



FAN  
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# Food, Agriculture, and Nutrition in Bihar

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GETTING TO ZERO HUNGER

**Tata-Cornell Institute for Agriculture and Nutrition**  
CORNELL UNIVERSITY | COLLEGE OF AGRICULTURE AND LIFE SCIENCES



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# Food, Agriculture, and Nutrition in Bihar: Getting to Zero Hunger

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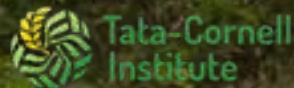
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Cover photo: A woman carries a basket on her head. *Photo by wimammoth on Shutterstock.*

Women and children walk  
through farmland in Bihar, India.  
*Photo by Kiera Crowley.*



FOREWORD

The Tata-Cornell Institute for Agriculture and Nutrition (TCI) is pleased to present the latest report from its series on Food, Agriculture, and Nutrition (FAN) in India. The inaugural FAN 2020 report detailed the state of hunger and malnutrition across India and assessed the prospects for enhancing productivity and farm incomes across the numerous and highly varied agroecologies and cropping systems in the country. One of the key lessons we learned from FAN 2020 was that regional socioeconomic disparities necessitate localized efforts to improve agricultural productivity and incomes. As such, TCI is producing a series of FAN reports on states that are critical to reaching the zero-hunger goal, starting with Bihar.

Bihar has one of the highest rates of malnutrition in India. At 48 percent, its proportion of children under the age of five that are stunted is the highest in the country. Bihar is the state with the second highest share of underweight women and children at 30 and 43 percent, respectively. It is also among the five states with the highest proportion of women and children with anemia in the country. Bihar’s rural population bears a disproportionate share of malnutrition burden, and it is heavily dependent on agriculture.

Food, Agriculture, and Nutrition in Bihar: Getting to Zero Hunger (FAN-Bihar) provides a detailed reassessment of the food system approach for achieving the 2nd Sustainable Development Goal (SDG2) — zero hunger by 2030 — in Bihar. The report emphasizes the high rates of malnutrition in the state and highlights the urgent need to address the chronic burden of undernutrition. The report focuses on key elements of the food system to address malnutrition: enhanced food production and availability, crop diversification, improved market linkages, gender empowerment, and improved nutrition behavior.

The report advocates for increasing both farmer income and productivity through effective yield stabilization and improved market linkages. It also makes the case for making agricultural policy more nutrition sensitive by diversifying cropping systems toward more non-staple crops.

Apart from increasing and diversifying production, the report advocates for improving nutrition by leveraging social safety nets channels to improve the availability of non-staples at the household level. Further, the report recognizes women’s empowerment as a critical pathway for increasing demand for micronutrient-rich foods. FAN-Bihar also highlights the nutritional impact of water, sanitation, and hygiene (WASH) throughout the food system, from crop production and postharvest activities to eventual consumption and nutrient absorption in the household.

Finally, the report highlights the multisectoral nature of India’s malnutrition problem and advocates for a convergence of program and policies to address nutrition across ministries and departments from the national level down to the village.

I hope that this report proves to be informative and thought-provoking, encouraging a results-oriented dialogue around the effort to achieve zero hunger in Bihar.

**Prabhu Pingali**  
*Founding Director*  
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EXECUTIVE SUMMARY

This report presents a food systems approach for achieving Sustainable Development Goal 2 (SDG2)—zero hunger by 2030—in Bihar, India. SDG2 explicitly focuses on both the importance of ending all forms of malnutrition and the role that agriculture can play in achieving that goal. These factors are crucial for Bihar, which has one of the highest rates of malnutrition in the country—especially among women and children—and is a largely rural population. Nearly half of children under the age of five in the state are stunted and underweight. It also ranks among the top five states in the country with the highest proportion of women and children with anemia. Most of the burden of malnutrition is concentrated in rural Bihar, where the population is heavily dependent on agriculture as a source of livelihood. Bihar’s Economic Survey 2019–20 recognizes that agriculture is the mainstay of the state’s economics, influencing food security and overall rural development. The sector accounts for one-fifth of the gross state value-added. Even though the share of agriculture in gross state domestic product (GSDP) has declined from 36 percent in 2000–01 to 20 percent in 2017–18, the sector continues to be an important source of employment for more than 70 percent of the population.

The food systems approach for getting to zero hunger in Bihar is based on investments in agriculture, leading to better household-level nutrition via higher incomes, access to diverse foods, more equitable intrahousehold food allocation, and improved health environments.

Agriculture in Bihar is characterized by small and marginal holdings that are exceedingly dependent on monsoons for irrigation. Together, these two characteristics have resulted in low productivity, inadequate price realization, and increasing postharvest losses. Improvements in agricultural productivity can help achieve gains in nutrition through improved access to diverse, nutritious foods, like pulses, fruits, vegetables, and livestock products, which are more nutrient-dense compared to staple grains like rice and wheat. At the same time, improved agricultural yields can also result in an increase in incomes for farmers. The increased income can result in an increased demand for, and access to, a more micronutrient-rich basket of foods that can be supplied by well-functioning local markets.

However, household availability and access to food will not necessarily ensure adequate consumption. This report also considers the importance of women’s empowerment and the health environment for better health outcomes. At the individual level, women’s empowerment, particularly in agriculture, can ensure an equitable distribution of nutritious foods within the household, resulting in improved dietary diversity. Individual-level nutrition outcomes will also depend on the surrounding health and hygiene environment that influences the absorption of nutrients in the body. An overarching theme in this report is the need for convergence in the design and implementation of policies across sectors and stakeholders to achieve SDG2 in Bihar.

The key findings of the report are summarized below:

**1. Bihar has some of the highest rates of malnutrition in the country and has made the slowest progress toward SDG2.**

Despite impressive gains in per capita gross domestic product (GDP) in the last decade, poverty is widespread in Bihar, and more so in the northern districts, as compared to the south. This is reflected in poor diets and nutritional outcomes for women and children. Dietary intake is primarily based on staples like rice and wheat. Protein-rich meats and eggs are consumed by less than 30 percent of children (2–4 years old) and women. Vegetables, fruits, milk, and oils account for 6 percent of calorie intake in Bihar, while the share of calories from eggs, fish, and meat are less than 1 percent. Such a lack of intake of diversified foods is reflected in poor anthropometric outcomes for children. Bihar not only has the highest prevalence of child stunting (42 percent) in the country but also poor nutritional outcomes for women, as reflected in the high rates of anemia (53 percent) and low body mass index (BMI) (35 percent). It occupies the lowest rank on the SDG India Index for 2019 and is one of the five states with the lowest indicator score for SDG2.

A major constraint preventing households from accessing diverse, nutritious foods is food prices. In 2019, cereals, vegetables, and dairy products each accounted for about one-fifth of monthly household food expenditures. Fruits account for just 3 percent, while protein-rich foods, like meat, fish, and eggs, make up 15 percent. Recent estimates suggest that the cost of meeting global dietary guidelines is approximately US\$3.50 per person per day in India. Our results indicate that it could cost nearly US\$5.00 per person per day to meet those dietary guidelines in Bihar if individuals purchased food items in each food group at average cost.

In order to ensure that a safe, nutritious diet is affordable, food systems will need to be reoriented in ways that make such foods accessible and affordable to all. That would mean a diversification of production systems, efficient market structures, and complementary strategies that address intrahousehold food allocation and nutrient absorption.

**2. Efforts to double farmer incomes and productivity need to prioritize yield stabilization and improved market linkages.**

Bihar’s traditional rice–wheat cropping system is characterized by one of the lowest yields in the Indo-Gangetic Plain (IGP). A doubling of farmer incomes in Bihar would increase the supply of and access to nutritious foods for small and marginal households in the state.

The stability of yields in Bihar can be ensured by investing in irrigation infrastructure, including flood and watershed management in the northern districts and the curbing of overexploitation of groundwater in the southern districts. Investments in irrigation can also help increase cropping intensity, especially in the south, by way of traditional systems like the Ahar-Pyne. Ensuring farmers have access to improved seed varieties, like shorter duration, hybrid rice and longer maturing, disease-resistant cultivars for wheat will also boost productivity. This will require investments in agricultural research and a strengthening of the seed supply chains. Policy efforts should also focus on sustained adoption of improved crop management practices, such as following an optimum date for transplantation of rice or early sowing of wheat. The adoption of technologies needs to be supported by Krishi Vigyan Kendras (KVKs) extension services and ensuring that complementary inputs are also accessible.

In order for income gains to be realized from yield improvements, there is a need to invest in accessible, well-functioning markets. For farmers to realize income gains, this will require strengthening farmer producer organizations (FPOs) and other aggregation models to link farmers to markets, bringing in private sector buyers following the repeal of the Agricultural Produce Market Committee (APMC) Act in Bihar, and further streamlining of government procurement activities.

**3. Agricultural policy needs to be nutrition-sensitive in order to incentivize the diversification of the cropping system toward more nutritious nonstaple foods.**

Bihar’s agricultural policies need to focus on the explicit goal of nutrition security, that is, ensuring that households can access and afford diverse, nutritious foods throughout the year. A diversification of the cropping system in Bihar stands to benefit small-holder farmers by ensuring the supply of nonstaples essential for nutritional security. The predominantly rice–wheat cropping system can be diversified by introducing intercropping of pulses using high-yielding, short duration seeds in a rice–lentil system in the rice fallow regions in high residual moisture zones. Similarly, the cultivation of hybrid varieties on raised beds in flood-prone districts in Bihar can further diversify the production of maize, which has one of the highest productivity levels in Bihar. Additionally, the growth in fruits and vegetables needs to be sustained, and even improved, with supporting investments in postharvest, cold-storage infrastructure to limit losses of these perishable products. For livestock, efforts should focus on improved breeds in order to realize higher yields of animal-sourced foods, like milk and meats. Promoting Makhana (fox nut) and fishery-based farming systems in north Bihar would also diversify cropping systems, as well as make fish available for consumption.

The move toward a diversified production system must not exclude women. They can influence the modifications of the mix of crops cultivated both for consumption by their households, as well as for sale in the market. Focusing on women farmers is also a key component of SDG2.3.

A diversification of the production system can also potentially increase smallholder incomes if supported by adequate market linkages and infrastructure investments.

**4. Bihar’s food safety nets should be leveraged as channels for ensuring that nutrient-rich nonstaples are available to households for increased consumption.**

Improvements in yields and a diversified basket of agricultural produce can contribute to an increase in the supply of diverse, micronutrient-rich foods in Bihar’s food safety net programs, namely the Integrated Child Development Services (ICDS), Mid-Day Meal (MDM), and the Public Distribution System (PDS). This will require a convergence between the objectives and activities of the Departments of Women and Child Development; Education; Health; and Food and Consumer Protection. For example, small fish, green leafy vegetables, and biofortified crops, such as high-zinc rice and wheat, high-iron pulses, and orange-fleshed sweet potatoes (OFSP) could be grown by the Jeevika groups and procured for Anganwadi child care centers, schools, and the PDS. Milk fortified with vitamins A and D could be supplied in collaboration with Sudha Dairy. Take Home Rations (THR), prepared and supplied by Jeevika groups to the Anganwadi, could be scaled up under appropriate food safety regulations for use in locally processed food. This would provide a boost to the local economy and ensure livelihoods for women. Animal-sourced foods, like eggs and milk, and diversified crops, like pulses and Nutri Millets, can be procured by the Food and Consumer Protection Department for consumption in Anganwadi centers and schools. The PDS can also be made more nutrition-sensitive by working toward decentralized procurement and supply of millets, pulses, and other biofortified crops by the Department of Food and Consumer Protection and the Food Corporation of India.

**5. Women’s empowerment is a pathway for increasing demand for micronutrient-rich foods for household consumption.**

Women’s empowerment is a strong channel for ensuring that there is an increased demand for micronutrient-rich foods for household consumption. Ensuring women’s access to productive resources in agriculture (like land, irrigation, and credit) and enabling them to have greater input in decisions related to production, use of income, and time use are some areas where interventions can be targeted to empower women

in agriculture. Women can be part of the move toward diversified production systems, such as the farming of nutrition-rich crops like pulses and millets, maintenance of kitchen gardens, and management of livestock/poultry/fisheries through the Jeevika groups already present in Bihar. The Departments of Agriculture and of Animal Husbandry and Fisheries can provide technical support to the Jeevika groups in their efforts toward diversification of farming systems. Rural development departments can use the Mahatma Gandhi National Rural Employment Guarantee Act 2005 (Ministry of Rural Development) program to help landless people and women get work on projects that could transform the soil and water conservation situation across the state, especially in the drier regions of south Bihar. Women need to be linked to markets by way of information (on prices, for example), infrastructure (roads, transport), and institutional arrangements like self-help groups or FPOs, which result in better price realization because of collective bargaining power. These avenues can result in both an increased supply of micronutrient-rich foods and increased incomes for women. The latter, in turn, can increase demand for such foods.

Women can also play an important role in influencing intra-household food allocation. Positive nutrition behavior campaigns that address allocation can be implemented by bringing together government departments, development sector organizations, and public and private sector companies that have a presence in Bihar. More than 900,000 women’s self-help groups have been formed across Bihar. These social capital-rich women’s institutions offer an opportunity to layer together programs related to women’s empowerment and positive nutrition behavior.

**6. The role of water, sanitation, and hygiene for nutrition security should be recognized throughout the food system, beginning with crop production and postharvest activities, to eventual nutrient absorption in the household environment.**

The existing drinking water and sanitation programs of the national and state government need to emphasize the importance of water, sanitation, and hygiene (WASH) for nutrition security. In addition to investments in infrastructure, like latrines and piped drinking water supplied in homes, there is a need to spread awareness of the importance of good hygiene practices,



such as handwashing. The health and family welfare departments can collaborate with the JEEViKA groups in this effort. Similarly, the Department of Education can bring awareness campaigns to schools. Finally, there needs to be investment in food safety, such as using airtight bags for storing food and taking steps to address occupational risks, like disseminating information about waterborne diseases.	
<b>7. Getting to zero hunger in Bihar will require a convergence in the policy objectives and implementation of related actions across departments and ministries, not just at national and state levels but crucially also at district and village levels.</b>	
Bihar can realize the goals of SDG2 more effectively if there is convergence between the objectives and activities of various government department policies. This begins with an explicit incorporation of nutrition security as the primary goal—not just related to reducing malnutrition (as in the POSHAN Abhiyaan, the national nutrition mission), but also related to other inter-linked components of the food system like doubling productivity, empowering women, and promoting healthy environments. Such a convergence of objectives must be backed up by a convergence in implementation on the ground, meaning that these goals are jointly addressed through interlinked, coordinated activities across the departments.	
Such a convergence in objectives and implementation begins at the national level and ends at the village level. Implicit in such a decentralization of goals is the setting of nutrition-related targets at the local level. Setting targets related to reducing hunger at the district level makes it easier to galvanize resources and ensure coordination than if the same targets were set at the state level.	
<b>8. To monitor and effectively evaluate progress toward SDG2, there is an urgent need for improved data systems.</b>	
Given that the SDGs are interconnected in nature, there is a need for a unified database that can be used for evidence-based decision-making. At present, there is a dearth of recent, up-to-date data on key statistics relating to household expenditures, consumption, and prices for India. The most recent publicly available data relating to these areas available from the National Sample Survey Office (NSSO) of the Ministry of Statistics are from 2011. Poverty figures that come from the census are also limited to 2011. The present impact of policies based on these data cannot be adequately assessed. At the same time, there is a need to track new indicators that reflect a food system approach. Dietary diversity, as tracked by the National Family Health Survey (NFHS), should correspond to standard food groups to allow for international comparisons. Similarly, data on women’s empowerment should focus on aspects that are related to both agriculture and nutrition. The indicators used to track SDG2 in the SDG India Index can also be made more nutrition-sensitive by emphasizing nonstaples in both agricultural production and individual consumption.	

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ABBREVIATIONS

APMC	Agricultural Produce Market Committees
BCC	Behavior change communication
BMI	Body mass index
CD	Credit-to-deposit ratio
CWMI	Composite Water Management Index
DGLV	Dark green leafy vegetables
DISHA	District development coordination and monitoring committee
DSR	Direct-seeded rice
EIGP	East Indi-Gangetic Plain
FFSs	Farmer field schools
FPOs	Farmer producer organizations
GDP	Gross domestic product
GR	Green Revolution
GSDGR	Global Sustainable Development Goals Report
GSDP	Gross state domestic product
IAY	Indira Awaas Yojana
ICDS	Integrated Child Development Scheme
ICMR	Indian Council of Medical Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IYCF	Infant and Young Child Feeding Program
JSPVAT	JEEViKA Special Purpose Vehicle for Agriculture Transformation
K	Potassium
KCC	Kisan credit cards
KVKs	Krishi Vigyan Kendras
LMP	Livestock master plan
LSBA	Lohiya Swachhta Yojana
MDM	Midday Meal Scheme
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MOSPI	Ministry of Statistics and Program Implementation
MSP	Minimum support price
MUAC	Middle upper arm circumference
N	Nitrogen
NCDs	Noncommunicable diseases
NFHS	National Family Health Survey
NFSA	National Food Security Act
NHM	National Health Mission
NHRDF	National Horticulture Research and Development Foundation
NIF	National Indicator Framework
NRDWP	National Rural Drinking Water Program
NSS	National Sample Survey
NSSO	National Sample Survey Office
ODF	Open defecation-free
P	Phosphorus
PDS	Public Distribution System
PMGSY	Pradhan Mantri Gram Sadak Yojana
RABCs	Rural agri-business centers
SCBs	Scheduled commercial banks
SCHs	Single-cross hybrids
SDGs	Sustainable Development Goals
SECC	Socio-Economic Caste Census

SMART	Sustainable Multi-species Agricultural Resources Model Trials
SRI	System of rice intensification
TARINA	Technical Assistance and Research for Indian Nutrition and Agriculture
THR	Take Home Rations
UNICEF	United Nations Children’s Fund
VECs	Village education committees
VHSNCs	Village health sanitation and nutrition committees
VNR	Voluntary National Review
WASH	Water, sanitation, and hygiene
WCD	Women and child development
WEAI	Women’s Empowerment in Agriculture Index
WHO	World Health Organization
WIGP	West Indo-Gangetic Plain
ZT	Zero till

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A woman walks across some farmland in Khopawar, Bihar.

# 1 Introduction

This report presents a food systems approach for meeting SDG2—zero hunger and malnutrition by 2030—in Bihar. The 2030 Agenda of the United Nations defines 17 Sustainable Development Goals (SDGs) that are related to social, economic, and environmental aspects of sustainable development. SDG2 has five subgoals that aim to: (1) end hunger and ensure access to sufficient and nutritious food for all people year round; (2) end all forms of malnutrition; (3) double agricultural productivity and incomes of small-scale farmers; (4) ensure an environmentally sustainable food production system; and (5) maintain genetic diversity of seeds and cultivated plants (see Box 1.1 for details).

While Bihar has made strides in terms of economic growth, it has one of the highest rates of malnutrition in India. At 48 percent, its proportion of children under the age of 5 that are stunted is the highest in the country. It is second only to Jharkhand for the share of underweight women and children at 30 and 43 percent, respectively. It is also among five states with the highest proportion of women and children with anemia in the country. Bihar’s rural population bears a disproportionate share of the malnutrition burden. It is heavily dependent on agriculture and allied activities as sources of income. In that context, agricultural policies can play a central role in reducing the persistent problem of malnutrition in Bihar by emphasizing the production of nutritious foods and ensuring that smallholder farming households have access to such foods throughout the year.

A food systems approach for tackling malnutrition in all its forms brings together the several interconnected domains that have a bearing on nutritional outcomes. At the center of this approach is a focus on reorienting agricultural policies in ways that are associated with better health outcomes for women, children, and households.

Although agriculture plays an important role in determining food availability and accessibility, activities and outputs from the sector do not influence nutrition in isolation. Equally relevant are factors that determine the eventual intake of food by individuals and the absorption of nutrients therein. These factors come together in a set of four overlapping pathways from agriculture to nutrition that are the main focus of this report.<sup>1</sup> Pathway 1 focuses on the role of incomes in determining food access, while Pathway 2 is related to ensuring that households have access to diverse foods throughout the year. Both household income and access to a diverse set of nutritious foods determine household food access. At the same time, this household-level food access translates into individual nutritional outcomes when mediated by factors, like women’s empowerment, that influences both intrahousehold food allocation (Pathway 3) and the health environment that influences absorption of nutrients (Pathway 4). Each of these pathways can determine nutritional outcomes independently as well as in a convergent manner.

In this report, our aim is to reorient the discourse on agriculture, women’s empowerment, and the role of the health environment with a nutrition lens. Although our focus is on SDG2 progress along these four pathways, there are also direct or indirect

<sup>1</sup> Pingali and Ricketts (2014)



implications for the achievement the subgoals of SDG2. Pathways 1 and 2 are priorities in India’s national policies and are embodied in SDG 2.3, which calls for the doubling of agricultural productivity and incomes of smallholder farmers, and in SDG 2.4, which calls for resilient agricultural practices to increase productivity and production.

Although the SDGs are national-level targets, there is a need for regional perspectives in analyzing progress.<sup>2</sup> In this report, we discuss each of the four nutrition pathways, specifically, for Bihar. In doing so, we can focus on the context-specific nature of agricultural production and challenges for increasing incomes in the state, as well as the subnational status of factors, like women’s empowerment, that together determine the eventual nutritional status for individuals.

The NITI Aayog, the nodal agency for monitoring India’s progress on SDGs, recognizes that “sub-national governments hold the key to India’s quest for sustainable development.”<sup>3</sup> In other words, India’s progress on the SDGs will be a function of how well it is able to progress toward realizing them in the states and Union territories. In large part, this is for two reasons: first, a significant chunk of the planning, budgeting, and implementation of social, economic, and development policies related to the SDGs happens at the sub-national level; second, there are regional differences in the level of agricultural growth and structural transformation between states that can help explain why states are lagging behind the SDGs to different degrees and also indicate an optimal, context-specific policy mix to address the gap in meeting

them. Related to SDG2, there is spatial variation in the distribution of malnutrition within India. Eastern states like Bihar, Uttar Pradesh, and Odisha are characterized by low agricultural productivity, a high share of agriculture in the gross domestic product (GDP), and low levels of urbanization. Together, these factors result in low incomes and less access to diverse foods, as reflected in the high rates of undernutrition.

The NITI Aayog has developed the SDG India Index, which assesses the performance of each state relative to each of the SDGs. It assigns a score, ranging from 0 to 100, to each state, with the score of 100 reflecting achievement of the goal in question. The score is generated for each SDG, in addition to a composite score based on the 17 SDGs and 100 underlying indicators. The SDG score for India was 60 in 2019, up from 57 in 2018. However, at 35, the subgoal score for SDG2 is the lowest across all SDGs. The spatial differences in the prevalence of malnutrition in India are also reflected in results of the state-level results. With an overall score of 50 on the SDG Index in 2019, Bihar has the lowest rank among all states. It has the highest proportion of children under 5 who are stunted. Furthermore, nearly 60 percent of pregnant women have anemia, and approximately 40 percent of children below 4 years of age are underweight. These statistics are reflected in Bihar’s performance for SDG2, in which it scored a dismal 26, placing it ahead of only Jharkhand, Madhya Pradesh, and Daman and Diu. The

Bihar SDG Vision report recognizes that the poor state of nutrition persists, despite impressive gains in economic growth in the state.

In this report, we suggest that Bihar’s agricultural policies need to move away from staple cereals, like rice and wheat, to encourage diversified production systems through the promotion of pulses, coarse cereals, fruits, and vegetables, as well as animal husbandry. Such a shift in policy will both ensure a supply of diverse micro-nutrient-rich foods in the state and generate demand for the same. Increased demand can also stem from increases in the incomes of smallholder farmers as yields of rice and wheat are improved. Some strategies for this include

strengthening the input supply chain and ensuring access to technologies and information by way of extension services. Well-functioning market arrangements, along with procurement policies, are also important for price realization. Women farmers cannot be excluded from such policy changes, and therefore, their access to productive inputs and control over income should be ensured. Behavior change campaigns should address stakeholders at all points of the food system: (1) farmers—about the importance of cultivating diversified crops for nutrition; (2) women—about the importance of cultivating, purchasing, preparing, and distributing nutritious foods within the household; and (3) communities—about the importance of clean water and hygiene for eventual nutrient absorption.

Box 1.1 | GOAL 2: ZERO HUNGER

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

TARGETS

2.1 | By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.

2.2 | By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

2.3 | By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

2.4 | By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

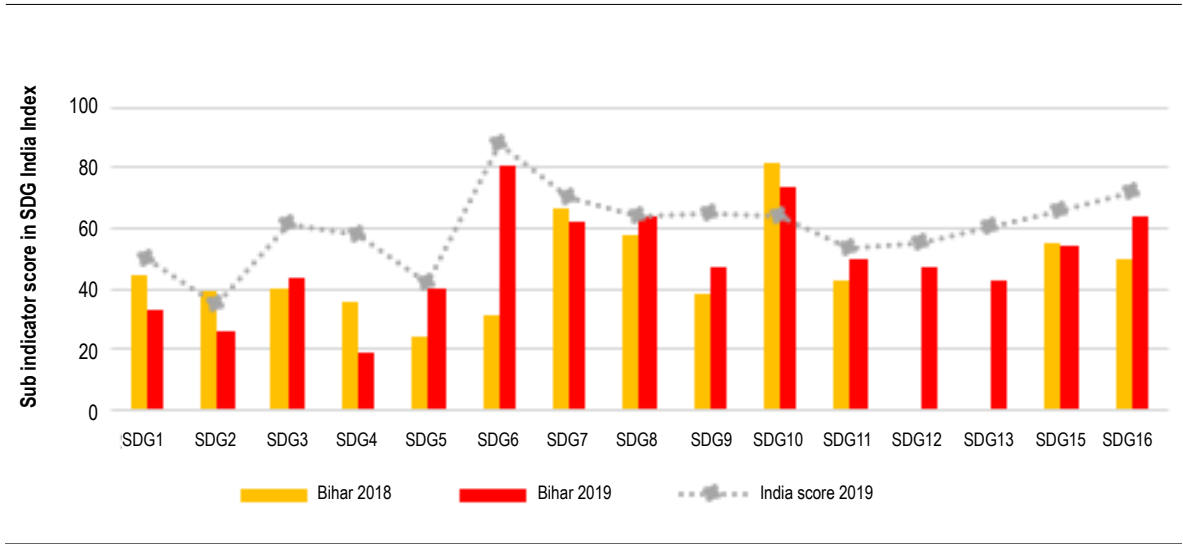
2.5 | By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed.

2A | Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries.

2B | Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round.

2C | Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility.

Figure 1.1 | Bihar’s performance on the SDG India Index (2018, 2019)



Data source: NITI Aayog SDG India Index 2018, 2019

<sup>2</sup> NITI Aayog (2019b); UN (2019b)  
<sup>3</sup> NITI Aayog (2019b, vii)

Data source: Sustainable Development Knowledge Platform, <https://sustainabledevelopment.un.org/sdg2>, <https://www.un.org/sustainabledevelopment/hunger/>





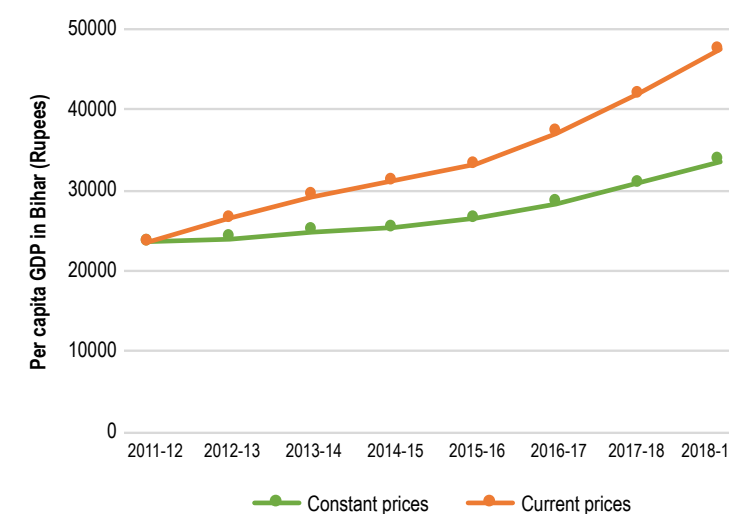
Women from the villager of Khopawar in Bihar.

## 2

# The State of Nutrition in Bihar

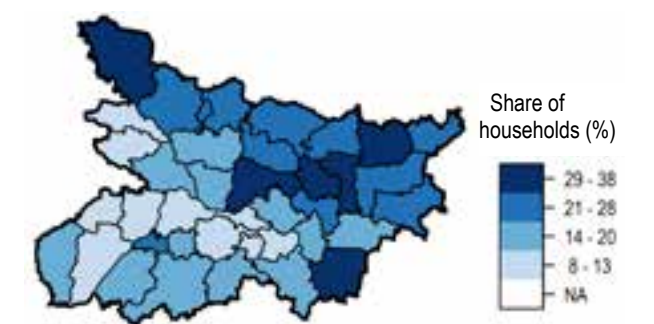
Bihar is the third most populous state in India and one of the fastest growing low-income states in the country. However, despite increasing per capita GDP (Figure 2.1), poverty is widespread in the state, especially in the northern districts (Figure 2.2). While one-fifth of India's population falls in the poorest quintile, in Bihar this proportion is as high as one-third (see Box 2.1).

**Figure 2.1** | Trends in Per Capita GDP of Bihar (2011-2019)



Data sources: Economic Survey of Bihar, 2019-20

**Figure 2.2** | Share of poor population, by district (2015-2016)



Data sources: NFHS-4 (2015-16)







childhood. A poor nutritional status during childhood also affects outcomes and abilities later in life. Children who are poorly nourished may be faced with lower cognitive skills, poor educational outcomes, and reduced incomes as adults. For girls, in particular, poor childhood nutrition can have negative implications for the course of their future pregnancies and health of their babies, resulting in a cycle of malnutrition that is transmitted across generations.

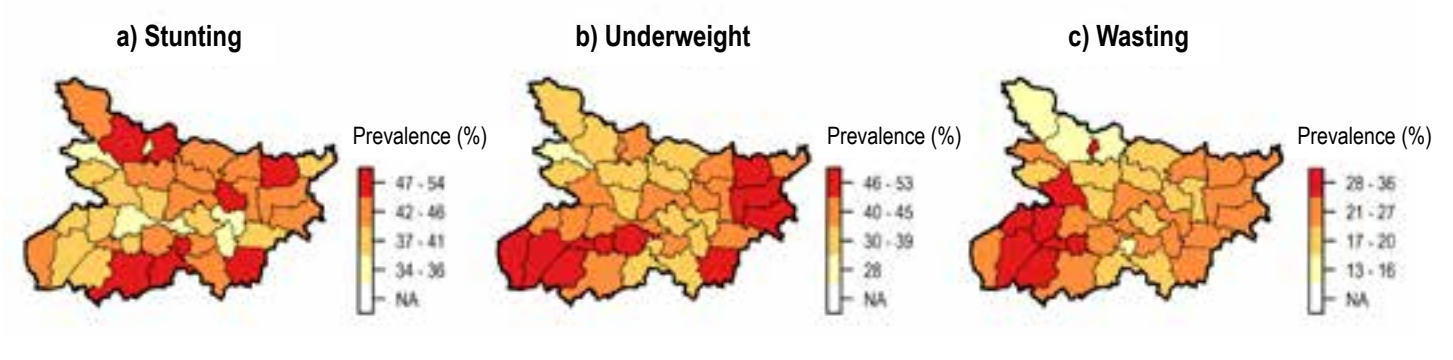
As of the latest estimation of 2018–19,<sup>5</sup> a little more than 40 percent of children under the age of 5 were stunted (low height-for-age) and underweight (low weight-for-age), and slightly more than one-fifth were wasted (low weight-for-height). These rates of malnutrition are higher than those for the country (Figure 2.4). Although the prevalence of stunting, wasting, and underweight did decline from 2005–15, the gains have been slow, and there was a recent increase in stunting and wasting between 2016 and 2019. Another

national-level estimation of child nutrition indicates that 40 percent of children under 5 continue to be stunted and underweight in Bihar.<sup>6</sup> Another indicator of acute malnutrition is the absolute value of the mid-upper arm circumference or MUAC.<sup>7</sup> With nearly 6 percent of children between the ages of 6–59 months acutely malnourished in Bihar, as measured by MUAC, the state has one of the highest rates of malnutrition across the country.

There is considerable variation in the distribution of malnutrition among children across the state (Figure 2.5). The high overall rates for stunting are reflected by the fact that, in most districts, the rates are at least 47 percent. The prevalence of underweight and wasting in children is greater in the southern districts, as compared to the north. The spatial distribution shows that some districts are burdened with high rates of multiple types of child malnutrition. For instance, in the southern districts, like Gaya, Arwal, Patna, Banka, and Jamui, the prevalence of all three—stunting, underweight and wasting—are very high.

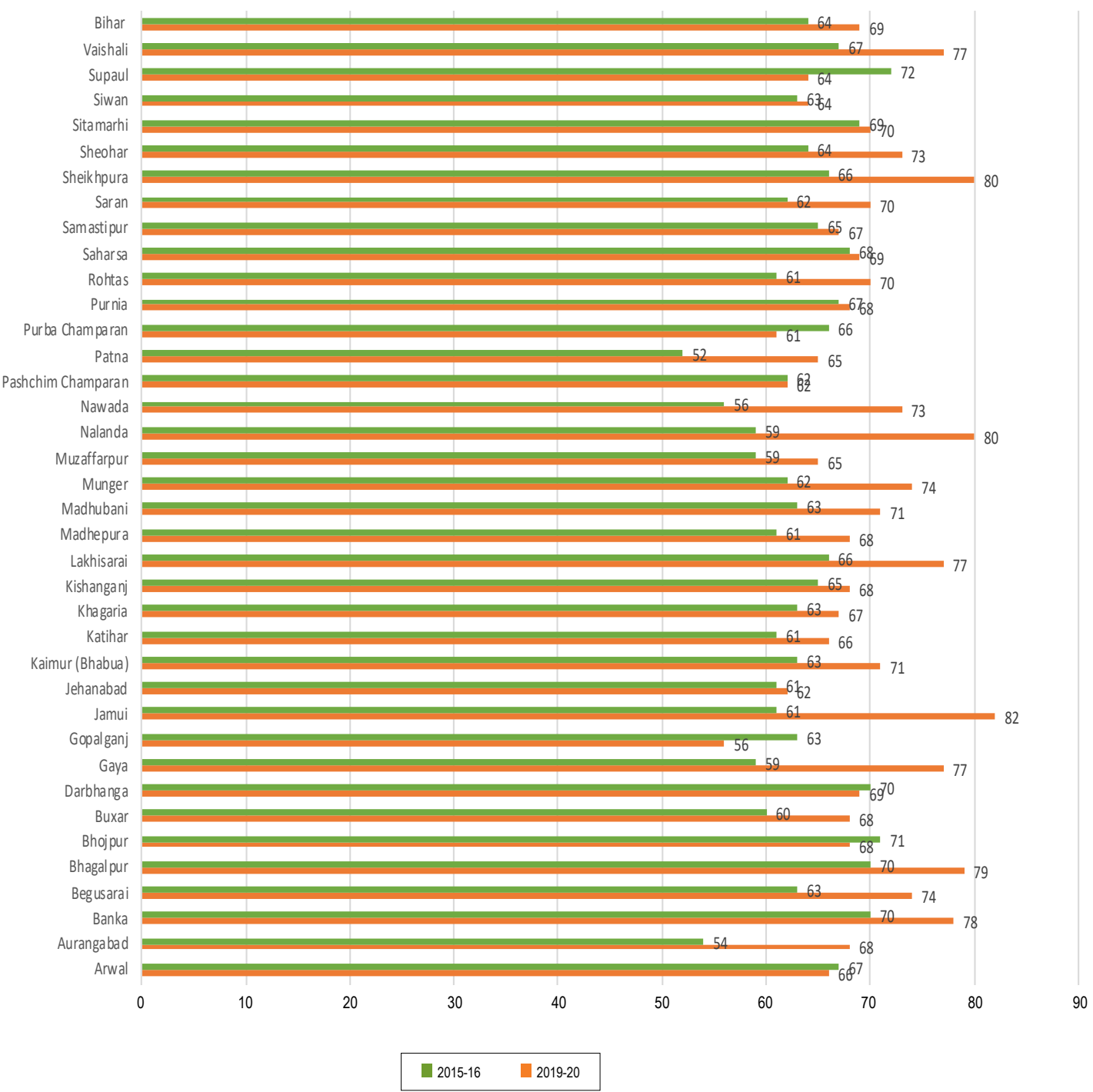
Children in Bihar also suffer from high rates of micro-nutrient deficiencies, known as hidden hunger. In every district of the state, at least 50 percent of the children below the age of 5 are anemic (Figure 2.6), and most of the districts have shown an increased number of anemic children in the past three years. In the state overall, a little less than 70 percent of children are anemic. Interestingly, the increased rates of anemia are seen even when there is an improvement in the number of pregnant women consuming iron and folic acid supplements, which jumped from 10 to 18 percent between 2015–16 and 2019–20. In addition to anemia, approximately 20 percent of children in the state are deficient in vitamin A, vitamin D, and zinc.<sup>8</sup> Other prominent deficiencies prevalent among children are vitamin B12 (13.8 percent) and folate in blood (6.1 percent).<sup>9</sup>

Figure 2.5 | Prevalence of child malnutrition in Bihar, by district (2019-20)



Data source: NFHS-5 (2019–20)

Figure 2.6 | Prevalence of anemia in children (6-59 months) in Bihar, by district



Data source: NFHS-5 (2019–20)

<sup>5</sup> GoI (2020)  
<sup>6</sup> MoHFW, UNICEF, and Population Council (2019)

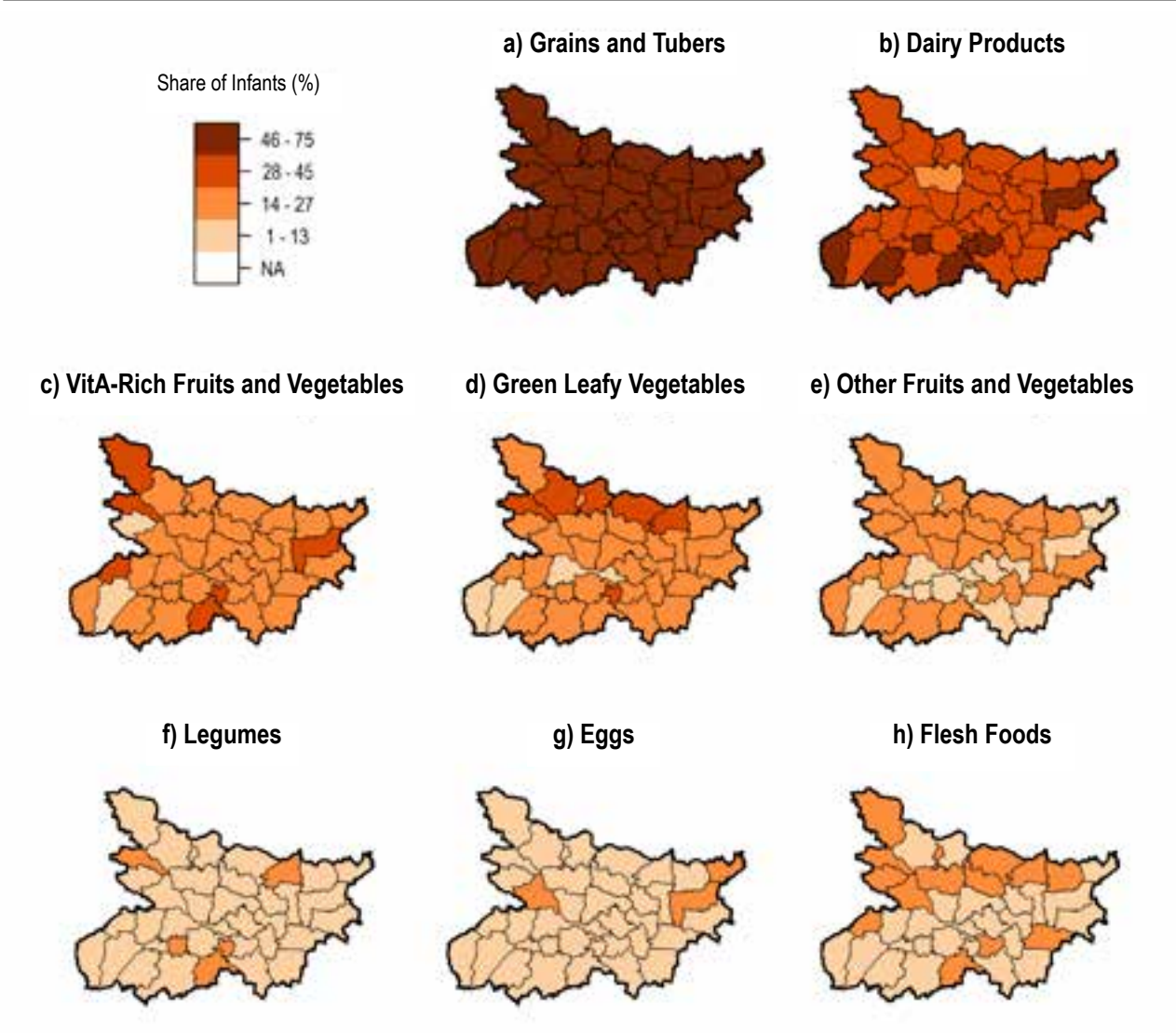
<sup>7</sup> Mid-upper arm circumference (MUAC) is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder (acromion)

and the tip of the elbow (olecranon process), and it is used for the assessment of nutritional status (WHO 2009).

<sup>8</sup> MoHFW, UNICEF, and Population Council (2019)  
<sup>9</sup> MoHFW, UNICEF, and Population Council (2019, 202, Table 7.10)

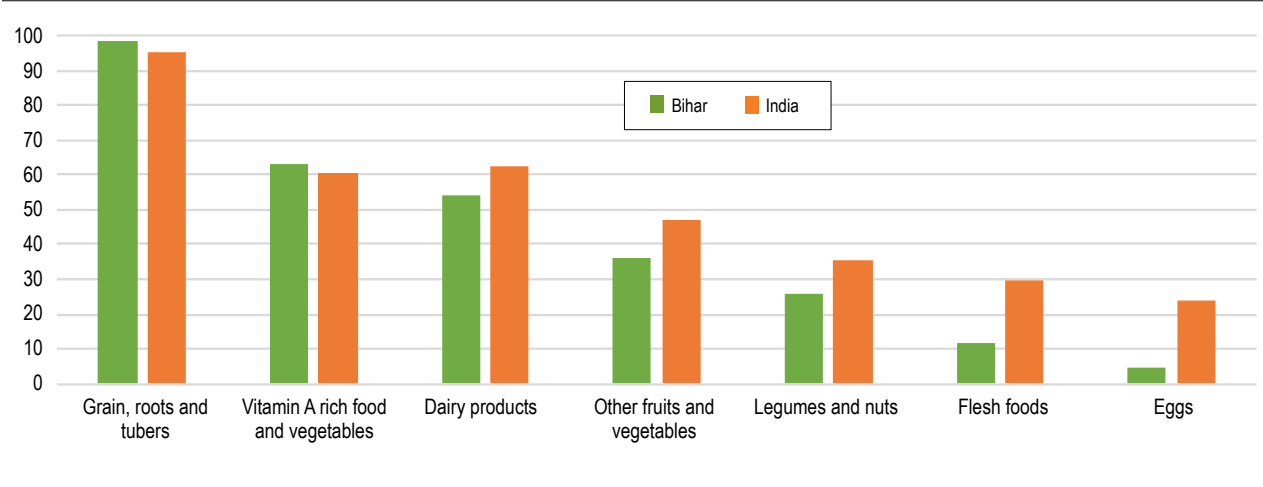


**Figure 2.7** | Dietary intake of children 0-2 years (% children), by district (2015)



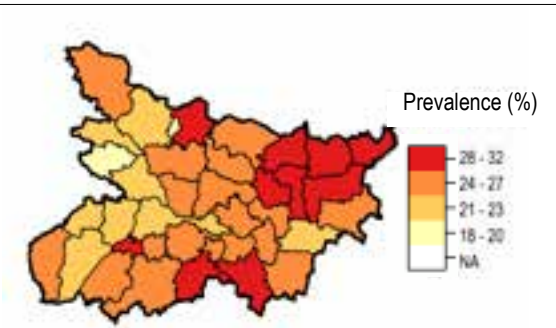
Data source: NFHS-4 (2015-16)

**Figure 2.8** | Dietary intake of children (2-4 years)



Data source: CNNS report 2019

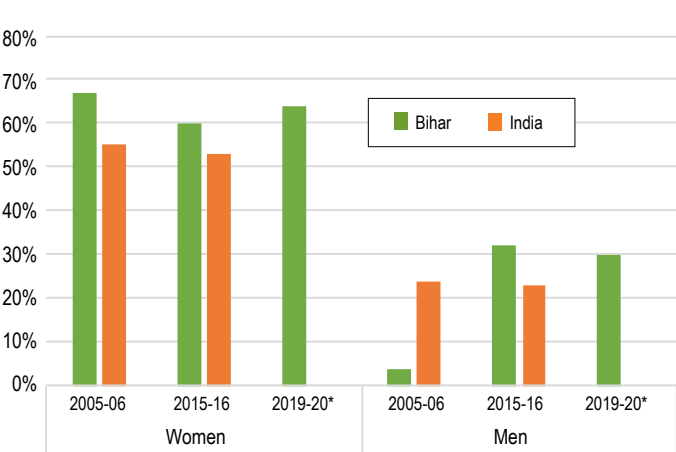
**Figure 2.9** | Prevalence of low body mass index in women, by district



Note: Low BMI: Women whose Body Mass Index (BMI) is below normal (BMI < 18.5 kg/m2)

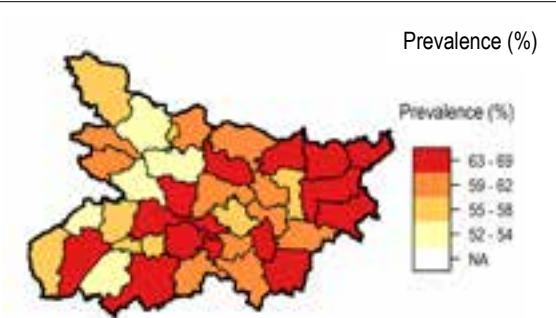
Data source: NFHS-5 (2019-20)

**Figure 2.10** | Prevalence of anemia in women and men (2005-20)



Data source: NFHS-3 (2005-06), -4 (2015-16) and -5 (2019-20) \*NFHS-5 (2019-20) data are not available for India.

**Figure 2.11** | Prevalence of anemia in women, by district



Data source: NFHS-5 (2019-20)

One of the immediate causes of poor nutritional outcomes in children is inadequate dietary intake.<sup>10</sup> Just over half of the children under 6 months of age in Bihar were exclusively breastfed in 2015.<sup>11</sup> Furthermore, less than 10 percent of children aged 6–23 months—7 percent of those who were breastfeeding and 9 percent of those who were not—received an adequate diet. A look at dietary intake for children 0–2 years of age indicates the predominance of grains, roots, and tubers over legumes, dark green leafy vegetables, and meat products, all of which are more nutrient dense than staple cereals (Figure 2.7). Along with the low consumption of nutritious diets, as per the NFHS-4 report for Bihar, only 8 percent are fed according to World Health Organization (WHO)-recommended dietary practices. Less than one-third of children between the ages of 0–2 years are fed the recommended minimum number of times per day, and even fewer, 18 percent, are fed from the appropriate number of food groups. A similar cereal-centric dietary pattern is also reflected in food consumption patterns of children between the ages of 2 and 4 (Figure 2.8).

## 2.2 Nutritional status of women

Women’s nutritional status is the pillar around which the nutritional status of the household is built. There is strong evidence pointing to the important role of maternal health in ensuring better nutritional outcomes for children.<sup>12</sup> At the same time, women’s health status determines their ability to take care of their children, work and earn income, and allocate time to domestic tasks like food preparation and consumption. In Bihar, a little over a third of women have a low body mass index (BMI). There is spatial variation, however. In districts like Araria and Purnea, 40 percent of women have low BMI while in districts like Bhojpur and Saran, the prevalence is 25 percent (Figure 2.9).

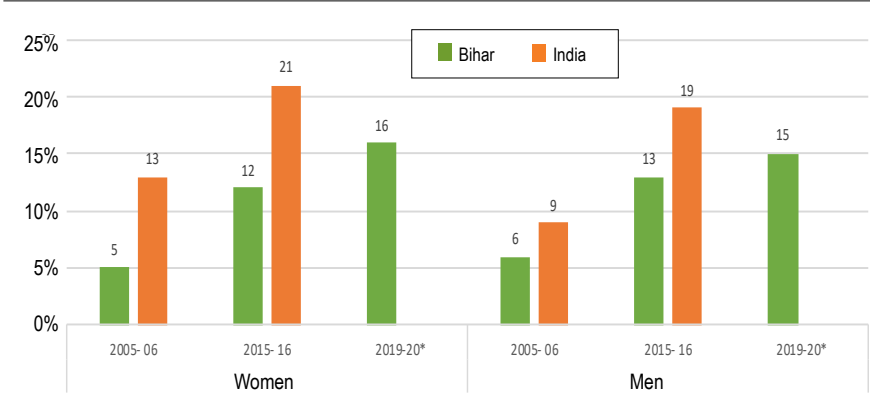
Anemia is a public health concern in India. The condition can result in maternal mortality, weakness, diminished physical and mental capacity, increased morbidity from infectious diseases, perinatal mortality, premature delivery, and low birthweight. Though the share of anemic women in Bihar had declined from 68 to 60 percent between 2006 and 2016, the latest 2020 NFHS data indicate an increase in the past three years. The data also show that the initial decline was not sustainable and the prevalence of anemia continues to be high, with rates for women nearly double that for men (Figure 2.10). In every district of the state, more than 50 percent of women are anemic (Figure 2.11). In districts, like Araria, Supaul, and Purnea, the prevalence of anemia in women is almost 70 percent.

<sup>10</sup> UNICEF (1990)  
<sup>11</sup> GoI (2016)

<sup>12</sup> Rana et al. (2019)

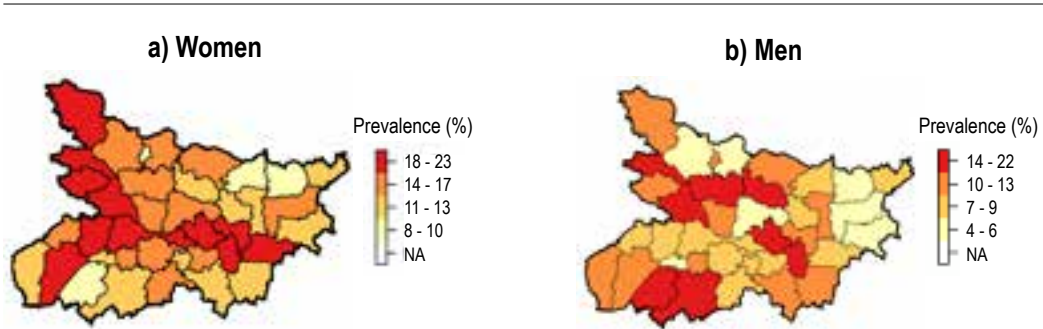
Poor nutritional status, as measured by BMI, and micronutrient deficiencies like iron deficiency (which leads to anemia) are just one part of the malnutrition faced by women. Poor health can also result from an excessive intake of calories, relative to essential micronutrients, as reflected in overweight and obesity. Obesity is a known risk factor for noncommunicable diseases (NCDs), such as diabetes, heart disease, and cancer. These diseases can increase the likelihood of health issues for future generations. In Bihar, the share of men and women who are overweight or obese has tripled since 2005. Approximately 16 percent of men and women in Bihar were obese in 2020, compared to approximately 20 percent in India overall (Figure 2.12). Districts with a low proportion of underweight women have higher rates of overweight or obese women (Figure 2.13).

Figure 2.12 | Prevalence of obesity in adults



Data source: NFHS-5 (2019–20)

Figure 2.13 | Prevalence of obesity in women and men, by district (2015)

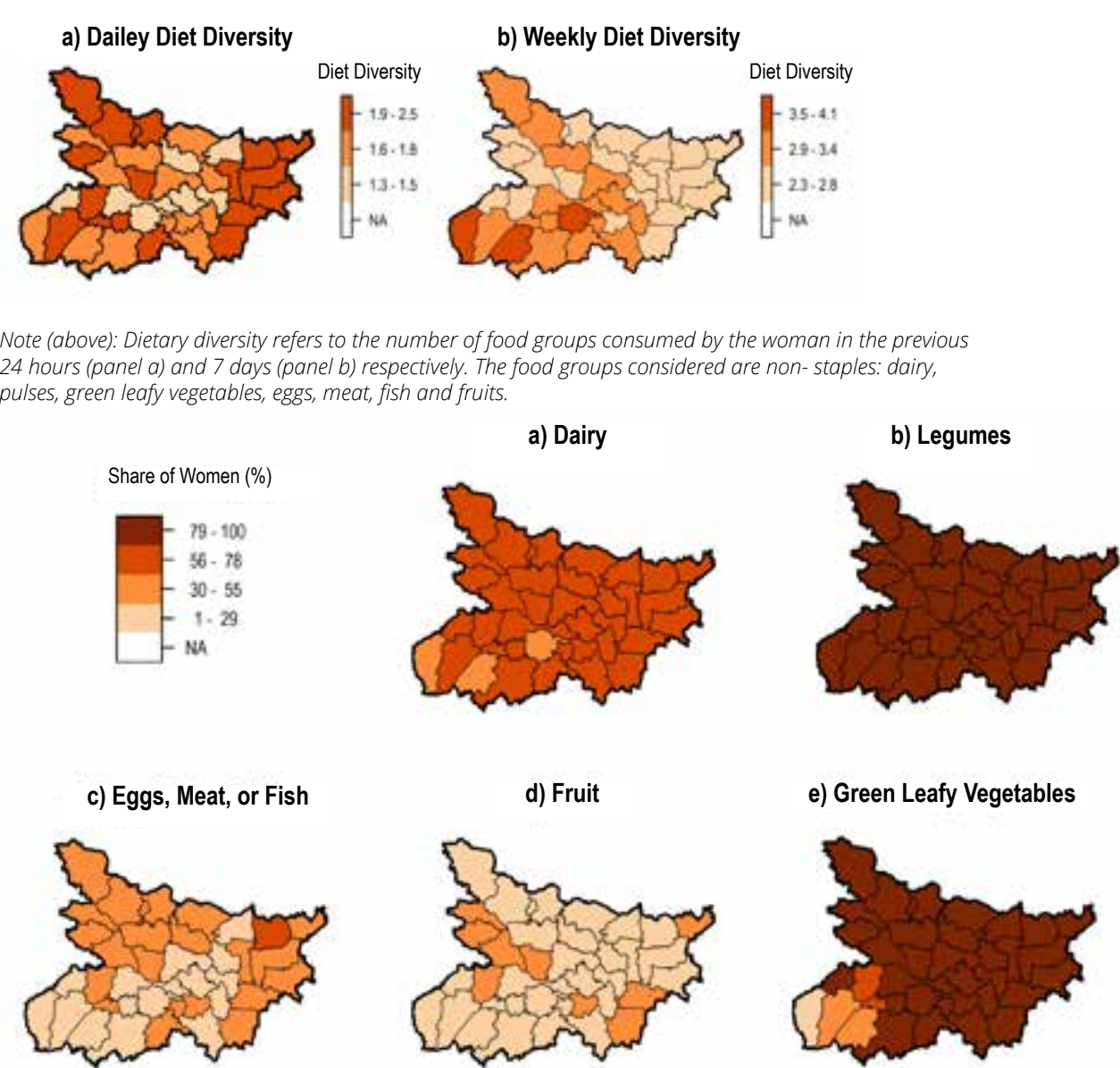


Data source: NFHS-5 (2019–20) for women and NFHS-4 (2015–16) for men

While cereals, like rice and wheat, form the staple diet for most households, nutritional outcomes will depend on consumption of nonstaple food groups, such as dairy, pulses, leafy vegetables, fruits, eggs, meat, and fish. In this regard, data from the NFHS indicate that, on average, there is not a single district in the state where women reported having consumed more than 3 such nonstaple food groups in the previous 24 hours. In most districts, this remains the case even for a weekly diet (Figure 2.14). Although at least 80 percent of women reported consuming legumes and green leafy vegetables, either daily or weekly, the share of women who consumed dairy products, fruits, eggs, meat, or fish is much lower.

“While cereals, like rice and wheat, form the staple diet for most households, nutritional outcomes will depend on consumption of nonstaple food groups, such as dairy, pulses, leafy vegetables, fruits, eggs, meat, and fish.”

Figure 2.14 | Women’s dietary diversity in Bihar (2015)

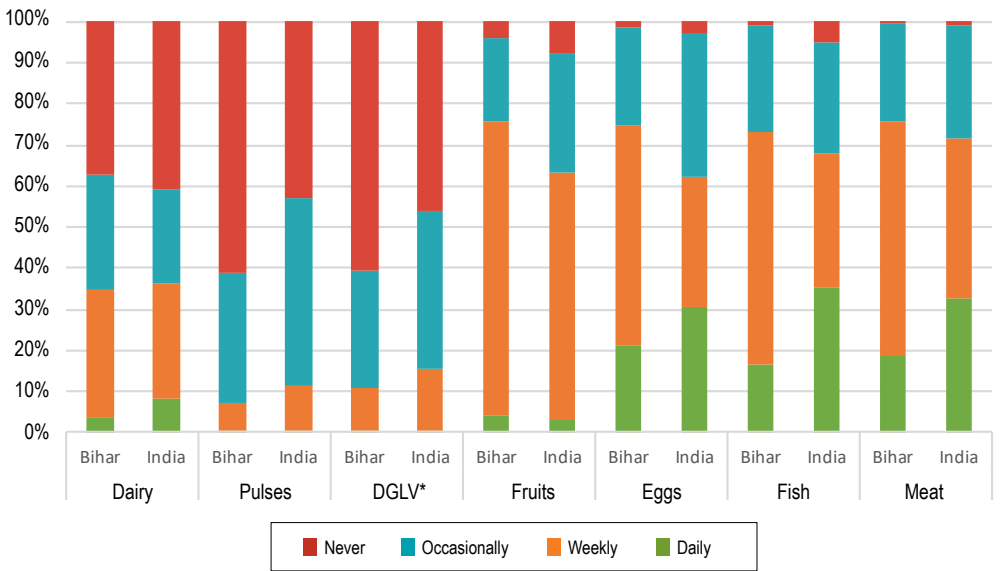


Note (above): Dietary diversity refers to the number of food groups consumed by the woman in the previous 24 hours (panel a) and 7 days (panel b) respectively. The food groups considered are non- staples: dairy, pulses, green leafy vegetables, eggs, meat, fish and fruits.

Data source: NFHS-4 (2015–16)



**Figure 2.15** | Frequency of consumption of non-staple food groups by women (2015)



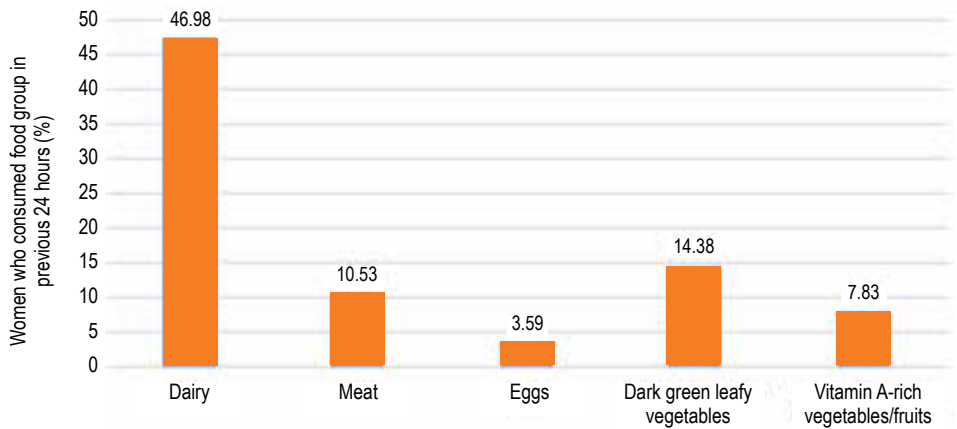
Data source: NFHS-4 (2015-16)  
\*DGLV: Dark green leafy vegetables

### Box 2.2 | DIET DIVERSITY AMONG WOMEN IN THE DISTRICT OF MUNGER

*Diet diversity among women in the district of Munger, evidence from Technical Assistance and Research for Indian Nutrition and Agriculture (TARINA) pilot program*

*A fact sheet developed by TARINA shows that cereals and pulses form the staple diets in Bihar and the intake of micronutrient-rich food among women is below 30 percent.*

**Figure 2.16** | Share of women who consumed non- staples in previous 24 hours



Data source: NFHS- 4 (2015-16)

### 2.3 Transitioning diets

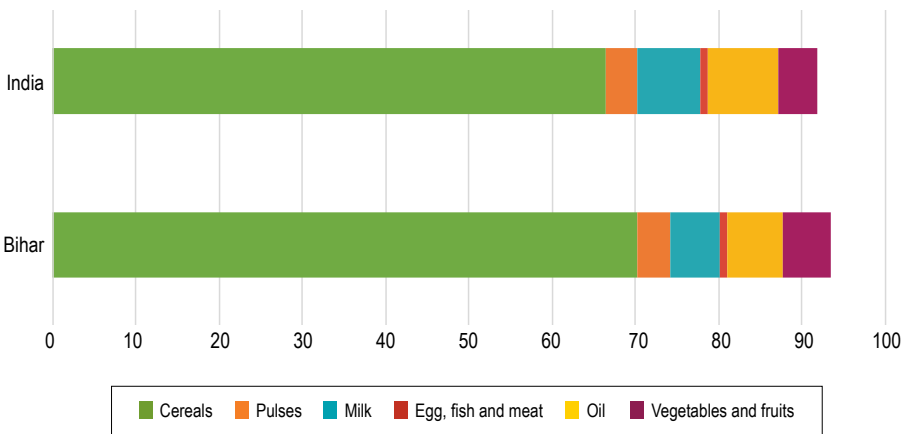
Conventional definitions of food security have focused on ensuring adequate food for populations, so that caloric needs are met. Although outdated, National Sample Survey (NSS) data indicated that cereals accounted for 66 percent of calorie intake in India and 70 percent in Bihar. Vegetables and fruits, milk, and oils accounted for another 6 percent of calorie intake in Bihar, while the share of calories from eggs, fish, and meat was less than 1 percent (Figure 2.17).

Per person per day intakes of energy and protein in Bihar exceed that of the average for the country. However, per capita energy intake has declined from 2,096 kcal to 2,010 kcal from 2004–05 to 2011–12 and is lower than the recommended 2,155 kcal per person per day. Per person per day intake of proteins has remained unchanged at 58.1 g over the same time and exceeds dietary recommendations by 10 g. The intake of fat was 29.7 g per person per day, just above the recommended value of 28 g.

In order to meet SDG2, the focus needs to shift from food security to nutritional security. The latter refers to ensuring that individual diets not only meet basic calorie requirements, but they provide individuals with the required micronutrients as well. This requires that dietary intake be comprised not just of calorie-dense staple cereals, like rice and wheat, but also nonstaple food groups, like dairy, pulses, meats, eggs, fruits, and vegetables, that together are rich in proteins, vitamins, and minerals. Such a focus on nutritious foods is important for Bihar, where diets have been primarily cereal-centric and access to and consumption of nonstaples have been lagging.

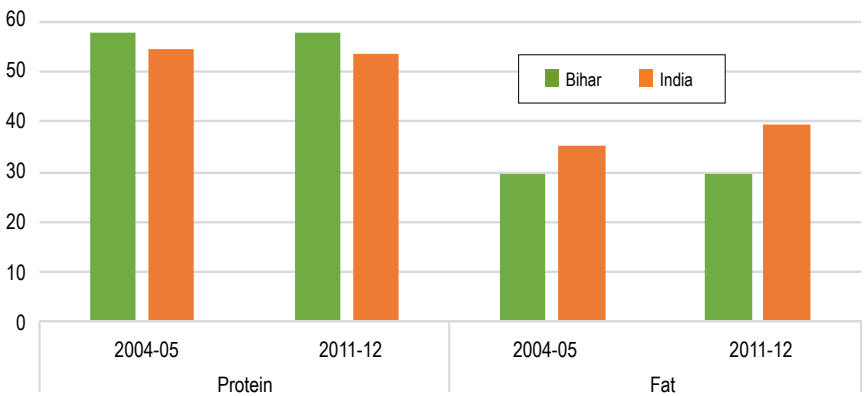
A major constraint to households accessing diverse, nutritious foods is cost. A proxy indicator for food prices examines how much households are spending on different food groups. In Bihar, nearly 60 percent of total household expenditures was on food in 2019. This amounts to Rs. 4453.80 per household per month, on average.

**Figure 2.17** | Share of per capita calorie intake from different food groups in India and Bihar, 2011



Data source: National Sample Survey Office (NSSO), 61st Round (2004-05) and 68th Round (2011-12)

**Figure 2.18** | Trends in per capita intake of protein and fat



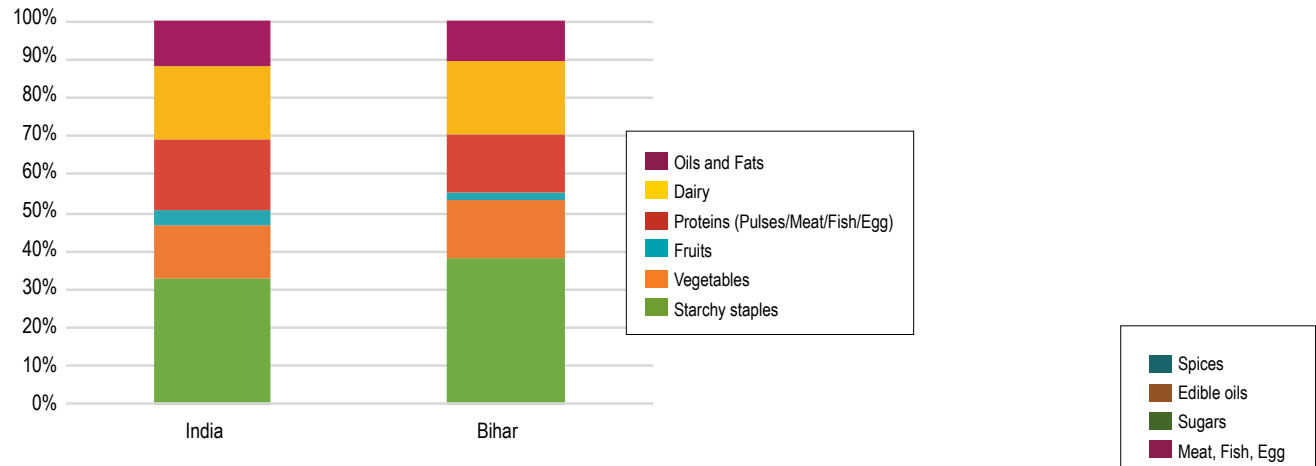
Data source: National Sample Survey Office (NSSO), 61st Round (2004-05) and 68th Round (2011-12)

Cereals, vegetables, and dairy products each account for nearly one-fifth of monthly food expenditures. Fruits account for just 3 percent, while protein-rich foods, like meat, fish, and eggs, make up 15 percent of the total expenditure on food in any given month.

Although the food expenditures described here reflect redistribution toward nutrient-rich non-staples, they are still far below what is required for healthy diets. Food-based dietary guidelines offer a recommended intake of the various food groups required for a healthy diet. Recent estimates suggest

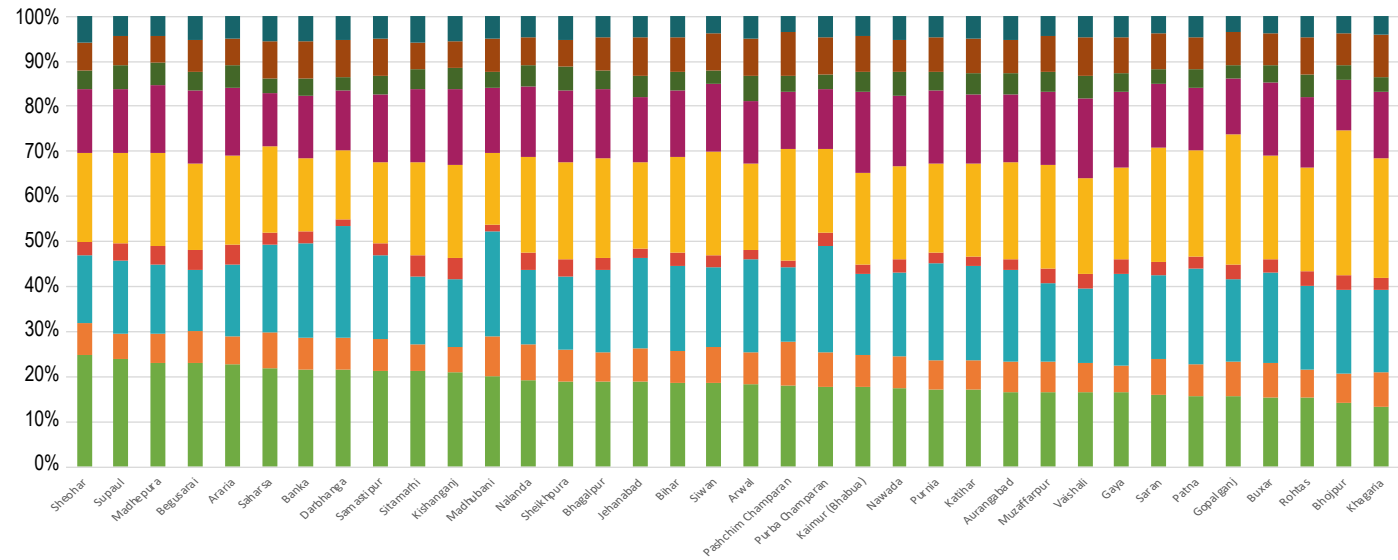
a healthy diet costs approximately US\$3.50 per person per day in India.<sup>13</sup> The role of food prices is implicit in the calculation of such an estimate. To ensure that a nutritious diet is affordable, food systems will need to be reoriented in ways that make such foods accessible and affordable to all. That requires a diversification of production systems, efficient market structures, and complementary strategies, which address intrahousehold food allocation and nutrient absorption. These food system components are discussed in detail in the subsequent sections of this report.

Figure 2.19 | Share of food expenditure on non-staples



Data source: NSSO, 68th round (2011-12)

Figure 2.20 | Composition of monthly food expenditure in Bihar, by district (2019)



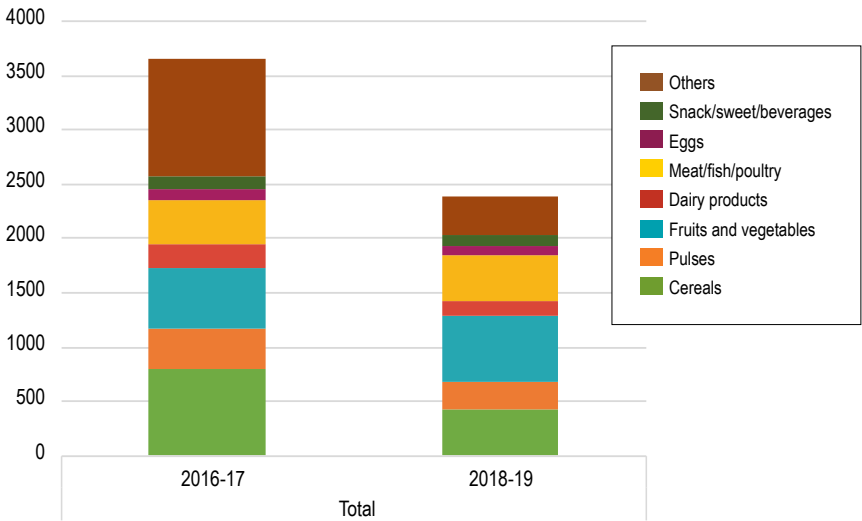
Data source: TARINA Baseline and Midline Survey



Box 2.3 | EXPENDITURES BY FOOD GROUP

Data from TARINA and its baseline and midline surveys suggest similar food expenditure patterns as the state average. Figure 2.21 shows that monthly food expenditures are allocated to different food groups between the two surveys. There is a decline in the share of expenditures on cereals but an increase in expenditures on fruits and vegetables, meats, and other food items.

Figure 2.21 | Share of monthly consumption expenditure of household



Data source: TARINA Baseline and Midline Survey



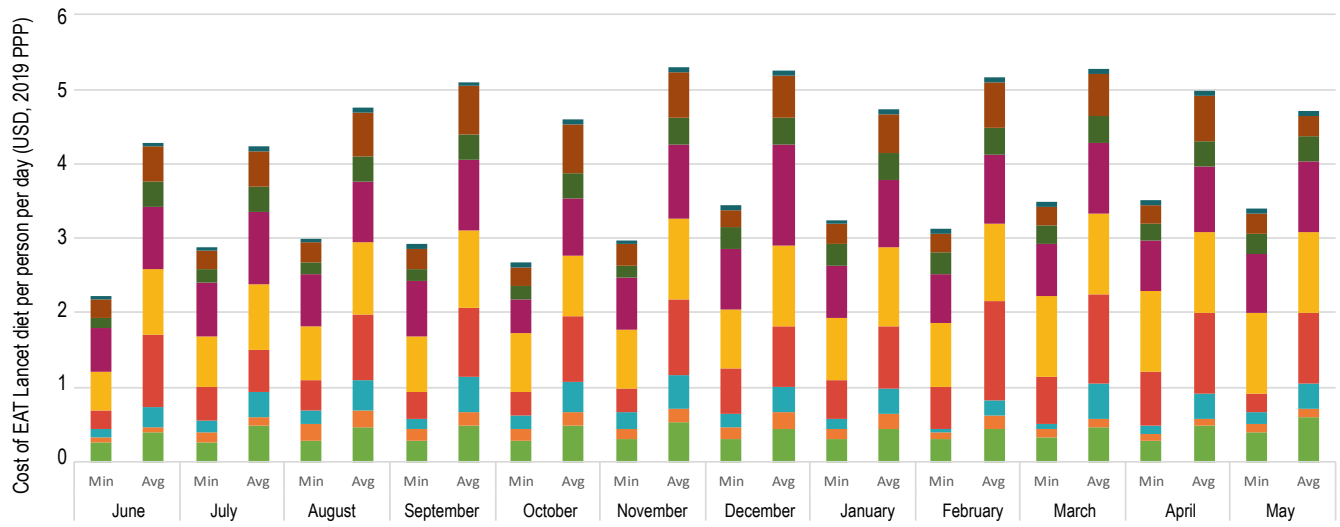
Box 2.4 | COST OF DIETS IN MUNGER FROM TARINA'S MARKET DIVERSITY STUDY

The TARINA market diversity study collected high frequency data on the availability and prices of nearly 250 food items in rural markets (haats) in Munger from June 2018 to May 2019. Using the prices from the study, we estimated how much an individual will have to spend each day to

meet the global dietary recommendations put forward by the EAT–Lancet Commission in 2019.<sup>14</sup> Our results indicate that the EAT–Lancet diet will cost nearly US\$5.00 per person per day if individuals purchase the average cost food items in each food group.

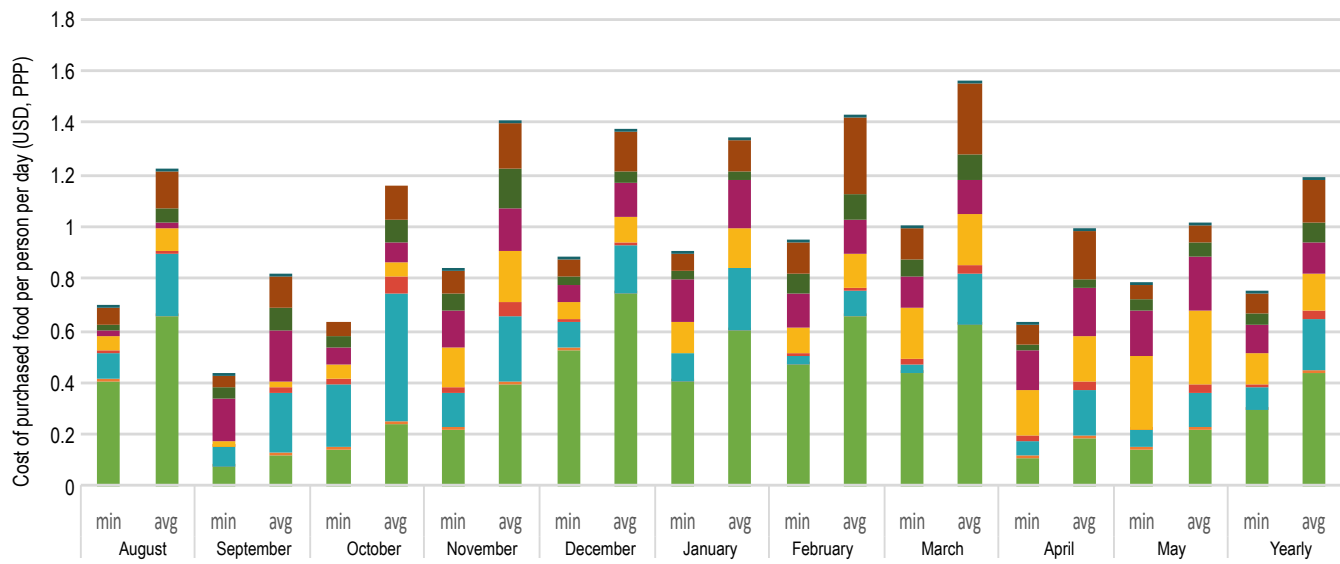


Figure 2.22 | Cost of EAT Lancet diet based on monthly average market prices in rural haats in Munger



Data source: Willett et al. (2020)

Figure 2.23 | Actual food expenditures per person per day

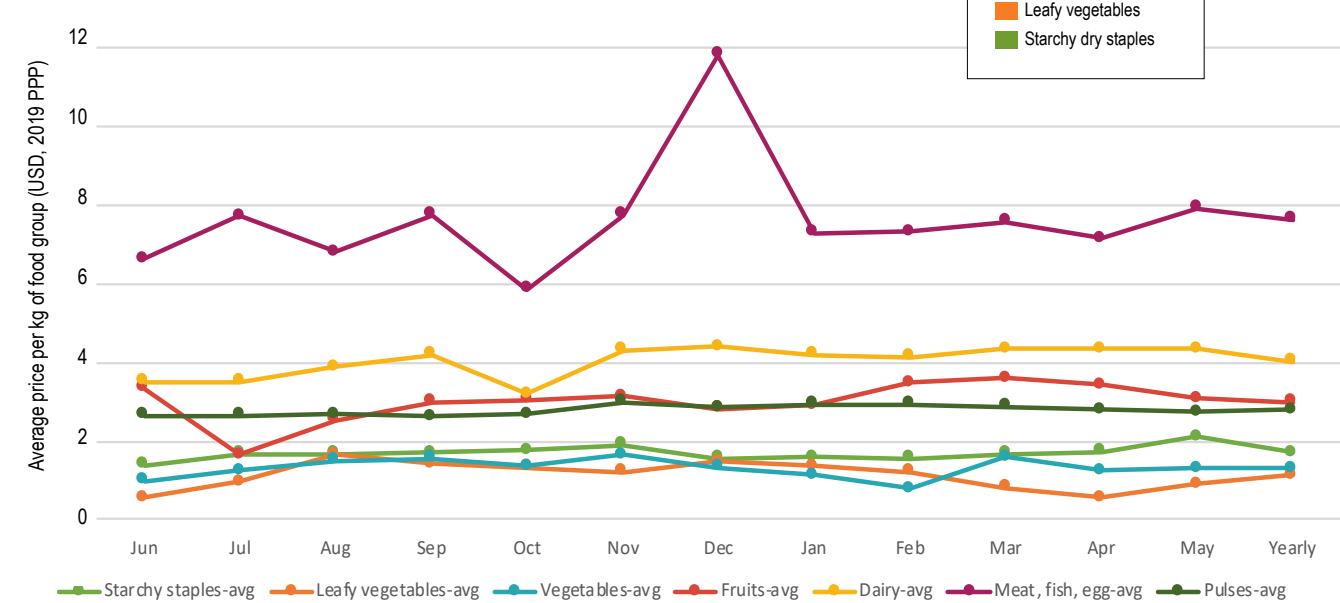


Data source: TARINA, Baseline (2016–17) and Midline (2018–19) Surveys

Households in Munger were spending an average of US\$1.20 per person per day on food purchased from the market. This suggests that, on average, per capita spending on food will have to increase fourfold. The bulk of this increase comes from nonstaples, like leafy vegetables, meats, and dairy products.

The biggest deficit in spending on actual diets, relative to the EAT–Lancet recommendations, is centered around food groups such as meats and dairy, which correspond to the relatively higher market prices for these food groups.

Figure 2.24 | Average food group prices per kg in Munger



Data source: TARINA, Baseline (2016–17) and Midline (2018–19) Surveys

Some of the underlying factors that have resulted in such high rates of malnutrition in Bihar and the rest of eastern India are low levels of agricultural productivity, low per capita GDP with a high share of agriculture in GDP, and urbanization.<sup>15</sup> The rest of this report presents a food systems framework that comprehensively addresses these factors, together with those that determine individual-level nutrient status.

“To ensure that a nutritious diet is affordable, food systems will need to be reoriented in ways that make such foods accessible and affordable to all.”

<sup>14</sup> Willett et al. (2020)  
<sup>15</sup> Pingali et al. (2019)





# 3

## Agriculture–Nutrition Pathways for Achieving the SDG2 Goal in Bihar

In this section, we highlight the four main pathways by which agriculture can influence nutritional outcomes for individuals and households: increased incomes, year-round access to diverse foods, equitable intrahousehold food allocation, and nutrient absorption. The first two of the pathways determine household food access while the latter two are instrumental in determining individual-level nutrition outcomes. For smallholder farmers in India, incomes are a function of productivity, market linkages, and nonfarm opportunities. Household access to diverse foods largely depends on proximity to markets, on-farm diversification, and safety-net programs. Intrahousehold allocation depends on women’s empowerment, while nutrient absorption is determined by factors like clean water and sanitation. Readers are referred to Pingali and Sunder (2017) for a detailed discussion of this framework.

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Livestock grazes on a farm  
in Khopawar, Bihar.  
*Photo by Kiera Crowley.*



### Pathway 1 Agriculture as a source of household income

Nearly two-thirds of India’s population is rural, and one-third of the rural population depends on agriculture as a source of livelihood.<sup>16</sup> In this context, an increase in agricultural productivity can increase incomes, resulting in improved nutritional outcomes. Higher incomes allow rural households to purchase diverse foods, invest in health care and sanitation, and protect against shocks, like those resulting from poor harvests. Rao and Pingali found that, for rural households in India, a 10-percentage point increase in agricultural income was associated with a 0.10 percentage point growth in women’s BMI over a period of four years.<sup>17</sup>

### Pathway 2 Household access to diverse foods

Households can access a nutritionally diverse basket of foods through three main sources: own- production, markets, and safety-net programs. A diversification of production at the farm-level can allow households to access and consume a diverse set of foods throughout the year. Such a relationship, however, is more likely in instances where market integration is less developed, as in many parts of sub-Saharan Africa. Production and consumption decisions decouple as market integration increases, allowing households to purchase foods from local markets, subject to household incomes and market prices. According to Bennet’s Law, as household incomes increase, households spend a greater share of income on nonstaples, resulting in demand for a diversified diet. An increase in the supply of diverse foods in local markets, then, can ensure that diverse foods are available and at affordable prices to the rural poor. In addition to own-production and markets, households also rely on various kinds of safety nets to access food. One example is India’s Public Distribution System (PDS), which provides subsidized staple grains.

### Pathway 3 Intrahousehold food allocation

Which foods are consumed by different members of the household, and in what quantity and frequency, can determine eventual nutritional outcomes. Women often tend to eat last and eat the least. This, in turn, results in poor health outcomes for both women and children.<sup>18</sup> Research indicates that, in India, women’s empowerment in agriculture has a significant association with their dietary intake and micronutrient status, such as iron deficiency.<sup>19</sup> Ensuring women’s input in production decisions, access to resources like credit, and encouraging their participation in self-help groups are avenues for improving empowerment levels. Women’s time use between agriculture and non-agricultural activities is also an important factor that determines nutritional outcomes.

### Pathway 4 Health environment

The health environment refers to the status of sanitation and hygiene in the environment. It helps to determine the absorption of nutrients in the body, and thus, influences final individual-level nutritional outcomes. Behavior change strategies aimed at reducing the prevalence of open defecation and promoting practices like washing hands with soap before eating and sanitizing drinking water can improve the health environment. Furthermore, sustainable agricultural management practices, such as adequate postharvest storage facilities that limit the growth of fungal toxins, can also ensure an environment that is geared toward improved health outcomes.

A food systems approach for improved nutritional outcomes is useful for understanding and addressing the interlinkages between various SDGs and their sub-goals. Pathways 1 and 2 directly

align with SDG2.3 (double agricultural productivity and incomes of smallholder farmers) and SDG2.4 (resilient agricultural practices that increase productivity and production). Pathways 3 and 4 align more closely with other goals of the SDGs and eventual nutritional outcomes of SDG2. The goals of SDG6, involving water and sanitation, as well as the targets for maternal and child health within SDG3, are strongly linked to Pathway 4. Similarly, Pathway 3 is linked to the goals of SDG5 for achieving gender equality and women’s empowerment. While Pathways 1 and 2 are sufficient from a food-security perspective, it is in conjunction with Pathways 3 and 4 that agriculture can effectively influence nutritional security.

In subsequent sections, each pathway will be discussed in detail, with supporting state- and/or district-level data, together with evidence from the TCI–TARINA experience.

Figure 3.1 | Agriculture–nutrition pathways

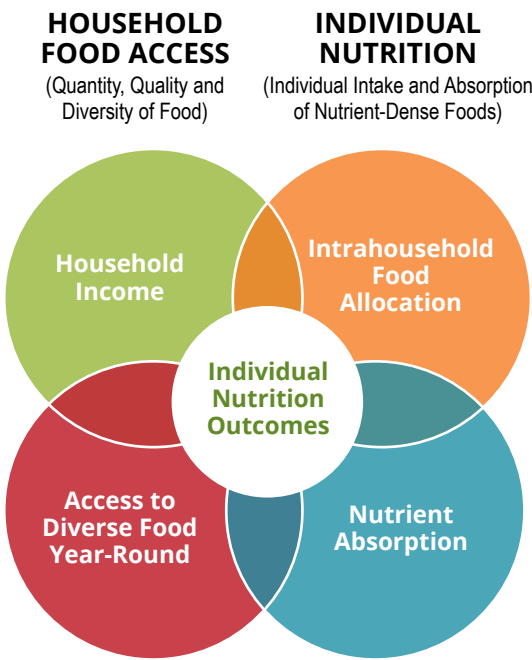
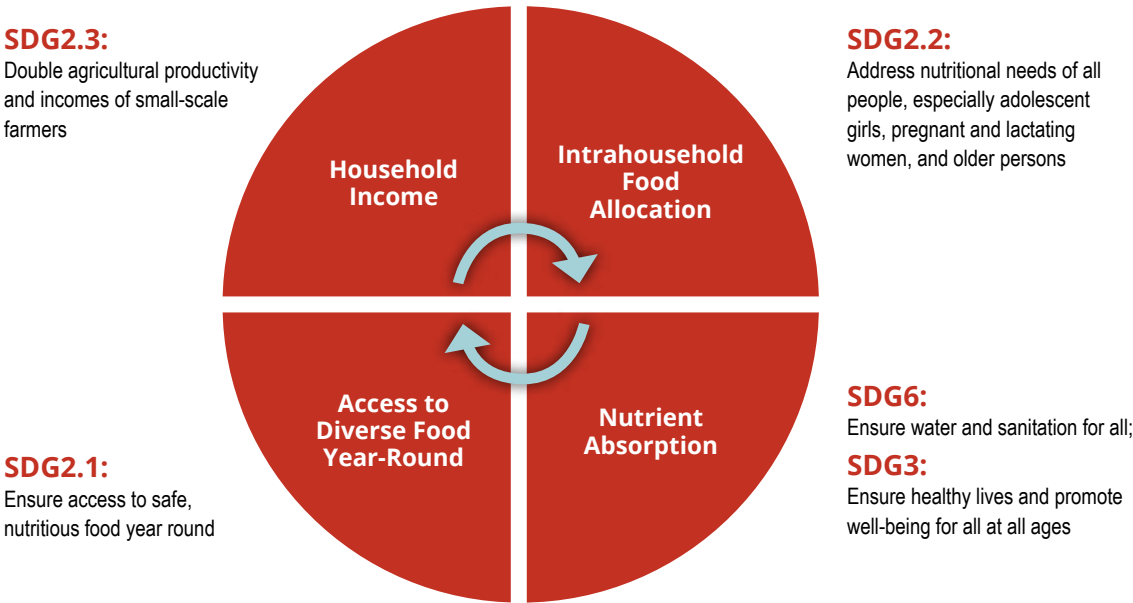


Figure 3.2 | Mapping SDG2 to the agriculture–nutrition pathways



<sup>16</sup> Crowley and Rahman (2020)  
<sup>17</sup> Rao and Pingali (2018)

<sup>18</sup> Harris-Fry et al. (2017); Pingali and Rao (2017)  
<sup>19</sup> Gupta et al. (2019a, 2019b)





# 4

## Agriculture in Bihar: Cereal-Centric, Smallholder Cropping System

Bihar's Economic Survey 2019–20 notes, "Agriculture is the mainstay of economies such as Bihar, underpinning their food security, rural employment and rural development." The sector accounts for one-fifth of the gross state value-added. Even though the share of agriculture in gross state domestic product (GSDP) has declined from 36 percent in 2000–01 to 20 percent in 2017–18, the sector continues to be an important source of employment for more than 70 percent of the population.

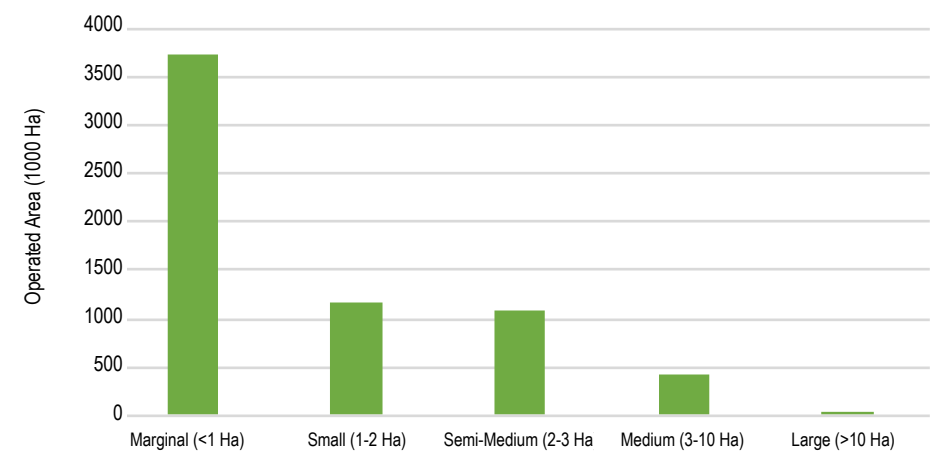
Crop cultivation in Bihar is predominantly carried out by "small" or "marginal" farmers, defined by the Indian government as those who own 1–2 ha or less than 1 ha of land, respectively. In Bihar, 97 percent of operational holdings are small or marginal. The number of marginal landholdings, and area under them, have consistently increased since the 1970s, mirroring the national-level trend. The average area of small and marginal landholdings in

Bihar—0.25 ha and 1.25 ha, respectively—is lower than the all-India averages of 0.38 ha and 1.40 ha. Taken together, these two categories of landholding account for 75 percent of the area under operational landholdings in the state. The share of gross cropped area in landholdings <1 ha is at least 50 percent in every district.

A field of rapeseed in Bihar.  
Photo by Mathew Abraham.

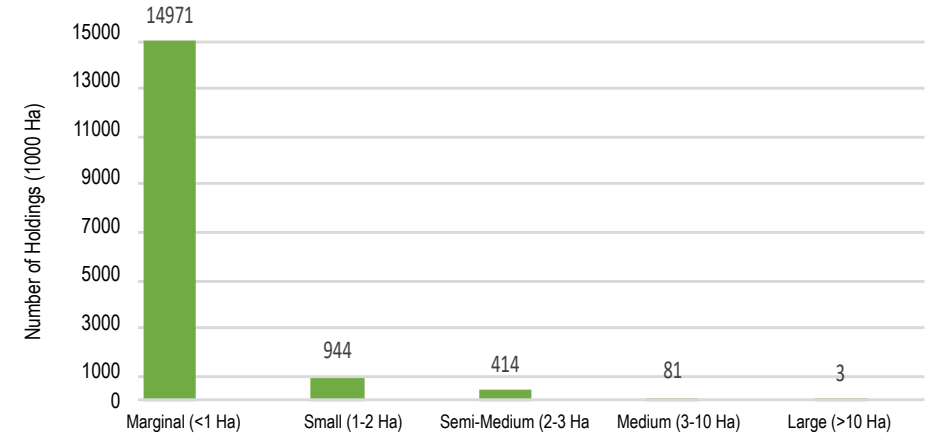


**Figure 4.1 (A)** | Area of landholdings, by size category in Bihar



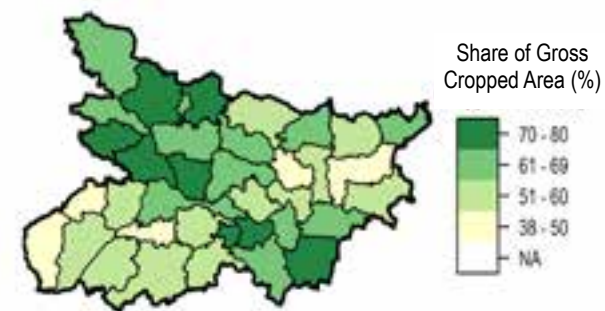
Data source: Agricultural Census 2015–16

**Figure 4.1 (B)** | Number of landholdings by size category in Bihar



Data source: Agricultural Census 2015–16

**Figure 4.2** | District-level % gross cropped area under small and marginal landholdings

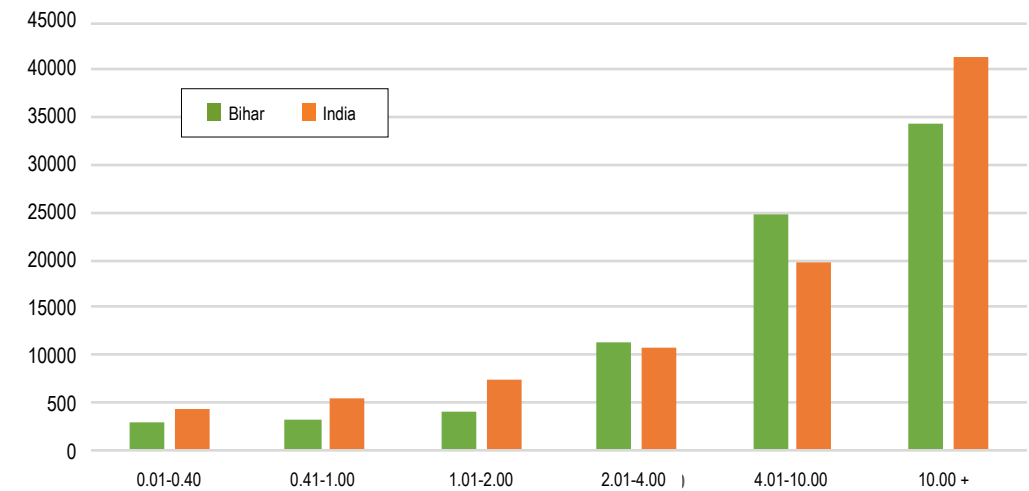


Data source: All India Report on Input Survey (<https://inputsurvey.dacnet.nic.in/statetables.aspx>), 2011–12

There is a clear relationship between land size and incomes. Across India, districts with a greater proportion of cropped area under marginal landholdings are in the states where the per capita agricultural incomes are the lowest.<sup>20</sup> The average monthly income of agricultural households in Bihar was INR 3,558 in 2012–13. It was around INR 3,000 for households with small or marginal landholdings (<1 ha), while households that own 2 ha or more of land have incomes nearly three times that amount.

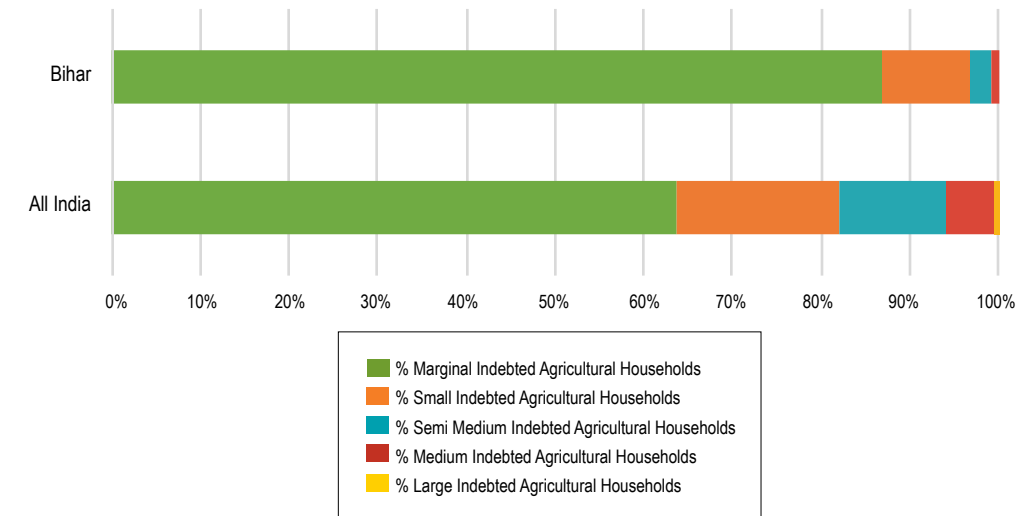
Marginal agricultural landholders have the most debt, compared to other categories of landholdings. In India, around two-thirds of marginal households are indebted, but in Bihar the number of households is close to 90 percent.

**Figure 4.3** | Average monthly income of agricultural households (INR) by land size (Ha)



Data source: National Sample Survey Office (NSSO) situational analysis of agricultural households, 2012–13 (also in Pocket Book of Agricultural Statistics 2019)

**Figure 4.4** | Incidence of indebtedness by size of landholding



Data source: NSSO situation analysis of agricultural households, 2012-13

<sup>20</sup> Crowley and Rahman (2020)



With smallholder farming as the dominant form of production in Bihar, household income is determined by smallholder productivity, market linkages, and nonfarm opportunities. Small farms face numerous challenges in production, especially in terms of access to essential factors of production, such as credit, inputs, information, and production technologies, in addition to poor access to output markets. Addressing these challenges is crucial for agricultural development and for successfully achieving SDG2.

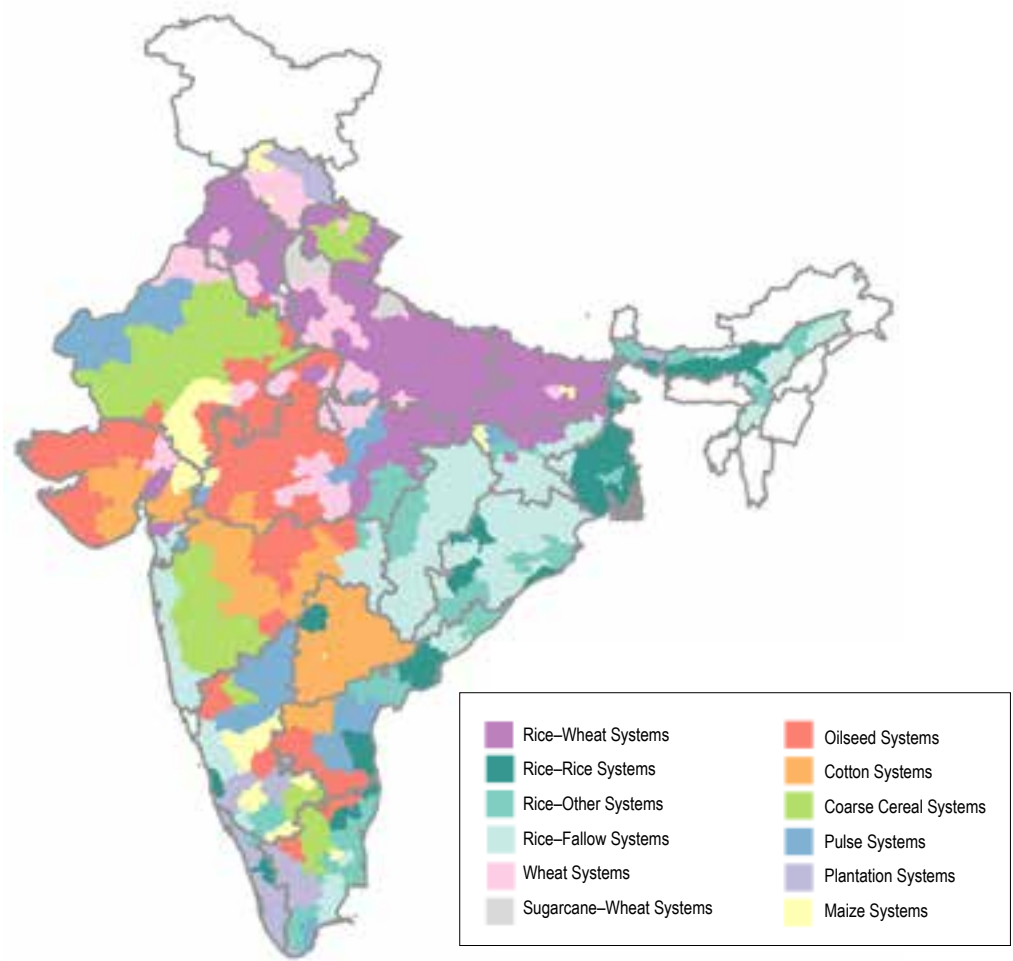
Bihar’s predominantly small-holder farming is centered around two key staple cereals: rice and wheat. Such a rice–wheat crop-ping system is

characteristic of the nearly 13.5 million hectares of land in the Indo-Gangetic Plain (IGP) that stretches from Pakistan in the west to Nepal and Bangladesh in the east.<sup>21</sup> The term “cropping system” is used to characterize the crops grown in a given region, both spatially and temporally. Located in the Eastern IGP (EIGP), crop cultivation in Bihar is dominated by sequential rice–wheat cultivation.

Cereals account for nearly 90 percent of the gross cropped area in Bihar. Of that, more than 70 percent is rice and wheat. The staples also account for nearly 70 percent of the total food grain production in the state.

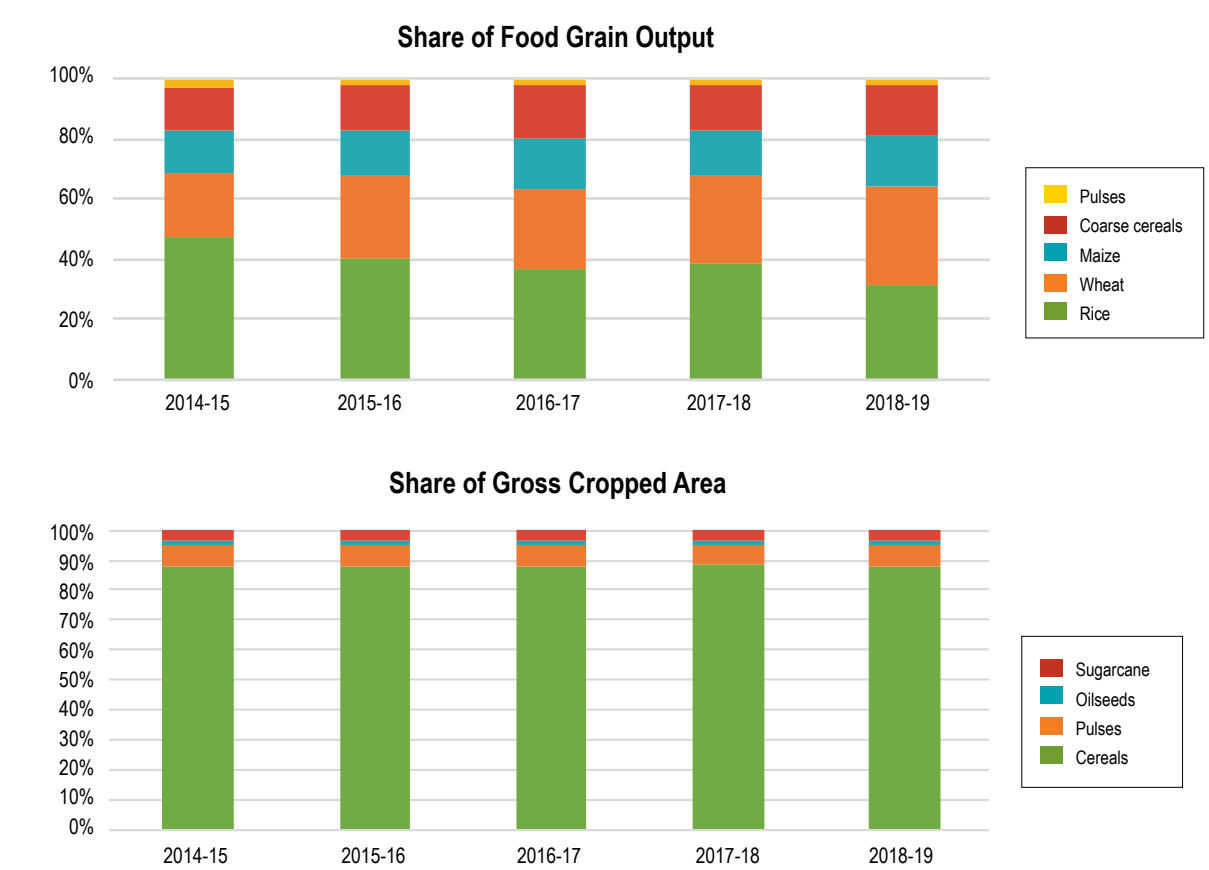
Such a rice–wheat cropping system is the result of underlying agroclimatic and topographical factors in Bihar. The Ganges demarcates the state into two halves: North Bihar, which is more densely populated, predominantly agrarian, and flood-prone; and South Bihar, which reflects a mix of agricultural and industrial activities and is largely drought-prone. North Bihar consists of two agroclimatic zones: the northwest alluvial plain and the northeast alluvial plain, both of which receive more rainfall relative to the agroclimatic zone of the South Bihar alluvial plain. The differences in rainfall, temperature, and soil underlying these different agroclimatic zones are important determinants of land use patterns within the state and associated cropping systems that, in turn, influence food and nutrition security, as well as environmental sustainability. (Details are in the Appendix.)

Figure 4.5 | Dominant cropping systems in India



Source: Crowley and Rahman 2020: FAN Report.  
Data source: Government of India. Accessed through the ICRISAT–TCI District Level Database, 2015 district boundaries.

Figure 4.6 | Rice–wheat cropping system in Bihar



Data source: Bihar Economic Survey 2019-20

Nearly half of the state's total rice output is cultivated in the southwest agroclimatic zone in Bihar. Another 25 percent of output originates in the northwest zone. The northeast and southeast zones account for one-fifth of rice production, while the northeast zone accounts for the smallest share of rice output, at 12 percent. For these two zones, the share of area under rice cultivation is the same as their share of rice output. The northwest and southwest zones account for nearly 40 percent and 30 percent of the area under rice cultivation, respectively. In contrast to rice, each agroclimatic zone's share of wheat production is nearly identical to its share of area under wheat cultivation. Production is centered primarily in the northwest zone. Cultivation of maize is concentrated in the northeast agroclimatic zone. It accounts for nearly two-thirds of the total maize output, spread over nearly half of the area used for maize cultivation in Bihar.

There are variations in output and productivity across different types of crops (Figure 4.9). The increase in cereal production has largely stemmed from an increase in output and productivity of wheat and maize (for maize, these increases are predominantly in the rabi season, while output and productivity of rice has decreased in each of the three cultivating seasons. It will be interesting to examine further if the reduction of rice is being replaced by the increased production of wheat (Figure 4.9). Pulses have not seen significant yield improvements over the period 2014–19.

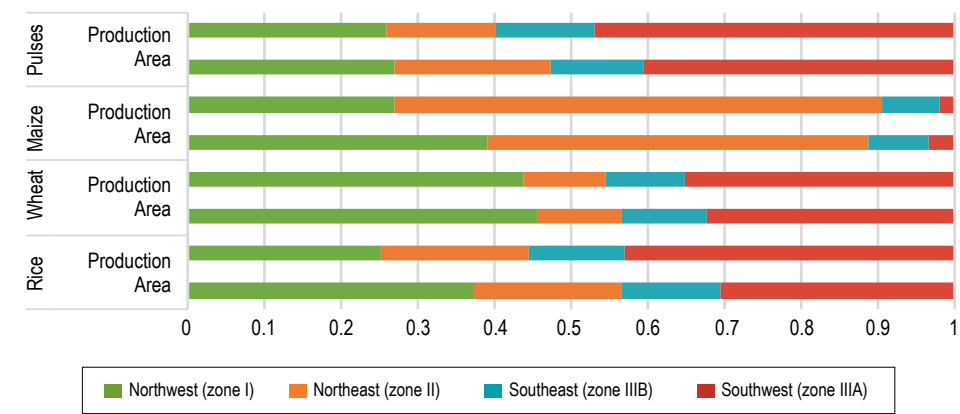
The cereal-centric, smallholder farmer-driven agriculture in Bihar has implications for both nutrition security (SDG2) and environmental sustainability (SDG12, SDG13). Agroclimatic variations within Bihar will eventually determine the growth of incomes and yields in the agricultural sector. The potential for increasing farmer incomes by improvements in yields and diversification of the cropping system is presented in the next chapter.

Figure 4.7 | Agroclimatic zones in Bihar



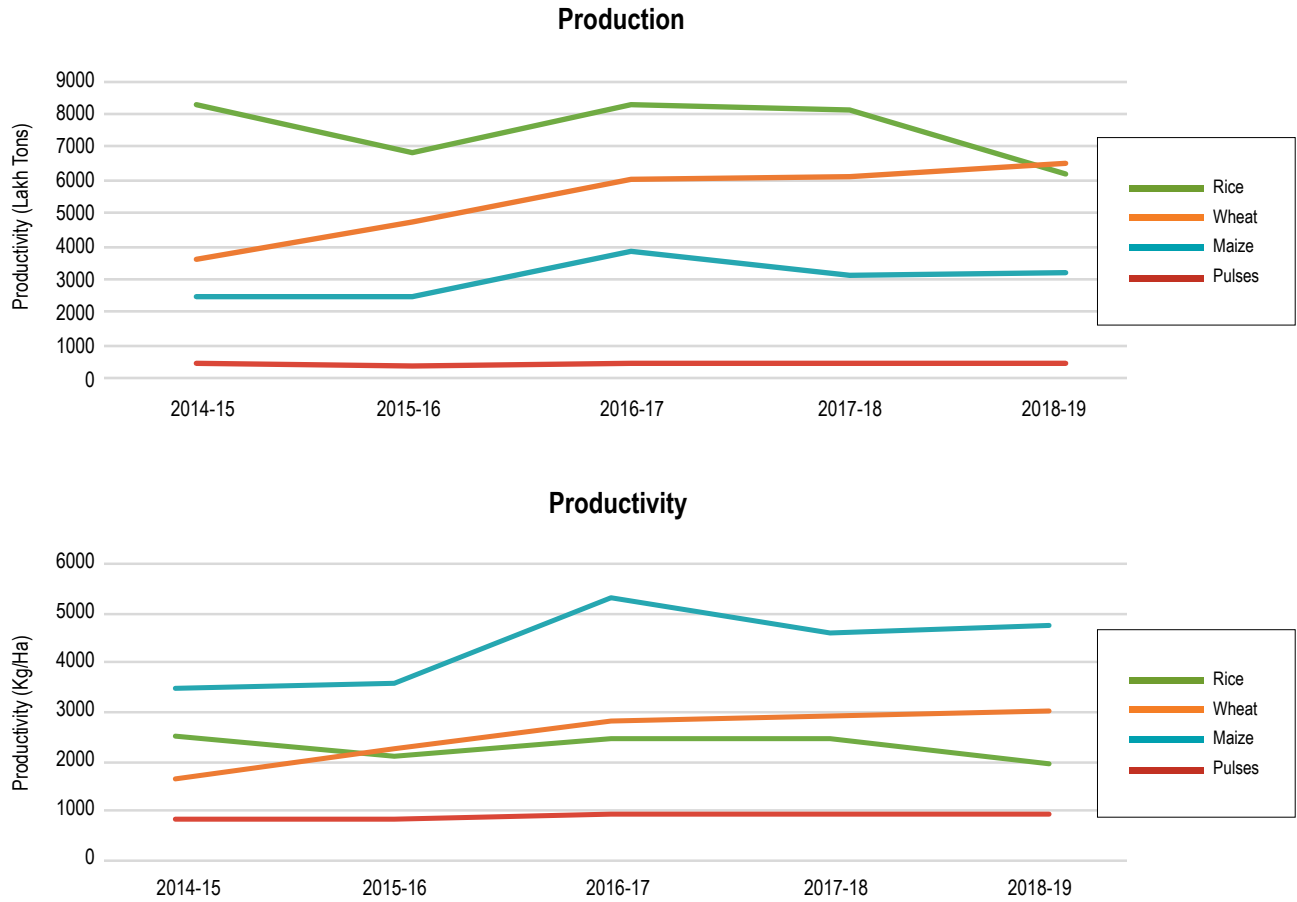
Data source: Agricultural Mechanization Guide for Bihar (2011): <http://farmech.dac.gov.in/FarmerGuide/BI/index1.html>

Figure 4.8 | Distribution of major food crops (area, output) by agroecological zones in Bihar



Data source: Bihar Economic Survey 2019-20

Figure 4.9 | Production and productivity levels of major food crops in Bihar



Data source: Bihar Economic Survey, 2019–20





A man sells vegetables at a market in Munger district, Bihar.  
Photo by Mathew Abraham.

# 5

## The Income Pathway— Doubling Incomes While Reducing Risks

Doubling the incomes of smallholder farming households is a key area of focus, both of the SDG2 and for the Indian government. SDG2.3 calls for doubling incomes of small-scale farmers by 2030, placing particular importance on smallholders. In the case of crop agriculture, income growth could come from increasing yields, intensification of cultivation—growing two or three crops per year on the same piece of land—or increasing the efficiency of input use, thereby raising total factor productivity. Presumably, all these strategies would lead to an increase in farm incomes. Income growth-oriented strategies should also include production system diversification for crops and livestock, improved market access, and enhancement of rural nonfarm employment opportunities.

In this chapter, we focus on incomes from crop production and animal farming. For agricultural households in Bihar, as throughout India, these two areas account for nearly 60 percent of the average monthly income of agricultural households. Data from 2012–13 suggest that agricultural income in Bihar is almost half of the national average. The average monthly income from agricultural activities was INR 1,994 for Bihar in the year 2012–13, whereas it was INR 3,844, on average, throughout India.



Crop cultivation is the main source of income for small and marginal agricultural households in Bihar, accounting for nearly half of the average monthly income of agricultural households (2012–13). Conversely, small farmers reported negative returns from animal rearing, demonstrating a need for more support for the activity (Figure 5.1).

### 5.1 Increasing productivity of staple cereals

An improvement in crop yields can act as a catalyst for improving nutritional outcomes through the income pathway, wherein higher yields can allow farmers to earn higher incomes from the production of a greater marketable surplus. In this respect, Bihar’s Third Agricultural Roadmap (2017–22) aims to create an environment geared toward profitability and sustainability of farming, while ensuring food and nutritional security.

The Green Revolution (GR) significantly increased the productivity of the rice–wheat cropping system. Much of these gains, however, were concentrated in the Western Indo-Gangetic Plain (WIGP), in states like Punjab and Haryana. In contrast, gains from the GR were low in the EIGP, a region that is characterized by high population density, smallholder farming, poor market infrastructure, low access to new technologies, and climatic variations.<sup>22</sup> While there has been a steady increase in rice yields in the state, they are lower than yields found in the rest of the country, particularly in the WIGP. Wheat is the main rabi crop in Bihar, and the productivity levels have increased in the last five years. However, the levels remain below average for India and the WIGP.

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Viewed from the district level, the differences in cereal yields between the Western and Eastern IGP appear more nuanced. Data from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) indicate that rice yields are highest in Punjab and Haryana at 3.8 tons/ha and 2.7 tons/ha, respectively. In comparison, rice and wheat yields in Bihar fall below 2.7 tons/ha and 2.4 tons/ha, respectively, in most districts.

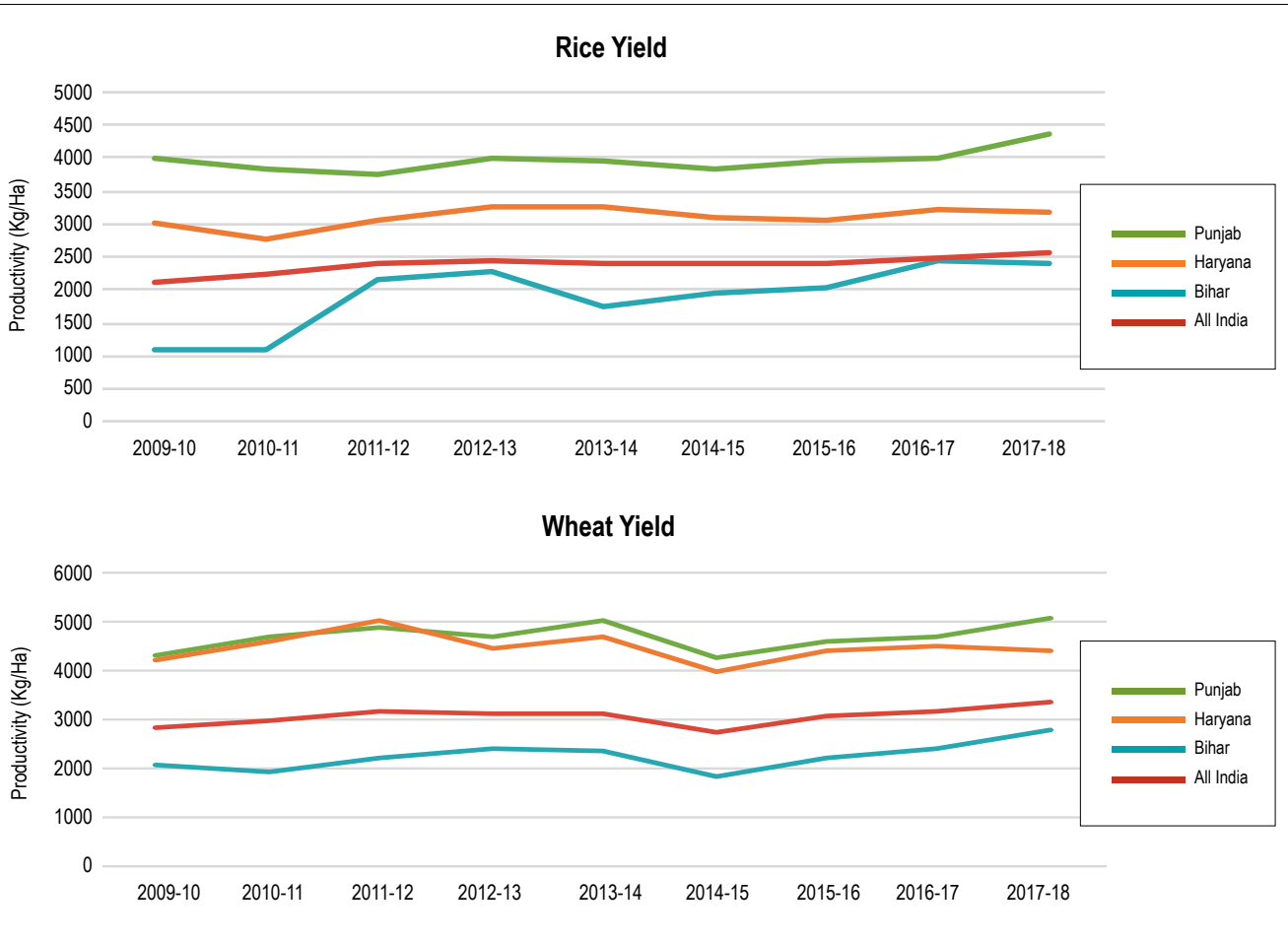
Yields are a function of several factors, including climate, investment in rural infrastructure, and availability of various inputs of production. A recent analysis of Bihar’s agricultural sector examines the contribution of different sources—area, prices, diversification, and yields—to crop output growth for Bihar for the period 2001–2017.<sup>23</sup> The researchers found that the role of yields was an important determinant of growth in output, especially for staples like rice and wheat. However, for improvements in yields to translate into increased incomes, the report identifies two binding constraints that need to be addressed: (1) ensuring stability in crop yields in the face of factors like weather, technologies, and occurrence of pests and diseases; and (2) ensuring adequate price realization and appropriate market linkages. Next, we discuss each of these constraints, first at the level of the state, and then at the district level, for rice and wheat.

A sustained increase in crop yields in Bihar will depend on inputs of production, like irrigation, mechanization, and the use of fertilizers. The availability of, and access to, adequate and timely irrigation is an important issue. Farmers need to have access to the right amount of irrigation at the right time for yield improvements to be realized. At 70 percent, the irrigated area cultivated for food grains is lower in Bihar (70 percent) than the nearly 100 percent coverage in Punjab and Haryana. The share of gross cropped area in the state that is irrigated has increased from 67.45 percent in 2011–12 to 72 percent as of 2017–18.<sup>24</sup>

Tube wells are the largest source of irrigation in each agroclimatic zone in Bihar and covered 63 percent of the total gross irrigated area in the entire state as of 2018.<sup>25</sup> The high share of tube wells is associated with overexploitation of groundwater resources and an associated decline in the water table. A lack of adequate power is a major constraint in expanding the area under groundwater irrigation.<sup>26</sup>

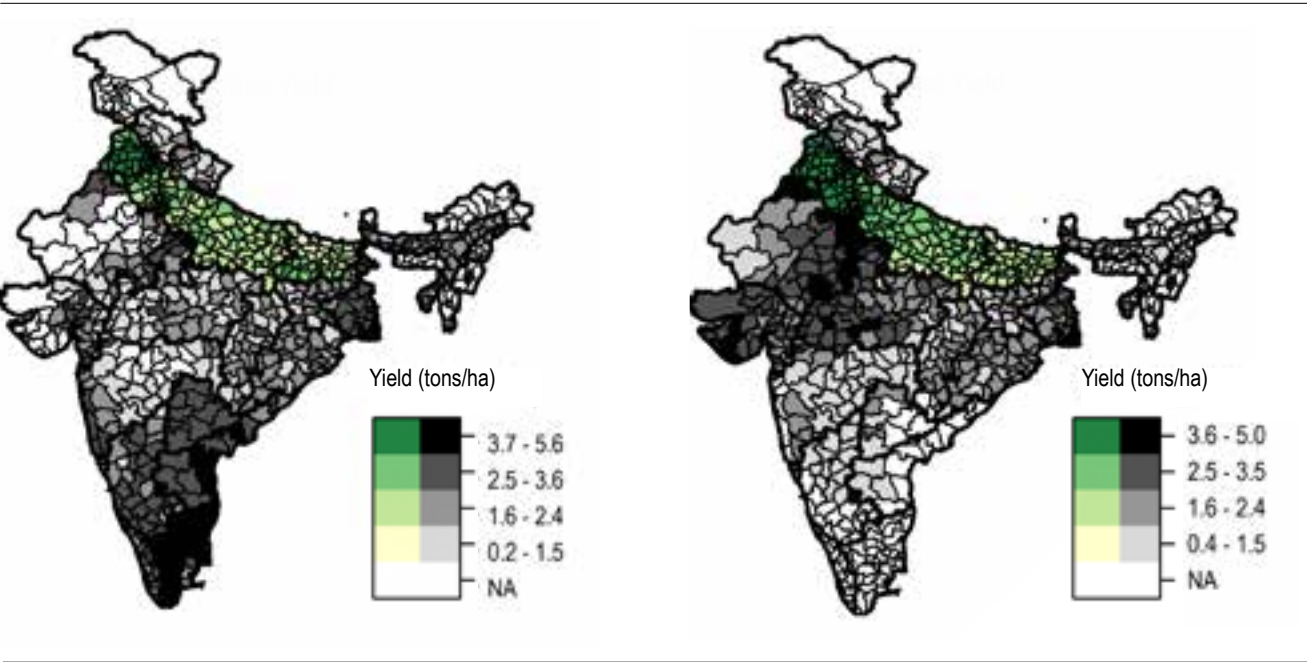
The importance of irrigation for yield stability is, in large part, because of the rainfed nature of crop cultivation in Bihar. Climate plays a big role in determining crop yields in the state. Even though the state is endowed with fertile soils and abundant water, extreme weather patterns have adverse impacts on the stability

Figure 5.2 | Comparison of rice and wheat yields in the IGP



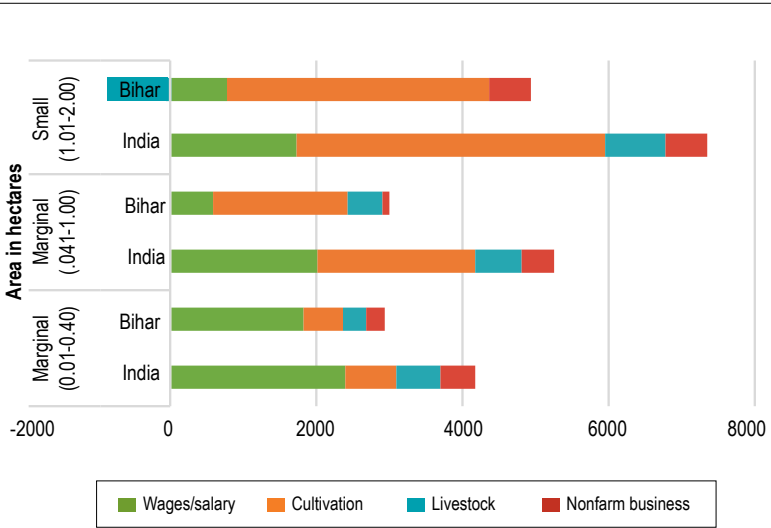
Data sources: Ministry of Statistics and Programme Implementation (MoSPI) Agriculture Statistical Yearbook 2018 and Pocketbook of Agricultural Statistics 2019.

Figure 5.3 | District-level rice and wheat yields in the Indo Gangetic Plains, 2013-15



Data source: TCI- ICRISAT District Level Database

Figure 5.1 | Sources of income for small and marginal agricultural households (area in ha)

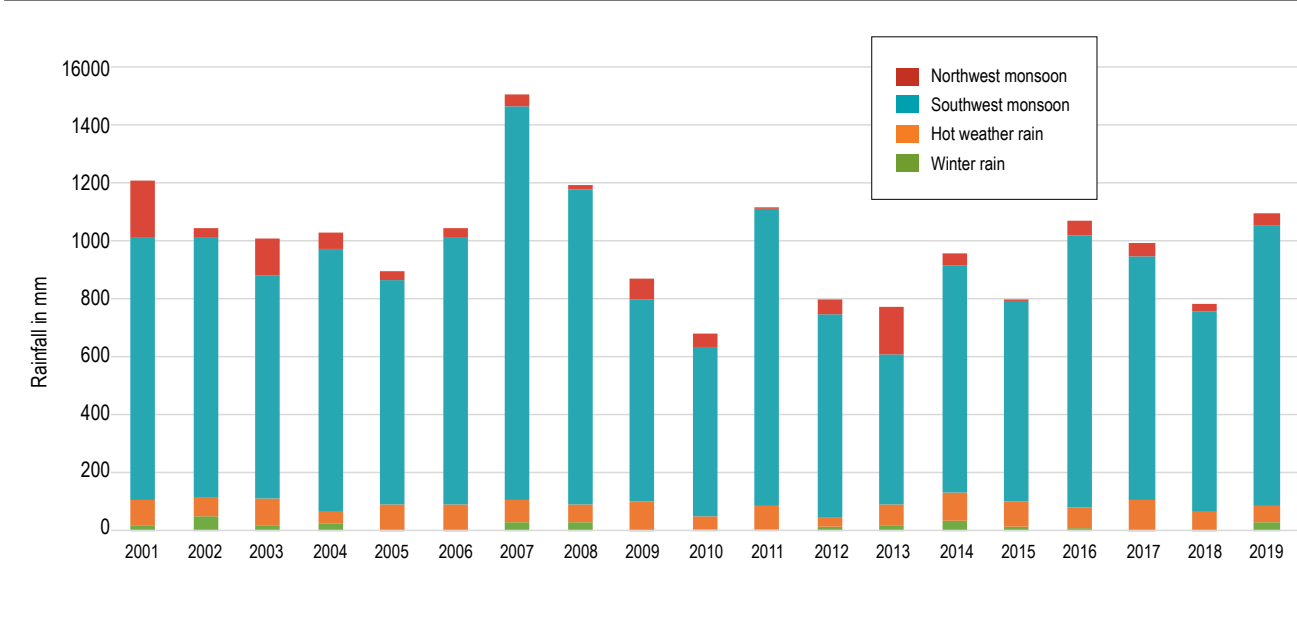


Data source: National Sample Survey Office (NSSO) Situational analysis of agricultural households, 2012–13



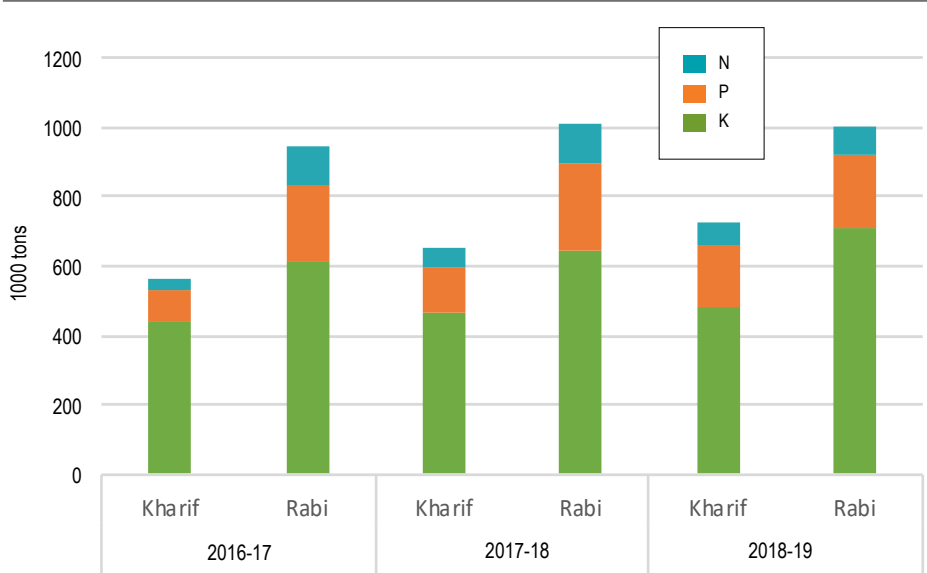
“While there has been a steady increase in rice yields in the state, they are lower than yields found in the rest of the country, particularly in the Western Indo-Gangetic Plain.”

Figure 5.4 | Trends in annual rainfall in Bihar (mm)



Data source: Bihar Economic Survey, 2019–20

Figure 5.5 | Fertilizer use in Bihar



Data source: Bihar Economic Survey, 2019–20

of yields of rainfed crops like rice and wheat. The erratic nature of rainfall is reflected in the occurrence of droughts in the eastern parts of the state and floods in the northern districts. Crop yields are also constrained by way of ineffective use of rainwater, lack of rainwater harvesting, and inefficient use of irrigation water.<sup>27</sup> Addressing these issues requires investments in irrigation infrastructure, including flood and watershed management.<sup>28</sup>

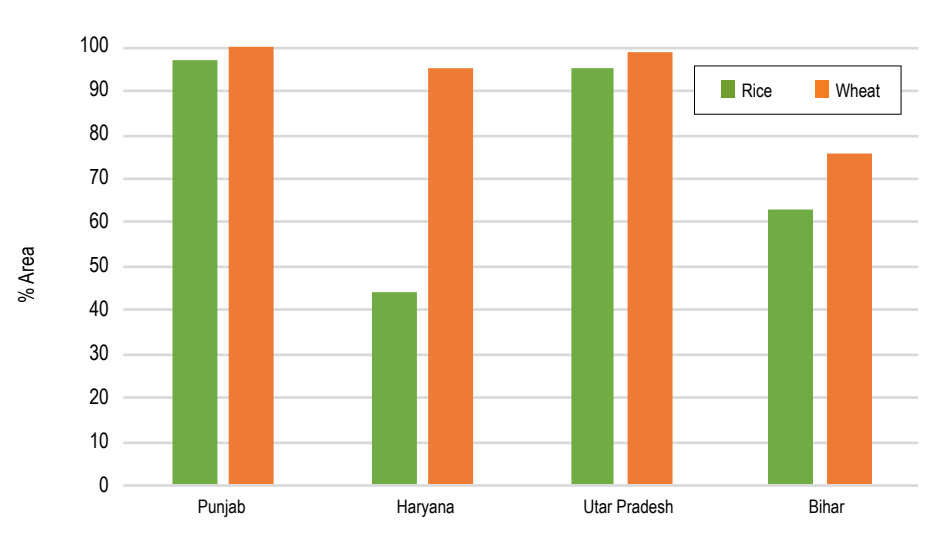
The availability and use of other inputs, like fertilizers, pesticides, and seeds, also determine crop yields. The use of fertilizers in Bihar is high, at 201 kg/ha in 2018–19, with seasonal variations of 224 kg/ha in rabi and 177 kg/ha in kharif. Nearly half of the total fertilizer used is urea. However, the disproportionate use of nitrogenous fertilizers (N),

relative to phosphorus (P) and potassium (K) (Figure 5.5), has contributed to imbalanced nutrient use and associated deficiencies in the availability of micronutrients in the soil. Fertilizer policies should be reoriented to correct such an imbalance and support the achievement of increased yields in a sustainable manner.

Crop yields are also a function of the quality of seeds. The adoption of high-yield varieties of rice and wheat seeds was higher in the Western IGP than the Eastern IGP, contributing in part to low productivity in the east.

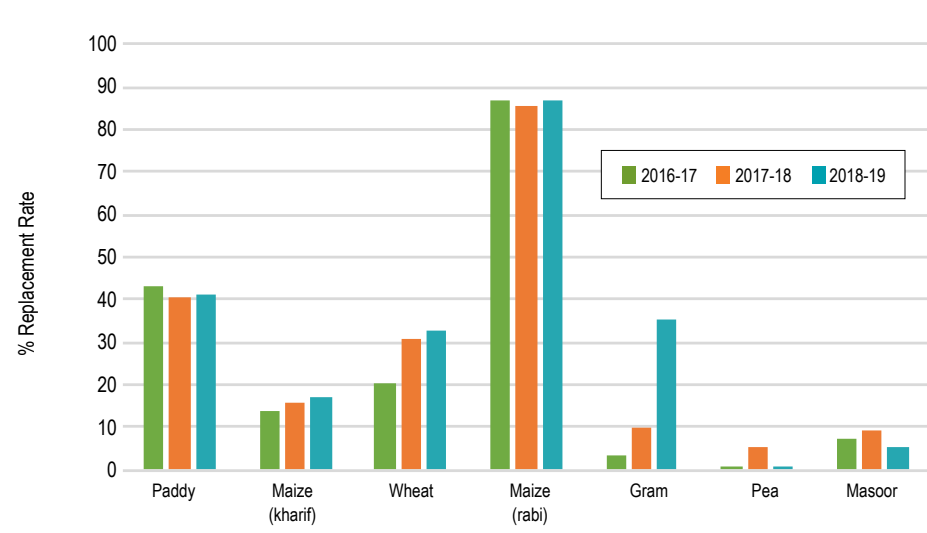
In Bihar, seed replacement rates for paddy and wheat are below 50 percent, in contrast to those for maize, which are close to 90 percent. Pulses, too, are characterized by a low seed replacement rate (Figure 5.7).

Figure 5.6 | Rates of adoption of high-yielding varieties for rice and wheat in IGP



Data source: Bihar Economic Survey, 2019–20

Figure 5.7 | Seed replacement rates for major food crops in Bihar

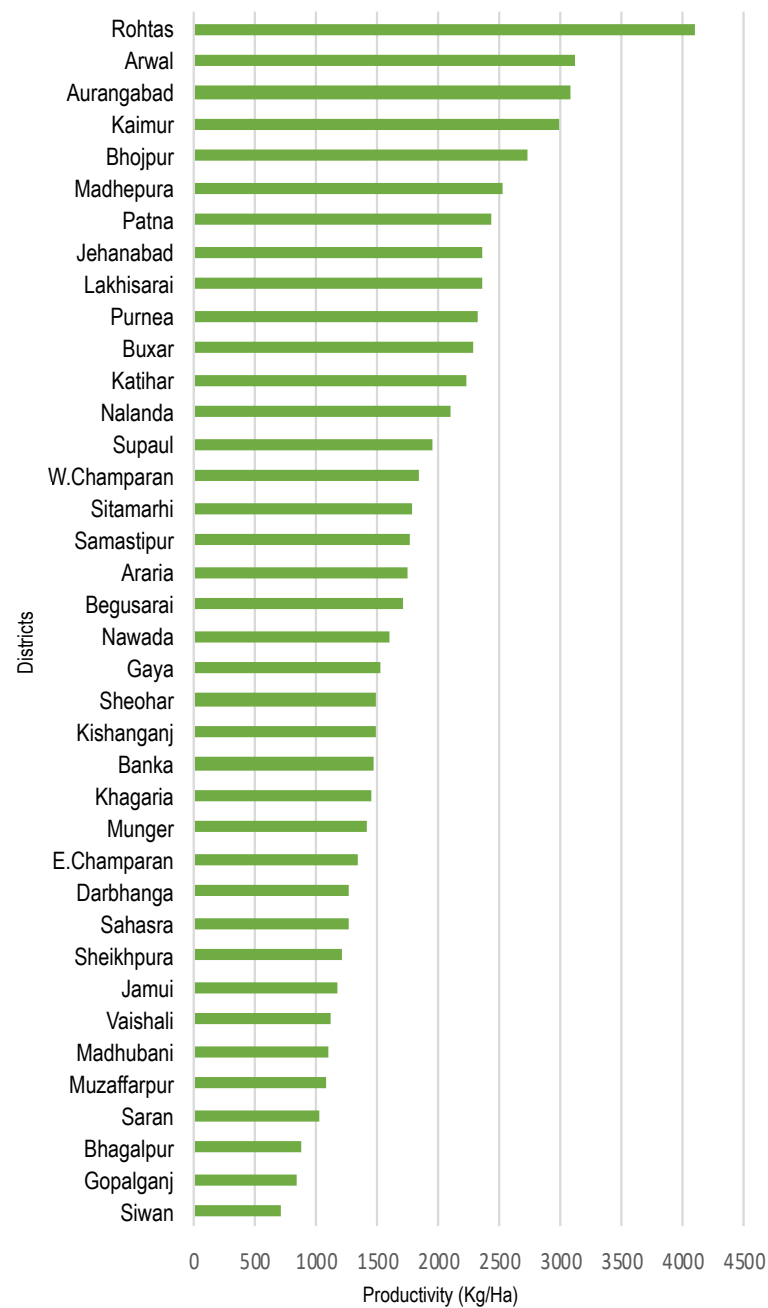


Data source: Bihar Economic Survey, 2019–20

<sup>27</sup> Najmuddin et al. (2018)

<sup>28</sup> NCAER (2019)

Figure 5.8 | Rice yields, by district (2018–19)



Data source: Bihar Economic Survey, 2019–20

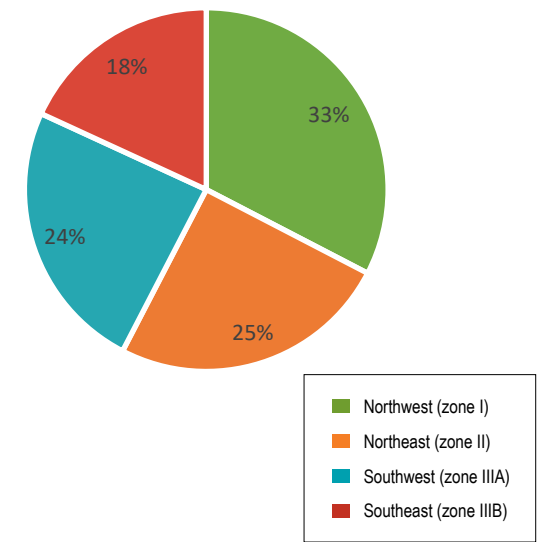
Finally, crop yields also depend on agricultural practices like the timing of planting and seed spacing.

There is considerable district-level variation in the yields of staples and pulses within Bihar.<sup>29</sup> These variations can be understood in terms of the underlying differences in factors like climate, irrigation infrastructure, and availability of inputs in each of the four agroclimatic zones. Next, we discuss yield potential and constraints to growth for rice and wheat at the district level.

**Rice** is the main kharif crop and is cultivated across all districts in Bihar. Rice yields are highest in the southwestern districts, exceeding 2,500 kg/ha in Rohtas, Arwal, Aurangabad, Kaimur, and Bhojpur. The lowest rice yields are in the northwest and southeast zones of the state.

These differences are a function of climate and irrigation facilities. The southwest zone receives sufficient southwest monsoon showers while the northern districts often face flood-like conditions. This is reflected in the low yields seen in flood-prone districts like Siwan and Gopalganj in the northwest zone. Rice yields are also low in Bhagalpur, which is in the southeast and prone to drought. The incidences of flood and drought have been associated with significantly lower water productivity for rice in

Figure 5.9 | Distribution of southwest monsoon by agroclimatic zones



Data source: Bihar Economic Survey, 2019–20

<sup>29</sup> GoB (2020)

Bihar. Flood-prone areas are constrained by water logging and a poor drainage system. Drought-prone areas are constrained by inadequate water conservation. In this context, crop management practices, such as establishing and holding to an optimum date for transplanting rice; adopting hybrid rice varieties that are shorter duration, and therefore, less susceptible to drought; supplemental post-establishment irrigation; and/or direct seeding of rice, show promise for increasing rice yields.<sup>30</sup> Examples of stress-tolerant, high-yield varieties are Swarna Sub 1 and Varshadhan for flood conditions and Sahbhagidhan cultivars for drought conditions.<sup>31</sup> Adequate supply of such improved cultivars will have to be ensured.

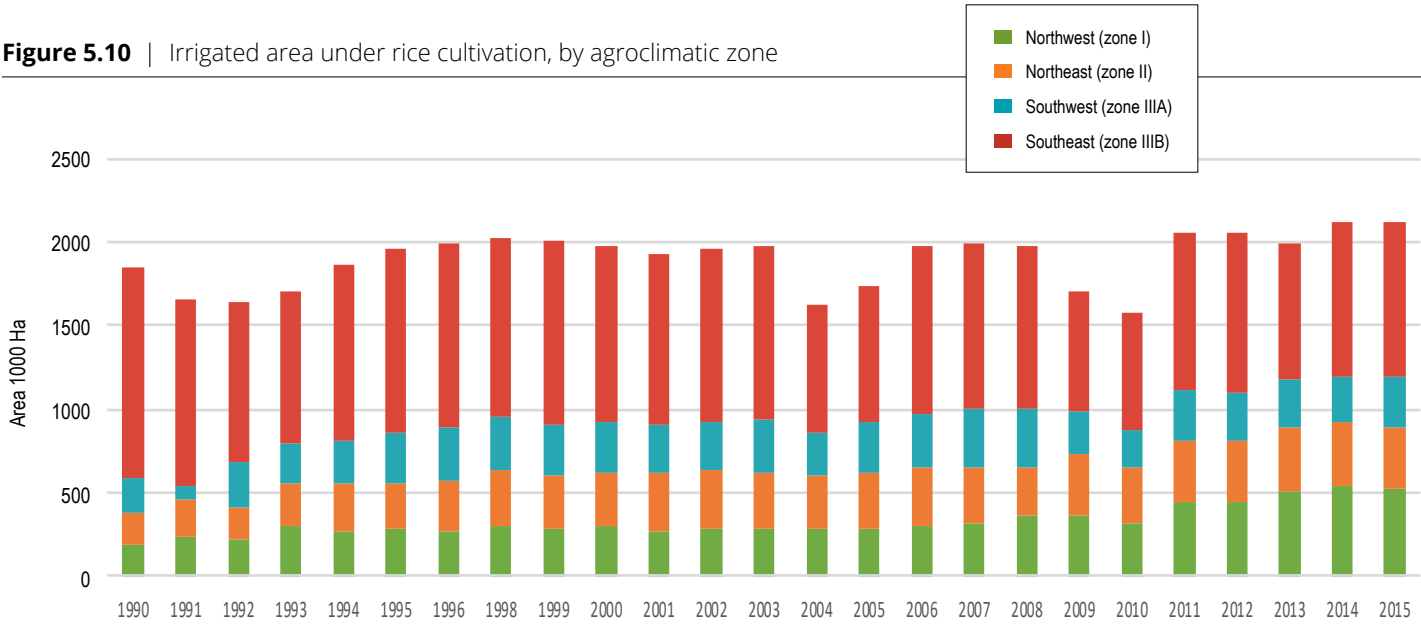
The variations between agroclimatic zones are also a function of the availability of irrigation infrastructure. The southwest accounts for nearly 30 percent of the gross irrigated area in the state, which is a mix of canal and tube well irrigation. It also accounts for the greatest share of area under rice cultivation, which is irrigated.

Gains in rice yields in the lower and mid-Gangetic plains will depend on investment in infrastructure for rainwater harvesting and checking the over-exploitation of groundwater.<sup>32</sup> Such policies can impact yields positively by way of improvements in water productivity in the region.<sup>33</sup>

Rice yields can also benefit from adoption of technologies like direct-seeded rice (DSR) and self-propelled paddy transplanters.<sup>34</sup> DSR merges the benefits of timely sowing, lower water use, and high yields. Similarly, the mechanization of the transplantation process can increase yields by almost 20 percent while reducing seed requirements by 40 percent. Other examples of mechanization include power tillers, pedal threshers, and paddy reapers. These can be facilitated through custom hiring centers and machinery hubs using the existing Krishi Vigyan Kendras (agricultural extension centers). Under some conditions, the System of Rice Intensification (SRI) can also potentially increase rice yields through an integrated nutrient management approach.

“Wheat production is constrained by three critical factors: temperature during the grain-filling period, application of water and nutrients, and incidence of diseases such as rusts and leaf blight. These factors have resulted in wheat yields in Bihar half that of the Western Indo-Gangetic Plain.”

Figure 5.10 | Irrigated area under rice cultivation, by agroclimatic zone



Data source: ICRIAT- TCI District Level Database

<sup>30</sup> Balwinder-Singh et al. (2019)

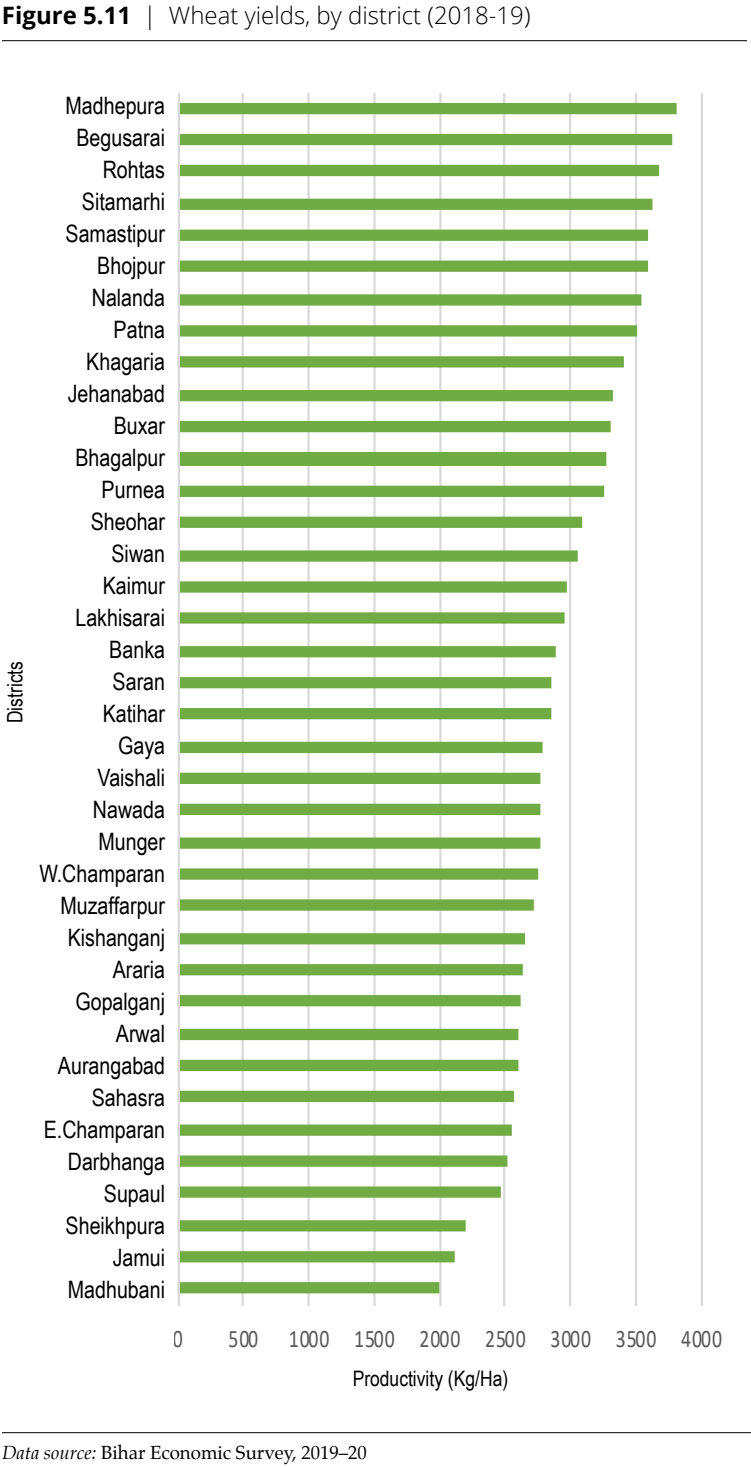
<sup>31</sup> Joshi et al. (2016)

<sup>32</sup> Timsina and Connor (2001)

<sup>33</sup> Najmuddin et al. (2018)

<sup>34</sup> NCAER (2019)





The highest wheat yields are found in the southwest (Rohtas, Bhojpur, Nalanda, and Patna) and northwest zones (Begusarai, Sitamarhi, and Samstipur). The southeastern districts of Sheikhpura and Jamui had the lowest wheat yields in the state.

Wheat production is constrained by three critical factors: temperature during the grain-filling period, application of water and nutrients, and incidence of diseases such as rusts and leaf blight.<sup>35, 36, 37</sup> These factors have resulted in wheat yields in Bihar half that of the WIGP, even though the potential is similar, based on soil properties.<sup>38</sup>

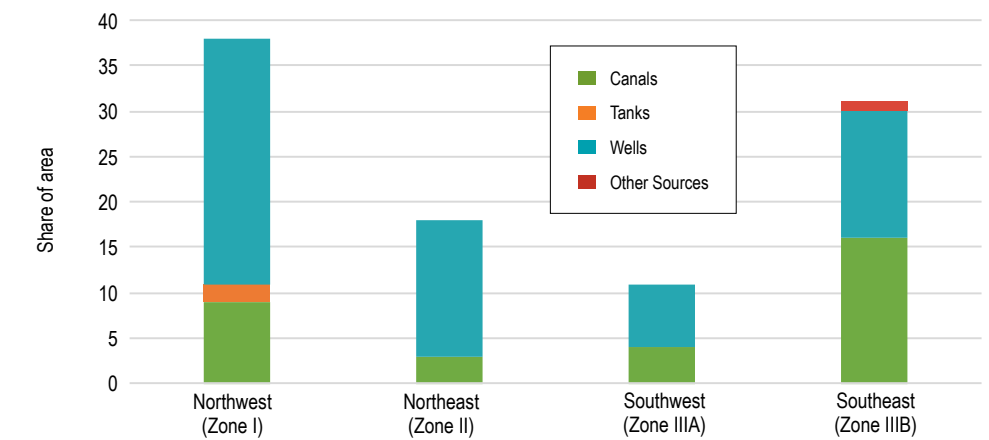
The wheat crop can face heat stress as a result of two factors: (1) the EIGP is facing shorter winters and early onset of high temperatures; and (2) the wheat crop is planted late because of late rice harvests. Together, these two factors result in poor quality and yields, with a yield gap of nearly 2.5 tons per hectare in the EIGP.<sup>39</sup> Early sowing with long-maturing varieties has been associated with a reduction in the yield gap for wheat in Bihar.<sup>40</sup> Delay in sowing and associated heat stress can also be avoided by carrying out surface seeding of wheat in the standing rice crop or by sowing zero-till (ZT) wheat using ZT drills.<sup>41</sup>

The northwest zone receives the highest amounts of winter rain in the state. This supports the higher yields found in the area, since wheat is the main rabi crop in the state. Furthermore, both the northwest zone and the southwest zone have the largest shares of gross cropped area that is irrigated: 35 percent and 30 percent of the gross cropped area that is irrigated in Bihar falls in these zones, respectively. These zones also have the most irrigated area that is under wheat cultivation. This suggests that farmers have access to irrigation (rain and/or tube wells) for the wheat crop, contributing to the high yields. However, given that two-thirds of wheat is grown under partial irrigation conditions, there is a need to improve irrigation infrastructure and access to irrigation in order to boost yields.<sup>42</sup> Significant reductions in the yield gap in Bihar have been realized as irrigation increased.<sup>43</sup>

In addition to water, it has also been found that higher rates of fertilizer application, especially potassium, is associated with a 6.5 kg/ha reduction in the gap in wheat yields in Bihar.<sup>44</sup> Data indicate that fertilizer use is higher in the northern zones. However, most of the fertilizer used is nitrogen, rather than phosphorous and potassium. The priority of the fertilizer policy, therefore, needs to shift from nitrogen to potassium.

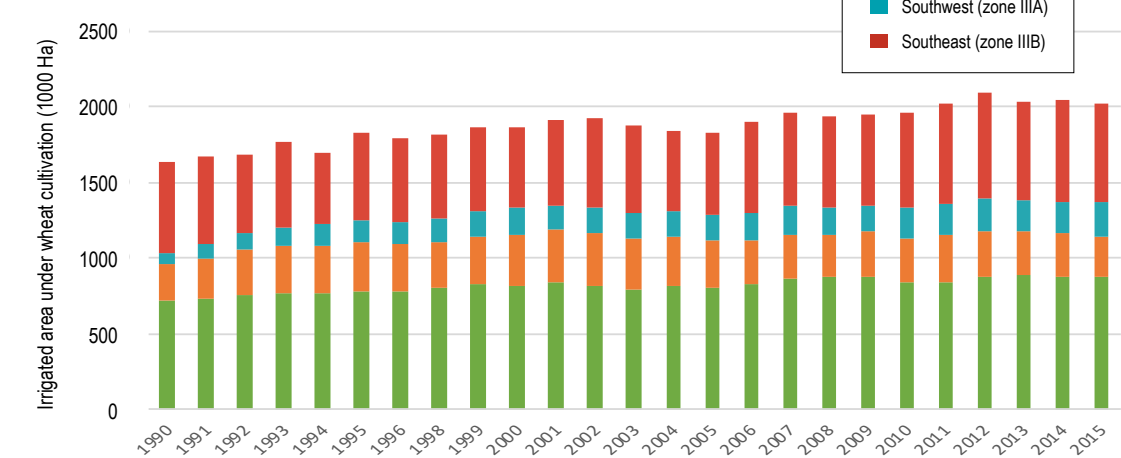
Finally, in response to crop diseases like spot blotch disease, development and extension services related to production and adoption of disease-resistant wheat cultivars will be required.<sup>45</sup> From the perspective of markets, relatively low procurement levels for wheat are a constraint as well.

**Figure 5.12** | Share of gross irrigated area by source of irrigation in each agroclimatic zone



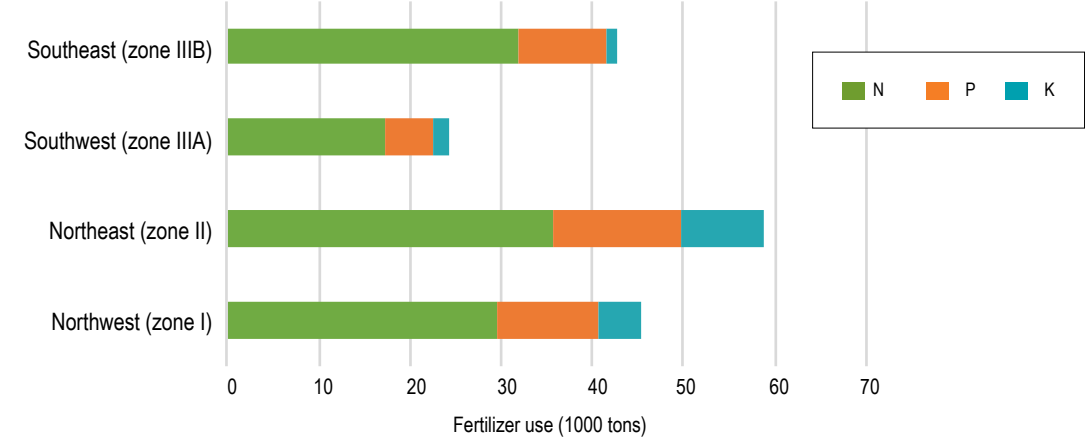
Data source: Economic Survey of Bihar, 2019–20

**Figure 5.13** | Irrigated area under wheat cultivation, by agroclimatic zones



Data source: ICRISAT–TCI District Level Database

**Figure 5.14** | Use of fertilizers, by agroclimatic zones



Data source: Bihar Economic Survey, 2019–20

<sup>35</sup> NCAER (2019)  
<sup>36</sup> Ortiz Ferrara et al. (2007)

<sup>37</sup> Tesfaye et al. (2017)  
<sup>38</sup> Park, Davis, and McDonald (2018)

<sup>39</sup> Joshi et al. (2016)  
<sup>40</sup> Joshi et al. (2016)

<sup>41</sup> NCAER (2019)  
<sup>42</sup> NCAER (2019)

<sup>43</sup> Park et al. (2018)  
<sup>44</sup> Park et al. (2018)

<sup>45</sup> NCAER (2019); GoB (2020)

5.2 Increasing cropping intensity

Cropping intensity refers to the number of times the same land is cultivated each year. There are three main cropping seasons in India: kharif (harvested in fall), rabi (harvested in winter), and zaid (harvested in the summer). Farming households can potentially cultivate in more than one season every year.

According to the BES for 2017–18, nearly 56 percent of Bihar’s total geographical area was accounted for by net sown area, around 53 lakh hectares. Approximately 75 lakh hectares were under gross cropped area, resulting in a cropping intensity of 144 percent, on average. The northern districts are more intensely cropped, with intensities ranging between 1.65–2.24. The southern districts have a cropping intensity of 1.6 or less.

The post-kharif fallow occurs mainly in the southern districts, where access to water is a constraint. Therefore, there is potential to increase the cropping intensity in most districts by investing in traditional irrigation systems, like the Ahar-Pyne. Agricultural intensification, without corresponding increases in availability of inputs, like water and fertilizers, can often reduce water productivity (that is, crop output per cubic meter of water), adversely affecting rice yields.<sup>46</sup>

5.3 Diversification of cropping systems

In addition to yield improvements, agriculture can also influence nutritional outcomes by ensuring the availability of diverse, nutritious foods throughout the year (SDG2.1). This is where the diversification of cropping systems toward horticultural products,

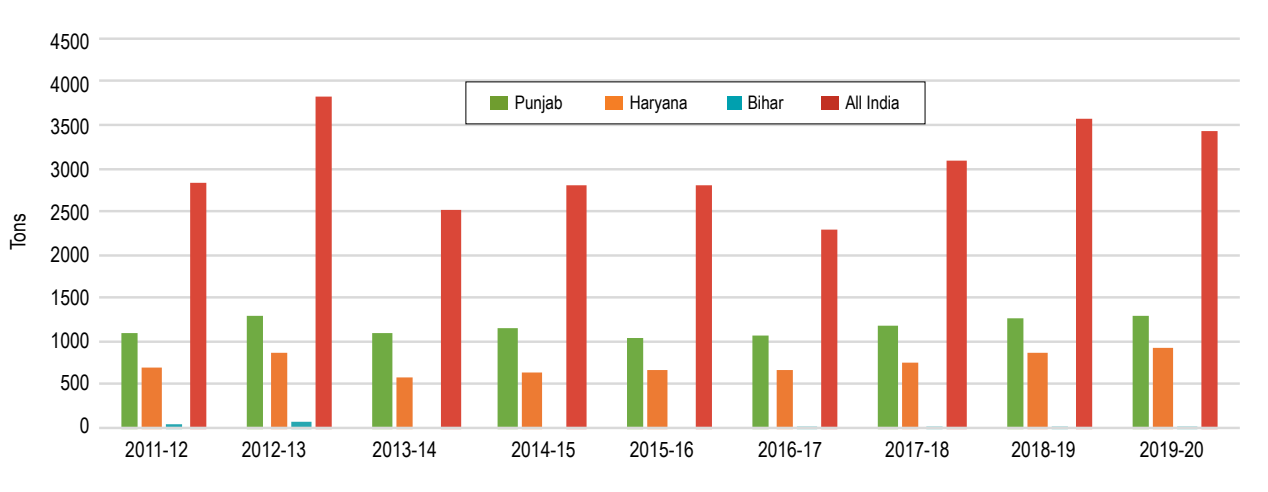
like fruits and vegetables, and dairy products, like milk, meat, and eggs, can be an avenue for increasing incomes and contributing to nutritional security in Bihar. A lack of agricultural diversification has been a hindrance to increasing farm incomes, which are stagnating as productivity gains in staple crops have slowed. As demands for diverse foods increase, options like pulses, livestock, and fruits and vegetables offer promising avenues for diversification.

In this chapter, we discuss two types of diversification of the production system in Bihar. The first relates to crop diversification, where land is reallocated away from staple cereals and used to grow other crops, such as coarse cereals, pulses, fruits, and vegetables. Such a reallocation can occur by redistributing the existing cultivable area and by bringing uncultivated areas (like fallow lands)

under cultivation. The second type of diversification relates to livestock systems. Rearing small and large ruminants and poultry can provide supplemental incomes for households, as well as protein-rich, animal-sourced foods like milk, eggs, and meat.

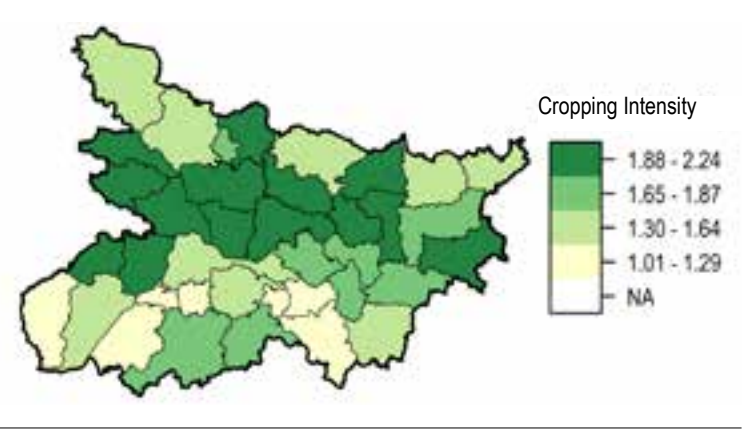
In a recent analysis of the agricultural sector in Bihar, diversification was identified as one of the key sources of crop output growth over the period 2001–17, reflecting the move, in recent years, toward coarse cereals, pulses, and commercial crops, such as sugarcane, linseed, and vegetables.<sup>48</sup> However, the extent to which farmers are able to change the mix of crops that they cultivate depends on two main factors: the level of productivity of their land and the strength of market linkages. These factors are discussed here in terms of pulses, maize, fruits, and vegetables, as well as for the livestock sector.

Figure 5.15 | Procurement of wheat in major wheat-producing states



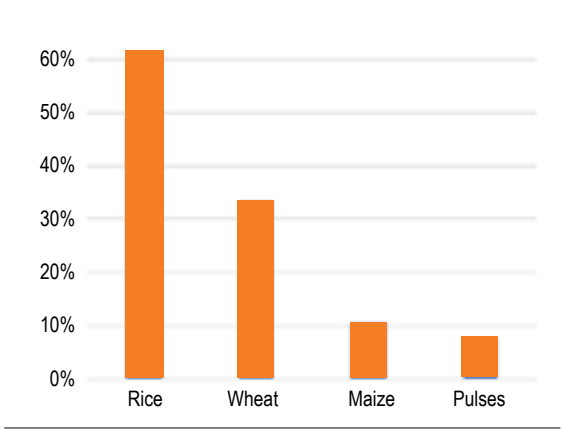
Data sources: Pocket Book of Agricultural Statistics 2019

Figure 5.16 | Cropping intensity by district, 2013-15



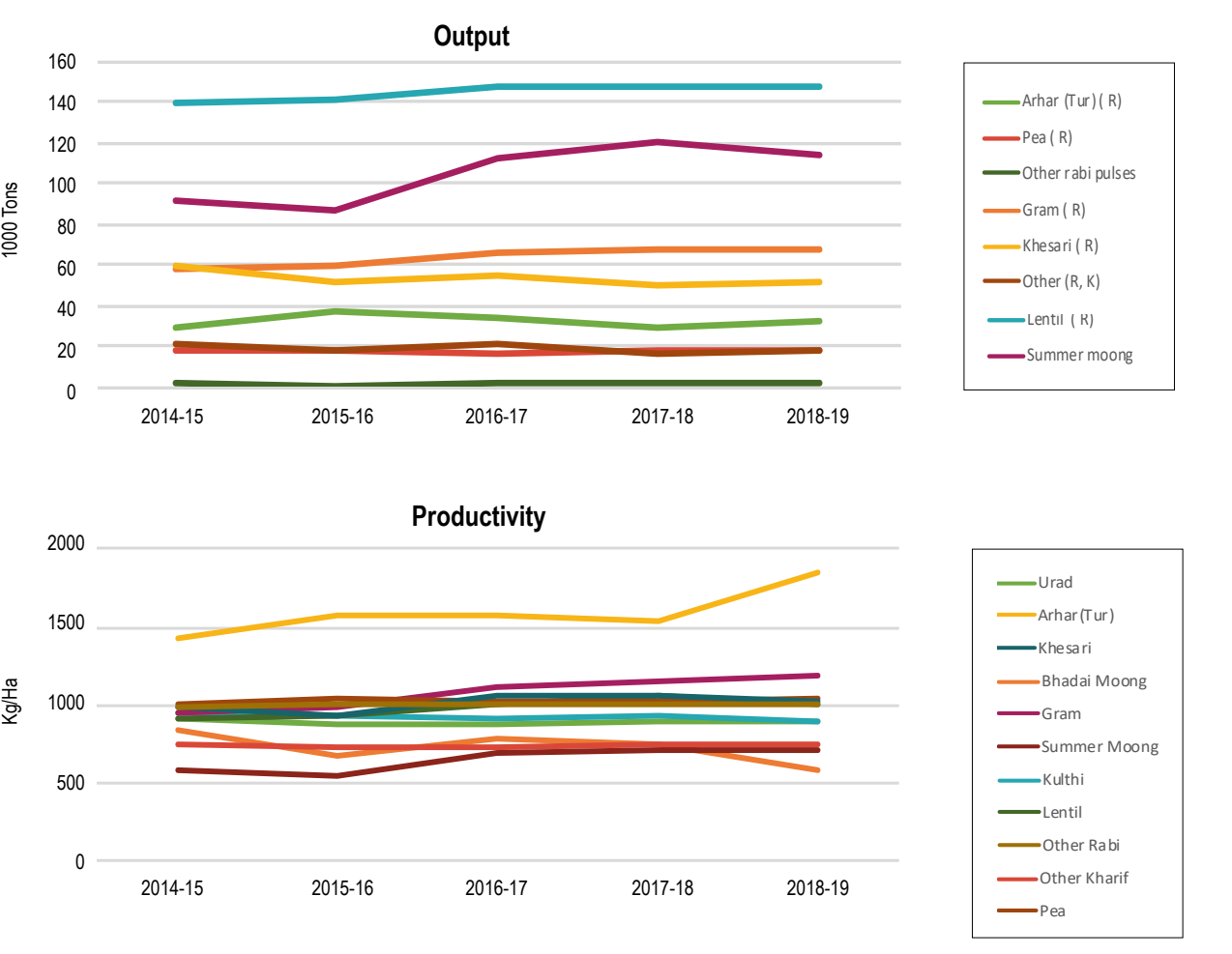
Data sources: Compiled from the ICRISAT–TCI District Level Database

Figure 5.17 | Share of area under major foodcrops, 2018-19



Data sources: Bihar Economic Survey, 2019–20

Figure 5.18 | Output and productivity of Pulses in Bihar



Data source: Bihar Economic Survey, 2019–20  
Note: K and R in parentheses refer to kharif and rabi.

season, for all crops. Cropping intensity was calculated by dividing net cropped area by gross cropped area. A 3-year average was taken, from 2013–15, to determine the final cropping intensity variable.

<sup>48</sup> NCAER (2019)

<sup>46</sup> Najmuddin et al. (2018)

<sup>47</sup> For each season, total cropped area was calculated by adding up the areas under each crop during that season. Net cropped area was defined as the total cropped area for the season with the highest total cropped area. Gross cropped area was calculated by adding together the total cropped areas for each

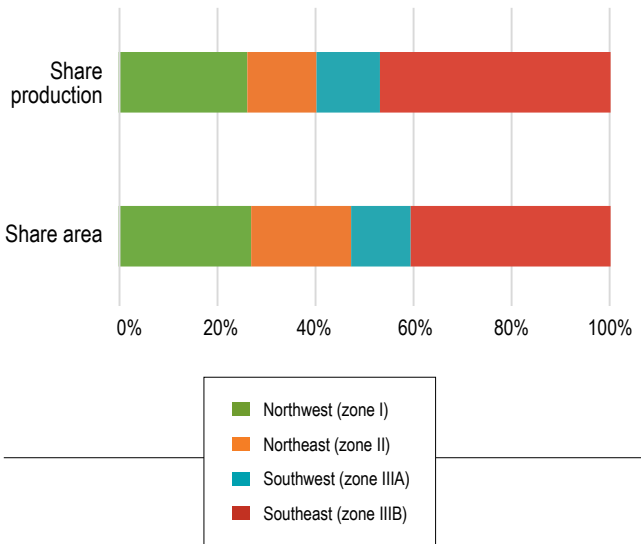


5.3.1 Pulses

The Green Revolution’s emphasis on rice and wheat resulted in a reduction in the area under cultivation of nutrient-rich coarse cereals and pulses. In Bihar, pulses account for less than 10 percent of the gross cropped area. There has been a 20 percent reduction in the area under pulses over the period 2002–03 to 2016–17, despite an increase in the minimum support price (MSP) and a policy emphasis on increased production and procurement of pulses in the government’s National Food Security Mission.<sup>49</sup>

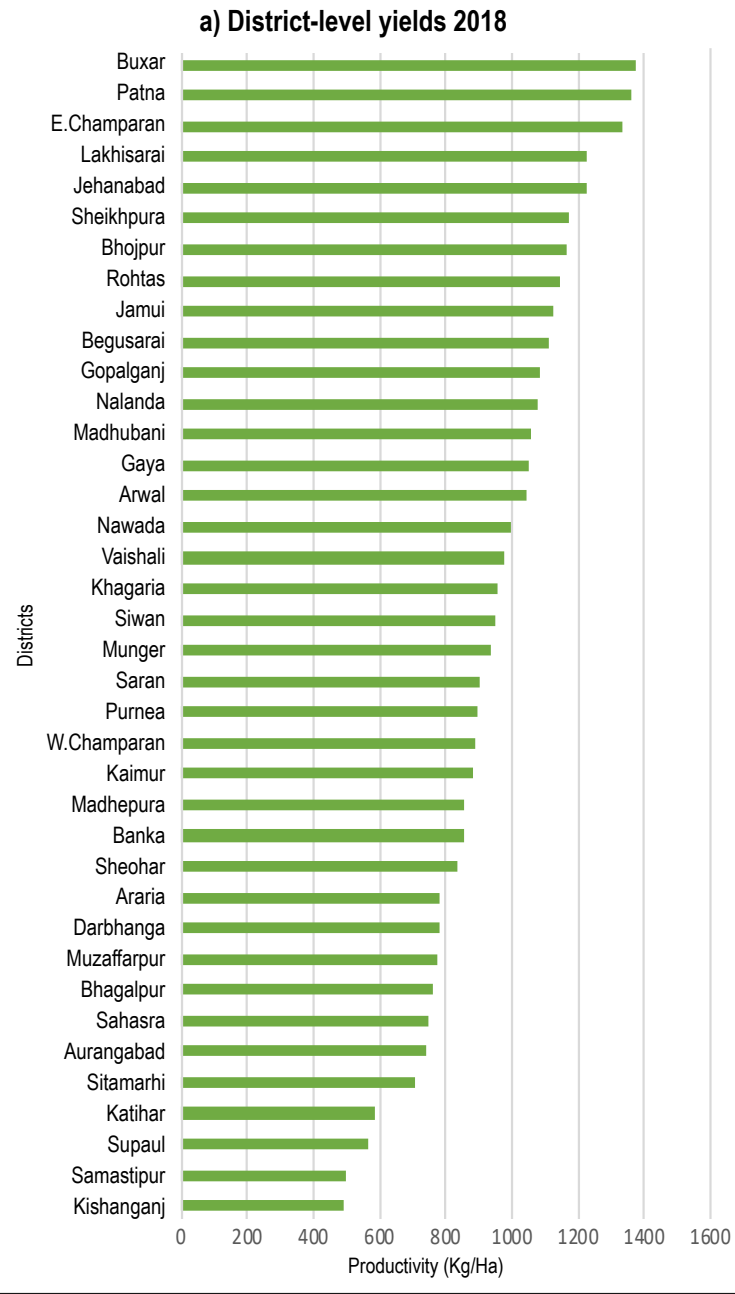
Pulses account for less than 5 percent of the total food grain output in Bihar (Figure 5.20). In absolute terms, the output of pulses has remained relatively constant over the past five years (2014–19). While the productivity of pulses in Bihar is greater than the all-India average (800 kg/ha), it has remained fairly constant around 900 kg/ha, as of 2018–19 (Figure 5.20). More than half of the area and output of pulses falls in the districts across the southwest and southeast agroclimatic zones (Figure 5.21). Yields of pulses are high in these regions—the districts of Patna, Aurangabad, Nalanda, and Buxar lead in the production and productivity of pulses in the state.

Figure 5.19 | Cultivation of pulses by agroecological zones in Bihar

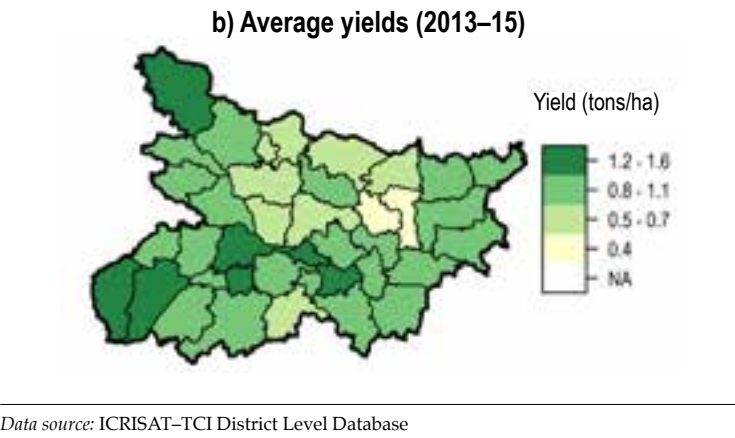


Data sources: Bihar Economic Survey, 2019–20

Figure 5.20 | Pulse productivity, by district (2013-18)



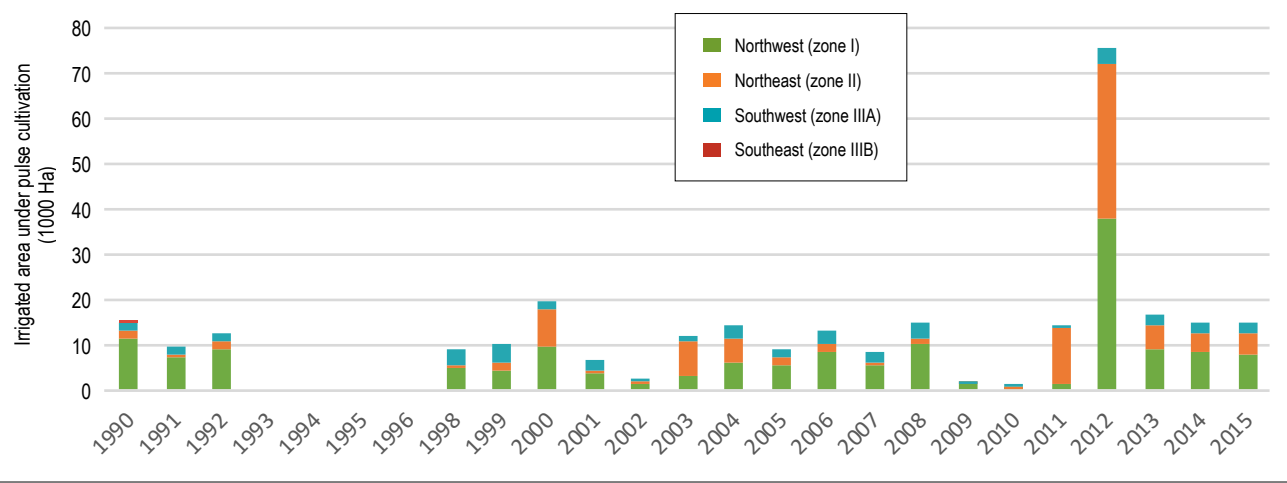
Data sources: Bihar Economic Survey, 2019–20



Data source: ICRISAT–TCI District Level Database

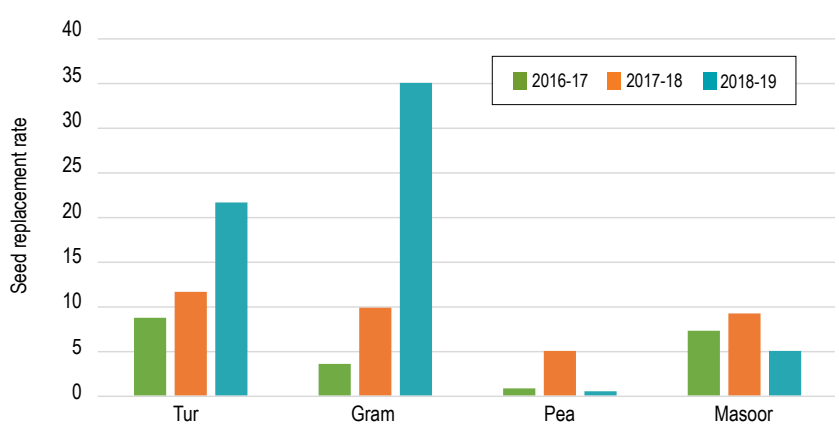


Figure 5.21 | Distribution of irrigated area under pulse cultivation, by agroclimatic zone



Data source: ICRISAT–TCI District Level Database

Figure 5.22 | Seed replacement rate for pulses in Bihar



Data source: Bihar Economic Survey, 2019–20

Box 5.1 | TARINA INTERVENTION ON DIVERSIFICATION INTO NONSTAPLES IN MUNGER DISTRICT, BIHAR

TCI's Technical Assistance and Research for Indian Nutrition and Agriculture (TARINA) program has promoted a diversification of production systems by focusing on the cultivation of vegetables, pulses, and oilseeds in the Munger district of Bihar, an intervention aimed at increasing the availability and accessibility of nutritious foods for smallholder farming households. TARINA introduced the Sustainable Multi-species Agricultural Resources Model Trials (SMART) in Bihar. SMART develops mixed, sequential cropping models for farmers with small and marginal landholdings for the intensification of their production. Cultivation of mixed crops of maize and pulses, or oilseeds and pulses, has been encouraged. In another model, TARINA is working toward the integration of pulses and vegetables into existing cropping systems. To create an enabling environment and pathway for increased adoption of nonstaples, an integrated approach of providing technical inputs and capacity-building interventions has been used. The availability and accessibility of quality seeds played a major role in encouraging farmers to cultivate different varieties of pulses and vegetables, depending on their diet preferences and market demands. In Bihar, this intervention has relied on leveraging existing community platforms, like self-help groups and other interest groups, to promote crop diversification, especially among women farmers. This intervention directly relates to SDG2.1 (ensuring access to nutritious foods) and SDG2.3 (focus on women). In 2016–19, there has been an increase in the number of households that have diversified their production systems, reflected in both an increase in area under nonstaples and an increase in the average number of crops cultivated (production diversity score). The diversified production also translated to increased consumption diversity.

Figure 5.23 | Households growing nonstaples

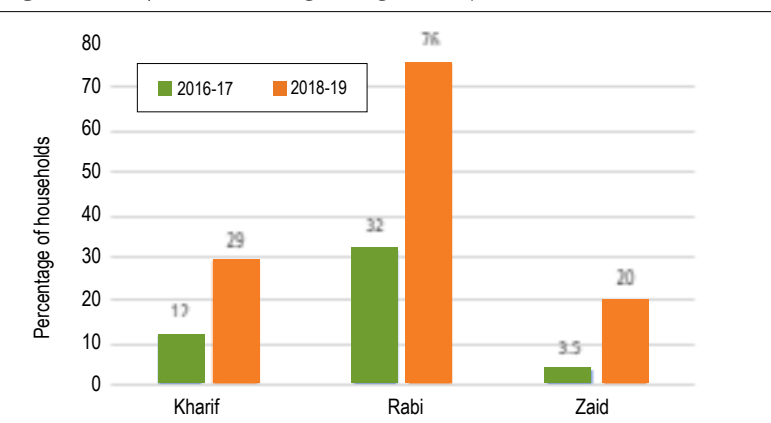
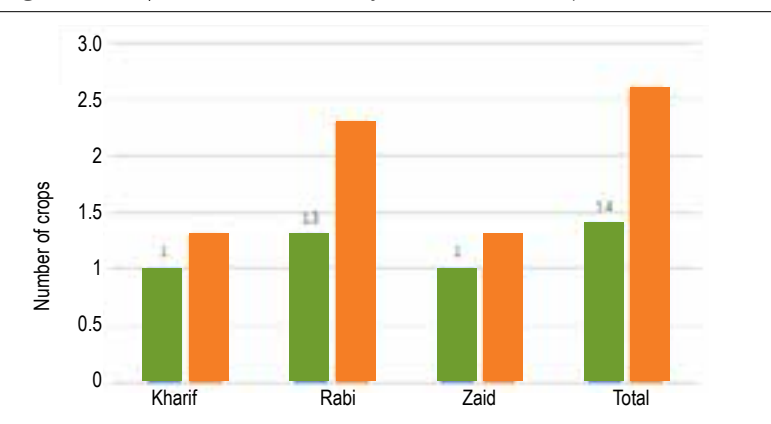
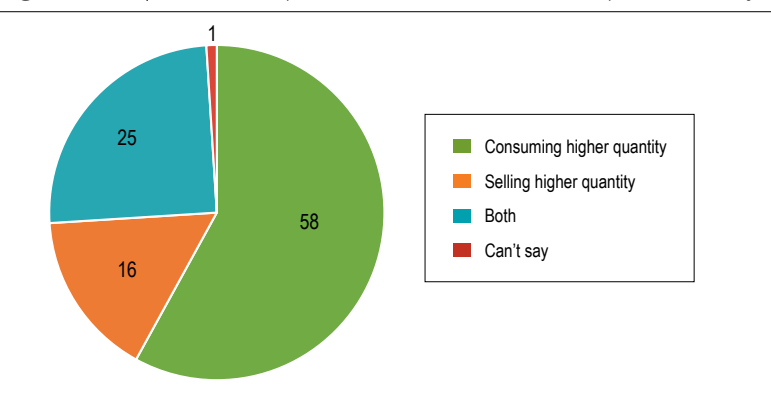


Figure 5.24 | Production diversity of number of crops



Data source: TARINA, Baseline (2016–17) and Midline (2018–19) Surveys

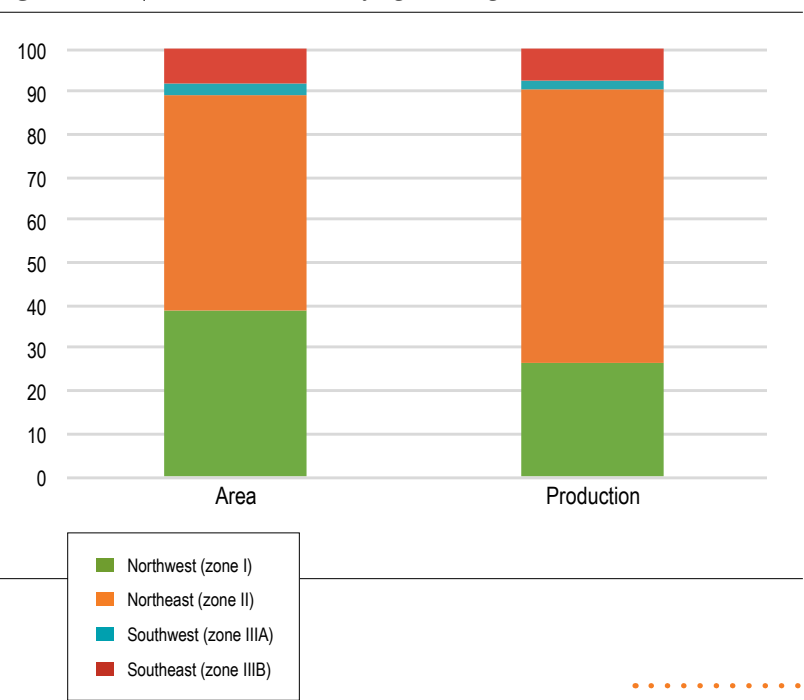
Figure 5.25 | Diversified production enhances consumption diversity



More than 90 percent of pulse production is carried out in the rabi season. It is largely rainfed, with very little cultivation taking place on irrigated land (Figure 5.24). Yields of pulses are constrained due to several factors, including low productivity lands, frequent pest and disease problems, lack of assured markets, inadequate irrigation, cultivation on inferior lands, and limited extension services and technology transfer.<sup>50</sup> One of the main factors limiting yields of pulses is the lack of high-yield, short-duration seed varieties. The available stress-tolerant, high-yielding varieties need to be provided through improved supply chains.<sup>51</sup> The lack of quality seeds is also reflected in the low seed-replacement ratio for pulses in Bihar (Figure 5.25).

The diversification into pulses can take place by bringing nearly 2.2 million hectares of rice–fallow land under pulse cultivation as a rice–lentil system. These lands have sufficient residual moisture for growth of short-duration pulses, like lentil, moong, urad, and lathyrus. Area expansion can also take place by intercropping short-duration pulses like moong or urad with sugarcane in the spring and summer. Similarly, pigeon peas can be promoted as post-monsoon pulses in northern Bihar, while black gram and moong bean can be introduced as winter crops in rice–fallow areas of northeastern Bihar.<sup>52</sup> Also, investment is needed in infrastructure to reduce postharvest losses. Postharvest loss accounts for nearly 10 percent of the total pulse production.<sup>53</sup> The relatively higher procurement price for pulses also offers an incentive for increasing the area and output of pulses (Figure 5.26).

Figure 5.26 | Maize cultivation by agroecological zones in Bihar



“One of the main factors limiting yields of pulses is the lack of high-yield, short-duration seed varieties. The available stress-tolerant, high-yielding varieties need to be provided through improved supply chains.”

<sup>50</sup> Kumar and Singh (2016); NCAER (2019)  
<sup>51</sup> NCAER (2019)

<sup>52</sup> NCAER (2019)  
<sup>53</sup> Najmuddin et al. (2018)



5.3.2 Maize

In addition to rice and wheat, the other major food crop grown in Bihar is maize. It accounts for 20 percent of the total food grain output in the state. Bihar is the third largest producer of maize in the country. Farmers choose to substitute paddy with maize, given its increasing importance as a commercial crop, to meet the demands of the food processing industry and its use as poultry feed.<sup>55</sup> Bihar has a special advantage with respect to maize production: unlike most other states, it produces maize in the rabi season. This means that maize from Bihar fills a demand from processing units during this time—a demand that originates largely from the growing poultry industry. The share of area under maize cultivation has marginally increased over the last few years from 7.6 percent in 2002–03 to 9.3 percent in 2016–17. As of 2018–19, a little over 10 percent of the area under cultivation was being used for maize.<sup>56</sup> The northern districts account for 75 percent of the area under cultivation and output from maize cultivation in the state.

Maize cultivation faces three risks in Bihar: inputs, prices, and yields.<sup>57</sup> One of the important inputs of production is access to irrigation. The northern districts where maize cultivation is concentrated face flood-like conditions during the monsoon season.

Nearly two-thirds of the area under maize cultivation in Bihar is irrigated and is within the northwest and northeast agroclimatic zones. Maize is, however, less water intensive than rice and wheat, a characteristic that allows it to be relatively more resilient at times of water stress.

Maize yields in Bihar are below the yields at the national level and lower than those in states like Andhra Pradesh and West Bengal.<sup>58</sup> Since the northeast zone’s share of production is greater than its share of area, maize yields are expected to be highest there; this can be seen in districts like Purnea, Araria, Supaul, and Katihar, where yields were in excess of 7,000 kg/ha in 2018. These yields are significantly higher than the state average of 4,700 kg/ha. One of the main inputs that is associated with yields of maize in Bihar is the use of hybrid varieties, in particular single-cross hybrids (SCBs). Yield improvements can occur as efforts are stepped up to promote the adoption of hybrid maize, particularly in the rainy season in districts where such adoption is low.<sup>59</sup> In flood-prone districts where adoption is poor, maize cultivation can be carried out on raised beds and ridges that reduce the risks associated with excessive water. Concurrently, seed supply chains need to be strengthened to ensure timely availability of hybrid seeds.

5.3.3 Fruits and vegetables

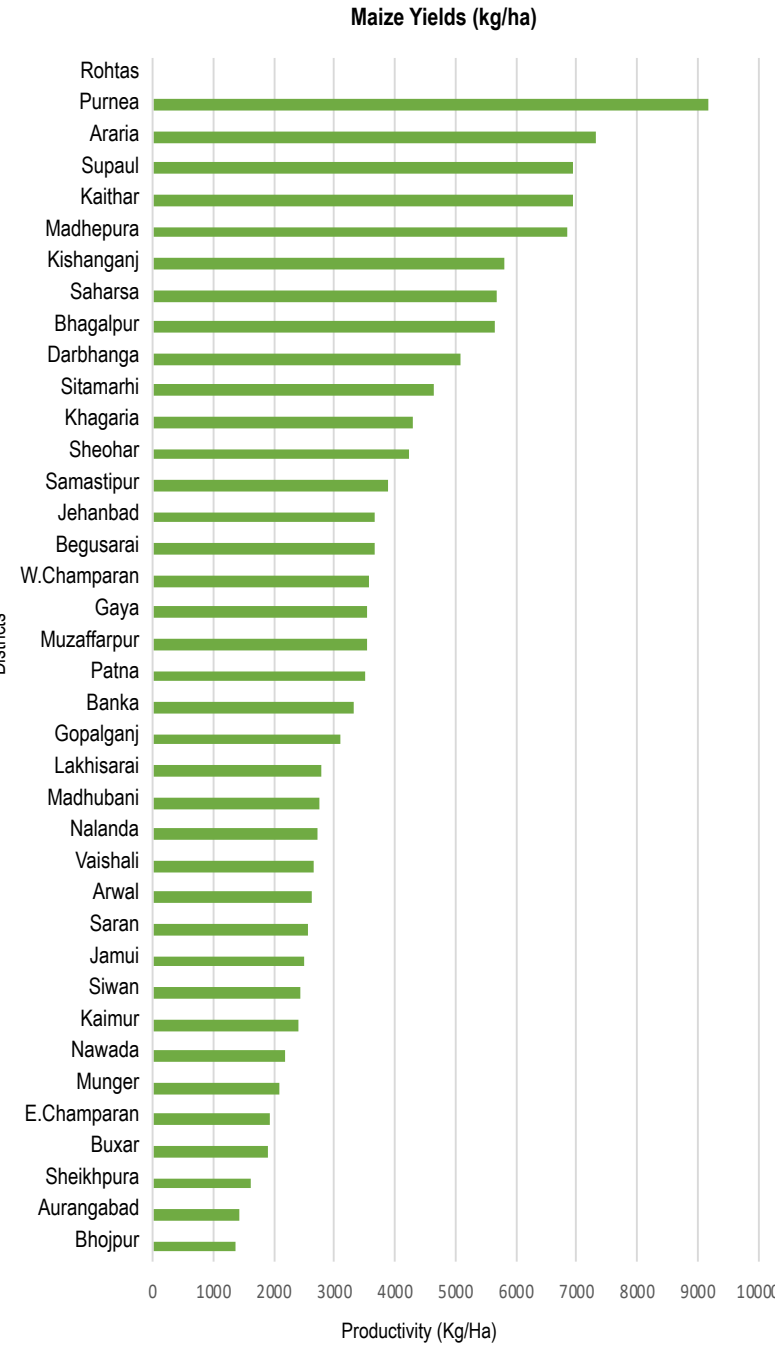
Horticultural products like fruits and vegetables offer a source of diversification of income for farming households and are important contributors to nutritional security in the state. Bihar accounts for about 5 percent of total fruit production in India and slightly less than 10 percent of the vegetable production. The government’s emphasis on horticulture is evident in the latest agricultural roadmap that focuses on organic cultivation under the Bihar State Organic Mission (which has a dual objective of sustainable farming and increased incomes) and rooftop cultivation, as part of the Chief Minister’s Horticulture Mission. Yet, even though the productivity of land is higher for horticultural crops, compared to cereals, the overall level of diversification is low in Bihar, as reflected by the fact that rice, wheat, and maize continue to account for 80 percent of gross cropped area.

Both the area and production of fruits and vegetables in Bihar have increased over the 3-year period from 2016–19. Fruits and vegetables accounted for approximately 6 percent of the cropped area and 40 percent of the total value of output.<sup>60</sup> Despite adequate irrigation and a change in consumption demand toward these products, the increase in the area under cultivation of fruits and vegetables has been slow.<sup>61</sup> The average yield for fruits have remained constant at 14 tons per hectare over 2016–18, slightly below the all-India yield of 15 tons per hectare. For the same period, the growth in productivity for vegetables has been greater in the state, increasing from 17.4 tons per hectare in 2016 to 19.4 in 2018, surpassing the 18 tons per hectare average for the country as a whole.

While horticultural crops offer a diversified source of income for smallholder farmers, their share of the value of output in Bihar declined from 47.5 percent to 42 percent between 2002–03 and 2016–17.<sup>62</sup> Even so, Bihar has a comparative advantage in growing fruits and vegetables. This is because the share of area under fruits and vegetables in Bihar is greater than the corresponding share in the country as a whole.<sup>63</sup> Bihar also stands to benefit from the growing demand for fruits and vegetables, with the decline in per capita consumption of cereals and an increase in that of fruits, vegetables, and animal-sourced foods.

One of the factors important for horticultural crops like fruits and vegetables is improved methods of irrigation. For example, drip irrigation has been associated with less water usage and greater yields for important fruits and vegetables.

Figure 5.28 | Maize yields, by district (2018–19)



Data source: Bihar Economic Survey, 2019–20

Figure 5.27 | Irrigated area under maize cultivation, by agroclimatic zones



Data source: ICRISAT- TCI District Level Database

<sup>54</sup> NCAER-(2019)

<sup>55</sup> NCAER-(2019)

<sup>56</sup> GoB (2020)

<sup>57</sup> Pandey (2016)

<sup>58</sup> Ortiz Ferrara et al. (2007)

<sup>59</sup> NCAER (2019)

Increased incomes can only be realized when binding constraints are addressed. The main constraints for the promotion of fruits and vegetables are a lack of proper marketing arrangements, poor infrastructure, and inadequate institutional support.<sup>64</sup> The cost of being able to access markets is typically very high for small and marginal farmers, primarily because of low economies of scale, reduced bargaining power, and factors like limited connectivity to markets and the inability to obtain information on prices and quality standards in real time.<sup>65</sup> The lower prices that these farmers receive often are the result of the presence of several intermediaries between the farmers and retailers. In this respect, further development and improved functioning of FPOs can enable farmers to benefit from economies of scale to sell their produce at remunerative prices because of collective bargaining.

In addition to facilitating access to markets for final output/produce, FPOs can also help farmers to access markets for credit, inputs, and technology. The collective model also helps to reduce costs, such as those related to quality determination and transportation of produce. FPOs can also enable better linkages to financial services.<sup>66</sup>

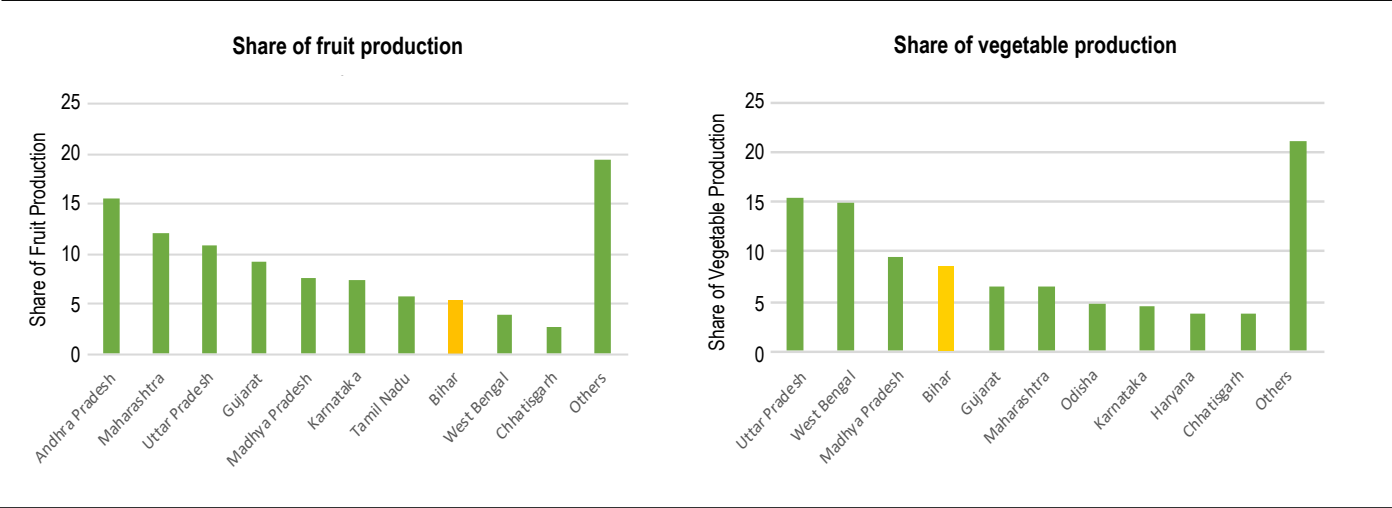
In addition to FPOs, contract farming can also help promote diversification by assuring market access and incomes from agribusiness firms in the state. Contract farming is a form of vertical coordination between buyers and sellers wherein the farmer and the retailer/wholesaler agree, in advance, on the time of delivery, quantity, quality, and the variety of produce to be exchanged. This reduces uncertainties.

Diversification of production activities also needs to be supported by public extension activities that inform farmers about new varieties of crops, methods of cultivation, and technologies. This is especially important for women farmers.

Finally, given the perishable and seasonal nature of produce, investments need to be geared toward ensuring adequate postharvest infrastructure along the supply chain, including processing centers, cold chains for transport, and cold storage warehouses. As of 2019, the cold storage capacity in Bihar was 1,437,767 metric tons.<sup>67</sup> In addition to promoting storage units and a cold chain for marketing, the Government of Bihar is also promoting organic farming, new technology, high-yield varieties, micro-irrigation methods, and the use of quality planting materials.<sup>68</sup>

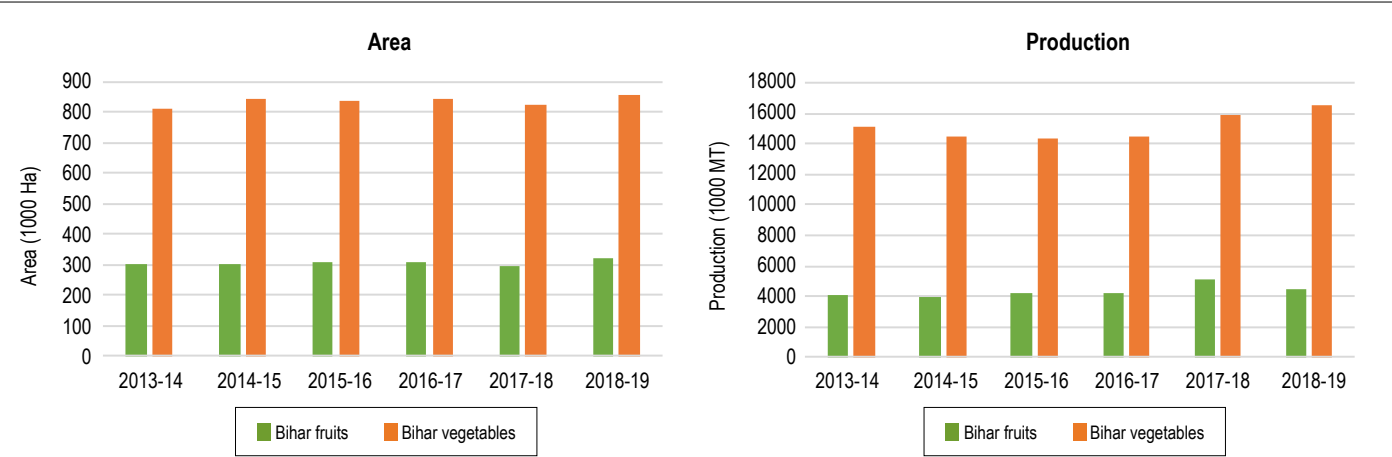


Figure 5.29 | Share of all-India production of fruits and vegetables



Data source: Horticulture Statistics at a Glance 2018

Figure 5.30 | Fruits and vegetables: area and production



Data source: Horticulture Statistics at a Glance 2018; Bihar Economic Survey, 2019–20

Figure 5.31 | Excess demand for fruits and vegetables in Bihar



Data source: Horticulture Statistics at a Glance 2018

Note: Supply is based on production in 1,000 metric tons and converted into 75 percent by assuming 25 percent of food is lost. Demand estimates are derived by multiplying population in crore by recommended dietary allowance.\* 365 (days).



5.3.4 Livestock

In addition to crop diversification, another avenue for increasing incomes is diversification to include livestock systems. The livestock sector in Bihar has grown in recent years, with its share of gross state value-added increasing from 5.4 percent in 2013–14 to 5.6 percent in 2018–19.<sup>69</sup> The sector accounts for nearly 20 percent of total rural income.<sup>70</sup> An expansion of the livestock sector stands to benefit from increasing per capita incomes in the state, accompanied by urbanization and an adequate network for transportation.<sup>71</sup>

Poor animal health, poor breeding, and poor reproduction each account for nearly one-third of animal losses in Bihar. Inadequate feed and nutrition account for an additional 30 percent of livestock losses (Bihar Livestock Sector Analysis, CGIAR–BMGF).

Any improvements in the productivity of livestock will depend on the health and breed quality of the animals. This is reflected in the Bihar Livestock Master Plan that, together with the agriculture roadmap, aims to promote the quantity and quality of veterinarian and preventive care services to minimize animal morbidity and mortality. Regular vaccination campaigns are a key component of this strategy—the number of animals immunized increased from 26 lakh in 2014–15 to 555 lakh in 2018–19. Furthermore, nearly 31 lakh animals were covered as part of artificial insemination programs.

The Government of Bihar is placing an emphasis on increasing the productivity and production of livestock to improve per capita incomes in the state, particularly for women and land-poor households. Livestock ownership contributes to household in-

comes, especially for households that are landless or have small or marginal landholdings. Goats, in particular, are an important source of additional income for small and marginal farmers and play an important role in poverty alleviation.

Milk and animal sales are the two major constituents of sale from livestock in Bihar. Together, they account for 90 percent of livestock-related monthly receipts.

The role of the livestock sector in supplementing smallholder incomes and providing key protein-rich foods is reflected in Bihar’s Livestock Master Plan (LMP), which runs from 2018–19 through 2022–23. Its objective is to increase the production and marketing of animal-sourced food like milk, meat, eggs, and fish. Poultry farming

and associated market linkages are also being supported by the government through the Rural Backyard Poultry Scheme 2014–15. On a larger scale, the Integrated Poultry Development Scheme is promoting the construction of broiler poultry farms, aimed at enhancing employment and meat production. Bihar has witnessed an increase in the production of milk, eggs, wool, meat, and fish for the period 2014–19. Milk production in the state

“Despite adequate irrigation and a change in consumption demand toward these products, the increase in the area under cultivation of fruits and vegetables has been slow.”

Table 5.1 | COMPARISON OF WATER USE IN TRADITIONAL AND DRIP IRRIGATION SYSTEMS (WATER: MM; YIELD: T/HA)

Traditional method		Drip irrigation		% Saving in water	% Increase in yield
Crop	Water	Yield	Water		
Banana	1,760	57.5	970	45	52
Grapes	532	26.4	278	48	23
Citrus	1,660	100	640	61	50
Tomato	300	32	180	39	50
Brinjal	90	28	42	53	14
Chile	100	4.2	42	62	44
Sugarcane	2,150	128	940	56	33
Cotton	90	2.3	42	53	27

Source: Horticulture Statistics at a Glance, 2018

Table 5.2 | DISTRIBUTION OF COLD STORAGE FACILITIES, BIHAR

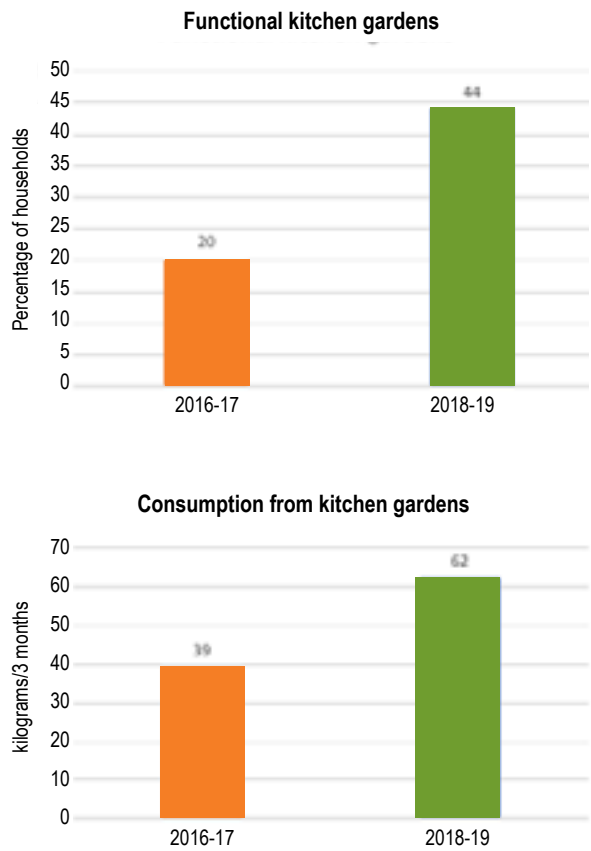
2009–10 to 2017–18 (in Metric Tons)									
Up to 2009*		National Horticulture Board (NHB)		National Horticulture Mission (NHM)		Ministry of food Processing Industries (MoFPI)		Total	
No.	Capacity (t)	No.	Capacity (t)	No.	Capacity (t)	No.	Capacity (t)	No.	Capacity (t)
6	1,147,041	28	111,821	29	153,233	3	3,500	306	1,415,595

Source: Horticulture Statistics at a Glance, 2018

Box 5.2 | USING KITCHEN GARDENS TO ENSURE YEAR-ROUND ACCESS TO NUTRITIOUS FOODS IN MUNGER, BIHAR

In Bihar’s Munger district, the TARINA program is promoting homestead horticulture as a strategy to ensure that farmers have increased access to and availability of diverse foods throughout the year. Using community platforms like self-help groups, farmer field schools (FFSs), and other interest groups, TARINA designed a unique combination of technical inputs, which includes: (1) generating an understanding and awareness of the role kitchen gardens can play in ensuring nutritious diets; (2) developing a package of practices focused on land preparation, sowing methods, and pest management; and (3) arranging for a subsidized provision of quality seeds in a timely manner through the National Horticulture Research and Development Foundation (NHRDF) and private agencies. As a result, the proportion of households with kitchen gardens in Munger increased from 20 percent in 2016–17 to 44 percent in 2018–19. Furthermore, production diversity in homestead gardens has increased from 3–4 types of vegetables to up to 13 (including green leafy vegetables). This intervention directly relates to SDG2.1 (ensuring access to nutritious foods throughout the year).

Figure 5.32 | Intervention on kitchen gardens



Data Source: TARINA, Baseline (2016–17) and Midline (2018–19) Surveys

<sup>64</sup> NCAER (2019)  
<sup>65</sup> Pingali et al. (2019)

<sup>66</sup> Chatterjee and Krishnamurthy (2020)

<sup>67</sup> MoA&FW (2019b)  
<sup>68</sup> NCAER (2019)

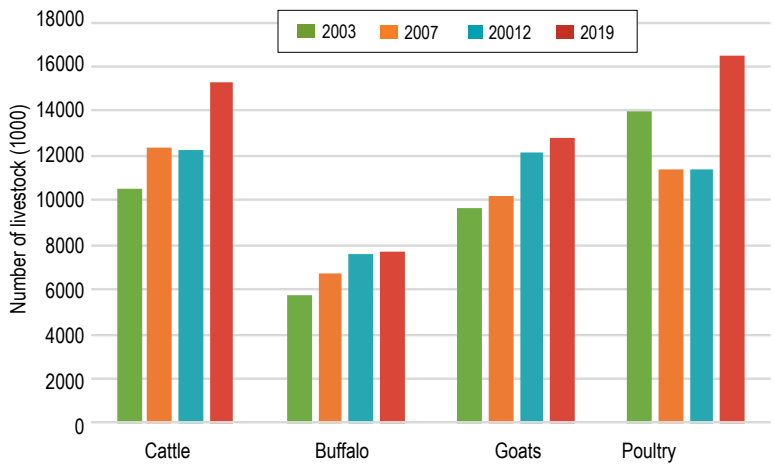
increased from 6 million tons in 2011–12 to nearly 10 million tons in 2018–19. Egg production recorded an annual growth rate of 14.6 percent between 2014 and 2019. It has increased due to high production, low initial cost, and low land requirements. Meat production registered a modest increase from nearly 3 lakh tons in 2014 to 3.6 lakh tons in 2019. At an annual growth rate of 6 percent, the production of fish increased from 4.8 lakh tons in 2014–15 to 6 lakh tons in 2018–19.

The per capita availability of milk has increased from 147 grams in 2004–05 to 228 grams in 2016–17. This is, however, lower than the average for the country as a whole and just above the minimum daily intake for dairy products of 220 g per person per day recommended by the Indian Council of Medical Research (ICMR). From a nutrition perspective, the per capita availability of other animal-sourced foods in Bihar is less than the minimum amounts that are recommended by the ICMR. The per capita availability of eggs of 12/

person/year falls short of the recommended 180/ person/year.<sup>72</sup> Similarly, the per capita per year availability of meat of 2.1 kg/ person/year falls short of the recommended 10.95 kg.

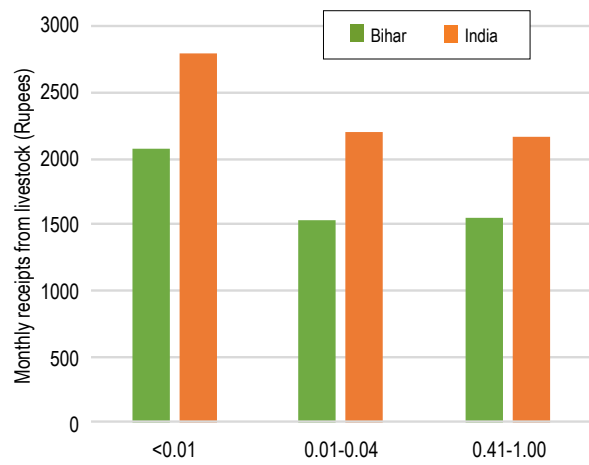
Although Bihar has witnessed increases in the number of livestock, there is scope for improvement in yield of livestock-based products like milk, eggs, and meat. For instance, while Bihar accounts for nearly 10 percent of national milk production, it has one of the lowest milk production rates in the country at 3.7 kg/ day/ milking animal. Most of the increase in milk production from 2008–09 to 2016–17 has come from a 78 percent increase in the number of crossbred cows, which resulted in an increase in their share of total milk production, from 17 percent in 2008 to 32 percent in 2017. At 5–7 liters/ day, the daily milk production for crossbred dairy is double that of indigenous breeds.<sup>73</sup> Steps geared toward enhancing productivity of dairy cattle and expanding milk-processing capacity are areas for growth.

Figure 5.33 | Number of livestock in Bihar, 2003–2019



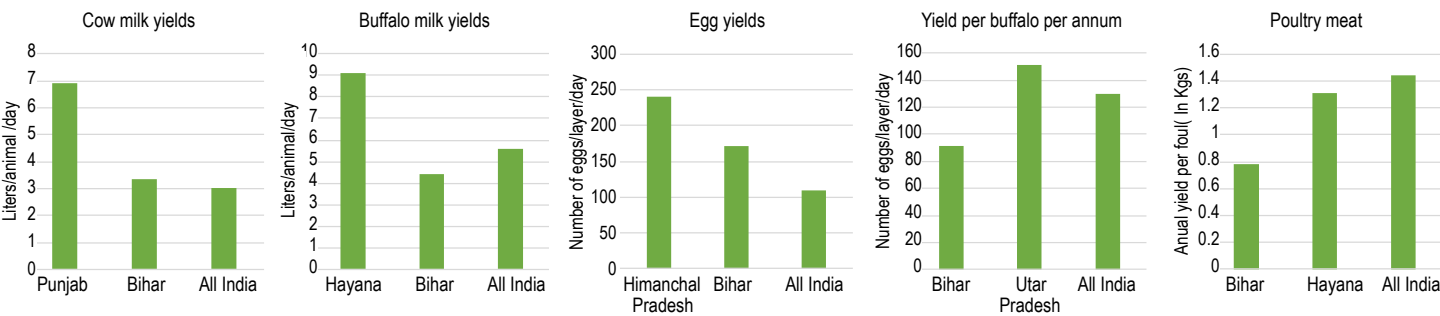
Data source: Bihar Economic Survey, 2019–20

Figure 5.34 | Average monthly receipts from farming of animals by land size



Data source: NSSO Situation Assessment Survey of Agricultural Households, 2013

Figure 5.35 | Comparison of yields of animal source foods (2018–19)

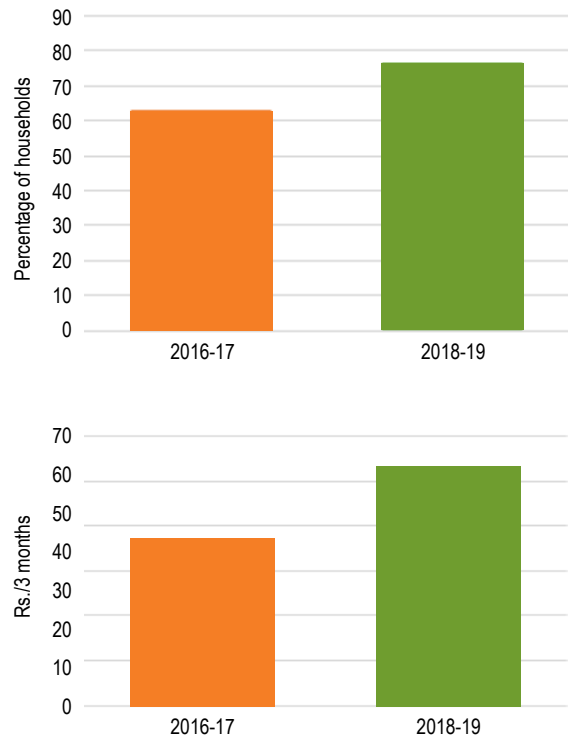


Data source: Basic Animal Husbandry Statistics 2019

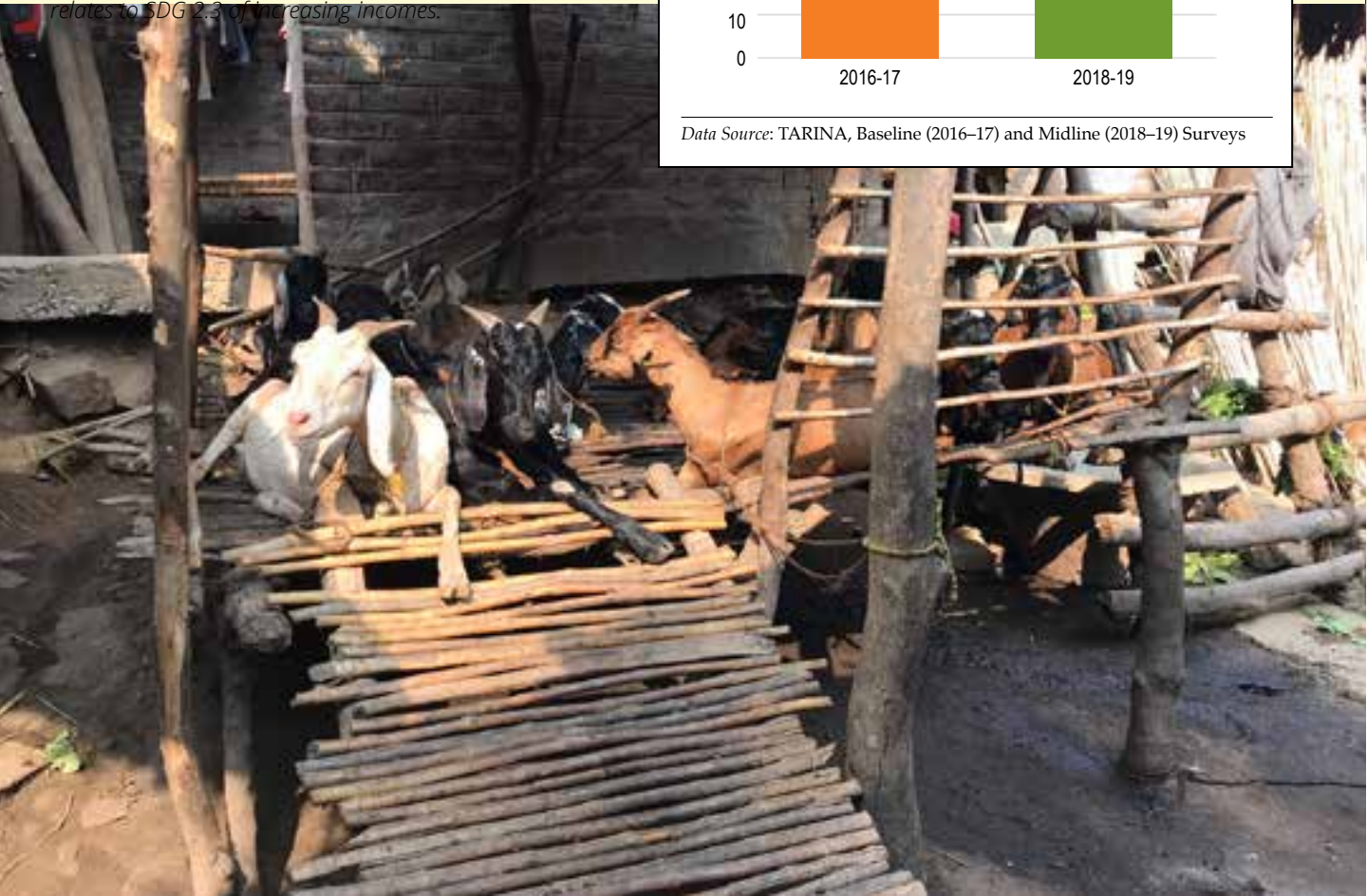
Box 5.3 | PROMOTING SMALL RUMINANTS IN MUNGER, BIHAR

Promoting small ruminants such as goats and poultry, dairy production through improved animal health services, and advanced livestock management, are other strategies employed by the TARINA program in Munger. The objective of this intervention is to strengthen the income pathway for improved nutritional outcomes. As a result of the intervention, there has been an increase in the share of households that own livestock from 63 percent to 77 percent. Such an increase has resulted from a multi-pronged program that identified and responded to existing constraints and challenges in a comprehensive manner. Improved breeding, feeding systems, preventive health care, and better market linkages are the pillars on which the intervention with small ruminants is designed and are mediated through buck user groups and the women farmers' collectives. Over the last four years, TARINA has focused on improving animal health and services management in Munger by way of vaccination and deworming camps for farmers with goats, as well as training on feed management. Figure 5.37 shows that in Bihar, farmers were able to increase their income from livestock from Rs. 1,847 per household to Rs. 2,642 per household. This intervention relates to SDG 2.3 of increasing incomes.

Figure 5.36 | Keeping livestock and income from sale of livestock



Data Source: TARINA, Baseline (2016–17) and Midline (2018–19) Surveys





5.4 Better market structure and access to credit are crucial to improving agricultural income

The volatility in prices of agricultural commodities (after the repeal of the Agricultural Produce Market Committee [APMC] Act in 2006), as a result of poorly functioning markets, has been identified as one of the two binding constraints for agricultural growth in Bihar.<sup>54</sup> What is required, therefore, is an increase in market density through the establishment of new markets and strengthening the institutional arrangements related to procurement. Market access for farmers can be ensured by expanding the road infrastructure and promoting farmer producer organizations (FPOs). Well-functioning, accessible agricultural markets, storage infrastructure, and systematic and timely procurement by the government are some other areas for improvement.

Access to credit is another important factor that can determine the ability of smallholder farmers to invest in inputs or infrastructure to either attain yield improvements and/or to diversify their production base. In rural Bihar, the credit-to-deposit (CD) ratio of scheduled commercial banks (SCBs) stood at a low of 34 percent in 2018–19, as compared to

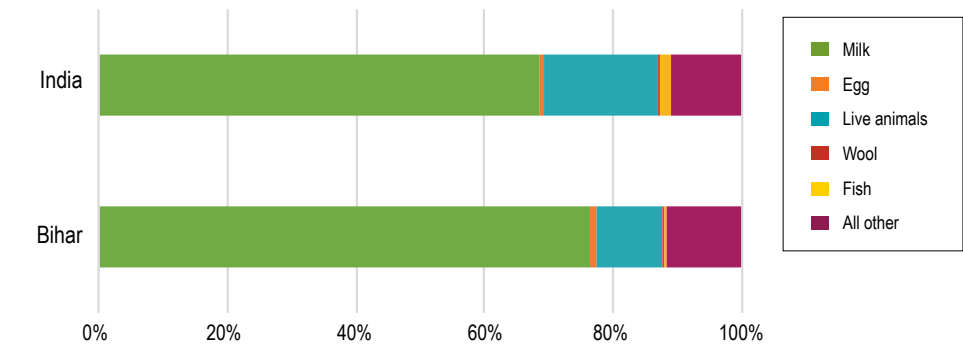
the national average of 78.2 percent. The CD for regional rural banks (RRBs) was close to 50 percent. Both SCBs and RRBs have a dominant presence in rural areas, as reflected by the distribution of branches between rural and urban areas. Small finance banks that were set up with the specific purpose of increasing the financial inclusion of small and marginal farmers have become an important source of credit since their inception in 2015, as reflected in their CD ratio of 452 percent. Agriculture’s share in total credit has been reduced from 48 percent in 2016–17 to 46.2 percent in 2018–19. At the same time, the extent of achievement of the annual credit plan for agriculture has also declined from 85.6 percent to 72.7 percent over the same period. The number of Kisan credit cards (KCC), issued with the specific aim of providing credit to farmers, has seen consistent shortfalls relative to the target of 15 lakh KCCs every year till 2017–18 and 10 lakh KCCs per year thereafter. In 2018–19, only 21 percent of the target of 10 lakh KCCs was achieved by banks in the state.

We call for strengthening the market system and for better access to credit for small-scale farmers to improve their incomes from agriculture.

Table 5.3   PRODUCTION OF ANIMAL SOURCE FOODS IN BIHAR, 2014–19				
	Milk (million tons)	Eggs (million)	Meat (1,000 tons)	Fish (1,000 tons)
2014–15	7.756	983	294.3	479
2015–16	8.288	1,002	301.7	507
2016–17	8.71	1,112	326.3	509
2017–18	9.241	1,219	343.0	587
2018–19	9.818	1,277	364.0	602

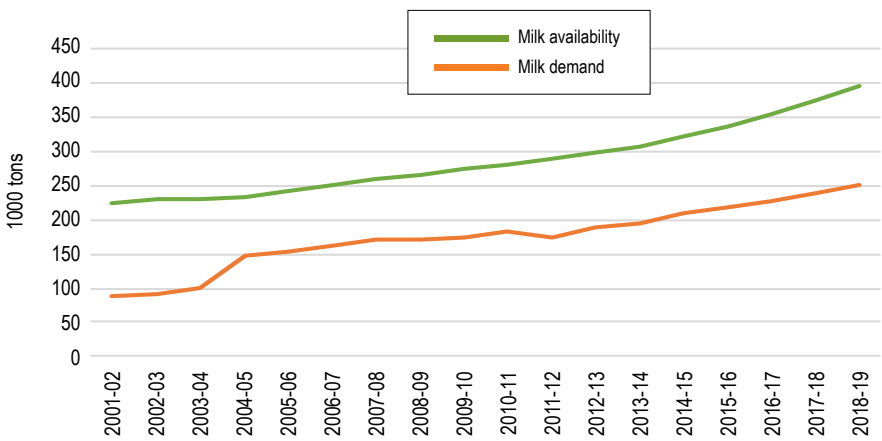
Source: Basic Animal Husbandry Statistics 2019; Bihar Economic Survey, 2019

Figure 5.37 | Composition of monthly receipts from livestock for agricultural households engaged in farming of animals



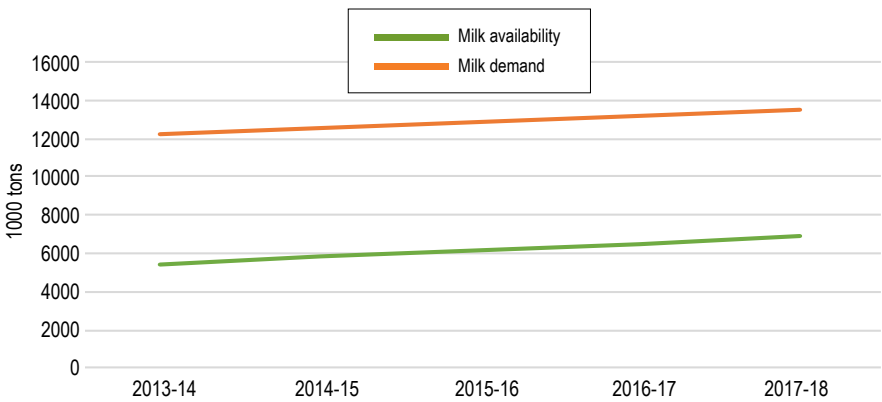
Data source: NSSO Situational analysis of agricultural households, 2012–13

Figure 5.38 | Per capita availability of milk (2001-2019)



Data source: National Dairy Development Board (NDDB)

Figure 5.39 | Excess demand for milk in Bihar



Data source: Horticulture Statistics at a Glance 2018

Note: Supply is based on production in 1,000 metric tons and converted into 75 percent by assuming 25 percent of food is lost. Demand estimates are derived by multiplying population in crore by recommended dietary allowance.\* 365 (days).

<sup>72</sup> MFAHD (2019)  
<sup>73</sup> GoB (2018)



## 5.5 Recommendations

With respect to yield stability, one of the biggest constraints to productivity levels in Bihar’s small-holder farming system is assured access to timely irrigation. This needs to be addressed by way of continued investment in irrigation infrastructure, including flood and watershed management, as well as containment of overexploitation of ground-water resources. Investments in irrigation can also help increase cropping intensity, especially in the southern districts, by way of traditional systems like the Ahar-Pyne.

Crop management practices can also aid in reaching yield potential for staple crops. For rice, this can mean following an optimum date for transplantation; adoption of shorter-duration, hybrid varieties; direct seeding; and supplemental irrigation. In the case of wheat, the use of early sowing, long-maturing seeds; higher rates of application of potassium fertilizers; ZT; and more frequent irrigation are some recommended practices. The supply chain for improved seed varieties of rice and wheat also needs to be strengthened. Adoption of technologies like DSR and ZT needs to be supported by Krishi

Vigyan Kendras extension services while ensuring that complementary inputs are also accessible for the successful adoption of such technologies. Finally, development and extension services related to production and adoption of disease-resistant cultivars, especially for wheat, are required to see sustained gains in yields.

Ensuring an adequate availability of inputs like seeds is also important for diversification of the cropping system. Provision of hybrid seeds for maize and high-yield, short-duration seeds for pulses needs to be ensured. Diversification can also be promoted by appropriate crop management practices, like cultivation of maize on raised beds in flood-prone districts or intercropping of pulses in a rice–lentil cropping system. Farmers will also need to be made aware of how they can diversify, by using which crops, inputs, and technologies, and in which seasons. For all this to occur, a well-functioning extension system needs to be in place that can reach farmers, especially small and marginal landholders. The Departments of Agriculture and of Animal Husbandry and Fisheries can provide technical support to the JEEViKA groups in their

efforts toward diversification of farming systems. For pulses, the state needs to invest in postharvest storage infrastructure that reduces crop loss. Similarly, for perishables like dairy, fruits, and vegetables, investment in cold storage facilities along the supply chain needs to be increased to reduce food waste. For livestock, improved market linkages and improved breeds will contribute to better yields. The move toward a diversified production system should not exclude women. They can act as influencers in modifying the mix of crops cultivated both for consumption by their households and for sale in the market. Focusing on women farmers is also a key component of SDG2.3.

The establishment of accessible and well-functioning markets is required for income gains to be realized from both improvements in yields and diversification of the cropping system. Steps toward an increase in market density by way of setting up new markets and strengthening the institutional arrangements related to procurement are required. Following the repeal of the APMC Act, Bihar has not seen procurement by the private sector increase, as was expected. This situation is more the case for rice and wheat, compared to maize. In this context, diversification toward high-value crops can act as an incentive for private sector to engage with the markets. Market access by farmers can be ensured by expanding road infrastructure and promoting FPOs and contract farming, which can reduce transaction costs for smallholder farmers and result in better price realization.

Markets are important for ensuring a supply of locally produced, micronutrient-rich foods. JEEViKA can play a catalyzing role in transforming the agriculture and food sectors in Bihar with help from the Department of Agriculture and the Department of Animal Husbandry and Fishery, as well as major food-based companies with a significant interest and presence in Bihar, like ITC, Ruchi Soya, and Godrej Agrovet. Scaling up production of biofortified crops could be another strategy whereby international agencies like HarvestPlus can lead the way. Promoting different varieties of location-specific, biofortified crops could further diversify Bihar’s agricultural system. The Department of Industries can encourage investments in the food processing industry, specifically crop-based production clusters of the state. FPOs (formed by JEEViKA) or cooperatives can help aggregate produce that can be directed toward such processing clusters. The JEEViKA Special Purpose Vehicle for Agriculture Transformation (JSPVAT) could help catalyze the process and accelerate the learning curve.

While increased incomes are an intrinsic goal by themselves, our larger focus is on how improvements in yields and gains from diversification can eventually be translated into better nutritional outcomes for all people. On the production side, this message can be communicated by way of a diversification-for-nutrition behavior change communication campaign, which brings together the work of extension services and health and education departments to show farmers how diversification can help them financially and nutritionally, as they learn how to best diversify their crops.

On the consumption side, improvements in yields and a diversified basket of agricultural produce can contribute to an increase in the supply of diverse, micronutrient-rich foods in Bihar’s food safety-net programs—Integrated Child Development Scheme (ICDS), Midday Meal scheme (MDM), and the Public Distribution System (PDS). This can occur if there is convergence between the diversification of production activities together with procurement by various government departments. For example, small fish, green leafy vegetables, and biofortified crops, like high-iron pulses and orange-fleshed sweet potatoes, could be grown through the JEEViKA groups and procured for Anganwadi, schools, and the PDS programs. Similarly, animal-sourced foods and diversified crops like pulses and Nutri Millets could be procured by the Food and Consumer Protection Department for consumption in Anganwadi centers and schools. The PDS can also be made more nutrition-sensitive by working toward decentralized procurement and supply of millets, pulses, and other biofortified crops by the Department of Food and Consumer Protection and the Food Corporation of India. Complete coverage of all eligible households within the PDS program should be pursued to ensure that all vulnerable segments of society, such as the Musahars, are food and nutrition secure. Bihar could also follow the actions of Chhattisgarh and Uttarakhand by providing 1 kg of pulses per person per month through the PDS program. Take Home Rations (THR) prepared and supplied by JEEViKA groups to the Anganwadi could be scaled up under appropriate food safety regulations for locally processed food. This would provide a boost to the local economy and ensure livelihoods for women.





Woman in her okra field.  
Photo by Kiera Crowley

## 6

# Role of Women's Empowerment for Improved Nutrition

SDG2.1 focuses on ensuring access to nutritious foods throughout the year by all members of households. To achieve an equitable intrahousehold distribution of food that meets the nutrition requirements of all individuals, there must be: (1) an adequate quantity of food at the household level; (2) adequate quality of food available; (3) an understanding of the nutrition needs of different members of the household; and (4) distribution of food according to the needs of each member of the household. Women play an important role in all these areas. The pathway from women's empowerment to improved nutrition can be examined using various direct and indirect indicators, such as women's education and control over income, and the extent to which women have input in decisions related to agricultural production, food purchases, preparation, and consumption.

Empirical evidence suggests that empowering women improves nutrition for mothers, their children, and other household members. For example, more than half of reductions in all child stunting from 1970 to 1995 can be attributed to increases in women's status.<sup>74</sup> Some studies have found that women's discretionary income has a greater impact on child nutrition and food security than does men's, and among agriculture interventions that have improved nutrition, women's active involvement has been a consistent element.<sup>75, 76, 77</sup>

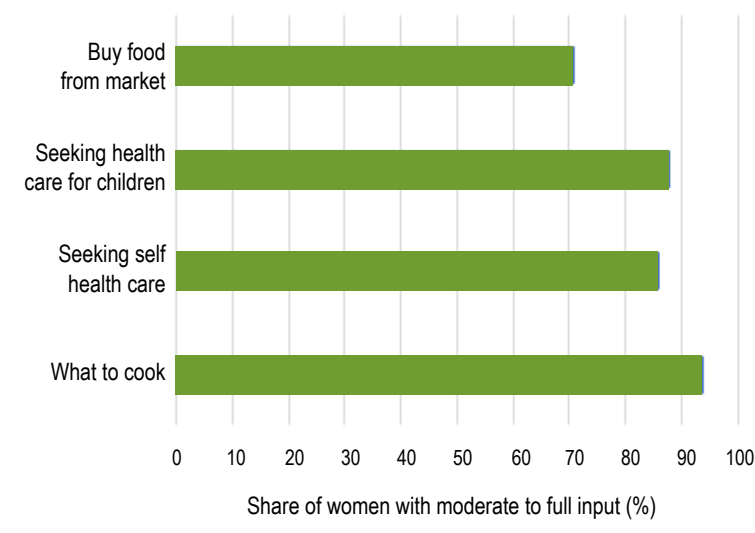
Women's empowerment is a key component of the SDGs. "Women's empowerment is essential for supporting transformations to sustainable development."<sup>78</sup> In fact, SDG5 calls for gender equality and the empowerment of all women and girls. In this chapter, we focus on a set of areas in which the status and/or participation of women can directly or indirectly influence nutritional outcomes, and therefore, determine the progress toward achieving SDG2 in Bihar. This is founded on women's ability to influence intrahousehold food distribution, based on existing social norms, knowledge, skills, and how decision-making power is shared within households.



## Box 6.1 | WOMEN AND NUTRITION OUTCOMES

TCI-TARINA research indicates women play an important role in determining nutritional outcomes. This can be seen in terms of their input in decisions related to the purchase and preparation of food. They are also key influencers in accessing health care for themselves and their children.

**Figure 6.1** | TARINA Baseline Survey—Munger: Women's input in decisions related to nutrition status



Data source: TARINA Baseline Survey, 2017

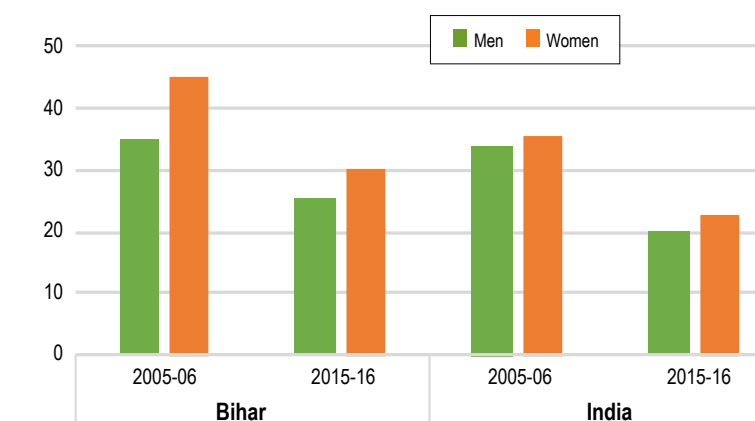
The Indian pattern of women and girls consuming lower quantities and quality of food than men and boys is a key aspect of household and social inequality that leads to comparatively higher undernutrition among women and girls. In many cases, women forego their needs in favor of their children, brothers, husband, and elder members of the family, resulting in inadequate availability of nutritious foods, irrespective of their physiological condition. These nutritional deficiencies lead to hunger, especially among women. This is highlighted by the higher percentage of women whose BMI is below normal, compared to men.

### 6.1 Women's empowerment in agriculture

While increasing yields and diversification will influence food availability at the household level, women's ability to access resources and make decisions in various spheres of agriculture, like production, marketing, sales, and so on, can have implications for their nutritional outcomes and that of their households. This is because women can influence the availability of food by having inputs in the mix of crops that are cultivated. They can play an important role in influencing which types of crops will be grown and sold, and which types of allied activities that the household should engage in, like livestock rearing or kitchen gardens. This is especially true in Bihar, where women constitute a dominant share of the agricultural workforce. Women can also influence how income is spent on food purchases and their time spent in agriculture can impact time available for childcare and food preparation activities. SDG2.3 focuses on increasing productivity and incomes of women farmers "including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment." A similar recognition of the role that women play in agriculture and an emphasis on facilitating their empowerment in agriculture by ensuring access to inputs, equipment, and credit, in addition to strengthening self-help groups, is also reflected in Bihar's agricultural roadmap.

Women's input and decision-making in agricultural activities can influence how land is allocated to the cultivation of different crops, holding the potential to move away from the state's predominantly cereal-centric production patterns toward one that incorporates nonstaples. Such a diversification of the cropping pattern can take place on the field or in the form of kitchen gardens/vegetable gardens. One way to look

**Figure 6.2** | Prevalence of low body mass index, by gender (%)

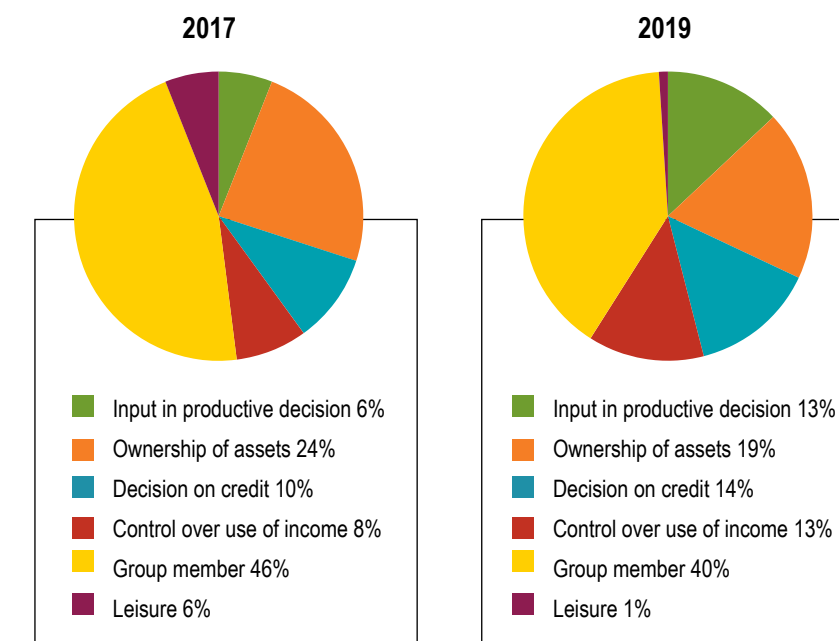


Data source: TARINA Baseline Survey, 2017

## Box 6.2 | TCI-TARINA RESEARCH ON THE EMPOWERMENT-NUTRITION PATHWAY IN MUNGER, BIHAR

TCI-TARINA estimated empowerment levels of women involved in agricultural activities in Munger, Bihar based on the Women's Empowerment in Agriculture Index (WEAI). After adapting the WEAI to the agricultural context of India, it was found that more than 80 percent of women in agricultural households are disempowered across five domains of agriculture: input, resources, control over income, leadership, and time use. The main drivers of this disempowerment are a lack of membership in agriculture-related self-help groups and a lack of ownership of agricultural land.<sup>79</sup>

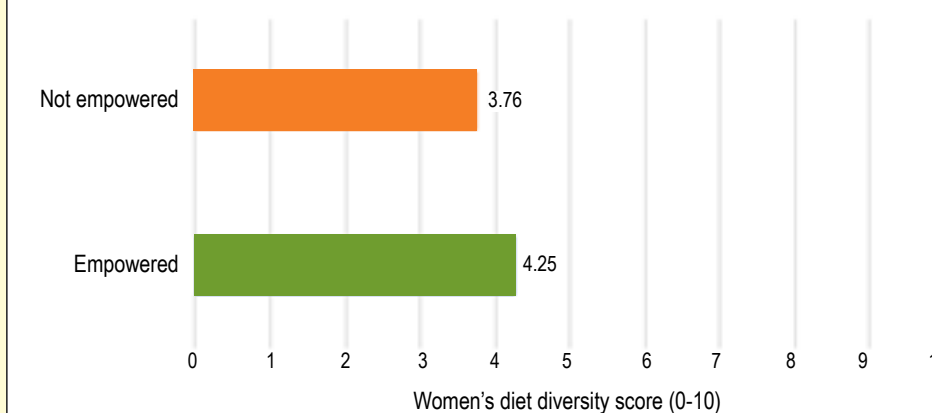
**Figure 6.3** | Main drivers of women's disempowerment in agriculture in Munger



Data source: TARINA Baseline Survey,(2016–17) and Midline (2018–19) Surveys

For a given level of household per capita food purchases, we find that women who are empowered in agriculture have significantly higher dietary diversity scores, as compared to women who are disempowered. More specifically, women's ability to influence production decisions and membership in self-help groups correlate with improved dietary diversity.

**Figure 6.4** | Women's Dietary Diversity



Data source: TGupta et al. (2019b): "Nutritional Outcomes of Empowerment and Market Integration for Women in Rural India."





at women’s input and decision-making is through their participation in the agricultural workforce. Women constitute 60 percent of the labor force in the agricultural sector in Bihar.<sup>80</sup> Women’s economic and social security is factored into the state government’s schemes, like the Lakshmbai Social Security Pension scheme, Mukhyamantri Kanya Vivah Yojana, and Mukhyamantri Nari Shakti Yojana. The Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) ensures the participation of women by requiring that one-third of total person days of work created goes to women. Women’s share of MNREGA employment stood at 52 percent in Bihar in 2018–19.

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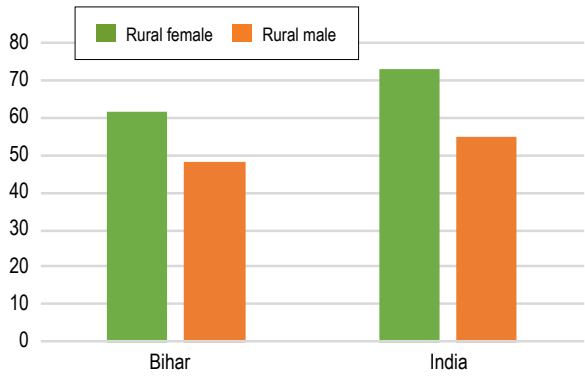
**Empirical evidence suggests that empowering women improves nutrition for mothers, their children, and other household members.**

While women form the predominant share of agricultural workers in Bihar, their ownership of agricultural land is extremely low. Land is a key asset that can determine both agricultural production and income. Across districts in the state, less than 13 percent of women own agricultural land. Moreover, women’s ownership of land is concentrated mainly in marginal landholdings. The total area of the landholdings is significantly lower than male-owned landholdings. This is true for each category of land ownership, with implications for the ability to diversify production and increase productivity.

The numerous barriers to land ownership faced by Indian women include a lack of awareness about their inheritance rights, their reluctance to claim property from hostile family members, and the skewed implementation of laws fueling gendered social discrimination. One of the primary reasons for this is the mediation of women’s land rights in India through various personal laws and customary practices, rather than through legal procedures.

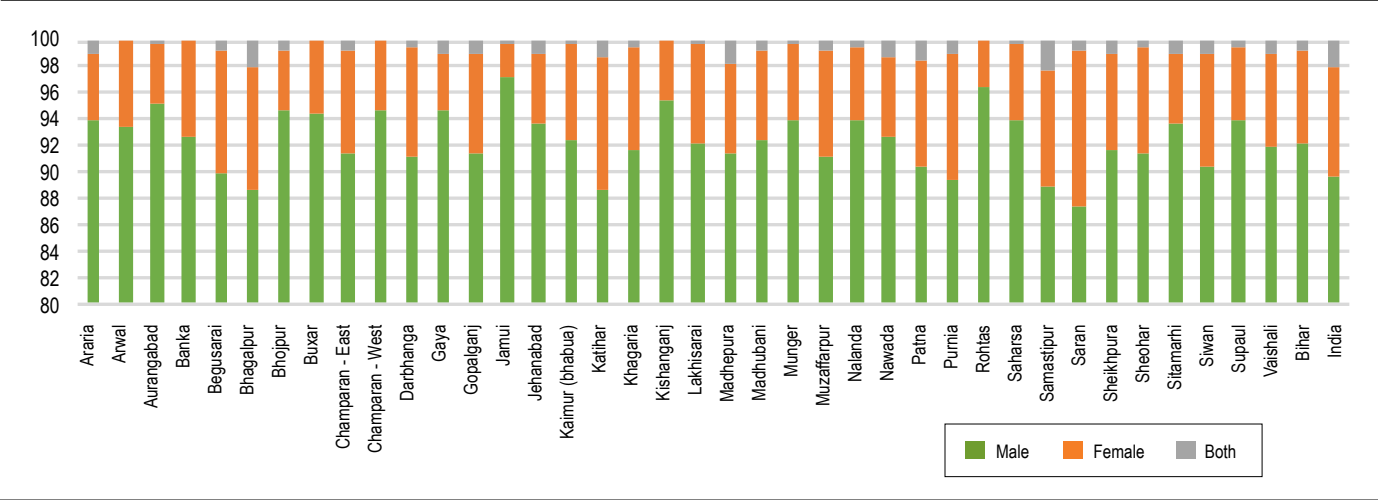
The differences in women’s participation in agriculture and ownership of land are also reflected in a wage gap. Women’s incomes are important not only because they contribute to overall household income, but because they are also likely to influence decisions related to nutritional outcomes, such as which foods are purchased and how much is spent on nutritious nonstaples. The latter depends on both how much women earn and their ability to make decisions related to the use of that income. The women’s wage rate lags behind that of men. In Bihar, women on average earn 80 percent of the corresponding wages earned by men.<sup>81</sup> The gap is marked by seasonal fluctuations as well.

**Figure 6.5** | Women’s participation in the agricultural labor force (%)



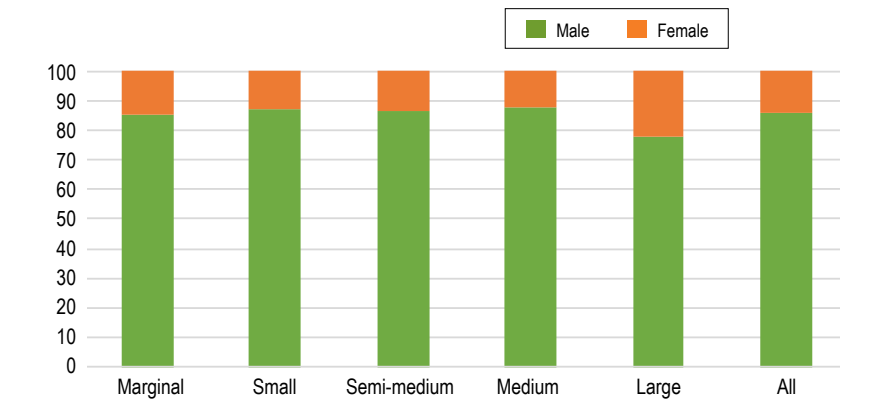
Data source: Periodic Labor Force Survey (PLFS), NSO, July 2017- June 2018

**Figure 6.6** | Agriculture land ownership by district (%)



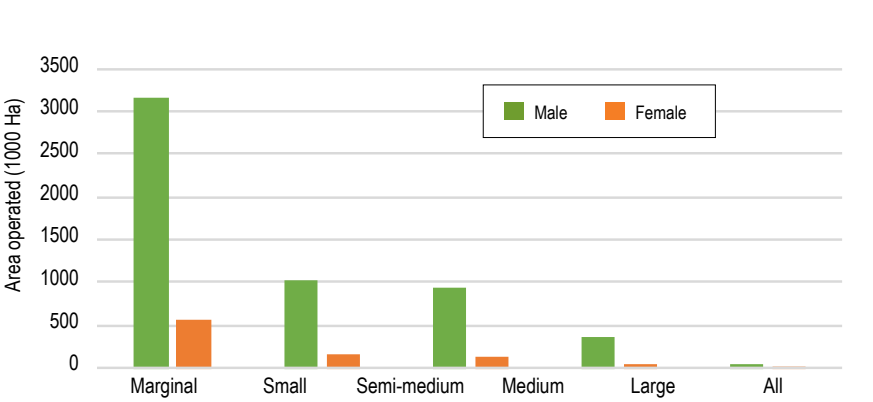
Data source: NFHS 4, 2015-16

**Figure 6.7** | Ownership of operational holdings by gender (%)



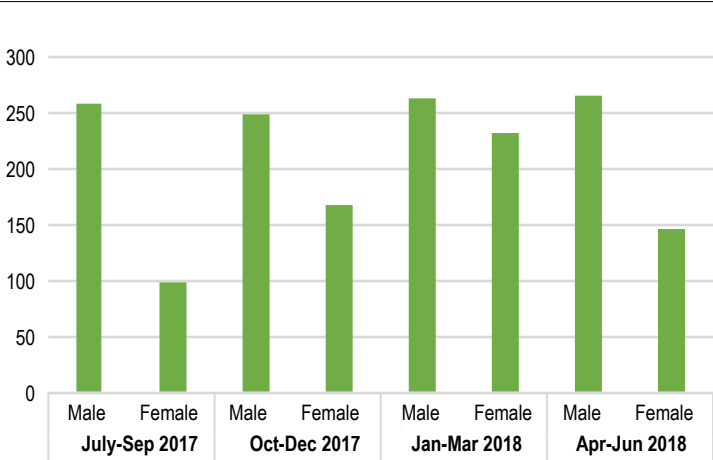
Data source: Bihar Economic Survey 2019-20

**Figure 6.8** | Area of operational landholdings in Bihar, by gender



Data source: Bihar Economic Survey 2019-20

**Figure 6.9** | Average agricultural wage earnings from casual labor work in Bihar



Data source: NFHS 2005-06 & 2015-16 and NSS 75th Round – 2016-18

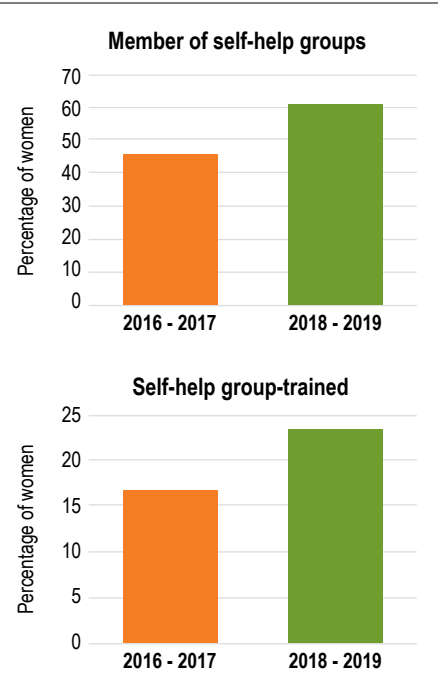
Another domain that can influence women’s empowerment in agriculture is their access to credit and the extent to which they can make decisions related to the use of that credit. In this respect, financial inclusion is important for women to access loans and credit, and to make transactions. It is also essential for them to be able to save money and build assets in a safe place, which can, in turn, take them out of poverty. A wide body of literature shows that closing the gender gap in financial inclusion could have positive effects in smoothing consumption, lowering financial risks and costs, providing security, increasing saving and investment rates, and facilitating new business opportunities. There has been general progress made in terms of financial inclusion at the state and national level. As of March 2018, there are more than three crore female bank accounts in Bihar with a consolidated amount of more than 60,000 crores. Women’s self-help groups can prove beneficial in ensuring women’s access to inputs and services in agriculture. In Bihar, the JEEViKA self-help groups have been associated with higher socioeconomic empowerment levels for women.<sup>82</sup> The JEEViKA platform has also promoted women’s financial literacy by working with cellphone providers for digital financial inclusion of women.

**Box 6.3 | TCI-TARINA RESEARCH ON WOMEN’S SELF-HELP GROUPS**

Women’s group membership holds potential for providing women access to information and resources of various kinds. TCI-TARINA has been working toward the strengthening of women’s self-help groups and other interest groups in Munger, Bihar. These groups are being used as a platform for carrying out TARINA activities, such as behavior change communication (BCC), increasing awareness on homestead gardens, and introducing technologies related to the reduction of women’s drudgery and postharvest losses. In addition to trainings, the groups are also strengthened by organizing interface meetings with market value chain actors and exposure visits to other locations for cross-learning. Exposure visits to successful women’s collec-

tives, buyer-seller meetings, and interface meetings have also helped the women’s self-help group leaders to familiarize themselves with the management of federations and the benefits of collectively marketing their agricultural produce. TARINA has also developed leadership skills among the group members through focused training. These trainings catalyze members to take up leadership roles in community-level committees and self-help group federations, community-level collectives, cooperatives, and FPOs. Through TARINA’s work, membership in self-help groups in Munger has increased by 15 percent over the span of two years.

**Figure 6.10** | Women’s membership in self-help groups and leadership training



Data source: TARINA, Baseline (2016-17) and Midline (2018-19) Surveys

**6.2 Education**

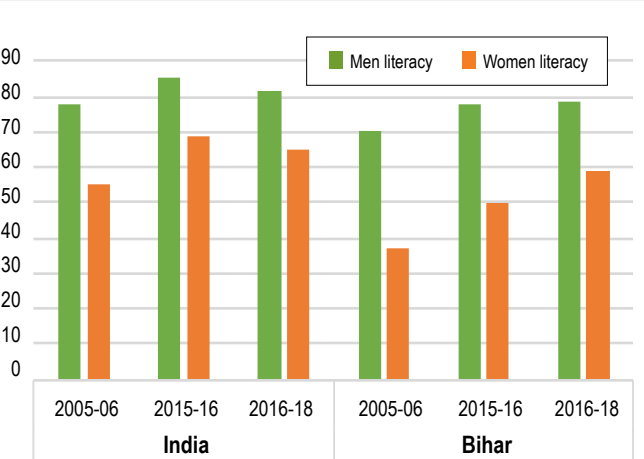
Poor nutritional outcomes are often the result of a diet that is lacking in essential nutrients. Women play a central role in determining what foods are purchased, prepared, and consumed within the household. While these choices are based, in part, on preferences and taste, education plays an important part in generating awareness about the importance of a nutritious diet. Rural literacy rates in Bihar lag behind the national average in the state are illiterate, as compared to nearly 80 percent of men.

A lack of access to education and training has a striking association with nutritional outcomes. In Bihar, as in

India, higher levels of mothers’ education are associated with a lower prevalence of malnutrition in children under the age of 5.

Only 65 percent of the female population above the age of 6 in Bihar has ever attended school, and less than 30 percent of women have 10 or more years of schooling.<sup>83</sup> These figures are lower than the corresponding national-level statistics of 58 percent and 20 percent, respectively. The relationship between mothers’ education and nutritional outcomes becomes particularly stark when comparing the prevalence of stunting and underweight in children below 5 for mothers who had no education with mothers who had completed higher education.

**Figure 6.11** | Male and female literacy rates



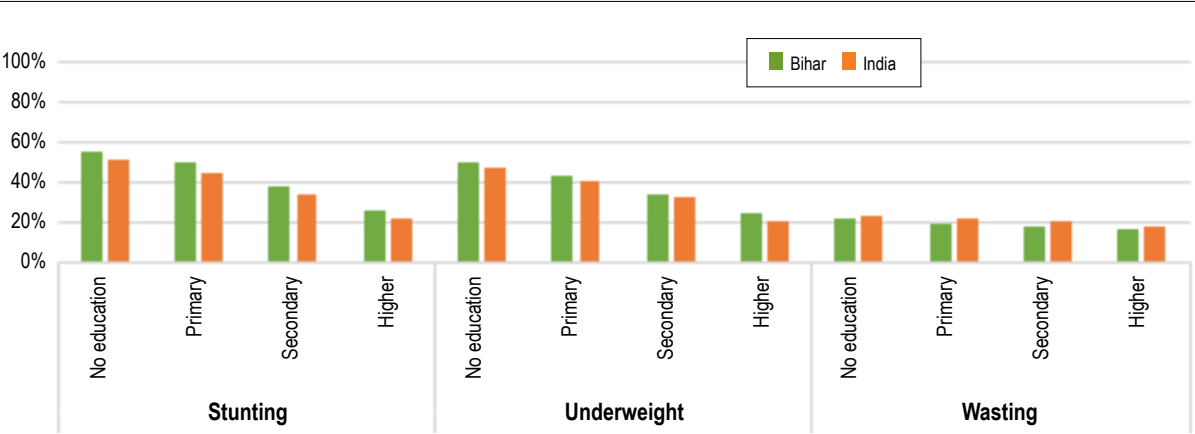
Data source: NFHS 2005-06 & 2015-16 and NSS 75th Round – 2016-18

**Table 6.1 | FEMALE BANK ACCOUNT HOLDERS**

	Number of accounts (in thousands)	Amount (in Cr)
India	621,753	2,302,476.70
Bihar	37,258	60,533.60

Source: Basic Statistical Returns of Scheduled Commercial Banks in India

**Figure 6.12** | Prevalence of child malnutrition in children (0–5), by mother’s education level



Data source: NFHS 2005-06 & 2015-16 and NSS 75th Round – 2016-18



6.3 Recommendations

Women’s empowerment, specifically in agriculture, needs to be promoted, not just as an end in itself, but as a means for achieving improved nutritional outcomes. Ensuring women’s access to productive resources and enabling them to have greater input in decisions related to production, use of income, and time use are areas for targeted intervention. Since most women are engaged in agriculture, they need access to and ownership of inputs of production, like land, irrigation, seeds, and credit, as well as access to the information needed to effectively use them. To achieve this, public extension systems need to be strengthened to specifically address the challenges and constraints faced by women farmers.

Access to gender-specific technologies can also have implications for nutritional outcomes. Agricultural activities at different points of time in the crop cycle can take up a lot of women’s time. This not only influences their own nutrition, but also affects the time they have available for childcare and food preparation. In this respect, technologies aimed at reducing women’s drudgery should be promoted. Efforts to do so should consider the specific nature of the work done by women and address the challenges and constraints that they may face in adopting the technology.

Focusing on women’s empowerment is a strong channel for ensuring that there is an increased demand for, and purchase of, micronutrient-rich

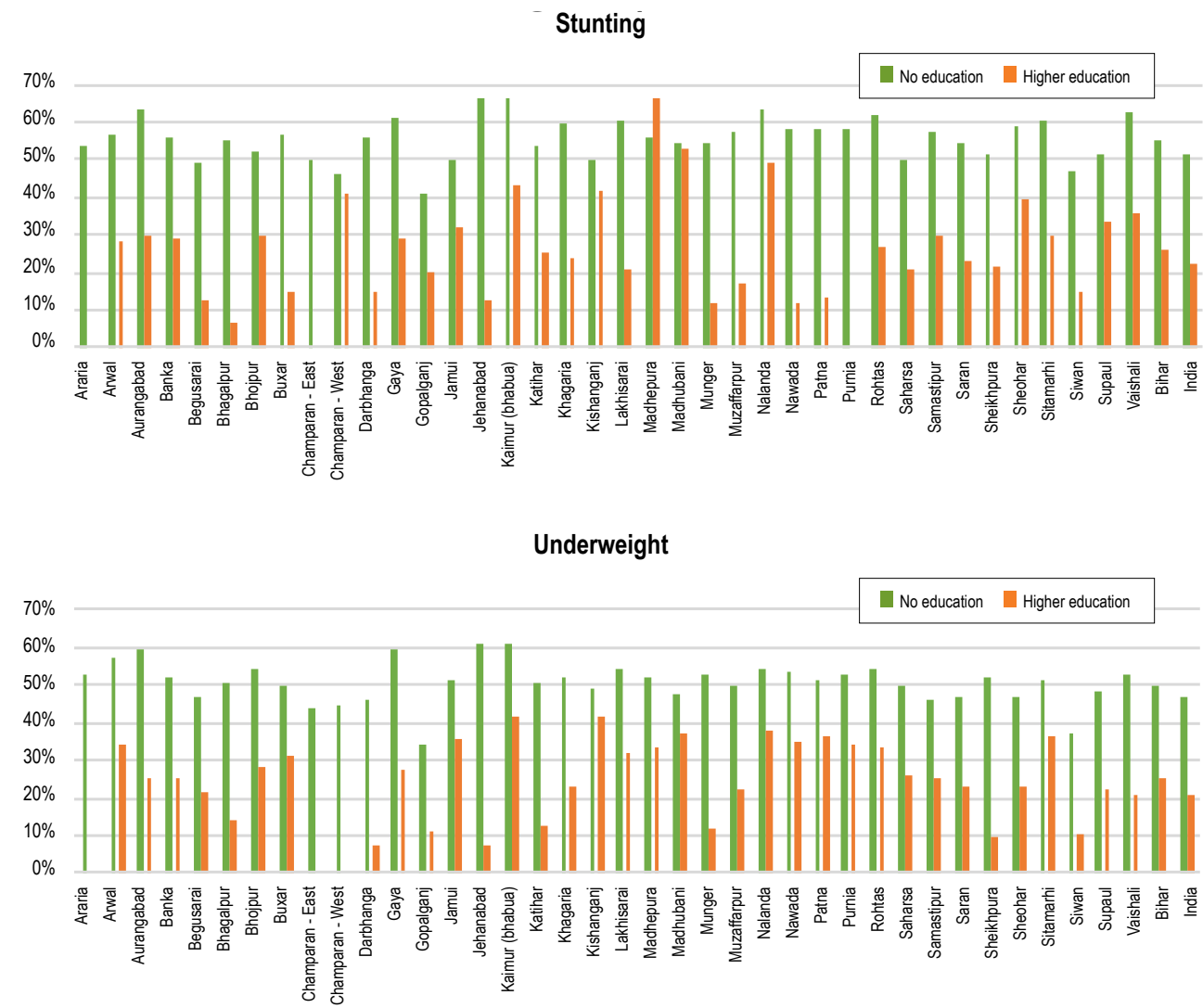
foods for household consumption. Women’s participation in the labor and produce markets will determine their wages and/or income from sale of produce. For this, women need to be linked to markets by way of information, infrastructure, and institutional arrangements, like self-help groups or FPOs, that result in better price realization through collective bargaining power.

JEEViKA’s livelihood programs have benefited women immensely by ensuring that incomes reach their hands. Empowered women with cash in hand can access nutrition-rich food for their families. If market signals are correct, JEEViKA programs can encourage women to take up the farming of nutrition-rich crops. JEEViKA’s kitchen garden program can be further improved to ensure a year-round supply of micronutrient-rich vegetables for the families. The JEEViKA program can help increase incomes by plugging into poultry and dairy value chains. As productivity and production of nutrient-rich vegetables and animal-sourced foods increase, they will be more accessible to the poor. Women play an important role in managing fisheries and small ruminants in Bihar. Technology and market support to such women can contribute to their incomes immensely, which can then be directed toward higher demand for nutrition-rich food.

The Department of Rural Development can use its MGNREGA program to help the landless and women get work on projects that could transform the soil and water conservation across the state, especially the drier regions of southern Bihar.

As discussed in this chapter, women play a crucial role in influencing not just the quantity and quality of food available, but also its preparation and distribution among members of the household. Nutrition awareness and behavior change communication (BCC) campaigns need to explicitly focus on what makes a diet nutritious and why it is important, with an emphasis on seasonal foods that can be locally sourced, in addition to the needs of vulnerable groups like infants and pregnant and lactating mothers. Additional areas where BCC can focus are food safety and zoonotic diseases. Such BCC should leverage existing platforms like the JEEViKA self-help groups, together with schools and Anganwadi centers, to target women and children. These can be supported by experts from the Departments of Health and Education, as well as development organizations like CARE India and Project Concern International. Such collaborations can help tailor the BCC for different age groups, such as the Infant and Young Child Feeding program (IYCF) for infants.

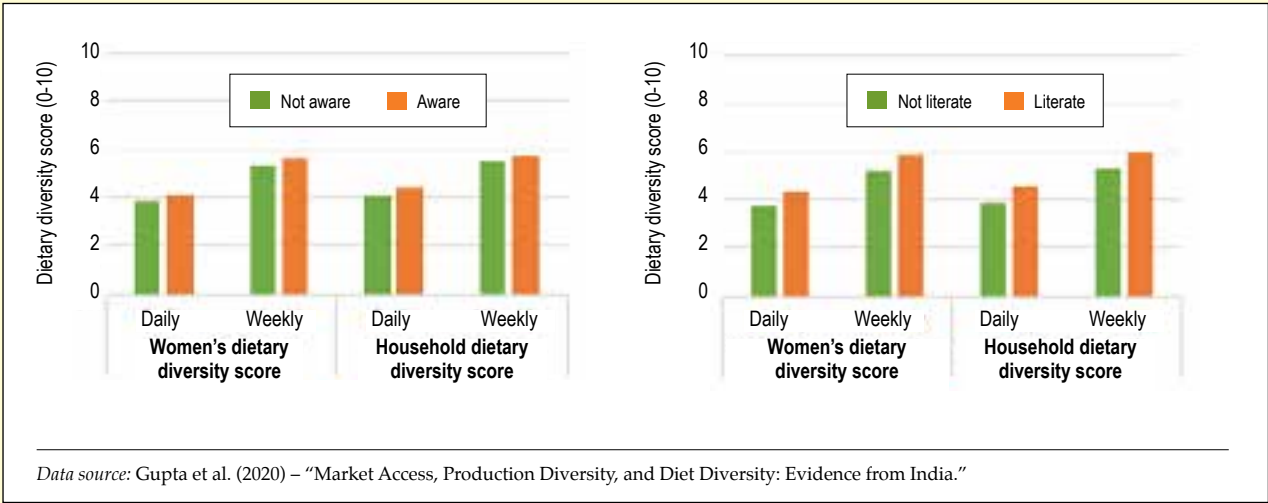
Figure 6.13 | Prevalence of stunting and wasting at district level by mother’s education level



Data source: NFHS 4

Box 6.4 | TCI-TARINA RESEARCH ON THE EDUCATION-NUTRITION PATHWAY IN MUNGER, BIHAR

The role of women's education is highlighted in a recent analysis of the determinants of dietary diversity for women and their households in Munger, Bihar. TCI-TARINA research suggests that women's literacy and awareness of dietary nutrition are both associated with significantly higher levels of dietary diversity.



Data source: Gupta et al. (2020) – “Market Access, Production Diversity, and Diet Diversity: Evidence from India.”





A young woman collects water in Khopawar, Bihar.  
Photo by Kiera Crowley.

# 7 | Health Environment: Water, Sanitation, and Hygiene

Water, sanitation, and hygiene (WASH) make up the environmental health pathway for improved nutritional outcomes.<sup>84</sup> Although agriculture directly and indirectly influences food availability, and women’s empowerment determines the intrahousehold allocation of that food, it is WASH-related factors that determine the eventual absorption of nutrients from dietary intake, and thereby, influence individual-level nutrient status. The absorption of essential nutrients can be adversely affected if individuals do not have adequate access to clean drinking water and sanitation facilities.

Poor health environments result in illnesses like diarrhea, which is the leading cause of child mortality in children under 5 in developing countries. According to the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF), diarrhea caused by unsafe water and a lack of basic sanitation and hygiene claims the lives of more than 1.5 million children of less than 5 years of age every year. Approximately 700 million people still practice open defecation throughout the world, mostly in South Asia.<sup>85</sup> According to NITI Aayog’s 2019 report, WASH factors are responsible for half of India’s undernutrition burden.<sup>86</sup>

The SDG agenda reflects the importance of WASH in the interactions between various SDGs. SDG6 focuses on ensuring availability and sustainable management of water and sanitation for all. Such an endeavor calls for expanding international cooperation and garnering the support of local communities in improving water and sanitation management. In Bihar, two of the seven areas identified in the state government’s “Saat Nishchay” program relate to WASH—Har Ghar Nal Ka Jal (every household should have running tap water) and Shauchalaya Nirman Ghar Ka Sammaan (construction of toilets enhances the prestige of the home).

<sup>84</sup> Pingali and Ricketts (2014)  
<sup>85</sup> UN (2019b)

<sup>86</sup> NITI Aayog (2019b)



7.1 Water: Access and quality

Globally, there are close to 800 million people without access to drinking water.<sup>87</sup> In Bihar, 64 percent of rural households had access to drinking water in 2017–18 (Figure 7.1). At the district level, the share of households with water within their premises ranges from 77 percent in Rohtas to 18 percent in Jamui (Figure 7.2).

Households access drinking water from different types of sources, like hand pumps, public taps or standpipes, and taps within their own homes. When such varied sources of water are considered “improved drinking water sources,” then we find that nearly all the households in the country, including Bihar, have access to water from an improved drinking water source.<sup>88</sup>

However, hand pumps are the source for 95 percent of rural households, while piped water reaches less than 10 percent of

rural households in the state. Based on the data published in the NITI Aayog’s SDG Annual Report 2020, sourced from the Ministry of Jal Shakti, the percentage of the rural population in Bihar receiving safe and adequate drinking water within their premises through piped water supply stood at just 5.76 percent in 2017 and increased to 7 percent in 2019. Thus, although Bihar has achieved universal coverage of drinking water, it is far from achieving universal coverage of piped water supply and providing quality water, which is consistent with international norms. Building on its water supply infrastructure, Bihar should aim to transition from a system that is dominated by hand pumps to a piped water system.

Since households predominantly rely on hand pumps for drinking water, an important concern is water quality. Unlike piped water, the water from hand pumps is not treated. Boiling

the water, filtering it with a cloth, or using an electric water purifier are some of the ways in which households often treat water before using it for drinking or cooking. Recent data from the NSSO indicate that 98 percent of the households reported not treating water in any of these ways before drinking it.

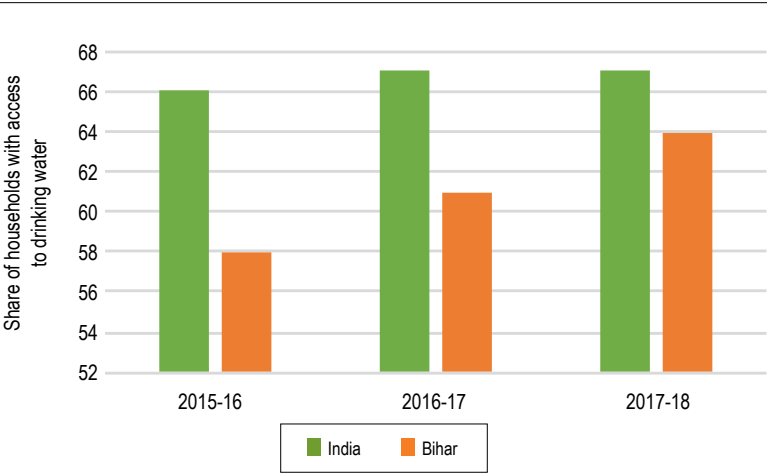
Bihar’s overall performance in ensuring access to clean drinking water for its rural population is poor. This is evident in its performance on NITI Aayog’s Composite Water Management Index (CWMI) for effective water management. The Index ranks states based on their performance on a comprehensive set of water indicators. The overall Index ranges from 0–100, with a higher score indicative of a better performance. In terms of rural drinking water, the Index focuses on the service delivery of water to rural areas, which accounts for 10 points in the Index. The low scores for Bihar and India, in

general, are indicative of the large gaps remaining in providing the rural population with water free of arsenic and fluoride contamination. A lack of access to clean drinking water brings the risk of waterborne diseases spread by water contaminated with viral or bacterial pathogens.

The Government of India has initiated policies like the National Rural Drinking Water Program (NRDWP) and the Jal Jeevan Mission, which aim to guarantee safe and affordable drinking water for all. The NRDWP was initiated in 2009 to ensure that every rural household has access to at least 55 liters of water per person per day, either within their household or within a distance less than 50 m, by 2024. Since 2017, the program has also focused on addressing issues of water quality stemming from arsenic and fluoride contamination in the country and in Bihar.

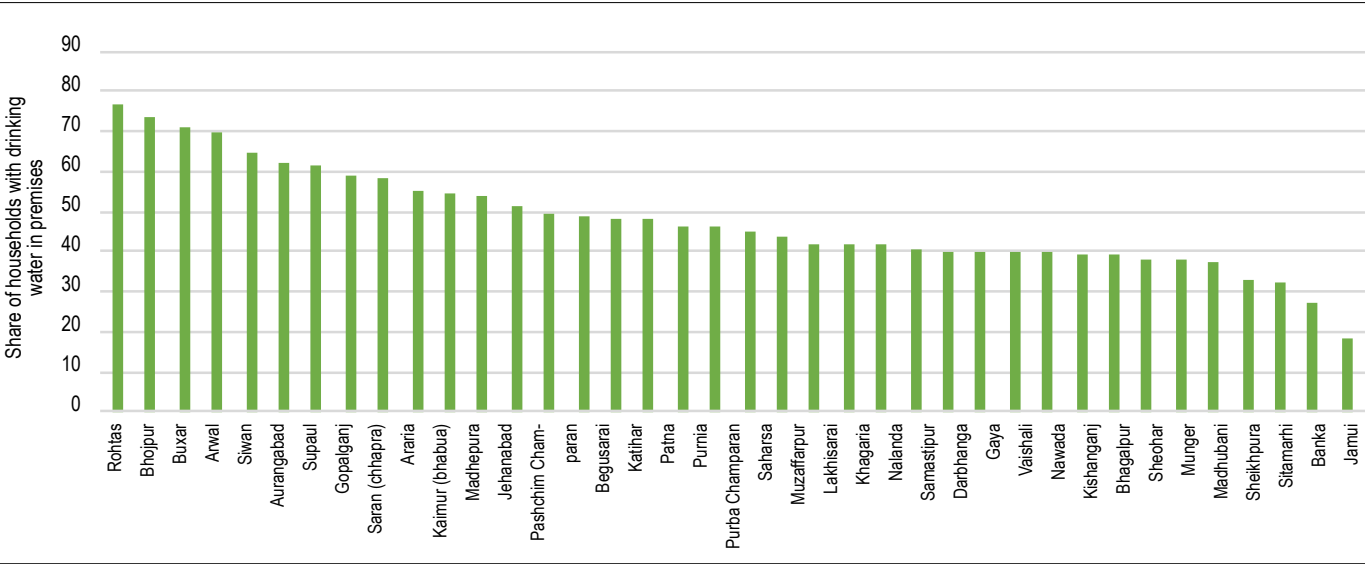


Figure 7.1 | Rural households with access to drinking water



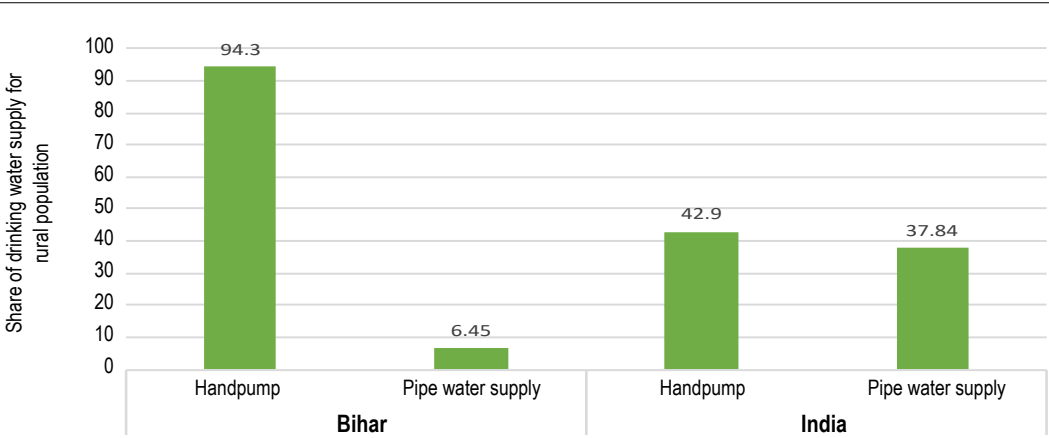
Data source: NITI Aayog–Composite Water Management Index Report 2019

Figure 7.2 | Share of households with drinking water within premises, 2015-16



Data source: NFHS-4 (2015–16)

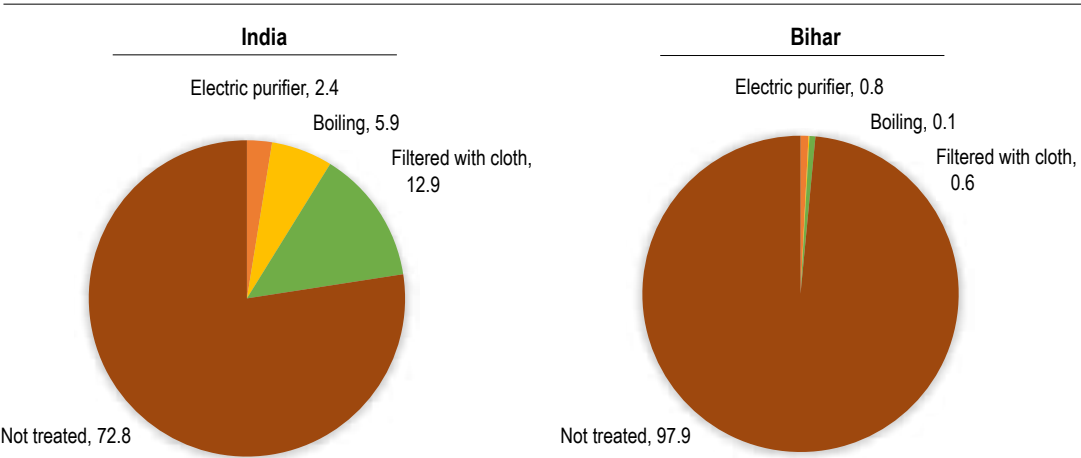
Figure 7.3 | Sources of drinking water supply for a rural population, 2018



Note: The hand pump data refer to share of rural households while the piped water supply data refer to share of rural population.

Data Source: Data on hand pumps is from “NSS Report No. 584: Drinking Water, Sanitation, Hygiene and Housing Condition in India 2018” from the Ministry of Statistics and Programme Implementation (MoSPI). Data on pipe water supply is from Department of Drinking Water and Sanitation, Ministry of Jal Shakti.

Figure 7.4 | Usage of different methods to treat drinking water (%)



Data Source: MoSPI NSS Report No. 584: Drinking Water, Sanitation, Hygiene and Housing Condition in India 2018

7.2 Sanitation and hygiene

The health environment is determined by sanitation and hygienic practices within the home and at the community level. Poor hygiene and sanitation in and around the household often results in diseases such as viral hepatitis and malaria.

Worldwide, and in India, one of the most significant contributors to a poor health environment is open defecation. Nearly 700 million people practiced open defecation globally in 2017.<sup>89</sup> Ending the practice is explicitly mentioned in SDG6.2, as part of reducing inequalities in WASH. However, open defecation remains a widespread health and environmental hazard challenge in India. Open defecation not only reduces the quality of water for household purposes but also makes it unfit for drinking. It contributes to the conversion of large areas of land within the community into “fecal fields” that put the village, and consequently, water sources at risk of flooding with fecal material during rains. Windblown dust particles often deposited in or near water sources also potentially carry fecal pathogens. Even where water containers are used for fetching water, poor handling practices, such as placing them on the ground, could introduce fecal pathogens.

As of 2015–16, more than 70 percent of the households in every district in Bihar practiced open defecation. While the remaining households reported using a latrine, the usage differs in terms of it being improved or not and shared with another household or not.<sup>90</sup> At the state level, the proportion of households with improved and non-shared sanitation facilities stood at 20 percent.

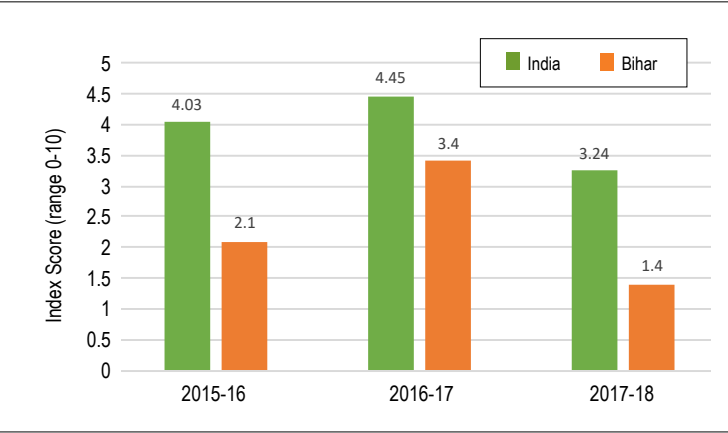
The share of households with latrine facilities is less than 30 percent at the district level. Less than 10 percent of households have latrines in some districts.

To address the persistent problem of open defecation, the Swachh Bharat Mission aimed to make India open defecation-free (ODF) by October 2, 2019. Based on the NITI Aayog SDG Index and Dashboard published in 2019, less than 35 percent of the districts in Bihar have been declared ODF.

Several factors need to be considered when declaring a region to be ODF. These include not just the availability of latrines but also supporting infrastructure that relates to handwashing facilities, water, and soap, together with safe containment of feces and management of solid waste.<sup>91</sup> Handwashing, in particular, promotes good hygiene and prevents the spread of diseases.<sup>92</sup> In Bihar, while nearly 70 percent of households reportedly wash hands with soap and water after defecation, less than one-third do so before mealtimes.

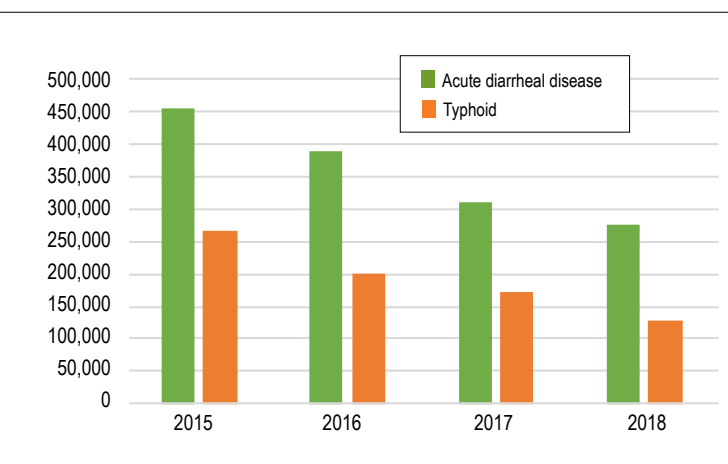
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Figure 7.5 | Performance of Bihar on rural drinking water



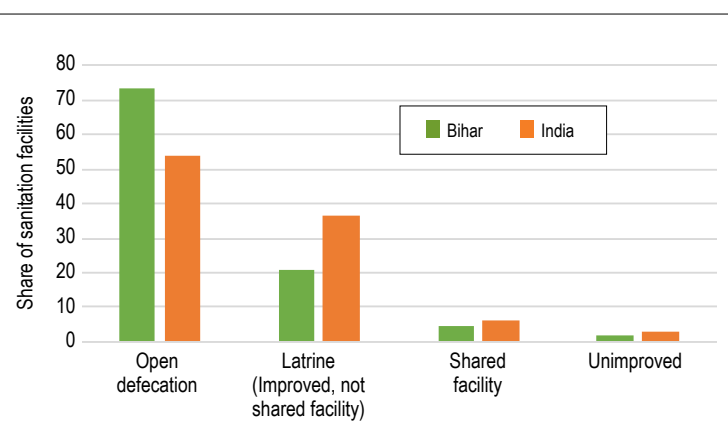
Data source: NITI Aayog-Composite Water Management Index Report 2019

Figure 7.6 | Number of cases of waterborne diseases in Bihar



Data source: National Health Profile of India, Central Bureau of Health Intelligence, Ministry of Health & Family Welfare

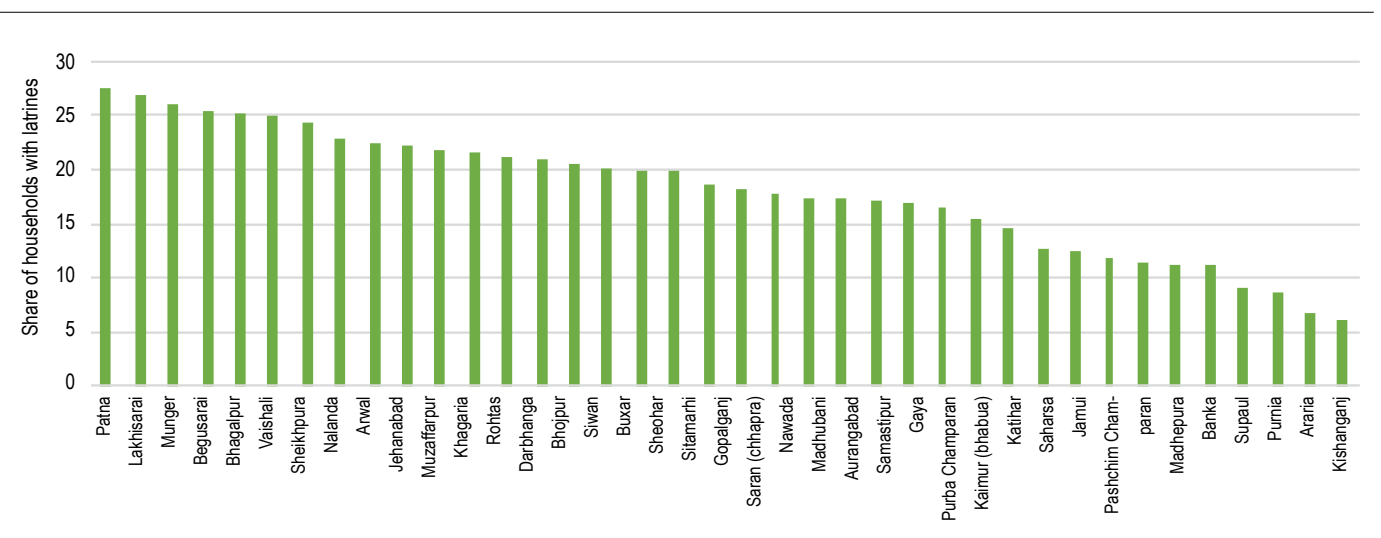
Figure 7.7 | Distribution of sanitation facilities, 2015-16



Data source: NFHS 4

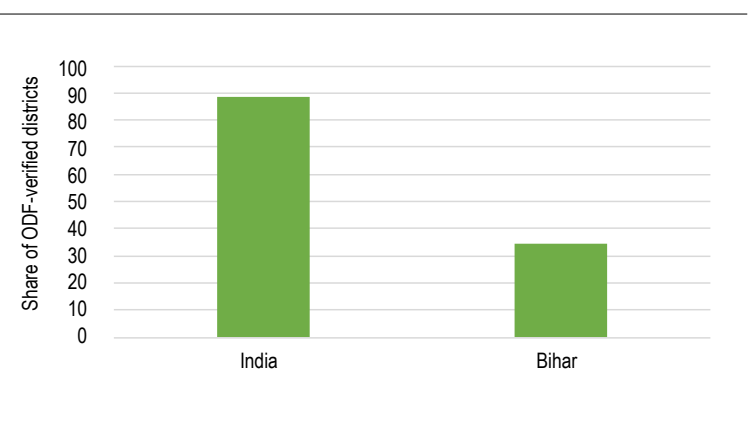


Figure 7.8 | Households with latrines, by district (2015-16)



Data source: NFHS-4 (2015–16)

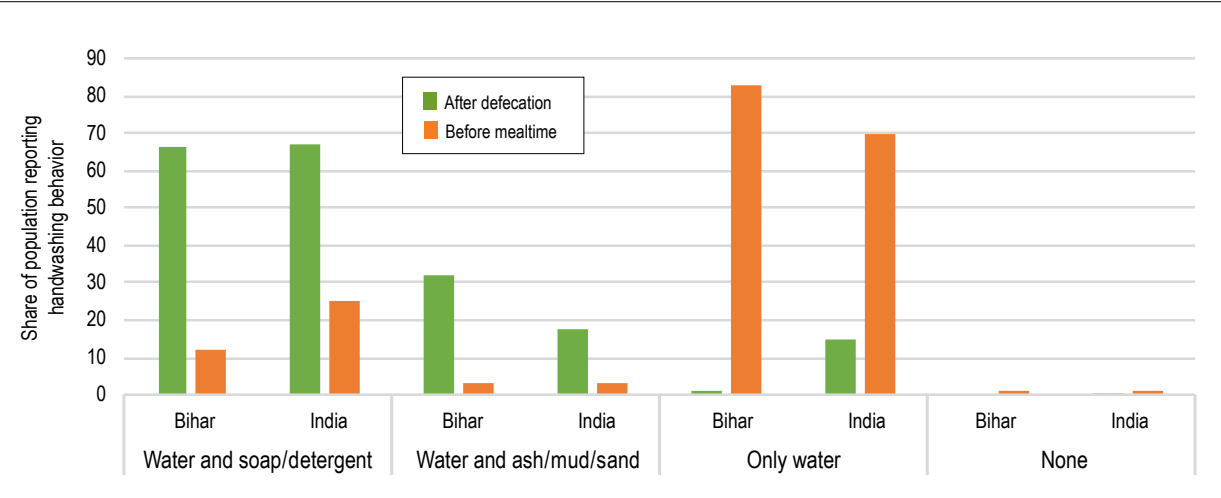
Figure 7.9 | Districts verified as open defecation-free (ODF)



Data source: NFHS-4 (2015–16)

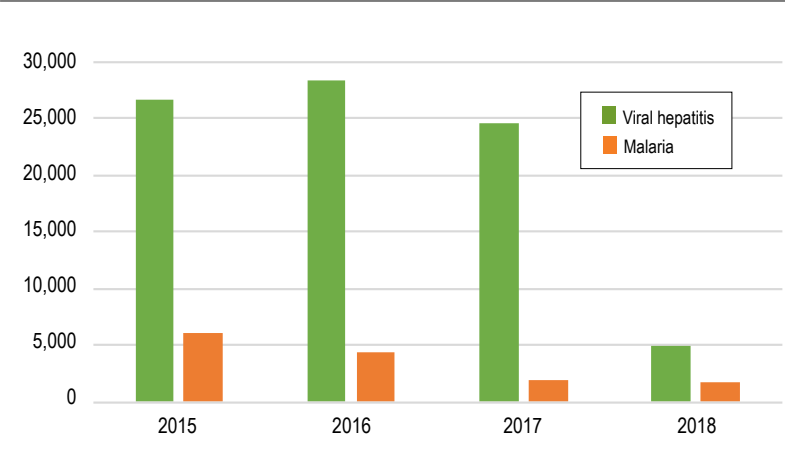


Figure 7.10 | Reported handwashing behavior



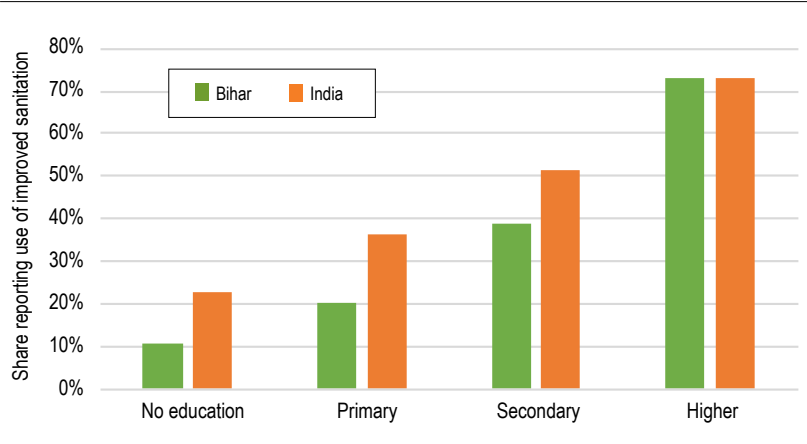
Data source: NSS Report No. 584: Drinking Water, Sanitation, Hygiene and Housing Condition in India 2018

Figure 7.11 | Cases of diseases related to poor sanitation and hygiene



Data source: National Health Profile of India, Central Bureau of Health Intelligence & National Vector Borne Disease Control Programme (NVBDCP), Directorate General of Health Services, Ministry of Health & Family Welfare

Figure 7.12 | Use of improved sanitation by mother's education level



Data source: NFHS-4 (2015–16)

The move toward a better health environment can be supported by BCC strategies that challenge traditional practices, inform communities about the need for change, and support them with investment in infrastructure. Women’s education and awareness can play an important role in influencing household behaviors in these areas. In rural Bihar, the Lohiya Swachh Bihar Abhiyan (LSBA) brings together the state government’s Lohiya Swachhta Yojana with the central government’s Swachh Bharath Mission (rural) to end open defecation. Since 2016, JEEViKA self-help groups have been implementing BCC campaigns to support the successful execution of the program.

While water and sanitation comprise the immediate health environment, hygiene in certain agricultural practices can also adversely affect nutrient absorption. A lack of adequate storage methods can affect food safety, as is seen with the presence of toxins in improperly stored grains postharvest. In this respect, food safety measures, like the use of airtight storage bags, should be promoted. Similarly, agricultural practices that use excessive amounts of chemical fertilizers and pesticides can have negative effects on health if these chemicals leach from the soil and enter the drinking water supply.



There are also occupational risks that result from the nature of crop cultivation itself. For example, workers on rice farms have to constantly bend for long periods of time and stand or squat in water-logged paddy fields that are often contaminated with bacteria, fungi, and chemicals. Flooded fields are also breeding grounds for diseases like malaria, tetanus, and schistosomiasis, all of which can adversely affect nutrient absorption.<sup>93</sup> Women’s exposure to extreme seasonal activities and stress while carrying out manual agricultural tasks can negatively impact their own nutritional status. It has also been associated with lower birthweight for babies in India and Bangladesh.<sup>94, 95</sup>

7.3 Recommendations

WASH factors influence the absorption of nutrients in the body once food is consumed by an individual. Any policy for achieving SDG2 and ending all forms of malnutrition needs to factor in the role of the health environment. The existing programs of the national and state government concerning drinking water and sanitation largely focus on infrastructure development, such as drinking

water infrastructure under the NRDWP and latrine construction under the LBSA. These programs can also be bolstered by campaigns that highlight the importance of WASH for nutritional outcomes. Health and family welfare departments can collaborate with the JEEViKA groups to spread awareness on the need for behavior change around issues like handwashing and open defecation. Similarly, the education department can implement awareness campaigns at the school level. Efforts to expand piped water should accentuate the link between it and increased time for women to spend doing alternate activities. Finally, investment in areas of food safety, like airtight bags for storing food, is needed, as are steps to address occupational risks, such as disseminating information about and assistance for waterborne diseases. This will require convergence between the health department and the agriculture and extension departments to inform farmers, especially women, of associated risks.

<sup>93</sup> SRI (n.d.) <http://sri4women.org/sri-women/sri-women-health/>

<sup>94</sup> Rao et al. (2009)

<sup>95</sup> Ahmed et al. (2020)





A man weighs lentils at a market in Bihar.  
Photo by Mathew Abraham.

## 8

## Policy Convergence

The food systems approach for getting to zero hunger in Bihar, as outlined in this report, highlights the multisectoral nature of the state's malnutrition problem. It brings to the fore the need for a coordinated set of policies that reflect the multidimensional nature of malnutrition, from agricultural policies and household access to diverse foods to intrahousehold food allocation and WASH.

The Bihar State Nutrition Action Plan (2019) focuses on the convergent actions required to address the immediate, underlying, and basic causes of malnutrition in the state. It recognizes the roles that the Departments of Women and Child Development (WCD), Health and Family Welfare, Agriculture, Education, Food and Civil Supplies, and Drinking Water and Sanitation can play, individually, in addressing malnutrition through existing schemes like the Integrated Child Development Scheme (ICDS), the National Health Mission, the Midday Meal Scheme, the Public Distribution System (PDS), the National Food Security Mission, and the Swachh Bharath Abhiyaan. A similar mapping of the various schemes/policies within each of these departments is also found in Bihar's SDG Vision document.<sup>96</sup> However, the current policy space lacks an explicit recognition of the need for convergence between these various departments.

Convergence at the level of objectives means that various departments work toward the same overarching goal of nutrition security. Thus far, the goals of food or nutrition security have been set in isolation, such as with the Department of Agriculture increasing the production of food grains or Poshan Abhiyaan reducing the prevalence of malnutrition. Given that SDG2 ex-

plicitly recognizes the role of agriculture for reducing hunger and malnutrition, what is required, first and foremost, is an incorporation of nutrition security as the broad objective for the various departments involved in agriculture and related fields. It could then be determined not just which aspect of nutrition security—doubling farmer incomes, improving productivity, empowering women, healthy environments—can be addressed by each department, but also how there can be synergies across departments. In practice, the nutrition-related activities of a department would feed into and reinforce the activities of other departments, and vice versa, empowering them all to better meet their nutrition-related goals. For this to work, a focus on nutrition security needs to be explicitly incorporated in the objectives and activities of the various government departments and ministries at both the central and state levels. To some extent, this is visible in Bihar government's map of various centrally and state-sponsored schemes that contribute to the subgoals of SDG2. However, that map shows that individual departments like Consumer Affairs, Health, and Woman and Child Development (WCD) operate in silos, rather than working together to achieve a shared goal.

<sup>96</sup> GoB (2017)



Convergence in objectives at the subnational level is critical for progress toward SDG2, since states play an important role in the design, implementation, and monitoring of policies on the ground. Implicit in such a localization of goals is the setting of nutrition-related targets at the local level. While the NITI Aayog recognizes the importance of a localized approach for achieving the SDG targets, it falls short on a union of objectives, especially at the local level. For instance, in the SDG India Index, each state’s performance on the SDGs is analyzed relative to national-level targets. Setting targets at the district level would make it easier to galvanize resources and ensure coordination. At the moment, district-level institutional mechanisms for collaboration between departments and sectors are in a nascent stage, especially with regard to implementation.

The Bihar State Nutrition Action Plan 2019 outlines a workplan for achieving the nutrition goals of the World Health Assembly, as well as the SDGs, through its Manav Vikas Mission. The plan envisages a three-level administrative and monitoring framework for reducing malnutrition at the ward, district, and state levels. It recognizes the relevance of identifying vulnerable families and individuals at the ward level as a starting point to ensure that the various departmental schemes reach their intended beneficiaries. The implementation of the latter is expected to occur under the purview of the district administration, while the overall state plan will be overseen by a state-level Empowered Body on Nutrition.

A convergence of objectives around nutrition security needs to be followed by convergence in implementation on the ground. Teams from various departments should work together on a joint program of action through interlinked, coordinated activities, from the central level to the village level. At the village and district levels, teams should implement site-specific policies in a coordinated manner. At the grassroot levels, district-level bodies, like the District Development Coordination and Monitoring Committee (DISHA), and village-level bodies, like the Village Health Sanitation and Nutrition Committees (VHSNCs) and Village Education Committees (VECs), need to be empowered with key responsibilities to ensure the implementation of policies related to nutrition security.

To achieve policy convergence, the Bihar government must enlist all stakeholders with a role to play in transforming nutritional outcomes in the state. Within the government, this includes the Departments of Agriculture, Animal Husbandry and Fisheries on the production side, the Department of Food and Consumer Protection for procurement,

and the Departments of Health, WCD, and WASH for programs related to nutrition awareness and behavior change. Additionally, convergence will also require the expertise of local development organizations, cooperatives like Sudha Dairy, and private sector players for markets and value chains. Finally, community-level platforms like self-help groups can be relied on for community mobilization and for layering the livelihood–agriculture–nutrition strategies discussed earlier in this report. Civil society can also contribute to this effort. The state (under the chief secretary) and district (under the collector/ district magistrate) must make special efforts to ensure the participation and commitment of all relevant stakeholders. In all the above programs, engaging with the Panchayat and Department of Urban Affairs will be critical for the achievement of goals.

In Table 8.1, we map out how the roles played by different departments fit within the four quadrants of the TCI framework. For each department, we mention the specific central- and /or state-level schemes that are relevant, and in subsequent columns, highlight to which aspect of the agriculture–nutrition pathways they can contribute. The pathways are color-coded to reflect in which of the four quadrants they refer: Q1 – household income; Q2 – access to diverse foods year-round; Q3 – intrahousehold food allocation; and Q4 – nutrient absorption.

It is imperative to recognize that the slow progress toward improving nutritional outcomes, despite a number of policies and programs focusing on women, child health, and nutrition, is in part because of the lack of convergence and coordination between social safety-net programs, agricultural policies, and food security programs. For meeting the targets of SDG2, specifically, the Vision Document emphasizes the production and delivery of food grains and the absorption of nutrients therein. Bihar’s SDG Vision Document outlines a three-pronged approach to achieving its targets for SDG2. This focuses on (1) gains in agricultural productivity as outlined in the third Agriculture Roadmap (2017–22); (2) improvement in nutritional status through MDMs, ICDS, and the National Health Mission (NHM); and (3) achieving food security by way of the National Food Security Act (NFSA)/ TDPS.

In this chapter, we use the TCI–TARINA food systems framework presented in this report to provide an illustration of concrete options for policy and programmatic convergence at the state, district, and village levels to achieve nutrition security in Bihar.



**“It is imperative to recognize that the slow progress toward improving nutritional outcomes, despite a number of policies and programs focusing on women, child health, and nutrition, is in part because of the lack of convergence and coordination between social safety-net programs, agricultural policies, and food security programs.”**



Table 8.1   MAPPING OF WELFARE SCHEMES AND TCI'S FOOD SYSTEM FRAMEWORK								
Department	Scheme (central)	Scheme (state)	Role for SDG2	TCI four-quadrant framework				
				Household income	Year-round access to diverse foods	Intrahousehold food allocation	Nutrient absorption	
				Q1	Q2	Q3	Q4	
Agriculture and Farmers Welfare	National Mission on Agriculture Extension and Technology, Rashtriya Krishi Vikas Yojana, PM Krishi Sinchai Yojana, National Food Security Mission	Bihar State Organic Mission, Jalvayu ke Anukul Krishi (climate smart agriculture)	Support increases in agricultural productivity					
			Support price stability, particularly for on-staples					
			Ensure market access					
			Support diversification of agricultural production					
			Targeted support to women farmers					
Animal Husbandry and Fisheries; and Horticulture	Mission for integrated development of horticulture (includes National Health Mission [NHM]), National Livestock Mission, Livestock Health and Disease Control Scheme, National Program for Bovine Breeding and Dairy Development	Bihar State Horticulture Mission, Bihar Livestock Master Plan	Diversified production					
			Improved yields for milk and meat					
			Awareness about local and seasonal sources of nutritious foods					
Food Processing	Pradhan Mantri Kisan SAMPADA Yojana (Scheme for Agro-Marine Processing and Development of Agro-Processing Clusters)	<ul style="list-style-type: none"> <li>Establishment of 100 Rural Agri-Business Centers (RABCs)/Primary Processing Centers</li> <li>Integrated Processing Facilities–Poultry and Abattoirs</li> <li>Development Plan–Makhana Cluster</li> <li>Interest subsidy scheme</li> </ul>	Investments in the food processing industry in specific crop-based production clusters of the state					
Rural Development	Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), National Rural Livelihoods Missions (NRLM)	JEEVIKA	Invest in infrastructure (irrigation, roads, postharvest storage, markets, etc.)					
			Put income in the hands of women					
Food Supplies; and Consumer Affairs	Public Distribution System (PDS)	Targeted PDS	Procurement of diversified foods					
			Diversification of the PDS food basket					
			Nutritive foods for vulnerable families with women/children under 2					
			Fortification as appropriate					
Women and Child Development; Education, Social Welfare	Midday Meal (MDM) and Integrated Child Development Services (ICDS) in National Food Security Act, National Nutrition Mission (POSHAN)	Kishori Balika Yojana (earlier Sabla Balika scheme)	Diversification of food menu in ICDS and MDM					
			Behavior change communication (BCC) related to health, nutrition, hygiene, and diets					
			Provision of nutrition supplements					
Health and Family Welfare	National Health Mission	National Rural Health Mission	BCC for nutritious diets and WASH					
Drinking Water and Sanitation; Public Health Engineering	National Rural Drinking Water Program, Swachh Bharat Abhiyaan	Lohiya Swachh Bihar Abhiyaan, Mukhyamantri Gramin Peyjal Nishchay Yojana	Ensure access to piped drinking water, free from contaminants					
			Ensure access to toilets + increase demand for their use					
			BCC for importance of WASH for nutrition security					
Panchayati Raj, Information and Public Relations	<ul style="list-style-type: none"> <li>MGNREGA</li> <li>Indira Awaas Yojana (IAY)</li> <li>Swachh Bharath Mission</li> <li>Socio-Economic Caste Census (SECC)</li> <li>Pradhan Mantri Gram Sadak Yojana (PMGSY)</li> </ul>	Mukhyamantri Graamin Gali-Nali Pakkeekaran Nischay Yojana Mukhyamantri Graamin Peyajal Nischay Yojana	Support the household economy Improve community water and sanitation					
			Ensure convergence					

Data Source: Adapted from Table 2.2 in Pingali et al. (2019)



### 8.1 Ensuring production and supply of locally grown, diverse, micronutrient-rich foods, including animal-sourced foods

On the production front, a move toward nutrition security requires, first and foremost, an urgent reorientation of agricultural policies away from rice and wheat, toward nonstaples, like pulses, coarse cereals, fruits and vegetables, and livestock. The former reflects the focus on calorie sufficiency, which was the goal of the Green Revolution (GR), while the latter reflects the goal of nutrition security. GR policies crowded out nutrient-dense, nonstaple crops, like coarse cereals and pulses.<sup>97</sup> A “crop-neutral policy” that incentivizes the diversification of agricultural production toward nonstaples is now needed. During the last few years, production of hybrid corn increased in Bihar, much of which is sent outside the state. In many parts of north Bihar, fisheries and Makhana cultivation increased in areas with large numbers of bodies of water. Fisheries, small ruminants, dairy, and poultry have immense potential for growth in Bihar. JEEViKA can play a catalyzing role in transforming the agriculture and food sectors in Bihar with help from the Departments of Agriculture, Animal Husbandry, and Fisheries, and major food-based companies with significant interests and presence in the state, like ITC, Ruchi Soya, and Godrej Agrovet. International agencies like HarvestPlus can play an important role in scaling up production of biofortified crops.

The producer response to increasing production of nonstaples has been low, even though nonstaple prices are higher than those of cereals. Incentives for production remain in favor of rice and wheat, and markets for nonstaples are poorly developed, following the abolition of the APMCs in Bihar and the limited presence of private sector players. Therefore, diversification of agricultural production will require a structuring of incentives like subsidies for inputs and investments in markets, credit, and input infrastructure. The Department of Industries can encourage investments in the food processing industry in specific crop-based production clusters of the state, while FPOs (formed by JEEViKA) or cooperatives can help aggregate produce that can be directed toward such clusters. The JEEViKA Special Purpose Vehicle for Agriculture Transformation (JSPVAT) could help catalyze the process and accelerate the learning curve. A massive investment in the procurement infrastructure for nonstaples is needed from the government, as well as remunerative MSPs. Such steps would indicate a convergence in the objectives of the Ministries of Agriculture and Consumer Affairs.

### 8.2 Improving the supply of diverse, micronutrient-rich foods in safety-net programs

A convergence of the objectives of diversification of agricultural production providing diversified, nutritious foods through the state’s food safety nets is imperative. Existing government food-based programs offer an opportunity for supplying micronutrient-rich foods to the most vulnerable sections of the population—pregnant and lactating mothers, infants and young children, and the poorest households in the state. The range of foods provided through programs like MDM, ICDS, and PDS can be diversified in connection with the diversification of agricultural production, reflecting the change in focus from calories to nutrient sufficiency. Diversification will entail pulses and coarse cereals in the case of the PDS and the inclusion of these, plus vegetables and animal-sourced foods, in the case of the MDM and ICDS. Similar to the child-feeding programs, the government should also consider providing biofortified crops, like high-zinc rice and wheat, high-iron pulses, and orange-fleshed sweet potato, through the PDS. Efforts should be made to provide maximum coverage to all vulnerable segments of the population in all the food safety-net programs, including migrants who have returned home after the COVID-19 crisis and their families.

An increase in the supply of micronutrient-rich foods through the ICDS and MDM programs, as well as in the PDS, can be achieved when similar goals are reflected in the activities of other government departments and programs. The Department of Women and Child Development and the Department of Education can increase their cost allocations per child for the nganwadi and school feeding programs. The enhanced allocation can be used to procure an increased quota of micronutrient-rich nonstaples by ensuring coordination with other relevant stakeholders. For instance, milk fortified with vitamin A and vitamin D could be supplied in collaboration with Sudha Dairy. The Departments of Agriculture and of Animal Husbandry and Fisheries can provide technical support to the existing JEEViKA groups in their efforts to diversify their farming systems to include vegetables and fisheries. Biofortified crops could also be grown through the JEEViKA groups and supplied to Anganwadi, schools, and the PDS program. Take Home Rations (THR), prepared and supplied by JEEViKA groups to the Anganwadi, could be scaled up, under appropriate

food safety regulations for locally processed food. The use of locally produced and procured material for preparing the THR would provide a boost to the local economy and ensure livelihoods for women. The Department of Food and Consumer Protection must be involved for changes to PDS supplies. Together with the Food Corporation of India (FCI), it must develop a mechanism for decentralized procurement and supply of millets, pulses, and other biofortified crops. Bihar could follow the direction of Chhattisgarh and Uttarakhand by providing 1 kg of pulses per person per month through the PDS.

### 8.3 Ensuring demand for and purchase of micronutrient-rich food in the market

Policy convergence for a nutrition-secure Bihar can also be conceptualized for the demand side. For starters, agricultural policies geared toward diversification with pulses, millets, and poultry and dairy value chains, as well as management of fisheries, can be targeted toward women. Empowered women, with cash in their hands, can both demand and access nutrition-rich food for their families. If appropriate market linkages and price signals are in place, production of diversified crops can ensure that incomes reach the hands of women. Technology and market support for women can help them to increase their incomes, which can then be directed toward higher demand for nutrition-rich food. Incomes for women can also be ensured through the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), which through its projects can have the benefits of income generation paired with investments in soil and water conservation across the state. In addition to produce sales, demand for micronutrient-rich foods can also be met by encouraging households to cultivate annual nutrition gardens that will take care of some of their vegetable requirements throughout the year, especially green leafy vegetables.

### 8.4 Investing in women’s empowerment and positive nutrition behavior

Women’s empowerment in agriculture should be leveraged as a pathway for improved nutritional outcomes. Extension services and input providers should ensure that women are able to access and own inputs of production, like land, seeds, fertilizers, and credit. At the same time, technologies that reduce women’s drudgery and time spent in agriculture should be promoted. Policies should focus on linking women to output markets by way of improved infrastructure and farmer producer

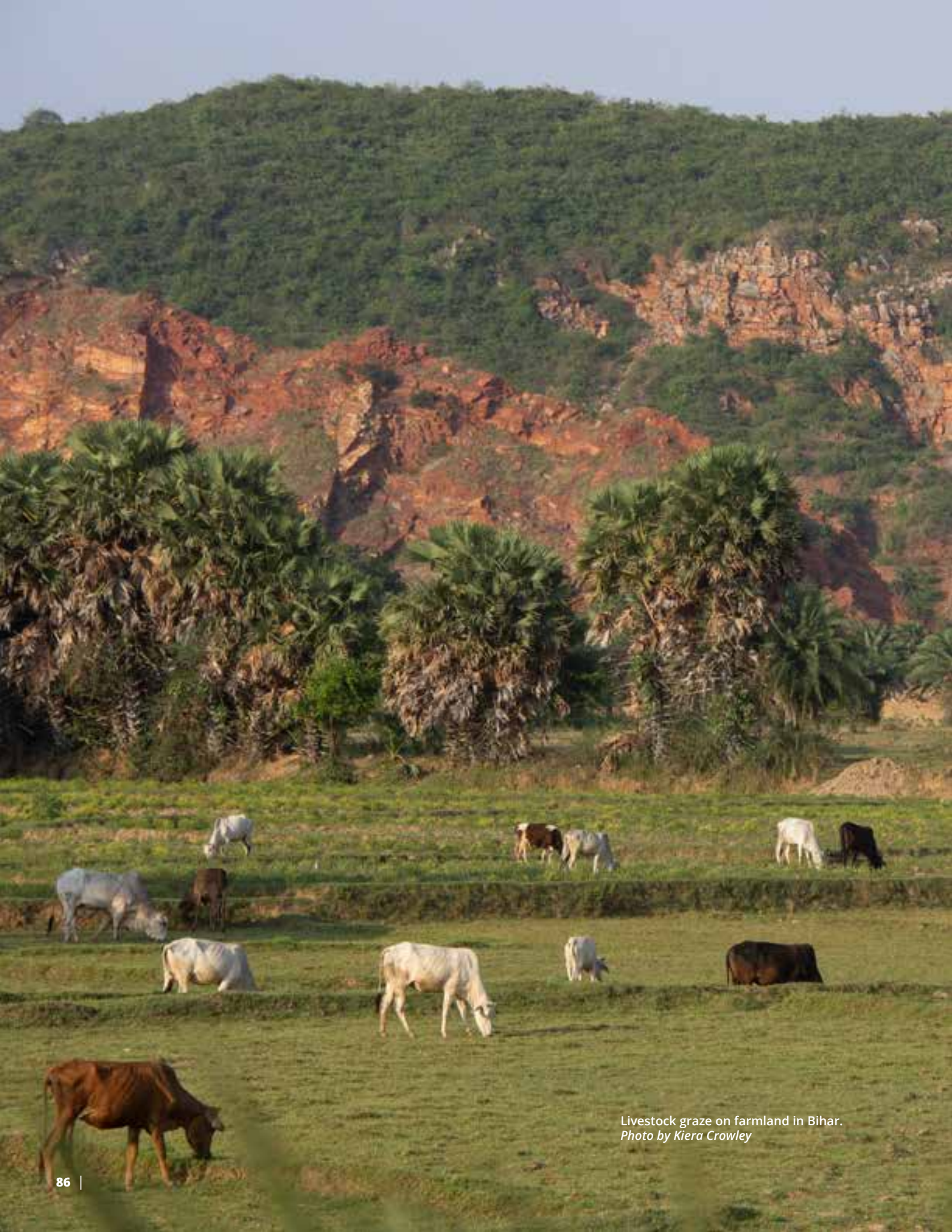
organizations (FPOs). Such steps will ensure that women have access to income, which in turn can spur the demand for nutritious foods. At the same time, women can play an important role in influencing intrahousehold food allocation.

Positive nutrition behavior campaigns that address these issues can be implemented by bringing together government departments, development sector organizations, and public and private sector companies like ITC and NTPC, who have a presence in Bihar. For instance, the Department of Health can bring in their own expertise on the health aspects of improved behavior change practices. Agencies like Care India and Project Concern International can play a critical role in building the capacities of JEEViKA’s frontline and community-level staff and volunteers for behavior change campaigns. More than 900,000 women’s self-help groups have been formed across Bihar. These social capital-rich women’s institutions are being leveraged for various livelihood programs. These institutions also offer a wonderful opportunity to layer programs related to women’s empowerment and positive nutrition behavior. The Departments for Women and Child Development and for Education can work closely with the JEEViKA program to ensure that there is convergence in their efforts.

### 8.5 Increasing investments in water and sanitation

WASH infrastructure in Bihar has been significantly improved in the last decade. There is now a need to build on those investments with regard to nutrition security. On the one hand, there is a need to ensure that all households have access to piped drinking water that is free from contaminants. This can be coordinated through the activities of the Departments of Public Health Engineering, Education, and Health and Social Welfare. On the other hand, there is a need to reinforce behavior change that is geared toward good hygiene practices. Departments like WCD, Health, and Education can design complementary BCC campaigns centered on these practices. The convergence of such efforts around the JEEViKA groups would catalyze these efforts and bring in an element of self-policing at the community level. The Department of Agriculture will also need to join forces with the Department of Health to address risks related to food safety, such as mycotoxin contamination, and crop cultivation, such as waterborne diseases from standing water.





Livestock graze on farmland in Bihar.  
Photo by Kiera Crowley

# 9

## Recommendations

### Invest in the agricultural sector for enhancing incomes for farmers

This report has presented a food systems approach for achieving SDG2—zero hunger—in Bihar. Central to that approach is the role that agriculture plays for improved nutritional outcomes. This is especially relevant for Bihar, where the rural population relies on agriculture as its main source of livelihood and bears the main burden of malnutrition. Small landholding size, low private investment, slow rates of technology adoption and farm mechanization, and recurrent incidents of flood and drought constrain agriculture in Bihar. Seed replacement rates for oilseeds and pulses are relatively low, while postharvest losses of horticultural crops like lychee and mangoes are high. To make matters worse, credit and marketing are weak, while connectivity, storage, and processing infrastructure are poor. Additional investments are required in all areas, including increasing the share of consumption of electricity for agricultural purposes that can kick-start the process of agricultural transformation in the state. There is a need for investment in the management of floods in north Bihar and in watershed and drought resilience programs in south Bihar. Increasing investments in surface- and groundwater-based irrigation systems and introducing small-scale group irrigation systems, like shallow dug wells, can help improve cropping intensity and productivity. Focused investments for enhancing productivity in dairy, fisheries, poultry (for both meat and eggs), and small ruminants could target marginal and landless communities. Continuing to provide support to FPOs would help aggregate the farm surplus for marketing purposes. In the absence of agricultural produce market committees (APMCs), Bihar must ensure that markets work for its farmers and the poor in general. The increased incomes, realized as a result of improved access to markets, can help transform nutritional outcomes by increasing smallholder farming communities’ demand for, and access to, more diverse, nutritious foods.

### Promoting nutrition-sensitive policies for enhancing the supply of nutrient-rich food

The broad objectives of Bihar’s food policy should be focused on nutrition security, that is, ensuring that households are able to access and afford diverse, nutritious foods throughout the year. This contrasts with the current focus on calorie sufficiency, a legacy of Green Revolution-era policies that promoted the production and consumption of staples, like rice and wheat, to alleviate hunger. Those policies now need to be reoriented toward the goal of nutrition security, given the persistent problem of undernutrition, together with the emergence of overnutrition, as reflected



in obesity and noncommunicable diseases (NCDs). Such a reorientation will result in a diversification of production activities toward nutrient-dense non-staples, like coarse cereals and pulses; protein-rich, animal-sourced foods; and micronutrient-rich foods, like fruits and vegetables; thereby ensuring an increase in supply of such foods. To achieve this, Bihar’s predominantly smallholder farming community will need access to irrigation, quality seeds, technology, extension services, and well-functioning markets. Promoting Makhana and fishery-based farming systems in north Bihar would diversify cropping systems, apart from making more fish available for consumption. Promoting pulses in the rice–fallow regions in high residual moisture zones, with improved technologies, would enhance pulses production while also improving soil health. Bihar has immense potential for enhancing fruit and vegetable production through the adoption of high quality seeds and an improved package of practices. With Krishi Vigyan Kendras (KVKs) situated in every district of Bihar, technology dissemination for last-mile outreach should be given a boost. The private sector must be encouraged to ensure supplies of seeds appropriate to field conditions in the state.

**Make food safety nets nutritionally diverse**

The three main food safety nets—the MDM, ICDS, and PDS—can be used as channels to make diverse, nutrient-rich nonstaples affordable and accessible to the poor by adding millets and pulses in the PDS supplies and increasing the proportion of vegetables and pulses in the ICDS and MDM programs. Bihar should consider providing milk, eggs, and fish through its MDM and ICDS programs to improve the nutritional outcomes of children and women, while boosting growth for these sectors in the state. (Bihar could aim to replicate what Odisha is trying by providing fish in food safety-net programs that target children.) Supplies to food safety-net programs could also include provisioning for fortified foods like fortified milk and biofortified foods, like high-zinc wheat and rice. HarvestPlus has been promoting high-iron pulses in Bihar, which could be introduced in the MDM and Anganwadis across the state. Bihar has also been piloting nutrition gardens in government schools in rural areas, and that effort can be scaled up and spread throughout the state. Efforts should be made to provide maximum coverage to all vulnerable segments of the population in all the food safety-net programs, including the migrants who have returned home after the COVID-19 crisis and to their families.

**Invest in women’s empowerment for improved health outcomes**

Women play an important role both as nutrition gatekeepers for their families and as participants in agricultural activities and decision-making. Research has shown that women who are empowered in agriculture are less likely to have micronutrient deficiencies and more likely to consume a diverse diet. Therefore, women need to be supported by ensuring their access to resources and input in decisions related to agricultural activities. At the same time, women also benefit from both awareness campaigns that highlight the importance of nutrition and support for nutrition-sensitive diversification activities, like kitchen gardens and backyard poultry raising. Fortunately, the JEEViKA program in Bihar has been focusing on social and behavior change communication interventions among women across the state. Change has been visible on the ground, but efforts must be increased to ensure that the empowered women act as agents of social change and accessibility of micronutrient-rich food.

**Invest in WASH to aid nutrient absorption**

To improve nutrient outcomes, there needs to be a recognition of the health environment’s impact on nutrient absorption. Efforts to increase the supply of, and demand for nutritious foods will be reflected in improved nutritional outcomes when conditions related to WASH are sufficiently in place. There must be investment in BCC programs related to open defecation and ensuring the supply of contaminant-free, piped drinking water. WASH interventions are especially important in the flood-prone areas of north Bihar, where every year communities suffer due to the breakdown of water and sanitation infrastructure and the spread of waterborne diseases like cholera. Bihar must also ensure safe drinking water that is free of harmful microbes and excess arsenic, fluoride, and other heavy metals. Related agricultural issues, like the loss in quality of food during postharvest storage, can be addressed through the use of airtight bags.

The Departments of Health and WCD can also address waterborne illnesses related to the nature of cropping practices, like standing in water during rice transplantation.

**SDG2 goals can be realized more effectively if there is a convergence in policy design and implementation**

Given that food systems comprise not just agricultural production, but also inputs, markets, women’s empowerment, and WASH, a convergence in the objectives and activities of the various government departments whose policies traditionally target a single aspect of the food system is needed. For policy convergence, the Bihar government must reach out to all stakeholders who have a role to play in transforming nutritional outcomes in the state, including various departments of the government, as well as development organizations, civil society bodies, and the private sector. Collaboration between stakeholders is needed at the start of the process, when policy objectives are conceptualized, all the way down to the implementation of activities on the ground. At the grassroots, there is a need for empowering village-level bodies like the village health sanitation and nutrition committees (VHSNCs) and village education committees (VECs) with key responsibilities ensuring the implementation of policies related to nutrition security.

**Invest in better data systems**

Given that the SDGs are interconnected in nature and related to the point of convergence in the policy schemes discussed here, there is a need for a unified database that can be used for evidence-based decision-making.<sup>98,99</sup> The Global Sustainable Development Goals Report (GSDGR) states that “tracking progress on the SDGs requires the collection, processing, analysis and dissemination of an unprecedented amount of data and statistics at subnational, regional and global levels.”<sup>100</sup> In this regard, the Ministry of Statistics and Programme Implementation (MOSPI), together with NITI Aayog, has prepared a National Indicator Framework (NIF) that includes a list of 297 indicators to measure progress toward each of the 17 SDGs. Each state can adapt the NIF to its requirements. According to the Voluntary National Review (VNR), about 60 percent of states in the country have developed a state indicator framework, and just 30 percent have put into place a district indicator framework.<sup>101</sup> Putting into place a mechanism for the collection of high-frequency data at the subnational level that can be disaggregated by characteristics like gender, caste, rural/urban, and so forth, will be critical for effectively monitoring progress toward achieving the SDGs.

For SDG2, specifically, the SDG India Index relies on the following indicators to track progress made by each state:

- ratio of rural households covered under PDS to rural households where monthly income of the highest earning member is less than INR 5,000
- percentage of children under 5 who are stunted and underweight
- percentage of pregnant women and children under 5 who are anemic
- rice, wheat, and coarse cereals produced annually (kg/ha)
- gross value-added (GVA) in agriculture per worker

Some of these indicators can be made more sensitive to nutrition. For example, instead of including production of rice and wheat with coarse cereals, one could account for nonstaples like pulses that are more nutrient-rich. Alternately, a composite measure of the nutrition diversity of a state’s agricultural production could be developed that accounts for not just crop production but also production and productivity in animal husbandry, horticulture, etc. Similarly, while the ratio of rural households covered under PDS reflects households that are vulnerable to food and nutrition insecurity, a sharper measure to reflect nutrition sensitivity might be the ratio of households that received key nonstaples from the PDS or a composite measure that also brings in the ratio of women and children who benefit from the ICDS and MDM.

One of the biggest data gaps in India comes from the National Sample Survey Office (NSSO). The latest disaggregated data on food expenditures and prices is available for the year 2011 at best. Similarly, estimates around poverty rates and population rely on the census that is conducted every 10 years. Too much has likely changed in the following 10 years to base current and future policies on such old data. More frequent surveys are essential. A change in the indicators used to track food and nutrition in national surveys would also be helpful. For instance, the food groups considered by the National Family Health Survey should correspond to the FAO food groups so as to allow for international comparisons. Data on women’s empowerment should focus on indicators that are related to both agriculture and nutrition. In this respect, TCI–TARINA has led the way in designing, testing, and analyzing context-specific metrics, specifically around the role that women play in agriculture and its relation to nutritional outcomes for women and their families.

<sup>98</sup> UN (2019a)  
<sup>99</sup> NITI Aayog (2019b)

<sup>100</sup> UN (2019a, 58)  
<sup>101</sup> NITI Aayog (2020)

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A boat floats in the Ganges near Munger, Bihar.  
Photo by Mathew Abraham.



**End hunger, achieve food security and improved nutrition and promote sustainable agriculture**



