# BUILDING FOOD SECURITY IN INDIA:

# A CASE STUDY OF BIHAR

By

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A CASE STUDY OF BIHAR

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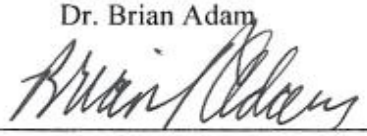

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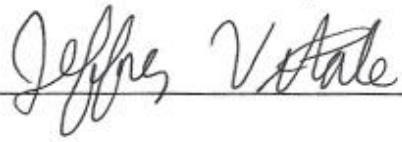

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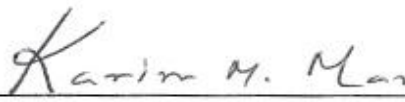

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

LIST OF PHOTOS

# LIST OF MAPS

# NOMENCLATURE

| | |
|---|---|
| AI | Artificial Insemination |
| ATMA | Agricultural Technology Management Agencies |
| BPL | Below Poverty Level |
| BT | Bacillus Thuringiensis |
| COMPFED | Co-operative Milk Producers' Federation |
| CSO | Central Statistical Organization |
| FAO | Food and Agriculture Organization |
| GADP | Gross Agricultural Domestic Product |
| GDP | Gross Domestic Product |
| GSDP | Gross State Domestic Product |
| GHI | Global Hunger Index |
| GM | Genetically Modified |
| GOB | Government of Bihar |
| GOI | Government of India |
| ICAR | Indian Council of Agricultural Research |

| | |
|---|---|
| IFPRI | International Food Policy Research Institute |
| IIDT | Indian Institute of Dairy Technology |
| INR | Indian Rupees |
| ISAAA | International Service for the Acquisition of Agri-biotech Applications |
| ISOPOM | Integrated Scheme of Oilseed, Pulses, Oil palm & Maize |
| KCC | Kisan Credit Card |
| KVK | Krishi Vgyan Kendrs |
| NABARD | National Bank for Agriculture and Rural Development |
| NAREGA | National Rural Employment Guarantee Act |
| NCAP | National Centre for Agricultural Economics and Policy Research |
| NSSO | National Sample Survey Organization |
| PDS | Public Distribution System |
| RDA | Recommended Dietary Allowance |
| SGOB | State Government of Bihar |
| SRR | Seed Replacement Rate |
| TE | Triennium |
| TERI | The Energy and Resources Institute |

# CHAPTER I

## INRODUCTION TO FOOD SECURITY

The concept of Food Security originated in the mid 1970s, during the time of the global food crisis (FAO, 2003). Initially this concept was fairly confined to the problem of food supply (supply side). During this period the issue food availability and price stability of basic food products were the main focus at both national and international levels. The initial definition of food security thus reflected the global concerns of the 1974 World Food Summit and defined food security as: states: "*Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices".*

The most significant factor that led to revision of the definition of food security was experiences from the green revolution. The green revolution helped increase production of staple food crops but did not reduce malnutrition. As the issues of famine, hunger and food crisis were examined deeply, the difficulty of securing access to food supplies by vulnerable groups was a major concern. These problems stemmed from the lack of effective demand (demand side). This brought about a whole new dimension to the issue of food security, implying that demand is just as important as supply for food security. In 1983, the Food and Agriculture Organization (FAO) of the United Nations redefined and

expanded the concept of food security to: *"Ensuring that all people at all times have both physical and economic access to the basic food that they need"*.

The most recent definitions to food security are multifaceted. They go beyond economics and physical availability and include social, health and nutritional aspects. The World Food Summit of 1996 adopted a more complex definition to include these aspects: *"Food security, at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life".*

This definition is further amended by FAO in 2001 to stress the significance and importance of social aspects to food security: *"Food security [is] a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"*

There have been numerous attempts to define the concept of food security in research and in policy arena. They all encompass and highlight the importance of food availability, food accessibility, and food adequacy/utilization, the three broad dimensions of food security. First, food availability refers to the supply side of food. If enough food is not produced for all, certainly there will be food insecurity. Food availability depends on domestic production, imports, food reserves, donations, post-harvest management, access

to markets, referring to different processes that transfer food products from producer to consumer (supply chain). Food accessibility refers to the demand side and includes issues such as affordability of food, income level, preferences, infrastructure, labor markets, and population growth. Lastly, adequacy/utilization of food take into account health, nutrition, absorption and food safety issues, as well as processing, value addition, and social aspects.

The food security issues are thus multidimensional. Efforts to improve food security, therefore, should target all three dimensions. For instance both increased production and increased household income will result in improved household access to food. Improvements in food accessibility along with efficient utilization will significantly improve nutritional security and thereby lead to physical well being and cognitive development of individuals.

# CHAPTER II

# OBJECTIVES AND METHODOLOGY

## Objectives

The overall objective of this study is to understand the food situation in Bihar and emphasize the importance of agriculture and allied sectors in building sustainable food security.

The specific objectives of this research project include:

1. Examine the agricultural and food systems in Bihar including the crop, livestock and fisheries sub-sectors.

2. Identify key constraints to the agricultural production and challenges to food security in terms of food availability, food accessibility, and food adequacy.

3. Examine the current strategies and interventions to address food security in Bihar and India.

## Methodology

Multiple approaches were used to collect the information and data for this study. These approaches included:

a) Literature review

b) Review of unpublished reports and documents

c) Site visits to New Delhi and Bihar, India

d) Personal interviews with stakeholders

This study uses both quantitative and qualitative data and information that were collected using the above approaches. The use of mixed methodology and techniques of data collection helped improve the reliability and verifiability of the findings. The study was carried out at both macro and micro levels. At the macro level the study investigated the general trends in food availability in India in general and for the State of Bihar. Accessibility and adequacy were evaluated at the micro level in terms of food prices, income, and nutritional intake.

The research project was initiated with the collection and analysis of information and data on agriculture and food security gathered through web searches, review of the existing reports, documents, books and papers (both published and unpublished literature), subsequently, followed by a site visit in March 2010 to New Delhi and Patna, Bihar.

Photo 1. Meeting with District Directors at ICAR, Patna, India

This visit was hosted by the National Centre for Agricultural Economics and Policy Research (NCAP) and The Energy and Research Institute (TERI) both located in New Delhi, India. A number of meetings were organized with key agricultural economists and researchers in New Delhi, who are involved in research and policy work related to food. security in India. Key publications and reports on the agriculture and food security situation in India were collected during these visits

During the site visit to Patna, the capital city of the State of Bihar, several interviews were held with senior economists and researchers working at the Indian Council of Agricultural Research (ICAR), the Indian Institute of Dairy Technology (IIDT) and Farmers Commission of Bihar. In addition, a panel discussion was held with a group of

13 District Directors that represented various areas of Bihar. The District Directors are responsible for supervising agricultural development activities in specific geographic areas. A summary table was created using subjective and qualitative information on the 39 districts of Bihar gathered through this discussion. A scale of 1 to 5 (where 1 is the most serious issue and 5 is the least serious) was used to rate the relative importance of the different components of food security covering all three dimensions – food availability, access, and adequacy from all 39 districts of Bihar State.

A meeting was held with Dr. R K P Singh, the former Professor of Rajendra Agricultural University, Bihar and the then Advisor to the Farmers Commission of Bihar. The district level information on agriculture and food security situation was verified against the Farmers Commission information to increase authenticity. Published secondary data on crop production, investment, agricultural State GDP, income, wholesale food commodity prices etc. were also gathered with the assistance and collaboration of Dr. Singh.

With the assistance of ICAR, IIDT and Dr. R K P Singh, three field visits were arranged to the Village of Bilap in Bihar, the Adami area near Patna and a neighborhood market near Patna.

**The Village of Bilap in Bihar:** A visit was made to a rural village called Bilap, 30 kilometers away from Patna with Dr. R K P Singh. Although very close to the main city, a paved road system was only available to the boundary of the village, the internal road network mainly consists of narrow dirt and gravel paths. Public utility services such as

electricity and water is available only to a limited number of families. The basic infrastructure such as drainage and sewage facilities is not well developed. Life in the village continues to functions in isolation. The main occupation of the villagers is crop production and brick industry. Livestock activities are also an integral part of the daily livelihood.

Photo 2. Meeting with farmers in the village of Bilap, Patna District, India

Within the three groups of farmers interviewed (25 informants), the majority of the farmers either cultivated their own land or cultivated land leased from other farmers or landowners. Many of them had very small land holdings of less than 1 hectare. A handful of progressive and economically well off farmers had 0.5-7 hectares of land. The main crops cultivated were rice and wheat. Seasonal fruits and vegetables such as

potatoes, guard, cauliflower, soyabean, leafy vegetables, bananas, papayas, etc. were also produced.

The majority of the farmers were subsistence farmers and produced for their own consumption and sold the surplus at the village mandi (market). The farmers with larger land holdings sold their surplus to wholesalers. Most of the women were actively involved in field work as well as post harvest activities and animal husbandry. Simple processing devices and manual labor were used to process grains and pulses. Grains, pulses and vegetables were stored in the farmers' homes until consumed or sold.

Photo 3. Urban poor in the Adami Area, Patna, Bihar

**The Urban Area of Adami near Patna city:** The second site visit was made to Adami area located in the suburbs of Patna City. The streets in this area were narrow and in poor condition. There were around 30 families in that area. The homes of the residents in this area were small and made up of substandard wooden shacks. In addition to these, there were row houses built by the states' welfare agencies and small private houses rented out by property-owners. Many families with limited resources shared their residences with

other families. The majority of people in this community were laborers living on low daily wages. Almost all of them were dependent on the ration cards provided by the state government to obtain their weekly/monthly supply of food staples and fuel (kerosene)

Due to limited employment opportunities, people from this area were migrating to Punjab and Haryana States in search of work. By doing various temporary jobs they earned roughly INR.1,500 to 3,000 per month, out of which they paid their house rents (roughly INR. 600 per month), and bought food and other daily necessities.

**The Neighborhood Market near Patna City:** The third site visited was the mandi or market located close to the Patna city. This was an open market where both the producers and retailers sell their products (cereal grains, pulses, vegetable, fruits, fish, meat, juggery etc). The food products were commonly arranged over plastic sheets placed on the ground. The prices of commodities such as rice were relatively the same amongst the different sellers. The sellers included both males and females belonging to different age groups.

A range of qualitative information was gathered through several field visits and semi-structured interviews with key informants including farmers and urban poor. Participatory research methods and site visits provided an opportunity to meet and interact with urban and rural communities at the grass-roots level and with government official working with the state of Bihar. The site visits not only helped in further verifying information collected through literature review but also provided an opportunity

to gather personal stories and experiences, values, backgrounds, and needs of the resource poor people on the ground. The researchers at ICAR and Farmers Commission have developed good rapport with stakeholder and thus contributed greatly to the authenticity and trustworthiness of the information and data obtained.

Photo 4. The Neighborhood Market near Patna City, Bihar

# CHAPTER III

# AGRICULTURE AND FOOD SECURITY SITUATION IN INDIA

## Agriculture in India

India is the second most populated country in the world with a population of more than 1.15 billion people (Registrar General & Census Commissioner of India, Ministry of Home Affairs, Government of India (GOI), 2010-11). Geographically, India is divided into 28 states and seven union territories with diverse landscapes, agro-ecosystems, cultures, religions and socio-economic status. India is predominantly an agrarian country supporting the livelihood of nearly 60 percent of the population (Ministry of Statistics and Programme Implementation, GOI, 2010). More than 60 percent of the people in India live in rural areas and are directly dependant on agriculture and related activities for their daily livelihood and well being. At present, agriculture and allied sectors contributes around 17 percent (2008-09) to the national Gross Domestic Product (GDP) (Ministry of Statistics and Programme Implementation, GOI, 2010).

Major climatic conditions of the world are present in India, ranging from coastal to arid to semi-arid to highland systems, thus allowing the cultivation of a wide range of crops. Even though Agriculture's share of national GDP has decreased over the years (Table 1),

agriculture continues to be the most important sector for national food security and poverty alleviation.

TABLE 1

CHANGE IN THE COMPOSITION OF
NATIONAL GDP (%) FROM 2001 TO 2009

| | Period | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 |
|---|---|---|---|---|---|---|---|---|---|
| **Sectors** | Agriculture | 24% | 21% | 22% | 20% | 20% | 19% | 18% | 17% |
| | Industry | 19% | 20% | 19% | 20% | 19% | 20% | 19% | 19% |
| | Services | 57% | 59% | 59% | 60% | 61% | 62% | 63% | 65% |

Source: Ministry of Statistics and Programme Implementation, Government of India, 2009

Since independence in 1947, the Indian government has placed a high priority on agricultural research and development. Further, with the adoption of new technologies and the realization of the green revolution, the overall agricultural sector in India has grown rapidly (Dandekar, 1988). With the policy reforms and new trends of globalizations, during the last decade, the economy in India has been booming. The country has achieved an impressive economic growth rate of more than 8% annually. This trend is continuing and, according to World Bank estimates (Global Development Finance Report, 2009), the Indian economy is projected to grow at 7 to 8 percent in 2010 and 2011 and beyond, which would make it one of the fastest-growing economies in the world. This impressive growth however, is mainly due to the expansion of the services sector. The share of the agricultural sector in national GDP has been declining (Table 1)

and government is concerned regarding the food security situation for the growing population. Food security continues to remain a major challenge for the Indian government.

National food grain production is projected to grow at 2.3 percent per year during the Eleventh Five Year Plan (2007-2012) (Planning Commission, Government of India, 2007) at a rate higher than the projected human population. If this projection holds true, overall national food security can be strengthened (Singh 2009). India has a large production base with a variety of crops and agricultural products. The production, however, has become stagnant in key staple and food security crops such as rice and wheat. Population and consumption needs, on the other hand have been increasing steadily. The highest per capita food grain availability was recorded in 1991 (approx. 180 Kg.), this declined to 152 Kg. in 2001, increased to 162 Kg. in 2006 and back around 152 Kg. in 2008 (Shiva, 2007 and Singh, 2009). This National trend is threatening food and economic well-being of the millions of rural and urban people in the country.

Increased investments and policy reforms have not percolated to the grass-roots level and to states where poverty is acute and where labor is used intensively (Bihar, Orissa, Madhya Pradesh, Jharkhand, Rajasthan and Uttar Pradesh). As a result there are many concerns over the slow pace of agricultural growth at both national and state levels, especially with the increase in demand for food for the growing population. Thus, there is a critical need to achieve "state and national level food security."

The Food Security Situation in India

As indicated earlier, India is one of the world's vibrant emerging economies, but it is finding itself under increasing pressure on food security issues. More than two-thirds of the country's 1.15 billion inhabitants are involved in agriculture and allied sectors (Ministry of Agriculture, GOI, 2010). But a range of issues from poor availability of national water resources for agricultural purposes, deforestation, and uneven monsoon rains resulting in flooding or droughts, lack of technology, poor access to inputs, markets and utilities to fragmented extension system has and is adversely affecting food production systems of the country, especially in the backward states.

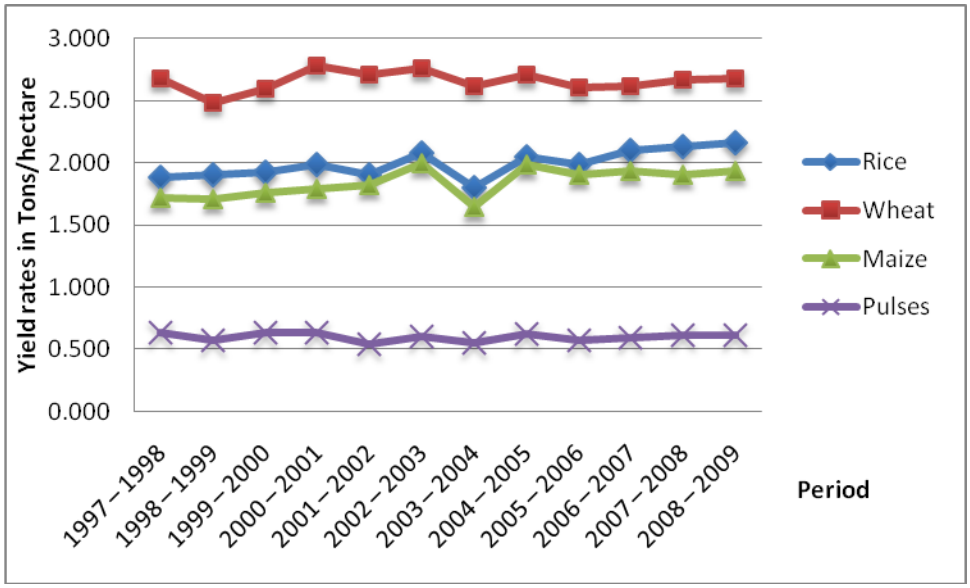



Figure 1. Production of Cereals and Pulses in India (1997 – 2009)
Source: Ministry of Agriculture, India (2009)

Food insecurity is multi-dimensional and is influenced by factors related to unavailability, inaccessibility and inadequacy of food. In India, there is evidence of each

of these aspects in one form or another contributing to food insecurity. Although, India experienced a rapid growth in food production in the 1980s for cereal grains and pulses, this growth has become slow and stagnant since the early 1990s (Figure 1).

According to 2010 data from the Ministry of Agriculture in India, the food requirement for next year is estimated to exceed food production by 7 million tons (Figure 2). The government of India is oriented toward food self-sufficiency and therefore importation of food is discouraged. But unless food production is intensified within the country to meet this demand, there will not be enough food for the rapidly growing population. Low and volatile agricultural growth rates and the recent escalation of agrarian crisis in several parts of India are not only a threat to national food security, but also to the economic well-being of the country. This lag in production is due to a number of reasons (Table 2).

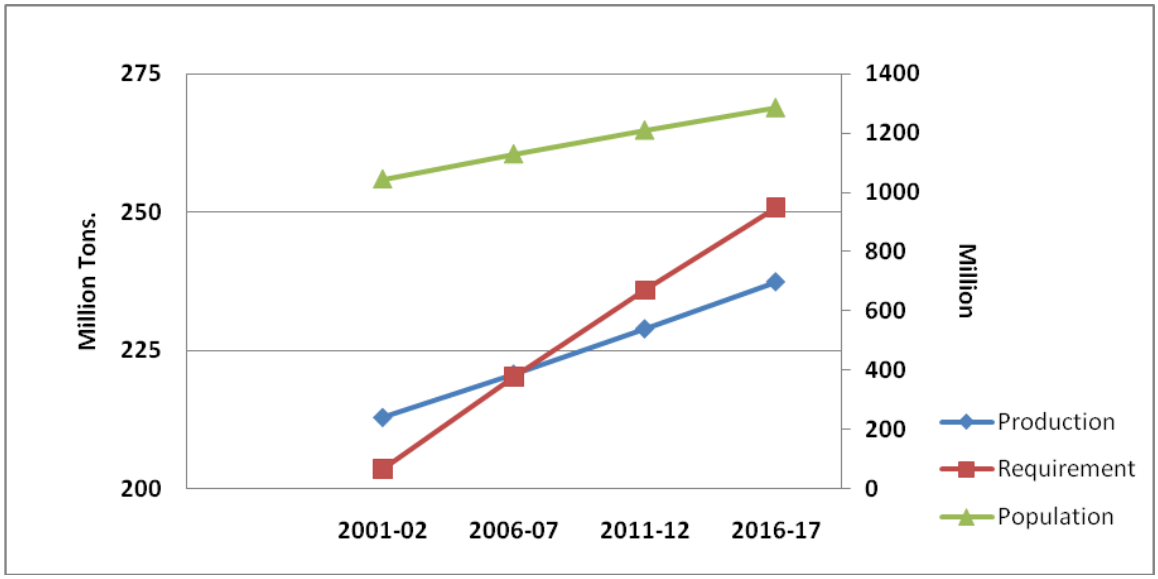



Figure 2: India Food Production, Food Requirement and Population (2001 – 2017)
Source: Ministry of Agriculture, India (2009)

TABLE 2

KEY CONSTRAINTS TO AGRICULTURAL PRODUCTION IN INDIA

| **Cause** | **Result** | |
|---|---|---|
| 1. Decreasing soil fertility and quality | ▪ Decrease in crop response to inputs and poor growth in crops | **Decrease in Production** |
| 2. Land lost to urbanization | ▪ Decrease in land available for agriculture | |
| 3. Lack of access and slow adoption of improved and high yielding varieties | ▪ Decrease in resistance to pests | |
| 4. Poor access and inefficient use of agricultural inputs and technology | ▪ Degradation of soil quality | |
| 5. Poor water management | ▪ Prone to floods and droughts<br>▪ Lack of water for agricultural production<br>▪ Poor response by improved seed and fertilizer | |
| 6. Poor Infrastructure | ▪ Lack of access to inputs and markets<br>▪ Inability to operate agricultural machinery | |
| 7. Reduced quality of agricultural research | ▪ Unsustainable growth in Agricultural systems | |
| 8. Dysfunctional extension system | ▪ Poor technology and information dissemination | |
| 9. Lack of Investment in agricultural research and education | ▪ Lack of new agricultural innovations and technologies | |
| 10. High input cost | ▪ Reduced of access to inputs | |
| 11. On-farm and off-farm losses of agricultural outputs | ▪ Loss of Income | |

Accessibility to food is mainly constrained by an increase in retail price of food products and a decrease in income levels. The government of India has been attempting to support low income groups, protecting them from increases in food prices by purchasing grain from farmers and selling them at subsidized prices though the Public Distribution System (PDS). The current situation reflects the conflicting policy objectives of the government. On the one side, there is a need to provide food to consumers at an affordable price and on the other side farmers' incomes and incentives need to be increased. The situation right now is transferring the increases in farm prices to the consumers in the form of increased food prices.

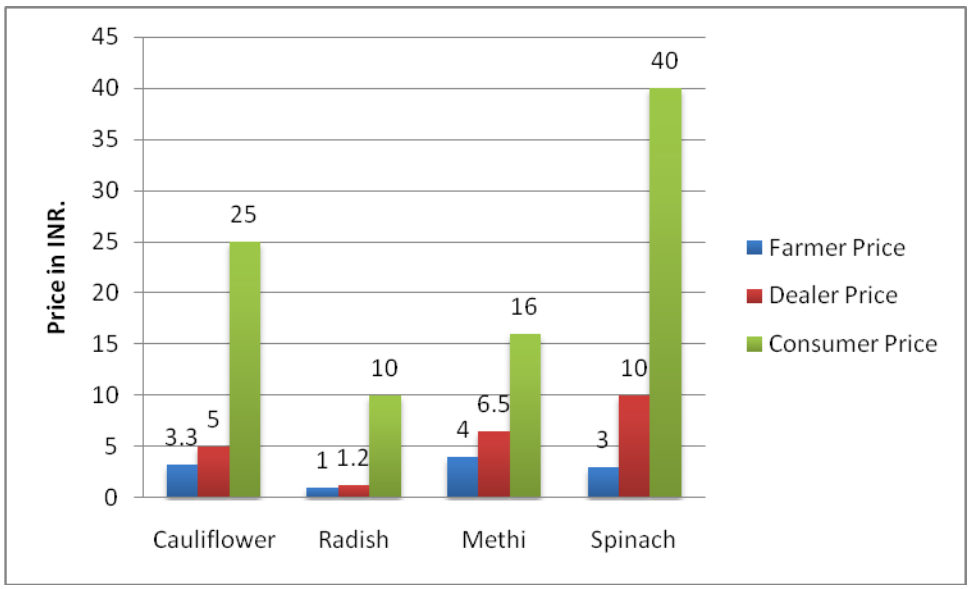



Figure 3: Prices across the Value-Chain for Selected Vegetables in India (December, 2009)
Source: The Times of India (December 17, 2009)

An article published in the prominent newspaper, The Times of India (Dec 18, 2009), states that according to the Indian Government, food prices rose by 19.95 percent in the

year 2009. The article further states that the cost of staple food items such as rice and wheat has outpaced wage increases in the same year. Another article in The Sunday Times of India (Dec 17, 2009) reported that the food items undergo 50 – 400% mark up when they travel from farmers to mandi (wholesale market) to the retail market (figure 3). There are two down sides to this story. On one side the poor farmers get only a fraction of the retail price for their hard work and on the other hand consumers have to pay high prices for basic food items. The Times of India further states that initially the retailers and the wholesalers attributed the increase in food prices to a bad cropping season, however, even in the favorable seasons some food prices have not changed. This article further states that although transportation, storage, and marketing cost contribute to the price increase, exploitive nature of middlemen are a major issue.

In response to the widespread public criticism in India (2008-2009) that the government statistics produced by the Planning Commission were unrealistically low poverty estimates (27 percent), the Tendulkar Committee was appointed to evaluate the methodology for estimating poverty and verify the government's claim that poverty has been reduced to some extent. The national rural poverty line is set at a monthly expenditure of INR. 446.68 per month (approx. $10) and the national urban poverty line is at INR. 578.8 a month (approx. $13). In spite of this very low benchmark on poverty, one in three Indians (37 percent) was found to be living below the poverty line (Report on Poverty Estimation, 2009). According to this report, Orissa and Bihar had the highest number of poor while Nagaland, Delhi and Jammu and Kashmir had the least number of poor.

Extensive discussions on the food security situation of India can be enabled through the use of tools and scientific methodology to determine the causes and consequences of food insecurity. To address the adequacy component of food security, an approach called the Global Hunger Index (GHI) was utilized. The GHI was developed by the International Food Policy Research Institute (IFPRI) in 2006 (Wiesmann et al. 2006) and is now a widely used statistical tool that ranks regions, countries and states based on their levels of hunger. Although inadequate food intake is the main cause of hunger, other factors such as low quality diet in combination with low birth weights and high rates of infection and mortality contribute as well. Thus, the GHI uses 3 equally weighted hunger indicators – the number of undernourished as a percentage of the population, the proportion of children suffering from weight loss, and mortality rate of children less than 5 years of age.

TABLE 3

GLOBAL HUNGER INDEX 2009 FOR SOUTH ASIAN COUNTRIES

| Country | Population (2009) | GHI (2009) | Population in Hunger (2009) |
|---|---|---|---|
| Bangladesh | 156,050,883 | 24.7 | 38,544,568 |
| India | 1,156,897,766 | 23.9 | 276,498,566 |
| Nepal | 28,563,377 | 19.8 | 5,655,549 |
| Pakistan | 174,578,558 | 21 | 36,661,497 |
| Sri Lanka | 21,324,791 | 13.7 | 2,921,496 |

Source: Collected data, 2009 Global Hunger Index

Although Bangladesh has the highest GHI for 2009 (Figure 3), India has the largest number of population in hunger and is ranked higher in the medium vulnerability category (Global Hunger Index, 2009). The agriculturally progressive states of India such as Punjab and Haryana that have a net state domestic product per capita of over INR. 30000 (2004-2005) are also ranked below 33 and 55 other developing countries respectively. Even though there are some States that are doing quite well in agriculture and have adopted state-of-the-art agricultural methods, the general trend in agriculture and food security situation in India is quite alarming.

Photo 5: Retail Markets in India, and Wheat Production

What is more alarming here is that the states that have the worst GHI index scores in India have scores similar to the countries in the world that have severe hunger and malnutrition problems. For example, Bihar and Jharkhand have scores of less than 73 and 75, and are ranked lower than Zimbabwe (67) and Haiti (69), while Madhya Pradesh with a score of 30.9 falls between Ethiopia (81) and Chad (82) (India State Hunger Index, 2009).

# CHAPTER IV

# SOCIO-ECONOMIC PROFILE AND HISTORICAL BACKGROUND ON AGRICULTURE

## Geographic and Socio-Economic Background of Bihar

Bihar is a landlocked state located in the eastern part of India situated between 83°-30' to 88°-00' longitude. It is mainly a vast stretch of very fertile land. Bihar contains several rivers: Ganges, Son, Bagmati, Kosi, Budhi Gandak, and Falgu. The river Ganges divides Bihar into two parts; north Bihar is 53.3 thousand square km and south Bihar is 40.9 thousand square km. Bihar is bounded by West Bengal in the east, Uttar Pradesh in the west, Nepal and the Himalayan mountains to the north and Jharkhand to the south. Jharkhand includes the Chota Nagpur plateau which was part of Bihar until 2000, but now is a separate state.

Bihar is divided into 9 divisions – Bhagalpur, Darbhanga, Kosi, Magadh, Munger, Patna, Purnia, Saran and Tirhut – and 38 districts. Patna is the capital city. The climate of Bihar is hot in the summer (40 to 45 degrees Celsius) and mildly cold during the winter (the lowest being 5 to 10 degrees Celsius). Bihar receives a good rainfall during monsoon months from June – September. Bihar has a mix of humid and sub humid climate.


**Map 1. State of Bihar**
Source: www.mapsofworld.com

Bihar is the ninth largest state of India by area and has a population of 94.5 million. Literacy rate in the state is 46.42 percent which is lower than India's national average of 65.38 percent. The economy of Bihar is mainly based on agriculture and the service sector. Agriculture represents one fourth of the Gross State Domestic product of Bihar. Agriculture and allied industries (livestock and fisheries) provide the primary source of income for almost 76% of Bihar's population (Department of Agriculture, State Government of Bihar (SGOB), 2009). The average annual income in Bihar was INR. 9,586 (US $ 213) for 2008 –09 (State Government of Bihar, 2009)

In spite of highly extremely fertile soil, adequate rainfall and good ground water

availability, Bihar has not yet realized its full agricultural potential. In fact, yields of staple food crops in Bihar are one of the lowest in India. For example for the past 10 years, rice yields have remained stagnant, while yields of wheat, the second most important crop, have declined by 20 percent (Department of Agriculture, SGOB, 2009). The situation for the fisheries industry and livestock industry is equally unsatisfactory. In spite of the abundance of fresh water bodies, the fisheries sector in Bihar does not fully meet the state's demand. While the dairy sector is growing, there is a widening gap between demand and the production and supply chain of meat and other byproducts of the livestock industry.

The recent expansion in the non-agricultural sector has brought about very little improvement to the socio-economic conditions of people in Bihar, especially the rural population. With so many people's livelihoods dependent on the success of agriculture, low agricultural production coupled with a very high population growth rate (4.1 percent in 2009 against the national average of 2.1 percent) has led to many socio-economic problems including food insecurity, income insecurity, malnutrition and migration of agricultural laborers to other States. Bihar's poverty level is one of the highest in the country. A recent article in Wall Street Journal (2009) reveals that more than half of Bihar's residents live below the international poverty line of about $1 dollar a day.

## Historical Background on Agriculture in Bihar – Pre-colonial, Colonial and Post-colonial Outlook

In order to understand the agriculture and food security situation in India and Bihar, it is

important to look at its recent history. The colonial and post-colonial development in agriculture in Bihar is closely linked to India's history. Rothermund (1993) described an historical perspective of agriculture in Bihar. Prior to British rule, India had a stable economy. The traditional Indian agricultural operations were carried out by small-scale subsistent peasant farm families organized in small village communities. Their methods were more or less what we would now call "appropriate technologies". There was an abundance of land and labor. Throughout medieval times, land was not a commodity that could be freely bought and sold. The peasant family who tilled the soil was in greater demand than the land. Landlords were not landowners; they only had the right or privilege to collect taxes from the peasants. If landlords were too exploitive, the peasants would flee and seek refuge under a less rapacious lord.

Capital, on the other hand, was not an essential factor for agriculture. Landlords kept some of the surplus for themselves and handed over the rest to the king or another privileged person in the hierarchy of those who lived on the work of the peasantry. Powerful rulers would tend to eliminate middlemen and concentrate the collection of surplus in the capital city. The Indian kings emphasized their ritual sovereignty and bestowed great deal of local autonomy and land to their subjects: Hindu priests and Brahmins, who in turn provided moral support for the king. The social system allowed land and labor to be substituted for capital when there was a requirement or scarcity (Rothermund, 1993).

The farmers bore the cost and risk of production and the landlords collected the surplus in

kind when the harvest was in. Variability in the monsoon discouraged organized agricultural production on a large scale. Pre-colonial villages were self-sufficient economic units and their interactions outside the village were limited to the purchase of necessary items from nearby villages or towns. The farmers usually raised enough produce to feed themselves and the non-agricultural members of the village community. Agricultural produce was exchanged for other items that were needed for domestic consumption. If the crop yield exceeded consumption needs, the farmers stored the surplus for the lean years. Storage of food grains was a common practice during the pre-colonial era and provided a remedy against famines. The British first arrived as traders in about 1614 (Mill, 1817) and received consent from the Mughal emperor to establish the East India Company. They began building their empire after their victories in the battle of Plassey in 1757 and the battle of Buxar in 1764, which gave them political control over the modern states of Bengal and Bihar. By the late 1800s a large portion of the Indian sub-continent was brought under British colonial rule and India was introduced to the capitalist system of economy.

British administration introduced new forms of land tenure and an export-driven agricultural system. The land tenure systems were called *Zamindars*, *Mahalwari* and *Rayatwari*. Under the *Zamindari* system, the lands of a village or few villages were held by one person or several joint owners who were responsible for payment of land revenue to the Government. In this system, the actual producers were exploited by way of exorbitant rents. The system was introduced for two reasons. First, to ensure a large and steady source of revenue for the government and secondly, to create a class of people

who would remain loyal to the British ruler in the country. However, there were little or no incentives for producers to improve the land or to use better cultivation practices due to the informal and impermanent tenancy agreements. This system of land tenancy was established mainly in Bengal, Bihar, Orissa, Madhya Pradesh and some parts of Tamil Nadu and Andhra Pradesh (Banerjee and Iyer, 2005).

In the *Zamindari* system, the agrarian structure was dominated by landlords from two traditionally-militant upper castes—the Bhumihars and the Rajputs. The *Dalits* or Scheduled Castes and poor Backward Castes were composed of peasant producers and agricultural laborers.

Parts of Tamil Nadu, Bombay and Assam adopted the R*aiyatwari* land tenure system. Here the revenue settlements to the government were made directly by individual tenants or land holder. The third was a village-based system called *Mahalwari* and was adopted by Panjab, Haryana, Uttaranchal states. In this system the village lands were held jointly by the village communities and they were jointly responsible for the payment of land revenue.

In Bihar, the colonial policies not only reinforced the dominant features of the feudal agrarian structure that maintained overlords, lords, tenants, subtenants but also altered the terms of trade against agriculture (Prasad, 1987). This disrupted the dynamism of the rural agriculture and economy. The landlord class gained much political power during the colonial times and as a result they were able to keep their revenue rates from decreasing.

During years of high production they were able to accumulate lot more wealth while the poor peasants and laborers were left to bear the burdens of production. Investments that made the land more productive were discouraged because of the risk of expropriation by the landlord (Banerjee and Iyer, 2005). Due to lack of agricultural investment in irrigation, flood control and drainage, agricultural produce was highly vulnerable to natural calamities. The colonial policies gave rise to unsystematic industrialization in India. Since the state of Bihar was created in the 1912, during the colonial era, Bihar was one such deprived region.

In 1947, India gained independence from Britain after two centuries of British rule. India emerged as a federation of a few relatively 'rich and industrialized' states and also of many poor states which subsisted mainly on agriculture with primitive techniques and semi-feudal agrarian relation (Prasad, 1988). The states were granted the power to enact their own land reforms under the new constitution. Over the years following independence, several states passed legislation to formally abolish landlords and other intermediaries between the government and the direct producers. Other laws included tenancy reform, ceilings on land holdings, and land consolidation measures. Some of these reforms loosened the stringent semi-feudal agricultural structure.

During the years following independence, Bihar and other states received significant private and public investment towards planning and development of the rural agricultural sector. Raising public investment on irrigation was foreseen as a key factor in mobilizing the agricultural sector in the country. Therefore the first five year plan (1951-55)

allocated one fifth of the plan's outlay for irrigation. As a result, agriculture expanded all over India during the early years of independence.

However, this spurt in the agricultural sector was temporary. The large and powerful industrialists started to condemn the allocation of large public funds towards agriculture. Indian economic policies started to favor industries at the expense of agriculture. Over time, the share of investment towards agriculture and auxiliary developments such as irrigation declined.

In spite of significant increases in per capita investments in public industries, agriculture remained the primary livelihood of the Bihari people. The decrease in investment on rural agricultural infrastructure increased the vulnerability of agriculture to natural disasters. Furthermore, according to Banerjee and Iyer (2005), the relationship between agricultural investments and production between landlord and non-landlord systems suggests that in areas like Bihar where proprietary rights in land were historically given to landlords, there were significantly lower agricultural investments and production in the post-independence period than areas in which these rights were given to the cultivators.

In the following decades, India's self-sufficiency slowly declined and India began to import cereals to meet the growing food demands. In the 1950s, 2.94 million tonnes of cereal was imported to India. This was increased to 5.75 million tonnes and 10.34 million tonnes in the early- and mid-1960s respectively. In light of this food crisis, a number of programs for "intensive agricultural development" were introduced. These programs

were implemented as a "package" of high yield inputs, improved technology, credit, and assured irrigation (Dantwala, 1986) in areas where less agricultural infrastructure development was needed and was expected to cover the entire country after 1966-67. This strategy called New Agricultural Strategy (NAS), commonly known as the green revolution, was intended to produce a large buffer food grain stock to feed the people. However, this strategy resulted in an uneven growth in agriculture and brought prosperity to only some states (Punjab, Haryana, Uttar Pradesh and Andhra Pradesh). Subsequently, this strategy required increase in government expenditure for food and fertilizer from 1.07% in 1970-71 to 7.29 in the early 1980s.

However, the new developmental policy could not mobilize Bihar's stagnant and unproductive agricultural sector. Despite relatively favorable conditions in the central districts, the annual compounded agricultural growth rate decreased to 0.5% and the per capita income revealed a downward trend. The state's economic growth rates remained low. During 1962 to 1978, all the districts in Bihar recorded very low yields and the overall compound growth rate of output of food grains was only 1.74 per cent (Wilson, 1999). The distribution of cultivated land remained highly inequitable. Aspects of the feudal agrarian relations including land tenancy were strongly embedded into Bihar's agriculture system, even in the post independent period. Bihar gradually became the poorest and most backward state in the country. The crop-sharing system made up of small fragmented holdings worked well prior to the colonial era as agriculture was not commercialized. However, with the emerging market-driven economy, this system posed many problems. There was hardly any cost sharing by the landlords, and the traditional

lenders such as village money lenders, employers and landlords charged very high interest rates. The interest rates varied based on where they were employed, whether on the landlord's farm or elsewhere. The practice of bondage of agricultural labor prevailed, with wage rates and the mode of payment varying across villages, seasons and persons. The new government system could only partially abolish the social and economic exploitation on the agricultural producers that existed from the colonial times.

After the abolition of the *Zamindari* system in 1947 (Bihar Zamindari Abolition Act), most of the peasants were expected to gain ownership rights to the land. But the process of implementation of this act was extremely slow. From those that gained ownership emerged a rich and assertive class of peasantry from the scheduled and backward castes. A 1973 land reform amendment in Bihar set a range of ceilings on holdings for a family of five, from ten to eighteen hectares. The holding size vary based on the land quality, and offered an allowance for each additional family member, subject to a maximum of one-and-one-half times the holding (Koshy, 1974). Within five years, the Bihar government had acquired 94,000 hectares of surplus land and had distributed 53,000 hectares to 138,000 landless families.

Furthermore, in the early 1970s under the *Garibi Hatao* (eliminate poverty) program, the national government of India supported intensive rural development programs, hoping to disseminate new high-yielding varieties of crops and to build public infrastructure in rural areas. Bihar and other landlord dominated areas were no exception to this even though they were not as efficient in adopting these high-yielding varieties and benefiting from

the growth in public investment. Most of these contracts were undertaken by the rural middle class and so a new rural oligarchy of powerful newly rich middle class emerged. As the economic situation in the country worsened, competition in the rural development sector increased. This upper middle class began to reinforce themselves through armed militia. Consequently, decisions on bids for contracts had little economic consideration. The emergence of a powerful peasantry impelled many of the higher-caste landholders to move away from the rural areas and to the towns. In most cases, the rich Backward Caste peasants bought their land. On the other hand these landowners were determined to maintain the traditional status quo. They sought to maintain their initial prosperity by increasingly exploiting the rural poor. The assertiveness of the rural peasantry led to a considerable decline in *begar* (unpaid labour) in this region and evolved into a state of confrontation demanding structural change in the existing social order. This led to a series of unsystematic and organized resistance in Bihar. The rural rich did not lie low; they started to retaliate against the spread of resistance by further strengthening their private militia.

The situation escalated in the mid 1970s. This caste-based military consolidation was referred to as Naxalism and the naxalites first emerged in the central region of Bihar which includes Patna, Nalanda, Bhojpur, Bohtas, Gaya and Aurangabad. The ensuing violence resulted in Central Bihar being characterized as the 'flaming fields' (Banerjee, 1984; Mukherjee, Singh and Yadav, 1980). The escalating agrarian violence and a struggling economy further crippled the state's economy and amplified the food insecurity.

After a century-long stagnation, agriculture in eastern India experienced a turnaround in the 1980s with the introduction and expansion of tube well irrigation. Bihar recorded higher production levels and surprisingly exceeded the national average. Yet, this development reached only a small base and lasted for a short time. Kishore (2004) stated that the increase in prices of inputs, lack of public capital formation and depreciating infrastructure such as rural roads, power supply, and absence of a new agrarian movement to lobby for price stability and improvement in public services contributed to this short-lived growth.

Although India embarked on a national development plan, differences in physical endowments, climatic conditions and institutional characteristics caused uneven agricultural performance across the states. The State GDP has been stagnant or worsened since the 1980s at 5% per annum (ICAR, Bihar, 2006-2007). Furthermore, the national plans did not incorporate solutions to state-specific issues which were necessary to revitalize agriculture in backward states like Bihar. Studies by Kalirajan et al. (2001) and Kalirajan et. al. (2009) showed that agriculture in states like Punjab, Karnataka and Tamil Nadu showed remarkable improvements while Bihar remained stagnant in the years from 1960 – 1996.

Indeed, Bihar experienced the sharpest decline, with yields declining from 2.7 percent per annum during the 1980s to 2.20 percent during the 1990s. Per capita agriculture income during the 90s declined annually at a rate of 5 per cent (ICAR, Policy Brief 8 DATE). The situation becomes more alarming with the over dependence of the workforce on

agriculture, increasing population (2.5% per year from 1991 to 2001, against 1.9% in the country), decreasing per capita income and increasing disparity between urban and rural income. Agriculture's place as the primary economic driver was further reinforced after the bifurcation of Bihar and the creation of Jharkhand in the year 2000, as most of the industries and the bulk of the mineral resources were lost to Jharkhand.

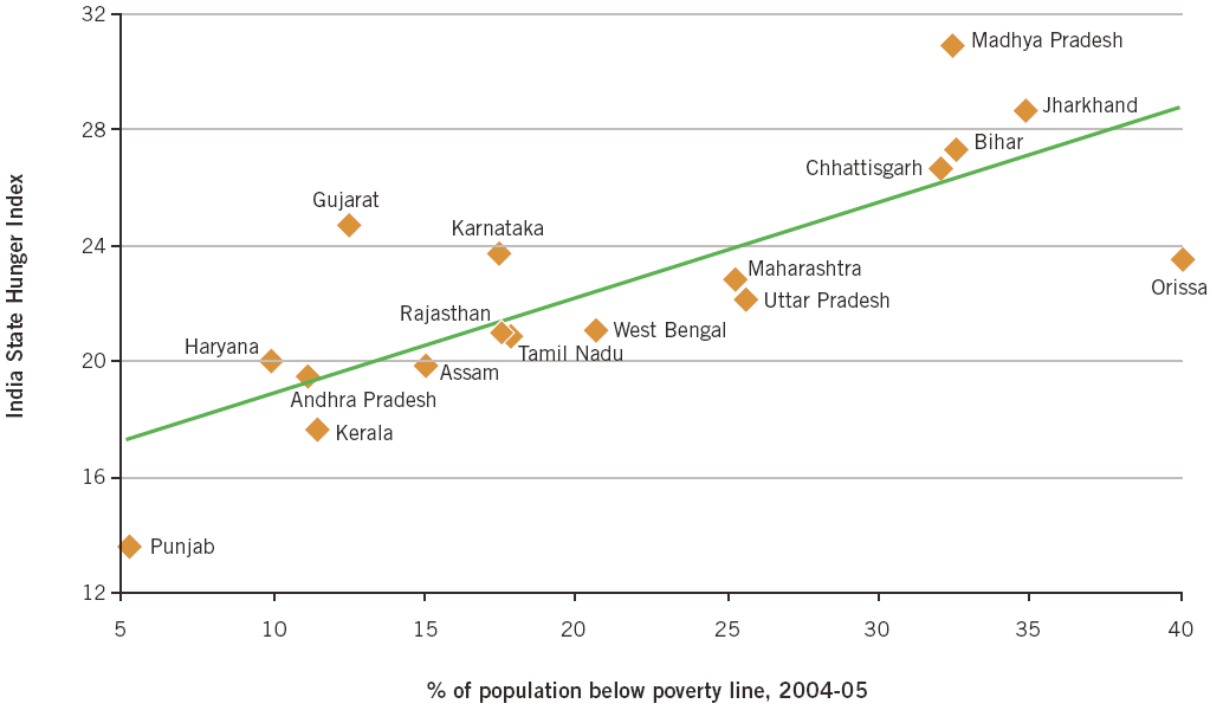



Figure 4. India State Hunger Index in relation to poverty (2004 – 2005)
Source: www.indiastat.com (2005)

Figure 4 shows that more than 30% of the people in Bihar live below the international poverty line of $1.25 a day. A more recent article in the Economic Times of India (Dec, 2009) reports that the figure for population below poverty line for Bihar has increased to over 40 percent. In Bihar, the Mishahar are considered to be the poorest of the poor. Almost two million of them are so impoverished that they supplement their diet with field

rats. Many people continue to have little to no access to clean water, sanitation, and food and health care they need to assure them a better quality of life. Rising food prices, increasing population and decreasing per capita agricultural land are all contributing to diminishing food and nutritional security in Bihar. The depleting condition and increasing food insecurity in the poorest states have prompted calls for immediate and sustainable interventions.

The agrarian violence in Bihar escalated over the years and Bihar has witnessed hundreds of killings every year by the Naxalites. According to Annual Reports published by the government's Ministry of Home Affairs, the Naxalites killed 311 people in 2001, 274 in 2002, 244 in 2003, 340 in 2004, 169 in 2006 and 44 through March 2007. These phenomena raised serious questions regarding food availability, income and security for the growing population of Bihar.

In September 2000, United Nations declared the Millennium Development Goals (MDG), identifying eight major development goals. Eradication of extreme poverty and hunger received major policy focus in several developing countries. However, until very recently India and its states did not take any bold steps to implement any policies to increase food security and reduce hunger and malnutrition. The cost of food items is increasing rapidly. Food is unaffordable to a majority of the people. From, 1994 through 2004 the state attracted $167 million in foreign direct investment. However, there has been little improvement in quality of life or infrastructure, literacy level, and food security,

especially at the rural level. Thus, decreasing food production remains a treat to the wellbeing of Bihar.

# CHAPTER V

## AGRICULTURAL AND FOOD SECURITY SCENARIO IN BIHAR - FINDINGS AND DISCUSSION

The Agricultural Sector includes not only the production of crops (cereal, pulses, vegetables, fruits) but also livestock and fisheries industries. With over 90 percent of the total population living in rural areas, agriculture provides the primary means of livelihood for the vast rural population and fuels the rural economy. In 1999-2000 Agriculture and allied sectors contributed more than one third to the Gross State Domestic Product (GSDP), but in 2009-2010 it was less than one fourth (Figure 5).

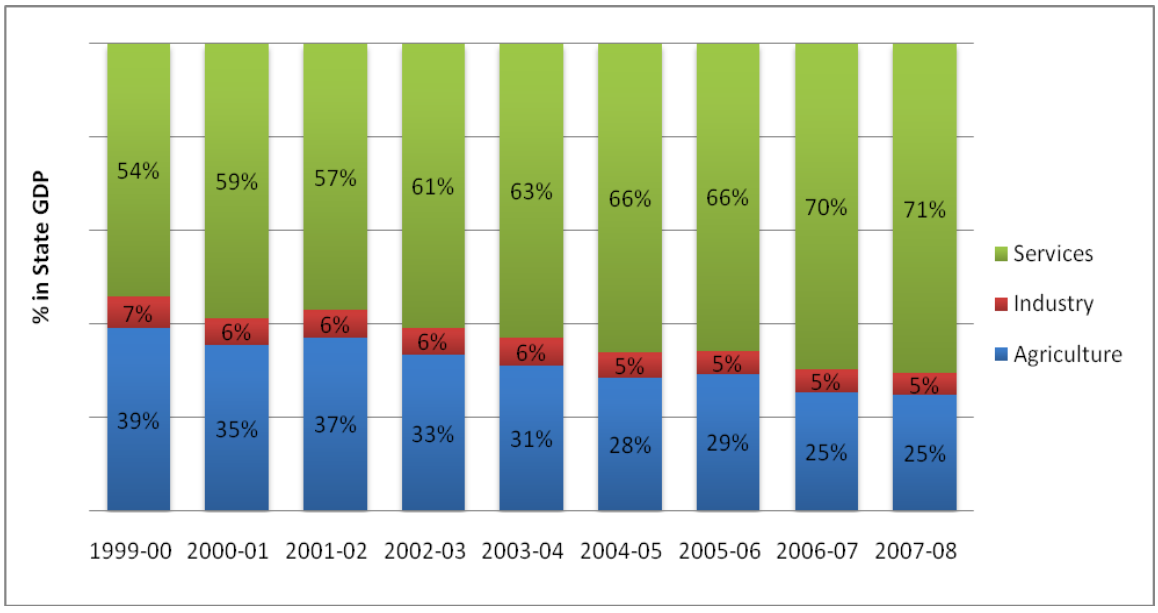



Figure 5. Change in State GDP from 1999 – 2009
*Source: Central Statistical Organization, India (2009)*

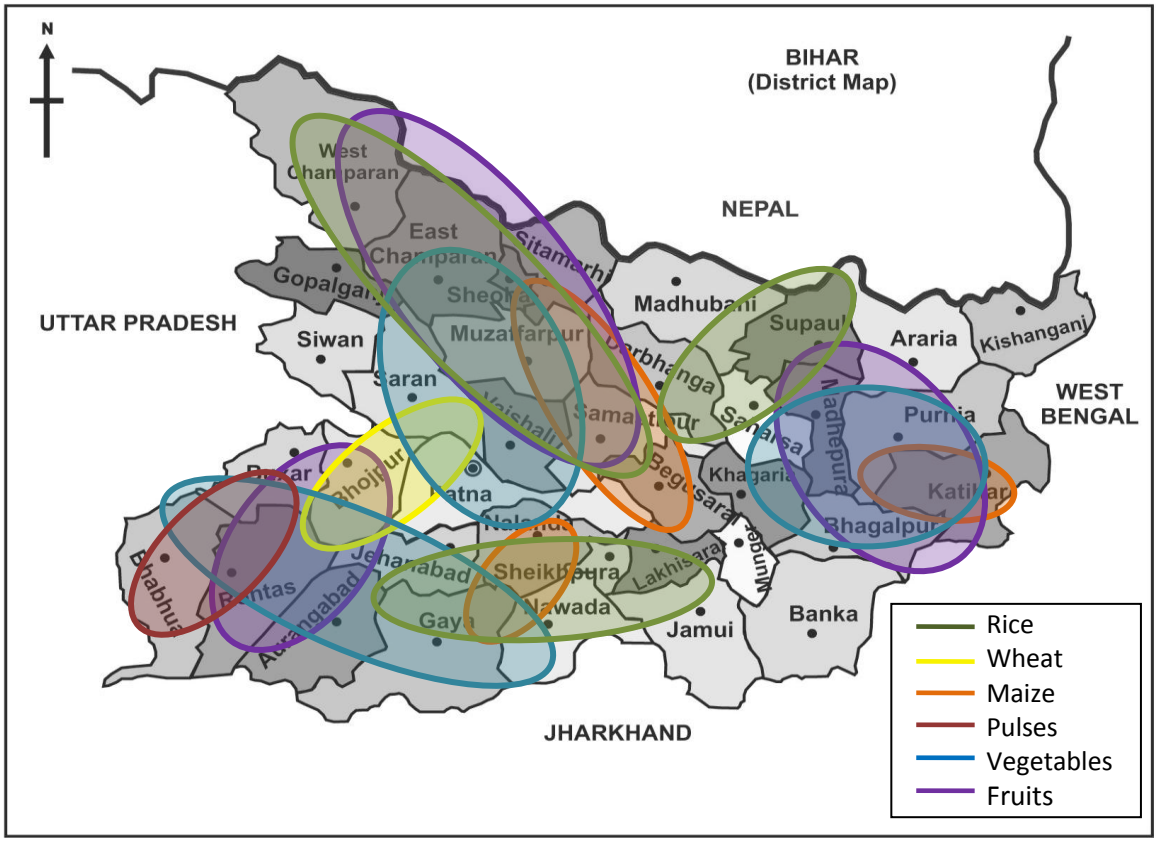
## Overview of Crop Production in Bihar

Cereals, pulses, vegetables, oil seed and fruits are major sources of food for the people in Bihar and provide the livelihood for almost half its population. The principal cereal crops include rice, wheat, and maize. Rice is the main food grain (Ahmad, 1961) and it covers more than 50 percent of cultivated area in Bihar (Map 2).

Photo 6. Wheat Fields in Bilap, Patna District, Bihar

Due to significant political, social, institutional and economic reforms during the last three years, per capita annual production of food grains increased from 141 Kg. in 1993-94 to 167 Kg. in 2007-08 (Singh, 2009). The intensity of cropping provides insight on the land use practices (generally measured as Net Cultivated Area/ Net Sown Area times

100). For Bihar intensity of cropping is 142%, which is high compared to other states. Past experiences have shown that agricultural production in Bihar is highly volatile. This is mainly due to the relatively low adoption of technology, poor input use and natural disasters.




Map 2. Diversity in Crop Production in Bihar
Source: Department of Agriculture, Government of Bihar, 2010

Bihar is the third largest producer of vegetables and fourth largest producer of fruits in the country. Bihar is also the largest producer of okra, second largest producer of cabbage, third largest producer of potato, brinjal (eggplant), onion and cauliflower in India. It also produces large quantities of a variety of fruits. Bihar is the largest producer

of litchi and guava fruits, third largest producer of pineapple and fourth largest producer of mango in India. Bihar is the largest and only commercial producer of makhana (gorgon nut). Other cash crops such as tomato, radish, carrot, beet, tobacco, oilseeds, sugarcane and spices are also produced.

## Major Inputs for Crop Production

### Land

Land is a scare resource in Bihar. Currently, less than 60 percent of the total geographical area is cultivated, which is higher than the national average of 47 percent (Department of Agriculture, Bihar). The total crop area has declined from 7.9 million hectares in the triennium (TE) ending in 2001 to 7.5 million hectares in the TE ending in 2006 (ICAR, 2008). Similar to the example of rice (Figure 6), the total cultivated land for other main food grains have also declined.

There are around 10.4 million registered landholdings in the State but land is highly fragmented. Around 84 percent of the holdings are less than 1 hectare (Table 4), making the use of such land for agricultural purposes less efficient and less profitable. Since the land tenancy agreements and employment contracts are unbinding and informal, cultivators have little incentive to invest in or develop land.

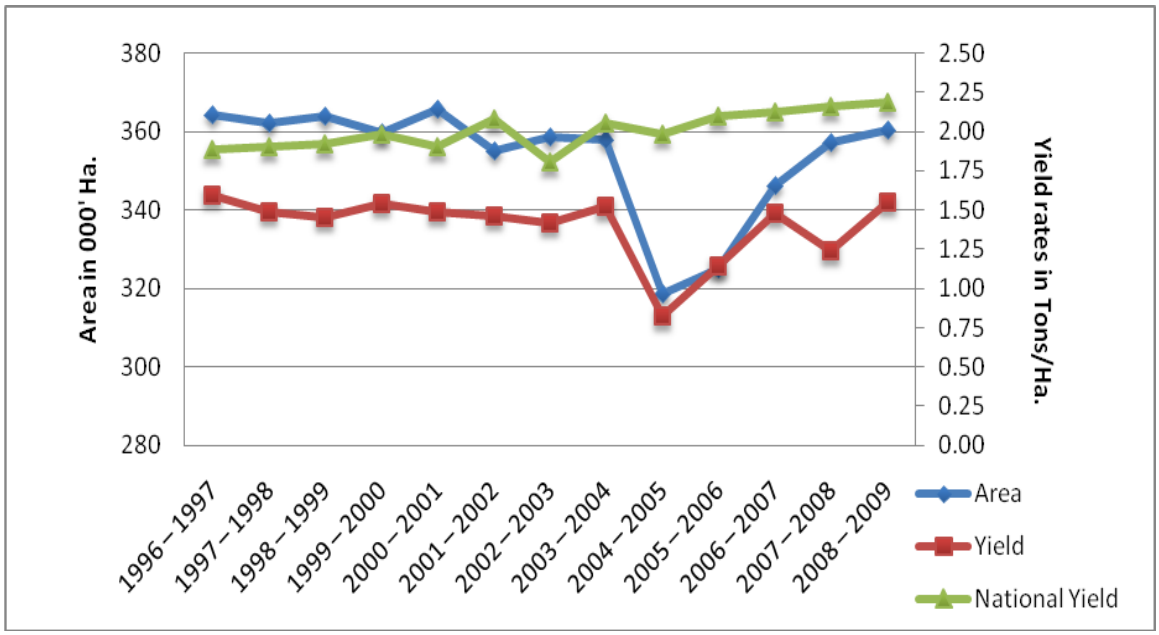



Figure 6. Area under Cultivation and Yields of Rice
Source: Ministry of Agriculture, State Government of Bihar, 2009

TABLE 4

DISTRIBUTION OF HOLDINGS BY SIZE CLASS
(2000 – 2001 CENSUS)

| Category of Holdings (Ha.) | Operation Holdings (000' no.) | Operation Area (000' Ha.) |
|---|---|---|
| Marginal (0-1Ha.) | 9743 | 2907 |
| | 84% | 43% |
| Small (1-2 Ha.) | 1069 | 1296 |
| | 9% | 19% |
| Semi-medium (2-4 Ha.) | 589 | 1544 |
| | 5% | 23% |
| Medium (4-10 Ha.) | 164 | 861 |
| | 1% | 13% |
| Large (10-above Ha.) | 9 | 140 |
| | 0% | 2% |
| All | 11574 | 6748 |
| Average size of holding | 0.58 Ha. | |

Source: Agricultural Statistics at a Glance, 2007, Ministry of Agriculture, Government of India.

Reverse tenancy is common in Bihar, where a large number of marginal farmers have migrated to other states for employment and leased out their lands to larger farmers (Singh, 2009). In addition, agricultural lands belonging to women-headed households (mainly widows) are generally leased out to bigger farmers and cultivators as a means of income.

Irrigation and Soil Fertility

Bihar has a rich endowment of water and soil resources. The average rainfall in Bihar is around 50 inches. Bihar has 4.6 million hectares of irrigated area, roughly 60% of its total geographical area of 9.4 million hectares (Jha, S. et al., 2008). Bihar's average irrigation intensity of 152% is higher than the national average. Historically, there was no government involvement in irrigation in Bihar and farmers managed all irrigation. In the years following independence, due to high demand and growing population, many government-sponsored irrigation projects have been implemented.

Bihar irrigation schemes are generally classified into three classes: a) Major and medium schemes - surface schemes irrigating over 2,000 hectares; b) Minor surface schemes – diversion or reservoir schemes irrigating less than 2,000 hectares; c) Life schemes – tube-well or small river lift irrigation schemes. More than 50% agriculture in Bihar is highly dependent on timely arrival of the monsoon season. All agricultural operations take place over three crop seasons: Kharif, Rabi and Zaid (summer). The Kharif season starts from early June with the south-west monsoon and ends in September. This is followed by the Rabi season is from November to May. Between the Kharif and Rabi there is short season during the summer months of March and June called Zaid. During the Rabi and Zaid

seasons, agriculture is primarily dependant on irrigated water. Ground water resources are sparsely extracted using tube wells and diesel pump sets.

Photo 7. Private irrigation system in the village of Bilap, Bihar

Agricultural Labor

In Bihar, over 75 percent of the total workers are engaged directly in agriculture. Of this percentage, nearly 30 percent are cultivators while 50 percent are landless agricultural laborers. Farmers employ laborers to do the field work. Some laborers lease land from larger farmers and land owners to cultivate. While the composition of the labor base has changed, the number of agricultural laborers increased in number from 12.6 million in 1981 to 26.5 million in 2006 (Singh, 2009). However, the opportunities and incentives in agricultural occupations in Bihar have been diminishing due to poor land tenancy agreements and a owing population, and the unemployment and underemployment rates

have increased over the past three decades. As a result the state is experiencing a steady stream of out-migration of farmers and labors over the past years. Both men and women play an active role in agriculture. While women are more involved in day to day field work, men focus their efforts on field work as well as input purchases and marketing issues. Female participation in food production has increased over last decades; though wage rates for the female labor are lower than for men (Khera, R. and Nayak, N, 2009)

Photo 8. Women Laborers in the fields

The Indian government has been assisting agricultural laborers in Bihar through various schemes. In 2005, the government of India enacted the Mahatma Gandhi National Rural Employment Guarantee Act (NAREGA) which guarantees 100 days of unskilled manual work per household per year to any adult who is willing to do unskilled manual work at the minimum wage to be employed in local public works within 15 days of applying. If employment is not provided within the 15 days of the receipt of application, the worker

shall be entitled to a daily unemployment allowance. The Minimum Wage Act of 1948 was instrumental in enforcing a minimum subsistence wage for the different categories of employment to prevent exploitation of labor. Furthermore, with effect from November 2009, the government of India increased the National Floor Level Minimum Wage from INR. 80 to INR. 100 (Rs. 35 in 1996).

Fertilizer & Quality Seeds

Fertilizer and high yielding seeds played a significant role in increasing agricultural yields. Fertilizer consumption in the State has steadily increased over the years (Table 5). The average consumption of chemical fertilizers in Bihar in 2009-2010 (181 Kg/ha) is higher than the national average of (116.5 Kg/ha) (table) and consumption in States like Punjab (212.7 kg/ha), Andhra Pradesh (208.2 kg/ha) and Haryana (190.9 kg/ha) is even higher. Besides, Bihar is yet to improve the balance and integrated use of fertilizer nutrient in crop production.

India provides fertilizer subsidizes to farmers to stimulate fertilizer use and thereby bring about increased production and yields. Fertilizer subsidies were considered particularly important in inducing farmers to adopt high yielding varieties, which often depend heavily on fertilizers. A recent study by Sharma et al. (2009) shows that India has increased its fertilizer subsidy from INR. 438.9 million in 1990-91 to INR. 7584.9 million in 2008-09 but that the fertilizer subsidy has not been distributed equitably across crops and states. Backward states like Bihar have not yet reaped its benefits.

The Government of Bihar is also promoting the use of organic fertilizers in crop production in order to minimize soil degradation cause by chemical fertilizer. The first organic village (Kothiya) was established two years ago in the district of Samastipur. Organic fertilizer is more expensive (INR. 600-1000 per quintal) than chemical fertilizers like urea (INR. 400 per quintal) but produce high yields, healthier crops and minimize soil damage so farmers prefer to use organic fertilizer (ICAR, 2010).

TABLE 5

CONSUMPTION OF NUTRIENTS (2005 – 2010)

| Nutrient | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 |
|---|---|---|---|---|---|
| N (in MTs.) | 688221 | 808712 | 929480 | 938320 | 894460 |
| P (in MTs.) | 131940 | 178718 | 191570 | 252680 | 247600 |
| K (in MTs.) | 98726 | 77375 | 84430 | 165890 | 167880 |
| Consumption Kg. per ha. | 119 | 141.71 | 155.55 | 170.76 | 181.11 |
| Nutrient ratio | 6.97:1.33:1 | 10.45:2.31:1 | 02:27.3 | 5.66:1.52:1 | 8.04:1.98:1 |

Source: Ministry of Agriculture, Government of Bihar, 2010

The Seed Replacement Rate (SRR) is the percentage of crop area sown using certified/quality seeds, rather than farm-saved seed. In Bihar, SRR has more than doubled from 11 percent in 2005-2006 to 26 percent in 2009-2010 (Singh, 2010 unpublished report). The goal is to achieve higher SRR by 2011-12. Continuous availability of quality seed is critical in sustaining agricultural production in Bihar. Modern seed varieties are adopted and used in the State, particularly for cereal crops. At present certified seed is

mainly produced by State Seeds Corporations, National Seeds Corporation, State Farm Corporation of India, State Departments of Agriculture, private companies and, cooperatives. In addition individual farmers are also producing certified seed. The existing seed producers in Bihar have not been able to meet the current demand for quality high yielding seeds. Biotechnology is used sparsely to develop Genetically Modified (GM) seeds. Programs are also planned for increasing availability of quality seed for horticultural crops.

The management of seed supply is very important to continue production. The Government of Bihar has planned and initiated several schemes to develop the seed sector and plans to increase investment in the seed sector. Four schemes are underway to boost seed production and distribution in the state.

- Certified Seed Distribution Scheme (Mukhyamantri Tibra Beej Bistar Yojana)
- Seed Village Scheme (Beej Gram Yojna)
- Revamping government farms to produce seed
- Subsidizing the seed sector.

Seed production by farmers is encouraged and more farmers are expected to be given training on seed production technology in the coming years. Bihar Rajya Beej Nigam and Pusa Seed Society will be reinforced to purchase of farmer produced seeds and provide processing & marketing support. In addition, seed users and seed producers can get their seed sample tested at a low fee at State Seed Testing Laboratories.

Investment and Credit Services

Even though the share of the agricultural sector in the state GDP has been declining over the years, government investments in agriculture and allied sectors have been growing, especially during the last three years with the favorable development policies of the new government in Bihar (Figure 7).

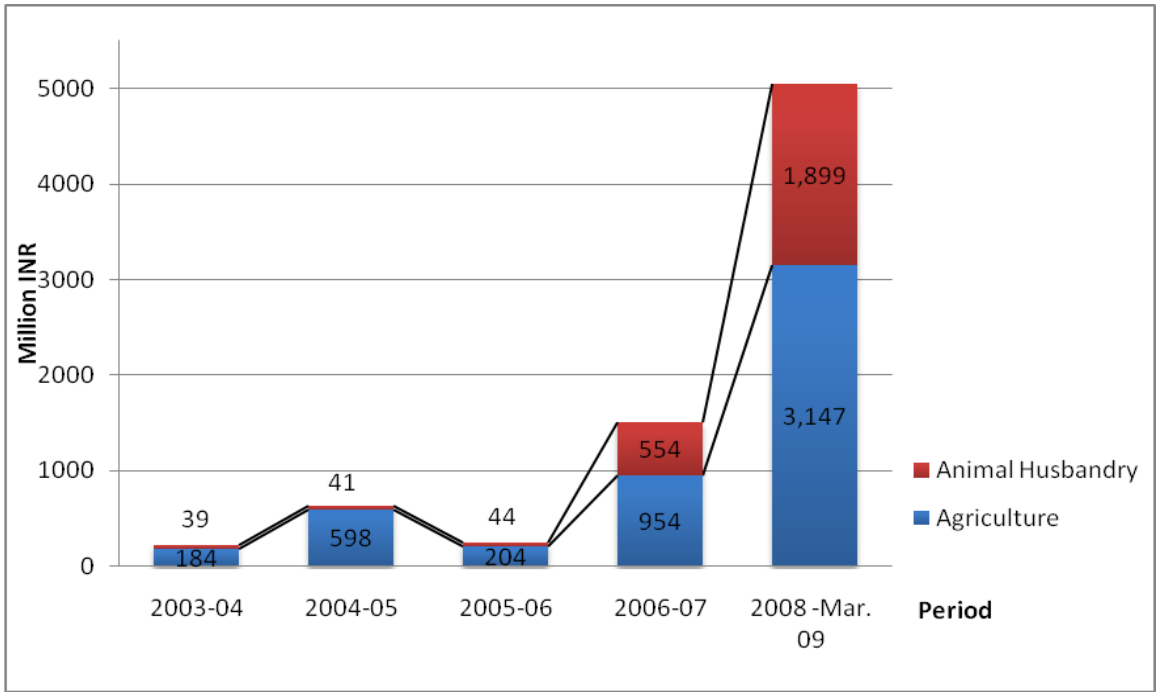



Figure 7. Expenditure figures for Agriculture and Livestock (2003-07 and 2008-09)
Source: Department Planning and Development, Government of Bihar (2009)

Also, the Central government has been supporting agriculture in Bihar through various mega agricultural development projects such as National Horticultural Mission, National Food Security Mission, Rastriya Krishi Vikas Yojana (National Agricultural Development Program), Macro-mode, ISOPOM etc. At state level, the government initiated innovative agricultural development programs like Mukhyamantri Triv Beej

Vistar Yojna (Chief Minister's Seed Distribution Program) and Vyagyanik Kisan Ke Dwar (Program implemented through scientists and farmers extension program).

For the majority of the farmers in Bihar, income from agriculture is not sufficient to redevelop their land, meet their daily consumption need and buy inputs for cropping activities. Thus there is a high dependency on credit to carry on agricultural production. For many years, farmers have been obtaining credit from public and private institutions and non-institutional sources. In most cases farmers prefer to approach non-institutional sources because of complexities in procedural formalities and also because they do not have collateral to offer for security. However the unofficial sources of credit often are made available only at high interest rates.

The National Bank for Agriculture and Rural Development (NABARD) introduced the Kisan Credit Card (KCC). KCC is an important medium for increasing short term agricultural credit and providing adequate and timely support to the farmers to fulfill their cultivation needs. The eligibility to hold a KCC is based on a farmer's land holdings – the more acres farmed, the greater the likelihood of obtaining a KCC. Number of KCC increased from 1.5 million in 2005 to 3.1 million 2009 (NABARD, 2009).

Other credit schemes include Micro finance institutions and co-operatives. Self Help Groups, Joint Liability Groups and Farmers Clubs have shown poor progress in dispersal of capital to farmers in Bihar. Strong cooperatives have been instrumental in providing agricultural credit to farmers in other states. The cooperative system in Bihar has become

dysfunctional over the years and currently provides less that 10% of the credit. The government is in the process of rejuvenating village level corporatives and establishing new ones. The National Agricultural Insurance Plan provides economic help to the insured farmers whose crops are damaged by natural disasters.

Research and Extension

Given the fact that over two thirds of the population is employed in agriculture and allied sectors, there is a significant need to improve and upgrade agricultural technology and extension to sustain the livelihood of people in Bihar. The public sector agricultural research and extension services are carried out by the Rajendra Agricultural University of Bihar, the seven Indian Council of Agricultural Research (ICAR) stations, State departments (agricultural and animal husbandry) and Farmers Commission. In spite of very poor government expenditure for research and development, these state institutions have been instrumental in the development of agricultural technologies and research. Most of this research is focused on the improvement of agricultural yields including crop and soil improvement, biotechnology, animal husbandry etc. However, only a few studies have been conducted to determine the food security situation of the state. These studies on food security are mostly concentrated on the supply side, emphasizing inputs to agricultural production (the food availability component).

There are three institutions responsible for the dissemination of agricultural technology in Bihar. They are Krishi Vgyan Kendrs (KVKs), government departments and Agricultural Technology Management Agencies (ATMAs). The State government universalized ATMAs to cover all districts of the State to enhance the extension and technology

transfer services to farmers. In addition, over 1,100 agriculture graduates have been trained to conduct agri-clinics in the State.

Photo 9. ICAR Research Station in Patna, Bihar

In 2007, the Kisan Samman Yojna was also launched to identify and acknowledge enterprising farmers in the State and to use them as extension agents. These reforms faintly helped the broken extension system in Bihar. Yet, there are tremendous opportunities and urgent needs to revive and strengthen the public agricultural extension system and public-private partnership in agricultural extension for increasing agricultural growth in Bihar.

## Livestock Production in Bihar

The second major contributor to Gross Agricultural Domestic Product (GADP) of Bihar is animal husbandry such as dairy, poultry farming, piggery etc. It contributes more than 35 percent to the State GADP. Livestock production is the second most important occupation in rural areas of Bihar.

TABLE 6

GROWTH RATES OF MAJOR LIVESTOCK PRODUCTS IN BIHAR (2001 – 2006)

| Item | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | Growth over the period (in %) |
|---|---|---|---|---|---|---|
| Total milk ( in 000 liters) | 2632 | 2869 | 3175 | 4743 | 5060 | 92.25 |
| Eggs ( in million) | 7.4 | 7.4 | 7.8 | 7.9 | 10.0 | 35.14 |
| Meat (in 000 tons) | 156 | 173 | 173 | 176 | 175 | 12.18 |
| Wool (in million Kg.) | 0.42 | 0.36 | 0.39 | 0.37 | 0.22 | -48.11 |

Source: Animal Husbandry and Fisheries Resources, Government of Bihar

Dairy is the most important livestock product, accounting for approximately 50 percent of the total livestock output, followed by meat (24 percent) and other livestock products (egg, dung, wool etc.).

### Dairy Sector

Bihar's dairy sector has been vibrant in the recent years (Table 6) with the adoption of COMPFED system (modeled after Amul). The secretary of the COMPFED reported to

the Times of India (Apr. 19, 2010) that the milk production in the state has increased 40 percent and the dairy business has seen an increase by 36 percent. Statistics on livestock distribution by the Ministry of Statistics and Programme Implementation (GOI) (2003-2004) suggests that the distribution of livestock is more equitable than land. The dairy sector contributes 5% to the national milk production and provides livelihood to over 6.4 million urban and rural people (State Government of Bihar, 2006-2007).

Adoption of new scientific techniques such as artificial insemination and immunization processing are less common in this sector. However, if the current pace of growth continues, the state will be able to achieve its target production of 6.3 million tonnes by the year 2012 and gain a strategic advantage to export to countries like Bangladesh and Nepal, which are deficit in meeting their domestic milk and milk product requirements.

## Fisheries, Poultry and Piggery Sector in Bihar

A significant proportion of Bihar's population depends upon fisheries, aquaculture and allied activities for their livelihood, subsistence and income. Nearly 4.6 million rural households are engaged in fisheries, with 500 fishermen' cooperatives located in the State (ICAR, 2009). Thus, these sectors play a key role in food security and employment generation, especially in the rural areas. Even though Bihar is a landlocked State, it has a rich endowment of inland water resources, including lakes, ponds, network of rivers, reservoirs, ox-bow lakes, swamps etc. They offer enormous opportunities for inland fisheries industry. Currently, Bihar produces 7 percent of India's inland fish production.

The State only meets half of its demand and the production levels have been almost stagnant for many years. Similarly opportunities are there in terms fish seed production, since only a third of the seed requirement is met (Animal Husbandry and Fisheries Resources, 2008). Although poultry has an expanding market, poultry is not an important enterprise in Bihar. Similarly, piggery is not a main subsidiary occupation of farmers in Bihar. Generally, landless labor and some marginalized poor households in the urban areas are engaged in piggery.

Photo 10: A Fish-seller in neighborhood market, Patna, Bihar

## Key Constraints and Strategies to Enhance Food Production and Food Security

This section discusses the key constraints to agriculture and food security situation in Bihar and strategies to enhance food security in the State. These finding are divided in terms of the three key dimensions of food security: a) availability of food b) accessibility of food and c) adequacy/utilization of food. Based on literature reviews, several key constraints were identified as factors hindering food security in Bihar (Table 7).

The District Directors were asked to rate these aspects based on the relative significance of each of these key constraints to their own districts. Based on the information collected from the 38 districts in Bihar during the site visit, extension services and access to agricultural inputs such as seed, fertilizer etc. were identified as the main constraints for food production and availability.

In terms of accessibility of food the major issues identified were transportation and infrastructure, market connectivity due to poor roads, and timely availability of transportation modes. Processing of food and knowledge on nutritional aspects were identified as key issues related to the utilization and adequacy of food. The safety and nutritional quality of food are also important factors that were highlighted by the government officials. In addition, interviews with groups of farmers, researchers, and urban poor were also conducted to obtain different perspectives on the different issues identified in table 7.

TABLE 7

THE RELATIVE SIGNIFICANCE OF DIFFERENT CONSTRAINTS TO FOOD PRODUCTION AND FOOD SECURITY IN BIHAR

| **Constraints to Food Production** | **Rate** |
|---|---|
| **Availability** | |
| Land quality related issues | 4 |
| Lack Irrigation | 4 |
| Lack of Infrastructure | 3 |
| Land holdings, land tenure issues | 5 |
| Poor access to agricultural inputs | 1 |
| Poor extension systems | 1 |
| Low investment in agricultural research and development | 2 |
| **Accessibility** | |
| Lack of transportation and infrastructure | 1 |
| Poor market connectivity | 1 |
| Lack of Income | 2 |
| Rising Food Prices | 3 |
| **Adequacy** | |
| Lack of processing facilities | 1 |
| Lack of Nutritional knowledge | 1 |
| Poor Quality of food | 2 |

Compiled using interview with Stakeholders

Availability of Food in Bihar

Agricultural Production Factors Affecting Food Availability:

The agriculture Sector in Bihar, especially the crop subsector, has witnessed a sharp decline and relative stagnation due to more than a decade of low investment in agriculture and infrastructure (Banerjee and Iyer, 2005). During the past three to five years, there has been a host of significant political, social, institutional and economic reforms in the state. As a result, the per capita production of food grains increased from 141 Kg. in 1993-94 to 167 Kg. in 2007-08 (Singh, 2009). However, the yields of major food crops are lower

than the national average (Table 7) and high-performing states like Punjab and Haryana (3996 Kg./Ha and 3087 Kg./Ha respectively in 2005 -06). The situation for commercial crops is the same.

Based on observations and interactions with District Directors, farmers, and researchers it was evident that agricultural production and food availability in Bihar is constrained by a number of reasons (Table 7). Different perspectives on the different issues were obtained:

- Land quality
- Lack of irrigation
- Lack of infrastructure
- Land holdings, land tenure issues
- Poor access to inputs and inferior farming practices
- Poor training, research and extension system
- Low investment in agricultural research and development

The District Directors ranked land quality related issues to be one of the less serious issues affecting food availability. However, several farmers responded that they were getting low yields due to weakening of soil fertility. Although Bihar is blessed with rich soils, continuous farming activities, use and overuse of poor quality inputs such as seed and fertilizer, and obsolete farming practices have undermined soil fertility. It was clear from the interaction with farmers in Bilap that farmers misapplied inputs such as fertilizer or used inferior farming methods due to either lack of knowledge or because they did not have the right quantities of fertilizer available to them at the required time.

Photo 11. Village of Bilap, Bihar.

When farmers in Bilap were asked their biggest challenges in the present day agriculture when compared to ten years ago, the majority of the farmers responded that it was the drastic change in the pattern of rain fall and uneven distribution of rain. Although close to 57 percent of the gross cultivated area is irrigated, the irrigation schemes are highly dependent on the timely arrival of the monsoon as most agricultural production uses surface water. The problem is that there is not enough rain harvesting systems to store rain for future use. In the village of Bilap, farmers have constructed small wells made of cement and concrete to harvest rain water; they were very basic and at the time of the visit they were mostly shallow. Some farmers mentioned that the state tube wells located in the village were mostly dysfunctional due to obsolete machinery or non-supply of electricity. Some progressive farmers have installed tube wells and diesel pump-sets to

extract ground water on their own to sustain their agricultural production. However, the operating cost of diesel tube-well for irrigation in the rural areas is costly and inefficient.

The Government of Bihar provides a 'diesel subsidy' to farmers to minimize cost. Initially this subsidy was available to both tenant-farmers and landowners, but at present this support is limited to landowners. Thus, this subsidy is only benefiting a small portion of the farmers as many farmers in Bihar do not own the land that they farm. Bihar's agricultural production is highly vulnerable to availability of water for cultivation. In the event of a severe drought; food availability will be at a greater risk unless water management methods are improved. District Directors confirmed that land tenancy issues and water management were limiting agricultural production.

Nearly 41 per cent of the land is prone to both floods and drought (NABARD, 2007). Thus in spite of the fertile soils, agricultural production is often destroyed by natural calamities. The problems of flood and drought are attributed to poor water management practices. In addition, there is also an inequitable distribution of water (rain, ground and surface water) within the State. According to Mr. Pandey, a local farmer in the village of Bilap, there is depletion of water sources in the area – he said that drinking water and irrigation water in the village is being depleted. Another farmer mentioned that they can plan their agricultural operation and reduce loss of harvest due to flood and drought if they received timely and reliable weather forecasts from the government. The District Directors however ranked poor water management as a less serious issue.

Lack of basic infrastructure and community services such as road systems, electricity, telecommunication, piped water, drainage etc. are prime impediments to the growth in agriculture, availability of food and standards of living. In Bihar, the basic infrastructure that connects farmers to inputs and agricultural products to consumer are lacking especially in rural areas. A site visit to Bilap provided visual demonstration of the dilemma. Poor infrastructure disconnects farmers from markets, thus increasing the cost of production but also reducing the potential to earn higher income. However, compared to inputs and extension, infrastructure seemed to be a less significant concern to farmers. The reason is that over time farmers have adapted to the existing conditions and have become less influenced by limitations of infrastructure and community services. The District Directors also reported similar problems.

Although issues related to land tenancy and obsolete land records are a problem in Bihar, it was not identified as significant issue by the farmers in Bilap. This is mainly because the majority of the farmers in this village are land owners. However, as mentioned earlier holding size varies from 0.5 to 7 hectares. Only three of the farmers interviewed in the village of Bilap had more than 2 hectares of land. They said fragmented land is a constraint to production and income. One farmer mentioned that production in some seasons is so low that the income (cash/kind) from cultivation is barely enough to remunerate the land owners. Furthermore, the District Directors also gave least importance to issues related to land holdings and land tenure issues. They stated that since the majority of the land is cultivated by poor marginal farmers, they often continue to farm in spite of land issues to earn their livelihood.

Almost 90% of the farmers stated that poor access to inputs was a major constraint to agricultural production in Bihar. In Bilap, almost all the farmers purchase their inputs for agriculture from the same suppliers irrespective of the land holdings. While their income from agriculture is becoming less and less, the cost of inputs is increasing. Many farmers often must buy the fertilizer and seeds from the black markets at high prices since these inputs are not available in a timely manner. They claim that some seed companies and their intermediaries are distributing defective seeds to them and most of these seeds do not grow into seedlings. Thus, the effective seed replacement rate is very low. Further, fertilizer and seed subsidies are available only to a very few farmers, and sometimes the beneficiaries of these subsidies are non-farmers or those that do not hold land (either leased or owned), in other word, the actual farmers are not getting the government assistance they ought to get. Thus, they cannot get the required amount of inputs at the right time to maintain their agricultural production. District Directors also identified poor access to agricultural inputs as a very serious constraint to agricultural production. Howver, they mentioned that the government is trying increase seed availability through various state-sponsored programs.

Both farmers and District Directors identified extension and transfer of new technology as the next major constraint. An effective extension system is needed to disseminate technologies and respond to farmers needs. According to a survey conducted by National Sample Survey organization (NSSO) (2003) under the Ministry of Statistics and Programme Implementation only 5.7 percent of farmers in Bihar got information on improved agricultural technology from the public extension system, while 32.4 percent

learned from input dealers and 41.3 percent obtained information from other progressive farmers.

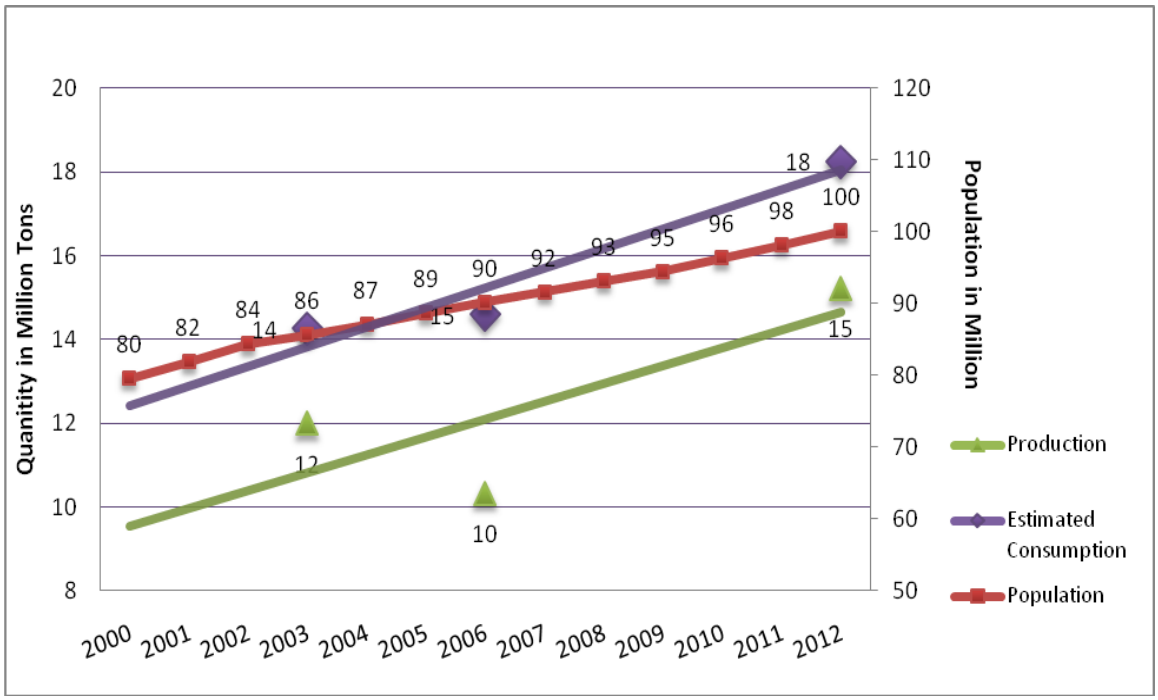



Figure 8. Production and Estimated Consumption of Foodgrains and Population in Bihar (2000 – 2009)
Source: Ministry of Statistics and Programme Implementation, Government of India 2009

Experiences in Bilap were similar to the results of the above survey. The farmers stated that they had very limited interactions with extension agents and they often learned about new inputs and technologies from other farmers. The extension problem in Bihar is complex. Farmers in Bilap mentioned that they have very little interaction with extension officers and they often learn about new inputs and methods from other farmers. Extension requirements vary from place to place based on the requirements of the farmers and available infrastructure. Also, many of the technical posts remain vacant and personnel need to be trained for extension positions. At the time of the site visit, there were 10 to 15

agricultural extension officers that been trained at ICAR on modern farming technologies. The District Directors reported that the total number of extension officers were less than 3,000 for the entire state. These factors hinder the transfer of technologies and innovations to the grass-root level (lab to land and vice versa).

Since agriculture is the main enterprise in Bihar and the main source of employment, continuous agricultural research is very important to keep upgrading existing agricultural technologies and services and extending them to the farmers in a timely manner. Farm production can be significantly improved by introducing modern technologies, innovations, and practices. In recent years the major research institutions in Bihar have become less innovative, mainly due to lack of expertise, funding and depreciating infrastructure (Department of Finance, SGOB, 2006-07 and ICAR, 2008).

In fact, very little applied research is conducted in cereals, pulses, horticulture, animal husbandry and fisheries. The District Directors identified lack of investment in agricultural research and development as a serious issue. Investment on agricultural research and extension has been lacking for many years. Only 0.2 percent of agricultural GDP is spent on agricultural research and education compared to the national average of 0.4 percent. Almost 95 percent of this investment is used for salaries and 5 percent for operating costs, thereby leaving few funds for conducting research (Department of Finance, GOB 2006-07). However, they added that the government investment has been gradually increasing, especially during the past three years.

The population of Bihar has been growing steadily over the past decade (figure 8). With this increasing population comes increasing consumption needs. However, agricultural production has not been able to keep pace with the growth in population in Bihar. Data from the National Sample Survey Office on annual food availability, which includes both food available through domestic production and estimated consummation suggest that Bihar was deficit in total food grain production since the early 1990s (Singh, 2009).

Production, consumption and population for 2012 (the terminal year of the 11$^{th}$ Five Year Plan, 2001 – 12) were estimated using available secondary data from 2000 to 2009. The average population growth rate was calculated from 2000 to 2009. This rate was assumed to be constant for the next three years (2010 to 2012). Bihar total population for 2010 to 2012 was projected using this rate. The normative food requirement for 2012 was calculated by multiplying the per capita food grain requirement for the year by the population. Data on anticipated production assumes that only 50 percent of target production increase set by the Road Map is achieved (Road Map Target: 191 Kg. per capita by 2012) provided that all new programs planned for agricultural development are implemented at grass-root level).

Although data was limited a trend line was generated for production and consumption from 2000 to 2012 (Figure 8). The above graph shows that there has been a continuous shortage in food production. If the current trend continues Bihar will be deficit in food grains in 2012 by about 3 million tons. Given the magnitude of the deficit and the existing production constraints, the target set by the Road Map may be hard to achieve

within the next two years. Thus, ensuring the timely availability of the required quantity of food is a major challenge to food security in Bihar.

## Changing Composition of Agriculture in Bihar

The composition of agricultural sectors itself has been changing over the years (Table 9). Table 9 shows that the share of crop subsector in the total agricultural GDP has declined over the years. On the other hand there has been a gradual increase in the contribution of the livestock subsector. This increase was mainly due to the flourishing dairy sector. Milk production has continued to increase over the years. Although production is high, demand for milk and other livestock products is limited by low levels of income and purchasing power of the majority of households in Bihar (Singh, 2009).

The fisheries industry, on the other hand, has been quite stagnant at less that 5% throughout this decade. With the livestock sector continuing to grow, part of the food production is diverted to livestock industry as animal feed. This is anticipated to be a major challenge to food security in the future unless food grain production is increased.

Although cereals and pulses continue to dominate the crop sector, it is evident that there has been a shift within the sector. In recent years, farmers have started to shift from low valued staple crops such as cereal and pulses to high-valued crops such as vegetables and fruits. The main reason for this shift is that income from staple crops has been poor compared to horticulture crops.

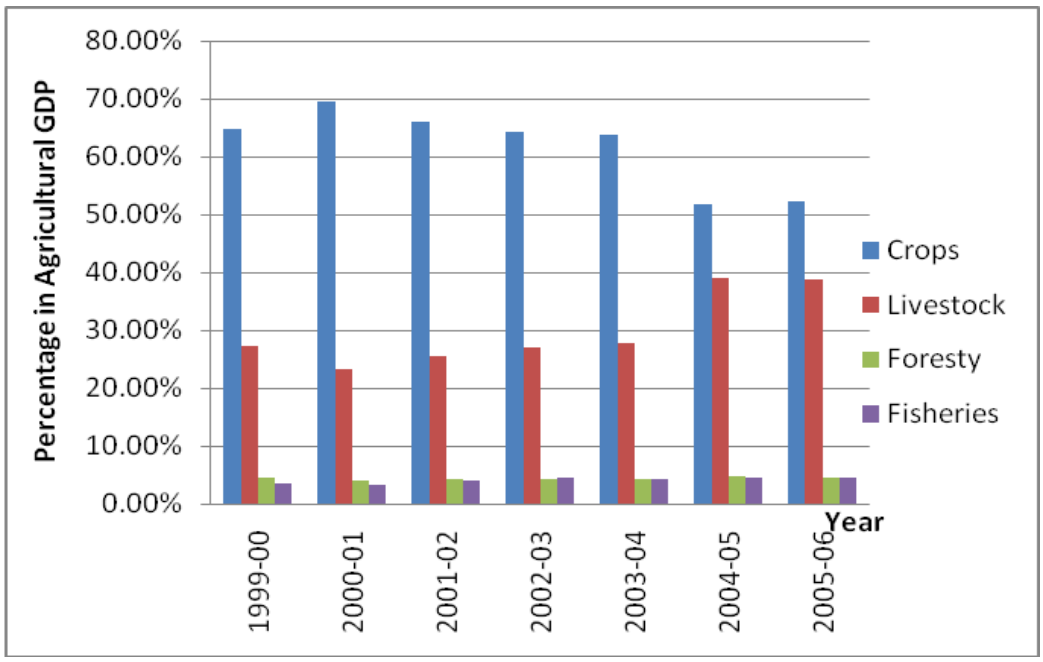



Figure 9. Structural Changes in Agricultural Economy from 1999 – 2006
Source Central Statistical Organization, India (2008)

Accessibility of Food

A sizable share of the population in Bihar lacks a combination of physical, economic and social access to food needed to meet the requirements of an adequate and nutritional diet. According to District Directors, physical access to food, especially in the rural areas is mired by a) poor infrastructure, logistics, and basic amenities and b) poor market connectivity. Site visits were instrumental in gaining first hand experiences on deficiencies in infrastructure and market connectivity. In Bilap, which is not more than 30 kilometers from Patna, there were no proper paved roads, efficient transportation services, electricity, piped water and other basic amenities.

In many of the developing countries, grains are stored in farmhouses until transported to the market. Vegetables, fruits, leafy vegetables, milk and meat spoil quickly unless they are stored in cold facilities. Thus, post-harvest losses are very high and improper storage also compromises hygiene and safety of food.

TABLE 8

PER CAPITA INCOME IN BIHAR FROM 1999 -2009

| Period | Per Capita Income (INR.) | Period | Per Capita Income (INR.) |
|---|---|---|---|
| 1999-2000 | 5786 | 2004-2005 | 6772 |
| 2000-2001 | 6554 | 2005-2006 | 6719 |
| 2001-2002 | 5994 | 2006-2007 | 8167 |
| 2002-2003 | 6658 | 2007-2008 | 8703 |
| 2003-2004 | 6117 | 2008-2009 | 9586 |

Source: Government of Bihar (2009)

In Bihar, mandi markets provide key access to fruits and vegetable. However, mandi markets are mostly confined to populated cities and villages. While access to these markets was not a major constraint to the residents of Adami, most people in Bilap indicated that there is no mandi in the villages of Bilap. The nearest mandi is around 5 kilometers away and since there are no regular transportation options within the village, they face serious difficulties in accessing this market. These constraints have not only adversely affected their food security but also standards of living as they have little to no access to other basic needs such as clothing, medicine etc.

TABLE 9

URBAN WHOLE SALE PRICES IN 2007 – 2010 (INR.)

| Food Item | 2007 -08 | 2009-10 | % Change |
|---|---|---|---|
| Rice (Kg) | 12.5 | 19.00 | 52.0% |
| Maize (Kg) | 6.75 | 8.50 | 25.9% |
| Wheat (Kg) | 9.75 | 14.00 | 43.6% |
| Lentil (Kg) | 30.50 | 38.50 | 26.2% |
| Milk (Litre) | 15.00 | 19.00 | 26.7% |
| Chicken (Kg) | 65.00 | 75.00 | 15.4% |
| Vegetable (Kg) | 11.00 | 17.50 | 59.1% |
| Average Increase in Food Prices | | | 35.6% |
| Per capita income | 8435.00 | 9586.00 | 13.6% |

Data collected with the collaboration of Dr. Singh

Economic accessibility to food is achieved when a person or household has the income to purchase food needed to meet the requirements of an adequate and nutritional diet without compromising the attainment of other basic needs such as clothing, shelter etc. According to estimates from the Planning Commission of India (2004-05), close to 40 percent of the people in Bihar lives Below Poverty Level (BPL), so there is a critical constraint to economic access to food by the poor.

A poor laborer in the Adami area of Patna stated that low wages and lack of employment are the biggest constraints to accessing food. Another person mentioned that although she

was entitled to the government mandated rations distributed through the PDS, she had not received her ration card due to bureaucratic steps and processes. Those who had ration cards claimed that the government distribution of rations was not equitable. She said that these services are not implemented properly and there is corruption at ground level. Children from poor families often have to give up schooling to earn and feed their families. The average per capita income is very low and has only increased by only 10.15% over the past decade (Table 8). One woman expressed that she has been working for the last 20-25 years and she started with INR. 1000 (approx. $22) per month and she still earns the same wage.

Photo 12. Mandi Market in Patna

Although the Central Government has set a minimum wage rate of INR. 100/day, the laborers are paid between INR. 50 to 100. Agriculture is the main occupation and means of employment for the majority of the people in Bihar. The majority of those employed in agriculture are small and marginal farmers who produce crops to feed their own families and take the surplus to the market to earn an income. Their quality of life will only improve if they gain a profit from this excess produce. Thus, farmers in poor States like Bihar are caught in a vicious cycle of poverty, poor farming practices, poor yields, poor market orientation and poor returns. Those in agricultural labor are the poorest of the poor, receiving compensation in cash or kind or both. Even though NAREGA has been able to lift the wage rate a little, wage rates in Bihar are still less than the minimum wage rate. Furthermore, NAREGA has not been able to reach all poor people mainly due to slow implementation and poor management.

While the agricultural sector has been growing very slowly, the number of laborers employed in the agricultural sector has been increasing. Performance of the agricultural sector directly impacts their income and livelihood. Thus, hunger and poverty likely cannot be reduced unless the agricultural sector is revived and sustained. The increasing reliance on agriculture is the main cause of poverty in Bihar.

The data on wholesale food prices in urban areas indicate that there has been a sharp increase in the price of basic food products. For example the price of rice has increased more than 50 percent while vegetable prices have increased by nearly 60 percent (Table 9). The growth of income has not kept pace with the rise in food prices. The result has

been food becoming increasingly more expensive and inaccessible to the poor. With the existing conditions it is highly unlikely that a dramatic change to income will occur in the near future (Singh, 2009).

The Food Security Atlas for Rural Bihar (2009) identifies improvement in the role and position of women as central to improving food security in the State. There are gender-based inequalities in food consumption in rural India. The existence of such gender-based inequalities in household consumption is demonstrated through numerous case studies (Jackson and Rao, 2009). Although women generally work longer hours than men, they get less food and less nutrition than men. This gender differentiation and discrimination influence the individual access to food within a household.

Adequacy and Utilization

Adequacy and utilization of food is important to meet the Recommended Dietary Allowance (RDA). An assortment of food items is commonly consumed for a balanced nutrient intake through the daily diet. In Bihar, these food items are classified into eight categories mainly cereals, pulses, vegetables, roots and tubers, fruits, oil and fat, meat, fish, poultry, milk and milk products, and sugar and jaggery. According to the National Statistics Survey conducted in 2005 – 06, the cereal intake in Bihar is higher than the RDA requirement (Table 10). In all other categories of the food items Bihar was in deficit in terms of meeting the RDA requirement. The District Directors identified lack of processing facilities and nutritional knowledge as serious issues to adequacy and

utilization. Poor maintenance of food safety and quality standards was also a serious issue.

TABLE 10

AVERAGE FOOD INTAKE, RECOMMENDED DIETARY ALLOWANCES (RDA) AND SURPLUS/DEFICIT IN BIHAR (KG./MONTH) FOR 2006-07

| Particulars | Average intake | R.D.A | Surplus/Deficit (%) |
|---|---|---|---|
| Cereals | 13.16 | 13.80 | 4.86 |
| Pulses | 0.71 | 1.20 | (-) 40.83 |
| Vegetables | 4.01 | 5.80 | (-) 16.46 |
| Tuber and root crops | 2.46 | 3.00 | (-) 18.00 |
| Fish/Egg/Meat | 0.45 | 0.90 | (-) 50.00 |
| Milk | 2.98 | 4.50 | (-) 33.78 |
| Oil & fats | 0.13 | 0.60 | (-) 78.33 |
| Sugar/Jaggery | 0.12 | 0.90 | (-) 86.67 |

Source: National Statistics Survey (2005-06)

These trends have continued in recent years. Consumption patterns indicate that diets are deficient in protein sources such as pulses, meat, and dairy products. This is due to the low purchasing power of the majority of the population whose income is not sufficient to meet their daily food needs. Several women from the Adami Area stated that they mostly eat cereals such as wheat and rice since they cannot afford to buy vegetable, fruits, meat, milk, etc due to low income and high cost of living. They have to split their income between food and other necessities, so sometimes they have to prioritize their spending

patterns to fulfill other obligations such as paying for rent, medicine, etc. Several of them said that they knew milk and meat was good for them but they just didn't have the money to buy them.

The general trend in Bihar is to consume fresh and unprocessed food products except cereal grains such as rice and wheat. The majority of fruits and vegetables is consumed fresh with very little processing, packaging and value addition. Less than five percent of fresh fruits and vegetables is processed. This aspect needs to be enhanced to improve the utilization of the food products and reduce post-harvest losses which are more than 30 percent. In the village of Bilap, inferior manual processing devices were used to extract grains. Simple processing of food at household level was observed in the Adami area, where women dry grains or spices for domestic use.

Food quality and safety is another important issue in Bihar. As in the case of Bilap and Adami, the majority of the villages in Bihar do not have electricity, so farmers cannot use cold storage facilities to store perishable food items. Unless they are consumed or sold quickly, spoilage of these food items is inevitable. Improper storage and processing exposes food to bacteria, fungi, insect pests and rodents, causing both negative health impacts and post-harvest food losses.

## Women's Roles in Agriculture and Food Security

Women comprise of nearly half of the population in any community, including rural and

urban communities of Bihar. Women play a critical role in household food security and development of agricultural and allied sectors in Bihar. In addition to household activities, women play an active role in crop production, livestock production, horticulture, post harvest operations, fisheries, etc. The nature and extent of women's involvement in agriculture, however, varies from region to region, farming systems, castes, classes and age etc. Women's roles are often flexible and circumstantial.

Photo 13. Left: a Woman Preparing Dung to be used as Fuel in Cooking,
Right: Woman Engaged in Post-harvest Activities

In Bihar, women are sometime home keepers, landowners, managers, farmers, landless laborers, and sometimes self-employed laborers and entrepreneurs. Some women are the sole bread winners for the family. Although most women engage in income generating activities in both urban and rural areas, their work is rarely seen as important. Women are

often not compensated for their participation in family enterprises—farms or family business activities. They are often exposed to hazardous work and sexual harassment.

Women's participation is extremely important for household food security and income generation. Therefore an important precondition for food security is the elimination of gender inequality by providing equitable access to food within the household and at the same time empowering women to be independent and enterprising so they can consume equitably. This should be coupled with the increase of literacy among women. The female literacy rate in Bihar has been ranked one of the lowest among various States in India (only 33.57%). Improving literacy of women will also help in several different ways: enable and enhance their role in family decision-making, improve knowledge about economic, health and nutritional aspects, increase their bargaining power and opportunities to access resources and services, and enhance their self-esteem. Decisions related to food and nutrition are often made by women; thus, educated women will not only attempt to improve their own nutritional levels but also those of their children and dependents. In an average Indian family, women most often make decisions related to food. Therefore, gender issues must be an integral part of an integrated approach to addressing food security issues in Bihar.

## New Interventions for Enhancing Food Production and Food Security in Bihar

A gradual approach to liberate the people of Bihar from the twin traps of hunger and poverty has proven to be inefficient both economically and socially. During the past three

years there have been considerable political, social and economic reforms in Bihar to curtail poverty, population growth, hunger and malnutrition.

TABLE 11

FIVE MAJOR GOALS OF THE ROAD MAP ON AGRICULTURE AND ALLIED SECTORS

| | |
|---|---|
| Goal 1 | To ensure increase in income of farmers to viable levels, especially considering the small size of holdings |
| Goal 2 | To ensure food security through increase yields Production combined with profitability. |
| Goal 3 | To foster nutritional security through raising levels of yields Production as well as raising living standards of rural societies |
| Goal 4 | To revitalize farming in order to create gainful employment and to check Migration |
| Goal 5 | To ensure agricultural growth with justice, with programs focusing on gender and human aspects |

Source: Bihar Road Map, Government of Bihar, 2010

In 2008, the present Government of Bihar under the leadership of Chief Minister Nitish Kumar formulated a Road Map for the development of agricultural and allied sectors and proposed to invest more than INR. 61350 Million (approx. 136 Million US$) in Eleventh Five Year Plan. The year 2008 was referred as the Agricultural Year in Bihar. The road map was presented to renowned scientists and experts, and to more than 2,000 farmers representing all districts of Bihar for their input. The road map is aimed to trigger "a Rainbow Revolution" in Bihar and thus its objectives went beyond farming. The primary

goal of the Road Map is to improve the income and living conditions of the people living in hunger in rural Bihar. The Major Goals of the Road Map are highlighted in Table 10.

The Road Map encompasses – a) Agricultural development; b) Animal husbandry development; c) Dairy development; d) Fisheries Development; e) Cooperative Sector development; f) Institutional Finance; and g) Financing the Road Map.

The Road Map was developed to achieve the major objectives of increasing farm income while assuring food and nutritional security and enhancing agricultural growth with justice. A series of programs was to be implemented under the Road Map. The agricultural development program section was developed to include various aspects such as seed plan, horticulture, soil health management, crop protection, farm mechanization, transfer of technology, agricultural extension, farming model, soil and water conservation technologies, weather stations, micro-irrigation project, agricultural marketing, and crop production targets/milestones. The proposed programs cover all aspects of agriculture from inputs to marketing of final products and institutional capacity building. They fall into five major groups:

a. Inputs, access, supply and quality.
b. Transfer of technology and extension.
c. Income generation schemes.
d. Marketing.
e. Capacity building and Institutional development.

**Improving access, supply and quality of Agricultural inputs:** For the purposes of enhancing productivity, 23 crops were selected for detailed attention during the duration of Road Map (2008-2012). The major pillars of these programs are input management. Among inputs, seed is an important factor that contributes to productivity. Considering the currently very low seed replacement rate, the Road Map is implementing a crash program to introduce new varieties of seeds in the Bihar villages. Other programs include innovative seed programs, production of certified seeds through seed village programs and agricultural universities, distribution of substantial quantities of good quality seeds at subsidized rates, enhanced seed production and seed certification capacity, etc. Similar to field crops, programs are in the process of been implemented for increasing availability of quality planting materials and seed production for horticulture crops, since horticulture is a way for marginal farmers to increase income.

The Road Map recognizes the importance of chemical fertilizer in increasing productivity. But taking into account the lack of assured availability of these fertilizers, the Road Map proposes that the State play a more direct role in import of phosphatic and potassic fertilizers. Considering the constraints in supply of these fertilizers, the Road Map pushes for a massive program for vermi-compost and green manures. The programs are also designed to ensure supply of boron, zinc, gypsum and pyrites at subsidized rates, wherever soil conditions so require. Another crucial input is pesticides. A program for rejuvenating existing plant protection centers forms a part of the Road Map.
Apart from ensuring supply of inputs and their popularization, the Road Map also emphasizes quality aspects of the inputs. Tissue culture laboratories for vegetable and

fruits are been established to assist innovation and improvement of crops. In addition, soil testing laboratories are to be constructed in all the Blocks. At the district level, the soil testing laboratories are expected to include seed testing wings. Apart from soil and seed testing laboratories, bio-control laboratories (for rearing natural defenders of crops), pesticide and fertilizer laboratories are also planned. An important requirement for increasing productivity is to prepare fields quickly and to reduce the time required between crop cycles. The Road Map includes a massive farm mechanization program with emphasis on gender-friendly farm tools/implements.

**Transfer of Technology and Extension:** In modern agriculture, extension services are the key for the transfer of agricultural technology at the grass-root level. The Road Map includes the establishment of 'schools', in farmers' fields. Farmers will be tutored on prescribed farming practices by trained personnel in their fields. Demonstration of various technologies and exposure visits of farmers to other states would also be important components of transfer of technology. The flagship scheme of agricultural extension of the state, the Kisan Samman Yojana, would be further strengthened with experiences learned in the past. At block level, use of information technology in agriculture is proposed to be enhanced through establishment of e-kisan bhavans, which will also have soil-testing laboratories, farmer information centers etc.

**Income Generation Schemes:** The Road Map primarily aims to increase the income of the farmers. With this in view, integrated farming models prepared by the Indian Council of Agricultural Research (ICAR) and the Rajendra Agriculture University are proposed to

be implemented. The scheme is to maximize farm-income through convergence of schemes like dairy, fisheries, horticulture, poultry and duck rearing and crop husbandry ideally on a one-acre. The road map also visualizes reclamation of degraded land through watershed development in districts of south Bihar.

**Marketing:** A major program included in the road map is integrated market development. The market development programs include Modern Terminal Markets at the top, agribusiness centers in the middle tier and rural haats (fairs) at the bottom tier. Around 10,000 on-farm primary processing centers are proposed to be built on farmers' fields. This program is aimed at developing value chains and marketing systems to enhance farm income.

**Capacity Building and Institutional Development:** The proposed program of action also includes rejuvenation of extension services. Therefore, revamping of the Agriculture Department and capacity building of its personnel are an important part of the Road Map. Similarly, the ambitious market infrastructure program also calls for an institutional mechanism to oversee developmental activities and for asset management. The road map recognizes the need for capacity building of both the farmers and the governmental staff. The various programs that are implemented under the Bihar Road Map for Agriculture and Allied Sectors are summarized in Appendix 2. This summary includes both potential intended benefits and unintended benefits and consequences.

# CHAPTER V

## SUMMARY

The information and data collected from India indicates that addressing food security and the alleviation of hunger and poverty remain high priorities for the Central and State governments of India. The government has recognized the challenges of the post green revolution in terms of stagnation in the production of staple and basic food grains. India was also affected by the global food crisis of 2007-2008 and this crisis has led to policy reforms and new interventions to address food security in a sustainable manner. At the national level, the government of India has drafted the Food Security Bill which is pending approval of the parliament.

This study reveals that food security is a complex problem encompassing issues related to availability, access and adequacy. Findings of this study indicate that the population of Bihar is increasing at a steady pace each year and food production is not keeping up with the pace of population growth. Food prices are increasing at a higher rate than the real incomes of the people. Addressing these issues will require an integrated approach to create an enabling environment at the local, state and national level.

**Food Security in India:** Over the past two decades there has been a significant change in

India's trade and economic structure. Public and private interventions in the early 1990s including trade liberalization, increased capital mobility, and development and adoption of new technological innovations are helping to revitalize India's agriculture, commercial and service sectors (Seema, 2006). In spite of the global economic crisis during the past few years, India's economy continued to grow and the country has emerged as one of the fastest growing economies in the world with accelerated annual growth rates around 7- 8 percent.

Despite the unprecedented economic growth, India's growing population means that ensuring a continuous supply of food and maintaining national food security remains a major challenge for the government of India. The State and Central governments are taking positive steps to address the challenges of food security.

To ensure national food security, the government of India drafted a new Food Security Bill. The Bill is referred to as the National Food Security Act, 2010. This draft bill is currently under discussion and debate in the country through the National Advisory Council (NAC). This bill, if approved by the parliament, is expected to provide a statutory framework to entitle families living below the poverty line to certain minimum quantities of food grains per month through targeted public distribution system. The key issues currently debated include the following:

a) Provide a legal right to every family below poverty line (BPL) to get 25 kg of rice or wheat at INR. 3 per kg.
b) Mandate the quality and nutritional aspects of food to ensure both food and

nutritional security.

c) Mandate government support to enhance and sustain food production to ensure adequate availability.

Science and technology is moving forward. Indian farmers have adopted GM Bt cotton which is now widely grown by smallholder farmers in many States. The introduction and use of GM cotton has provided increased employment opportunities, income and welfare of both men and women in rural areas (ISAAA, 2009). This is providing rural poor with additional income to purchase more quantities of food and at the same time to improve their standards of living. Biotechnology applications are underway in many other crops.

Furthermore, the Indian government has realized the importance of increasing funding for research and development in agriculture. In May 2009, the government announced an increase in investment in science and technology from 1% of GDP to 2% (News on S&T Policies and Developments, 2008). At both national and state levels scientists are encouraged to expand research and adopt cutting-edge technologies in plant breeding to extension to food safety to food processing and packaging with an aim to improve the availability and quality of food. Mobile technology is transforming agriculture information systems in rural villages of India. Some States are starting to use cell phone networks to provide extension services, weather information and market information to farmers in rural areas. These novel approaches are helping farmers to improve farming practices and mitigate losses from pests, disease, adverse effects of weather and also to connect farmers to markets.

Farmers are encouraged to adopt new technologies and produce to meet the demands of the local and export markets. With the new trends of supermarkets and grocery chains, contract farming is growing in India. These trends are uniting small scale and marginal farmers into cooperatives, farmers associations, self help groups and commodity groups so that they can benefit from bulk purchase of agricultural inputs at low cost, access to credit, technologies and extension services, access to markets and guaranteed price schemes.

Through the Council of Agricultural Research (ICAR) the government of India is implementing the National Agriculture Innovation Program with an intent to speed up the transformation of Indian agriculture and support income generation through innovation and collaborative partnership amongst farmers, private sector and the civil society. In order to facilitate and speed up the implementation of these programs the government is also in the process of developing and expanding the infrastructure that not only support agricultural production but other aspects of the value chain, health, education, transportation, etc.

**Food Security in Bihar:** Although not yet as progressive and cutting edge as some of the other states, food production and food security situation in Bihar is being addressed by the State and it is slowly improving. The State Government of Bihar has taken positive steps to address food security issues in the state. As discussed earlier, in 2008, the

Government of Bihar developed an ambitious road map for addressing food production and food security.

The New Road Map is devised to improve the agricultural sector by identifying weak parameters and addressing them gradually through various State wide interventions. Although all targets set by the Road Map may be hard to achieve in the set time frame of four years, some progress is already underway in terms of input supplies and marketing. If the current interventions and support for food production and food security programs are sustained at national, state and local levels, Bihar's food security situation is expected to improve and millions of rural and urban poor can be lifted out of poverty and hunger. The implementation of this new road map is still in the early stages. For this road map to achieve its goals it needs to be implemented effectively and monitored closely. It will take several years to see the real impacts of this roadmap and new interventions. Further, research will be required to measure the real impacts of this Road Map.

The review and analysis of the Road Map indicates that the programs and schemes are heavily focused on enhancing and ensuring food production and availability and to some extent food accessibility. However, the Road Map does not adequately address the issue of food utilization/adequacy especially in terms of food intake, food safety and nutritional quality aspects. In order to develop a comprehensive food security program all the components should be addressed and supported.

**Food Security in Sri Lanka:** The food production and food security issues observed in Bihar are to a large extent common to issues observed in neighboring countries. For example, in Sri Lanka with over 20 million people food security remains a challenge for the government. The country has just emerged out of a 30-year-long civil war which drained financial resources from other development programs. Sri Lanka is rich in biodiversity with diverse agricultural resources. Rice is the staple food crop of the country. Sri Lanka was historically known as "The Granary of the East." However, in recent years rice production has not kept up with the pace of population growth and in some years the country had to import rice.

Recent reports have recommended improvement in access to inputs, research and extension systems, food processing, market access and development of infrastructure. These issues are similar to those observed in Bihar. The current government of Sri Lanka is developing new programs to address the food security situation and rebuild the areas affected by war. The government has established a Presidential Food Security Group which is developing a strategy for building national food security.

# REFERENCES


1. *A Road Map for Agriculture and Allied Sectors*. (2010). Retrieved from Department of Agriculture, State Government of Bihar : http://krishi.bih.nic.in/Road_Map.html

2. Ahmad, E. (Apr. 1961). The Rural Population of Bihar. *Geographical Review* , 253-276.

3. *Animal Husbandry and Fisheries Resources*. (2010). Retrieved from State Government of Bihar: http://ahd.bih.nic.in/

4. Banerjee, A. and Iyer, L. (2005). History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India. *American Economic Review , 95*, 1190–1213.

5. Bathla, S. et al. (2006). *Indian Agriculture "The Winds of Change"*. New Delhi, India: Federation of Indian Chambers of Commerce and Industry.

6. *Bihar through Figures*. (2009-2010). Retrieved from State Government of Bihar: http://gov.bih.nic.in/

7. Dandekar, V. M. (1988). Indian Economy since Independence. *Economic and Political Weekly , 23(1/2)*, 41-43+45-47+49-50.

8. Dantwala, M. (1986). Strategy of Agricultural Development Since Independence. In *Indian Agricultural Development Since Independence.* Bombay: Oxford & IBH.

9. *Department of Agriculture*. (2010). Retrieved from State Government of Bihar: http://krishi.bih.nic.in/Introduction.htm

10. *Eleventh Five Year Plan (2007-2012)*. (2007). Retrieved from Planning Commission, Government of India: http://planningcommission.gov.in/plans/planrel/11thf.htm

11. *Finance Department*. (2010). Retrieved from State Government of Bihar: http://finance.bih.nic.in/

12. Food and Agriculture Organization of the United Nations. (2003). *Trade Reforms and Food Security: Conceptualizing the Linkages Expert Consultation.* Rome.

13. Indian Council Agricultural Research. (2009-2010). *Food Security.* Bihar.

14. Jackson, C. and Rao, N. (2009). Gender Inequality and Agrarian Change in Liberalizing India. In S. Razavi, *The Gendered Impacts of Liberalization.* Routledge, London.

15. Jha, S. et al. (2008). *Road Map for Rural Industrialization in Bihar.* Patna: State Government of Bihar.

16. Kalirajan, K. P., Mythili, G. and Sankar, U. (2001). *Accelerating Growth Through Globalization of Indian Agriculture.* New Delhi, India: Macmillan.

17. Kalirajan, K., Bhide, S. and Singh, K. (Working Paper (2009)). *Development Performance across Indian States and The Role of the Governments.* Australia South Asia Research Centre.

18. Khera, R. and Nayak, N. (2009). Women Workers and Perceptions of the National Rural Employment Guarantee Act. *Economic & Political Weekly , 44(43)*, 49-57.

19. Kishore, A. (2004). Understanding agrarian impasse in Bihar. *Economic and Political Weekly , 39 (31)*, pp. 3484-3491.

20. Koshy, V. C. (1974). Land Reforms in India Under the Plans. *Social Scientist , 2(12)*, 43-61.

21. Lalchandani, N. (2009, December 17). From farm to mandi, vegetable prices go up by 400%. *The Times of India* .

22. *Land Use Statistics at a Glance - State Wise* . (2010). Retrieved from Directorate of Economics And Statistics, Ministry of Agriculture, Government of Indai: http://dacnet.nic.in/eands/LUS_1999_2004.htm

23. Mill, J. (1817 ). *The History of British India.* London: Baldwin, Cradock, and Joy.

24. *Ministry of Agriculture*. (2010 ). Retrieved from Government of India: http://agricoop.nic.in

25. *Ministry of Statistics and Programme Implementation*. (2010). Retrieved from Government of India: http://mospi.nic.in/Mospi_New/site/Home.aspx

26. National Bank for Agriculture and Rural Development, Government of India. (2007). *Profile: National Bank for Agriculture and Rural Development.*

27. News on S&T Policies and Developments. (2008). *India S&T Newsletter* .

28. *Planning and Development Department, Government of Bihar*. (n.d.). Retrieved from http://planning.bih.nic.in/

29. *Planning Commission*. (2010). Retrieved from Government of India: http://planningcommission.gov.in/data/central.html

30. *Pocket K No. 5: Documented Benefits of GM Crops*. (2010). Retrieved from International Service for the Acquisition of Agri-biotech Applications: http://www.isaaa.org/resources/publications/pocketk/5/default.asp

31. Prasad, P. (1987). Agrarian Violence in Bihar. *Economic and Political Weekly , 22(22)* , 847-852.

32. Prasad, P. H. (13 Aug 1988). Roots of Uneven Regional Growth in India. *Economic and Political Weekly* , 1689-1692.

33. Purnima, M., Deolalikar, A., and Bhaskar, A. (2008). *India State Hunger Index.* Riverside: University of California.

34. *Registrar General & Census Commissioner of India*. (2010-11). Retrieved from Government of India, Ministry of Home Affairs: http://censusindia.gov.in

35. Rothermund, D. (2003). *An Economic History of India: from pre-colonial times to 1991* . Taylor & Francis.

36. Sharma, V.and Thaker, H. (unpublished, 2009.). *Fertilizer Subsidy in India: Who are the Beneficiaries?* Ahmedabad, India: Indian Institute of Management.

37. Shiva, V. (2008). The Food Emergency and Food Myths. *Seedling* , 10-12.

38. Singh, R. K. P. (2009). *Agricultural Development in Bihar : Problems & Prospects*. Retrieved from Bihar Times: http://www.bihartimes.com

39. Singh, R. K. P. (2009, July 29). *Threatened Food Security in Bihar*. Retrieved from Bihar Times: http://www.bihartimes.com

40. Tendulkar, S. et al. (2009). *Report on Poverty Estimation.* New Delhi.

41. *The Mahatma Gandhi National Rural Employment Guarantee Act*. (2010). Retrieved from Ministry of Rural Development, Government of India: http://164.100.12.7/Netnrega/mpr_ht/nregampr_dmu.aspx?state_code=05&flag=11&page1=D&month=Latest&fin_year=2008-2009

42. The World Food Program and Institute for Human Development. (2009). *Food Security Atlas of Rural Bihar.* New Delhi, India.

43. Times News Network. (2009, December 18). Food inflation soars to 20%. *Times of India* .

44. Times News Network. (2010, Apr 19). Nitish hails Compfed's progress, prosperity. *The Times of India* .

45. von Grebmer, K., Nestorova, B., Quisumbing, A., Fertziger, R., Fritschel, H., Pandya-Lorch, R., and Yohannes, Y. (2009). *Global hunger index: the challenge of hunger: focus on financial crisis and gender Inequality.* Bonn: International Food Policy Research Institute.

46. Wiesmann, D. (2006). *A Global Hunger Index: measurement concept, ranking of countries, and trends.* Washington DC: International Food Policy Research Institute.

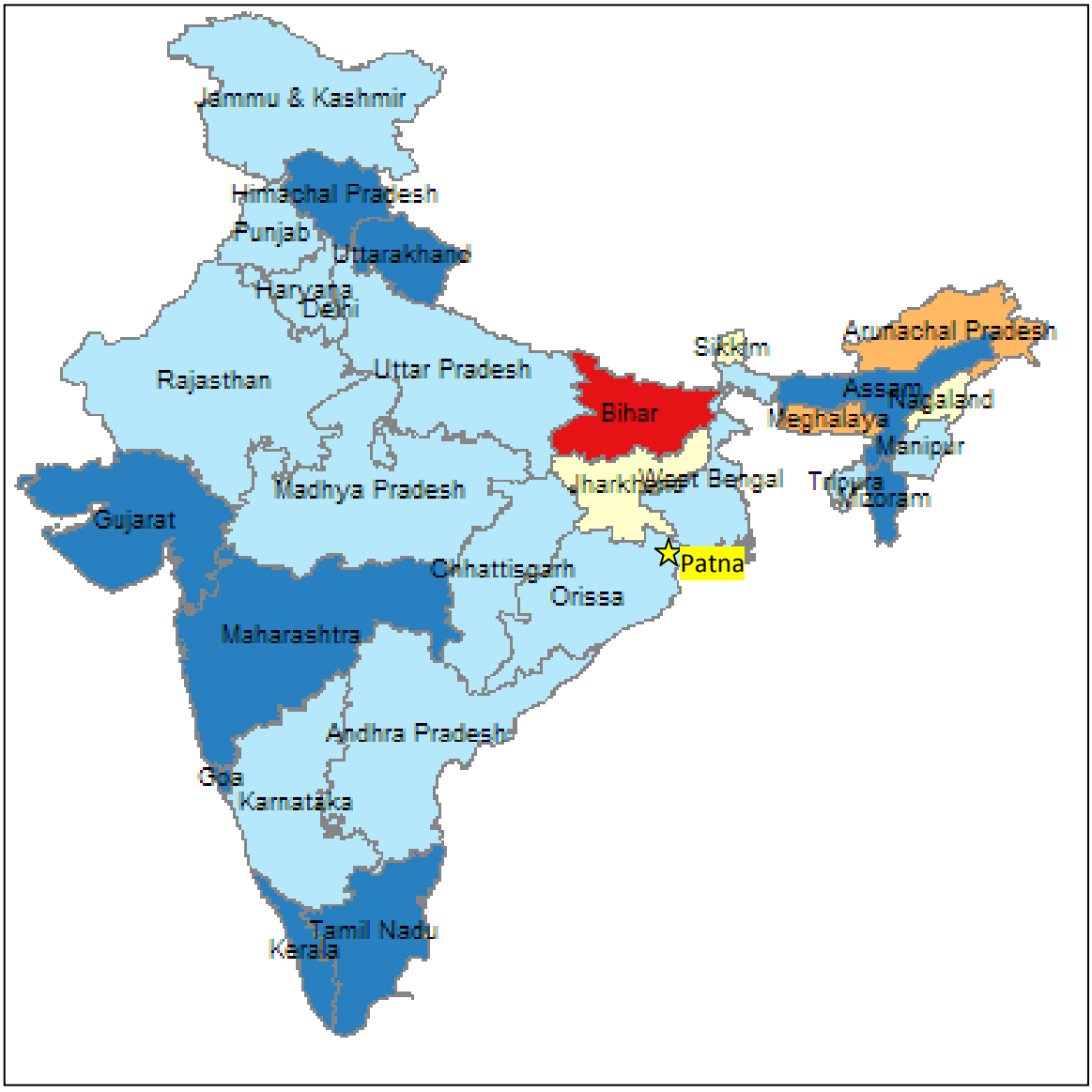
47. Wilson, K. (1999). Patterns of Accumulation and Struggles of Rural Labour: some aspects of agrarian change in central Bihar. *Journal of Peasant Studies , 26(2)* , 316-350.

48. Wonacott, P. (10 Apr. 2009). India Defies Slump, Powered by Growth in Poor Rural States.

APPPENDICES

APPPENDIX -1

Map of India



APPPENDIX -2

Summary of the Bihar Road Map for Agriculture and Allied Sectors

| CROP SECTOR | | |
|---|---|---|
| **Specific Projects** | **Incentives/Benefits** | **Unintended consequences** |
| 1. Seed Plan | Farmers will have access to good quality seeds at a relatively cheaper rate<br><br>Additional income and employment opportunities for the farmers producing certified seed<br><br>Enhanced productivity | Attract other farmers to produce seed and increased competition may drive seed price down<br><br>Monoculture of specific varieties and reduced crop diversity<br><br>Increased production may reduce commodity prices |
| 2. Horticulture Plan | Increased availability of good quality vegetable and fruit seed and planting materials to farmers at affordable prices<br><br>Enhanced productivity of fruits and vegetable crops<br><br>Creation of employment opportunities in rural areas | Monoculture of specific varieties<br><br>Increased production may reduce commodity prices |
| 3. Soil Health Management | Enhanced soil quality and health<br><br>Reduction in the use of fertilizer<br><br>Enhanced productivity | Improved ground water quality from reduction in leaching of fertilizers<br><br>Restoration of soil conditions, soil bio-diversity, and environmental impact |
| 4. Crop Protection | Reduction of crop losses due to pests and diseases | Reduced health impacts of chemical pesticides |

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| | Reduction in the use of toxic chemical pesticides and residues | Improved ground water quality<br><br>Better acceptance of products in the local and international markets |
| 5. Farm Mechanization | Enhanced efficiency in farm management practices<br><br>Reduces labor cost<br><br>Reduce pre and post harvest losses | Unemployment of rural labor<br><br>Migration of agricultural labor |
| 6. Transfer of Technology | Effective transfer of knowledge and improved technologies to farmers<br><br>Enhance agricultural productivity<br>Progressive farmers receive additional cash in rewards and honorary titles | Farmers may not adopt the new technologies due to social or financial constraints<br><br>May result in poor transfer knowledge and technologies |
| 7. Agricultural Extension | Farmers will have timely access to extension services<br><br>Farmers will be able to learn about new technologies and utilize new tools of information and communication technologies (ICTs)<br><br>Farmers can obtain real time market and weather information | |
| 8. Integrated farming model | Diversification of food sources and income sources for farmers | Farmers with small holdings may not adopt this model due to holding size and landscape constrains |

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| | Lower risks to farmers from farm losses<br><br>Farmers are rewarded to adopt this model | |
| 9. Soil and water conservation in rain fed areas | Efficient use of water resources and fertilizer<br><br>Prevent water bodies from siltation<br><br>Will provide and expand irrigation facilities in rural areas | Soil salinity problem<br><br>Reduce soil erosion |
| 10. Mini weather station | Better forecasting of weather conditions and pest outbreaks<br><br>Protection of crop against hazardous weather such as flood and drought | Lack of electricity in rural areas may prevent adoption and efficiency |
| 11. Bihar State Micro-Irrigation Project (BSMIP) | Efficient use of water resources<br><br>Efficient use of fertilizer | Marginal and small farms may not afford and adopt the technology |
| 12. Agricultural Market Development Program | Better access to local, regional and international markets<br><br>Ensuring a better price for farm products<br><br>Will provide a one stop shop for a range of agricultural services<br><br>Help establish backward and forward linkages with farmers and consumers<br>Promote entrepreneurship and increase sources | Agricultural product prices may decline |

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| | of revenue in rural communities<br><br>Stakeholders will obtain market intelligent and services at relatively low cost in a timely manner | |
| The financial requirements to be covered through public and private investment<br>Close monitoring and evaluation of the different projects is necessary to measure the progress and achievement of goals.<br>Total Budget US $ 835.1 million ( 4 years) | | |
| **ANIMAL HUSBANDRY SECTOR** | | |
| **Specific Projects** | **Incentives/Benefits** | **Unintended Consequences** |
| 1. Door Step Veterinary Service | Animal owners will receive better animal health services at their door step<br><br>Farmers and animal owners will be able to increase income<br><br>Will help safeguard rural people against diseases that may be transmitted via domestic animals | Low remuneration in the veterinary service sector may reduce the attractiveness to take up door step services |
| 2. Strengthening Animal Husbandry Offices | Better access to animal care | Poor management, low income and resources may lead to poor services |
| | Animal owners will have timely access to information and animal husbandry related services | The extension services may not reach village level due to shortage of trained staff and resources |

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| 3. Goat Breeding and Rearing Farms | Provide families with quality breeds<br><br>Increased rural employment and income opportunities especially for marginal and landless farmers and women<br><br>Diversification of diets and source of protein | Over grazing |
| 4. Disposal of Carcasses | Reduce pollution, spread of diseases and improve public health and sanitation<br><br>Will create a business and employment opportunities for selected individuals. | Loss of food for wild animals, birds (vultures) and very low income families |
| 5. Buffalo Development | Farmers and animal owners will be able to purchase an improved breed of buffalo from state farms<br><br>Provide an additional source of rural income<br><br>Diversification of diet and protein sources | Inadequate storage and refrigeration will impact quality and life span of fresh milk and milk products |
| 6. Rural Poultry Development | Provide a cheap source of protein in the daily diet<br><br>Will provide an additional source of livelihood and income for rural families | Dietary habits may constraint demand |
| 7. Strengthening of sub division level veterinary hospitals | Better access to veterinary services | Inadequate manpower and resources may limit services |
| 8. Cattle Insurance Scheme | Reduce risks of economic loss to the farmers | Insurance premium may prevent poor |

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| | | farmers from benefiting from this service |
| The financial requirements to be covered through public and private investment<br>Close monitoring and evaluation of the different projects is necessary to measure the progress and achievement of goals.<br>Total Budget US $ 183.5 million ( 4 years) | | |
| **DAIRY SECTOR** | | |
| **Specific Projects** | **Incentives/Benefits** | **Unintended consequences** |
| 1. Milk Production | Increase in per capita availability of milk and dairy products<br><br>Enhanced diversity and sources of protein in diet | Prices of milk may fall |
| 2. Increase Processing Capacity (Co-operative) | More facilities are available to store milk products<br><br>Improve processing can reduce milk spoilage | May not meet the national and international quality standards |
| 3. Milk Procurement (Co-operative) | Will help improve economic value of cows and buffaloes<br><br>Provide opportunities in international markets | |
| 4. Artificial Insemination Centers | Will help improve economic value of cows and buffaloes<br><br>Farmers will have Artificial Insemination (AI) services at centers or at Animal health Care centers or at their premises at an affordable price | May provide opportunities to supply milk and milk products to national and international markets |

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| 5. Vaccination /Animal Health | Will allow diagnosis and treatment of disease in due time<br><br>Animal owners will be able to rear healthy and disease free animals<br><br>Farmers will be able to sustain and increase his/her herd size and generate more income | Control of Zoonotic diseases<br><br>Residues of antibiotics may be transferred to humans |
| 6. Fodder/cattle feed production and fodder marketing unit | Farmers will be able to purchase fodder seeds<br><br>Increasing capacity of cattle feed plants<br><br>Doubling the fodder supply by the year 2012<br><br>Farmers will be able to sustain and increase his/her herd size and generate more income<br><br>Will allow diagnosis and treatment of disease in due time | Land available for food crops may be reduced<br><br>Part of the cereals produced will be lost as animal feed |
| 7. Farm management and Society operations | Men as well as women receive training on modern cattle rearing<br><br>Milk production will be increased | May provide additional employment opportunities and sources of income to the household |
| The financial requirements to be covered through public and private investment<br>Close monitoring and evaluation of the different projects is necessary to measure the progress and achievement of goals.<br>Total Budget US $ 104.8 million (4 years) | | |

| FISHERIES SECTOR | | |
|---|---|---|
| **Specific Projects** | **Incentives/Benefits** | **Unintended consequences** |
| 1. Fish Seed Production | Support the fish seed production and rearing facilities<br><br>Meet the state's annual requirement of fingerlings<br><br>New employment opportunities in the fisheries industry<br><br>Increase household income | Mass production may disrupt the ecological balance and diversity in natural ponds |
| 2. Culture Based Fisheries in Oxbow Lakes | Farmers will have better knowledge of inland fish production<br><br>Increase in inland fish production<br><br>Additional income for rural communities | Lack of water or flooding of lakes will disrupt the inland fisheries sector |
| 3. Development of Fisheries in Water Logged Area | Subsidy to farmers to develop water logged areas<br><br>Additional source of income and food sources | May create additional employment opportunities in water logged areas |
| 4. Feed Production | Increase availability of fish food at an affordable price | |
| 5. Post harvest Marketing | Improved marketing of fish<br><br>Reduce spoilage and increase shelf life of | Lack of utilities and infrastructure may impact marketing services |

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|---|---|---|
| | harvested fish | Additional food product in the market adding to the diversity |
| 6. Training of farmers | Transfer of knowledge and empowerment of farmers | Farmers may not fully utilize and share their training in the field |
| 7. Para Extension Workers Scheme | Farmers will receive consultancy services in fisheries and aquaculture testing<br><br>Additional sources of information and guidance to farmers | May be costly for resource poor farmers |
| 8. Survey of Ponds | The State will have a systematic inventory and database of ponds<br><br>Better planning and development of fisheries sector | May impact policy decisions on investments in the fisheries sector |
| 9. Extension Schemes | Farmers and other stakeholder will be able to access and share knowledge on effective fisheries methods | Lack of man power and resources may impact the efficiency of this scheme |
| 10. Establishment of an Aquarium House | Promote and help create market for ornamental fish and eco-tourism | Trained man power and resources may impact sustainability of the Aquarium House<br><br>Create new economic opportunities |
| 11. Group Accident Insurance Security to Active fisherman | Provide security and welfare to fisherman and their families in the case of an accident | Low income families will not be able afford the insurance |
| 12. Model Fisherman Village | Improve the quality of life and wellbeing of the fishermen | Sustainability will be an issue unless government support, community involvement, and buy in are discontinued |

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| 13. Fisheries Research Scheme | Improved fisheries technologies for will be available to farmers<br><br>New innovations in fisheries sector | Trained scientists, research facilities and financial resources may affect research programs |
| 14. Fisheries Training Center in Patna | Capacity building, training, and empowerment of farmers and other stake holder<br><br>Will serve as a local platform for training in the state | Trained scientists, research facilities and financial resources may impact sustainability of the training center |
| 15. Strengthening of Fish Farmers Development Agencies | Speedy implementation of development services<br><br>Empowering of fisherman and farmers with new knowledge and technologies | |
| 16. Crop Insurance Scheme | Farmers will get insurance benefits in the event of a natural calamity or damage by miscreant | Farmers may not be able to afford the insurance scheme |
| 17. Renovation of ponds | Improve efficiency in fish production | Provide additional employment opportunities in rural areas |
| 18. Matsya Krishak Samman Yojna | Increase fish production<br><br>Farmers will receive fisheries and aquaculture instruments | Many small scale fishermen many not qualify for this scheme |
| The financial requirements to be covered through public and private investment<br>Close monitoring and evaluation of the different projects is necessary to measure the progress and achievement of goals.<br>Total Budget US $ 91.5 million (4 years) | | |

| COOPERATIVE SECTOR | | |
|---|---|---|
| **Specific Projects** | **Incentives/Benefits** | **Unintended consequences** |
| 1. Agricultural Credit Program | Access to short term agricultural credit for farmers | Farmers without collateral may not have access to credit<br><br>Bureaucratic process to obtain credit may discourage farmers |
| 2. Agricultural Input scheme | More Farmers will have access to inputs<br><br>Enhanced agricultural productivity and better income for farmers | High cost of inputs may prevent farmers from purchasing inputs |
| 3. Crop Insurance Scheme | Farmers will be protected against the adverse effects of weather and other unanticipated crop losses<br><br>Increased coverage among farmers | The cost of insurance may discourage farmers to access this service |

VITA

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