

**CGIAR Research Program on  
Climate Change, Agriculture and Food Security (CCAFS)**

**Summary of Baseline  
Household Survey Results:  
Vaishali Site, Bihar State (Northeast India)**

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## Executive Summary

This report summarises the results of a household survey of the CGIAR Program on Climate Change, Agriculture and Food Security (CCAFS) carried out in the Vaishali sampling frame of Bihar, northeast India, with an objective to better understand the baseline characteristics of farm families, changes in farming practices over the last 10 years, household livelihood sources, and household food security and asset profiles, among others. Vaishali district lies in Bihar state, a northeastern part of the Indo-Gangetic Plains (IGP). Bihar is the third most populous state in India, and major crops in this district are wheat, paddy rice, maize, vegetables, potatoes and oil crops. Most of the farmers integrate crop production with livestock.

The majority of inhabitants in the surveyed villages were from OBC (other backward class, 40%), followed by scheduled caste (31%) and general caste (18%). The average household size in the surveyed area was 7. One fifth of the households surveyed include extended family (>8 members in the household). Nine out of 10 households have someone resident who obtained some level of education, while the remainder have no educated household member.

The households in the surveyed villages derive their livelihoods from diversified sources. Most of the households are integrating crops with livestock. Surveyed households are producing food crops, cash crops, fruits, vegetables, livestock, fodder and poultry. One quarter of the households are subsistence farmers, producing food and livestock only for their family needs. A majority of the households raise small livestock and poultry (goats and chicken mostly). Similarly, farmers do have large livestock such as cows and buffaloes, mainly for milk production and associated by-products such as manure and compost. Households producing a higher number of products on-farm tend to be more market oriented.

People in the surveyed villages also collect fruit, fodder, fuelwood and fish from outside their own farms, mainly for their household consumption. Selling wood, food or fodder collected off-farm is not a common activity in the surveyed area. A majority of the households are quite diversified, with many agricultural activities and products. Both males and females, including grown up children, share responsibilities for on-farm and off-farm activities in the surveyed villages. Forty percent of households share on-farm workloads between male and female members. Another 40% of the households' farm work is being done exclusively by male members of the household. A large proportion of the off-farm activities are being done conjointly by men and women, as reported by three quarters of households. Cash income sources include wage earnings (either as farm labourers or from jobs in other sectors); business and remittances; or revenues from renting out farm equipment and land.

On average, households made 7 changes to their main crops during the last 10 years. Nine out of 10 households had made changes to more than two crops. The rate of introduction of new crops and/or varieties is very high in the Vaishali area as most of the farming households had introduced some new crops and/or varieties. One of the highly remarkable changes in crop practices seen is the replacement of tobacco and sweet potatoes by hybrid paddy and other crops. Similarly, many households made some changes in land and water management, and/or tree/agro-forestry management over the last decade. The reasons given for making such changes primarily relate to

factors connected to climate, market and/or land. We also found that households are changing their livestock management practices, with an average of 2 changes made over the last decade. Some of the changes made to livestock management included changes in herd composition, feeding practices and general livestock care practices. Reasons for doing so related to market forces, climate factors, household food demands, and constraints related to labour.

In terms of household food security, slightly more than half of these households are food secure throughout the year. Nine out of 10 households have irrigation available for farming. Only one in 10 of these households solely depend on rainfall. In terms of farm sizes, the vast majority of them own less than one hectare of land. Very few households had planted or protected trees on their farmlands in the past year.

Some of the smallholder farmers still use an animal drawn plough as it is not economically feasible for them to use tractors on small parcels of land. Hiring a tractor is very common in this area and a large proportion of the farmers hired a tractor, thresher and pump set for land preparation, harvesting and threshing and irrigating fields. Hiring farm labor is also common in Vaishali as household farm labor is often insufficient during peak seasons. Approximately 9 out of 10 farmers buy seed and fertilizer inputs, while three quarters buy pesticides and half purchase veterinary medicines from the market.

The survey data shows that around half of Vaishali households receive absolutely no climate or weather-related information. The households that are receiving it are getting it via radio, TV, government department (agricultural extension), friends/relatives and newspaper. They are receiving forecasts about extreme events, pest or disease outbreaks, start of the rains, and extended (2-3 month) weather forecasts. In the vast majority of households, survey respondents reported that it is only the males that are receiving these climate-related forecasts.

Forty-four percent of the surveyed families stated that they are not members of any formal or informal groups operating in the community. One quarter are members of a local savings or credit group, however, while 40% belong to a farmers' group related to agricultural production, agricultural marketing and/or vegetable production. Further scrutiny of the data shows that only males are members of such groups.

An asset indicator suggests this is not a wealthy area –most households own between one and four assets from a pre-determined list and only one third have more than four of these assets. Less than one quarter have a radio, but 82% now have cell phones. Over two thirds of households have a bank account. Only 38% of these homes have electricity, and 9% have an improved cooking stove. In terms of assets related to food security, less than one quarter have an improved food storage facility.

## Keywords

Bihar, climate change, food security, livelihoods, Vaishali

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## 1.0 Introduction

This baseline study, carried out in Vaishali district of Bihar (north eastern part of the Indo-Gangetic Plains), India, was accomplished under the CCAFS project of CGIAR and its partners. Bihar is one of the poorest states in India. It is surrounded by Jharkhand, Uttar Pradesh and West Bengal states in the south, west and east respectively, and it shares a border with Nepal in the northern part (Figure 1.1). Surrounded by river Ganga in the south and Gandak in the west, the Vaishali district is located at 25° to 30° north latitude and 84° to 85° east longitude.

The fundamental objective of this baseline survey was to describe the characteristics of the farming systems in terms of resource availability and use, changes in farming practices over the last decade, livelihood sources, household assets, food security and access to and use of climate and agriculture-related information. A household-level survey was carried out in seven villages within the Vaishali grid (10 km x10 km in dimension, Figure 1.2). An enumeration of villages inside the grid (Appendix 3) was made using census records cross-checked with key informants. Seven villages (Appendix 1) were selected randomly from the list. Each household was listed from those selected villages using voter lists, and cross-triangulated with a census conducted by the team. Then 20 households (sampling unit) from each village were finally selected randomly, resulting in a total of 140 households surveyed.

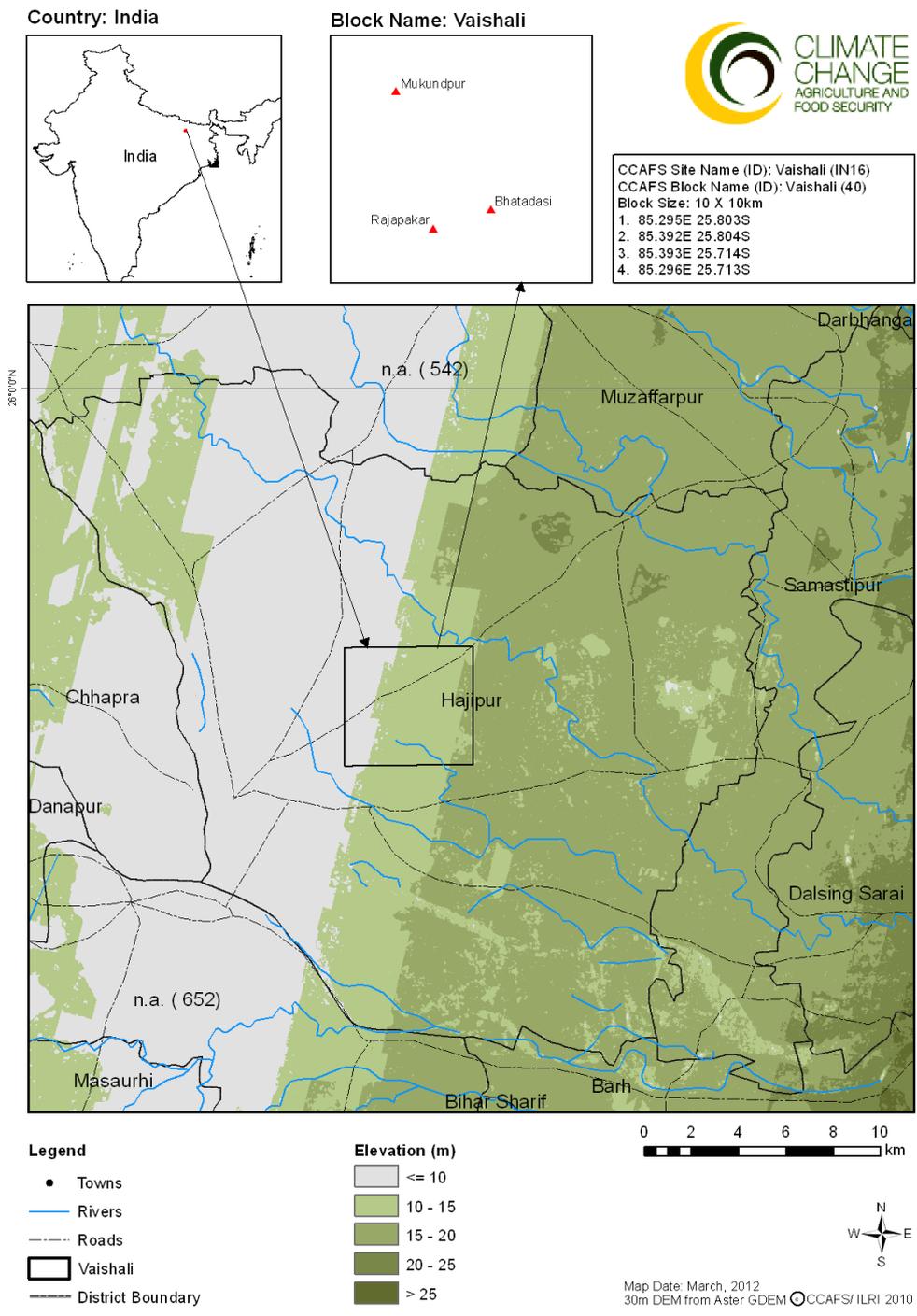
Figure 1.1 Map of Bihar state showing Vaishali district



Study site, grid, villages and household samples were drawn following the methodology and sampling framework suggested in the CCAFS Baseline Survey Manual. The household questionnaire was translated into the local language (Hindi) and the field enumerators and supervisors were trained. The questionnaire was pre-tested to assess the appropriateness of the language and develop necessary skills of the enumerators. The study team leader and the supervisor monitored the field survey activities and checked the quality of data regularly. The field survey was conducted

from April up until July 2012. The field team was led and supervised by RKP Singh. The name of the study team members and the field surveyors are listed in Appendix 2.

**Figure 1.2 CCAFS site in Vaishali showing 10 km X 10 km grid**

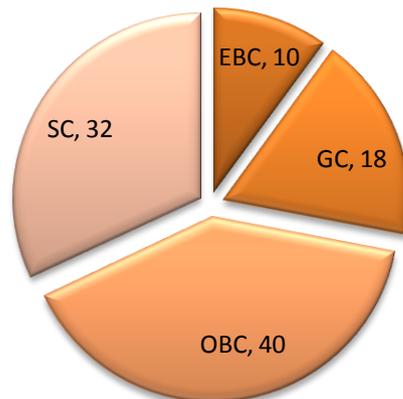


## 1.1 Household respondents and type

The household surveyors interviewed both male and female respondents. These female respondents were either widows or wives/mothers of the migrants who were away from home at the time of interview. The majority of the female respondents come from disadvantaged groups likely to be more vulnerable to climatic risks. Almost 70% of the surveyed respondents were males and the rest

were females. Ninety-nine percent of the surveyed households were headed by male members, with 1% female-headed households. The caste structure in India is based on government specified nomenclature, which aims to provide certain benefits to selected castes. Accordingly, the surveyed households were classified as extremely backward caste (EBC), general caste (GC), scheduled caste (SC) or other backward caste (OBC). General caste is considered a higher caste in hierarchy while EBC and OBC are lower ones. The majority of households surveyed fell within the OBC (40%), followed by SC (32%) and GC (18%) classes (Figure 1.3).

**Figure 1.3 Percentage distribution of the households according to their castes**



## 2.0 Household demographics

Vaishali district lies in Bihar, one of the most densely populated states in India. The population density in Vaishali district is also very high (1,335 person/km<sup>2</sup>). In the surveyed sample, one half of households do not have any very young children (<5 years), while 24% of households have one young child. Another 19% of households have 2 or more children under the age of 5 years. The survey data also shows that 51% of household don't have any elderly members (i.e., over 60 years), while 25% of households have one elderly resident, and only 33 households (24%) have two elderly residents. The majority of the households have more workers (i.e. people of working age), than non-workers resident full-time in the household.

### 2.1 Family size

The average household size in the surveyed area was 6.7 (SD=3.5, n=140) with a minimum of 2 members and a maximum of 22 members. One-third of respondents have a family size of 2-4 members, which is considered as a small family – typically the husband, wife and two children. A large proportion of the households (55%) are medium sized in terms of number of members. One-fifth of the households in the sample are extended families, with more than 12 members (Table 2.1).

**Table 2.1 Percentage distribution of households by family size**

Household size	Number of households	Percent of households
2-4 (small family)	34	24
5-8 (medium family size)	77	55
9-12 (large family size)	20	14
>12 (extended family size)	9	6

## 2.2 Education levels

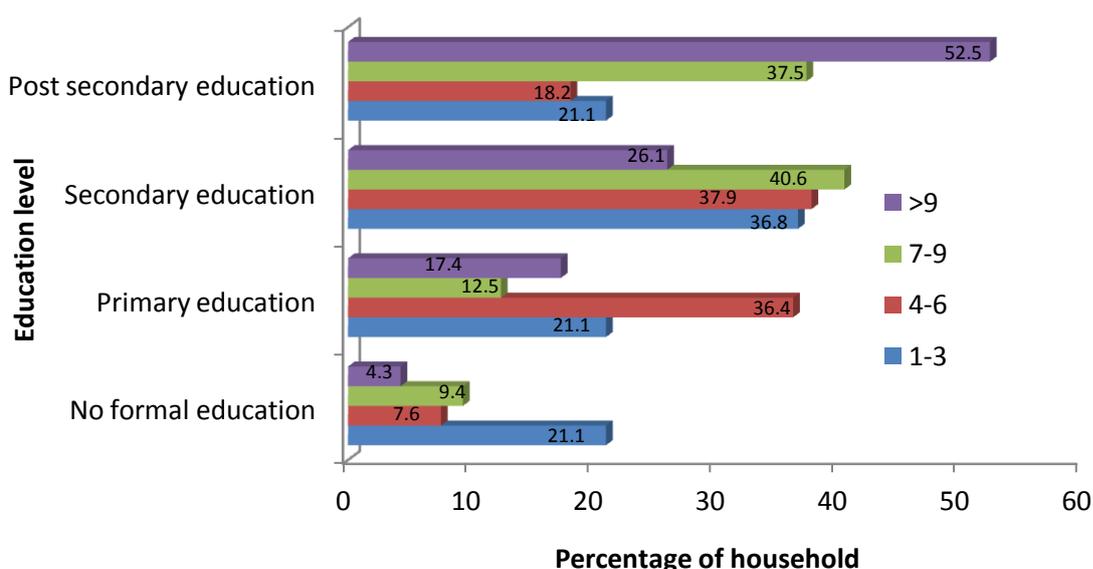
Bihar is the least literate state in India. About 91% households have someone who obtained some level of education, while 9% don't have any members in the household with a formal education. Among the educated households, 26% have a member with a primary education, 36% with a secondary degree, and 29% with a post-secondary education (Table 2.2). This is a fairly high level of literacy compared to the average for Bihar.

**Table 2.2 Highest levels of education within the households**

Highest level of education of any resident household member	% of households
No formal education	9
Primary	26
Secondary	36
Post-secondary	29

In terms of the relationship between family size and education level of the household members, a large percentage of households with a member with a post-secondary degree (52%), come from households with >9 members (Figure 2.2).

**Figure 2.2 Household size distributions as per different levels of education**



## 3.0 Sources of Livelihoods

### 3.1 On-farm livelihood sources

The households in the surveyed villages derive their livelihoods from diverse sources, and agriculture is the mainstay of livelihoods for many of them. Most of the households integrate crops with livestock. They are producing food crops, cash crops, fruits, vegetables, livestock, fodder and poultry and in few cases fish as well (Table 3.1). Almost one-quarter of these households are operating at a subsistence level, producing food and livestock only for their own consumption needs, and not selling any agricultural products.

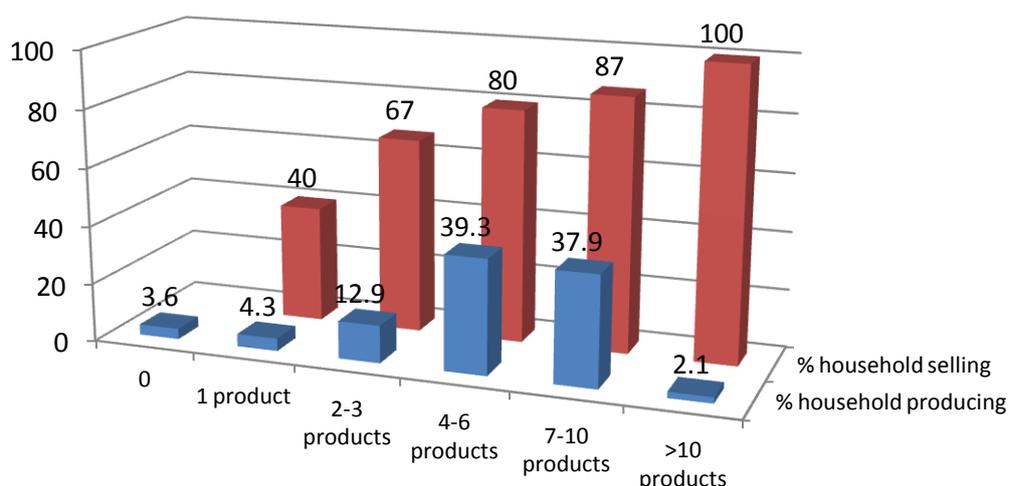
**Table 3.1 Percentage of households producing and selling farm products produced on-farm**

Produced in the farm	% of households producing	% of households selling
Food crops, fruits, vegetables	96	54
Livestock and crops	71	50
Livestock only	4	2
Timber, fuel wood, honey etc	57	2
Fish	1	2

Almost 96% of households are producing food crops (raw and processed), fruits, vegetables, fodder and manure, only 4% keep livestock only, while 71% of households integrate crops with livestock. Over half of these households also produce timber, manure, fuel wood and honey, while only 1% of households are involved in fisheries. A large number of crop growers sold their products in the market (54%). One-half of households engaged in both agriculture and livestock are selling some of their products in the market (Table 3.1).

A majority of the households (108 households) produced several products on the farm (4 to 10 products) although 4% of households produced no agricultural products last year (Figure 3.1). Another 4% produced 1 product last year, with 40% of these households also selling some produce, 13% produced 2 products, with 67% of these households also selling in the market, and 38% produced 7-10 products on-farm, and 87% of them sold in the market. All those households who produced more than 10 products were also selling some, suggesting the higher the number of products produced on-farm (i.e. the more diversified), the more commercialized the farm is.

**Figure 3.1 Percentage distribution of the household as per the number of farm products produced and sold in the market**



In order to further understand production and selling behaviour, households were asked which specific products they produced and sold in the market last year. In the surveyed villages, 129 households produced food crops, with some doing some further processing of these crops at home, mainly for home consumption. Fifteen households produced cash crops, 53 produced fruits and 96 produced vegetables. Key fruits grown in the area are mango, litchi, guava and banana. The most

common vegetables grown here are cauliflower, cabbage, brinjal and ladyfinger. A majority of the households raised small livestock and poultry (mainly goats and chicken). Some also have large livestock such as cows and buffaloes, mainly for milk production and to obtain by-products such as manure and compost. Most of the households who have livestock species also produce fodder to supply feed to the livestock (Table 3.2). Thirty-seven households produce fuelwood, mainly for household needs. Food crop producers sell surplus in the market (56 households out of 128). In general, small livestock are mainly raised to generate cash. Out of the 43 households, 32 sold their small animals in the market, while few sold large livestock as they are mainly raised to supply household nutrition (milk, for example) as well as generated a regular source of income through milk sales.

**Table 3.2 Number of household producing, consuming and selling various agricultural products from their own farm**

Product	Number of households producing	% of households producing	Number of households selling
Food crops	129	95	56
Cash crops	15	11	13
Fruits	53	39	9
Vegetables	96	71	32
Fodder	84	62	14
Large livestock	81	60	18
Small livestock	43	32	32
Fish	2	1	2
Timber	7	5	1
Fuel wood	37	27	0
Manure/compost	45	33	1

### 3.2 Off-farm livelihood sources

People in the surveyed villages also collect some fruits, fodder, fuel wood and fish from off-farm sources, mainly for their household consumption. However, this off-farm production and collection of agricultural products from communal lands doesn't appear to be a common practice of households in the surveyed villages.

Selling of collected food and fodder from off-farm is also not commonly done in the surveyed area, in general. Table 3.3 shows that 43% of households collect food grains, 35% collect fuel wood from the forest and community sources, while 9% of them collect fodder for their cattle from common property resources. The fact that 43% of households are collecting some food crops from off-farm sources suggests that their farm production is not sufficient for their family needs throughout the year, another indicator of the need to be concerned about food security issues in this area.

**Table 3.3 Agricultural products coming from off-farm sources**

Products coming from off-farm sources	Number of households	% of households
Food crops	39	43
Fruits	5	6
Fodder	8	9
Fish	4	4
Fuel wood	32	35
Charcoal	1	1
Manure	2	2

### 3.3 Diversification and commercialization indices

A production diversification index was created by adding up the total number of agricultural products produced on-farm:

- 1 = 1-4 products (low production diversification)
- 2 = 5-8 products (intermediate production diversification)
- 3 = >8 products (high production diversification)

On the selling/commercialization side, the total numbers of agricultural products produced on their own farms, with some of the products sold were added up to calculate commercialization index:

- 0 = no products sold (no commercialization)
- 1 = 1-2 products sold (low commercialization)
- 2 = 3-5 products sold (intermediate commercialization)
- 3 = >5 products sold (high commercialization)

The results of these diversification indices for the surveyed households in Vaishali are shown in Table 3.4. The data show that 9% households produce more than 8 items (high level of diversification), 59% produce 5-8 products (intermediate level of diversification), and 33% of households produce 1-4 products on-farm (low diversification).

Around one-quarter of households are not selling any agricultural products. But there are a sizeable percentage of households who sell 1-2 products (56%), or 3-5 products (19%). A majority of the households hence attain low levels of commercialization in the surveyed villages (Table 3.4).

**Table 3.4 Production and commercialization diversification indices**

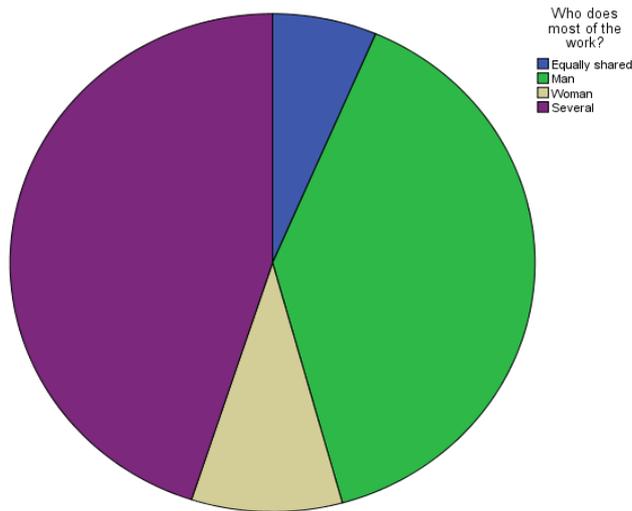
<b>Production Diversification</b>	<b>% of households</b>
1-4 products (low production diversification)	32
5-8 products (intermediate production diversification)	59
>8 products (high production diversification)	9
<b>Selling/Commercialization Diversification</b>	
No products sold (no commercialization)	24
1-2 products sold (low commercialization)	56
3-5 products sold (intermediate commercialization)	19
>5 products sold (high commercialization)	1

### 3.4 Participation in on- and off-farm activities in the households

In rural India, both men and women are typically involved in on-farm and off-farm activities. However, Bihar is a male dominated society. Most agricultural decisions are taken by males. At the

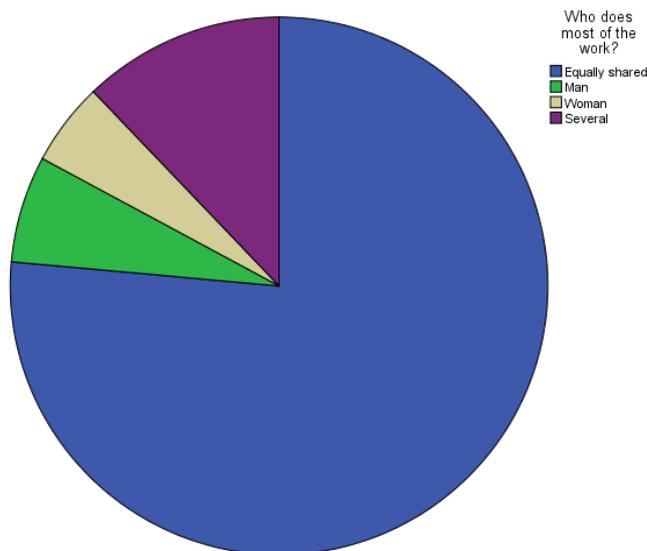
same time, most of the household responsibilities are borne by women. The husband and the wife, along with grown up children, share responsibilities of on-farm and off-farm activities, although the nature and intensity of involvement differ in different parts of the country. In Vaishali, we see that almost 40% of households share on-farm work between men, women and children, while another 40% of households state that farm work is being done only by male members of the household. Figure 3.2 also shows that for 14% of households, women are doing most of the work related to agriculture. In 11% of cases, on-farm activities are equally shared by men and women.

**Figure 3.2 Agricultural workload on-farm by gender/sex**



For off-farm activities, both males and females are involved. A large proportion of the off-farm activities are being done conjointly by men and women (for 75% of surveyed households). Similarly, almost 15% of the households noted that all family members share responsibilities for off-farm activities. For 6% of cases, only men are involved, and 5% of households said that only women are involved in off-farm gathering of fuelwood, fodder, fruits, etc.

**Figure 3.3 Agricultural workload off-farm by gender/sex**



### 3.5 Sources of cash in the household

Cash income sources are limited in the study villages. They include: employment in on-farm and off-farm activities; business and remittances; and renting out farm equipment and land. Almost 12% of households earn cash from working as farm labourers, while another 12% receive cash income from off-farm employment, particularly government and non-government jobs. Twenty-nine percent of the households derive income from government-initiated or other types of projects. Small business and trade is also a major source of income for 6% of households in the study villages. Remittances are an equally important source of cash in this area - 16% of households report it as an important source of cash for them. Almost 12% of households obtain cash through informal credit, whilst only 4% obtained cash through formal credit sources. Renting out farm equipment, particularly tractors, threshers and pumps, is also important source of cash to 5% of the households in Vaishali (Table 3.5).

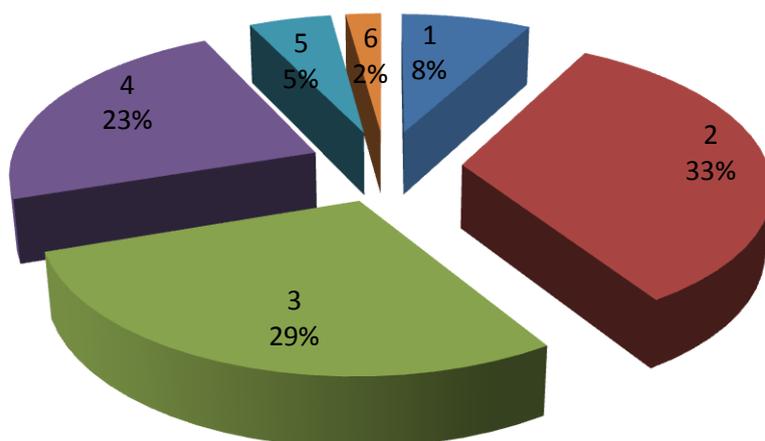
When asked about new sources of income in the last year, that they did not have previously, the most common responses relate to off-farm employment and government or project payments. Various agricultural and social development programs have been launched in recent years in Bihar State. Paid employment and remittances were not important new sources of income because migration for employment has been an old system for survival in the area. Loans through formal sources have increased in Vaishali, reported as a new source of cash-inflow to 4 households. Despite increases in credit from institutional sources, non-institutional credit was reported as a new source of cash income for 8 households. Hiring out agricultural machineries and land was also a new source of income for 5 households.

**Table 3.5 Sources of cash income other than from own farm**

Source of Cash Income	Current: number of households	New source in the last year - number of households
Employment on someone else's farm	50	0
Other off-farm employment	50	6
Business	23	2
Remittances/gifts	66	1
Payments from government or other projects/programs	118	9
Loan or credit from a formal institution	16	4
Informal loan or credit	50	8
Renting out farm machinery	21	2
Renting out your own land	10	3

In terms of the number of off-farm income sources, only one household reported having none, 8% reported one source, one-third reported 2, 29% had 3, and 23% had four different off-farm income sources (Figure 3.4).

**Figure 3.4 Percentage distribution of household according to number of off-farm income sources**



## 4.0 Crop, Livestock, Land and Water Management Changes

Adoption of modern farm technologies for crop and livestock production, soil, land and water management, and agroforestry practices is prerequisite for increasing employment, agricultural production and income of farming households. In Vaishali, the majority of farm households have small landholdings. While most of the farmers are progressive in adopting modern crop and livestock technologies, they do not easily access these technologies.

### 4.1 Crop-related changes

Households were asked what their 3 most important crops are (from an overall livelihoods perspective). The most important crops identified, i.e. by the greatest numbers of households cultivating them, are wheat, hybrid rice and potatoes. Maize comes in fourth in order of importance. While the most important crops a decade earlier were wheat, rice, tobacco and sweet potatoes, tobacco and sweet potatoes have now been completely replaced by other crops such as hybrid paddy rice.

They were next asked about what changes they had made to their farming system/practices over the last 10 years, and for which crops. Looking at the proportion of households who have made changes to one or more of their most important crops, we found that substantial changes have been made in crop production practices, including varietal changes. On average, households made 7 changes (SD= 3; n= 140) to their main crops. The maximum number of changes reported was 16. Almost 91% of the households made changes to more than two crops, and 1% of them made changes in one or two crops in the last 10 years, while 8% of households had made no cropping changes at all in the last decade. The major changes happened in wheat, rice, maize and potatoes.

#### Adopters of new crops/varieties

We looked into more detail at the type of farming practice changes households had made. The rate of introduction of new crops and/or varieties was high in the Vaishali area. With respect to how many households in the last 10 years had introduced new crops and/or new varieties, we found that many households had introduced some new crops and/or varieties. In the surveyed villages, 22

households introduced new crops. These included banana, cucumber, garlic, maize, mung bean, okra, onions, pumpkin and hybrid rice. This suggests a shift to growing more vegetables, e.g. in kitchen gardens, is happening, along with an increased use of hybrid rice.

At the same time, some of the farmers reported that they stopped growing certain crops in the last 10 years. Some of the crops that disappeared include tobacco (70 households stopped cultivating it), sweet potatoes (19 households no longer growing this crop), and peas (21 households switched out of this), among others. Almost 91% of the households made changes in terms of varieties sown. Wheat, considered a primary crop in the area, has been a focus of the introduction of new varieties, by 118 households.

### Cropping-related changes

With respect to cropping-related changes, we examined whether households had made one or more of the following changes over the last 10 years:

- Introduced intercropping;
- Earlier land preparation;
- Earlier planting;
- Later planting;
- Expanded area;
- Reduced area;
- Started using pesticides/herbicides;
- Integrated pest management;
- Integrated crop management.

The results show that most households have made some of the cropping-related changes mentioned above. However, the key changes made are area expansion, mechanization, earlier planting, introduction of agro-chemicals, and applying manure and compost. Cropping-related changes took place mainly in rice, wheat and potatoes.

### Water management-related changes

For the water management-related changes, the following changes in practice were considered:

- Started irrigating;
- Introduced micro-catchments;
- Introduced improved irrigation;
- Introduced improved drainage.

In this area, they have traditionally relied on a traditional irrigation system (*Ahar/Pyne/Tank*). However, the traditional irrigation system collapsed several years ago, and since then, farmers have not been able to irrigate their crops through these sources. Farmers thus started using tube wells (bore wells) for irrigation of crops. About 64 per cent of households under study have started using bore-wells for irrigation purposes in the last 10 years.

## Soil and land management-related changes

For the soil and land management-related changes, the study considered the following behavioural changes:

- Stopped burning;
- Introduced crop cover;
- Introduced ridges or bunds;
- Introduced mulching;
- Introduced terraces;
- Introduced stone lines;
- Introduced contour ploughing;
- Introduced rotations;
- Started using or using more mineral/chemical fertiliser;
- Started using manure/compost.

The results show many households have introduced new soil/land management changes in the last 10 years. For example, 33 households reportedly made 7 different changes in land management practices, including on-farm water management practices. There are reports of soil degradation in the area due to use of unbalanced amounts of chemical fertilizers (NPK). Farmers have started using vermi-compost, lime, micro nutrients and green-manuring to maintain the soil fertility.

The small numbers of farmers who have not made any changes to their soil management regimes are either marginal farmers or absentee landlords. In this area, vermi-compost has emerged as an important source of organic manure, particularly for cultivation of vegetable crops. About one-third of households interviewed were producing vermi-compost with assistance of the state government. KVK –*Krishi Vigyan Kendra* (Agriculture Science Centre) has been proactive in providing assistance to farmers for better management of soils through training, demonstration and soil testing facility.

## Tree/Agroforestry management-related changes

Farm diversification and healthy and sustainable land use is now being promoted in this region. However, it appears that agroforestry practices are still not common in Vaishali. Over 90% of surveyed households have not attempted to integrate agroforestry into their crop/livestock farming systems.

## 4.2 Reasons for crop-related changes

We looked into the reasons why households had made the specified changes. We grouped the reasons into the following areas: *Markets, Climate, Land, Labour, Pests & Diseases, and Project-related*. We found interesting results in the sense that almost all households mentioned multiple reasons of making changes in crops, land, water and agroforestry. From the results, it would be difficult to single out the key factors that made farmers change farming practices. This means that the reasons for making agricultural practice changes in this region are not only related to climate, market and land, but several others beyond the purview of the questionnaire.

Availability of high-yielding varieties emerged as the most important reason for making a change in farming practices, as reported by 96% of households producing rice, 96% in the case of wheat, and

85% for potatoes (Table 4.1). In Vaishali, the majority of farmers switched from improved to hybrid rice varieties. Improved varieties of wheat and potato are also commonly grown by these farmers.

The second most frequently mentioned reason behind changes in farming practices in principal crops had to do with labour-related issues, such as lack of access to labour when needed, or lack of cash to hire labour. Labour-related issues caused changes in farming practices in rice for 61% of households, in wheat for 40% of households, and in potato for 46% of households.

Market-related drivers of change in farming practices are the third most important reasons. About one-third of interviewed households reported market-related reasons (particularly a higher price, and new opportunities to sell) for changing farming practices in rice and wheat, but only 19% considered market-related reasons critical in driving changes in farming practices in potato production. This may be because there is an arrangement for procurement of rice and wheat by government agencies (and a set price), but there is no system of procurement for potato in Bihar in general, and in Vaishali in particular.

**Table 4.1 Non-Climate reasons for changes in farming practices of principal crops**

Reason for making change	Rice	Wheat	Potato
Higher/better yield	96	96	85
Higher/better price	29	26	17
New opportunity to sell	5	4	2
Land-related	21	28	18
Labour-related	61	40	46
Pest and disease-related	6	4	7
Government projects	1	1	0

### Climate-related reasons

Interestingly, less than one-quarter of respondents mentioned weather or climate-related reasons as being the most important drivers of change in farming practices. For those households that did, the specific reasons mentioned were perceptions of: more erratic rainfall, less overall rainfall, an increase in temperature, an increase in drought events, and an increase in groundwater table, among others (Table 4.2). For those that mentioned climate-related reasons, almost all reported more than one as having influenced the changes in farm-related practices they had made over the last 10 years, and this depended on the crop. So, for example, erratic rainfall was mentioned by 93% of these respondents for rice, whereas it is not an important climatic reason for change in farm practices for wheat and potatoes because these crops are grown after the return of the south-west monsoon.

More frequent drought was considered important by 65% of these respondents for driving changes in practices for rice production, and by 53% for wheat production. About two-thirds of these respondents reported more frequent floods as an important reason for changing farm practices in rice production. Declining ground water level and higher temperatures for wheat and foggy weather for potato production were also important causes for changing farm practices. Frequent floods, earlier start of rainfall and later start of rains were not important climate-related reasons for changing farming practices for these surveyed households.

**Table 4.2 Climate-related reasons for changes in farming practices of principal crops**

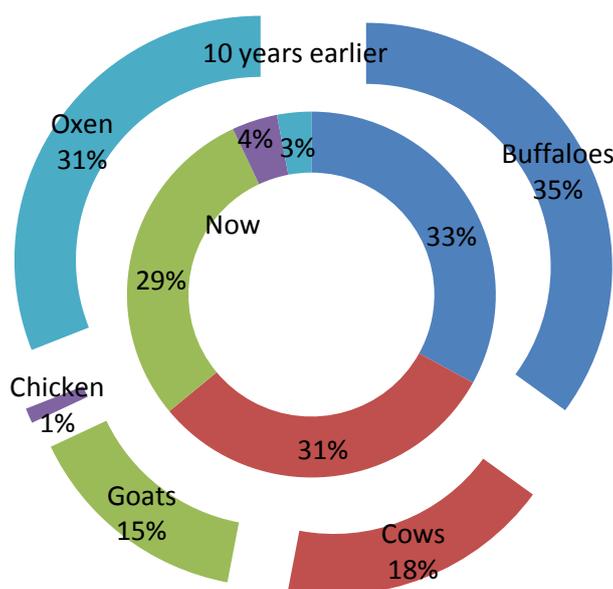
Causes	Rice	Wheat	Potatoes
More erratic rainfall	93	11	5
Less overall rainfall	65	53	11
More overall rainfall/frequent flood	17	0	0
More frequent drought	66	17	24
Earlier/late start of rain fall	7	1	3
More cold spells and foggy weather	2	8	68
Lower ground water table	3	29	16
High temperature	3	29	0

Thus less overall rainfall, erratic rainfall and frequent droughts appear to be the main climate-related reasons behind the changes seen in farming practices in this area. Lower groundwater table issues are caused by low rainfall along with absence of water harvesting and aquifer recharging arrangements in area under study.

### 4.3 Livestock-related changes

In Vaishali, livestock farming is an important complementary enterprise to crop production. This is because farm families derive certain products from livestock (e.g. manure) used in agriculture, and agriculture in turns supplies feed for the livestock. The results show that the majority of households have animals and poultry in this locality, and only a few of them reported having no animals. For instance, 31% of the surveyed households used to have oxen a decade before and now only 3% of them are using oxen for traction. The substantial decline in the use of oxen-driven traction is mainly due to an increased availability of tractors. The frequency of households keeping small livestock such as poultry has also increased (Figure 4.1). Now 29% of the households have goats (14% more households than before). Similarly, the importance of dairy cows has increased, as 31% of the farm households raise cows as compared to only 18% a decade previously.

**Figure 4.1 Distribution of farm households according to livestock species now and then**



On average, households made 2 different changes in livestock management practices over the last 10 years (SD= 1, n=140). Out of 129 farm families owning livestock, 111 reported some changes to livestock management practices. Thirty-one percent made changes in one animal, 25% in two animals, and 29% in more than two animal species and related management practices. The maximum number of changes made with respect to livestock practices is noted to be 8. These changes included the introduction of new types of animal and/or new breeds, as well as changes in herd size, and the care and management of livestock.

For herd related changes the following indicators were considered:

- Reduction in herd size;
- Increase in herd size; or
- Change in herd composition.

The data show that virtually all livestock owners had these three herd-related changes over the past 10 years in the locality. For animal management-related changes the study considered the following changes:

- Stall keeping introduced;
- Fencing introduced; or
- Cut and carry introduced.

Similarly, all the livestock owners had made some changes in animal management practices in the last 10 years. For feed-related changes we considered the following:

- Growing fodder crops
- Improved pastures
- Fodder storage

Again, almost all livestock owners had made one or more of the above mentioned changes related to use and management of feed.

Livestock-related changes were reportedly mainly due to market-related reasons, including easier access to markets through Dairy Co-operatives. The higher productivity/yield from improved buffalo/cross bred cows was another reason behind these changes. Switching from buffalo to cross-bred cattle was only made by the comparatively large farm households, due to shortage of labour along with an increase in farm wages in the area. Climate, and pests and disease-related reasons were not important drivers of change in livestock/breed in the villages under investigation.

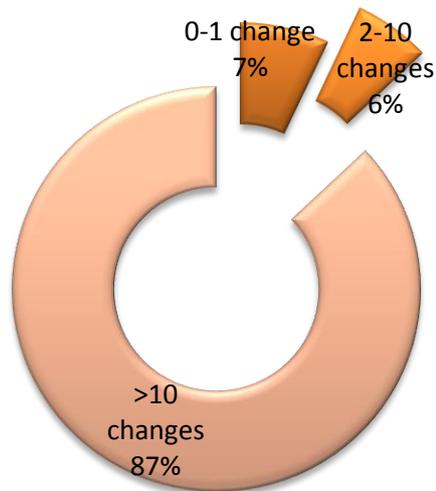
#### **4.4 Adaptability/Innovation index**

An adaptability/Innovation Index was defined as the following:

- 0-1=zero or one change made in farming practices over last 10 years (low level)
- 1=2-10 changes made in farming practices (intermediate level)
- 2=11 or more changes made in farming practices (high level)

The study has found that the adaptability index is relatively high in Vaishali, as 87% of households made more than 10 changes in their farming practices over the last decade (Figure 4.2).

**Figure 4.2 Number of changes made by farm households in the surveyed village**



### 4.5 Mitigation indices

Several climate mitigation-related behavioural changes were used to create the following indices:

**Tree management:** This index shows whether a household has either protected or planted trees within the last year. Fourteen percent of households undertook tree management activities in the locality during the last 10 years and only 13% of households reported planting and/or protecting trees in the last year.

**Soil amendments:** This index shows if the household has used fertilizer in the last year, or if they have started using fertilizer or manure on at least one crop. Almost 92% of households reported undertaking such soil management activities.

**Input intensification:** This index shows the level of input use in farming practices. Seven “changes in agricultural practices/behaviour” over the last 10 years were considered to create an index with 3 levels: a) no intensification (none of the following), b) low intensification (1-3 of the following), c) high intensification (4-7 of the following).

The changes are:

- Purchased fertilizer
- Started to irrigate
- Started using manure/compost
- Started using mineral/chemical fertilizers
- Started using pesticides/herbicides
- Started using integrated pest management techniques
- Planted higher yielding varieties

Despite poor infrastructure and relatively weak institutional arrangements for agricultural development in the area, according to this proxy indicator, the vast majority (92%) of households fall in the ‘high input intensification’ category. Only 8% reported pursuing no input intensification measures.

### Productivity index:

This index shows if a household has reported achieving a better yield from any crop, or if they think that their land has become more productive (for any crop) over the last 10 years – such households are classified as showing an "increase in productivity". A total of 91% households reported that their farm productivity had increased in the last 10 years. Table 4.3 shows the various mitigation indices.

**Table 4.3 Mitigation-related indices**

Index	No (% of hh's)	Yes (% of hh's)
Tree management	86	14
Soil amendments	8	92
Increase in productivity	9	91
Input intensification	8	92

## 5.0 Food Security

The monthly sources of food for the family were queried, i.e. whether it came mainly from their own farm, or from elsewhere (e.g. the market, gifts, food aid), for each month (in an average year). The survey found that 31% of households get enough food from their own farms to feed their families throughout the year.

**Figure 5.1 Main source of food by month**

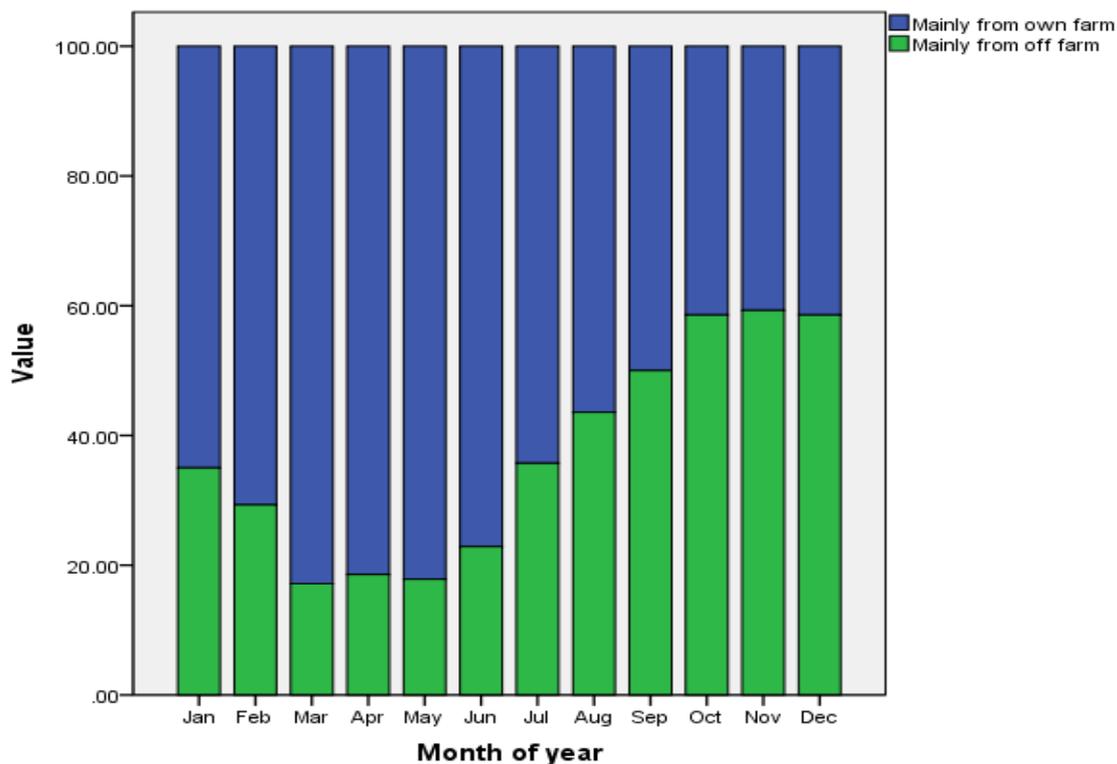
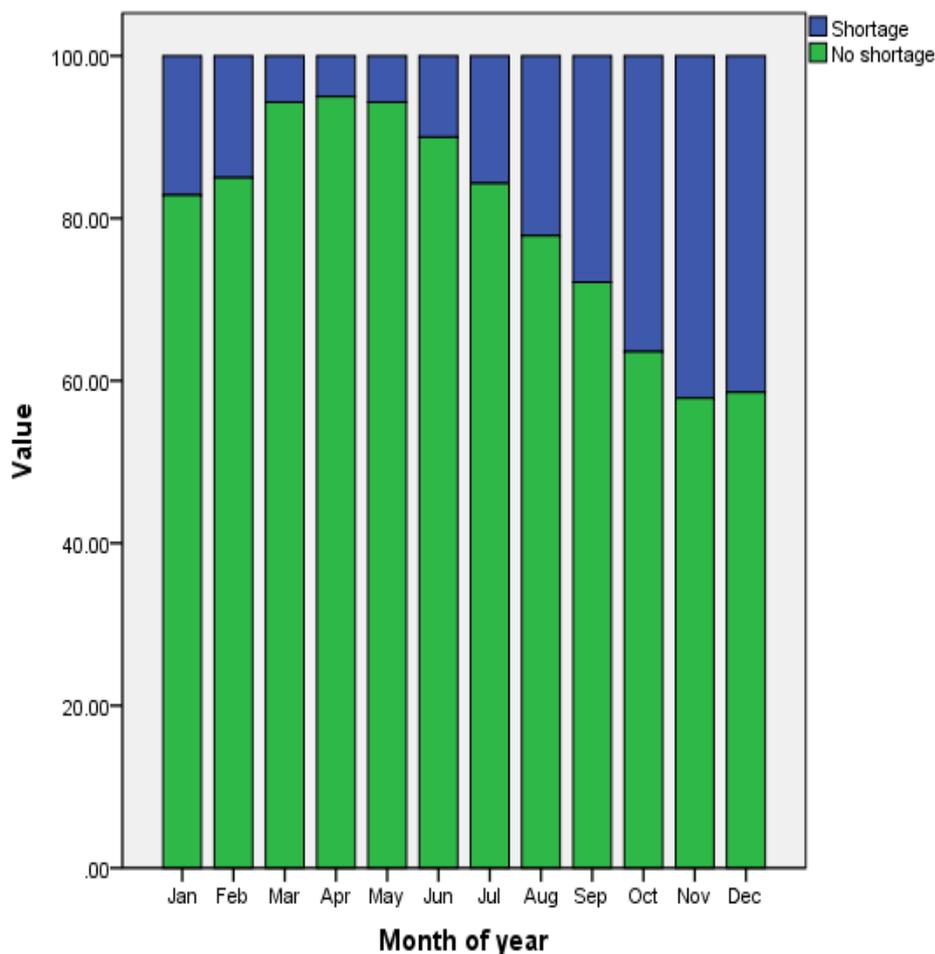


Figure 5.1 shows a good proportion of the households (about 80%) obtain food mainly from their own farms during March to June, but even during these good periods, roughly one-fifth of households are mainly relying on other sources, including the market, relatives, friends and government. October through December are the months when a majority of households (almost 60%) depend mainly on off-farm sources to fulfil their food requirements. The number of

households depending on off-farm source increases during the period of June until December. Farmers harvest wheat normally in April/May and soon after harvesting, most families depend largely on their on-farm production.

Households were also asked during which months of the year they struggled to have enough food to feed their family, from any source. Figure 5.2 shows the pattern of food shortages in the study villages. March, April and May are the months when most households have no food shortages. That is because of availability of wheat on-farm and in the market at a cheaper price. Starting in June, the percentage of households facing food shortages increases from 10 to 40 in December.

**Figure 5.2 Hunger/Food shortage months**



### 5.1 Food security index

The food security index we created is based upon the number of months that the household has difficulty in getting food from any source (i.e. from their own farm or stores, gifts, purchases or transfers). While only a crude proxy of complex phenomena, nevertheless, the fact that 45% of these households are struggling to find sufficient food for their families for one or more months per year is noteworthy (Table 5.1). Even more troublesome is the finding that 10% of households suffer more than 6 food deficit months per year.

**Table 5.1 Food security index**

Percent of surveyed households reporting:				
More than 6 food deficit months/year	5-6 food deficit months/	3-4 food deficit months/	1-2 food deficit months/	Food all year round/No food deficits
10	19	12	4	55

## 6.0 Land and Water

### 6.1 Water for agriculture

Agriculture production depends on availability of irrigation and some of the farmers in Bihar own wells/boreholes and also their fields are supplied with water through an irrigation canal. However, for resource-poor farmers water is a constraint, due to not owning a pump and lacking the means to invest in improved water management practices. The situation is aggravated by land fragmentation. However, 89% farmers have irrigation available from one source or the other, whilst 10% of the households solely depend on rainwater. Rain water has been a major source of water for agriculture (monsoon season rice), winter wheat and vegetable. 54% of families own boreholes for irrigation, 3% irrigate through dams and 11% own a water pump (Table 6.1).

**Table 6.1 Water sources for agriculture on-farm**

On-farm agricultural water source	% of households
Irrigation	89
Tanks for water harvesting	1
Dams or waterholes	3
Boreholes	54
Water pumps	11
Inlet/water gate	1
Other: Rain water	10

### 6.2 Land use

Farmers in the northeast part of the IGP have smaller parcel of lands and hence the majority are smallholder subsistence farmers. The same holds true in the households surveyed in Vaishali. The majority are poor both in terms of land ownership and income. Table 6.2 shows that 89% of them access (i.e. owned and/or rented) less than one hectare of land, 10% of these families access between one and five hectares, and 1% has >5 hectares of land. Rented land is negligible in this area.

**Table 6.2 Total land size owned and rented in by households**

Number of hectares of land owned and rented in	% of households
Less than one hectare	89
1-5 hectares	10
Over 5 hectares	1

**Trees.** Almost 13% of the farm families reported having planted trees in the last 12 months (10% planted <10 trees, 3% planted 10-50 trees, and 1% planted >50 trees in their farmlands). Similarly,

18% of the surveyed households said they had protected trees on their farms, and 11% either purchased and/or produced tree seedlings in the last 12 months.

**Hired machinery or labour.** Agricultural machines (tractor and threshers) have been introduced in recent years in Vaishali. Although animal drawn ploughs are not widely available in the locality, 31% of households reported hiring animal drawn ploughs. Hiring a tractor is also common in this area, and almost 89% of the farmers hired a tractor for land preparation, crop harvesting and threshing. Hiring farm labor is also common in this part of the world as household farm labor is insufficient during the peak seasons. Almost 58% of households hired farm workers, while 9% reported hiring no farm machinery or labor.

## 7.0 Inputs and Credit

These farmers are using various agricultural inputs including improved seeds, chemical fertilizers, pesticides and veterinary medicines in the locality, and a few also purchase crop and livestock insurance. We found that 92% of surveyed households bought seed and fertilizer inputs from the markets. Sometimes such inputs are obtained from the local government, who distributes high yielding seed varieties to a few farmers for testing them in the farmers' fields. Seventy-seven percent and 51%, respectively, also reported purchasing pesticides and veterinary medicines. The formal credit system is quite weak in this area, but 16% of households had obtained credit for agricultural purposes during the last 12 months (Table 7.1). The majority obtained loans through *Kisan Credit Cards* which has emerged as an important instrument for obtaining relatively 'hassle-free' loans from institutional agencies.

While there is not widespread awareness of crop or livestock insurance in this area, 5% of households had purchased crop insurance during the last 12 months. Crop insurance is linked with *Kisan Credit Cards*, so farmers utilized their credit cards for institutional loans and got their crops insured automatically. But officials of commercial banks do not cooperate in completing the process of crop insurance of loanee farmers and thus the majority of loanee farmers could not use the crop insurance facility. Weather-based insurance is still in an experimental stage here, but 4% of the households took part in a pilot project of weather-based insurance.

**Table 7.1 Purchased input use**

In the last year, did you purchase:	% of households
Seeds	91
Fertilizer	91
Pesticides	77
Veterinary medicine	51
Any credit for agricultural activities	16
Insurance for crop and livestock	5
Weather based insurance	4
None of the above	7

### 7.1 Fertilizer use

One-fifth of households used no purchased fertilizers from the market. When those households using it were asked what type of fertilizer they used, almost all replied that they used urea (Table 7.2) on most crops. Forty-four percent used three types of fertilizer, while 30% used two different

types of fertilizers. Ninety-two percent of these farm families used DAP and 15% used CAN. Some households used rock phosphate as well. Local mixture was being used by 16% of respondents. Farmers have also started using vermi-compost, lime, micronutrients and green manuring to increase soil fertility and enhance productivity.

All those who applied fertilizer did so to their most important crop, 88% applied it to their second most important crop, and 73% applied to the third important crop. These crops included wheat (98% of households reporting applying fertilizer), potatoes (83%), hybrid rice (77%) and maize (52%).

**Table 7.2 Different types of fertilizers used by farm families**

Fertilizer types	% of households
Urea	100
DAP	92
CAN	15
Rock phosphate	9
Local mixture	16
Several types	45

## 8.0 Climate and Weather Information

The survey data shows that 48% of community people get climate and weather-related information from various sources that include radio, TV, government department (agricultural extension), private organizations and community members. Farm households received information on extreme events, pest or disease outbreaks, start of the rains and 2-3 month weather forecasts.

### 8.1 Information recipients in the households

Both male and female members of the surveyed families get information on weather (Table 8.1). However, in most cases, males are the primary recipient of the information from the external sources in rural Vaishali, as reported by 90% of households. Ten percent of them reported this information is received by both males and females.

**Table 8.1 Gender breakdown of different kinds of weather-related information**

Type of weather-related information received	% of households receiving information	% of households reporting only <b>men</b> are receiving this information	% of households reporting <b>both</b> men and women are receiving this information
Extreme events	28	89	11
Pest or disease outbreak	19	89	11
Start of the rains	44	93	7
Weather for the next 2-3 months	21	87	13
Weather for the next 2-3 days	34	91	9
No information	52	14	6

## 8.2 Types of weather-related information

Forty-eight percent of surveyed households reported receiving some type of weather or climate-related information over the last year. Rural people get weather-related information from various sources, including radio, television, agricultural extension, NGOs, friends, relatives, neighbour, newspaper, mobile phone and religious groups (Table 8.2). Farmers also find such information from school teachers and directly from the meteorology department.

### Forecasts of extreme events

**Table 8.2 Sources of information about extreme events**

Source of information on extreme events	Number of responses	Percent of responses
Radio	20	30
Television	15	22
Extension department	8	12
Friends, relatives or neighbours	8	12
Newspaper	14	21
Cell phone	2	3

In the surveyed area, 30% of families reported that they get information related to extreme events through radio, while 22% get weather information on extreme events through television (Table 8.2). Twenty-one percent obtained this information from a newspaper, and 12% of them get this information from friends, relatives and/or neighbours.

### Forecasts of pest or disease outbreaks

Nineteen percent of households are receiving information on pest and/or disease outbreaks. This is very important from the viewpoint of agricultural production, as it helps to adjust crop inputs accordingly to help offset the impacts of the particular disease or pest.

In Vaishali, 32% families reported getting information through radio, while 24% get weather information on extreme events from television. Twenty-four percent obtained this information from a newspaper, and 7% of them are getting this information from friends, relatives or neighbours (Table 8.3).

**Table 8.3 Sources of information about disease and/or pest outbreak**

Source of information on extreme events	Number of responses	Percent of responses
Radio	17	32
Television	13	24
Extension department	3	6
Friends, relatives or neighbours	4	7
Meteorology services	1	2
School teacher	1	2
Newspaper	13	24
Cell phone	2	4

### Forecasts of the start of the rains

The farmers and community people sometimes hear predictions about the timing of the start of the rains, which is very important for planning agricultural activities. People hear these forecasts on television or radio, typically, which in turn get such information from the government meteorological department and local met offices. Respondents said they receive information related to the start of the rains through radio, friends/relatives, newspaper and television. Information is also provided through cell phones (Table 8.4). Some of the households get such information through local people, particularly during meetings or gatherings.

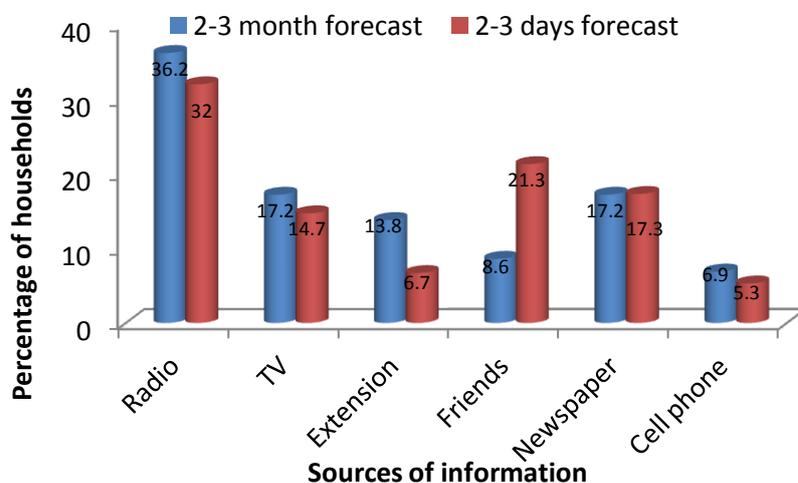
**Table 8.4 Sources of information on the predicted timing of the start of the rains**

Source of information on start of the rains	Number of responses	Percent of responses
Radio	31	31
Television	15	15
Government agricultural or veterinary extension	5	5
Friends, relatives or neighbours	30	30
Newspaper	16	16
Local people	1	1
Cell phones	2	2

### Weather forecasts for the next 2-3 months and 2-3 days

Short and longer-term weather forecasts are being provided in many places of India, including in the surveyed district. Such forecasts are crucial for agricultural operations. Farm households were asked whether they received weather forecasts for the next 2-3 days, and for the next 2-3 months. One-fifth receives 2-3 month weather forecasts and two-thirds are hearing 2-3 day weather forecasts (Figure 8.1). The sources of this information include radio, TV, newspaper, friends, extension services and cell phones. The most important is radio. However, friends/family/neighbours remain the main source of short-term weather information for over one-fifth of households. Cell phones are starting to be used by a few households.

**Figure 8.1 Distribution of households according to the sources of information**



## 9.0 Community Groups

In the rural areas, farmers form groups in collaborative efforts related to production, marketing, savings and credit, and water use. Sometimes such groups are required in order to access subsidies/benefits provided by the government. The few functional and vibrant groups are an Agricultural Cooperative Credit Society, a Dairy Cooperative Society and a Productivity Enhancement Group. Primary Agricultural Cooperative Societies have been organized in all villages and the State Government has been making efforts to make them multipurpose groups so that input supply and output marketing issues and opportunities are also addressed by this group in the village. The Dairy Cooperative is one of the few successful rural institutions found within Bihar State. Almost one-half of the surveyed families reported that they were not members of any of the group, 24% were members of a local saving or credit group, while 40% belonged to a group either based upon production, agricultural marketing, or vegetable production. Further scrutiny of the data shows that only males are members of such groups.

## 10.0 Assets

Households were asked about what assets they had, from the following set list:

*Transport:* Bicycle, motorcycle, car, truck

*Energy:* solar panel, generator (electric or diesel), battery, biogas digester

*Production assets:* tractor, plough, mill, thresher, treadle pump, fishing net

*Information assets:* radio, TV, cell phone, computer, internet access

*Luxury items:* refrigerator, air conditioning, electric fan, bank account, stove

Sixteen percent of households use a motorcycle as the primary means of transport, and one of the female-headed households also owns a motorcycle. Eighteen percent of these households don't have any assets related to transport. Similarly, 86%, 82%, 12% and 25%, respectively, of the households report not owning any of the listed assets, relating to either production, energy, information or luxury items.

**Table 10.1 Distribution of farm household according to the asset ownership**

Assets	Number of households	% of households
Radio	30	21
Cell phone	115	82
Bank account	97	69
Improved storage facility	30	21
Improved housing	102	73
Improved roofing	76	54
Well/borehole	125	89
Electricity from grid	53	38
Separate housing for livestock	70	50
Improved cooking stove	12	9

Among the different agricultural production-related assets, 10% of households reported owning a treadle pump. Fifteen percent possess LPG as a household energy asset, 82% have a cell phone, and 58% of households have a bank account. Irrigating fields through wells/boreholes is common in this area, and 89% of the households have a borehole (Table 10.1). Three-quarters of households have

improved housing and one-half have improved roofing. In terms of facilities supporting household food security, one-fifth has some kind of improved food storage structure and one-half have separate housing for their livestock. Only 9% own an improved stove, and 38% have electricity in their homes.

## 10.1 Asset index

The total numbers of assets in all categories were added up and the following asset index created:

- 0 = no assets (basic level)
- 1 = 1-3 assets (intermediate level)
- 2 = 4 or more assets (high level)

The majority of families (69%) fall in the high asset category (more than four from the list); and 27% are in the intermediate asset category. Only 4% of these households own none of these assets (Table 10.2).

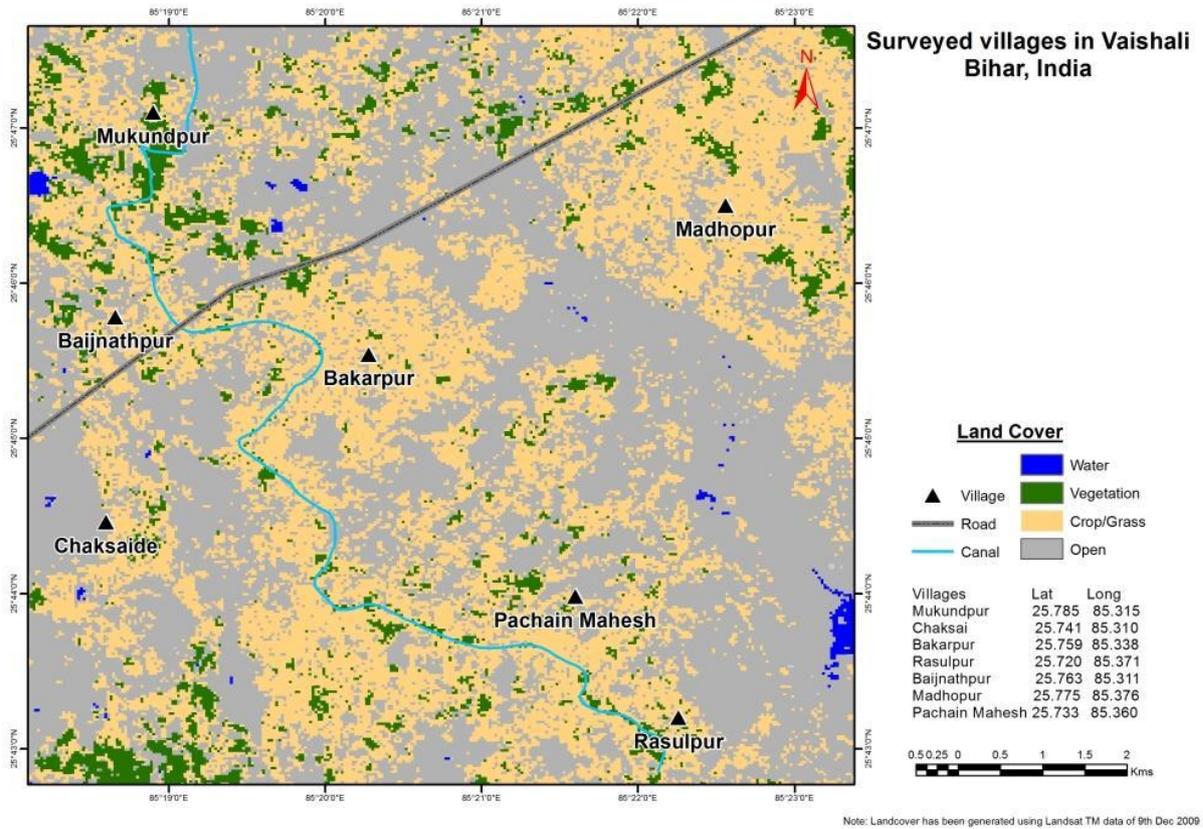
**Table 10.2 Asset index of the farm households in Vaishali**

Number of queried assets	% of households
None (basic level)	4
1-3 (intermediate level)	27
4 or more (high level)	69

## 11. Conclusions

Mixed crop-livestock agriculture is the primary source of livelihoods for the majority of the farmers in Vaishali district of Bihar, however, landholdings are very low (<0.5 ha) and land fragmentation is a common occurrence. We see that households have been making farming practice changes. The most common change seen is to varieties of principal crops sown, including rice, wheat, potatoes and maize. Adoption of new agricultural technologies has been high, and it is largely technology and market-related reasons that are driving many of the changes in agricultural practices that households have been making. However, climate-related reasons are also a factor in many of the changes seen in agricultural practices in this area over the last decade. Livestock, off-farm income – largely from employment on farms other than their own, migration and other wage employment – are all very important sources of livelihoods for these households. However, livestock and migration are emerging as the main sources of livelihood, particularly on households with small land area. Over the period of the last 10 years, few crops have been replaced partially or completely. Tobacco and sweet potatoes are such cases, though, as they have been completely replaced by hybrid rice and vegetables. Tube wells (bore wells) provide the main source of irrigation water these days. They are operated by diesel and farmers cannot always afford to give sufficient quantities of water at the right time to their crops due to its high cost. Oxen traction has been replaced by use of tractors, in most cases through rental. Many farm households now possess cell phones and bank accounts. However, food security remains a significant challenge in Vaishali.

## Appendix 1: Locations of seven surveyed villages in Vaishali



## **Appendix 2: Study team members**

R K P Singh - Team Leader

Manoj Kumar - Team Manager

Shashi Kumar - Supervisor

Vijay Narain Singh - Enumerator

Dhananjay Kumar - Enumerator

Shailendra Kumar Singh - Enumerator

Anand Kumar - Data Entry Operator

Manu - Data Entry Operator

### Appendix 3: List of villages

1. Tajpur
- 4. Mukundpur**
7. Mirpur patagh
10. Rampur Dilawar
13. Baikunthpur
16. Bishunpura
19. Panapur
22. Bhakhari Barai
25. Alipur
28. Dumri khurd
31. Pokhrai
34. Jagadish pachai
- 37. Panchain Mahesh**
40. Bhattadasi
43. Mirza nagar
- 46. Baijnathpur**
49. Hassan pur
52. Parsouni
55. Bishunpur bejha
58. Singhpur
61. Narayan pur
64. Loma
67. Dharampur
70. Banghara
73. Khatari chak
76. Surat pur
2. Karihon
5. Mansinghpur
8. Rampur ratnakar
11. Sarai
14. Kanhouli Dhanraj
17. Kanhouli
20. Kalyan pur
23. Rampur Rajdhari
- 26. Madhopur**
29. Saidpur
32. Chain pur
- 35. Bakarpur**
38. Biland pur
41. Lagurao
44. Kutubpur
47. Rajapakar
50. Chakraju
53. Dohji Ramchander
56. Nayatola Panapur
59. Fatehpur Fulwaria
62. Sa-pha
65. Mahadeo math
68. Dhelphorwa
71. Chakzinjam
74. Dhanepatti
3. Dumari
6. Belkunda
9. Luxmipur Bakhari
12. Karenpura
15. Sidhauri
18. Benjha
21. Vishunpur Ram
24. Kanhouli Garhwal
- 27. Chaksaide**
30. Kutubpur sahmali
33. Sarsee
- 36. Rasulpur**
39. Pachai mubarak
42. Bsaraha
45. Sahori
48. Bhaluee
51. Bhoraha
54. Shambhu patti
57. Kaji dhobji
60. Berua
63. Birna lakhansen
66. Jahingra
69. Fulwaria
72. Rampurani
75. Kanhouli Saidpur

N.B. Villages with yellow color were surveyed