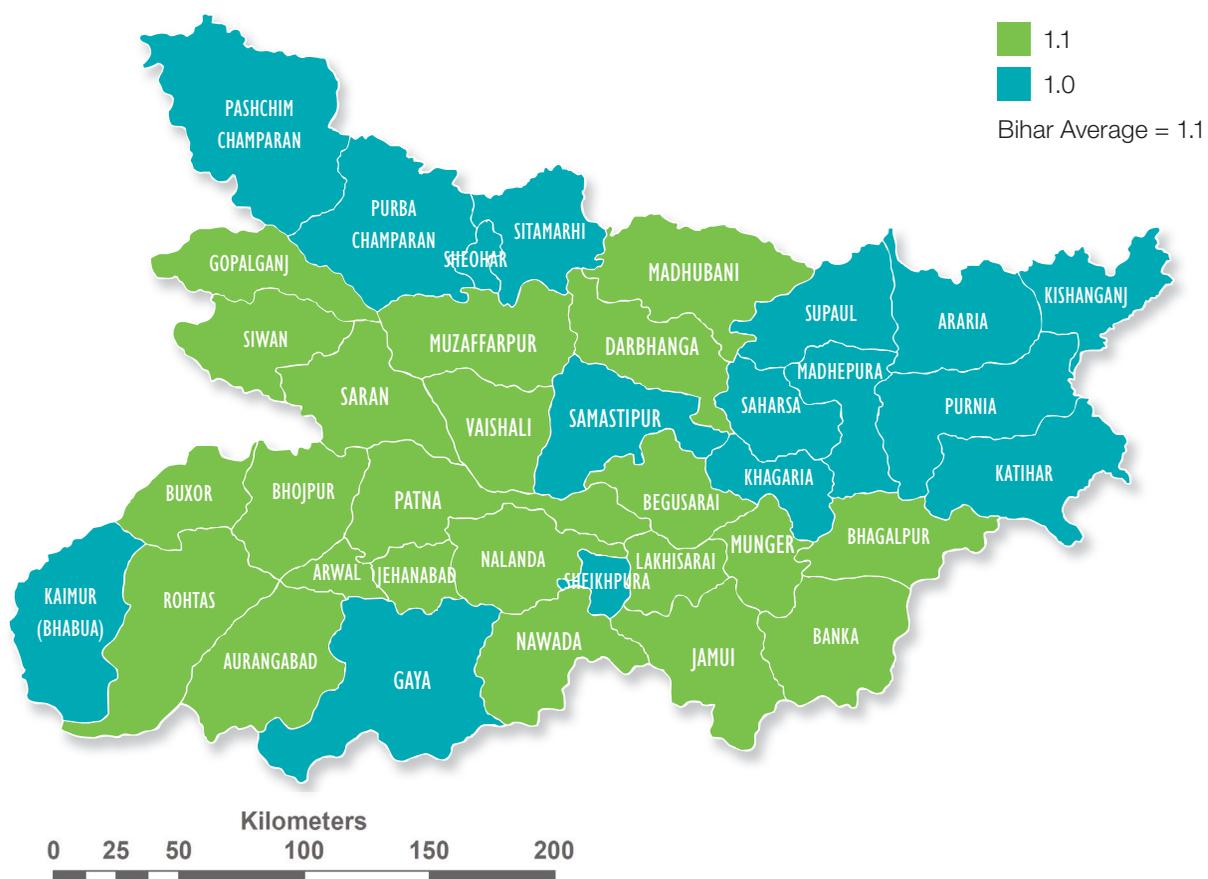
decline and the proportion of population in the working age group increases, resulting in a 'bulge' in the working age group. This leads to the hypothesis that the 'demographic dividend' derived from this gain would accelerate economic growth with a more productive population (Chandrasekhar, et al., 2006). A ratio higher than unity represents a positive scenario, with a more productive population compared to the dependent population. The position of each district between 2001 and 2011 is shown in Table 3.8. Map 3.7 also shows the position of the districts in 2011 in terms of ratio of working age population.

3.2.4 Monthly per capita consumption expenditure (inequality adjusted)

The NSS estimates of per capita consumption expenditure, adjusted for inequality, are a proxy for per capita income and are a significant dimension of the access to food. This variable accounts for all sources of income, including those which are captured through the availability of food as measured in terms of the value of agricultural output. For instance, a district showcasing

a low value of agricultural output coupled with a high value of consumption reflects that non-agricultural incomes, including remittances from migrants, is playing an important role in enabling consumption to be higher than actual agricultural production. This is the only way in which we can indirectly bring in and capture migration, which is a crucial component of households' food security strategies.

Low income levels directly affect consumption levels and therefore, per capita consumption expenditure in absolute terms can be considered as a good indicator of food security in rural areas. The value of per capita consumption expenditure in rural Bihar (Rs 778) was substantially lower than the national average (Rs. 816) and about 24 percent less than Kerala (Rs. 1018) in 2011-12. However, an analysis of monthly per capita expenditures (mpce) by social groups reveals some interesting results. Over the NSS time periods 2004-05 to 2011-12, there has been a marginal increase in MPCE for the population as a whole, but disaggregated by social groups we find that the MPCE for the Scheduled Tribes has in fact declined. Though the state as a whole has very low consumption levels, there

Table 3.9 : Monthly Per Capita Consumption Expenditure by District (in Rupees) for Bihar, 2004-05 and 2011-12

District	2011-12		2004-05		2001-12/2004-05
	MPCE(RS)	Rank	MPCE (RS)	Rank	
Araria	1105	12	307	31	3.60
Arwal	1093	14	289	35	3.78
Aurangabad	930	32	282	37	3.30
Banka	907	34	312	26	2.91
Begusarai	1099	13	314	25	3.50
Bhagalpur	980	27	315	23	3.11
Bhojpur	833	38	324	19	2.57
Buxar	967	29	309	29	3.13
Darbhanga	1075	16	323	20	3.33

| District | 2011-12 | | 2004-05 | | |
	MPCE(RS)	Rank	MPCE (RS)	Rank	2001-12/2004-05
Gaya	1072	17	336	17	3.19
Gopalganj	1005	25	358	13	2.81
Jamui	961	30	312	27	3.08
Jehanabad	1011	23	289	36	3.50
Kaimur (Bhabua)	1009	24	309	30	3.27
Katihar	1050	20	343	15	3.06
Khagaria	1174	7	384	6	3.06
Kishanganj	1089	15	307	32	3.55
Lakhisarai	1039	22	384	7	2.71
Madhepura	1436	2	451	1	3.18
Madhubani	1133	9	315	24	3.60
Munger	916	33	384	8	2.39
Muzaffarpur	1108	11	293	34	3.78
Nalanda	1063	18	331	18	3.21
Nawada	1062	19	347	14	3.06
Pashchim Champaran	1112	10	267	38	4.16
Patna	1411	3	320	22	4.41
Purba Champaran	1045	21	395	4	2.65
Purnia	989	26	386	5	2.56
Rohtas	903	35	338	16	2.67
Saharsa	1308	4	451	2	2.90
Samastipur	1175	6	310	28	3.79
Saran	1154	8	305	33	3.78
Sheikhpura	971	28	384	9	2.53
Sheohar	849	37	384	10	2.21
Sitamarhi	888	36	384	11	2.31
Siwan	953	31	373	12	2.55
Supaul	1226	5	435	3	2.82
Vaishali	1445	1	323	21	4.47
Total	1067		270.26		3.95

Source: NSSO 61st Round (2004-05) and 68th Round (2011-12)

Map 3.8 : **Monthly Per Capita Consumption Expenditure (inequality adjusted), Bihar Districts, 2011-12**

Legend:
- > 1322
- 1200 – 1322
- 1078 – 1200
- 955 – 1078
- < 955

Bihar Average = 1067

3.2.5 Rural casual wage rate
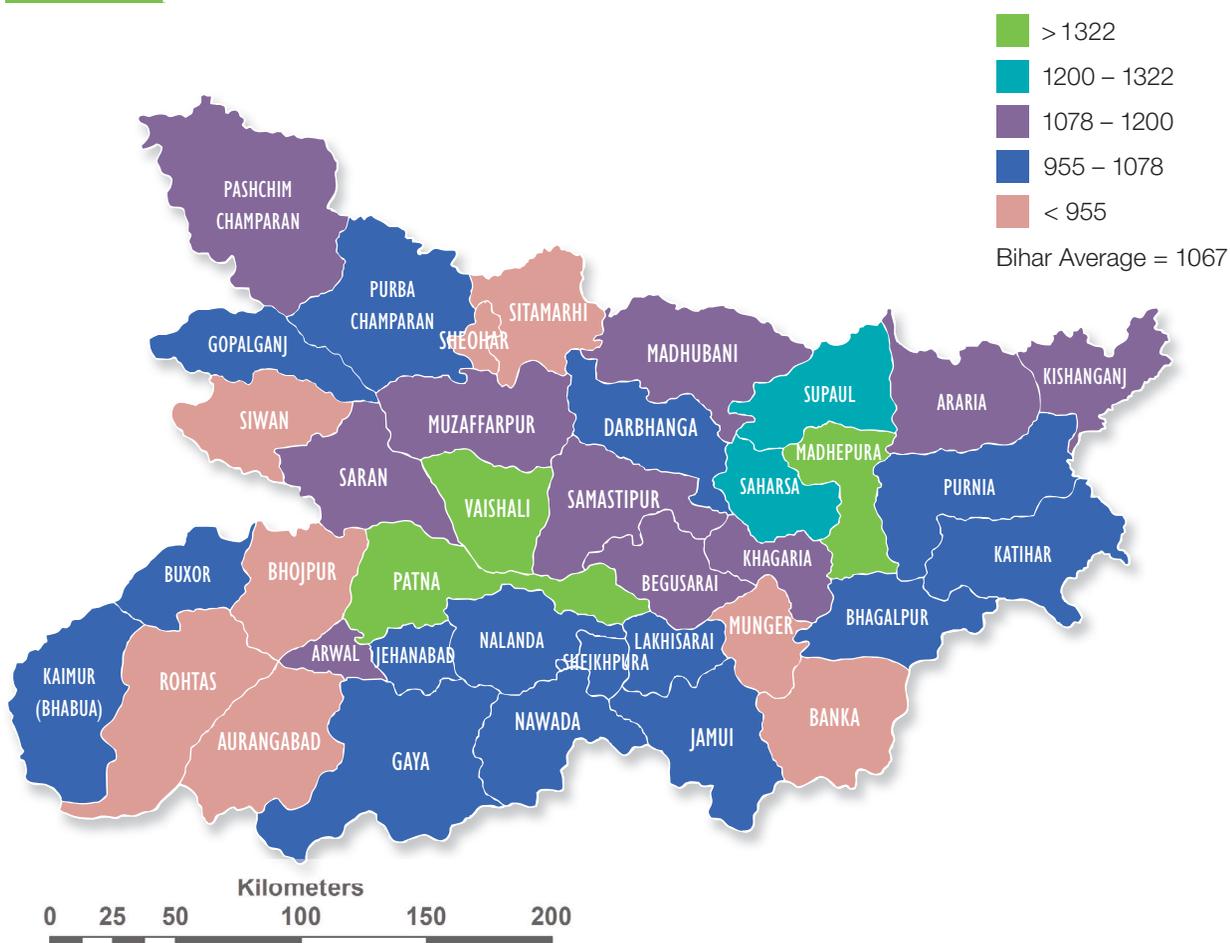
are stark inter-group disparities in consumption levels within the state. The position of each district between 2004-5 and 2011-12 is shown in Table 3.9. Vaishali, Madhepura and Patna were the top rankers in terms of monthly per capita consumption expenditures in the state in 2011-12. Since the MPCE given in the table for two periods of time is at a current prices and hence is not comparable, the ratio of the MPCE between two periods does give some indication of changes over time in the same indicator. This mpce ratio is high for the districts of Vaishali, Patna and Paschim Camparan. Status of the districts in terms of the monthly per capita consumption expenditure in 2011-12 is shown in Map 3.8.

The casual wage rate is an important indicator for access as it captures the standard of living of a rural household. The higher the casual wage rate, the higher the likelihood of a better standard of living and, hence, more food secure the household can be taken to be. The NSS defines a casual wage worker as one who was is casually engaged in others' farm or non-farm enterprises (both household and non-household) and, in return, received wages according to the terms of the daily or periodic work contract. Casual wage workers constitute about one-fifth of the workers in the unorganized non-agricultural sector while almost

Table 3.10 : **Rural Casual Wage Rate by District in Bihar (in Rupees)**

District	2011-12		2004-05	
	Average wage rate	Rank	Average wage rate	Rank
Araria	129.26	19	45.44	17
Arwal	187.59	1	32.29	35
Aurangabad	121.36	23	33.69	34
Banka	115.36	28	45.44	17
Begusarai	113.27	32	50.08	9
Bhagalpur	127.83	20	47.02	14
Bhojpur	114.63	30	55.98	3
Buxar	110.06	34	53.94	5
Darbhanga	131.95	17	43.70	23
Gaya	87.97	38	36.17	33
Gopalganj	149.91	4	54.74	4
Jamui	100.11	37	49.28	11
Jehanabad	140.34	10	32.29	35
Kaimur (Bhabua)	160.90	3	47.25	13
Katihar	124.87	22	47.02	14
Khagaria	118.81	26	42.89	26
Kishanganj	132.26	15	36.93	32
Lakhisarai	106.87	36	53.53	6
Madhepura	134.25	12	43.70	23
Madhubani	142.74	8	42.74	27
Munger	113.93	31	53.53	6
Muzaffarpur	142.89	7	49.69	10
Nalanda	127.56	21	44.16	21
Nawada	133.70	13	31.86	37
Pashchim Champaran	109.59	35	31.86	37
Patna	141.95	9	58.38	1
Purba Champaran	129.28	18	41.28	30
Purnia	115.21	29	42.20	28
Rohtas	120.50	24	45.80	16
Saharsa	143.32	5	43.70	23

District	2011-12		2004-05	
	Average wage rate	Rank	Average wage rate	Rank
Samastipur	111.58	33	43.94	22
Saran	170.46	2	47.66	12
Sheikhpura	118.73	27	53.53	6
Sheohar	132.04	16	41.28	30
Sitamarhi	135.68	11	41.36	29
Siwan	119.16	25	57.45	2
Supaul	133.25	14	45.44	17
Vaishali	143.29	6	44.78	20
Total	127.77		43.95	

Source: NSSO 61st Round and 68th Round

Map 3.9 :   **Casual Wage Rate (Rural) Bihar 2011-12**

Legend:
- > 168
- 148 – 168
- 128 – 148
- 108 – 128
- < 108

Bihar Average = 129
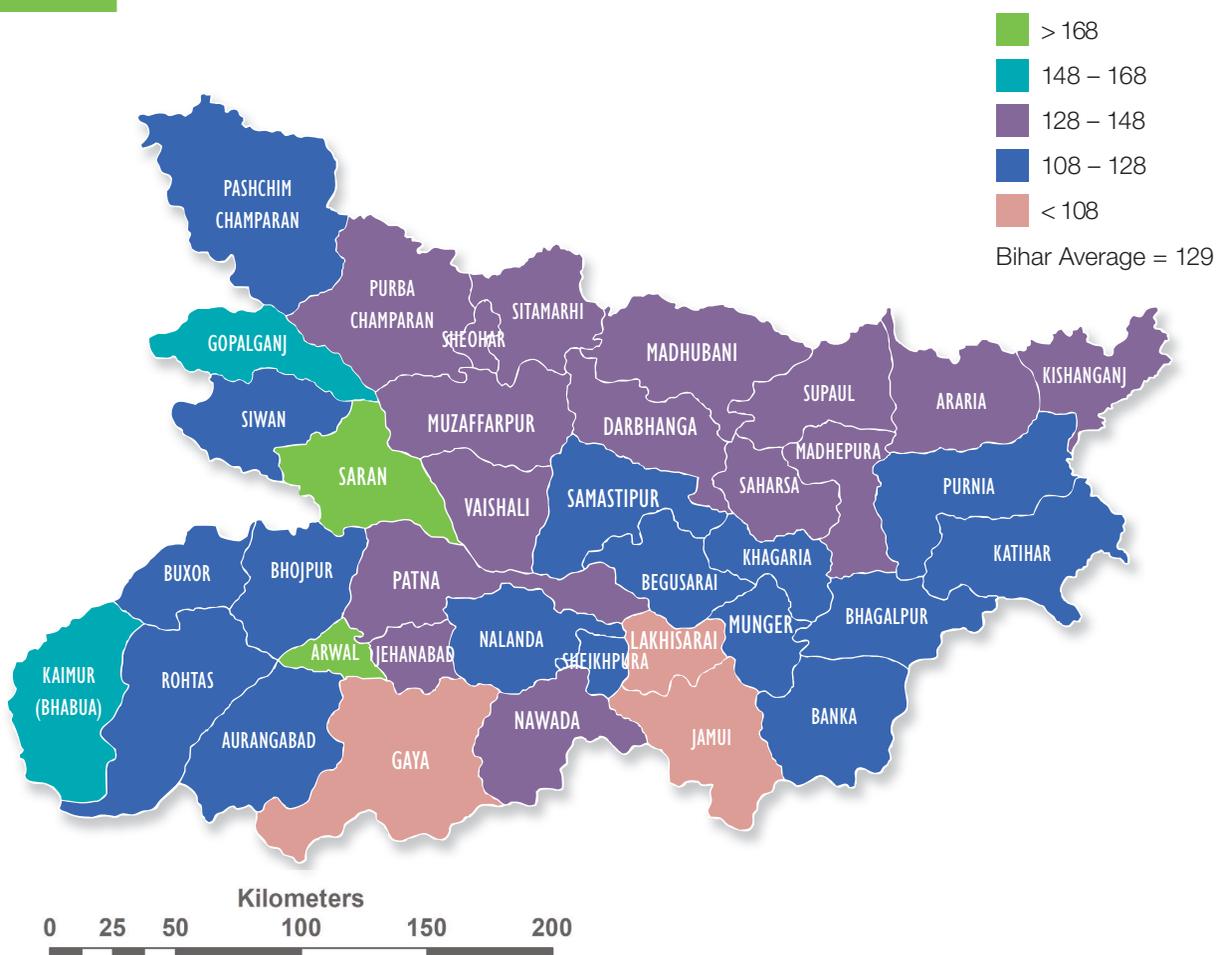
all agricultural labourers are casual workers (NCEUS, 2007). Casual workers tend to have the lowest level of earnings. The understanding is that agricultural labour, without the fall back of self-produced food, is particularly vulnerable to food insecurities and thus the earnings of agricultural labour is of utmost importance. Data on the rural casual wage rate (Table 3.10) presented and analysed for two NSS Round years shows a markable increase in the districts of Arwal, Jehanbad, and Nawada. Map3.9 also presents the rural casual wage rate by districts for the year 2011-12 with Arwal and Saran having the highest wage rate for casual labour.

3.2.6 Female Literacy Rate

Low literacy rates of Indian women has been one of the major impediments in the way of women's empowerment. Poor educational achievements limits their ability to participate in decision making processes at the family, community and national levels. It also adversely affects their access to information and technology. Women's education has been seen to have a positive impact on the food and nutrition security of a household (Sraboni et al., 2014). Not only will educated women be more productive, but they will

Map 3.10 : **Female Literacy Rate (Rural) Bihar, 2011**

Legend:
- > 57
- 53 – 57
- 48 – 53
- 44 – 48
- < 44

Bihar Average = 49
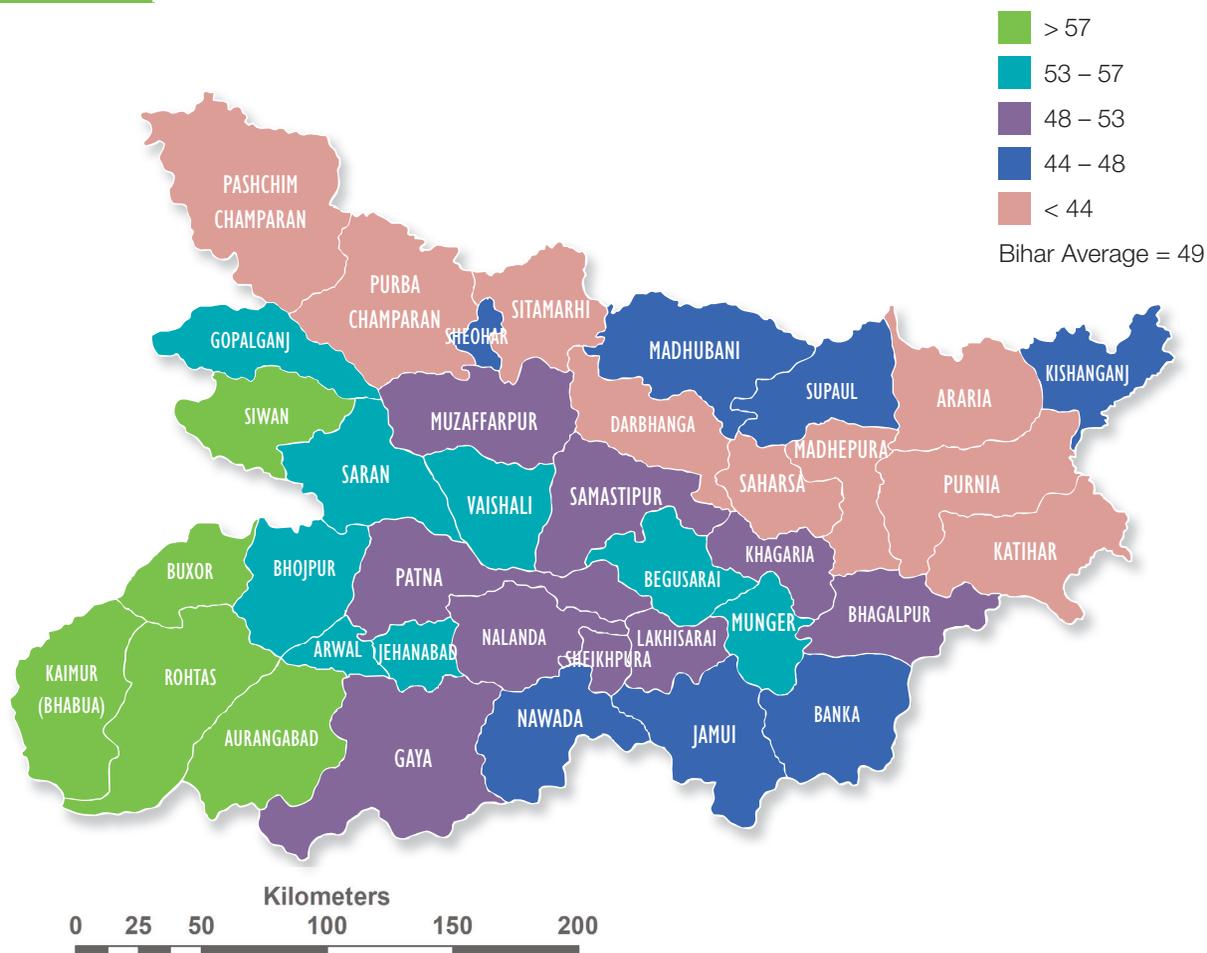
Table 3.11 :   **District-wise Female Literacy in Rural Bihar (%), 2001 and 2011**

District	2011		2001	
	Female literacy rate (7+) (Rural)	**Rank**	**Female literacy rate (7+) (Rural)**	**Rank**
Araria	42.50	32	20.44	34
Arwal	54.09	9	37.88	6
Aurangabad	58.37	2	39.91	2
Banka	46.98	23	27.87	23
Begusarai	52.68	13	33.96	14
Bhagalpur	50.86	17	32.14	15
Bhojpur	55.82	8	38.50	4
Buxar	57.10	5	37.53	8
Darbhanga	42.64	31	27.61	24
Gaya	50.02	21	31.81	17
Gopalganj	53.99	10	31.03	19
Jamui	45.56	25	23.90	28
Jehanabad	53.10	12	37.88	6
Kaimur (Bhabua)	57.62	4	37.88	5
Katihar	41.59	34	19.69	35
Khagaria	48.30	22	27.33	25
Kishanganj	44.74	28	15.39	38
Lakhisarai	50.71	18	31.24	18
Madhepura	40.56	36	20.57	33
Madhubani	45.55	26	25.36	26
Munger	56.68	6	39.27	3
Muzaffarpur	52.27	14	32.14	16
Nalanda	50.24	20	34.99	12
Nawada	46.70	24	29.68	22
Pashchim Champaran	42.46	33	21.95	32
Patna	51.04	16	36.57	9
Purba Champaran	43.41	30	21.98	31
Purnia	39.28	37	19.63	36
Rohtas	61.53	1	42.85	1
Saharsa	39.20	38	22.14	30
Samastipur	50.63	19	30.33	21
Saran	53.17	11	33.98	13

District	2011 Female literacy rate (7+) (Rural)	Rank	2001 Female literacy rate (7+) (Rural)	Rank
Sheikhpura	51.42	15	30.88	20
Sheohar	44.92	27	23.55	29
Sitamarhi	41.01	35	24.28	27
Siwan	57.94	3	35.60	10
Supaul	43.82	29	19.31	37
Vaishali	55.95	7	35.21	11
Bihar	49.00		29.61	

Source: Census 2001 & 2011

also bring up better educated and healthier children. As per the Census 2011, the female literacy rate of the state is only 49 percent. The decadal change in female literacy rates (2001 to 2011) reveals thatthe largest improvement was reported by Kishanganj, Supaul and Gopalganj (Table 3.11 and Map 3.10).

3.2.7 The Food Access Index

The Food Access Index was also calculated using the Range Equalisation and Mean Standardisation Methods and is presented in this section. Based on the Range Equalisation Method, (Table 3.12.1 and Map 3.11a) nine districts (Purnia, Pashchim Champaran, Sheohar, Gaya, Katihar, Araria, Sitamarhi, Purba Champaran, Sheikhpura) fall in the two lowest categories of severely food insecure and extremely food insecure when ranked on the basis of the Food Access Index. The seven food secure districts include Rohtas, Muzaffarpur, Gopalganj, Siwan, Patna, Saran, and Vaishali. On the other hand, going by the Mean Standardisation Method, only Patna, Saran, and Vaishali also food secure (Table 3.12.2 and Map 3.11b).

Table 3.12.1: Status of Districts for the Food Access Index 2016-17 (Range Equalisation Method)

Extreme Insecure		Severely Insecure		Moderate Insecure		Moderately Secure		Secure	
Purnia	0.228	Araria	0.344	Supaul	0.415	Bhagalpur	0.512	Muzaffarpur	0.597
Pashchim Champaran	0.254	Sitamarhi	0.353	Kishanganj	0.418	Kaimur (Bhabua)	0.516	Gopalganj	0.6
Sheohar	0.297	Purba Champaran	0.366	Khagaria	0.423	Begusarai	0.533	Rohtas	0.605
Gaya	0.303	Sheikhpura	0.395	Banka	0.432	Madhubani	0.547	Siwan	0.633
Katihar	0.318			Saharsa	0.433	Jehanabad	0.548	Patna	0.659
				Madhepura	0.44	Munger	0.561	Saran	0.676
				Darbhanga	0.458	Buxar	0.563	Vaishali	0.68

Extreme Insecure		Severely Insecure		Moderate Insecure		Moderately Secure		Secure	
				Nalanda	0.462	Bhojpur	0.582		
				Jamui	0.463	Arwal	0.587		
				Nawada	0.474				
				Lakhisarai	0.474				
				Samastipur	0.481				
				Aurangabad	0.484				

Map 3.11a : **Food Access Index, Bihar (Range Equalization Method), 2016-17**

Legend:
- < 0.31 — Extreme Insecure
- 0.31 – 0.39 — Severe Insecure
- 0.39 – 0.48 — Moderate Insecure
- 0.48 – 0.58 — Moderately Secure
- > 0.58 — Secure

Bihar Average = 0.519
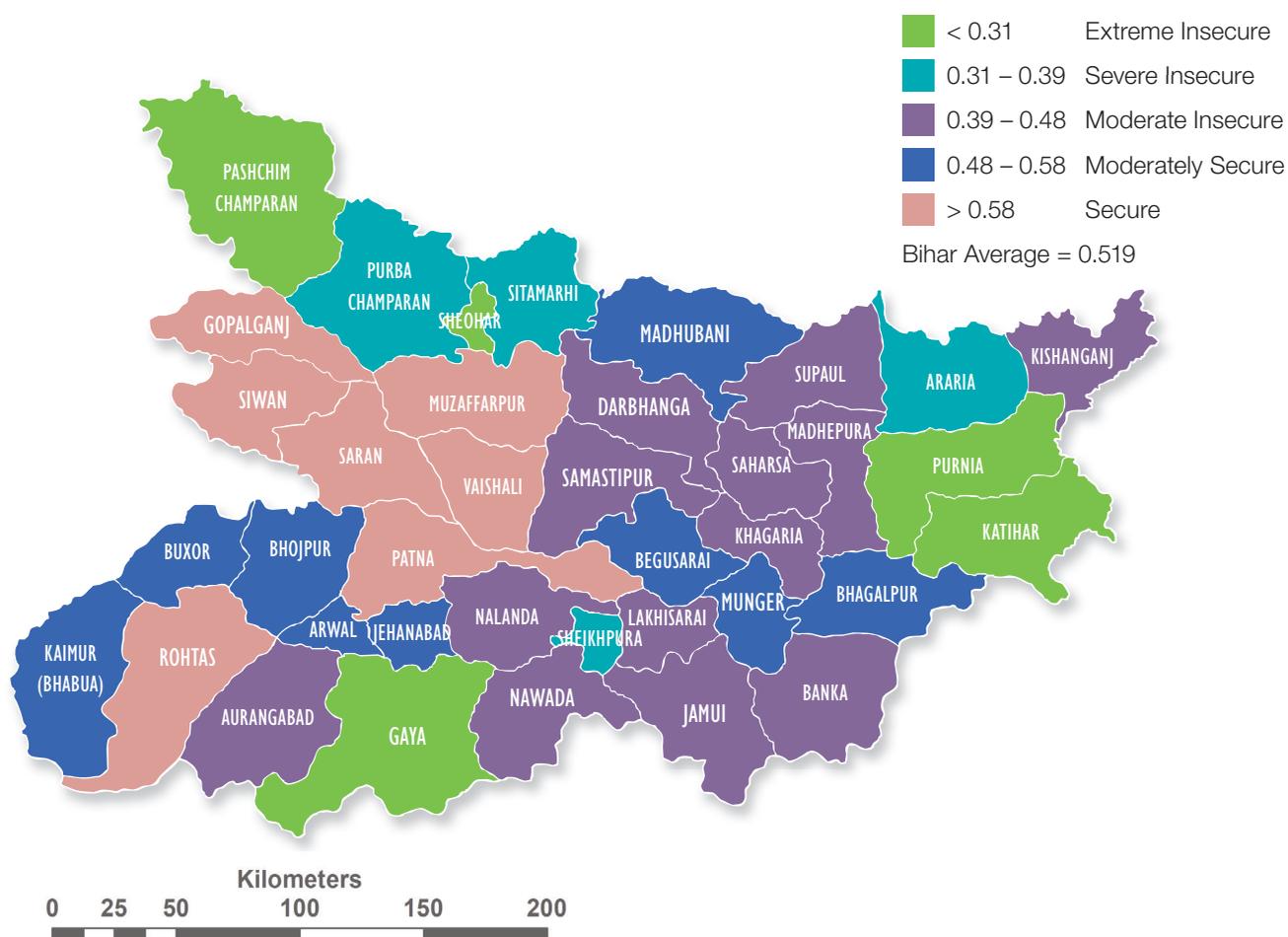
Map 3.11b : **Access to food Index, Bihar (Mean Standarization Method)**

Legend:
- 🟩 < 5.57 — Extreme Insecure
- 🟦 5.57 – 5.86 — Severe Insecure
- 🟪 5.86 – 6.15 — Moderate Insecure
- 🟦 6.15 – 6.44 — Moderately Secure
- 🟧 > 6.44 — Secure

Bihar Average = 1.88
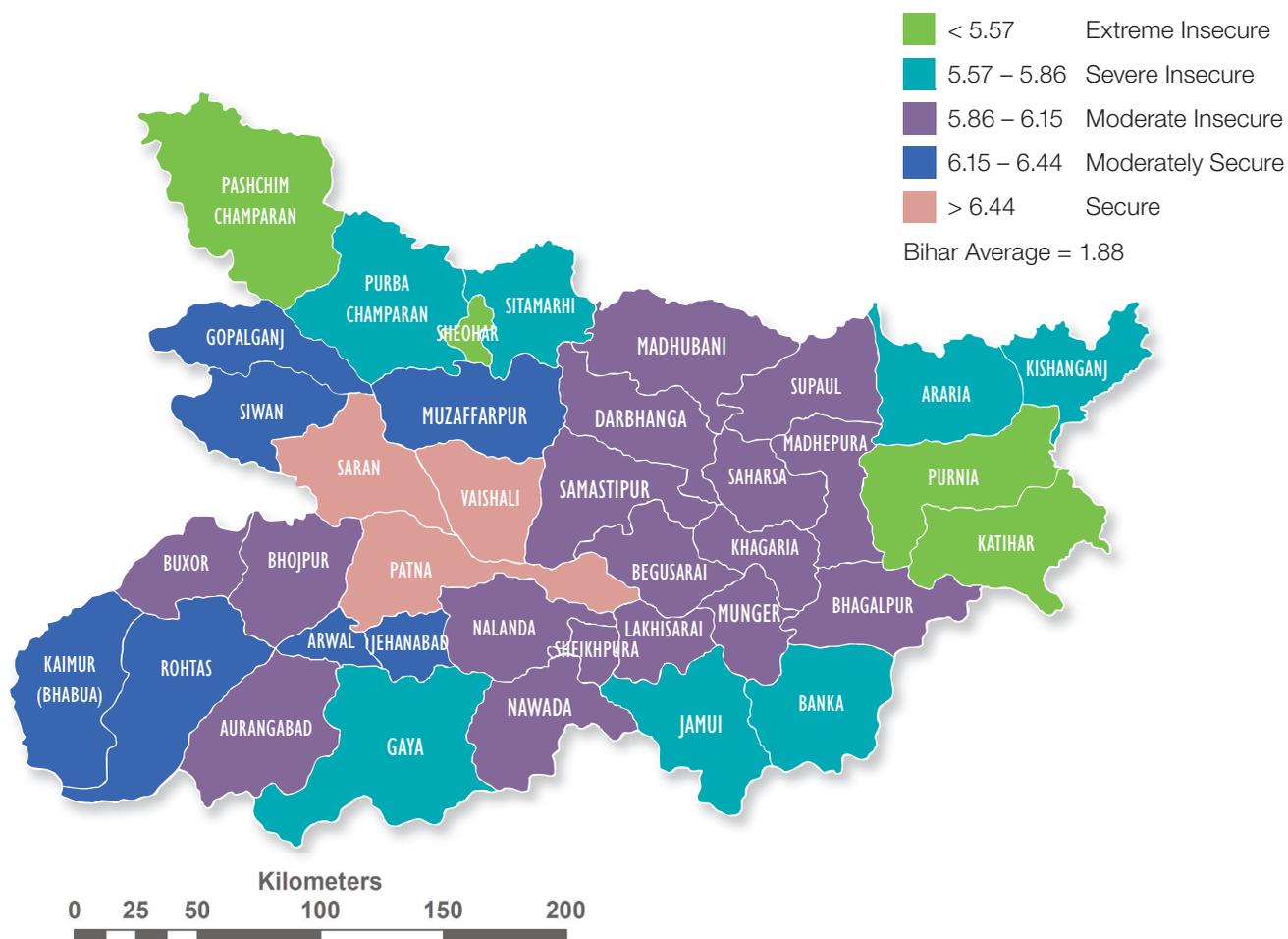
Table 3.12.2 : **Status of Districts in Access Index 2016-17 (Mean Standardisation Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Purnia	5.287	Gaya	5.601	Khagaria	5.905	Jehanabad	6.209	Patna	6.573
Pashchim Champaran	5.343	Araria	5.651	Lakhisarai	5.932	Rohtas	6.241	Saran	6.694
Katihar	5.49	Banka	5.664	Darbhanga	5.933	Kaimur (Bhabua)	6.308	Vaishali	6.735
Sheohar	5.546	Sitamarhi	5.686	Nalanda	5.969	Muzaffarpur	6.322		
		Purba Champaran	5.721	Munger	5.976	Siwan	6.393		

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
		Kishanganj	5.815	Aurangabad	5.989	Arwal	6.43		
		Jamui	5.821	Bhagalpur	6.006	Gopalganj	6.431		
		Supaul	5.875	Samastipur	6.009				
		Sheikhpura	5.876	Madhepura	6.01				
				Nawada	6.032				
				Saharsa	6.068				
				Bhojpur	6.075				
				Buxar	6.116				
				Begusarai	6.131				
				Madhubani	6.135				

3.3 FOOD UTILIZATION ■

3.3.1 Access to Safe Drinking Water

Diseases due to contamination of drinking water constitute a major burden on the health of the populace. Improvements in the quality of drinking water significantly benefit the health and well being of people. A reduction in the proportion of people without access to safe drinking water by half has been mentioned as part of the seventh Millennium Development Goals. Polluted and contaminated water undermines the safety and the nutritional well being of individuals. Clean and safe water supply is an essential element for achieving food security and good nutrition. It has been observed that water and sanitation account for a substantial portion of the difference in infant and child mortality rates of the rich and the poor (Leipziger, et al., 2003). In 2011, in most of the districts in Bihar had more than 90 percent of the households having access to safe drinking water with the three exceptions of Jamui 56.4 percent, Banka 71.5 percent and Munger 76.1 percent) (Table 3.13 andMap 3.12). The districts reporting large improvements in terms of access to safe drinking water between 2001 and 2011 were Sheikhpura, Munger, Lakhisarai.

Table 3.13 :   **Access to Safe Drinking Water in Rural Bihar (%)**

| District | 2011 | | 2001 | |
	Percentage	Rank	Percentage	Rank
Araria	987	7	98.65	2
Arwal	96.8	16	82.67	24
Aurangabad	94.8	26	82.53	26
Banka	71.5	37	49.42	36

	2011		2001	
District	**Percentage**	**Rank**	**Percentage**	**Rank**
Begusarai	95.7	22	88.97	20
Bhagalpur	85.7	34	65.38	32
Bhojpur	97.5	14	90.2	19
Buxar	96.8	17	87.39	21
Darbhanga	98.5	6	99	1
Gaya	88.9	33	68.55	30
Gopalganj	99	3	97.28	8
Jamui	56.4	38	36.31	38
Jehanabad	95.3	24	82.67	24
Kaimur (Bhabua)	90.3	30	74.18	28
Katihar	96.8	19	96.85	9
Khagaria	98.3	8	95.91	14
Kishanganj	95.3	23	90.43	18
Lakhisarai	83.4	35	53.63	35
Madhepura	97.9	12	96.57	11
Madhubani	98.3	9	98.08	4
Munger	76.1	36	42.76	37
Muzaffarpur	97.8	13	92.62	16
Nalanda	89.9	32	61.6	33
Nawada	90.3	31	72.98	29
Pashchim Champaran	98.3	10	96.66	10
Patna	93.5	28	67.76	31
Purba Champaran	98.6	5	92.71	15
Purnia	96.8	18	98.18	3
Rohtas	96.6	20	92.06	17
Saharsa	96.9	15	96.41	12
Samastipur	96.5	21	86.49	23
Saran	95.3	25	87.07	22
Sheikhpura	90.5	29	55.89	34
Sheohar	99.2	1	98.01	6

District	2011		2001	
	Percentage	Rank	Percentage	Rank
Sitamarhi	98.8	4	98.02	5
Siwan	99	2	96.3	13
Supaul	98	11	97.38	7
Vaishali	94	27	77.94	27
Total	94.6		86.11	

Source: Census 2001 & 2011

Map 3.12 : **Proportion of Households Having Access to Safe Drinking Water (percentage), Bihar Districts, 2011**

Legend:
- > 98
- 97 – 98
- 96 – 97
- 90 – 96
- < 90

Bihar Average = 93
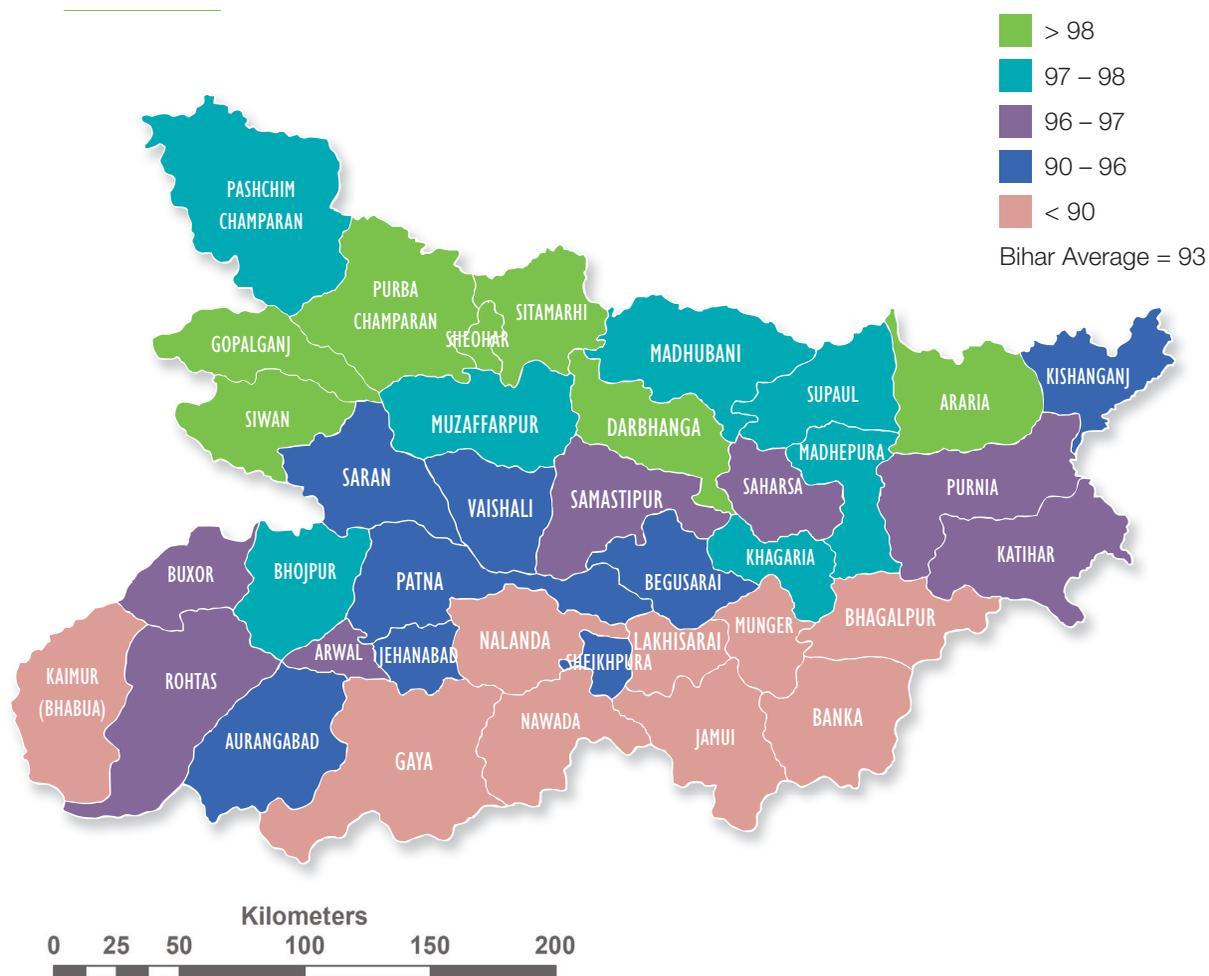
3.3.2 Villages having access to Primary Health Centres

Access to health services is very critical for the food and nutrition security of rural households. The inability to effectively treat morbidity, frequent health realted ailments and diseases can hamper the absorption of food and nutrient intakes into the body. In order to capture this element, the proportion of villages having access to public health centers (within a distance of 5 kilometers) has been considered as a utilization indicator. It is seen that between the Census years 2001 and 2011, the proportion of villages having access to PHCs within a five km distance reported an increase in most of the districts in Bihar with the exceptions being Aurangabad, Banka, Buxar, Gaya and Rohtas. The improvments in access to PHCs between 2001 and 2011 was the highest for the districts of Madhepura (49.85 percentage points), Sheohar (44.95 percentage points), Arwal (39.75 percentage points), Khagaria.

Map 3.13 : **Proportion of Inhabited Villages Having Access to Primary Health Center in Rural Areas within 5 Km Range, Bihar Districts (%)**
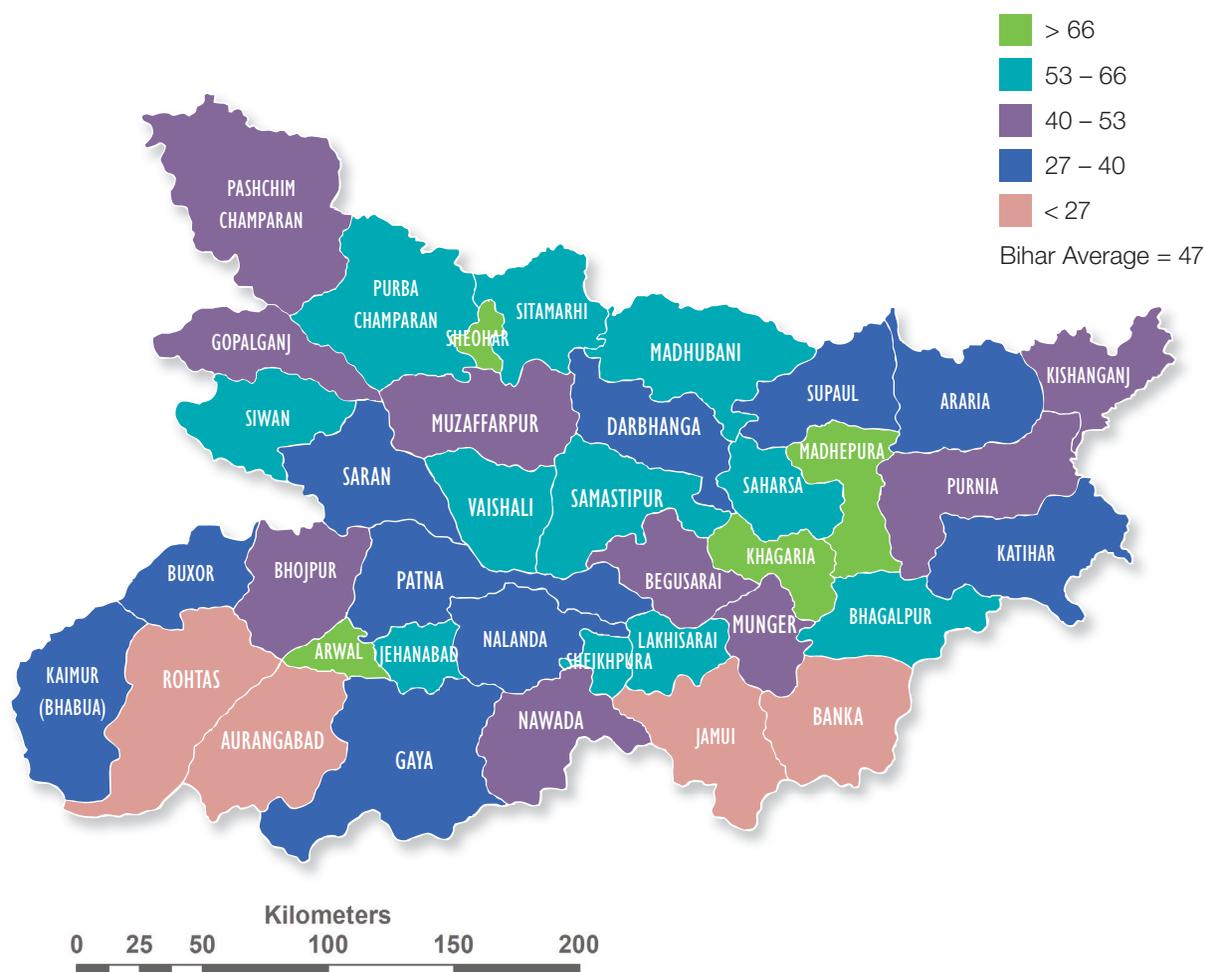
| Table 3.14 : | **Proportion of Villages Having Access to PHCs within Five Km Distance, Bihar Districts, 2001 and 2011 (%)** |

| | **2011** | | **2001** | |
District	Percentage	Rank	Percentage	Rank
Araria	38.4	27	24.62	34
Arwal	71.9	3	32.15	18
Aurangabad	23.3	35	29.99	23
Banka	21.7	36	25.71	31
Begusarai	44.8	22	37.10	8
Bhagalpur	58.0	10	37.20	7
Bhojpur	46.6	20	37.61	6
Buxar	28.0	33	36.53	10
Darbhanga	37.7	29	32.76	16
Gaya	28.0	34	32.42	17
Gopalganj	41.0	24	38.68	5
Jamui	13.4	38	14.73	38
Jehanabad	56.9	12	32.15	18
Kaimur (Bhabua)	39.3	25	25.35	32
Katihar	39.1	26	21.95	36
Khagaria	69.8	4	30.80	21
Kishanganj	41.5	23	24.39	35
Lakhisarai	63.8	8	25.90	30
Madhepura	79.5	1	29.65	25
Madhubani	55.5	13	39.52	3
Munger	51.7	16	39.16	4
Muzaffarpur	49.9	18	36.22	11
Nalanda	36.2	30	32.11	20
Nawada	46.1	21	33.77	14
Pashchim Champaran	51.6	17	28.15	27
Patna	32.9	32	27.87	28
Purba Champaran	64.9	5	34.18	12
Purnia	48.9	19	24.80	33

District	2011		2001	
	Percentage	**Rank**	**Percentage**	**Rank**
Rohtas	15.3	37	28.75	26
Saharsa	54.4	15	27.15	29
Samastipur	59.2	9	33.71	15
Saran	34.5	31	43.90	1
Sheikhpura	57.9	11	19.33	37
Sheohar	74.9	2	29.95	24
Sitamarhi	55.3	14	33.94	13
Siwan	64.7	6	36.56	9
Supaul	37.8	28	30.43	22
Vaishali	64.3	7	43.13	2
Total	42.4		31.91	

Source: Census 2001& 2011

3.3.3 The Food Utilization Index

Based on the two indicators discussed above, namely, safe drinking water and access to PHCs, a utilization index was calculated (Tables 3.15.1 and Table 3.15.2) using the two methodologies of Range Equalisation and Mean Standardisation. In terms of food utilization, the index shows that the districts in the southern region of the state are worse off while those in the northern region are relatively better off. Arwal emerges to be the best district with a food utilization index of 3.18, whereas Jamui is has the lowest value of 0.719 (mean standarization method). Maps 3.14a and 3.14b show the position of the districts in terms of utilization index for the range equalization method and mean standardization method respectively.

Table 3.15.1: Food Utilization Index 2016-17, (Range Equalisation Method), Bihar Districts

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.005			Gaya	0.409	Patna	0.592	Jehanabad	0.796
Banka	0.176			Munger	0.442	Nawada	0.629	Madhubani	0.812
				Aurangabad	0.505	Bhojpur	0.632	Samastipur	0.83
				Nalanda	0.516	Darbhanga	0.636	Sitamarhi	0.841
				Buxar	0.541	Supaul	0.637	Siwan	0.862
				Rohtas	0.553	Araria	0.641	Sheohar	0.954

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
				Kaimur (Bhabua)	0.567	Katihar	0.647	Arwal	0.973
				Bhagalpur	0.579	Kishanganj	0.651		
						Lakhisarai	0.668		
						Begusarai	0.679		
						Pashchim Champaran	0.679		
						Gopalganj	0.697		
						Saharsa	0.707		
						Saran	0.712		
						Sheikhpura	0.715		
						Muzaffarpur	0.726		
						Madhepura	0.734		
						Purnia	0.735		
						Purba Champaran	0.741		
						Khagaria	0.755		
						Vaishali	0.761		

Table 3.15.2 : Status of Districts in Food Utilization Index 2016-17 (Mean Standardisation Method), Bihar Districts

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.719	Aurangabad	1.344	Darbhanga	1.741	Purnia	2.211	Sheohar	3.02
Banka	0.862	Buxar	1.413	Patna	1.749	Khagaria	2.238	Arwal	3.183
Gaya	1.17	Rohtas	1.472	Kaimur (Bhabua)	1.762	Sheikhpura	2.36		
		Nalanda	1.57	Bhojpur	1.762	Vaishali	2.424		
				Supaul	1.762	Lakhisarai	2.435		
				Araria	1.765	Madhubani	2.47		
				Munger	1.777	Jehanabad	2.517		
				Katihar	1.854	Sitamarhi	2.571		
				Kishanganj	1.922	Samastipur	2.611		

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
				Pashchim Champaran	1.928	Siwan	2.648		
				Gopalganj	1.973				
				Bhagalpur	1.987				
				Nawada	2.02				
				Begusarai	2.023				
				Saharsa	2.092				
				Muzaffarpur	2.139				
				Madhepura	2.166				
				Purba Champaran	2.171				
				Saran	2.173				

Map 3.14a : **Food Utilization Index (Range Equalization Method)**

🟩	< 0.17	Extreme Insecure
🟦	0.17 – 0.57	Severe Insecure
🟪	0.58 – 0.73	Moderate Insecure
🟦	> 0.73	Secure

Bihar Average = 0.635
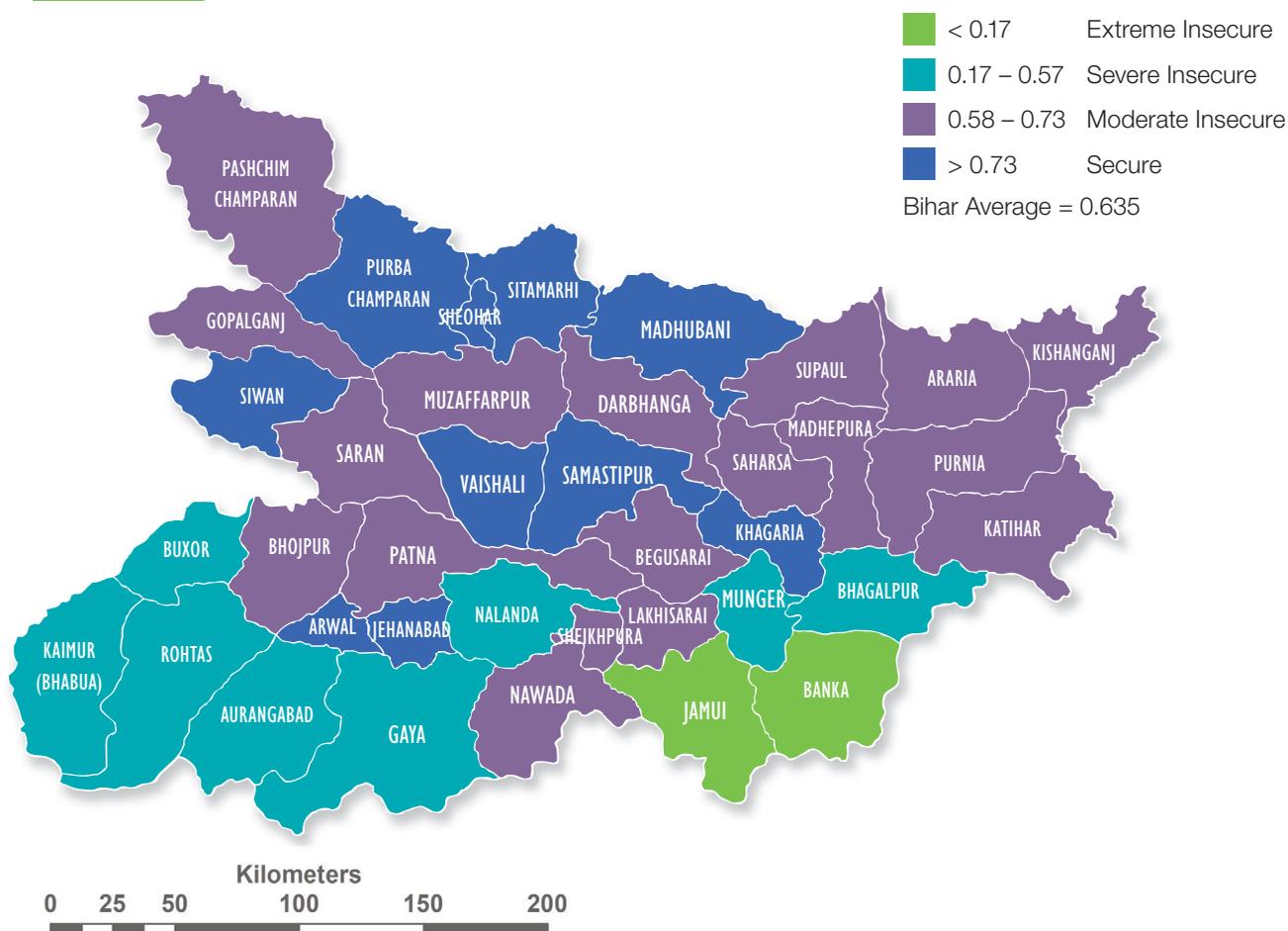
Map 3.14b : **Food Utilization Index (Mean Standarization Method), Bihar Districts**

Legend:
- < 1.21 — Extreme Insecure
- 1.21 – 1.70 — Severe Insecure
- 1.70 – 2.19 — Moderate Insecure
- 2.19 – 2.69 — Moderately Secure
- > 2.69 — Secure

Bihar Average = 1.88
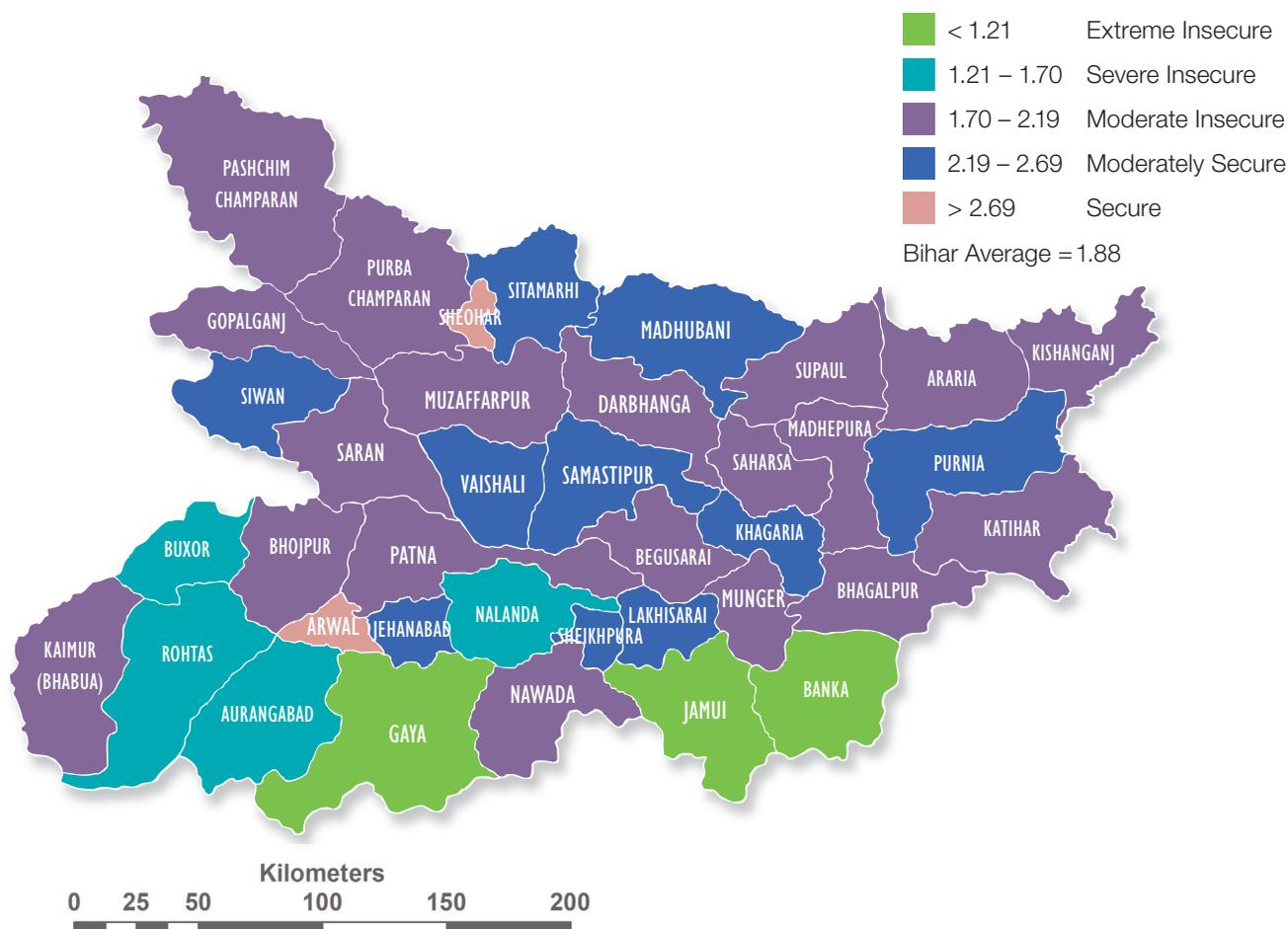
3.4 OUTCOME INDICATOR FOR FOOD SECURITY

The nutritional status of an individual can be considered as the outcome of food and nutrition security. Although the intake of food is not the only factor that affects nutritional status (othr factors such as water, sanitation, hygiene behavior, etc also have a bearing on the same), it is definitely the prime one. The outcome index calculated here is based on child underweight (weight for age -2SD) and adult female Body Mass Index (BMI). The rural population, particularly children, are affected more by malnutrition due to low dietary intake, lack of appropriate care and inadequate distribution of food within the members of households. Malnutrition among children weakens the immune system and makes the child more prone to diseases and less able to fight for infection. Studies show that the chance of dying of a child is 10 times more likely if they severely underweight (black et al 2008).The underweight indicator used for this analysis captures both chronic and acute under nutrition. The BMI is an important indicatorto measure the general health status of adults and can be taken to measure obesity as well as thinness. For our analysis we have considered the number of women with BMI below 18.5 (women moderately or severely thin) and above 25 (women moderately or severely obese).

Child mortality is an important outcome of under nutrition but we could not consider this variable for calculating the outcome index as recent data for this variable was unavilable.

Table A3.1 provides the weight and BMI status of children and women across districts of Bihar. Map 3.15 and map 3.16 highlights the district with underweight of children and abnormal BMI of women in Bihar. Large inter-district variations are found in terms of these indicators. Gopalganj (30.2 percent) and Siwan (32 percent) have the lowest percentage of undernourished children while Gaya and Arwal (54 percent each) registered the highest proportions. Similarly, for abnormal female BMIs (either obese or too thin) , Sheikhpura (46 percent) and Gaya (47 percent) registered a high percentage whereas Bhojpur (37 percent) and Bhagalpur (37 percent) are districts that registered a low percentage of women reporting the same.

Map 3.15 : **Bihar, District wise proportion of Underweight women (%) (Below -2 SD)-2015- 16**
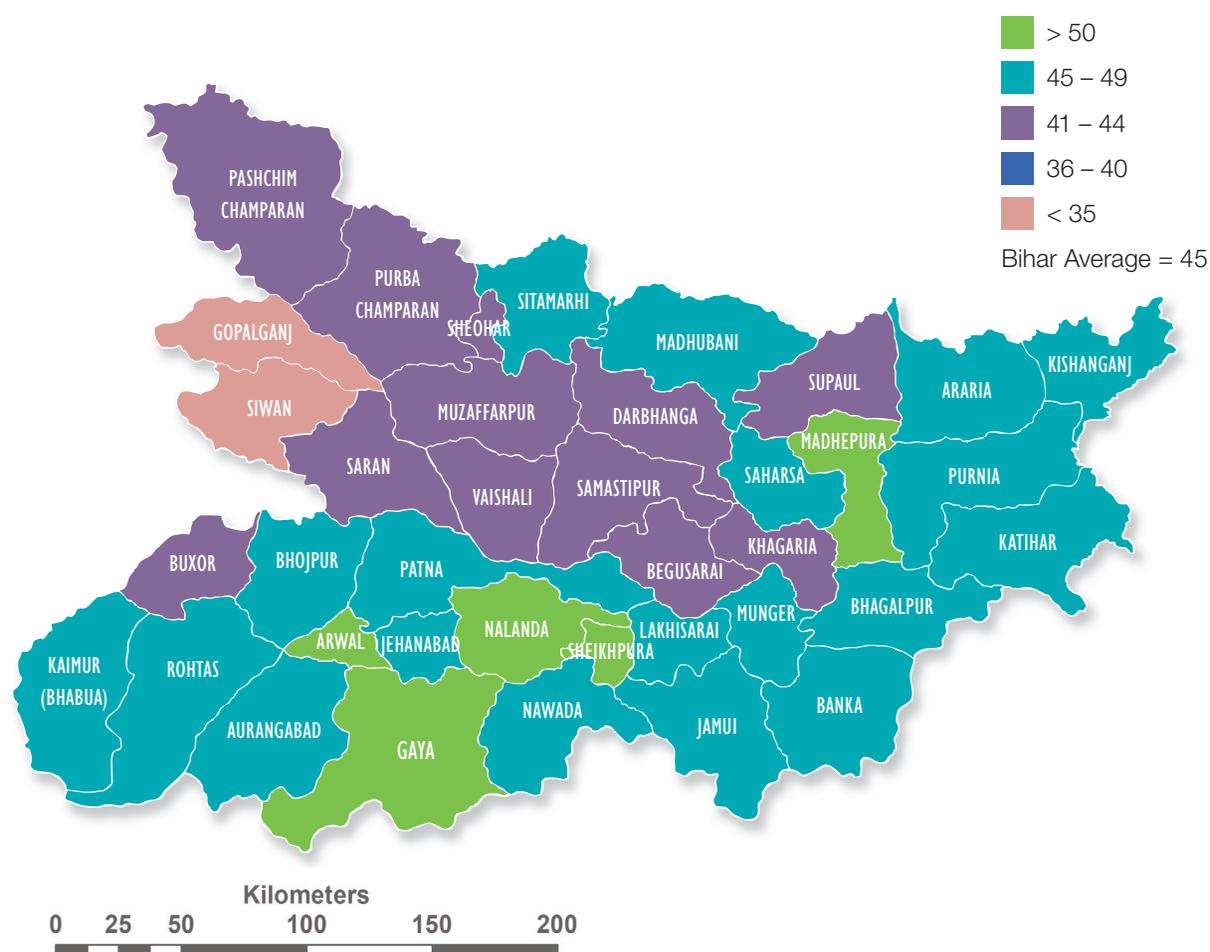
Map 3.16 : **Bihar, District wise proportions of women with Abnormal BMIs 2015-16**

Legend:
- > 46
- 44 – 45
- 42 – 43
- 40 – 41
- < 39

Bihar Average = 41
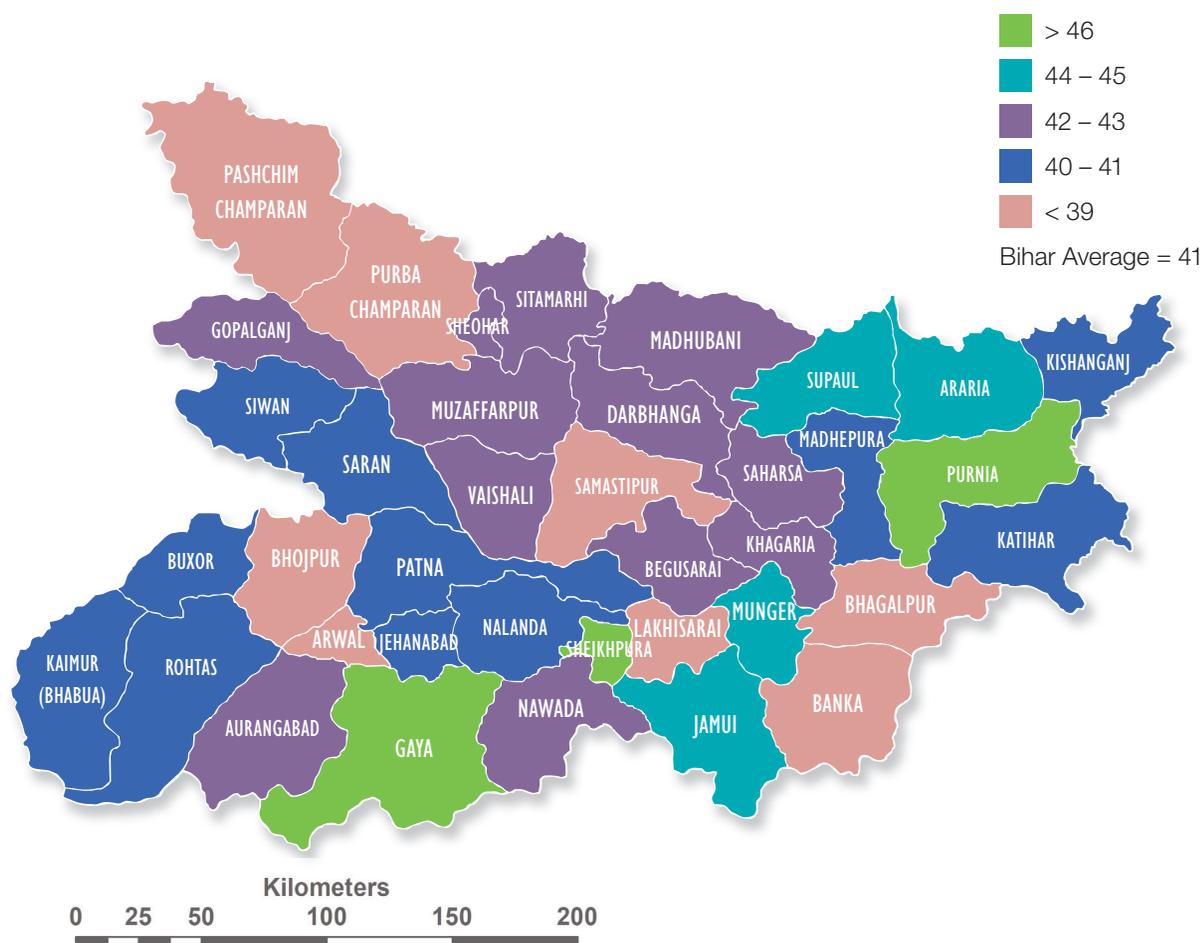
3.4.1 The Food Security Outcome Index

The Food Security Outcome Index was calculated using the same two methods as earlier, viz., the Range Equalisation and the Mean Standardization Methods. As may be observed from Table 3.16.1, the secure group contains 7 districts, followed by 11 in the moderately secure group, 14 in the moderately insecure group, 3 in the severely insecure group, and 2 in the extremely insecure group in terms of the food security outcome index (Range Equalization Method). The two most outcome insecure districts were Sheikhpura and Gaya. These districts lie in the South and South East corners of Bihar and belong to the least developed regions in the state. Among the

three districts in the severely insecure category for the outcome index, Araria, Jamui also lie in the South and South East regions and north eastern region which are also under developed. These five districts call for special targeted policies to improve the outcome of food security aimed interventions. The fourteen districts in the moderately insecure (MIS) category comprise a mix of districts. Madhubani, Sheohar, and Sitamarhi are all lie in the North Central region and belong to the low development category. Sahrasa, Supaul and Madhepura are placed in the North-Eastern region of Bihar which is less developed agriculturally. Jehanabad, Arwal, Munger and Nawada are in South and South Eastern regions which is again a less advanced region. The rest of

the districts are belong to the South Central region, Western and South Western regions, which are the relatively more developed parts of the state (Tables 3.16.1 and 3.16.2 and Maps 3.17a and 3.17b).

Map 3.17a : **Food Security Outcome Index (Range Equalization Method)**

	> 0.82	Extreme Insecure
	0.69 – 0.82	Severe Insecure
	0.51 – 0.69	Moderate Insecure
	0.34 – 0.51	Moderately Secure
	< 0.34	Secure

Bihar Average = 0.54
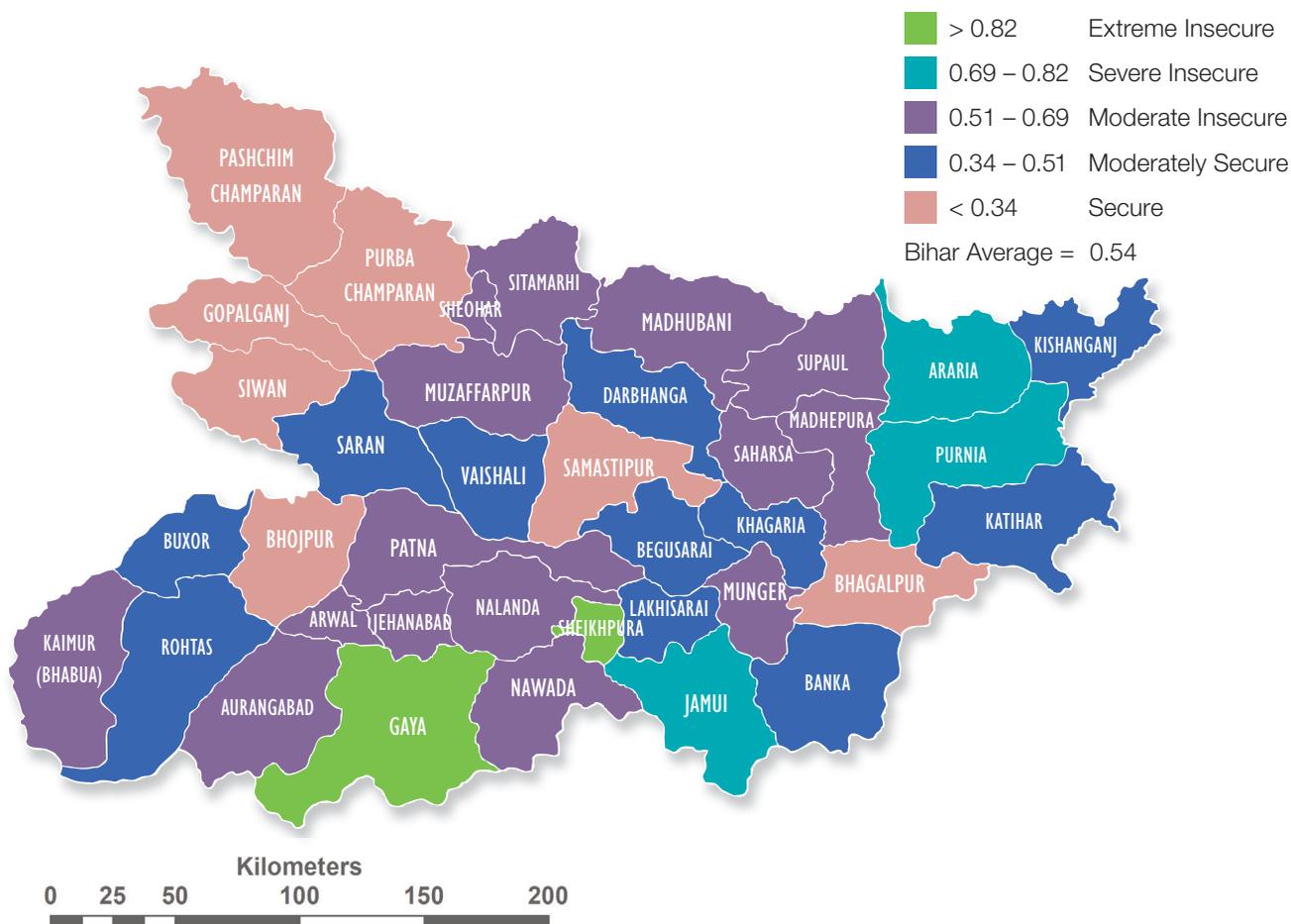
Table 3.16.1 : **Bihar, Status of Districts for theFood Security Outcome Index 2016-17 (Range Equalisation Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Sheikhpura	0.91	Araria	0.73	Madhubani	0.55	Buxar	0.43	Gopalganj	0.235
Gaya	1.00	Jamui	0.77	Sheohar	0.56	Saran	0.43	Samastipur	0.239
		Purnia	0.82	Saharsa	0.58	Banka	0.46	Siwan	0.242
				Kaimur (Bhabua)	0.58	Lakhisarai	0.46	Bhagalpur	0.32
				Nalanda	0.59	Begusarai	0.46	Purba Champaran	0.326

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
				Jehanabad	0.59	Katihar	0.47	Bhojpur	0.332
				Patna	0.59	Khagaria	0.49	Pashchim Champaran	0.342
				Arwal	0.61	Vaishali	0.50		
				Madhepura	0.61	Kishanganj	0.50		
				Sitamarhi	0.63	Rohtas	0.51		
				Supaul	0.63	Darbhanga	0.51		
				Munger	0.64				
				Nawada	0.65				
				Aurangabad	0.69				

Map 3.17b : **Bihar Districts Food Security Outcome Index (Mean Standarization Method)**

- > 2.19   Extreme Insecure
- 2.06 – 2.19   Severe Insecure
- 1.93 – 2.06   Moderate Insecure
- 1.80 – 1.93   Moderately Secure
- < 1.80   Secure

Bihar Average = 2.00
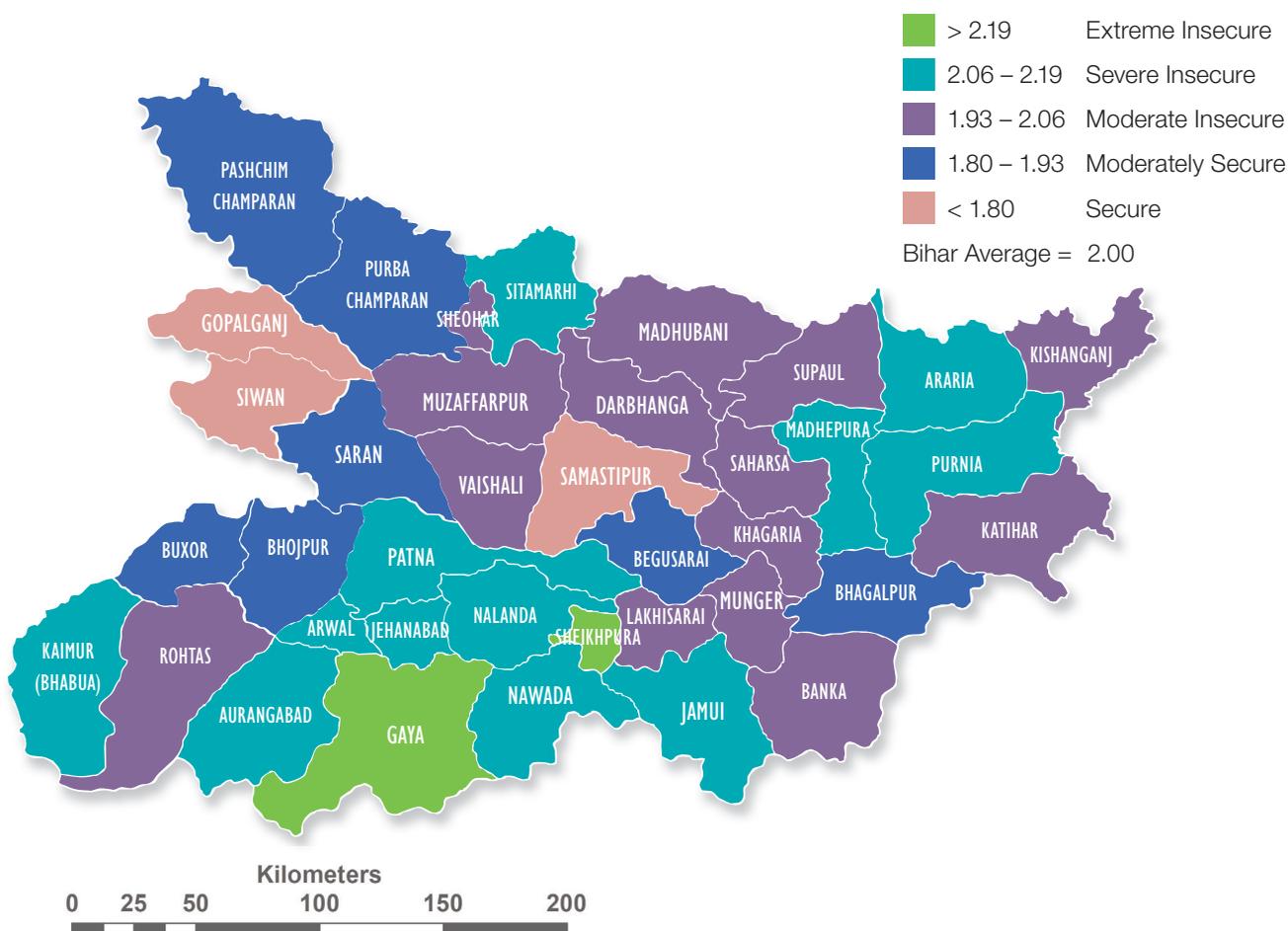
Table 3.16.2 : Bihar, Status of Districts for theFood Security Outcome Index 2016-17 (Mean Standardization Method)

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Sheikhpura	2.26	Patna	2.08	Banka	2.01	Purba Champaran	1.84	Gopalganj	1.67
Gaya	2.33	Sitamarhi	2.08	Madhubani	2.01	Pashchim Champaran	1.86	eSiwan	1.70
		Nalanda	2.08	Saharsa	2.02	Bhagalpur	1.89	Samastipur	1.80
		Nawada	2.09	Supaul	2.02	Saran	1.89		
		Madhepura	2.09	Munger	2.04	Begusarai	1.91		
		Aurangabad	2.11	Kaimur (Bhabua)	2.07	Bhojpur	1.91		
		Araria	2.11	Jehanabad	2.07	Buxar	1.92		
		Arwal	2.14			Darbhanga	1.94		
		Jamui	2.15			Vaishali	1.94		
		Purnia	2.17						

3.5 SUMMING UP

The primary focus of this chapter was on estimating food security at the district level for Bihar. The Food Security Index was estimated as a synthesis of the three dimensions of food security (availability, access, utilization). Selected indicators were considered for developing the food security index. The range equalization and mean standardization methods have been used to identify the districts by placing them in the secure-insecure ranges. The South and South-Eastern districts (Jamui, Banka, Nawada, Gaya) as well as the North-Eastern districts (Dharbhanga, Purnia, Supaul, Araria) were found to be insecure in terms of the availability dimensions as compared to the Central and Western districts. In terms of the food access index, mostly districts belonging to the North-Central region (East Champaran. Sitamarhi,

Sheohar) were insecure compared to the other regions. In terms of the utilization index, On the other hand, districts in the Southern region of Bihar (Jamui, Banka, Gaya, Arungabad, Rohtas, Buxar, and Nalanda) were insecure whereas the districts in the northern region were relatively secure for the same. The food security outcome index finds Sheikhpura and Gaya belong to South and South East corners of Bihar as the two most insecure districts. The Southern, South Eastern and North Eastern parts of Bihar are less advanced agriculturally and have high tenancy. Most of the individual dimension specific insecure districts food security outcome index specific insecure districts are mainly from the Southern, South Eastern and North East parts of Bihar. The development of these specific regions is very crucial for further improvements in the each of the dimensions of the food security outcome index as well as for the index itself.

APPENDIX

| Table A3.1: | Percentage Children Underweight and Percentage of women with abnormal BMIs in Rural Bihar, 2015-16 |

District	Underweight (%) Below -2 SD	BMI <18	BMI >25	Abnormal BMI
Araria	46.7	40.0	4.6	44.6
Arwal	53.8	31.4	7.8	39.2
Aurangabad	48.0	32.7	10.7	43.4
Banka	49.1	32.2	6.0	38.2
Begusarai	40.7	33.4	8.4	41.8
Bhagalpur	44.5	29.0	8.4	37.4
Bhojpur	46.0	24.7	12.3	37.0
Buxar	43.1	25.4	14.7	40.1
Darbhanga	40.9	32.9	9.8	42.7
Gaya	54.0	37.4	9.6	47.0
Gopalganj	30.2	25.3	16.4	41.7
Jamui	48.1	37.9	6.9	44.8
Jehanabad	49.3	31.2	9.5	40.7
Kaimur (Bhabua)	49.1	29.0	11.6	40.6
Katihar	46.2	33.5	6.1	39.6
Khagaria	42.9	31.5	10.0	41.5
Kishanganj	45.3	35.2	5.4	40.6
Lakhisarai	47.6	28.4	10.5	38.9
Madhepura	50.0	33.6	7.2	40.8
Madhubani	45.6	32.7	8.9	41.6
Munger	44.8	30.9	12.7	43.6
Muzaffarpur	42.3	33.7	9.2	42.9
Nalanda	50.0	33.3	7.1	40.4
Nawada	47.8	33.1	9.5	42.6
Pashchim Ch	41.7	29.2	9.8	39.0
Patna	49.2	28.6	12.3	40.9
Purba Ch	40.7	29.5	9.6	39.1

Purnia	48.3	39.9	5.8	45.7
Rohtas	44.7	27.5	13.5	41.0
Saharsa	45.2	35.5	6.7	42.2
Samastipur	40.4	30.0	7.5	37.5
Saran	40.3	24.3	17.1	41.4
Sheikhpura	52.0	36.8	9.3	46.1
Sheohar	42.9	33.4	9.4	42.8
Sitamarhi	47.9	34.4	7.7	42.1
Siwan	32.2	25.0	16.0	41.0
Supaul	43.2	38.6	5.6	44.2
Vaishali	41.9	29.4	12.6	42.0
Bihar	44.6	31.8	9.7	41.5

Source: NFHS 4 Fact Sheet

ADDRESSING FOOD INSECURITY IN BIHAR

Chapter 3 developed indices to show the ranks of districts by availability, access, utilization and outcomes of food insecurity. In this chapter, all these factors are taken together to form a single index called the Food Security Index (FSI) to understand and explain food security across the various districts in Bihar (Table 4.1). The critical question to be asked here is whether there is an overlap between the ranks of districts on the food security outcome index and the ranks on the food security index? In other words, do the districts that have poor outcomes (in terms of under- five mortality and underweight children) also have low availability, access and utilization? As we see that the factors or indicators that are included in the composite FSI do indeed contribute to food insecurity in any way, any strategy to improve food security must automatically address them too (Table 4.2).

4.1 THE FOOD SECURITY INDEX (FSI)

In this section, we bring together all the indicators chosen to explain food insecurity viz., the availability, access and utilization indicators. This index captures the combined effect of all the indicators. Further, comparisons with the individual sets of indices reveal their relative significance in the Food Security Index.

From Table 4.1.1, using the Range Equalisation Method, it can be seen that that in case of food availability index, the five worst districts are Darbhanga, Madhubani, Banka, Patna, Gaya and Jamui. These districts are from North Eastern, Central-North, Southern, South Eastern and Central-South regions. In terms of the access index, the five worst districts are Gaya, Katihar, Purina, Sheohar, and Paschim Champaran. With the exception of Gaya, the remaining districts are from North Bihar. The opposite is true when we look at the food utilization index as the five worst ranked districts

include Jamui, Banka, Gaya, Munger Aurangabad that are located in the Southern and South Western parts of Bihar. Thus, we get a mixed rankingwhen we look at the food security index as a whole: Out of the five most insecure districts, three (Jamui, Gaya and Banka) are from south Bihar and two (Purnia, and Katihar) from North Bihar. Looking at the Food Security Outcome Index, we see three (Gaya, Sheikhpura, Jamui) out of the five most food insecure districts are from South Bihar. In terms of the FSI, two most secured districts are Jehanabad and Arwal (South Bihar) where as in terms of the FSO index, the two most secured districts are Gopalganj and Samastipur (North Bihar). For a similar comparison of the FSI and the FSO using the Mean standardization method, please refer to Table 4.1.2.

Table 4.2.1 and Table 4.2.2 present the status of districts in terms of the food security index. For the range equalization method, the districts coming under the extremely insecured category include Jamui, Gaya, Banka, Purnia while those in the severe category include Katihar, Araria, Pashchim Champaran and Supaul (Map 4.1a). For the Mean Standardization Method three districts come under the extremely insecure category and two districts in the severely insecure category (Map 4.1b). Other than Pashchim Champaran, these districts are either from the South, South east and North-eastern regions which are comparatively less advanced. These districts need urgent attention in terms of improving the food security input indicators.

On the other hand the most food secured districts include Gopalganj, Saran, Vaishali, Siwan, Rohtas, Arwal and Jehanabad (Range equalization method). Other than Arwal and Jehanabad, the remaining districts are from the north-western, western and south western regions of Bihar which have advanced agricultural facilities and low urbanization.

Table 4.1.1: **Bihar, District Ranks: Composite Food Security Index and its Components (Range Equalisation Method)**

Availability Index		Access Index		Utilization Index		FSI		FSO	
Jehanabad	0.831	Vaishali	0.68	Arwal	0.973	Jehanabad	0.67	Gopalganj	0.24
Rohtas	0.798	Saran	0.676	Sheohar	0.954	Arwal	0.66	Samastipur	0.24
Aurangabad	0.74	Patna	0.659	Siwan	0.862	Rohtas	0.648	Siwan	0.24
Pashchim Champaran	0.714	Siwan	0.633	Sitamarhi	0.841	Siwan	0.648	Bhagalpur	0.32
Kaimur (Bhabua)	0.674	Rohtas	0.605	Samastipur	0.83	Vaishali	0.639	Purba Champaran	0.33
Lakhisarai	0.654	Gopalganj	0.6	Madhubani	0.812	Saran	0.635	Bhojpur	0.33
Sheohar	0.649	Muzaffarpur	0.597	Jehanabad	0.796	Gopalganj	0.615	Pashchim Champaran	0.34
Nalanda	0.625	Arwal	0.587	Vaishali	0.761	Muzaffarpur	0.593	Buxar	0.43
Sheikhpura	0.604	Bhojpur	0.582	Khagaria	0.755	Bhojpur	0.584	Saran	0.43
Arwal	0.597	Buxar	0.563	Purba Champaran	0.741	Patna	0.569	Banka	0.46
Gopalganj	0.59	Munger	0.561	Purnia	0.735	Kaimur (Bhabua)	0.568	Lakhisarai	0.46
Khagaria	0.59	Jehanabad	0.548	Madhepura	0.734	Samastipur	0.562	Begusarai	0.46
Madhepura	0.563	Madhubani	0.547	Muzaffarpur	0.726	Lakhisarai	0.558	Katihar	0.47
Bhojpur	0.555	Begusarai	0.533	Sheikhpura	0.715	Aurangabad	0.558	Khagaria	0.49
Buxar	0.549	Kaimur (Bhabua)	0.516	Saran	0.712	Buxar	0.555	Vaishali	0.50
Sitamarhi	0.546	Bhagalpur	0.512	Saharsa	0.707	Begusarai	0.539	Kishanganj	0.50
Samastipur	0.544	Aurangabad	0.484	Gopalganj	0.697	Madhubani	0.534	Rohtas	0.51
Siwan	0.533	Samastipur	0.481	Pashchim Champaran	0.679	Khagaria	0.529	Darbhanga	0.51
Saharsa	0.51	Lakhisarai	0.474	Begusarai	0.679	Madhepura	0.527	Muzaffarpur	0.55
Saran	0.502	Nawada	0.474	Lakhisarai	0.668	Nalanda	0.516	Madhubani	0.55
Purba Champaran	0.499	Jamui	0.463	Kishanganj	0.651	Sheohar	0.512	Sheohar	0.56
Muzaffarpur	0.496	Nalanda	0.462	Katihar	0.647	Munger	0.51	Saharsa	0.58

Availability Index		Access Index		Utilization Index		FSI		FSO	
Katihar	0.484	Darbhanga	0.458	Araria	0.641	Sheikhpura	0.51	Kaimur (Bhabua)	0.58
Araria	0.484	Madhepura	0.44	Supaul	0.637	Saharsa	0.504	Nalanda	0.59
Vaishali	0.477	Saharsa	0.433	Darbhanga	0.636	Nawada	0.502	Jehanabad	0.59
Nawada	0.475	Banka	0.432	Bhojpur	0.632	Bhagalpur	0.498	Patna	0.59
Kishanganj	0.464	Khagaria	0.423	Nawada	0.629	Sitamarhi	0.494	Arwal	0.61
Begusarai	0.458	Kishanganj	0.418	Patna	0.592	Kishanganj	0.473	Madhepura	0.61
Munger	0.455	Supaul	0.415	Bhagalpur	0.579	Darbhanga	0.473	Sitamarhi	0.63
Supaul	0.425	Sheikhpura	0.395	Kaimur (Bhabua)	0.567	Purba Champaran	0.471	Supaul	0.63
Purnia	0.417	Purba Champaran	0.366	Rohtas	0.553	Supaul	0.458	Munger	0.64
Bhagalpur	0.417	Sitamarhi	0.353	Buxar	0.541	Pashchim Champaran	0.457	Nawada	0.65
Gaya	0.415	Araria	0.344	Nalanda	0.516	Araria	0.436	Aurangabad	0.69
Darbhanga	0.392	Katihar	0.318	Aurangabad	0.505	Katihar	0.423	Araria	0.73
Patna	0.373	Gaya	0.303	Munger	0.442	Purnia	0.371	Jamui	0.77
Banka	0.351	Sheohar	0.297	Gaya	0.409	Banka	0.363	Purnia	0.82
Madhubani	0.321	Pashchim Champaran	0.254	Banka	0.176	Gaya	0.353	Sheikhpura	0.91
Jamui	0.258	Purnia	0.228	Jamui	0.005	Jamui	0.324	Gaya	1.00
Total	0.498	Total	0.519	Total	0.635	Total	0.534	Total	0.54

Table 4.1.2:	Bihar, District Ranks: Composite Food Security Index and its Components (Mean standardization Method)

Availability Index		Access Index		Utilization Index		FSI		FSO	
Rohtas	4.392	Vaishali	6.735	Arwal	3.183	Jehanabad	13.011	Gopalganj	1.67
Jehanabad	4.285	Saran	6.694	Sheohar	3.02	Arwal	12.786	Siwan	1.70
Aurangabad	4.143	Patna	6.573	Siwan	2.648	Rohtas	12.105	Samastipur	1.80
Pashchim Champaran	3.936	Gopalganj	6.431	Samastipur	2.611	Siwan	11.959	Purba Champaran	1.84

Availability Index		Access Index		Utilization Index		FSI		FSO	
Kaimur (Bhabua)	3.816	Arwal	6.43	Sitamarhi	2.571	Sheohar	11.95	Pashchim Champaran	1.86
Lakhisarai	3.504	Siwan	6.393	Jehanabad	2.517	Kaimur (Bhabua)	11.886	Bhagalpur	1.89
Sheohar	3.384	Muzaffarpur	6.322	Madhubani	2.47	Lakhisarai	11.871	Saran	1.89
Nalanda	3.372	Kaimur (Bhabua)	6.308	Lakhisarai	2.435	Vaishali	11.771	Begusarai	1.91
Buxar	3.305	Rohtas	6.241	Vaishali	2.424	Gopalganj	11.684	Bhojpur	1.91
Gopalganj	3.28	Jehanabad	6.209	Sheikhpura	2.36	Saran	11.58	Buxar	1.92
Sheikhpura	3.264	Madhubani	6.135	Khagaria	2.238	Samastipur	11.55	Darbhanga	1.94
Khagaria	3.182	Begusarai	6.131	Purnia	2.211	Sheikhpura	11.5	Vaishali	1.94
Arwal	3.172	Buxar	6.116	Saran	2.173	Aurangabad	11.476	Khagaria	1.95
Bhojpur	3.161	Bhojpur	6.075	Purba Champaran	2.171	Khagaria	11.325	Muzaffarpur	1.97
Madhepura	3.127	Saharsa	6.068	Madhepura	2.166	Madhepura	11.302	Katihar	1.98
Katihar	3.028	Nawada	6.032	Muzaffarpur	2.139	Sitamarhi	11.272	Rohtas	1.98
Saharsa	3.018	Madhepura	6.01	Saharsa	2.092	Muzaffarpur	11.215	Sheohar	1.98
Sitamarhi	3.015	Samastipur	6.009	Begusarai	2.023	Pashchim Champaran	11.207	Kishanganj	1.98
Araria	2.964	Bhagalpur	6.006	Nawada	2.02	Saharsa	11.178	Lakhisarai	1.99
Samastipur	2.93	Aurangabad	5.989	Bhagalpur	1.987	Bhojpur	10.999	Banka	2.01
Siwan	2.919	Munger	5.976	Gopalganj	1.973	Nalanda	10.911	Madhubani	2.01
Purba Champaran	2.757	Nalanda	5.969	Pashchim Champaran	1.928	Begusarai	10.859	Saharsa	2.02
Muzaffarpur	2.754	Darbhanga	5.933	Kishanganj	1.922	Buxar	10.834	Supaul	2.02
Saran	2.713	Lakhisarai	5.932	Katihar	1.854	Nawada	10.762	Munger	2.04
Nawada	2.711	Khagaria	5.905	Munger	1.777	Purba Champaran	10.649	Kaimur (Bhabua)	2.07
Kishanganj	2.708	Sheikhpura	5.876	Araria	1.765	Patna	10.647	Jehanabad	2.07
Begusarai	2.705	Supaul	5.875	Supaul	1.762	Madhubani	10.603	Patna	2.08

Availability Index		Access Index		Utilization Index		FSI		FSO	
Supaul	2.656	Jamui	5.821	Bhojpur	1.762	Bhagalpur	10.456	Sitamarhi	2.08
Vaishali	2.613	Kishanganj	5.815	Kaimur (Bhabua)	1.762	Kishanganj	10.445	Nalanda	2.08
Banka	2.59	Purba Champaran	5.721	Patna	1.749	Araria	10.379	Nawada	2.09
Munger	2.568	Sitamarhi	5.686	Darbhanga	1.741	Katihar	10.372	Madhepura	2.09
Gaya	2.555	Banka	5.664	Nalanda	1.57	Munger	10.321	Aurangabad	2.11
Purnia	2.553	Araria	5.651	Rohtas	1.472	Supaul	10.293	Araria	2.11
Bhagalpur	2.463	Gaya	5.601	Buxar	1.413	Purnia	10.051	Arwal	2.14
Patna	2.325	Sheohar	5.546	Aurangabad	1.344	Darbhanga	9.953	Jamui	2.15
Darbhanga	2.279	Katihar	5.49	Gaya	1.17	Gaya	9.326	Purnia	2.17
Madhubani	1.998	Pashchim Champaran	5.343	Banka	0.862	Banka	9.115	Sheikhpura	2.26
Jamui	1.855	Purnia	5.287	Jamui	0.719	Jamui	8.395	Gaya	2.33
Bihar	2.884	Bihar	1.883	Bihar	1.883	Bihar	10.787	Bihar	2

Table 4.2.1: Food Security Index: Districts Status (Range Equalisation Method)

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.324	Katihar	0.423	Purba Champaran	0.471	Madhubani	0.534	Gopalganj	0.615
Gaya	0.353	Araria	0.436	Darbhanga	0.473	Begusarai	0.539	Saran	0.635
Banka	0.363	Pashchim Champaran	0.457	Kishanganj	0.473	Buxar	0.555	Vaishali	0.639
Purnia	0.371	Supaul	0.458	Sitamarhi	0.494	Aurangabad	0.558	Siwan	0.648
				Bhagalpur	0.498	Lakhisarai	0.558	Rohtas	0.648
				Nawada	0.502	Samastipur	0.562	Arwal	0.66
				Saharsa	0.504	Kaimur (Bhabua)	0.568	Jehanabad	0.67
				Sheikhpura	0.51	Patna	0.569		

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
				Munger	0.51	Bhojpur	0.584		
				Sheohar	0.512	Muzaffarpur	0.593		
				Nalanda	0.516				
				Madhepura	0.527				
				Khagaria	0.529				

Map 4.1a: Food Security Index: Bihar (Range Equalization Method)

Legend:
- < 0.37 — Extreme Insecure
- 0.37 – 0.45 — Severe Insecure
- 0.45 – 0.52 — Moderate Insecure
- 0.53 – 0.59 — Moderately Secure
- > 0.59 — Secure

Bihar Average = 0.534
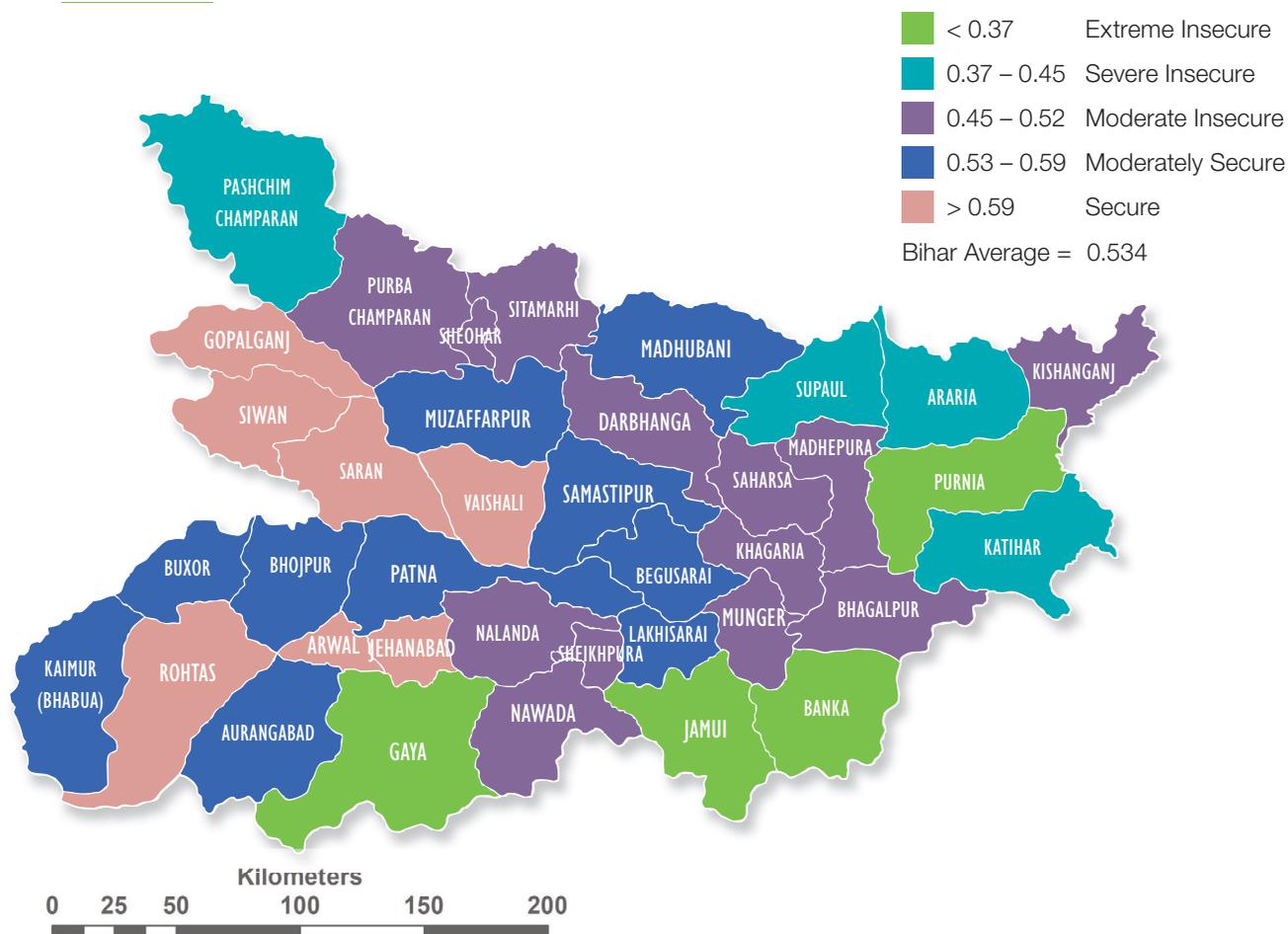
Map 4.1b: **Food Security Index, Bihar (Mean Standarization Method)**

< 9.31	Extreme Insecure
9.31 – 10.24	Severe Insecure
10.24 – 11.16	Moderate Insecure
11.16 – 12.08	Moderately Secure
> 12.08	Secure

Bihar Average = 10.78
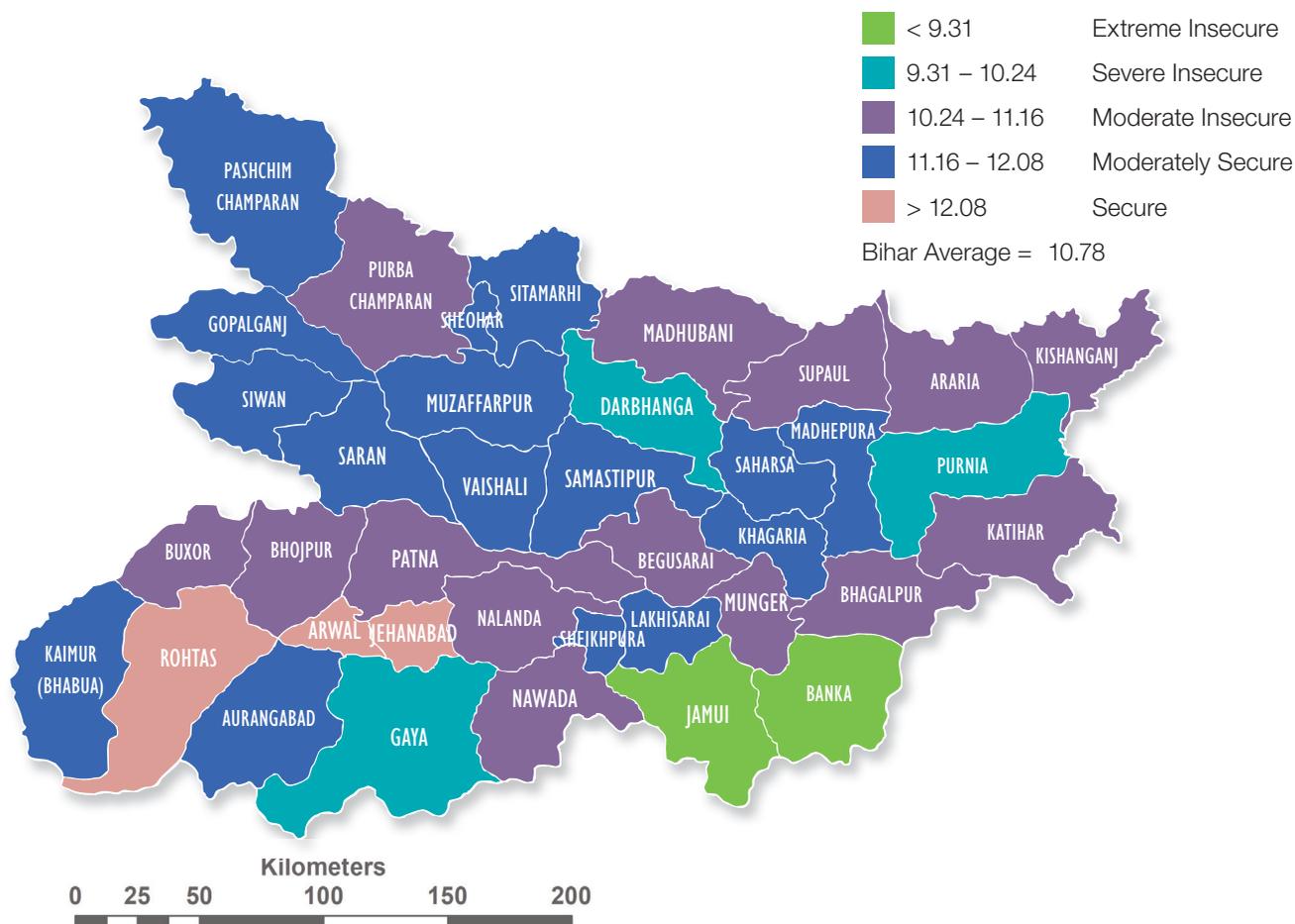
Table 4.2.2: **Food Security Index : Districts Status (Mean Standardisation Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	8.395	Darbhanga	9.953	Supaul	10.293	Saharsa	11.178	Rohtas	12.11
Banka	9.115	Purnia	10.05	Munger	10.321	Pashchim Champaran	11.207	Arwal	12.79
Gaya	9.326			Katihar	10.372	Muzaffarpur	11.215	Jehanabad	13.01
				Araria	10.379	Sitamarhi	11.272		
				Kishanganj	10.445	Madhepura	11.302		
				Bhagalpur	10.456	Khagaria	11.325		

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
				Madhubani	10.603	Aurangabad	11.476		
				Patna	10.647	Sheikhpura	11.5		
				Purba Champaran	10.649	Samastipur	11.55		
				Nawada	10.762	Saran	11.58		
				Buxar	10.834	Gopalganj	11.684		
				Begusarai	10.859	Vaishali	11.771		
				Nalanda	10.911	Lakhisarai	11.871		
				Bhojpur	10.999	Kaimur (Bhabua)	11.886		
						Sheohar	11.95		
						Siwan	11.959		

4.2 Identifying the Priority Districts

The Food Security Index detailed earlier provides direction for prioritizing developmental efforts in the most food insecure districts of Bihar. The districts in the two lowest categories, that is, the extremely and severely food insecure categories need to be prioritised on an urgent basis for development interventions for enhancing food security. These include a total of 17 districts of which 8 are from North Bihar, and 9 from Central Bihar. These have been put under the priority districts for food security intervention category in Table 4.3. The districts which fall under the insecure category for both the inputs and outputs approach have been categorized as alarming districts and include Jamui, Araria, Gaya and Purnia. The rest of the priority districts which need special attention are as follows: Supaul, Darbhanga Pashchim Champaran, Katihar, Banka, Sheikhpura, Patna, Sitamarhi, Nalanda, Nawada, Madhepura, Arungadabad and Arwal. These districts find a place in the insecure category in either of the two approaches used to calculate the Food Security Index.

Table 4.3: Region-wise Priority Districts for Food Security Interventions

Prioritization	Region	District	Input	Outcome
Alarming	Central	Jamui	Yes	Yes
	Central	Gaya	Yes	Yes
	North	Purnia	Yes	Yes
	North	Araria	Yes	Yes

Prioritization	Region	District	Input	Outcome
Need high Attention	North	Pashchim Champaran	Yes	No
	North	Katihar	Yes	No
	Central	Banka	Yes	No
	North	Supaul	Yes	No
	North	Darbhanga	No	yes
	Central	Sheikhpura	No	Yes
	Central	Patna	No	Yes
	North	Sitamarhi	No	Yes
	Central	Nalanda	No	Yes
	Central	Nawada	No	Yes
	North	Madhepura	No	Yes
	Central	Aurangabad	No	Yes
	Central	Arwal	No	Yes

Table 4.4 reports the ranks of 17 priority districts in Bihar for the food security and outcome indices. Comparisons in the table show that although districts like Banka, Katihar, Darbhanga and Pashchim Champaran find a place in the list of food insecure districts in terms of input indicators, they find a rather opposite place in the list of secure districts in the output indicators. Similarly, while Patna and Arwal are food secure in terms of input indicators they find a place in the list of insecure districts in terms of the outcome indicators.

Table 4.4: **Bihar, Comparing the Ranks of Districts in Terms of the FSI and FSO Indices**

	Range Equalization Method		Mean Standardization Method	
	FSI	FSO	FSI	FSO
Jamui	38	35	38	35
Gaya	37	38	36	38
Purnia	35	36	26	36
Araria	33	34	34	33
Pashchim Champaran	32	7	18	5
Katihar	34	13	31	15

	Range Equalization Method		Mean Standardization Method	
Banka	36	10	37	20
Supaul	31	30	33	23
Darbhanga	28	18	35	11
Sheikhpura	23	37	12	37
Patna	10	26	26	27
Sitamarhi	27	29	16	28
Nalanda	20	24	21	29
Nawada	25	32	24	30
Madhepura	19	28	15	31
Aurangabad	13	33	13	32
Arwal	2	27	2	34

Having identified the nine most insecure districts in terms of the food security input index, we now analyse the status of these **priority districts** in terms of the individual indices, viz., the availability, access and utilization indices as well as the variables used to construct the food security index (Tables 4.5, 4.6 and 4.7). We find that although Pashchim Champaran and Darbhanga are classified as priority districts in terms of the food security index,they are classified as moderately secure for the availability dimensions. In terms of individual variables, it is seen that most of the districts classified either as extremely in-secure, moderately in-secure and severely in-secure. However, Pashchim Champaran and Darbhanga get classified as moderately secure in terms of proportions of villages with access to paved roads.

Similarly, while Gaya and Jamui are classified as priority districts in terms of the food security index, yet they are classified as moderately secure in the access dimension. A majority of the districts belong to the extremely insecure, moderately insecure and severely insecure categories for the individual variables of the access dimension. Among the identified priority districts, Jamui falls under secure category in terms of the percentage of agricultural labours to total workesr, and the ratio of working age population. Banka, Purnia, Katihar, Araria, Supaul, and Darbhanga are categorized as either moderately secure or secured in terms of the proportion of SC/ST population. Supaul also comes under the secure category for the MPCE while Jamui falls under the secure category for the proportion of working age population.

Out of nine priority districts, five districts (Purnia, Katihar, Supaul, Darbhanga and Paschim Champaran) belong to the moderately secure category for the food utilization index. This is mainly due to the access to safe drinking water. But in the case of access to health services in rural areas (a PHC within 5 kms of villages), the position is not that favorable. For access to PHCs, all the priority districts come under the extremely insecure, moderately insecure and severely insecure categories.

Table 4.5: Priority Districts Ranked by the FSI Availability Index (Input Variables)

	Availability Index	Net irrigated area(%)	Villages with access to paved road	Per capita value of Agricultural output
Jamui	EIS	SIS	MIS	EIS
Banka	EIS	MS	EIS	SIS
Gaya	SIS	MS	MIS	EIS
Purnia	SIS	EIS	MS	SIS
Katihar	SIS	EIS	MIS	MS
Araria	SIS	SIS	MIS	MIS
Supaul	SIS	SIS	MIS	MIS
Darbhanga	SIS	SIS	MS	EIS
Pashchim Champaran	MS	MIS	MS	MIS

Table 4.6: Priority Districts Ranked by the FSI Access Index (Input Variables)

	Access Index	Agricultural Labour	Proportion of SC/ST	MPCE	Wage rate	Ratio of working age population	Female literacy rate
Jamui	MS	S	MIS	SIS	EIS	S	SIS
Banka	MIS	MIS	MS	EIS	SIS	MS	SIS
Gaya	MS	MS	EIS	SIS	EIS	SIS	MIS
Purnia	EIS	EIS	MS	SIS	SIS	EIS	EIS
Katihar	EIS	EIS	S	SIS	SIS	SIS	EIS
Araria	EIS	EIS	MS	MIS	MIS	EIS	EIS
Supaul	MIS	SIS	MS	MS	MIS	SIS	SIS
Darbhanga	MIS	MIS	MS	SIS	MIS	MIS	EIS
Pashchim Champaran	EIS	EIS	MIS	MIS	SIS	SIS	EIS

Table 4.7: **Priority Districts Ranked by the FSI Utilization Index (Input Variables)**

	Utilization Index	Access to Safe Drinking water	Access to PHCS
Jamui	EIS	EIS	EIS
Banka	EIS	SIS	EIS
Gaya	MIS	MS	SIS
Purnia	MS	S	MIS
Katihar	MS	S	SIS
Araria	SIS	S	SIS
Supaul	MS	S	SIS
Darbhanga	MS	S	SIS
Pashchim Champaran	MS	S	MIS

Tables 4.8 to 4.10 highlight the status of districts which are categorized as severely and extremely insecure in terms of the food security outcome index. We analyse the category status of these districts in terms of the food security availability index, access index and utilization index. It is seen that for the outcome index, out of the eight extremely or severely insecure districts, only three districts fall under the moderately secure or secure category for the availability index. Most of these eight districts also belong to in secure category for the proportion of net irrigated area and the per capita value of agricultural output. Also, other than Aurangabad, the other districts are secure or moderately secure in terms of villages having access to paved roads. In addition,

only two districts fall in the secure or moderately secure category for the access index. The main reason for this could be that most of these districts belong to either the insecure, severely insecure or moderately insecure category in terms of the individual variables of the access index. Of these districts, only Nalanda and Aurangabad are moderately insecure in terms of the utilization index. This is mainly accounted for by the access to safe drinking water. All these districts are categorized as secure or moderately secure for access to safe drinking water. Except for Sheikhpura, Sitamarhi, Arwal, all the other districts belong to either the severely insecure, moderately insecure or extremely insecure categories for access to PHCs.

Table 4.8: **Priority Districts (in terms of the Outcome Index) Ranked by the FSI Availability Index (Input Variables)**

	Availability Index	Net irrigated area(%)	Villages with access to paved road	Per capita value of Agricultural output
Sheikhpura	MS	MIS	S	MIS
Patna	SIS	SIS	MS	SIS
Sitamarhi	MIS	MS	MS	SIS
Nalanda	MS	MS	S	MS

	Availability Index	Net irrigated area(%)	Villages with access to paved road	Per capita value of Agricultural output
Nawada	SIS	MIS	MS	MIS
Madhepura	MIS	SIS	S	SIS
Aurangabad	S	SIS	MIS	SIS
Arwal	MIS	MIS	S	MIS

Table 4.9: Priority Districts (in terms of the Outcome Index) Ranked by the FSI Access Index (Input Variables)

	Access Index	Agricultural Labour	Proportion of SC/ST	MPCE	Wage rate	Ratio of working age population	Female literacy rate
Sheikhpura	SIS	SIS	MIS	SIS	EIS	EIS	SIS
Patna	S	SIS	MIS	SIS	MIS	MS	SIS
Sitamarhi	SIS	MIS	EIS	EIS	MIS	EIS	EIS
Nalanda	MIS	MIS	MIS	SIS	EIS	MIS	SIS
Nawada	MIS	SIS	MS	SIS	MIS	MS	SIS
Madhepura	MIS	MS	SIS	SIS	MIS	SIS	EIS
Aurangabad	MIS	MIS	MS	EIS	EIS	MS	SIS
Arwal	MS	MS	MIS	MIS	S	MIS	MS

Table 4.10: Priority Districts (in terms of outcome index) Ranked by FSI Utilization Index (Input Variables)

	Utilization Index	Access to Safe Drinking water	Access to PHCS
Sheikhpura	MS	MS	MS
Patna	MS	S	SIS
Sitamarhi	S	S	MS
Nalanda	MIS	MS	SIS
Nawada	MS	MS	MIS
Madhepura	MS	S	S
Aurangabad	MIS	S	EIS
Arwal	S	S	S

To understand how the results of the two index calculation methods are comparable, we find the correlation between the range equalization method and mean standardization method. It is seen that the correlation between the RE methods and MS method for availability, access and food security indices are highly significant (Table 4.11) indicating that the results of these two methods are justifiable.

Table 4.11: **Comparing the significance of the method used**

	Availability Index_MS	Access Index_MS	Utilization Index_MS	FSI_MS	FSO_MS
Availability Index_RE	0.97*				
Access Index_RE		0.95*			
Utilization Index_RE			0.11		
FSI_RE				0.87*	
FSO_RE					-0.228

4.3 COMPARATIVE SIGNIFICANCE OF THE FOOD SECURITY POLICY VARIABLES

The preceding discussion focused on the district level positions for the component indices of Food Security. In order to examine the degree of influence exercised by different variables on the food security scenario in the state, we now examine the strength of the relationship of the Food (Input) Security and Food (Outcome) Security indices to the three component indices, as well as the inter-relationship of the aggregate input and outcome indices using the correlation method (Table 4.12).

Table 4.12: **Inter correlation Matrix of the input and output Components of Food Security**

	Availability Index	Access Index	Utilization Index	Food Security Index	FSOI
Availability Index	1				
Access Index	0.034	1			
Utilization Index	0.367*	0.035	1		
Food Security Index	0.563*	0.763*	0.557*	1	
FSOI	-0.244***	-0.368***	-0.267***	-0.432**	1

*Note * 1 percent level of significance ** 5 percent level of significance *** 10 percent level of significance*

The correlation between the aggregate food security index and the Food Security Outcome Index works out to be - 0.432. As the food secturity outcome indicators i.e. underweight children and women's BMI are negative variables and food security index is positive index hence the relation between food security outcome index and fodd security index is negative. However strength of the relationship is less. Secondly, the Food Security Input Index is very strongly positively and significantly correlated to the Access

Index (+0.763**) and to some extent to the Availability (+0.563*) and Utilization Indices (+0.557*). The Food Security Outcome Index is significantly related to the Availability Index and access and utilization index. but relation less significant.

We now focus on the inter-relationships between the individual food security variables and the aggregate Food Input Security Index in order to assess the strength of the relationship of these variables to the food security index (Table 4.13). It is seen that the percentage of agricultural labour to total workers is negatively correlated (-0.485) with the Food Security Index. Further, the correlation coefficients of the

overall food security index and its various components variables can be seen as positive and significant viz., the percentage of net irrigated area to net sown area (0.371), rural casual wage rate (0.543), female literacy rate (0.668), percentage of villages having paved road (0.566), percentage of household has access to safe drinking water (0.446) and percentage of villages having PHCS with in 5kms (0.487).

We have also studied the correlation between the individual variables and the three component composite Indices in order to understand the importance of these variables in constructing the indices.

Table 4.13: **Correlation Matrix of Food Security Index and its Components**

	Availability Index	Access Index	Utilization Index	Food Security Index	FSOI
Per capita Value of Agricultural Output	0.673*	-0.202	-0.017	0.513**	-0.065
% Net Irrigated Area to Net Sown Area	0.670*	0.145	-0.005	0.371**	0.009
% of villages having access to paved road	0.408**	0.159	0.745*	0.566*	-0.212
Percentage of Agricultural labourer to total worker	-0.0611	-0.7291*	0.195	-0.485*	0.13
MPCE	-0.2162	0.1772	0.208	0.125	0.019
Percentage of SC & ST population	-0.219	-0.03	-0.356	-0.072	0.504
Ratio of working age population	-0.081	0.686**	0.439*	0.304	-0.158
Rural casual wage rate	0.127	0.418*	0.480*	0.543*	-0.128
Female literacy rate	0.388*	0.737*	-0.073	0.668*	-0.206
% HH Access to safe drinking water	0.379*	-0.026	0.816*	0.446**	-0.262
% of villages having PHCs within 5 km	0.246	0.078	0.862*	0.487**	-0.192

4.3.1 The Availability Index

The three variables that go into forming this index are the per capita value of agricultural output, irrigation percentage and percentage of villages having an access to paved roads. All these three reveal a very

strong correlation with the Availability Index and in the case of the per capita value of agricultural output and net irrigated to net sown area, lesser with the food security index. The percentage of net irrigated area shows the strongest correlation(r=+0.670*) with the Food Security Availability Index. Per capita value of

agricultural output also shows a very strong correlation (+0.673*) also with the availability index. Villages having access to paved roads are somewhat less strongly correlated (r=+0.408*) to the Availability Index in comparison to its other two component indices. Since these three variables are of key importance for the Availability component of food security, in order to strengthen food security in the state, policy formulations need put equally strong emphasis on the measures that specifically address these three variables.

4.3.2 The Access Index

We now look at the correlation of the Food Security Access Index with its six components. Among these, four variables reveal a strong and statistically significant correlation, namely, the proportion of agricultural labourer to total workers (r= -0.729*), female literacy (r=0.737*), the ratio of working age population (0.686**) and the rural casual wage rate (r=+0.418*). The result revels that that the proportion of agricultural workers reveals quite a high correlation with the Index of Food Access. Further female literacy rate, casual wage rate and ratio of working age population also plays important role in case of access to food security. Hence we need to take into account these variables in the policy support to raise the food security level of the state.

4.3.3 The Utilization Index

The Food Security Utilization Index comprises only two variables, namely, the availability of safe drinking water and Public Health Centres. Therefore, their separate correlations with the composite Index could be expected to be quite high and they emerge to be very strong (r=+0.816** & r=0.862*, respectively). However, these two variables also bear quite a strong correlation with the food security index as well, viz. 0446* & 0.487*. Hence, these two variables are of crucial importance from the point of view of food security.

Table 4.14 lists the prioritized districts which lie below the state average in terms of the food security policy variables which focus specific attention for improving food security. Under the prioritized districts, alarming districts are those districts in which out of the eleven policy variables considered, six to eight policy variables are below the state average. In the rest of the prioritized districts also, most of the policy variables are below the state average. Some of the high attention districts are Pashchim Champaran, Katihar, Supaul, and Banka where six to seven of the policy variables are below state average. Thus, policy-makers can assess, which of the variables should be targeted for priority action for each of the low ranking food security districts.

Table 4.14:	Identified the Protarized Districts which are below State Average in terms of Food Security Policy Variables

Prioriti-zation	Region	District	PCVAO	% NIA	Road	% NAGLAB	% non SCST	RWAP	MPCE	Wage	FLR	DW	PHC
Alarming	Central	Jamui	BSA	BSA	BSA	ASA	BSA	ASA	BSA	ASA	BSA	BSA	BSA
	Central	Gaya	ASA	BSA	BSA	ASA	BSA	BSA	BSA	BSA	ASA	BSA	BSA
	North	Purnia	BSA	BSA	BSA	BSA	ASA	BSA	BSA	BSA	BSA	ASA	ASA
	North	Araria	ASA	BSA	BSA	BSA	ASA	BSA	ASA	ASA	BSA	ASA	BSA

Prioriti-zation	Region	District	PCVAO	% NIA	Road	% NAGLAB	% non SCST	RWAP	MPCE	Wage	FLR	DW	PHC
Need high Attention	North	Pashchim Champaran	ASA	ASA	BSA	BSA	BSA	BSA	ASA	BSA	BSA	ASA	ASA
	North	Katihar	ASA	ASA	BSA	BSA	ASA	BSA	BSA	BSA	BSA	ASA	BSA
	Central	Banka	ASA	ASA	BSA	BSA	ASA	ASA	ASA	BSA	BSA	BSA	BSA
	North	Supaul	BSA	BSA	BSA	BSA	ASA	BSA	ASA	ASA	BSA	ASA	BSA
	North	Darbhanga	BSA	ASA	ASA	ASA	ASA	ASA	ASA	ASA	BSA	ASA	BSA
	Central	Sheikhpura	BSA	ASA	ASA	ASA	BSA	BSA	BSA	BSA	ASA	BSA	ASA
	Central	Patna	ASA	ASA	BSA	ASA	BSA	ASA	ASA	ASA	ASA	ASA	BSA
	North	Sitamarhi	BSA	ASA	ASA	BSA	ASA	BSA	BSA	ASA	BSA	ASA	ASA
	Central	Nalanda	ASA	ASA	ASA	ASA	BSA	ASA	ASA	ASA	ASA	BSA	BSA
	Central	Nawada	BSA	ASA	ASA	ASA	BSA	ASA	ASA	BSA	BSA	BSA	BSA
	North	Madhepura	ASA	BSA	ASA	BSA	ASA	BSA	ASA	ASA	BSA	ASA	ASA
	Central	Aurangabad	ASA	ASA	BSA	ASA	BSA	ASA	BSA	ASA	ASA	ASA	BSA
	Central	Arwal	BSA	ASA	ASA	BSA	BSA	ASA	ASA	ASA	ASA	ASA	ASA

Note: BSA: below State AverageASA: Above state average

4.4 COMPARISON OF THE FOOD SECURITY INDEX (2008-09 TO 2016-17)

According to the Food Security Atlas of Rural Bihar prepared by IHD in collaboration with the World Food Program, 2008, 12 districts of the state have been identified as either severely or extremely food insecure. In this section we discuss how the districts of Bihar have changed their positions over the period 2008-9 and 2016-17 in terms of the food security index as well as the individual dimensions of food security. Using the Spearman rank correlation between 2008-09 and 2016-17 for the food security index is 0.58, which is not very high. Alternatively, it indicates that in most of the cases, the ranks of the districts have changed between 2008-

09 and 2016-17 in terms of food security index. Now it is interesting to see the transition of the districts from being food insure to being food secure and vice versa. The individual dimension wise comparative picture is given in Appendix Tables 4.1A to Table 4.3A. In terms of the availability dimension, it can be seen that the situation for some of the districts has worsened over the period under study (Gaya, Supaul, Paschim Champaran).. These three districts were moderately food insecure in 2008-09 but become extremely or severely food insecure in 2016-17. Further, districts such as Nawada, Saharsa, Munger, Nalanda and Madhepura who were moderately food secure in 2008-09 moved to being moderately food insecure in 2016-17. On the other hand Madhubani, Muzaffarpur, Patna and Samastipur who were moderately food insecure in

2008-09, moved to being moderately food secure in 2016-17. These districts belong to the South and South Eastern region, the North Centralregion and South Central regions. The districts from North Western region of Bihar such as Saran, Vaishali, Gopalganj are also seen to have improved their status in the availability dimension over the same time period. These districts were moderately food secure in 2008-09 but became food secure in 2016-17. For the access dimension also, Begusarai, Madhubani, Bhagalpur, Kaimur Muzaffarpur and Patna which were in the moderately food insecure category moved to being either moderately food secure or food secure in 2016-17. Saran, Vaishali and Gopalganj districts also shifted from being in the moderately food secure category to the food secure category in 2016-17. On the other hand, districts like Saharsa, Lakhisarai, Jamui and Nalanda showed a shift from the moderately food secure to the moderately food insecure category while Aurangabad and Nawada transited from the food secure category to the moderately insecure category. Mainly, it is seen that the North Western region of Bihar has been improving in terms of the access dimension. However, in the utilization dimension, the progress has been comparatively lesser as thirteen districts have shifted from the food secure category to the moderately food secure category and while five more districts shifted from the moderately secure to the moderately food insecure position. Only Patna, Samastipur and Jehanabad were better off in 2016-17 as compared to their situation in 2008-09 for the utilization dimension.

Five districts namely Araria, Banka, Jamui, Katihar and Purnia were either severely insecure or extremely insecure in food security index (Table 4.15). Out of these five districts three are from the north east region and other two districts are from the south and south east region. Kishanganj has shifted from severely insecured to moderately insecured. Kishanganj is also from north east region. On the other hand Lakhisarai a district from south and south east region has shifted from severely insured status to moderately secured position. Gaya and Supal has shifted from moderately insecured to extremely insecured and severely insecured position. These two districts are from south and south east region and north east region respectively. These districts are much better in 2008-09 compared to 2016-17 in terms of food security index. Further Paschim Champaran a district from west and south west region was also better in 2008-09 but fall under severely insecured category in 2016-17. Khagaria a district from north east region was under secured categoty in 2008-09 but shifted to moderately insured category in 2016-17. There are six districts which are moderately secured in 2008-09 but become moderately insecured in 2016-17. These districts are : Mungar, Bagalpur and Nawda from south and south east region; Saharsa and Madhepura from north east region and Nalanda from centre south region. There are four districts which are moderately insecured in both the time periods: Madhubani, Samastipur, Muzaffarpur, Patna, from centre north (2 districts), South and south east region and centre south region respectively.

Table 4.15: Comparison of Food Security Indices for districts between 2008-09 and 2016-17

		2008-09				
		Extreme Insecure	**Severe insecure**	**Moderate insecure**	**Moderately secure**	**Secure**
2016-17	**Extreme Insecure**	Jamui	Purnia, Banka	Gaya		
	Severe insecure		Katihar, Araria	Supaul, Paschim Champaran		

2008-09

		Extreme Insecure	Severe insecure	Moderate insecure	Moderately secure	Secure
2016-17	**Moderate insecure**		Kishanganj	Purba Champaran, Darbhanga, Sheohar, Bhagalpur Sitamarhi, Sheikhpura	Nawada, Saharsa, Munger, Nalanda, Madhepura,	Khagaria
	Moderately secure		Lakhisarai	Madhubani, Muzaffarpur, Patna, Samastipur	Aurangabad, Kaimur, Begusarai	Buxar, Bhojpur
	Secure				Saran, Vaishali, Gopalganj	Jehanabad, Rohtas, Siwan

4.5 SUMMING UP

The primary focus of this chapter is on estimating the overall food security index at the district level in Bihar, identifying those districts which are at the lowest level and need specific policy interventions. The districts that need special attention include: (i) Jamui (ii) Gaya (iii) Purnia (iv) Araria (v) Pashchim Champaran (vi) Katihar (vii) Banka (viii) Supaul (ix) Darbhanga (x) Sheikhpura (xi) Patna (xii) Sitamarhi (xiii) Nalanda (xiv) Nawada (xv) Madhepura (xvi) Aurangabad (xvii) Arwal. Specific state policy interventions are needed to improve the food security patterns of these districts.

A comparison of the food security index for the districts of Bihar over the period 2008-09 to 2016-17 indicates that in most of the cases, the district ranks have changed. It is seen that some the districts from the Southern and South East regions of Bihar (such as Munger, Bhagalpur and Nawada) and from the North East region who were moderately food

secure in 2008-09 became moderately food insecure in 2016-17. It indicates that the districts in South South East and North Eastern parts of Bihar were not only food insecure in 2016-17, but also some of the districts which were moderately secure in 2008-09 but becomes moderately insecured in 2016-17. Hence, it is very important to put into place the necessary policy instruments to develop the region in the first place and then improve the various aspects of food security in that region. The state government needs to directly focus on irrigation, roads, female literacy, provisioning of safe drinking water and public health facilites in such regions as well as in all the food insecure districts. Further, the state could indirectly lay emphasis on agricultural output, consumption expenditures and the agricultural wage rate. Further, the proportions of of SC/STpopulation, the dependency rate and the proportion of the agricultural workforce could be improved through welfare development programmes.

APPENDIX

Table A4.1: Comparison of Food Security Index between 2008-09 and 2016-17 in Availability Index

2008-09

Avalability Index		Extreme Insecure	Severe insecure	Moderate insecure	Moderately secure	Secure
2016-17	**Extreme Insecure**	Jamui	Madhubani, Banka			
	Severe insecure	Kishanganj	Purnia, Bhagalpur, Katihar, Darbhanga ,Araria	Gaya, Patna, Nawada, Vaishali, Supaul	Munger, Begusarai	
	Moderate insecure		Muzaffarpur, Saran,Purba Champaran, Sitamarthi,	Samastipur, Gopalganj, Saharsa, Siwan	Bhojpur, Madhepura, Khagaria,	Buxar
	Moderately secure		Lakhisarai, Sheohar	Pashchim Champaran	Nalanda	Sheikhpura, Kaimur (Bhabua)
	Secure			Aurangabad	Jehanbad	Rohtas

Table A4.2: Comparison of Food Security Index between 2008-09 and 2016-17 in Access Index

2008-09

Access Index		Extreme Insecure	Severe insecure	Moderate insecure	Moderately secure	Secure
2016-17	**Extreme Insecure**	Purnia, Katihar, Pashchim Champaran		Sheohar	Gaya,	
	Severe insecure	Araria,		Purba Champaran	Sitamarhi, Sheikhpura	
	Moderate insecure		Kishanganj	Khagaria, Banka, Darbhanga, Madhepura, Supaul, Samastipur	Saharsa, Lakhisarai, Jamui, Nalanda	Aurangabad, Nawada
	Moderately secure			Begusarai, Madhubani, Bhagalpur, Kaimur	Bhojpur, Buxar	Jehanabad, Munger
	Secure			Muzaffarpur, Patna	Saran, Vaishali, Gopalganj	Rohtas, Siwan

Table A4.3: Comparison of Food Security Index between 2008-09 and 2016-17 in Utilization Index

		2008-09				
Utilization Index		**Extreme Insecure**	**Severe insecure**	**Moderate insecure**	**Moderately secure**	**Secure**
2016-17	**Extreme Insecure**	Jamui	Banka			
	Severe insecure					
	Moderate insecure			Gaya, Kaimur, Munger, Nalanda	Aurangabad Rohtas Bhagalpur	Buxar
	Moderately secure		Lakhisarai, Sheikhpura	Patna	Araria Nawada Kishanganj Katihar Purnia	Bhojpur, Darbhanga, Supaul, Purba Champaran, Paschim Champaran, Gopalganj, Saharsa, Saran, Muzaffarpur, Begusarai, Khagaria, Vaishali, Madhepura
	Secure				Samastipur Jehanabad	Madhubani Siwan Sheohar Sitamarhi

THE REVISED FOOD SECURITY INDEX

5.1 INTRODUCTION

In Chapters 3 and 4 we constructed the food security index and food security out come index based on the variables used in the Food Security Atlas of rural Bihar 2008-09. Based on the literature review, it became clear that the sanitation and health behavior of the household are also important factors for food security, mainly for the utilization dimension which was missing in our earler index. Hence, we now incorporate those variables in the utilization dimension and estimate the revised food security index. Based on these revisions this chapter constructs the revised food security input and food security outcome indices.

Table 5.1 shows the comparison of the variables used in the three main dimensions of food security i.e. availability index, access index and utilization index as well as the components of the outcome index. Appendix Table 5A.1 lists the sources of the various variables used for the calculations of these indices.

Table 5.1: Comparison of the Variables used for Calculating the Food Security Availability, Access, Utilization and Output Indices

	Old Variables	New Variables
Availability Index	1. Per capita value of agricultural output	1. Per capita value of agricultural output
	2. Proportion of net irrigated area to net sown area	2. Proportion of net irrigated area to net sown area
	3. Percentage of inhabited villages having access to paved roads	3. Percentage of village access to town within 10 km distance
Access Index	1. Percentage of agricultural labour to total workers.	1. Percentage of agricultural labour to total workers
	2. Proportion of ST and SC population to total population (Rural)	2. Proportion of ST and SC population to total population
	3. Ratio of working age Population (Rural)	3. Ratio of working age Population
	4. Monthly per capita consumption expenditure (inequality adjusted)	4. Monthly per capita consumption expenditure (inequality adjusted)
	5. Rural casual wage rate	5. Rural casual wage rate
	6. Female literacy rate (7+) (Rural)	6. Percentage of inhabited villages having access to paved roads.

	Old Variables	New Variables
Utilization Index	1. Percentage of households having access to safe drinking water.	1. Percentage of households having access to safe drinking water.
	2. Percentage of inhabited villages having access to Primary health centre in Rural Areas within 5 km range	2. Percentage of inhabited villages having access to Primary health centre in Rural Areas within 5 km range
		3. Female literacy rate (7+) (Rural)
		4. Disease and health behaviour (100-Prevalence of diarrhoea (reported) in the last 2 weeks preceding the survey (%))
		5. Percentage of household access to toilet
Outcome Index	1. % of children underweight (0-5 years) under 2SD	1. Children under 5 years who are underweight (weight-for-age) (%)
	2. BMI among women	2. Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)
		Children age 6-59 months who are anaemic (<11.0 g/dl) (%)
		Micronutrient (percentage of household not satisfying recommended calorie, protein and fat all three)

5.2 The Availability Index ■

In the availability index three important variables were taken into account (the per capita value of agricultural output, the proportion of net irrigated area to net sown area and the percentage of villages having access to a town within a 10 km distance).

The access of villages to towns is an important indicator of food security. Good access to urban areas leads to the efficient marketing of rural agricultural products. People staying in villages which are far from the town have a harder time making connections with market –based opportunities (Krishna et.al. 2011). Also, the access to agricultural inputs for rural areas as well as employment opportunities in the non-agricultural sector is high if the villages are close to towns.

Table 5.2 and Map 5.1a present the status of the districts in terms of the availability index using the mean standardization method. Going by this method of calculating the food availability index, Jamui, Madhubani, Dharbhanga and Purnia are districts identified as extremely food availability insecure districts in Bihar while Rohtas, Aurangabad, Jehanabad, Sheikhpura and Bhojpur were the five districts identified as secure. The four moderately secure districts were Gopalganj, Begusarai, Pashchim Champaran and Sheohar. Ten districts were in the moderately insecure category and fourteen in severely the secure category in terms of the new food availability index. Table 5.3 and Map 5.21b represent the status of the districts in terms of the availability index using range equalization method

Map 5.1a: Revised Availability Index (Mean Standarization Method)

Legend:
- < 2.27 — Extreme Insecure
- 2.27 – 2.83 — Severe Insecure
- 2.84 – 3.40 — Moderate Insecure
- 3.40 – 3.96 — Moderately Secure
- > 3.97 — Secure

Bihar Average = 0.534
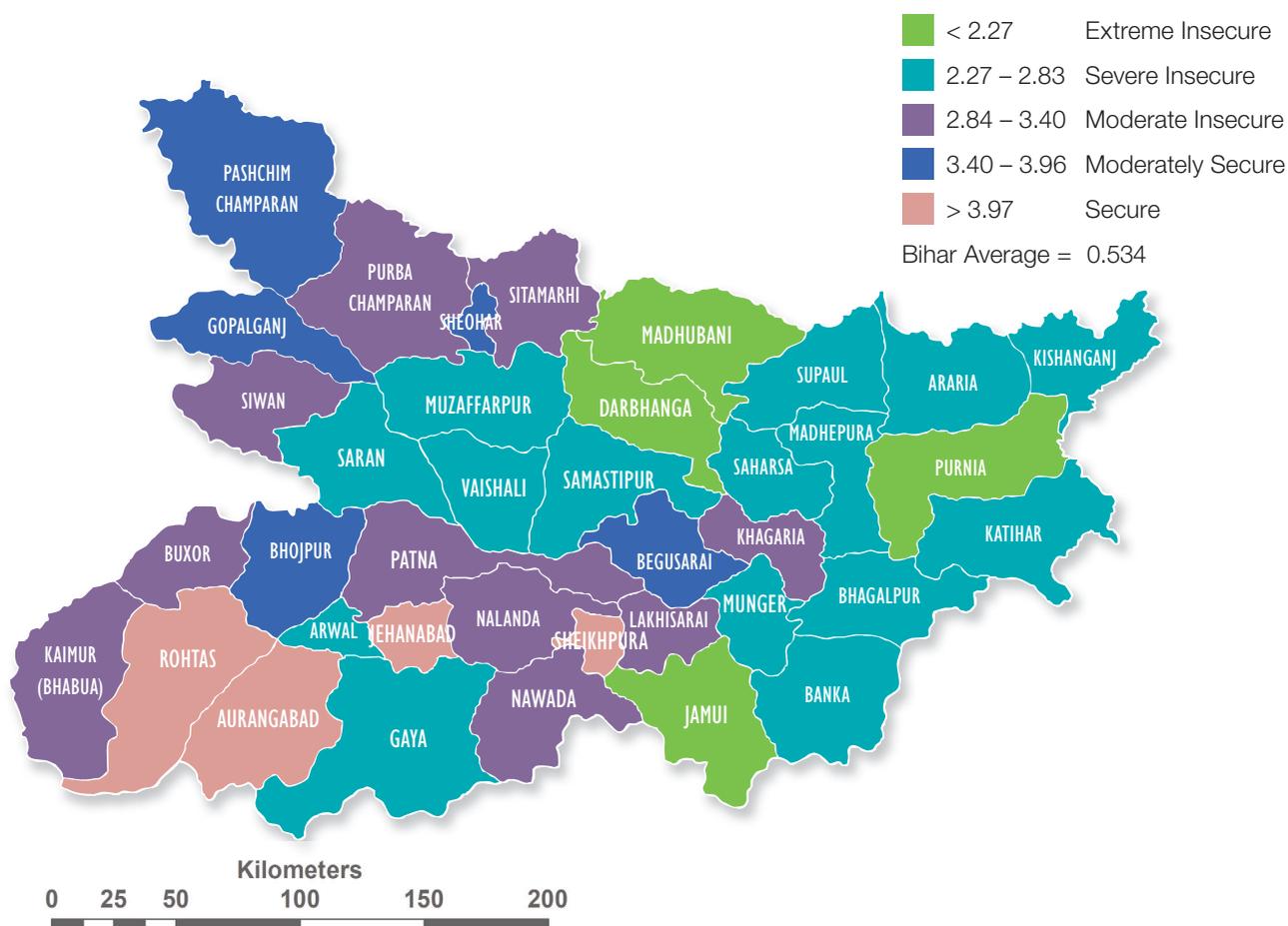
Table 5.2: Revised Availability Index (Mean Standarization Method)

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	1.709	Kishanganj	2.354	Siwan	2.860	Gopalganj	3.477	Bhojpur	3.913
Madhubani	1.967	Vaishali	2.386	Sitamarhi	3.067	Begusarai	3.536	Sheikhpura	4.063
Darbhanga	2.005	Muzaffarpur	2.469	Nawada	3.070	Pashchim Champaran	3.685	Aurangabad	4.372
Purnia	2.125	Gaya	2.499	Purba Champaran	3.123	Sheohar	3.717	Rohtas	4.379
		Supaul	2.524	Kaimur (Bhabua)	3.225			Jehanabad	4.534

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
		Bhagalpur	2.534	Buxar	3.236				
		Saran	2.576	Khagaria	3.273				
		Saharsa	2.577	Patna	3.293				
		Katihar	2.585	Lakhisarai	3.383				
		Arwal	2.659	Nalanda	3.386				
		Madhepura	2.664						
		Banka	2.666						
		Samastipur	2.682						
		Munger	2.684						

Table 5.3: **Revised Availability Index (Range Equalization Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.158	Vaishali	0.295	Siwan	0.393	Gopalganj	0.513	Sheikhpura	0.628
Darbhanga	0.208	Supaul	0.305	Nawada	0.434	Begusarai	0.529	Rohtas	0.682
Madhubani	0.208	Katihar	0.307	Purba Champaran	0.435	Pashchim Champaran	0.543	Aurangabad	0.702
Purnia	0.222	Muzaffarpur	0.311	Sitamarhi	0.442	Sheohar	0.568	Jehanabad	0.743
Kishanganj	0.258	Bhagalpur	0.312	Kaimur (Bhabua)	0.450	Bhojpur	0.597		
		Saharsa	0.321	Buxar	0.457				
		Gaya	0.329	Patna	0.473				
		Araria	0.329	Khagaria	0.481				
		Saran	0.335	Lakhisarai	0.497				
		Madhepura	0.335	Nalanda	0.502				
		Arwal	0.351						
		Banka	0.356						
		Samastipur	0.360						
		Munger	0.368						

Map 5.1b: **Revised Availability Index (Range Equalization method)**

< 0.275	Extreme Insecure
0.276 – 0.392	Severe Insecure
0.393 – 0.509	Moderate Insecure
0.510 – 0.626	Moderately Secure
> 0.627	Secure

Bihar Average = 0.388
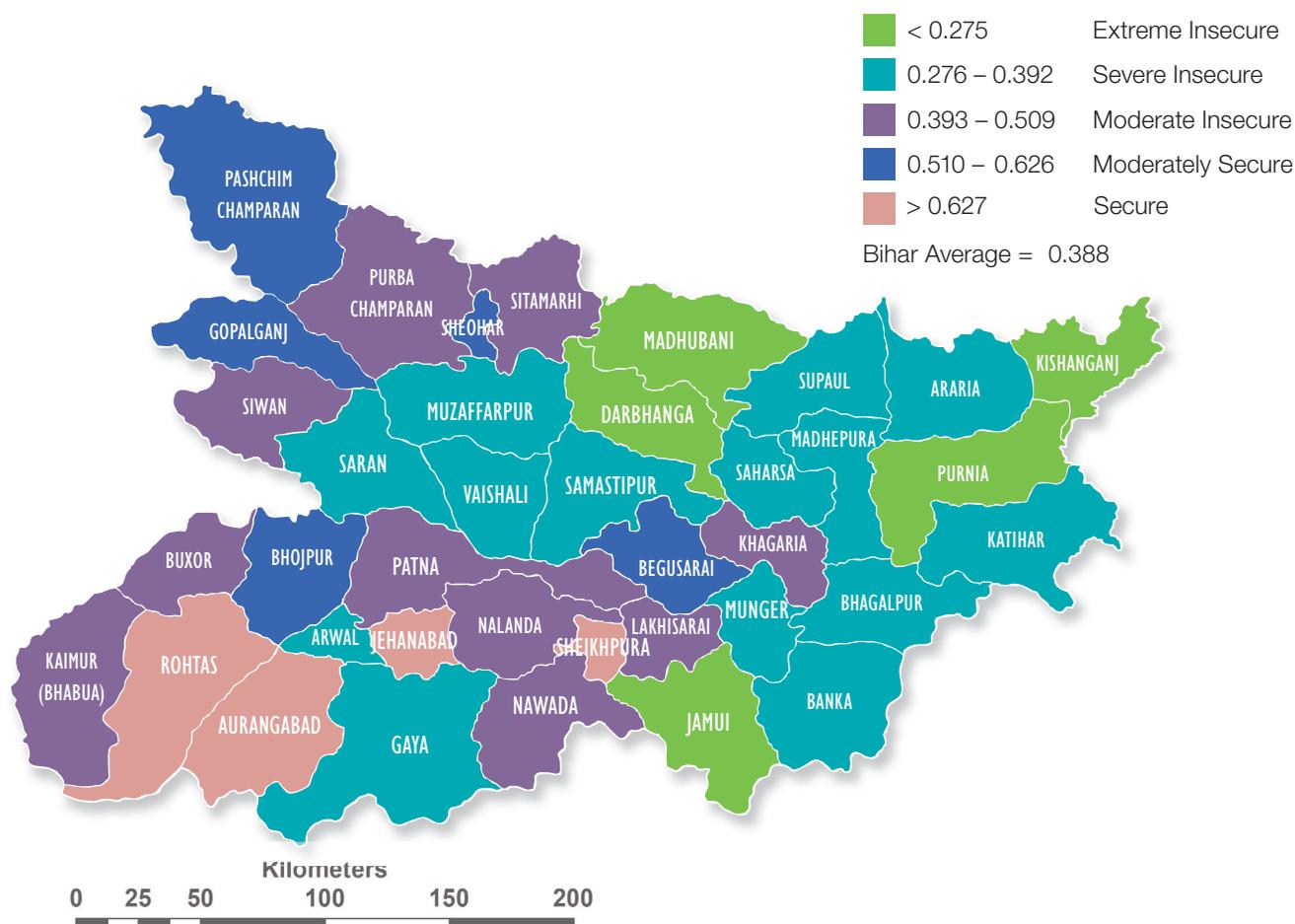
5.3 THE ACCESS INDEX

The access dimension comprised of six variables viz., the percentage of agricultural labourers to total workers, proportion of ST and SC population to total population, ratio of working age population (rural), monthly per capita consumption expenditure (inequality adjusted), and the rural casual wage rate. The changes between the previous and the revised access index was that the percentage of villages with access to paved roads was previously considered in the availability index where as in the revised index, this indicator has been taken as an access index. Another variable, the female literacy rate, which

was previously in the access index has now been considered as a part of the utilization index. The detailed description of the importance of the variables used to construct revised access index has been given in Cchapter 3.

Table 5.4 and Map 5.2a show that nine districts (Purnia, Pashchim Champaran, Banka Gaya, Katihar, Araria, Jamui, Aurangabad and Buxar) fall in the two lowest categories (severely insecure and extremely insecure) of the food access index. The three districts that are food secure are Arwal, Saran, and Vaishali. (For the range equalization method, please refer Table 5.5 and Map 5.2b).

Map 5.2a: **Revised Food Access Index (Mean Standarization Method)**

Legend:
- < 5.35 — Extreme Insecure
- 5.35 – 5.71 — Severe Insecure
- 5.71 – 6.07 — Moderate Insecure
- 6.08 – 6.44 — Moderately Secure
- > 6.44 — Secure

Bihar Average = 5.98
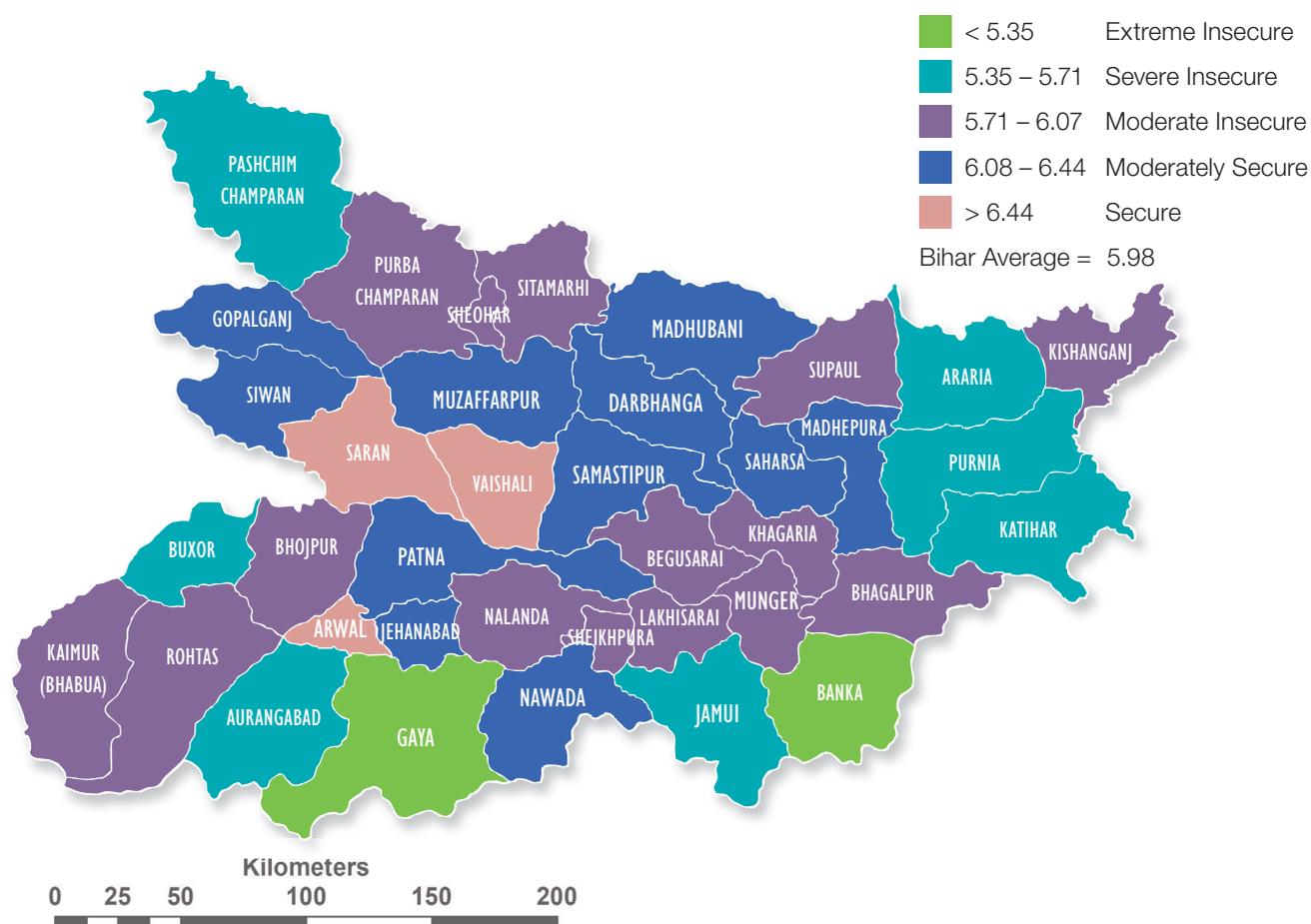
Table 5.4:   **Revised Food AccessIndex (Mean Standarization Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Banka	4.991	Purnia	5.457	Supaul	5.849	Nawada	6.092	Arwal	6.539
Gaya	5.312	Katihar	5.460	Sitamarhi	5.864	Darbhanga	6.124	Vaishali	6.763
		Pashchim Champaran	5.537	Sheohar	5.889	Samastipur	6.139	Saran	6.805
		Jamui	5.591	Munger	5.899	Saharsae	6.179		
		Aurangabad	5.602	Bhojpur	5.923	Madhubani	6.217		

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
		Araria	5.652	Begusarai	5.953	Jehanabad	6.319		
		Buxar	5.713	Rohtas	5.995	Siwan	6.333		
				Sheikhpura	6.017	Madhepura	6.339		
				Bhagalpur	6.018	Muzaffarpur	6.361		
				Khagaria	6.027	Gopalganj	6.366		
				Purba Champaran	6.028	Patna	6.424		
				Nalanda	6.042				
				Lakhisarai	6.046				
				Kishanganj	6.060				
				Kaimur (Bhabua)	6.074				

Table 5.5: Revised Food Access Index(Range Equalization Method)

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Gaya	0.298	Katihar	0.391	Supaul	0.480	Rohtas	0.562	Patna	0.674
Purnia	0.345	Araria	0.419	Jamui	0.487	Darbhanga	0.565	Vaishali	0.706
Pashchim Champaran	0.362	Sheohar	0.421	Purba Champaran	0.490	Munger	0.566	Saran	0.727
Banka	0.374	Aurangabad	0.429	Kaimur (Bhabua)	0.490	Bhojpur	0.578		
		Sheikhpura	0.458	Khagaria	0.495	Madhepura	0.579		
		Sitamarhi	0.465	Buxar	0.511	Jehanabad	0.600		
				Nalanda	0.519	Gopalganj	0.618		
				Kishanganj	0.526	Madhubani	0.624		
				Lakhisarai	0.535	Arwal	0.634		
				Begusarai	0.537	Siwan	0.636		
				Saharsa	0.540	Muzaffarpur	0.640		
				Nawada	0.542				
				Samastipur	0.546				
				Bhagalpur	0.555				

Map 5.2b: **Revised Food Access Index (Mean Standarization Method)**

Legend:
- < 0.384 — Extreme Insecure
- 0.385 – 0.470 — Severe Insecure
- 0.471 – 0.555 — Moderate Insecure
- 0.556 – 0.641 — Moderately Secure
- > 0.642 — Secure

Bihar Average = 0.562
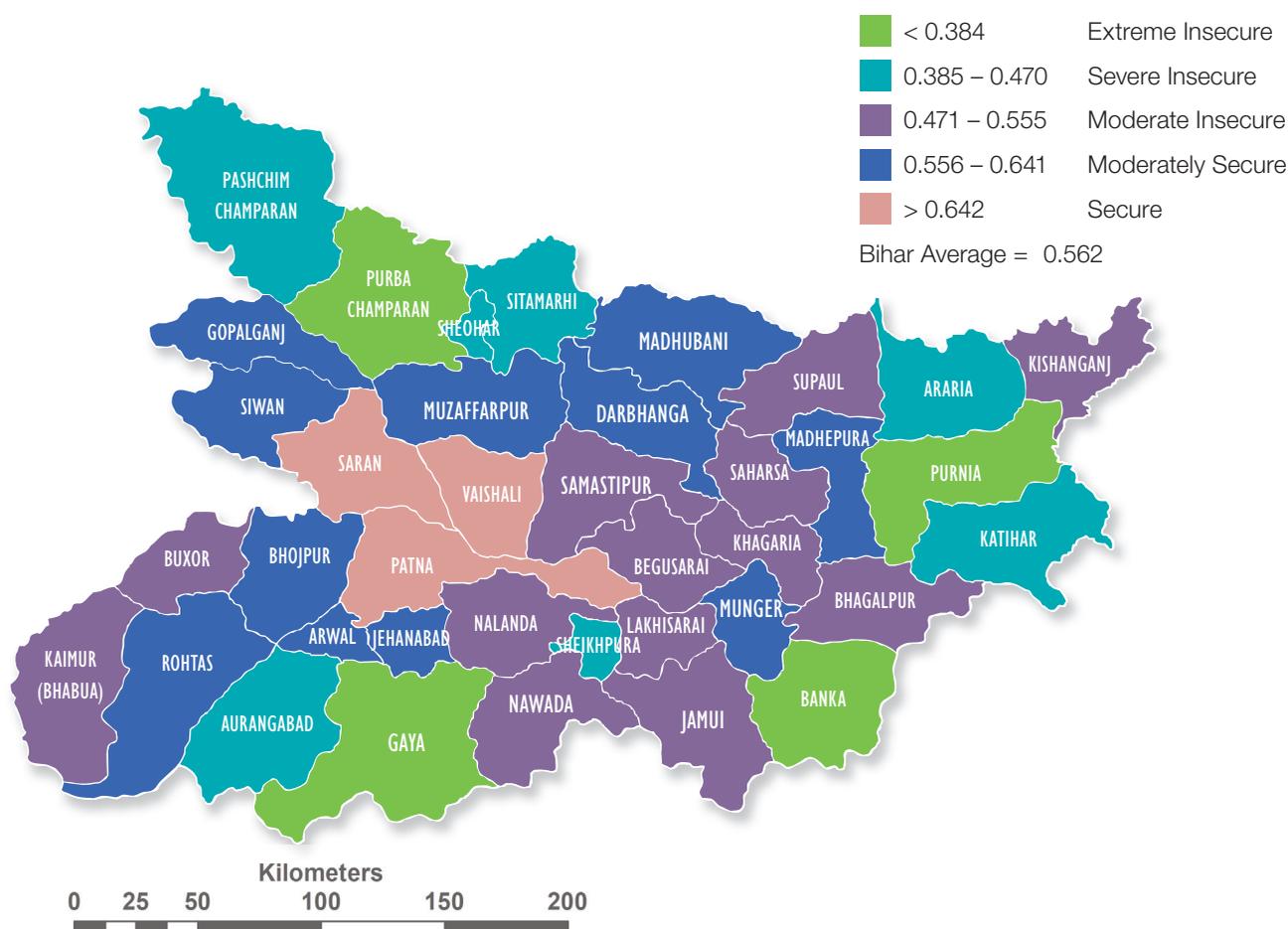
5.4 THE UTILIZATION INDEX

In the revised utilization index a total of five variables were taken into consideration including the percentage of households having access to safe drinking water, the percentage of inhabited villages having access to Primary Health Centres in rural areas within a 5 km range, female literacy rate (7+) (rural), disease and health behaviour (prevalence of diarrhoea (reported) in the last 2 weeks preceding the survey (%)) and the percentage of households with access to toilets). The first two variables were also included while constructing the utilization index in chaper 3 and the female literacy variable was previously included in the food access index. The detailed explanations of the importance and

reason for taking the literacy, access to PHCs and safe drinking water variables hava already been explained in detail in chapter 3. The remaining two variables have been newly included in the constriction of the revised food utilization index.

Research shows a clear association between morbidity and severe food insecurity. Guburt et al (2016) found a high degree of association between severe food insecurity and the prevalence of common morbidities. They also show that severely food-insecure children had a greater likelihood of experiencing cough and of being hospitalized for diarrhoea. The other variable is sanitation (Toilet). Without access to proper sanitation and proper hygiene, food is easily

contaminated. This can also cause diarrhoea and other intestinal diseases and eventually lead to under nutrition through decreased nutrition absorption. Undernutrition in turn reduces the body's ability to fight off further infections. Due to high exposure to lack of sanitation, children usually are at a high risk of contracting diarrhoea.

From the data depicted in Table 5.6 and Map 5.3 it can be seen that Arwal emerges to be the most secure district having a utilization index of 5.89, whereas Jamui is the least secure district with utilization index value of 3.52 (using the mean standarization method). For similar results for the range equalization mehod, please refer Table 5.7 and Map 5.3b.

Map 5.3a: **Revised Utilization Index (Mean Standarization method)**

	< 3.99	Extreme Insecure
	3.99 – 4.47	Severe Insecure
	4.47 – 4.94	Moderate Insecure
	4.94 – 55.42	Moderately Secure
	> 5.42	Secure

Bihar Average = 4.98
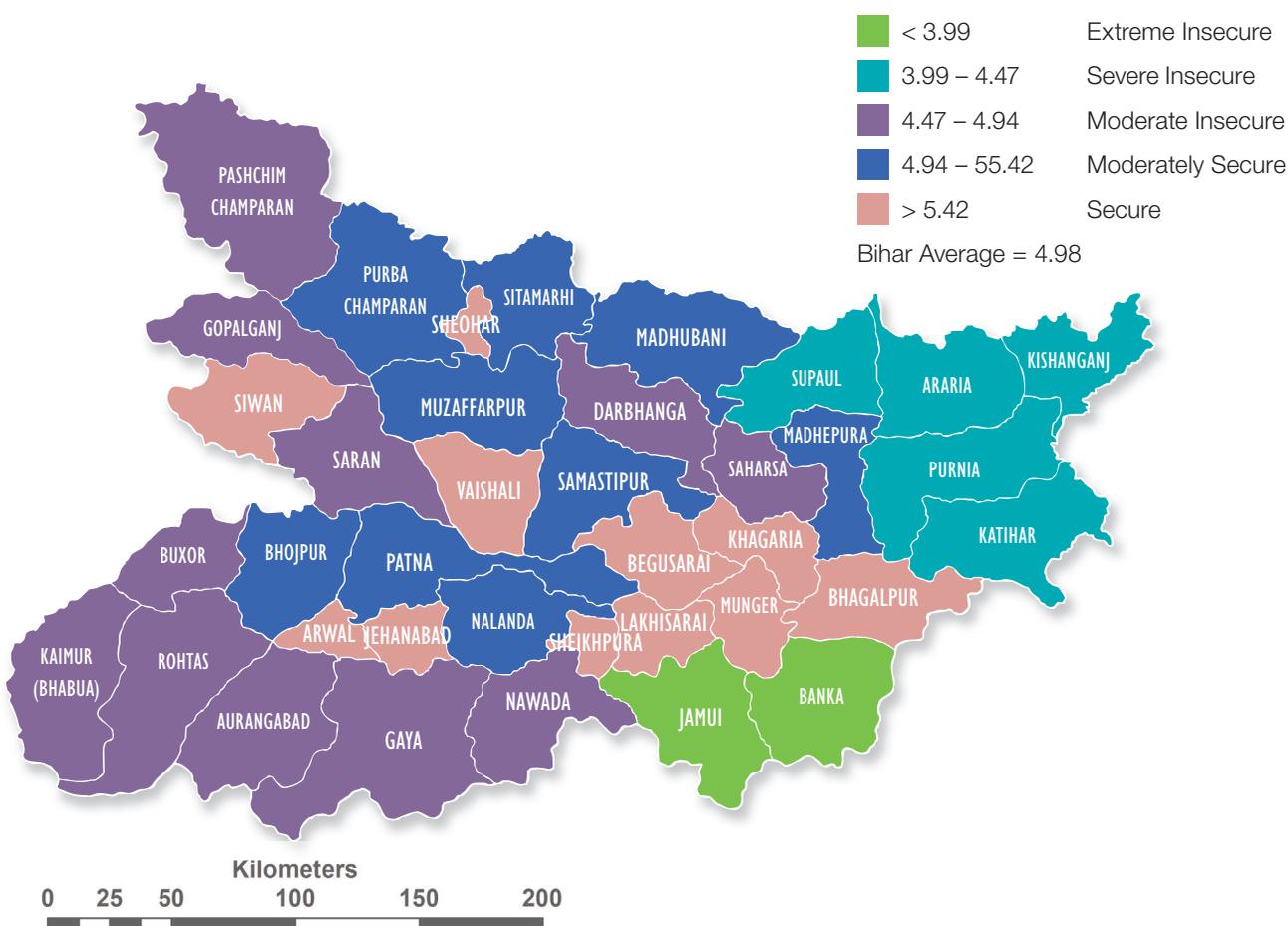
Table 5.6:   **Revised Utilization Index (Mean Standarization Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	3.524	Araria	4.050	Saran	4.763	Sitamarhi	5.039	Munger	5.455
Banka	3.826	Kishanganj	4.218	Darbhanga	4.815	Nalanda	5.042	Begusarai	5.462

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
		Supaul	4.256	Kaimur (Bhabua)	4.824	Purba Champaran	5.084	Jehanabad	5.547
		Purnia	4.310	Rohtas	4.836	Madhubani	5.105	Bhagalpur	5.591
		Katihar	4.419	Nawada	4.874	Madhepura	5.188	Sheohar	5.609
		Gaya	4.524	Gopalganj	4.922	Samastipur	5.226	Sheikhpura	5.620
		Pashchim Champaran	4.650	Buxar	4.944	Bhojpur	5.288	Siwan	5.692
		Aurangabad	4.692			Muzaffarpur	5.296	Khagaria	5.739
		Saharsa	4.715			Patna	5.310	Lakhisarai	5.787
								Vaishali	5.862
								Arwal	5.896

Table 5.7: **Revised Utilization Index (Range Equalization Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.281	Supaul	0.451	Kishanganj	0.480	Madhubani	0.602	Bhagalpur	0.686
Araria	0.349	Katihar	0.453	Darbhanga	0.481	Muzaffarpur	0.603	Buxar	0.693
Banka	0.358			Pashchim Champaran	0.501	Samastipur	0.616	Begusarai	0.718
Purnia	0.369			Purba Champaran	0.502	Sheohar	0.627	Sheikhpura	0.725
				Saharsa	0.508	Nalanda	0.628	Rohtas	0.731
				Sitamarhi	0.516	Munger	0.643	Jehanabad	0.734
				Saran	0.525	Aurangabad	0.650	Siwan	0.738
				Gopalganj	0.525	Kaimur (Bhabua)	0.657	Patna	0.738
				Madhepura	0.565	Bhojpur	0.670	Lakhisarai	0.742
				Gaya	0.572			Khagaria	0.747
				Nawada	0.574			Vaishali	0.763
								Arwal	0.775

Map 5.3b: **Revised Utilization Index (Range Equalization Method)**

■	< 0.380	Extreme Insecure
■	0.381 – 0.479	Severe Insecure
■	0.480 – 0.577	Moderate Insecure
■	0.578 – 0.676	Moderately Secure
■	> 0.677	Secure

Bihar Average = 0.583
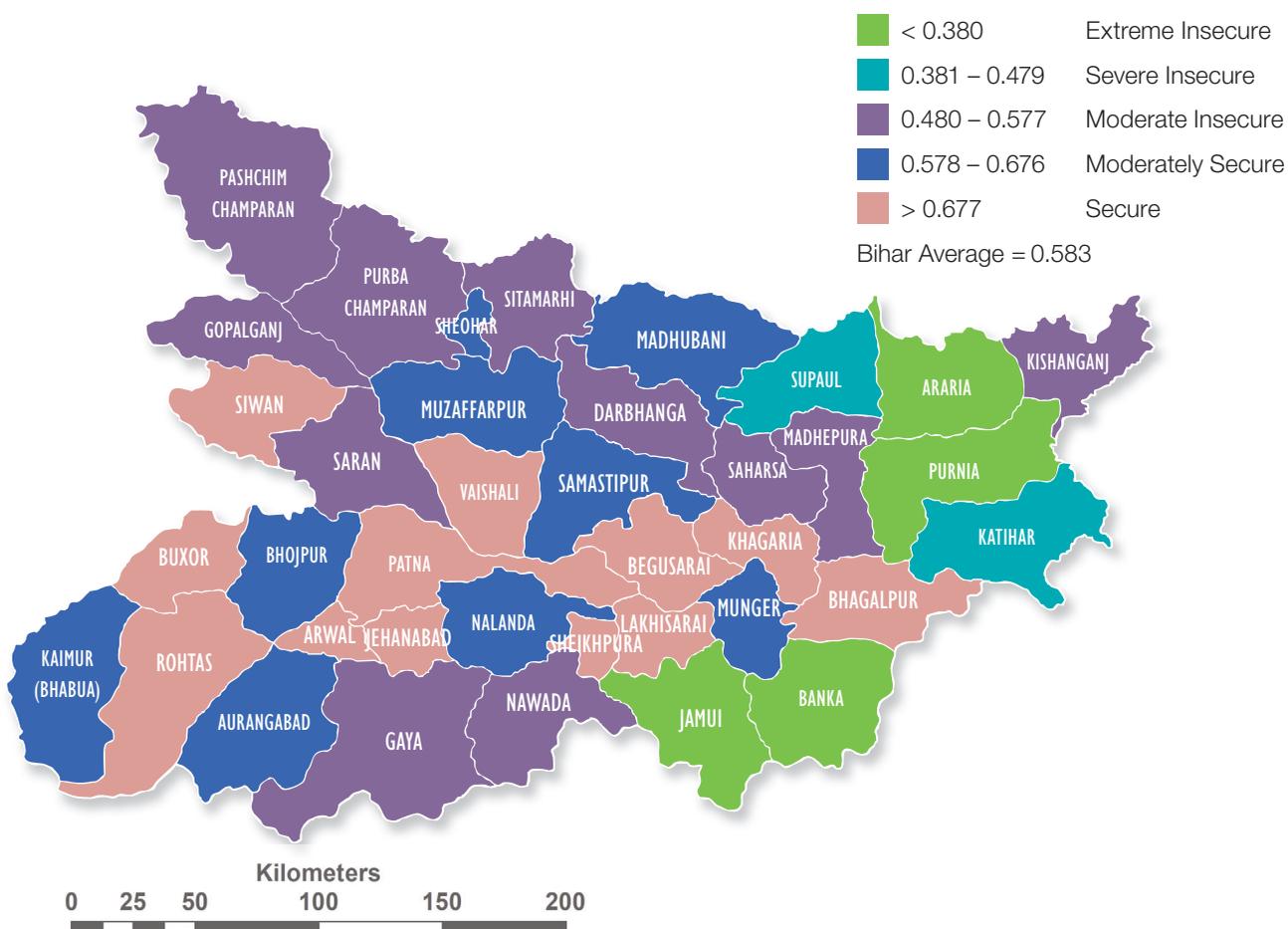
5.5 OVERALL FOOD SECURITY INDEX ■

The overall food security index using the mean standardization method was calculated and the districts were grouped into five broad categories from extremely food insecure to extremely food secure. Table 5.8 and Map 5.4a identify the status of the districts in terms of food security index using Mean Standardization Method. There are three districts which are extremely food insecurewhich are Jamui, Banka and Purnia and another six districts that are severely food insecure districts (Gaya, Katihar, Araria, Kishanganj, Dharbhanga, Supaul). These districts need urgent attention in terms of enhancements and imporvements in the food security input indicators. On the other hand, the most food secure districts come out as Sheikhpura and Jehanabad. A similar status and categorization of the districts using the range equalization method is presented in Table 5.9 and Map5.4b below.

Map 5.4a: **Revised Food Security Index (Mean Standarization method)**

< 11.93	Extreme Insecure
11.94 – 13.05	Severe Insecure
13.05 – 14.17	Moderate Insecure
14.17 – 15.28	Moderately Secure
> 15.28	Secure

Bihar Average =13.82
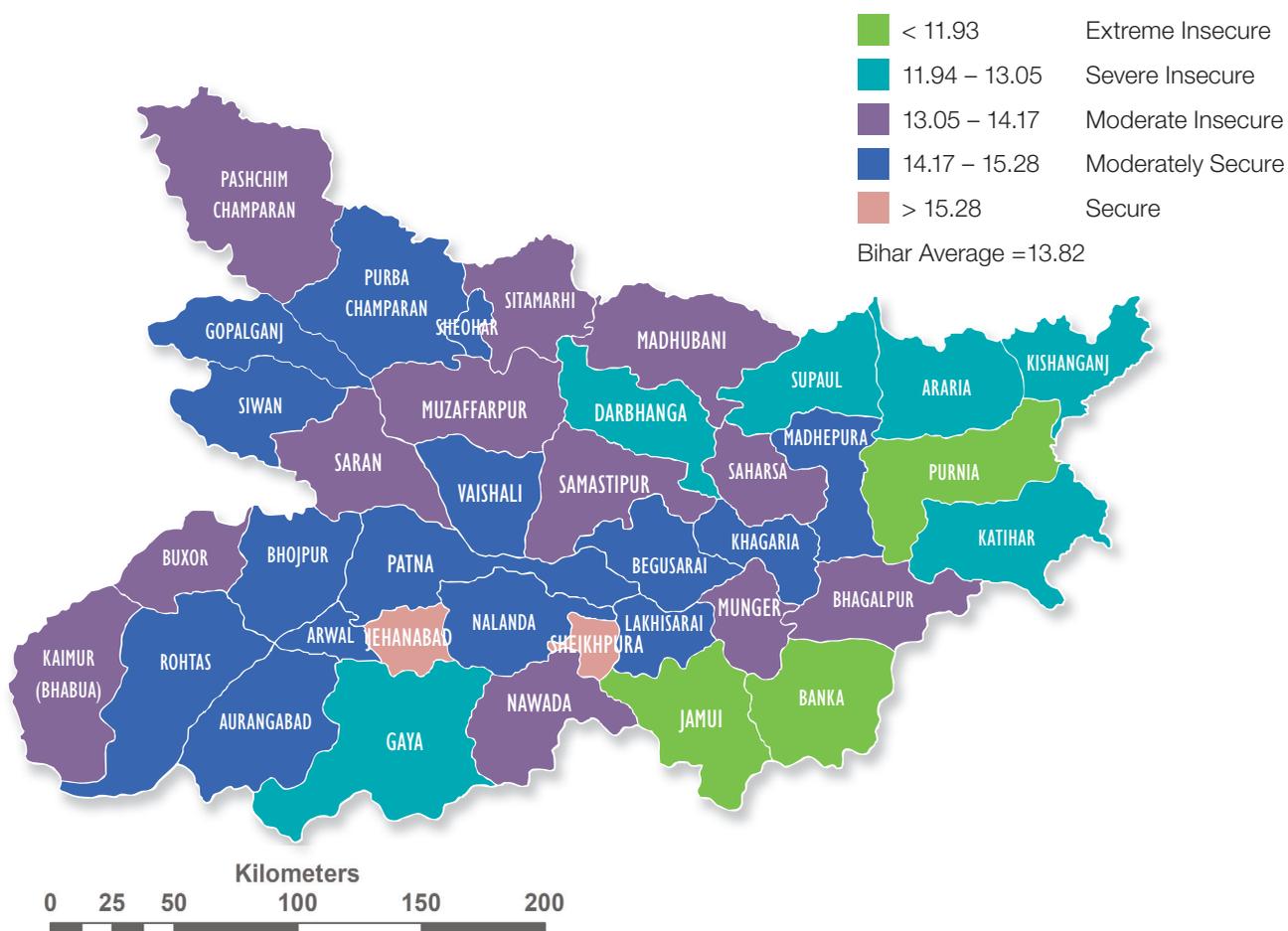
Table 5.8: **Revised Over all Food Security Index (Mean Standarization method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderate secure		Secure	
Jamui	10.824	Gaya	12.335	Madhubani	13.328	Madhepura	14.193	Sheikhpura	15.700
Banka	11.499	Araria	12.366	Saharsa	13.471	Purba Champaran	14.235	Jehanabad	16.400
Purnia	11.892	Katihar	12.464	Pashchim Champaran	13.873	Nalanda	14.470		
		Supaul	12.629	Buxar	13.893	Aurangabad	14.666		
		Kishanganj	12.632	Sitamarhi	13.969	Gopalganj	14.765		

Extreme insecure		Severe insecure		Moderate insecure		Moderate secure		Secure	
		Darbhanga	12.906	Nawada	14.036	Siwan	14.885		
				Samastipur	14.049	Begusarai	14.951		
				Munger	14.095	Vaishali	15.012		
				Kaimur (Bhabua)	14.123	Patna	15.027		
				Muzaffarpur	14.125	Khagaria	15.038		
				Bhagalpur	14.143	Arwal	15.094		
				Saran	14.145	Bhojpur	15.124		
						Rohtas	15.210		
						Sheohar	15.215		
						Lakhisarai	15.216		

Table 5.9: Revised Over all Food Security Index (Range Equalization method)

Extreme insecure		Severe insecure		Moderate insecure		Moderate secure		Secure	
Purnia	0.327	Gaya	0.402	Sitamarhi	0.478	Kaimur (Bhabua)	0.541	Bhojpur	0.615
Jamui	0.343	Supaul	0.432	Saharsa	0.482	Bhagalpur	0.550	Siwan	0.620
Banka	0.364	Pashchim Champaran	0.451	Purba Champaran	0.482	Munger	0.551	Arwal	0.624
Araria	0.375	Kishanganj	0.452	Madhepura	0.522	Nalanda	0.554	Vaishali	0.639
Katihar	0.395	Darbhanga	0.459	Sheohar	0.526	Muzaffarpur	0.556	Rohtas	0.648
				Madhubani	0.527	Gopalganj	0.562	Patna	0.654
				Nawada	0.530	Buxar	0.564	Jehanabad	0.678
				Samastipur	0.531	Aurangabad	0.566		
						Saran	0.571		
						Khagaria	0.582		
						Sheikhpura	0.590		
						Begusarai	0.600		
						Lakhisarai	0.601		

Map 5.4b: Revised Food Security Index (Range Equalization Method)

< 0.397	Extreme Insecure
0.398 – 0.467	Severe Insecure
0.468 – 0.538	Moderate Insecure
0.539 – 0.608	Moderately Secure
> 0.608	Secure

Bihar Average = 0.532
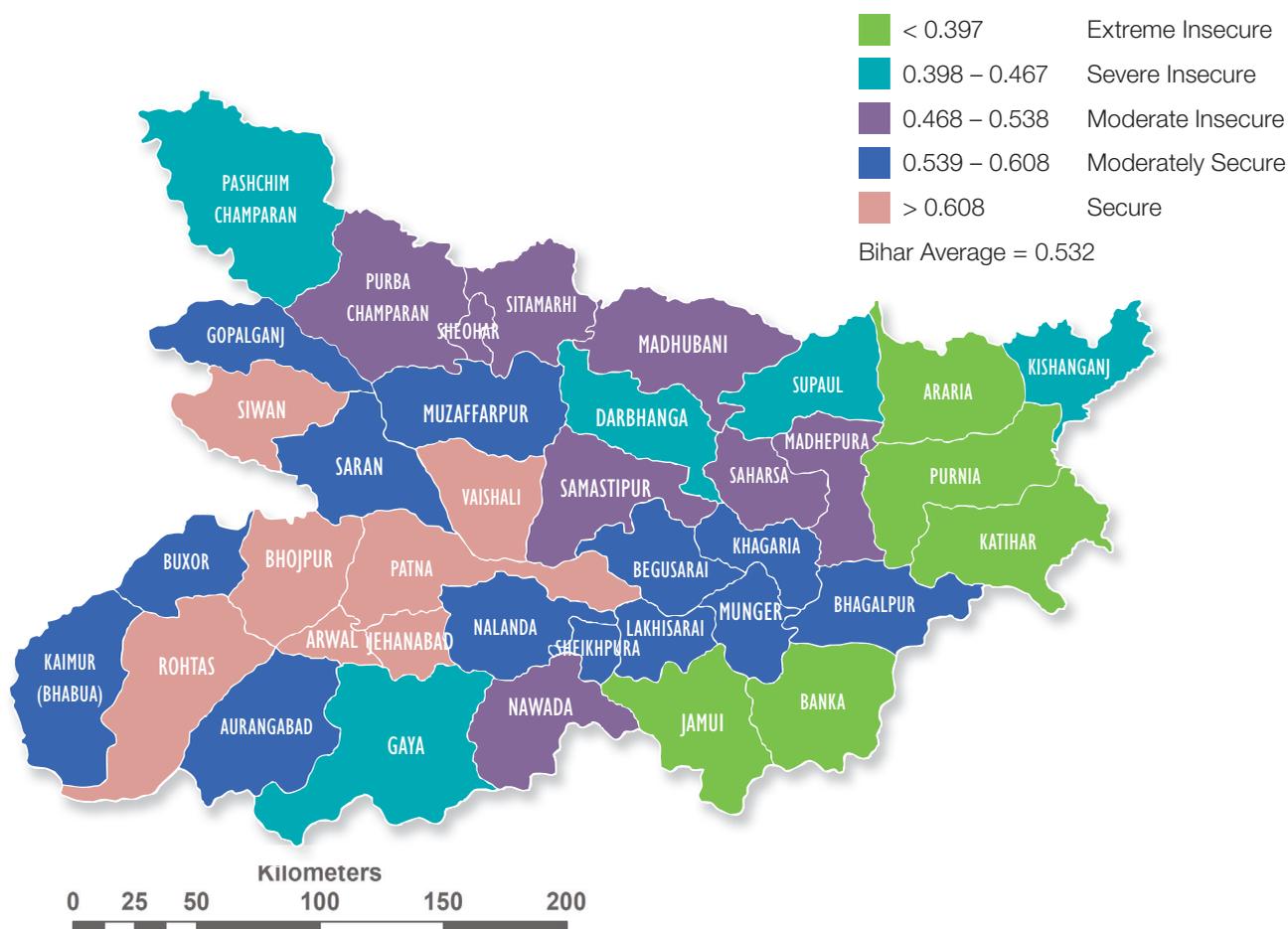
Further, the Principal Component Analysis Method, a very used technique to analyse food security, was also used to construct the overall food security index. PCA is used to compute the Factor Loading and weights of these indicators. The objective of Principal Component analysis is to reduce the dimensionality (number of indicators) of the data set alongwith retaining most of the original variability in the data. We find that the first Principal Component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.

Table 5.10a: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.659
Bartlett's Test of Sphericity	Approx. Chi-Square	240.799
	df	91
	Sig.	.000

The KMO statistic varies between 0 to 1. In our findings, the KMO is 0.659 which shows the pattern of correlation is compact and that the factor analysis gives a distinct and reliable factor (Table 5.10a). According to Hutcheson Sofro (1999) if the KMO value lies between 0.7 to 0.8, then the result is good. The Bartlett's measure tests the null hypothesis that the original correlation matrix is an identity matrix. For factor analysis to work we need some relationship between the variables and if R-matrix is an identity matrix than all the correlation coefficient would be zero. Our results shows that the R matrix is not an identity matrix therefore there does exits some relationship between the variables. The results also show that the Bartlett's test is highly significant as the significance level $P<0.001$ and therefore factor analysis is appropriate.

In the PCA. the "factor loading" of a variable indicates the relative importance of that variable in the food security index. We find that the female literacy rate, the ratio of working age population, prevalence of diarrhoea in the last 2 weeks preceding the survey, access to toilet facility, the percentage of other than agricultural labourers to all labourers and the proportion of net irrigated area to net sown area emerge as the important policy variables for the overall foodsecurity of the state.

Table 5.10b: Factor Loadingsfrom PCA

Proportion of net irrigated area to net sown area	0.5349
Per capita value of agricultural output	0.0155
Percentage of villages having access to town within 10 km	0.2162
Percentage Other than Agricultural Labourers to All Labourers;	0.7541
Percentage Non SC&ST Population;	-0.4982
Ratio of working age Population (Rural)	0.7349
Monthly per capita consumption expenditure (inequality adjusted)	-0.325
Rural casual wage rate	-0.245
Percentage of inhabited villages having access to paved roads.	-0.3009
Percentage of households having access to safe drinking water.	-0.4679
Percentage of inhabited villages having access to Primary health centre in Rural Areas within 5 km range	-0.4739
Female literacy rate (7+) (Rural)	0.7705
Prevalence of diarrhoea (reported) in the last 2 weeks preceding the survey (%)	0.5254
Toilet facility	0.5145

| Table 5.11: | Overall Food Security Index based on the Principal Component Analysis Method (PCA) | | | | | | | | |

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Jamui	0.750	Supaul	0.857	Madhepura	0.966	Kaimur (Bhabua)	1.055	Sheikhpura	1.137
Purnia	0.785	Madhubani	0.907	Purba Champaran	0.970	Gopalganj	1.071	Rohtas	1.147
Banka	0.802	Darbhanga	0.912	Pashchim Champaran	0.977	Siwan	1.073	Jehanabad	1.232
Kishanganj	0.825	Gaya	0.924	Sitamarhi	0.990	Begusarai	1.077		
Araria	0.829	Saharsa	0.934	Bhagalpur	0.992	Nalanda	1.079		
Katihar	0.841			Samastipur	1.007	Khagaria	1.080		
				Buxar	1.014	Sheohar	1.081		
				Nawada	1.014	Bhojpur	1.084		
				Munger	1.015	Patna	1.086		
				Muzaffarpur	1.022	Vaishali	1.100		
				Saran	1.023	Lakhisarai	1.110		
						Arwal	1.113		

Table 5.11 identifies the status of the districts in terms of the food security index on the basis of PCA method. There are five districts which are extremely food insecure viz., Jamui, Banka, Purnia, Kishanganj, Araria and Katihar and another five districts that are severely food insecure viz., Supaul, Madhubani, Dharbhanga, Gaya and Saharsa. These districts need urgent attention in terms of improving the food security input indicators. On the other hand, the most food secure districts from this method emerge as Sheikhpura, Rohtas and Jehanabad.

5.6 The Outcome index ■

With an understanding that food intake is the basic, though not the only factor that affects nutritional status of individuals, the outcome of food security can be taken to be the nutritional status of the individual. In developing countries, the rural population, particularly children, is vulnerable to malnutrition because of low dietary intakes, lack of appropriate care and inequitable distribution of food within the household. For the outcome indicators we have considered four important variables:

1. Children under 5 years who are underweight (weight-for-age) (%)

2. Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)

3. Children age 6-59 months who are anaemic (<11.0 g/dl) (%)

4. Micronutrient intakes (percentage of household not satisfying recommended calorie, protein and fat all three)

Underweight (weight-for-age)

Children who are more than two standard deviations below the reference median on the index of weight-for-age are considered to be 'underweight'. We have opted for the proportion of underweight children as the indicator for capturing malnutrition among children. The primary reason being that weight-for-age is a composite measure that takes into account both chronic and acute under-nutrition.

Body Mass Index

Research studies show a clear link between low BMI and low dietary intakes. Hence low BMI can be taken as an indicator of food insecurity (Ramachandran et. al, 2013). Singh et al (2014) have found that among the severely food insecure households, 27 percent of married women had BMIs below 18.5 kg/m2 compared to only 13 percent of women from food secure households. Also, women from severely food insecure households were 1.50 (95 percent CI, 1.17 to 1.92) times as likely as women from food secure households to have a BMI below 18.5 kg/m2.

Anaemia

The prevalence of anaemia is closely linked to food insecurity that households face. It is also reported to be the most prevalent nutritional deficiency that affects pregnancy and could be a threat to the life of both mother and fetus (Oslon 2010). Household food insecurity has a depressing impact on food consumption levels and eventually impacts an individual's health (Miller et al., 2009). The probability of iron deficiency leading to anaemia would be lesser when the households are in better living conditions (Zang et al., 2008). The study found that women who reported food insecurity were about 1.6 times more likely to suffer from anaemia compared to their food secure counterparts. The relation between food security and anaemia is more pronounced among women in the reproductive age

and especially for pregnant women (School, 2005). A study in Bangladesh among women found that apart from the high burden of anaemia the women under study also suffered from under-nurtition (Ahmed et.al. 2012). Here for the outcome indicator we have considered anaemia of women in the 15-49age group.

Micronutrient intakes

The problems of poor nutrition and food insecurity are intertwined. Chronic malnutrition among Indian children is low in India compared to other developed countries. The proportions of children stunted, wasted or underweight though is very high in India, particularly in Bihar. These poor nutritional outcomes are closely linked to food security in India. A large part theof Indian population cannot meet the basic calorie, protein and fat requirement. A large proportion of the population consumes a diet that lacks adequate dietary diversity, thus affecting their micro- nutrient intakes. Moreover, the problem of food insecurity gets compounded in the lean seasons where there is no agricultural production (Sibhatu, 2017).

Here the fourth variable used in the outcome index is the proportion of population not fulfilling the recommended dietary requirement of 2110 calorie, 57.5 proteins and 7.5 fats. Using data from the NSS 68th Consumption Expenditure Survey (2011-12) we have compiled information on households whose members' do not fulfil the minimum calorie requirement.

As may be observed from Table 5.12 and Map 5.7a, in terms of the outcome index, the secure category contains 5 districts, followed by 12 in the moderately secure category, 11 in the moderately insecure category, 7 in the severely insecure category, and 3 in the extremely insecure category. The two most food insecure districts were Sheikhpura and Purnia. Hence these districts need targeted policies to improve the outcomes of food security. Table 5.13 and Map5.7b identify the secure and insecure districts in terms of the range equalization method for the output index.

Map 5.6a: **Revised Outcome Index (Mean Standarization Method)**

Legend:
- > 5.47 — Extreme Insecure
- 5.19 – 5.47 — Severe Insecure
- 4.91 – 5.19 — Moderate Insecure
- 4.64 – 4.91 — Moderately Secure
- < 4.64 — Secure

Bihar Average = 5.01
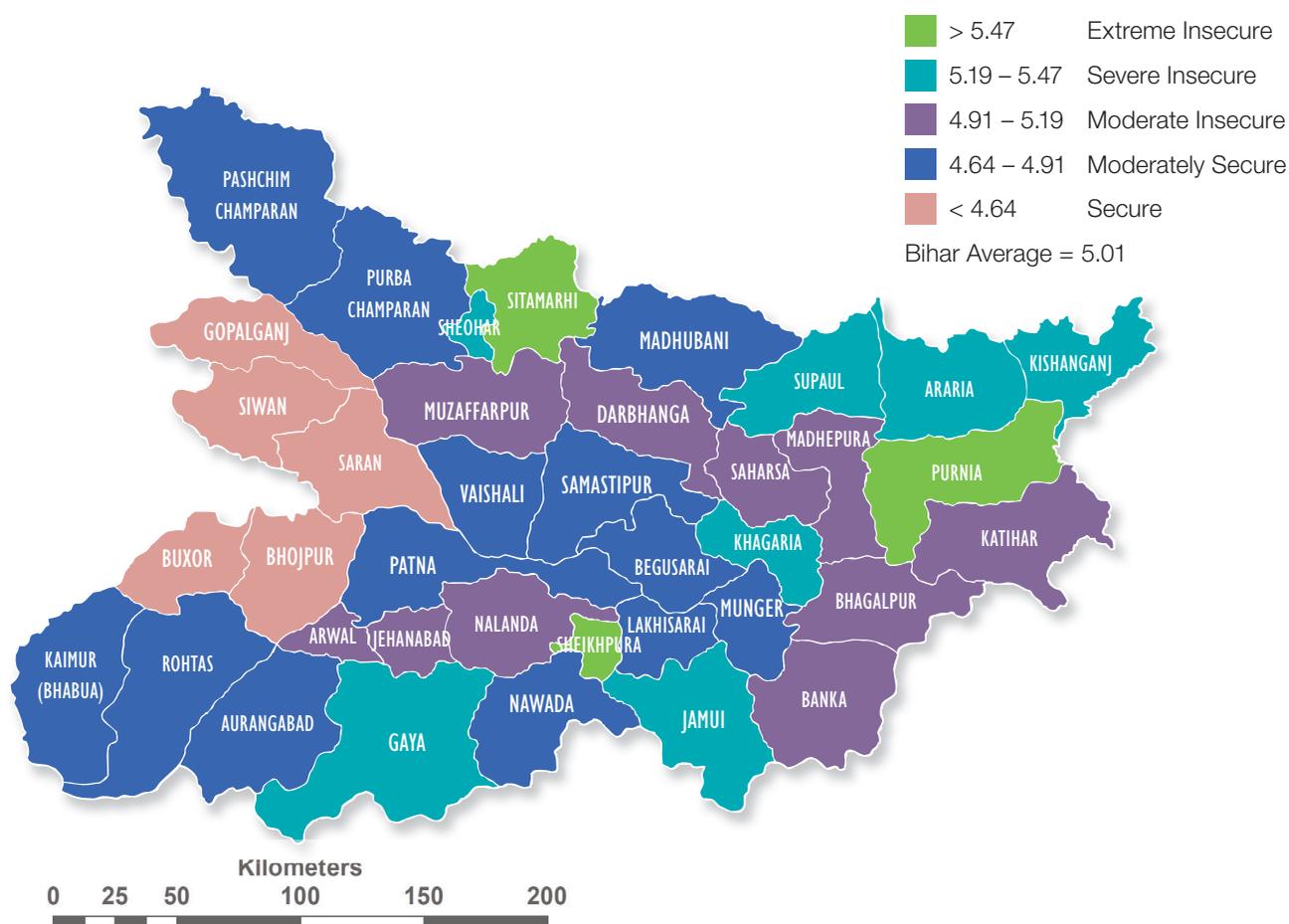
Table 5.12: **Revised Outcome Index (Mean Standarization method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Sheikhpura	5.473	Kishanganj	5.231	Pashchim Champaran	4.917	Patna	4.697	Gopalganj	4.366
Purnia	5.608	Gaya	5.234	Bhagalpur	4.966	Rohtas	4.739	Siwan	4.441
Sitamarhi	5.747	Khagaria	5.264	Banka	4.970	Kaimur (Bhabua)	4.740	Saran	4.528
		Sheohar	5.269	Jehanabad	5.033	Aurangabad	4.776	Buxar	4.581
		Jamui	5.341	Katihar	5.046	Vaishali	4.787	Bhojpur	4.611

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
		Supaul	5.375	Madhepura	5.076	Madhubani	4.816		
		Araria	5.440	Arwal	5.100	Nawada	4.828		
				Muzaffarpur	5.117	Purba Champaran	4.838		
				Darbhanga	5.140	Lakhisarai	4.883		
				Nalanda	5.148	Begusarai	4.887		
				Saharsa	5.176	Munger	4.902		
						Samastipur	4.907		

Map 5.6b: **Revised Outcome Index (Range Equalization Method)**

Legend:
- > 0.73 — Extreme Insecure
- 0.63 – 0.72 — Severe Insecure
- 0.52 – 0.62 — Moderate Insecure
- 0.42 – 0.51 — Moderately Secure
- < 0.41 — Secure

Bihar Average = 0.54
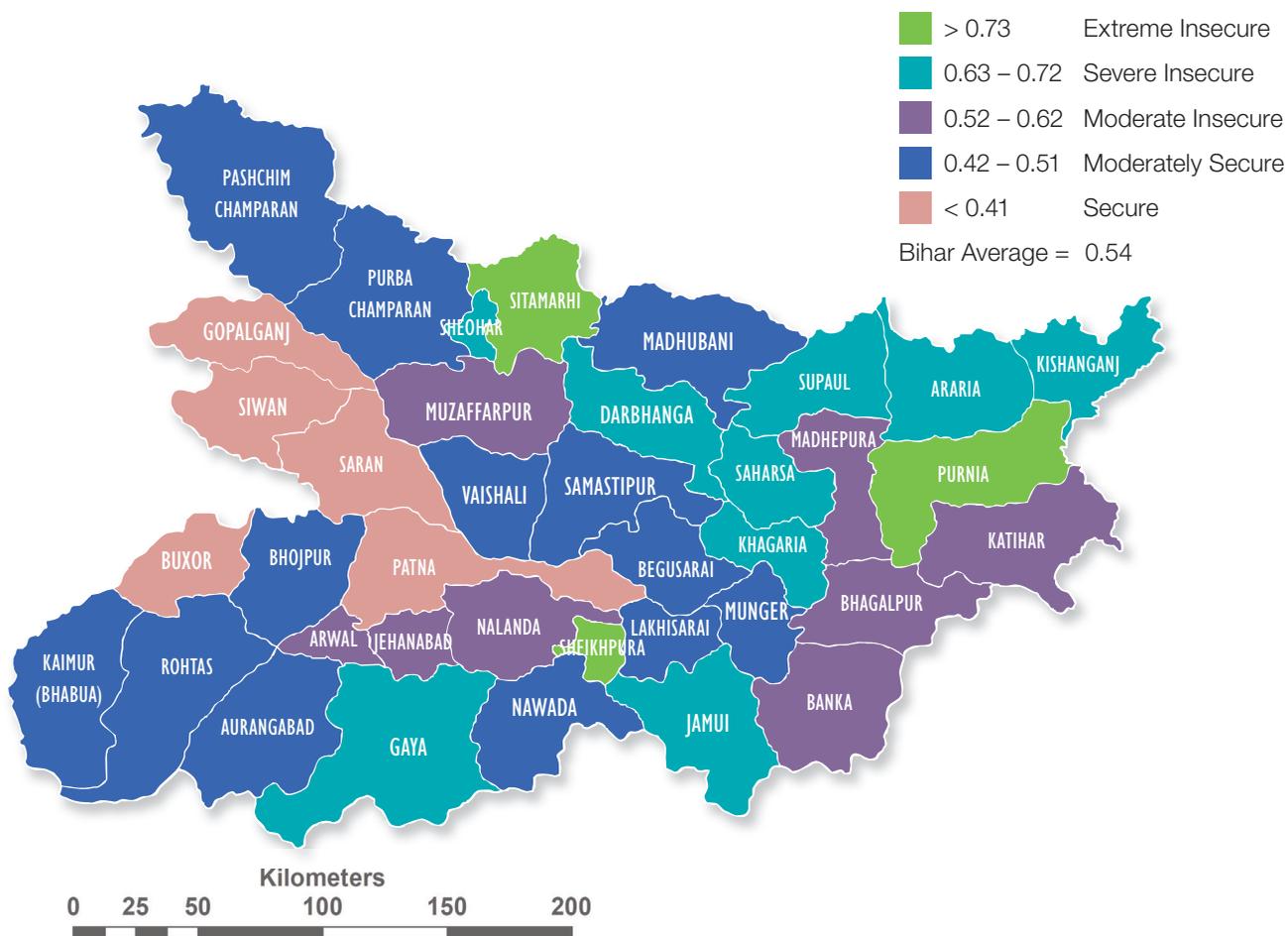
Table 5.13: **Revised Outcome Index (Range Equalization Method)**

Extreme insecure		Severe insecure		Moderate insecure		Moderately secure		Secure	
Sheikhpura	0.7454	Khagaria	0.6170	Madhepura	0.5306	Aurangabad	0.4245	Gopalganj	0.2987
Purnia	0.7724	Gaya	0.6174	Muzaffarpur	0.5471	Bhojpur	0.4254	Siwan	0.3230
Sitamarhi	0.8278	Darbhanga	0.6213	Katihar	0.5477	Kaimur (Bhabua)	0.4384	Saran	0.3513
		Saharsa	0.6218	Jehanabad	0.5583	Rohtas	0.4474	Buxar	0.3545
		Sheohar	0.6402	Bhagalpur	0.5702	Nawada	0.4566	Patna	0.3885
		Jamui	0.6579	Banka	0.5740	Madhubani	0.4655		
		Araria	0.7031	Nalanda	0.5766	Vaishali	0.4854		
		Supaul	0.7204	Arwal	0.5958	Purba Champaran	0.4983		
				Kishanganj	0.6158	Munger	0.5003		
						Begusarai	0.5019		
						Pashchim Champaran	0.5036		
						Lakhisarai	0.5046		
						Samastipur	0.5094		

5.7 SUMMING UP ■

In this chapter we have presented revised variables used in the food security atlas report and reconstructed a new food security index using the mean statndarization method and the prinicipal component analysis method. Based on the new index calculated using the mean standadrization method it is seen that the three extremely food insecure districts were Jamui, Banka and Purnia while another six districts were severely insure namely, Gaya, Katihar, Araria, Kishanganj, Dharbhanga, and Supaul. The PCA method also indicates that Jamui, Banka, Purnia, Kishanganj, Araria and Katihar were the most insecure districts while Supaul, Madhubani, Dharbhanga, Gaya and Saharsa were the severely insecure districts. These districts need urgent attention in terms of improving the food security input indicators. Based on the old variables that were identified in chapter 4, the mostly insecure districts were Jamui, Banka and Gaya while the severely insecure districts were Dharbhanga and Purnia. The analysis indicates that after revising our indicators the status of the districts remained almost the same. Hence the variables used for the analysis were robust.

APPENDIX

Table A5.1: New Indicators used to Analyse Food and Nutrition Security: Rural Bihar

Name of Variable	Ref. Year	Source
(a) Availability		
1. Per capita value of agricultural output	2012-13 to 2014-15	Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi
2. Proportion of net irrigated area to net sown area	2012-13	Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi
3. Percentage of village access to town within 10 km distance	2011	Village Directory, Census of India, 2011
(b) Access		
1. Percentage of agricultural labour to total workers	2011	Census of India 2011
2. Proportion of ST and SC population to total population	2011	Census of India 2011
3. Ratio of working age Population	2011	Census of India 2011
4. Monthly per capita consumption expenditure (inequality adjusted)	2011-12	68th NSS round 2011-12
5. Rural casual wage rate	2011-12	68th NSS round 2011-12
6. Percentage of inhabited villages having access to paved roads.	2011	Census of India 2011
(c) Utilization		
1. Percentage of households having access to safe drinking water.	2011	Census of India 2011
2. Percentage of inhabited villages having access to Primary health centre in Rural Areas within 5 km range	2011	Census of India 2011
3. Female literacy rate (7+) (Rural)	2011	Census of India 2011
4. Disease and health behaviour (100-Prevalence of diarrhoea (reported) in the last 2 weeks preceding the survey (%))	2015-16	NFHS 4, 2015-16
5. Percentage of household access to toilet	2011	Census of India, 2011

Name of Variable	Ref. Year	Source
Outcome indicator		
1. Children under 5 years who are underweight (weight-for-age) (%)	2015-16	NFHS 4, 2015-16
2. BMI among women	2015-16	NFHS 4, 2015-16
Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2) (%)	2015-16	NFHS 4, 2015-16
Children age 6-59 months who are anaemic (<11.0 g/dl) (%)	2015-16	NFHS 4, 2015-16
Micronutrient (percentage of household not satisfying recommended calorie, protein and fat all three)	2011-12	NSSO, 68 Round Consumption Expenditure, 2011-12

6

POLICY IMPLICATIONS

In the previous chapter we have identified districts that are food insecure and need policy interventions on a priority basis. Broadly, the measures needed to improve food availability must include improving irrigation and agricultural productivity, increases in farm incomes hrough better rural connectivity, improved access via policies that enhance rural wages leading in turn to increases in spending on food, land re-distribution and improvements in the status of women.

The central and state government have launched a number of schemes and programmes that are aimed at enhancing food security in the state. Some of them are recent and it is too early to see their impact, while some have been under implementation for longer. This section discusses the food security interventions in the state.

6.1 ENHANCING ABILITIES ■

To improve the food security of the state government of Bihar has taken number of initiatives:

6.1.1 Increasing Food Production: The National Food Security Mission, 2007

The dismal rate of growth in the agricultural sector in the country has been a cause for concern–the sector grew at a meagre rate of 1.8 per cent per annum during the 1990s. This has been coupled with rising international prices as well occasional wheat imports, bringing into question the food security of the country. With a view to increasing the rate of agricultural growth to 4 percent, the government launched the National

Food Security Mission (NFSM) in 2007 entirely funded by the Central Government. The programme specifically aims at increasing the production of crops such as rice, wheat, pulses and coarse cereals. The related ongoing schemes like the Integrated Cereal Development Programme (ICDP Rice/Wheat) and the Integrated Scheme on Pulses, Oilseeds and Maize (ISOPOM) would cease to operate in the identified districts once the relevant component of the NFSM comes into execution in the district.

The Mission will operate at multiple levels from the national level, to the state and district levels. At the grassroots level, the Panchayati Raj Institutions (PRIs) would play an active role and would be involved in the selection of beneficiaries, the identification of priority areas and local initiatives.

Two notable points about this Mission are: first, it aims at enhancing food production, in turn resulting in the increased availability of food crops. In the approach to food security followed by us in theis Report, food security of individuals comprises three dimensions, namely the availability, access and utilization (body-absorption) of food. No doubt, as argued by us earlier, while the availability of food is of prime importance, the access to food is almost equally important as well. Therefore, the Mission objective forms only one component of food security.

Second, the districts which are chosen for implementing the scheme are not based on the adequacy or inadequacy of food available in them, but on the basis of their production potential in the three specified crops. Efforts will be made to enhance farm productivity through the extension of improved technologies and enhancing the capacity of farmers

to use these technologies in these districts. This is essentially an outcome of the primary objective of the Mission, which is to raise the production of three specific food crops.

The districts which have been earmarked for enhancing production of wheat, rice, pulses and coarse cereals in Bihar are listed in Table 6.1. (The nine least food secure districts have been presented in **bold font**).

Table 6.1:   The Districts under the National Food Security Mission in Bihar

Wheat	Rice	Pulses	Coarse Cereals
1. **Araria**	1. **Araria**	1. **Araria**	1. Begusarai
2. Aurangabad	2. **Darbhanga**	2. Arval	2. Bhagalpur
3. Bhojpur	3. Champaran (East)	3. Aurangabad	3. Champaran (east)
4. **Gaya**	4. Gopal ganj	4. **Banka**	4. **Katihar**
5. Gopalganj	5. Katihar	5. Begusarai	5. Khagadia
6. Nalanda	6. **Kishanganj**	6. Bhagalpur	6. Madhepura
7. Patna	7. Madhepura	7. Bhojpur	7. **Purnia**
8. Sitamarhi	8. Madhubani	8. Buxar	8. Saharsa
9. Siwan	9. Muzaffarpur	9. **Darbhanga**	9. Samastipur
10. Supaul	10. **Purnia**	10. Champaran (east)	10. Saran
	11. Saharsa	11. **Gaya**	11. Vaishali
	12. Samastipu	12. Gopal Ganj	
	13. Sitamarhi	13. Jahanabad	
	14. Siwan	14. **Jamui**	
	15. **Supaul**	15. Kaimur	
		16. **Katihar**	
		17. Khagadia	
		18. Kishanganj	
		19. Lakhisarai	
		20. Madhepura	
		21. Madhubani	
		22. Monghyr	
		23. Muzaffarpur	
		24. Nalanda	
		25. Nawada	
		26. Patna	
		27. **Purnia**	

Wheat	Rice	Pulses	Coarse Cereals
		28. Rohtas	
		29. Saharsa	
		30. Samastipur	
		31. Saran	
		32. Seikhpura	
		33. Seohar	
		34. Sitamarhi	
		35. Siwan	
		36. **Saupal**	
		37. Vaishali	
		38. **Champaran (West)**	
Total districts: 10	Total districts: 15	Total districts: 38	Total districts: 11

Note: The districts in bold font are the "Special Category Districts".
Source: National Food Security Mission (2016-17)

It may be observed that in the case of the ten specified NFSM-wheat districts, two belong to the least food secure districts. In case of the fifteen NFSM-rice districts, 5 are from the least food secure category while in the case of pulses, the number of such districts is 9 out of 38. In the case of coarse cereals, the number of least secure districts is 2 out of 11. This confirms that whereas the Mission would be helpful in raising food security in the state, it would serve the cause of raising food security in the most food insecure distitcs only to a limited extent.

6.1.2   Rural Road Connectivity

Rural road connectivity is a key component of rural development as it promotes access to economic and social services and thereby generates increased agricultural incomes and productive employment opportunities. As a consequence of its myriad economic and social benefits, road connectivity is also a key ingredient in ensuring sustainable poverty reduction. It is well known that even where connectivity has been provided, the roads constructed are of such quality (due to poor construction or maintenance) that they cannot always be categorised as all- weather roads. With a view to redressing the situation, Government launched the Pradhan Mantri Gram Sadak Yojana on 25th December, 2000 to provide all-weather access to unconnected habitations.The Pradhan Mantri Gram Sadak Yojana (PMGSY) is a 100 per cent centrally sponsored scheme wherein 50 per cent of the cess on high speed diesel (HSD) is earmarked for this programme. The primary objective of the PMGSY is to provide connectivity by way of all-weather roads (with necessary culverts and cross-drainage structures, which are operable throughout the year).

The PMGSY represents a rare public programme that qualifies as a success in terms of achieving both the equity and efficiency objectives. The latter is measurable by way of connectivity targets being reasonably met, as well as the quality of assets created. The roads built under the PMGSY are required to meet technical specifications and geometric design standards for rural roads. Table 6.2 gives the progress of the PMGSY in Bihar for the period 2015-16, 2016-17 and 2017-18.

The total expenditure on the Pradhan Mantri Gram Sadak Yojana (PMGSY) in India was Rs. 16538 crores

in the year 2014-15. The expenditure incurred under the PMGSY in Bihar in 2014-15 accounted for 13.65% of the total expenditure under the scheme in India which has increased to 21.52 percent in 2017-18. (Table 6.3).

Table 6.2: **Progress of the PMGSY in Bihar**

	Target length	Completed length	Targeted Habitations	Connected Habitations
2017-18	5,600	5,226.69	3,800	3,418
2016-17	6,540	6,601.62	3920	4499
2015-16	4000	3,445.51	2,311	2,567

Source: http://omms.nic.in/

Table 6.3: **Expenditure Incurred Under the PMGSY (in crores):**

Year	Bihar	All India
2012-13	1,992 (23.7%)	8,387
2013-14	1,845 (14.08%)	13,095
2014-15	2,259 (13.65%)	16,538
2015-16	1776.87 (11.25%)	15785.36
2016-17	2830.38 (21.52%)	13152.68

Source: http://164.100.47.190/loksabhaquestions/annex/14/AS97.pdf

6.2 Improving Access to Food ■

The results from our food security study in this paper show that improving access comes about through improvements on several fronts. These include:

- Enhancing access to food provided in government schemes
- Improving wages, incomes and employment opportunities
- Improving the position of the most marginal sections including women, and the SC/ST communities

6.2.1 The Public Distribution System (PDS)

The most important single anti-poverty programme in Bihar is the Public Distribution System (PDS). This programme has changed over time, but presently it provides subsidised foodgrains to the poor (the targeted PDS) while the rest of the population pays close to the economic cost of procuring the grain. Bihar is one of those states where the functioning of the PDS has been extremely bad with foodgrains hardly reaching the beneficiaries with low coverage of target groups, leakages and low off take of foodgrains from the central pool. In order to make functioning efficient and check the leakages, the Government of Bihar made some important policy and operational changes in the programme in 2007 under which the poor (BPL) and extremely poor (AAY) households were given food coupons specifying the quantity of their entitlements. The AAY households are entitled to 21 kg of rice and 14 kg of wheat per month and the BPL households to 15 kg of rice and 10 kg of wheat. Under this system, the PDS dealer collects the coupons

from the beneficiaries about their entitlements and the dealers get the food grains quota only on the basis of the coupons used by consumers. The BPL households do not get anywhere near their theoretical allowance. The AAY households do get distinctly more, almost 18 kg of rice and 13 kg of wheat (Table 6.4). It is also important to reflect that wrong identification of the BPL households is also one of the important reasons for higher food insecurity in the state. The identification problem leads to exclusion and inclusion errors. In Table 6.5 and Table 6.6, an attempt is made to to find the exclusion and inclusion errors by social category and by different

regions in Bihar for the year 2011-12. It is seen that 55.82 percent of the households although above the poverty line (APL) in terms of poverty estimation by monthly per capita consumption expenditures, have Antyodaya+BPL card. On the otherhand 22.17 percent of the households are identified as BPL in terms of the MPCE but they do not have any card and are categoriesed under the OTHER category of card holders. Exclusion errors are more problematic than inclusion errors. Inclusion error is higher for SC households compared to ST, OBC and other. The exclusion error is also high among the SC households compared to the other social groups (Table 6.5).

Table 6.4: Purchases from PDS shop last month by Ration Card Type

Household category	Rice (kg)	Wheat (kg)
AAY	17.81	12.60
BPL	12.82	8.75
APL	13.61	9.02
Total	13.25	9.02

Source: IHD Bihar Survey 2016

Table 6.5: Exclusion and Inclusion Errors by Social Category, 2011-12

	ST		SC		OBC		Other		Total	
Card holder	BPL	APL	BPL	APL	BPL	APL	BPL	APL	BPL	APL
Antodaya	90.15	9.85	51.45	48.55	51.14	48.86	6.75	93.25	49.87	50.13
BPL	49.49	50.51	49.13	50.87	33.48	66.52	25.14	74.86	39.31	60.69
Antyodaya+BPL	86.61	62.03	89.34	81.80	73.85	50.91	46.04	28.53	73.96	55.82
Other	25.34	74.66	34.40	65.60	16.45	83.55	12.52	87.48	22.17	77.83

Source: NSSO 68th round

Table (6.6) explains the region wise percentage of households excluded and included from the benefits of the TPDS programme. In the northern region of Bihar, 13 percent of the households have been excluded from the BPL+Antodaya card holding where as in central Bihar it is almost 22 percent. Thus, exclusion error is relatively high in central Bihar compared to Northern

Bihar. Further, in the northern region of Bihar, 66.2 percent households who although are above the poverty line, but have BPL+Antodaya cards. On the other hand, in cenral Bihar, 49 percent of the households wwere above the poverty line but still had BPL+Antodaya cards. So it is seen that inclusion errors are much higher in the northern region than in the central region.

Table 6.6: **Exclusion and inclusion error by NSS Region, 2011-12**

			BPL	APL
Northern	Champaran(W), Champaran(E), Sheohar Sitamarhi Madhubani Supaul Araria Kishanganj Purnia Katihar Madhepura Saharsa Darbhanga Muzaffarpur Gopalganj Siwan Saran Vaishali Samastipur Begusarai Khagaria	Antyodaya	44.1	55.9
		BPL	32.8	67.2
		BPL+Antodaya	33.8	66.2
		others	13.0	87.0
		Total	26.4	73.6
Central	Bhagalpur Banka Munger Lakhisarai Sheikhpura Nalanda Patna Bhojpur Buxar Kaimur (Bhabua) Rohtas Jehanabad Aurangabad Gaya Nawada Jamui Arwal	Antyodaya	61.7	38.3
		BPL	49.7	50.3
		BPL+Antodaya	51.0	49.0
		others	21.4	78.6
		Total	35.4	64.6

Source: NSSO68th round

6.2.2 Mid Day Meals (MDMs)

With a view to enhance enrolments and retention along with the nutritional levels of the children, MDM schemes were launched in August 1995. In IHD Bihar survey 2016 respondents were asked about the functioning of the MDM schemes. In Bihar, it was found that 88 percent of the school going children received MDM benefits. Household's perceptions on the performance of the MDM schemes shows that 61

percent of the beneficiaries found the food quality as average and a little over one third of the beneficiaries reported thefood uality to be good. Overall, it is clear from the survey that the beneficiaries were satisfied with the performance of MDMs. More than half the parents reported that the food their children get from the MDMs accounts for more than half of the food child consume. Another 40 percent reported that it accounted only for the light meals of the child (Figure 6.1). It was emphasized that the school and

Figure 6.1: **Account of MDM Food Account for Children's Food Intake/Nutrition**
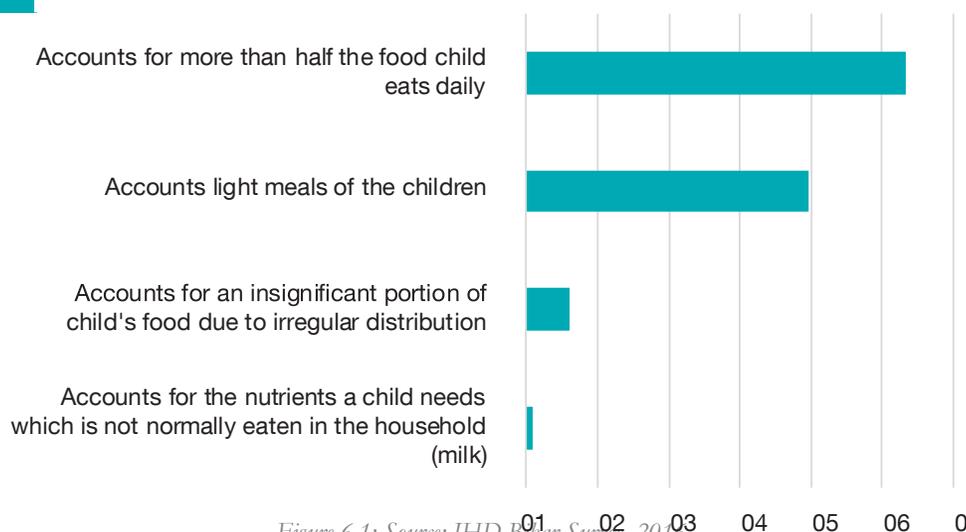
Figure 6.1: Source: IHD Bihar Survey, 2016

village committees need to be responsible to check the quality and quantity of the food before it is supplied to the school. Teachers are responsible for monitoring the quality of food before it is served to the children. Sonme parents expressed concern that food is not hygienic specially the way it is cooked which needs to be urgently addressed.

The National Food Security Act, 2013

The Central Government introduced the National Food Security Act, 2013, on 10th September, 2013, with the objective to provide food and nutritional security, by ensuring access to adequate quantity and quality food at affordable prices to people to live a life with dignity. The Act provides for coverage of upto 75 percent of the rural population and upto 50 percent of the urban population for receiving subsidized foodgrains under the Targeted Public Distribution System (TPDS), thus covering about two-thirds of the population. The eligible persons receive 5 Kgs of foodgrains per person per month at subsidised prices of Rs. 3/2/1 per kg for rice/wheat/coarse grains.

Table 6.7: **Coverage of the National Food Security Act, 2013**

	India	Bihar
Rural	75%	86%
Urban	50%	75%

source: author'scalculation based om BSSO 68th round

Table 6.7 shows the areas covered under the National Food Security Act for India and Bihar. In India 75 percent of the rural areas are availing the benefits of the NFSA, whereas 50 percent of the urban areas are covered under the Act. Whereas in Bihar, 86 percent of the rural areas have been benefitting from the NFSA and 75 percent of the urban areas are covered under this Act.

The "Bihar National Food Security Act (NFSA) Survey", was carried out to assessthe ground realities about the PDS a year after the Bihar government implemented the NFSA on February 1, 2014. The survey was conducted in the rural areas of the four districtsof Banka, Gaya, Purnia and Sitamarhi and covered 1,000 households, selected randomly from the socio-economic and caste census (SEEC) list of 48 randomly selected villages.Under the NFSA, a new list of PDS beneficiaries has been generated on the basis of the SECC data. This list is more inclusive, logical, reliable and transparent than the earlier 'BPL list'. Of the 1,000 sample households, 89 percent are eligible for PDS entitlements under the NFSA, based on their SECC data. Of those who are eligible, 84 percent have a valid ration card, either a new 'priority card' or an 'Antyodaya card'. Thus, Bihar has today a more reliable list of eligible households for entitlement of PDS. The survey revealed that the leakages in the PDS have been significantly reduced. Households with a new ration card ('priority households' under the NFSA) received 76 percent of their PDS entitlements in November 2014, the month preceding the survey, with only 3.8 kgs of wheat or rice each being distributed as against the entitlement of 5 kgs.

6.2.3 Increasing Wages and Employment

The Mahatma Gandhi National Rural Employment Guarantee Act (henceforth MGNREGA), is one of the important poverty alleviation programmes being undertaken in the country. This universal wage employment programme is being implemented in Bihar since 2006, as in other parts of India. While only a limited number of districts in other states were selected for its implementation in the initial phase, the Government of Bihar decided to implement

this programme in all the districts and hence the programme has been universal in Bihar for the last five years. The information available from the IHD survey shows that the number of members of the households participating in any work under the MGNREGA in the last 12 months was highest in Rohtas (11.3 percent) and lowest in Gopalganj (1 percent). The average number of days worked was 18 days per year. The average wage received was Rs 157. Nine out of 23 workers said that the wages were paid regularly while the rest 14 said that the wages were not paid regularly. 70 percent of the total number of NREGA workers said that they mostly used the wage for the purchase and consumption of food items, 13 percent was devoted

to 'non-food consumption' and, 'savings for difficult times' and 4 percent devoted the NREGA wage for other expenses. It was also found that the reason for not participating in the MGNREGA work was mainly due to the fact that they did not have job cards (73 percent) and the wage rates lower than the market rate (6 percent) (IHD survey 2016). The employment generated for SCs through this Programme was 28 percent in Bihar compared to 22.41 percent in India. However employement creation for STs was very low in Bihar at 1.62 percent vis-a-vis for the country at16.96 percen). In the case of women also, the proportion was very low in Bihar as compared to the all- India figure (37.32 per cent versus 54.88 per cent) (Table 6.8).

Table 6.8:	Employment Generated During The financial Year 2014-2015	
	Bihar	**All India**
Employment provided to households (in lakhs)	10.342	413.716
Total person days (in lakhs)		
Total	351.97	16618.5
SC	99.62 (28.20%)	3723.52 (22.41%)
ST	5.69 (1.62%)	2819.29 (16.96%)
Others	246.65 (70.08%)	10075.68 (60.63%)
Women	131.35 (37.32%)	9120.40 (54.88%)

Source: MGNREGA, Government of India

6.2.4   Improving Gender Relations

Female literacy in rural areas is the most significant factor determining food security of the rural population. The rural female literacy is rather low in Bihar. It is imperative that girls' literacy be prioritized and that all barriers to their access to education be effectively tackled, taking care to see that girls from the poorest and most marginalized communities get priority access to education. Historically, other than in China, land reforms have excluded women. But in some second-generation land reform movements in India (e.g. the Bodh Gaya movement of the 1980s) women raised the demand for land to be allotted in their names. "We had

tongues but could not speak; we had feet but could not walk. Now that we have land, we have the strength to speak and walk" (Poor peasant women of Bodh Gaya, 1987); and, "We were there in harvesting the fields. We were there in carrying ploughs and snatching arms from the zamindar'sgoondas.

6.2.5   Agricultural Labourers

Agricultural labourers comprise an important category of the food insecure populace in Bihar of which a high proportion can be expected to be the dalits. Agricultural wages and the number of days of employment can be influenced by a number of factors including transfer of

land and resources to the landless and creation of other avenues of employment. The object of distributing land to the landless is not one of creating "viable" farms, but of enabling a reduction of food insecurity among the landless. In the current scenario where there is a lot of migration from the countryside, there could be scope for a market-mediated land reform programme. The National Commission on Farmers, 2004 points out that land reform is the first task for agrarian renewal. The issues in the currently needed round of land reforms are not the same as in the earlier rounds of the 1950s and 1960s. The abolition of intermediary tenures is not any more an issue. What is important is: a) security of tenancy; b) redistribution of ceiling surplus land to the landless; and c) land rights of women. The last two are directly important for food security. One can also include the reduction of land ceilings in order to restrict ownership to the size of a family farm.

At the production level, the case for these kinds of land reform rests on three main propositions: that owner-operated family farms are in general more efficient in the use of land and other inputs than large farms that operate with supervised wage labour; that secure tenancy rights promote longer-term investments in enhancing productivity and conservation, compared to insecure rights; and that securing women's land rights too increases agricultural productivity. Land reform then qualifies as a productivity enhancing asset redistribution, something that is an important consideration in a globalised situation (Bowles and Gintis, 1998).

Redistribution to the landless is difficult to implement, and important in India, where the former untouchable castes (dalits) constitute a large proportion of the landless. It is well known that the dalits are concentrated among the agricultural labourers in most of the Indian states.

Traditionally in the caste system, the dalits have been excluded from the ownership of land. It is thus a major step in ending the age-old social exclusion of the dalits to gain ownership of land. This issue remains relevant for the dalits all over India.

The transfer of property rights to the landless and the land poor increases their bargaining power in the wage market. But the study from Andhra Pradesh (da Corta and Venkateshwarlu, 1997) points out that women agricultural labourers, whose families have got some wasteland, did not share in the improved bargaining position. The responsibility of women for household maintenance, and the diversion of men's incomes into liquor and other channels of personal consumption, left women with lower reservation wages than men and forced women to accept various onerous conditions of work, conditions that men refused to accept. This shows that it is not enough to increase the bargaining power of men in the name of the household. Specific attention has to be paid to increasing the bargaining power of women (especially as agricultural labourers) by allotting them individual land rights too.

The implementation of land reforms that would lead to the redistribution of land from large owners to the landless and marginal owners, as was done in China, South Korea and Taiwan, would go a long way in ensuring food security for the poor. Market assisted land reforms, that attempt land reallocation by 'voluntary' land market transactions, have been touted as an alternative to redistributive land reforms. However, 'voluntary' land markets cannot function without deliberate policy interventions that support the purchase of land by the poor households. Such interventions can be justified not only on equity grounds but also by the fact that generally small farms are more efficient than large farms.

Thus, one way of redistributing good quality land is through government purchases of designated lands and their subsequent transfer to the poor. Large landowners, anxious to migrate to urban locations with better education and more economic opportunities, may be keen to sell off their lands. Without adequate political mobilisation, the landless could be by-passed in yet another round of land reform. For the success of market-mediated land reforms, linkups between the landless in the various stages of identification, take-over and redistribution is the need of the hour.

Is it likely that there would be enough land available on a "willing seller, willing buyer" basis for the majority of the land-aspiring poor to gain access to it? As pointed out above, with larger landowners, and particularly their children, keen to migrate to urban areas that provide superior educational facilities and new economic opportunities, there could be land available for such market-mediated transfers. There is also pbserved a growth in fallow lands, not all of which may be for the above reasons though. The role of employment and food-based programmes could help in supporting those newly-acquiring lands to invest in labour for improving their lands. Employment schemes could be directed towards this end.

6.2.6   Micro Credit

Poverty plays as catalyst for the myriad issues faced by the poor. They are not able to access better health services, education and livelihood opportunities resulting in high MMR, IMR, malnutrition, migration, trafficking, etc.

Poverty is like a vicious cycle, one cannot move out of poverty unless external support is provided to break the cycle. Many of the people would like to start their business or expand their small business but without capital, they are not able to do it.

SHG-Bank Linkage (SBL) Approach

The SBL approach initiated by NABARD in 1992 had the objective of delivering financial services to the unreached poor to alleviate poverty. The SBL programme has emerged as the most popular and dominant model of microfinance in India. It involves the formation of Self Help Groups (SHGs). An SHG is a small homogenous affinity group of about 15 to 20 people who join together to address common issues. The group undertakes voluntary thrift activities on a regular basis and the pooled savings are used to give out interest-bearing loans among its group members. The formal beginning of the microfinance movement in India was initiated by the NABARD through its pilot project the 'SHG-Bank Linkage' programme in 1992 for linking 500 SHGs with banks.

The Health and Microfinance Alliance

In 2010, the Microcredit Summit Campaign and Freedom from Hunger joined forces to provide technical assistance to partner financial service providers in India to model and demonstrate what could be achieved on a global scale. A year later came the idea for a global alliance that would provide access to an international team of microfinance, health, and development practitioners, researchers, and policy makers working with microfinance organizations around the world to implement and test innovative approaches to address poverty. Currently, the Microcredit Summit Campaign and Freedom from Hunger are working with strategic partners to plan the launch of the Health and Microfinance Alliance. They would work with microfinance institutions (MFIs), non-governmental organizations (NGOs), networks, and government

Implementing Partners (Type Of Organization)	Program Components	Clients Reached (As of Sept 2015)
Nidan, Bihar SHPI	Education on "Plan for Better Health" and WASH modules Planning education around nutrition and health savings Linkage with the health sector for supply of deworming tablets in one block	103,000

Source: microcreditsummit.org

agencies. In India, self-help promoting institutions (SHPIs), are NGOs that serve self-help groups (SHGs).

Nav Bharat Jagriti Kendra (NBJK)

NBJK is one of the most renowned organisations of Bihar and Jharkhand working for the past 43 years at the grassroots level. The NBJK has been implementing micro credit programmes for the past twenty years in districts such as Hazaribag, Ranchi, Khunti, Ramgarh, Koderma, Pakur and Patna in Jharkhand and Bihar. The NBJK through its micro credit programme, provides small loans to those who want money for their business. The promotion of women Self Help Groups and their smooth functioning have made the NBJK a successful program.Micro credit provides easy and door step service to the beneficiaries. The SHG members have become more organized and their awareness levels is amazing. The NBJK works with 7,051 women in 7 districts of Jharkhand and Bihar. For men, the program facilitates JLGs (Joint Liability Groups). The Self Help Groups and the Joint Liability Groups have been formed at basicallt at the village level. Each group saves from Rs.50-Rs.100 per month and they use this saving for small internal lending among the group members. When a member of the group requires an amount more than the group's savings, the group reviews her/his requirement and submits an application to the NBJK. After reviewing the needed amount, the NBJK gives a small loan to the member through the group. Repayment is done by the person in easy instalments.

Through its micro credit activities, the NBJK has introduced a transparent and people friendly monetary system that reduces practices like land/asset mortgage and advance crop selling. Above all, it has reinstated the dignity of women giving them more stake in the home and outside.

6.3 Enhancing Utilization

Increasing the nutrient intake of the poor is not the end of the road for food security. It is also necessary that the human body is able to utilize the increased intake of nutrients. This closely depends on complementary measures, such as access to safe drinking water, hygiene and sanitation as well as proper access to health centres. These inputs would substantially reduce exposure to water-borne and gastro-intestinal diseases, such as diarrhoea and cholera, which often destroy the benefits of the food consumed. We discuss below measures/interventions that have been undertaken to improve the access to clean drinking water and to promote hygiene and sanitation for the populace.

6.3.1 The National Rural Drinking Water Program (NRDWP)

The National Rural Drinking Water Programme (NRDWP) was launched in 2009 under Bharat Nirman with the objective of ensuring the provisioning of safe and adequate drinking water through hand-pumps, piped water supply etc. to all rural areas, households and persons. This programme was launched after merging the three erstwhile programmes viz., the Accelerated Rural Water Supply Programme (ARWSP), the Swajaldhara and the National Rural Water Quality Monitoring & Surveillance. The aim and objective of the National Rural Drinking Water Programme (NRDWP) has been to provide every rural person with adequate safe water for drinking, cooking and other basic domestic needs on a sustainable basis, with a minimum water quality standard, which should be conveniently accessible at all times and in all situations. Under the NRDWP, the Ministry of drinking water and sanitation gives special emphasis to piped water supply in rural habitations. States are being asked to plan for the coverage of habitations with piped water supply through stand posts or household connections. In addition to the fact that this shall reduce the drudgery and time taken in the collection of water, it shall also tackle the problem of drinking water quality in the habitations affected with water issues. Inaddition, to accelerating the setting up of piped

water supply systems in rural areas in states where such coverage is low, the Ministry has proposed a project with the World Bank to support the same in parts of Assam, Bihar, Jharkhand and Uttar Pradesh which focuses on setting up piped water supply systems. The NRDWP has the following six components: coverage, sustainability, water uality, the Desert Development Programme (DDP) areas, Natural Calamity and support. The Objectives of this programme are to provide:

■ 40 liters per capita per day (lpcd) of safe drinking water for human beings.

■ One hand-pump or stand post for every 250 persons.

■ The water source should exist within the habitation/ within 1.6 km in the plains and within 100 mtrs elevation in hilly areas.

Table 6.9 depicts the physical coverage of the NRDWP in Bihar in 2014-15. It shows that the proportion of habitations covered in the year 2014-15 were 46.64 percent of the total habitations in Bihar. Whereas the SC and ST dominated habitations covered were 50.91 percent and 45.92 percent of the total habitations respectively.

Table 6.9:   **Habitations covered the under NRDWP**

	Total Habitations Covered	SC Dominated Habitations Covered	ST Dominated Habitations Covered	Other Habitations Covered
As on 01/04/2014	5023 (46.64%)	4602 (50.91%)	811 (45.92%)	44790 (46.25%)
During 2014-15	12236	880	133	11223

Source: NRDWP, Ministry of drinking water and sanitation, GOI

6.3.2   Nutritional Practices

Nutritional practices are an important aspect of food utilization besides the other two factors viz., improved water and health facilities. Nutritional practices refer to those inputs (for example, proteins or micro-nutrients) that are both available and accessible, but are not consumed in desirable quantities. It also refers to behavioural practices such as breastfeeding which are not practiced properly. As the widespread problem of under-nourishment in India shows, nutritional problems affect not just those with severe security, but also those with reasonable levels of food security, in terms of their consumption of inadequate food and insufficient nutrition. India has programmes of providing nutrition supplements to the populace through the Integrated Child Development Services (ICDS) programmewhich is a government initiative for all round development (health, nutrition and education) of children under 6 years of age. Its aim is to reduce infant mortality, child malnutrition and to provide pre-school education.

The Supplementary Nutrition Programme, 1975

The Supplementary Nutrition Programme is one of the six services provided under the Integrated Child Development Services (ICDS) Scheme which is primarily designed to bridge the gap between the Recommended Dietary Allowance (RDA) and the Average Daily Intake (ADI) of people. Supplementary Nutrition is given to the children (6 months – 6 years) and pregnant and lactating mothers under the ICDS Scheme. The provision of supplementary nutrition under ICDS Scheme prescribed for various categories of beneficiaries is as follows:

(i)   Children in the age group 6 months to 3 years: food supplements of 500 calories of energy and 12-15 gms of protein per child per day as

the Take Home Ration (THR) in the form of Micronutrient Fortified Foods and/or energy-dense food marked as 'ICDS Food Supplement'.

(ii) Children in the age group 3-6 years: Food supplements of 500 calories of energy and 12-15 gms of protein per child per day. Since a child of this age group is not capable of consuming of meal comprising 500 calories in one sitting, the guidelines prescribed for the provisioning of morning snacks in the form of milk/banana/seasonal fruits/Micronutrient Fortified Food etc. and a Hot Cooked Meal.

(iii) Severely underweight children: food supplements of 800 calories of energy and 20-25 gms of protein per child per day in the form of Micronutrient Fortified and/or energy dense food as Take Home Ration.

(iv) Pregnant Women and Lactating Mothers: food supplements of 600 calories of energy and 18-20 gms of proteins per day in the form of Micronutrient Fortified Food and/or energy dense food as Take Home Ration.

6.4 Priorities for the District-wise Executive Action ■

In this section, an attempt is made to work out the order of importance of each of the eleven selected Food Policies for each special category district. The guiding principle on the basis of which the district level priorities have been derived is that the lower the level of a district in terms of a policy variable (say, variable Xm) affecting food security as compared to other special category districts, the higher should be the importance of that district (say, Yn) among the nine prority districts from the point of view of that variable (Xm). We have used the relative gap measure to identify the highly prioritized districts. The relative magnitude of the gaps can be expressed either in terms of ratios or percentages, preferably the latter,

since it is of larger and more easily comparable figures. Hence, we have taken the ratios of the district figure and the state average to get the relative gap between the districts and the state. Once the relative size of the gaps has been estimated, the highest priority within a district (Ym) is given to the variable which shows the highest magnitude for the relative gap. On the basis of the methodology outlined above, Table 6.10 gives the order of priorities for the eleven policy variables in case of the seventeen priority districts of Bihar. Districts are arranged region-wise in two separate cells namely 'most prioritized districts' and 'second most prioritized districts'.

Table 6.10 suggests that among the Northern region of Bihar, Supaul is deficient in interms of the value of agricultural output and Madhepura is deficient in terms of net irrigated area. Katihar is deficient in terms of access to pucca roads and the access to safe drinking water. Paschim Champaran is deficient in three policy variables viz., non agricultural workers, non SC/ST population and the casual wage rate. Further, Purnia is also deficient in two policy variables viz., a high dependency ratio and the female literacy rate. Sitamarhi is lacking in terms of the monthly per capita consumption expenditure. On the other hand, Dharbhanga is lacking in terms of access to a public health centre. On the contrary, if we consider the prority districts from Central Bihar, the data suggests that Jamui is deficient in four policy variables including the value of agricultural output, the female literacy rate, the availability of drinking water facility and the access to public health centre. Furthermore, Banka is also lacking in two other policy variables viz., access to pucca roads and monthly per capita consumption expenditure. Additionally, Gaya is lacking in net irrigated area, other than SC/ST population and the dependencyratio. Moreover Arwal, Nawada and Sheikhpura are deficient variables in other than agricultural labour i.e. in non agricultural variable, the casual wage rate and higher dependency ratio respectively.

Table 6.10:	Policy Variable-wise Prioritized Districts of Bihar 2016-17			
	Most Prioritized districts		**Second Most Prioritized districts**	
	North Bihar	**Central Bihar**	**North Bihar**	**Central Bihar**
Percentage of Net Irrigated Area to Net Sown Area	Madhepura	Gaya	Purnia	Jamui
Value of agricultural output (rupees) in Crore	Supaul	Jamui	Darbhanga	Arwal
% pucca road	Katihar	Banka	Araria& Supaul	Jamui
% Other then agl lab to total worker (2011)	Pashchim Champaran	Arwal	Katihar	Banka
% other then SC/ST to total population (2011)	Pashchim Champaran	Gaya	Madhepura	Nawada
Ratio of working age population to non working age population (2011)	Purnia	Sheikhpura	Araria	Gaya
MPCE	Sitamarhi	Banka	Katihar	Gaya
Casual rural wage rate	Pashchim Champaran	Nawada	Purnia	Banka
% of female literacy (2011)	Purnia	Jamui	Madhepura	Nawada
% HH safe drinking water	Katihar	Jamui	Purnia	Banka
Percentage villages having PHC within 5 km (2011)	Darbhanga	Jamui	Supaul	Banka

6.5 Summing up ■

This chapter highlights the major programmes related to food security and its performance in the context of Bihar. The chapter highlights the importance of various programme like the PDS, MGNREGA, MDM, NFSM, rural road connectivity and the rural drinking water programme. As far as the PDS is concerned, a huge gap exists between the entitled amount and the actual amount of food grains the beneficiaries receive. It is also concerned that neither of the beneficiaries have received foodgrains anywhere near the proposed limit by the government. Further, there is also the issue of exclusion and inclusion errors in targeting beneficiaries. Although the MGNREGA is a powerful means for providing income and hence access to food security, yet proportion of employment generated for women and STs is very low in Bihar. Further, the NFSM is also important but it primarily addresses the food availability dimension of food security, ignoring the access to food dimension. To improve the food security situation of the poorest districts, the state needs to first identify the right policy variables along with other food security intervention programmes so that the districts reach the food secure zone.

TOWARDS A
FOOD SECURE BIHAR

The economy of Bihar has a direct bearing on food security in the state. After the bifurcation of the state, agriculture has become more important because all the rich mineral resource regions now belong to the state of Jharkhand. The main strength of the Bihar economy now lies in its rich agricultural soil and water resources. But the flipside is the proneness of North Bihar to flood disasters on account of fast-flowing rivers which originate in Nepal. *Second*, the incidence of poverty in rural Bihar is one of the highest in the country although the pace of its decline during 1994-2011 was higher than at the all-India level. *Third*, in terms of its infrastructure, rural road connectivity which is essential to support agricultural growth is very poor in Bihar. Fourth, the share of agriculture to GSDP in Bihar has also been continuously falling. Fifth, the female literacy in Bihar (51.5 per cent) is well below the all-India level (65.46 per cent). These features exercise an adverse impact on food security in the state.

The primary focus of the second part of the report has been on estimating food security at the district level in Bihar, by identifying districts which are at the lowest level of food security and need specific policy interventions. Food security is dependent, in the first place, on the availability of food. But in the absence of adequate purchasing power, household level access to food gets curtailed even if physical availability exists. Thus, access to food is the second most important determinant of food security. However, even in the presence of these two determinants, unless adequate health status prevails at the household level, the bodily absorption of food and its nutritional impact would suffer for the households concerned. Thus, the third basic component of food security can be taken to be the body absorption of food or the

utilization of food. All these three, measured in terms of eleven indicators, can be taken as as inputs into food security. Over the long run, inadequate food security in terms of these factors results in harmful outcomes such morbidity, high mortality rates and low BMIs. But in view of the long lag involved, there could be a deviation between input indices of food security and the overall outcomes.

An examination of the correlations reveals that outcome and input Indices of food security are significantly related (r = -0.432, significant at the 5 percent level). Second, the relationship between the availability and access indices to the input and outcome indices of food security is significantly positive, although much less stronger in the case of the outcome index than in the case of the input index of food security. In terms of the relationship of the Input Food Security Index (FSI) to its individual indicators, eight variables emerge to be of prime importance, the first three being availability indicators, the next three the access indicators and the last two the utilization indicarors viz: (i) irrigation (ii) agricultural output per capita, and (iii) approach to a paved road, (iv) female literacy (v) proportion of non-agricultural workforce (vi) rural casual wage rate (vii) Availability of safe drinking water and (viii) easy accessibility to public health centers (PHC).

From the point of view of policy interventions, the relationship of Food Security to its individual indicators is much more relevant than the relationship of the FSI to overall availability, access or absorption indices, since policy can address individual variables but not their composite.

In terms of the Food Security Index and based on range equalization method, seven districts find a place

in the Secure category (S), ten in the Moderately Secure category (MS), thirteen in the Moderately Insecure category (MIS), four in the Severely Insecure category (SIS) and four in the Extremely Insecure category (EIS). For the mean standardization method, there are three districts in the Secure category (S), sixteen districts in the Moderately Secure category (MS), fourteen districts the Moderately Insecure category (MIS), two in the Severely Insecure category (SIS) and three in the Extremely Insecure category (EIS). The district finding a place in the two lowest Food Security categories (SIS & EIS) can be taken to be in need of concerted attention. According to the outcome approach, there are five districts belonging to the two lowest categories (SIS & EIS) in terms of the range equalization method and twelve districts belonging to the two lowest categories (SIS & EIS) in terms of the mean standardization method. However, all the lowest category districts under the output approach do not include all the lowest category districts according to the input approach. In our view, the list of districts needing specific attention should include all those districts which appear in the two lowest categories according to the input as well as outcome approaches to food security. If one follows this approach, the following seventeen districts can be designated as the Special Category Districts that need specific attention and interventions:

(i)	Jamui	(ix)	Darbhanga
(ii)	Gaya	(x)	Sheikhpura
(iii)	Purnia	(xi)	Patna
(iv)	Araria	(xii)	Sitamarhi
(v)	Pashchim Champaran	(xiii)	Nalanda
		(xiv)	Nawada
(vi)	Katihar	(xv)	Madhepura
(vii)	Banka	(xvi)	Aurangabad
(viii)	Supaul	(xvii)	Arwal

After the revision of the variables of the three main dimensions of the food securitity index and the food security outcome index, the status of the districts is almost same in 2016-17.

A comparison of the food security indices between 2008-09 and 2016-17 indicates that in most of the cases, the ranks of the districts have changed between 2008-09 and 2016-17 in terms of the food security index. Kishanganj has shifted from being severely food insecure to moderately food insecure. On the other hand Lakhisarai has shifted from the severely insecure status to a moderately secure position. Gaya and Supal have shifted from being moderately insecure to the extremely insecure and severely insecure positions respectively. Further, Paschim Champaran has worsened its podition from 2008-09 to severely insecure in 2016-17. Khagaria was under the secure category in 2008-09 but shifted to the moderately insecure category in 2016-17. Mungar, Bhagalpur and Nawada from the south and south east region; Saharsa and Madhepura from the north eastern region and Nalanda from the centre south region were moderately secure in 2008- 09 but became moderately insecure in 2016-17.

The Food Security policy outlined in this chapter follows two directions. The first approach stems from the view that the eleven variables which were taken to be the determinants of food security themselves indicate the channels through which food security can be enhanced. Under the prioritized districts, in most of the districts, out of the eleven policy variabls, almost six to eight policy variables are below the state average Thus, policy-makers can assess, which of the variables should be targeted for priority action for each of the low ranking food security districts. Out of the eleven policy variables, five variables including irrigation, roads, female literacy, provisioning of safe drinking water and public health care facilities can be directly improved upon by state policy interventions. On the other hand, the state can indirectly improve agricultural output, consumption expenditure and the agricultural wage rate. Further, the percentage of SC/STpopulation, the dependency rate and the proportion of agricultural workforce can be improved through welfare development programmes. It is suggested that to improve the food security condition of the mostly food insecure districts, the government and policy makers should devote more attention to these districts and improve the policy variable either by direct or

indirect policy instruments or by adopting special welfare prograame for the targeted group such as the SC/ ST or dependent people.

The second direction of food security interventions discusses the status of the state in terms of different types of food security interventions, namely, the status of the TPDS, MGNREGA, National Food Security Mission, Rural Road Connectivity and Mid-day Meal Scheme. The IHD Bihar Survey (2016) found that although BPL households never obtained foodgrains anywhere near the theoretical allowance of 15 kg of rice and 10 kg of wheat, the AAY households did get distinctly more, almost 18 kg of rice and 13 kg of wheat against their actual entitlement of 21 kg of rice and 14 kg of wheat per month. Further, there was also a high level of exclusion and inclusion errors in providing BPL and APL cards. The inclusion error was higher for SC households compared to the ST, OBC and other categories. Exclusion error was also high among SC households compared to households belonging to other social groups. The exclusion error was also found to be relatively high in Central Bihar compared to Northern Bihar (NSSO 68th round).

The MGNREGA is a powerful means of providing income and hence access to food security. Moreover, nearly 70 per cent of the income generated is spent on food in Bihar, which indicates its key role in providing food security (IHD Bihar Survey 2016). Further, while the proportion of SCs provided employment was much higher in the case of Bihar as compared to in India as a whole, the reverse was the position in the case of women and the STs.

When we consider the NFSM, an important point to remember is that it primarily addresses the food availability dimension of food security, but ignores the access to food dimension. Moreover, it covers only a very limited number of Special Category Districts.

In terms of rural road connectivity, in Bihar, the proportion of villages connected by roads is well below the all- India proportion. Moreover, the progress of providing rural connectivity under the PMGSY has been lower than that at the All-India level. In respect of future steps for connecting villages to main roads, we need to emphaze on construction of pucca road which will connect more habitats of the state.

The Mid-day Meal Scheme is a potent means of enhancing food security in the state. The IHD Bihar Survey analysed the perceptions on households on the performance of the MDM schemes and found that more than sixty percent of the beneficiaries reported the food quality to be average while the remaining one third of felt that the good quality of the food provided was good. More than half of the parents reported that the MDM food accounted for more than half the food that the children consumed.

In our view, to improve the food security of the poorest districts in Bihar, it is important to improve the food security policy variables along with food security intervention programmes. The state also needs to improve the welfare development programmes in the various districts.

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