A **Study of Agricultural Practices and Perceptions of Farmers** while **Cultivating High Yielding and Traditional Varieties of Seeds in Sitamarhi, Bhabhua and Palamau**

Chapter 1: Introduction

Background

The green revolution ushered in a new trend in agricultural production resulting in significant increase in the production of cereals, which turned India into a food exporting country. Initially started in a few selected areas, the program has gradually been expanded to nearly all states of the country with the intention of achieving uniformity in production and reducing regional disparity.

Although this new approach brought in self-sufficiency in terms of food production to the country, it has led to certain negative developments. These negative developments include degradation of soil, which include soil salinity, water logging, etc. It also resulted in the crops becoming more vulnerable to disease and pests.

With the advent of the Green Revolution ant the new High Yielding Varieties (HYVs) most of the farmers with access to water and agricultural inputs have shifted from cultivating traditional varieties to HYVs, because of better yield. This has led to a gradual loss of varieties in the field, a phenomenon referred to as genetic erosion. Although there is recognition of the problem of genetic erosion and the crucial need to conserve genetic diversity in the field, there is little understanding about how to achieve this.

In the light of the above cited issues, the present study is an effort to build a dialogue to understand farmers' perceptions and seek their co-operation in generating awareness about the long term perspective of loss of genetic diversity. It is also to facilitate policies that would be necessary in order to save genetic diversity by suggesting the opportunity cost that the farming community might be willing to bear. The study was carried out in three districts of Bihar, namely Sitamarhi, Bhabhua and Palamu which were selected on account of their geographical diversity.

Objectives

This study attempts at meeting certain objectives. These objectives are stated below:

- Primarily, this work seeks to understand the perception of farmers about the erosion of genetic diversity with the advent of green revolution.
- The study looks at the types of fertilisers that are used as per the varieties.
- It analyses the types of pesticides used by the farmers as per the varieties grown.
- The study seeks to analyse farmers' opinion about the drawbacks of traditional varieties if any.
- The objectives include an effort to understand the feelings of farmers regarding the loss of traditional varieties.
- It seeks to understand as to whether farmers are willing to grow traditional varieties at all.
- The study seeks to understand the farmers' views on efforts to preserve the large varieties of seeds that are part of their heritage.
- This study seeks to understand as to what farmers perceive and view as the advantages of the traditional varieties over HYVs and vice-versa.
- Finally, the study seeks to find out as to what the farmers want as material benefits in order to agree to growing traditional varieties, even if it is only on a portion of their land.

Data

Primary data was generated from three districts of Bihar, namely, Sitamarhi, Palamu and Bhabhua. This data was attained by conducting field surveys with a set of questionnaire, which was put across to the farmers (see appendix). Firstly, a preliminary survey was conducted to attain knowledge about the agro-climatic and environmental features of the locations selected. Thereafter, farmers' perceptions were taken note of.

Methodology

The methodological aspect of this study can be divided into two parts, firstly, the methodology that was used for conducting the primary survey and secondly, the one used for carrying out the analysis. While conducting the survey, a three stage random sampling method was adopted for the selection of the respondent farmer. At the first stage, three districts, namely Sitamarhi, Palamu and Bhabhua were selected in the state of Bihar. In

the second stage, fifteen villages from each district were selected. Finally, five households that depended on agriculture, from each village were selected randomly. Thus, for each location there were 75 farm families selected, making the total sample size of 225, thereby being statistically significant.

Analyses of the data generated on the field have been done quantitatively as well as qualitatively. Statistical and cartographic tools have been use to make diagrammatic presentations. Replies to the queries made on the field have been classified into groups of answers, converted into codes and then assimilated in a structured form. Data, experience and information gained on the field by speaking to the farmers and survey of available literature have all added to the preparation of this report.

Chapter 2: Introduction to the Districts Studied

Agricultural practices of any region are highly dependent on the physical environment. It is the geography that provides limitations to agriculture since every crop requires certain environmental condition for growth.

Sitamarhi

The district of Sitamarhi in the state of Bihar encompasses an area of 2,643 square Kms. It is surrounded by Nepal in the North, Darbhanga and Madhubani districts and part of Nepal in the east, East Champaran in the West and Muzaffarpur district in the south. It is spread length-wise from east to west covering about 55 Kms. and in north and south about 48 Kms. in breadth.

Topographically, the district forms a part of the Bihar plains and it is almost completely levelled and at no point does its elevation exceed 80 meters above the sea level. The only diversities seen on the surface are those caused by the erosion and depositional activities of the rivers. The important rivers of the districts are Bagmati, Lakhandei and Adhwara group of rivers. It has therefore all the advantages and disadvantages of being surrounded by rivers that are flooded during rains and mostly dry during summer.

The district can be divided into four natural divisions as under:

1. ***Land lying between Bagmati and Lakhandei*:** The area is generally low lying and prone to floods. Paddy and wheat ate the main crops grown in this area.
2. ***North-East region*:** The area is very low lying and always affected by flood in Bagmati.
3. ***Area lying between Adhwara group and Lakhandei river*:** There are many *'chaurs'* in this area.
4. ***Area lying between Adhwara and Nepal*:** This area is famous for mango orchards and bamboo groves. The fertility of this area is high.

Rainfall normally ranges between 1,100 mm and 1,370 mm in the district. The maximum temperature ranges between 32.2 degree Centigrade and 40.5 degree Centigrade. Humidity becomes high in the rainy season in north-east region due to its proximity to the Himalayas. The district also gets some winter rain, which improves the prospect of *Rabi* cultivation.

The soil of the district can be classified as loam, sandy-loam, clay and clay-loam in different regions. In the Bagmati zone alluvial soil is found which is very good for *Rabi* cultivation. The soil of the district is rich in mineral elements except zinc needed for good crops.

The main crops of the district are paddy, wheat and *khesari.* Besides gram, oil-seeds and other pulses are also grown. *Marua* and *Bhadai* paddy are two main *Bhadai* crops. Sugarcane is cultivated in a limited portion of the land to feed the only sugar mill of the district namely Balsand Sugar factory, Riga. During the last 20 years due to special *Rabi* drives and introduction of HYVs the area under *Rabi* cultivation has shown appreciable increase.

As a result of *Kharif* and *Rabi* drives launched every year by the Agricultural Department of the State Government there has been perceptible improvement in land use, cropping pattern, scientific cultivation, use of HYV seeds, chemical fertilisers and plant protection in the districts. The government has made a conscious effort to promote the HYV seeds. Thus, improved variety of paddy and wheat seeds are available at the seed multiplication farms (of 25 acres each) in all the development blocks of the districts. Besides, Fertiliser Depots have been set up in all the blocks of the district.

In matters of irrigation this district is still very backward. Only a small fraction of the entire district is under assured irrigation. Consequently, the cultivators have to make their own arrangements to irrigate their crops. Private tube-wells, bamboo-boring tube-wells, private diesel pump sets, a few minor irrigation projects and the Bagmati projects are the main source of irrigation facility available in this district.

Bhabhua

Bhabhua is primarily a plateau region. It comprises the plateau of Kaimur. It is bounded on the north by the districts of Buxar and part of the state of Uttar Pradesh; on the South by the district of Palamu; on the west by the state of Uttar Pradesh and on the east by the district of Rohtas. The foothills of Kaimur consist of alluvial soil and are naturally fertile. But the soil becomes harder as one proceeds southwards. As one moves up the foothills, the soil becomes stony and poor in fertility. The Kaimur plateau is an undulating tableland having thin shrub jungles and the land is not very fertile.

Karmanasa is an important river of this district. It originates in the Kaimur hills and passes through Mirzapur district in Uttar Pradesh. The Gurwat, which also has its source in the Kaimur hills, is its tributary. Though deep, the river does not have a perennial flow of water. Another river that rises in the Kaimur plateau is river Dhoba. River Durgawati is also an important river of the district. Originating in the Kaimur hills, it flows in the northern direction. Rivers Khoira and Sora are its tributaries. It is also joined by the rivers Kudra before it finally merges into the river Karmanasa. Durgawati is a perennial river.

The climate of the district is of moderately extreme type. It becomes quite hot during summer and fairly cool during winter. January is the coldest month when the mean minimum temperature comes down to approximately 10-degree centigrade. Winter season starts from the month of November and lasts till February. The temperature begins to rise in March and it reaches the peak in the month of May when the Mercury touches about 45 degree centigrade.

Rainfall sets in sometime in June and lasts till middle of September. Thereafter the humidity begins to fall. The district gets easterly wind from June to September. From October the direction of the wind is reversed and westerly wind blow till may. The district gets maximum rains during months of July and August, being the rainy months of the year. There is slight rainfall in October, but November and December are quite dry. Some winter rain occurs in January and February. The month of August gets the highest

rainfall of the order of 289 mm. closely followed by that in July when the total precipitation is 286mm. The total number of rainy days, on an average, is 12.5 days in the month of August as against 11.5 days in the month of July. September has 8.4 rainy days while June experiences 5 rainy days.

Paddy, wheat, maize and barley are the main cereal crops of the district. Among pulses, gram occupies the maximum area followed by *Masur, Arhar, Moong* and *Urd*. Sugarcane and potatoes are the main cash crops. The main produce from the forest are timber, bamboo, firewood and wood for charcoal. The minor produce consists of honey, fodder grass, *sabai* grass, and flowers. Agriculture is primarily dependent on irrigation facilities that are relatively more developed in this region as compared to the others in this state.

Palamau

The district of Palamau is on the north-western part of Jharkhand. On the north, Bihar borders it. To the east is the district of Chatra, to the west is the district of Garhwa and to the south is Latehar. The average elevation of Palamau is about 1,200 feet, the highest point being Netarhat at 3,900 feet.

The hills in the district are widely scattered. The drainage in the district is generally from south to north towards the Sone, which forms a part of the northern boundary of the district. The principal rivers are the Sone, Koil, Auranga and the Amanat. Koli is generally dry during summers. Among the minor rivers and rivulets are Jinjoi, Maila and Piri, which are tributaries of the Amanat. Sadabah, Tahleh and Banki drain the country near Unari, Danro flows past Garhwa and Karabar drains Japla area.

The clay type soil is more or less uniform throughout the district. Stretches of red and black clay soil are also found. Tanka and Bhandaria areas have laterite soil while that in Panki and Leslieganj is light black clay. The first fertile tract consists of the valleys of the rivers Koil, Amanat and Sone where rice is chiefly grown. The second type comprises hilly tracts where the soil is loose and full of gravel. The area is mostly covered with jungle and cultivation is restricted in valleys and narrow basins on either side of the hills,

rivulets and rivers. The entire hilly tract in the south comprises the soil of this kind in which maize and similar crops are chiefly grown.

This district has a dry climate. The mean daily temperature at Daltonganj falls to 8.2 degree centigrade in December while the mean daily maximum rises to 41.3 degree centigrade in May.

Conclusion

The three districts selected for this study display a wide diversity in terms of their physical environment, i.e., soil, topography, climate and drainage pattern. In all, Sitamarhi may be termed as a flood prone area; Bhabhua is an irrigated region. Palamau on the other hand is a rain fed region. Agriculture here is highly dependent on the vagaries of the monsoon.

Chapter 3: Existing Conditions

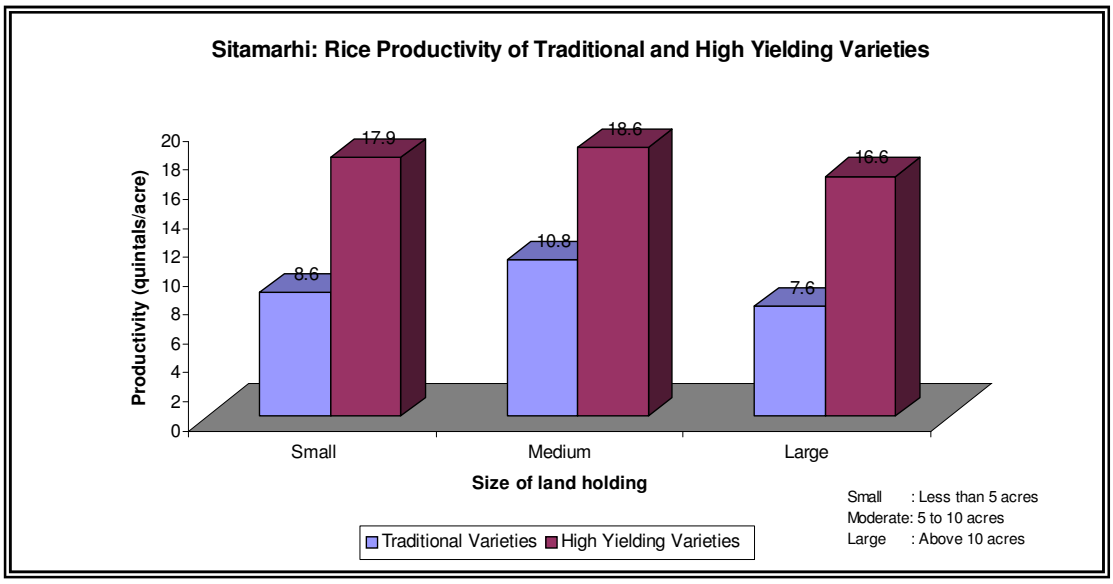
Introduction

This chapter looks into the pattern of distribution of land and its relationship with productivity. Besides, the sources of the seed and the types of fertilisers used in traditional as well as HYVs are analysed. The purpose is to bring to light the material conditions that exists in the three districts that have been taken up for this study so as to understand the background on which the perceptions of the farmers are based.

Pattern of Distribution of Landholdings and Productivity

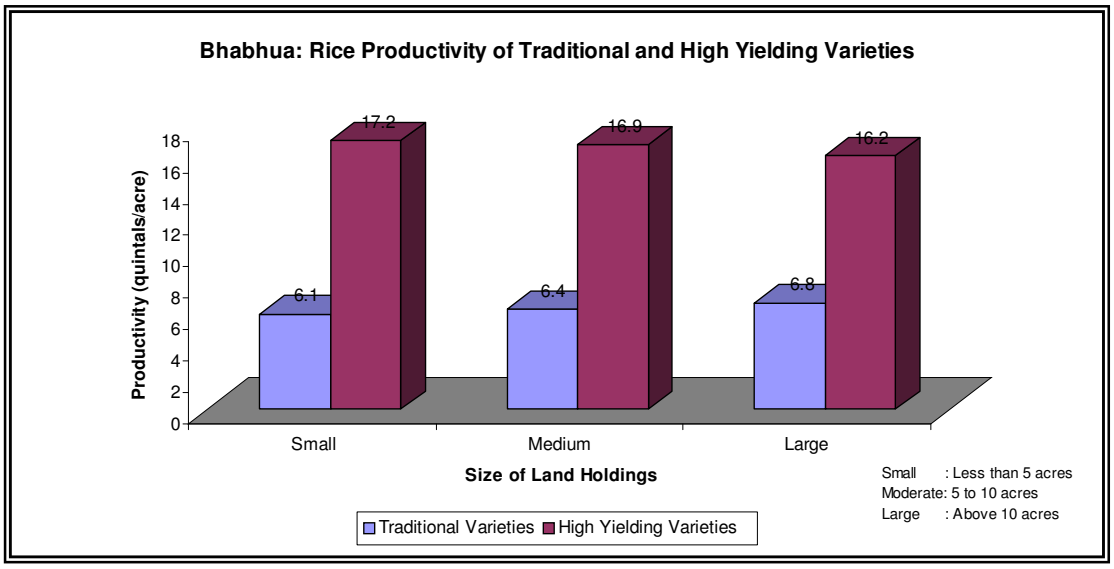
For the purpose of this study, landholdings have been divided into three categories. Landholdings of less than 5 acres, 5 to 10 acres and more than 10 acres have been classified as small, medium and large size landholdings respectively. Disparity in landholdings was comparatively highest in the district of Palamau. Here, where only 16 percent of farmers held comparatively large tracts of land under their possession, as many as 58 percent of farmers had small land holdings. Thus, a substantially large section of the farmers were what may be classified as, 'very small farmers'. Disparity in terms of landholdings is comparatively highest in Bhabhua amongst the districts taken up for this study.

Figure 3.1



As seen in figure 3.1, The flood prone district of Sitamarhi has traditional varieties as well as HYVs grown by the farmers. Irrespective of the size of Land holdings, the productivity of HYV rice is higher as compared to the traditional varieties. However, it is interesting to notice that in traditional varieties, highest productivity is seen in case of medium size land holdings, i.e., 10.8 quintals/acre. Even in the small land holdings, productivity of traditional varieties is higher than in large land holdings. This is on account of the fact that it is possible to provide higher inputs of labour on such fields. Usually we find that the families here are large in size and since such lands are their only source of sustenance, family members put in intensive labour to get out the most from it. It is to be noticed that even the productivity of the HYV is highest in medium size land holdings followed by the small land holdings.

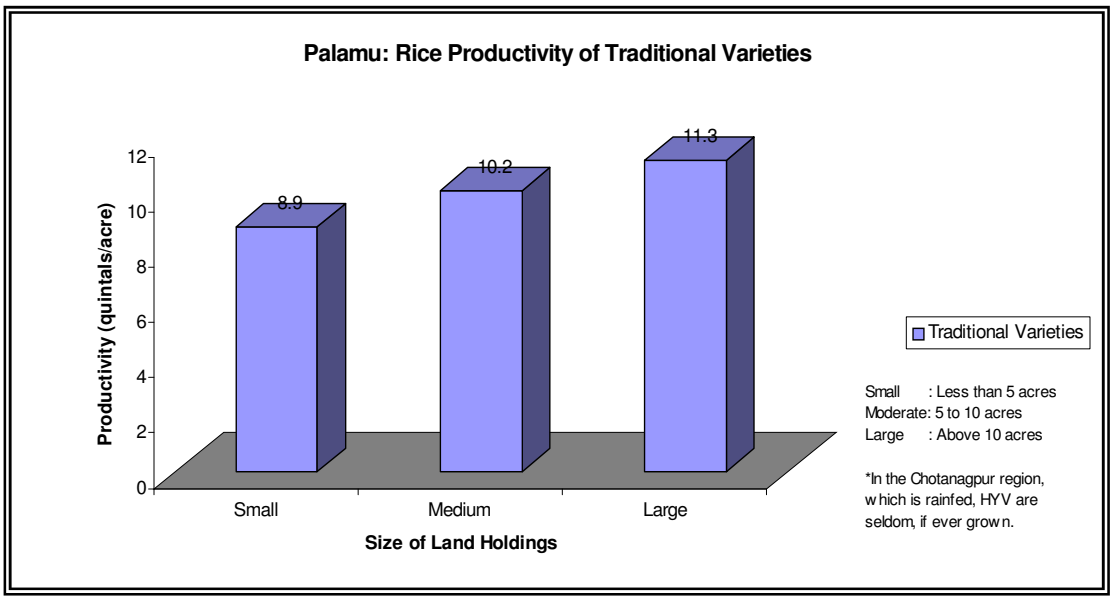
Figure 3.2



Bhabhua being an irrigated region is a classical 'green revolution' area that has been taken up for this study. Looking at figure 3.2, it is apparent that productivity of traditional varieties of rice is lower in all sizes of land holdings as compared to the HYV rice. Having observed this, we find that the productivity of traditional rice variety increase marginally as the size of land holdings increases. This is different from the pattern that was observed in Sitamarhi where productivity of traditional variety of rice was lowest in case of large land holdings. Low yield in small farms seems to be on account of

incapability of the small farmers to provide adequate agricultural inputs like water and fertiliser to their agricultural fields due to the limited capital at their disposal. Productivity in case of HYV across farm size does not show much of a difference, though it is to be noted that productivity is highest in the small land holdings. This is probably because mostly those small farmers who are able to provide irrigation facilities to their farms have ventured into growing HYV rice. This coupled with input of intensive labour has probably resulted in higher yields.

Figure 3.3



Palamau is a rain fed region with scarcity of water so HYV are seldom, if ever grown. Thus, as seen in figure 3.3, in the area surveyed in this district, farmers did not grow HYV. This region has retained genetic diversity with farmers growing traditional varieties. Compared to Sitamarhi and Bhabhua, this is the region where productivity of traditional rice varieties is the highest. Another interesting feature is that productivity in this district is highest in the large land holding and least in the small ones. This is because farmers possessing large fields were in a position to put in higher inputs of water and fertilisers on account of their greater investment making ability.

Seed Source

Farmers in India rely on numerous sources for the seed they use. Unlike in the industrial countries where seeds are purchased from the market, usually as a package along with pesticides and fertilisers, seeds in India are largely supplied by a variety of sources, principally by the farmers themselves.

Figure 3.4

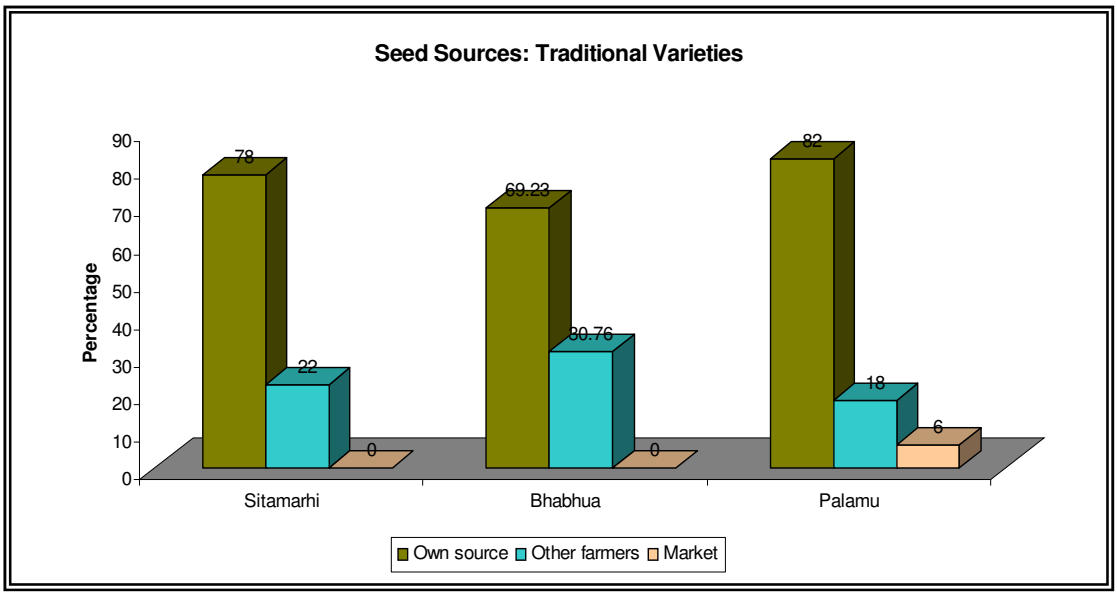


Figure 3.4 clearly indicates that an overwhelming majority of farmers in Sitamarhi, Bhabhua, as well as Palamau, use seeds from own source as far as traditional varieties are concerned. Own source over here implies the seeds that have been stored since the previous harvests and used in the subsequent years for cultivation. As observed in the diagram, 78, 69.23 and 82 percent of the farmers use traditional seeds from their own source in Sitamarhi, Bhabhua and Palamau respectively. Besides, other farmers as source for seeds is also quite high at 22, 30.76 and 18 percent in Sitamarhi, Bhabhua and Palamau respectively. On the other hand only 6 percent of the farmers growing traditional varieties in Palamau purchase seeds from the market. This is clear indication of the fact that it is storage of seeds for use in subsequent years or exchange of seeds amongst farmers that forms a traditional practice in India. Formal markets did not have much of a role to play in transfer of traditional seed varieties in the areas that were studied.

Figure 3.5

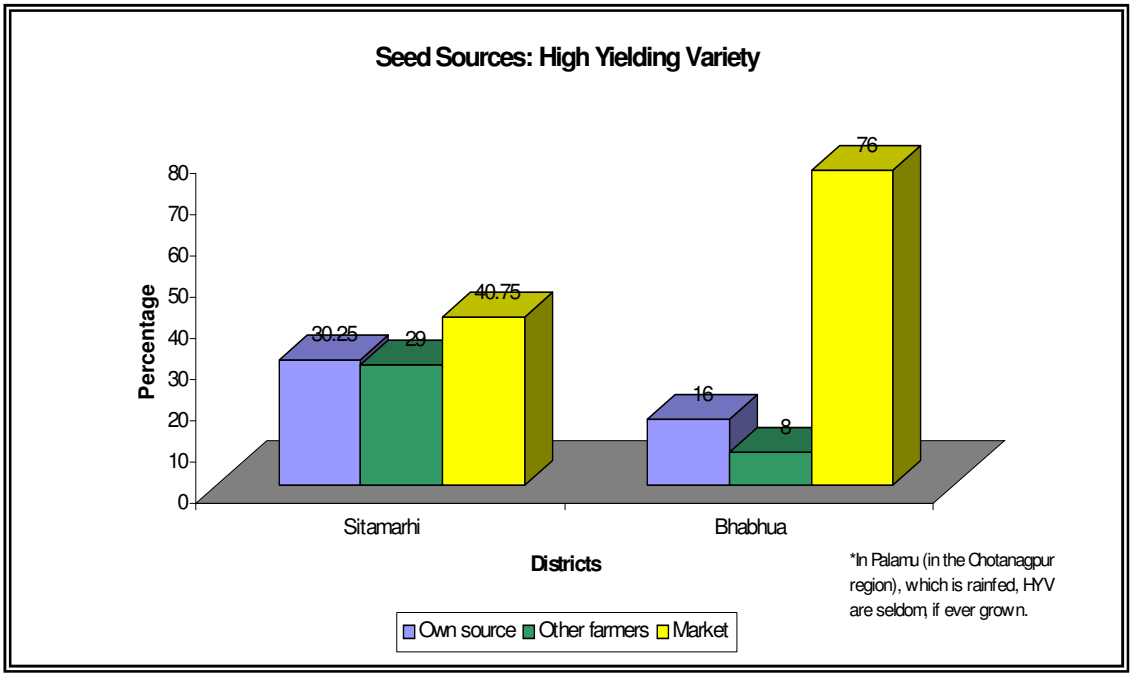


Figure 3.5 makes the difference between seed sources of traditional and HYVs very apparent. Whereas in the case of traditional varieties, market was of hardly any consequences, in case of HYVs, most farmers procure seeds from the market. In Sitamarhi, 40.76 percent of the farmers procure seeds from the market. For Bhabhua the figure goes up to 76 percent. As mentioned earlier, in Palamau, which is in the Chotanagpur region, a rain fed area, HYVs are seldom if ever grown. The fact that most farmers procure seeds from the market shows the strength of the market as an institution from where the kind of HYV seed to be grown by the farmers can be regulated. Despite this, the role of 'own source' and that of 'other farmers' as source of seeds cannot be overlooked since these sources do make up for a substantial proportion of the farmers total HYV source of seeds. In Sitamarhi, 30.25 percent of the farmers depend on their own source and 29 percent depend on other farmers to meet this need and that add up to 59.25 percent of the farmers who are not dependent on the market. In Bhabhua, 16 and 8 percent of the farmers rely on own source and other farmers respectively to procure HYV seeds. Another point to be noted here is the fact that even when the farmer responds by

saying that the source of his seed is the market, it is only once in three or four years that he/she actually purchases the HYV seed from here. In between, he/she relies on his or her own source. These figures point to the fact that seed transfer between farmers, or use of seeds from own source is an area that cannot be ignored. In fact, this has been one of the important mediums through which the diffusion of the HYV technology has taken place amongst farmers in most parts of India.

Use of Fertilisers

Figure 3.6

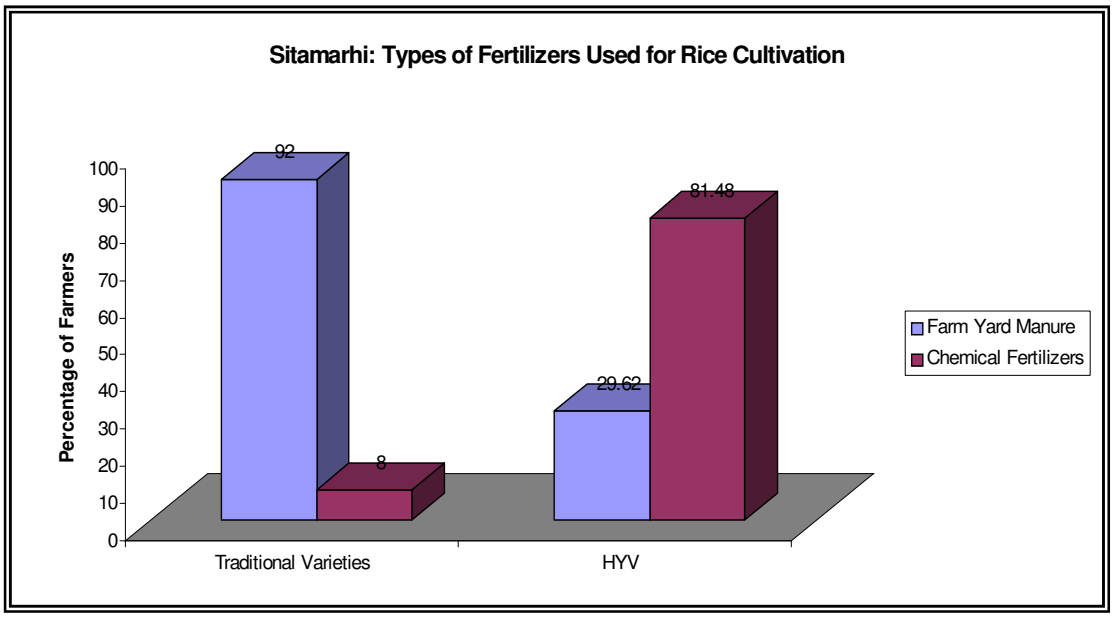
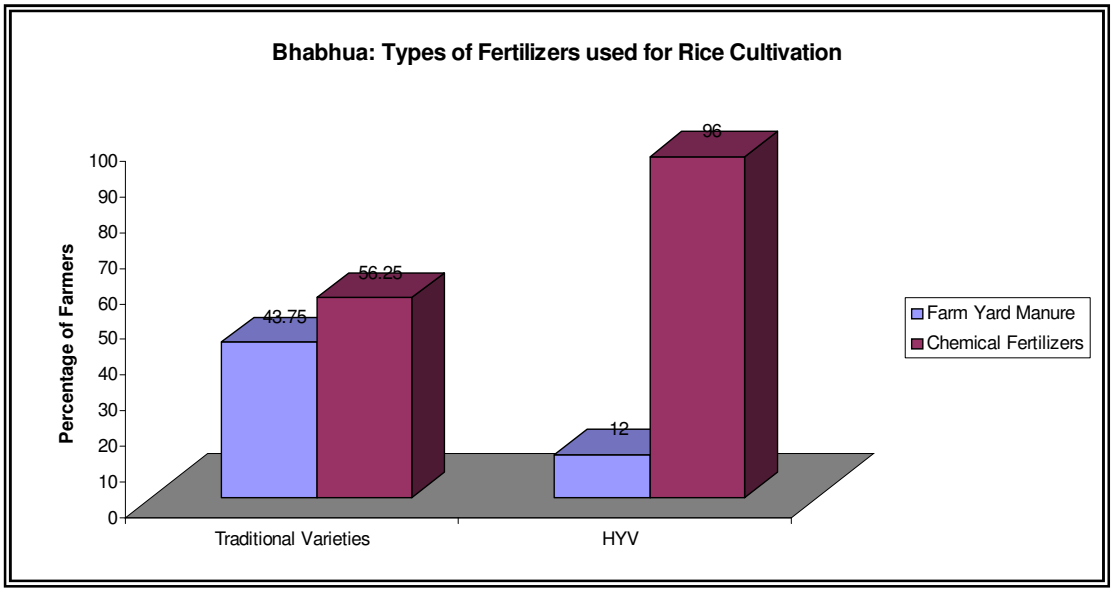


Figure 3.6 shows the types of fertilisers used for rice cultivation in the district of Sitamarhi. A clear-cut difference is seen between the types of fertilisers used in traditional varieties and that used in high yielding varieties. As many as 92 percent of the farmers growing traditional rice varieties use farmyard manure and only the rest, i.e., 8 percent use chemical fertilisers.

Figure 3.6 also brings to light the fact that in HYV, farmers in Sitamarhi primarily use chemical fertilisers. As many as 81.46 percent of the farmers reported that they were using chemical fertilisers to grow HYV rice. On the other hand 29.62 percent of the respondents reported that they were using farmyard manure while growing HYV rice.

This implies that 70.38 percent of the farmers were using only chemical fertilisers, 18.54 percent of the farmers were only using farmyard manure and 11.08 percent of the farmers were using a mixture of chemical fertilisers and farmyard manure to grow HYV rice.

Figure 3.7



Bhabhua presents a different picture in terms of types of fertilisers used for rice cultivation as compared to Sitamarhi. As seen in figure 3.7, 56.25 percent of the farmers were seen to be using chemical fertilisers to grow traditional varieties of rice. 43.75 percent of the farmers were using farmyard manure to grow traditional varieties of rice. As for growing HYV of rice, 96 percent of the farmers were using chemical fertilisers and 12 percent of the farmers were using farmyard manure. This implies that whereas 88 percent of the farmers were using only chemical fertilisers, 4 percent of the farmers were using only farmyard manure and 8 percent of the farmers were using a combination of chemical fertilisers and farmyard manure to grow HYV rice in Bhabhua. Here, the dependence on chemical fertilisers is high, even for growing traditional varieties. This is possibly because Bhabhua being a rain fed area, the impact of the HYV package technology has been higher and even though some farmers continue to grow traditional varieties, they have adapted techniques and technology, over here it is chemical fertilisers, to increase productivity of their land even while growing traditional varieties.

Figure 3.8

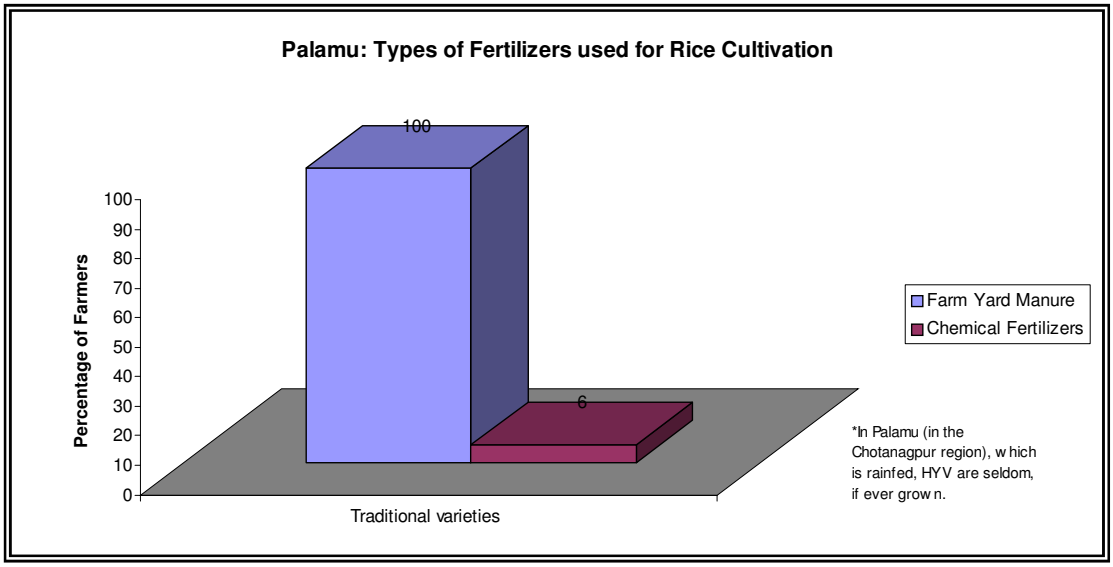


Figure 3.8 shows the type of fertilisers used for rice cultivation in Palamau. This is an area that has hardly been influenced by the HYV seed technology because of its own agro-climatic nuances. Since HYV rice is seldom if ever grown here, we find the use of chemical fertiliser extremely limited. Only 6 percent of the farmers, and that too in combination with farmyard manure use chemical fertilisers.

Use of Pesticides

Figure 3.9

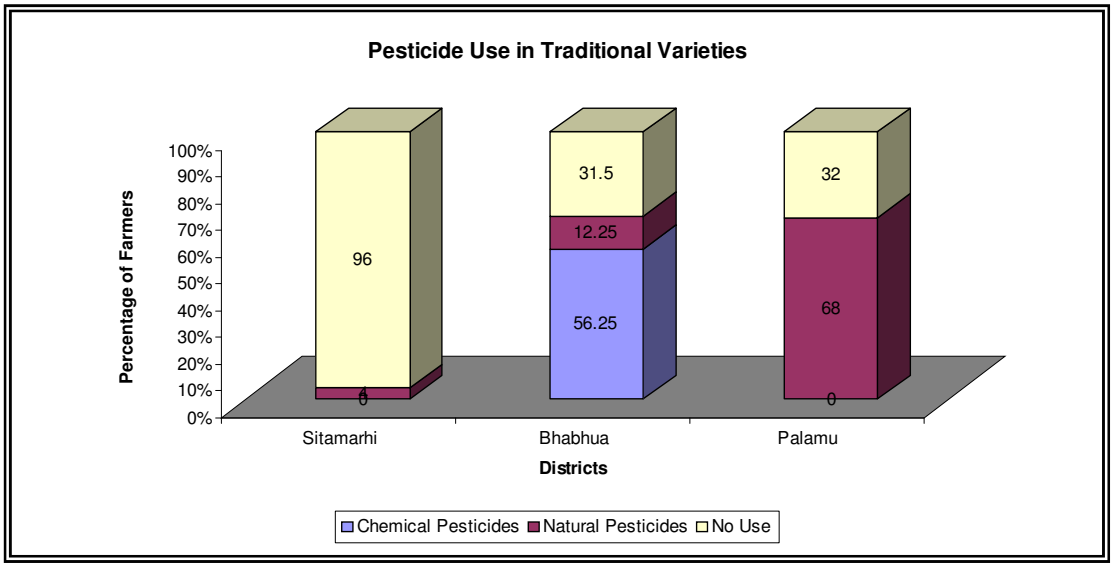


Figure 3.9 shows the use of pesticides in traditional varieties in the three districts under observation. In the district of Sitamarhi, use of any type of pesticide is extremely low. As many as 96 percent of the respondent farmers did not use any pesticides at all. This is probably on account of very high pest resistance in the traditional varieties of rice grown here. Only 4 percent of the farmers used natural pesticides with no respondent reporting usage of chemical fertilisers on their fields. The case of Bhabhua is starkly different as compared to Sitamarhi. In fact, one can observe a strong correlation between the type of fertilisers used and the type of pesticide used here. In Bhabhua we had observed relatively high usage of chemical fertilisers even in traditional varieties. Here we observe the use of chemical pesticides on traditional varieties of rice by a substantial proportion of farmers, i.e., 56.25 percent (in the case of chemical fertilisers in traditional rice varieties in Bhabhua, the figure was 56.25 percent). 12.25 percent of the farmers were using natural pesticides and 31.5 percent of the farmers were not using any pesticides at all. Pattern of the type of pesticides used in Palamau again coincides with the pattern of the use of type of fertilisers here. In Palamau none of the farmers were using chemical pesticides. As many as 68 percent of the farmers reported the use of natural pesticides

and the rest were not using any type of pesticides at all. Thus, once again we find that since Palamau is a district where the Green Revolution technology has not made any noticeable impact, the components of this technology, be it chemical fertilisers or chemical pesticides, are hardly in use.

Figure 3.10

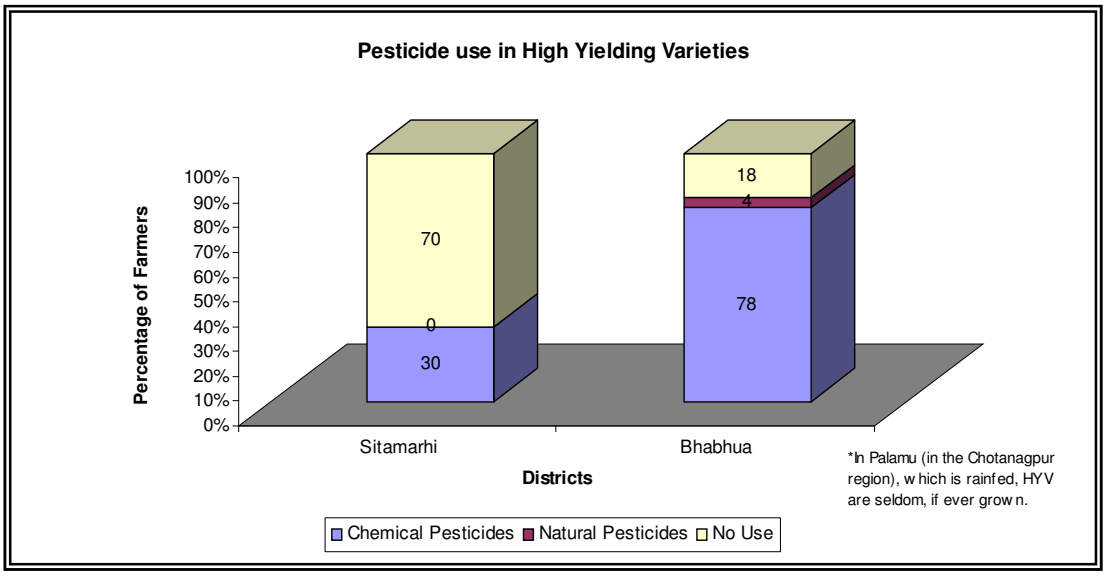
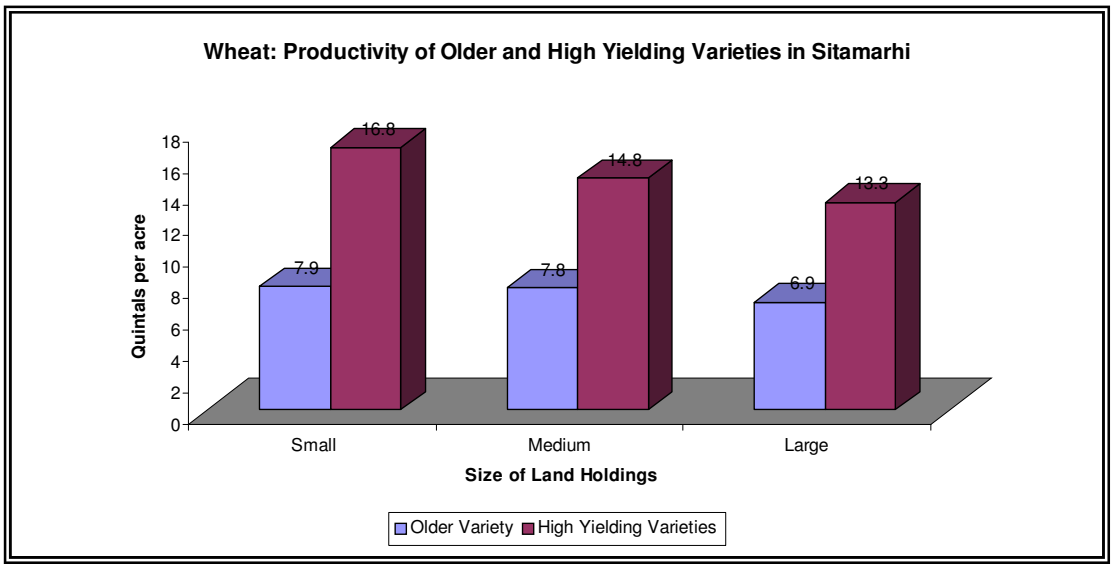


Figure 3.10 shows the proportion of farmers using chemical or natural pesticides or no pesticide at all while cultivating HYV in the districts under observation. The suitability or the agro-climatic demands of HYVs makes its impact apparent here too. Since Bhabhua is an irrigated region, most suitable for growing HYV crops, we find that the use of chemical pesticides, an accompanying component of the HYV technology, is high, i.e., 78 percent. In Sitamarhi, only 30 percent of the farmers were using chemical pesticides while growing HYV paddy. 70 and 18 percent of the farmers growing HYV paddy in Sitamarhi and Bhabhua respectively were not using any pesticide at all. Besides, 4 percent of these farmers were using natural pesticides in Bhabhua.

Wheat Cultivation and Productivity

Figure 3.11



The primary survey was particularly geared towards investigating the associated issue vis-à-vis rice cultivation in Sitamarhi, Bhabhua and Palamau. However, we had also looked at the ground realities related to wheat cultivation, especially with relation to productivity. Figure 3.11 looks at the productivity of Older and HYV varieties of wheat as per the size of land holding in the district of Sitamarhi. It needs to be mentioned that wheat is not an indigenous crop of this region. Thus, no variety has been classified as 'traditional variety'. Instead, we have the pre Green Revolution variety that has been labelled as older varieties and the Green Revolution varieties or the HYVs. Across the different sizes of land holdings, we find that productivity of HYV wheat is higher than the older varieties. However, an interesting feature is that we find that productivity decrease with increase in the size of land holdings. This is true for older as well as HYVs. Yield per acre for older varieties are 7.9, 7.8 and 6.8 quintals for small, medium and large size land holdings respectively. Similarly, yield per acre for HYV wheat are 16.8, 14.8 and 13.3 quintals for small, medium and large size holdings respectively. Here, intensive labour input seems to have had an impact on productivity of HYV wheat too.

Figure 3.12

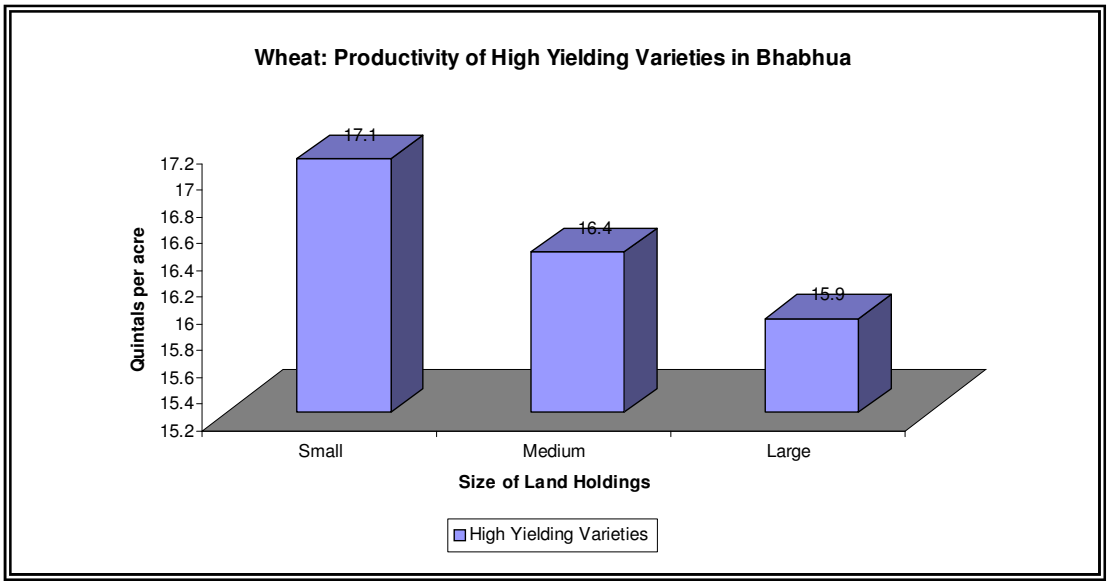


Figure 3.12 shows the productivity of HYV wheat in the district of Bhabhua. As observed in the case of Sitamarhi, in Bhabhua too, the productivity of wheat decreases with increase in the size of land holdings. It decreases from 17.1 to 16.4 quintals per acre from small to medium size land holdings. As we analyse the large size land holdings, productivity further decreases to 15.9 quintals per acre. Another point to be noticed is that farmers growing older varieties of wheat were not found. Such varieties are few if any since the suitability of this region in terms of HYV has led to most of the farmers growing this variety only. Palamau as an agro-climatic region is highly unsuitable for grow wheat. Thus, farmers growing either HYVs or older varieties of wheat could not be recorded for they are extremely few if any.

Conclusion

The observations made in this chapter could be broadly summarised as follows:

- Distribution of land is uneven with the majority of farmers having small or less than 5 acres of land holdings.
- In terms of relation between productivity and size of land holding with respect to rice cultivation, no set pattern was found across districts and across varieties. In some

cases, productivity increased with increase in size of land holdings and in others, it decreased with size of land holdings.

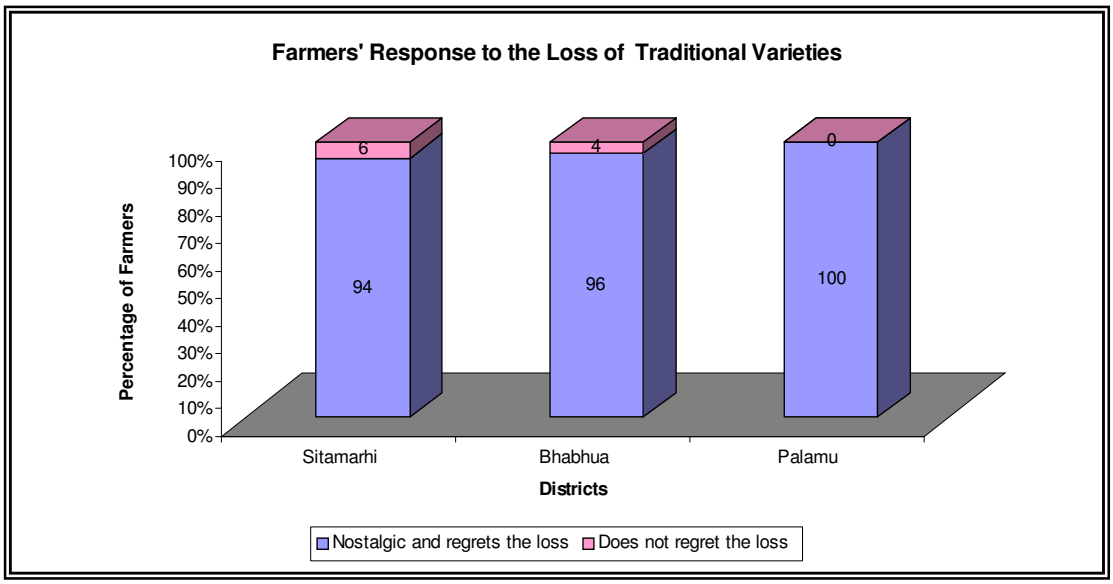
- Farmers relied heavily on their own source of seeds when it came to growing traditional rice varieties. They also relied heavily on other farmers as seed source when growing this rice. The role of market was insignificant. However, farmers who grew HYV rice relied heavily on the market for their seeds. However, the role of other farmers as sources as well as the farmers' own sources remained significant and important.
- Farmers used more of natural fertilisers and pesticides when they were growing traditional varieties of rice. While growing HYV rice they relied more on chemical fertilisers and pesticides. However, the use of natural fertilisers and pesticides while growing HYV rice was significant though it varied between districts.
- Productivity of wheat, be it HYV or older varieties, decreases with increase in size of land holdings in the districts under observation.

Chapter 4: Perceptions of Farmers

With the advent of the Green Revolution and introduction of HYVs, numerous traditional varieties stopped being cultivated by the farmers as they saw higher yields and profits in growing the new HYV varieties, which offered an immediate yield advantage. Over time, these varieties were lost since they neither existed on the fields, nor were their any formal provisions to store them for later use. The loss of traditional cultivation results in an increasing loss of genetic diversity in the field, a cause for concern to policy makers and planners. There is a need to conserve genetic diversity in the agricultural field. Thus, there is a need to understand farmers' perception about this.

Figure 4.1 shows the response of the farmers to the loss of traditional varieties. We observe that the overwhelmingly large proportions of farmers are nostalgic about the lost varieties and regret the fact that these varieties are no longer with them or grown by them. In Sitamarhi, as many as 94 percent of the farmers are nostalgic and regret the loss. This is despite the fact that Sitamarhi still has a substantial proportion of farmers cultivating traditional varieties, though this continues to decrease every year. Though a large number of traditional varieties continue to be grown, the advent of the HYV seeds has led to numerous varieties going out of production. The reason as to why they regret this loss could be out of the fact that those varieties might have been better to taste or smell or been more resistant to weather fluctuations or to pests and diseases, etc. Probably they miss these traits in the new varieties that have replaced them. At the same time, 6 percent of the farmers do not regret the loss at all. They are probably happy with the higher yields that they have reaped on account of cultivating HYVs and do not feel that they are missing any characteristic in the traditional varieties, which were in anyway superior to that found in the HYVs or offset the advantage of higher yields in them.

Figure 4.1



In the district of Bhabhua, 96 percent of the farmers are nostalgic and regret the loss of traditional varieties. Here this proportion is higher probably because the farmers of this district have experience greater advent and impact of the Green Revolution. They would probably be feeling the loss of traditional varieties more than the farmers of Sitamarhi would. On the other hand, the farmers of Palamau are not familiar with the HYVs. The nostalgia that they expressed and the loss that they were feeling is on account of the loss of certain traditional varieties with the greater use of another or other traditional varieties. This loss is not on account of the advent off new HYV seeds. As seen in the figure, all the respondent farmers of Palamau were nostalgic and regretted the loss of traditional varieties that they were growing earlier.

Seed Banks for Traditional Varieties

With the advent of technology in agriculture, be it with relation to HYV or genetic modification in crops, people have wondered as to how to save the rich genetic diversity that traditional seed varieties present. As the traditional seed varieties get replaced by HYVs, the idea of seed banks as means of protecting this heritage has gained popularity. Thus, seed banks have been set up at numerous places and there have been demands for

setting them up at numerous other places so that farmers could actually oversee the preservation of local traditional varieties.

Table 4.1: Farmers wanting Seed Bank for Traditional Varieties

Districts	Response	
	Yes (in %)	No (in %)
Sitamarhi	74	26
Bhabhua	68	32
Palamau	100	0

Very large proportions of farmers felt the need for seed banks for traditional varieties in all the districts under observation. As seen in table 4.1, in Sitamarhi, 74 percent of the farmers wanted seed banks for traditional varieties and 26 percent did not. In Bhabhua, the proportion of farmers wanting seed banks was slightly lower than that of Sitamarhi at 68 percent. This is a reflection of the understanding of farmers about the benefits associate with traditional varieties and genetic diversity. Though this does not imply that they plan to grow traditional variety all over again in the near future, yet, it brings forward their concerns and attachment to the bygone or what could be lost in the future depriving the coming generations from inheriting or being aware of it. In Palamau, all the respondent farmers felt the need for a seed bank. It seems that the desire to protect the traditional varieties over here is on account of the fact that this is what is grown here. The farmers must be aware on account of having travelled and seen it with their own eyes as to how the traditional varieties are being replaced by the HYVs or they might have herd about this from other farmers. The fear of the 'unknown' seems to have filled them with apprehensions, prompting them to voice their need of a seed bank.

Drawbacks of Traditional Varieties

Farmers in most parts of India have been shifting over to cultivating HYVs since they found certain advantages in them, which in their opinion, made them superior to the traditional varieties. A look at the drawbacks of traditional varieties as per the opinion of the farmers can help unearth the rationality behind this shift.

Table 4.2: Farmers' Opinion about Drawbacks of Traditional Varieties

Districts	Low yield (in %)	Unavailability (in %)	No drawback (in %)
Sitamarhi	72	24	4
Bhabhua	82	18	0
Palamau	0	14	100

Table 4.2 brings to light the opinion of farmers about the drawbacks of traditional varieties in Sitamarhi, Bhabhua and Palamau. In Sitamarhi and Bhabhua, where a substantial proportion of the farmers is growing HYVs, 72 and 82 percent of the farmers respectively complain about the low yield of traditional varieties. This makes it clear that economic rationality of reaping getting higher yields has been the most dominant force that has led to large number of farmers replacing traditional varieties with HYVs on their fields. Another problem that farmers of Sitamarhi and Bhabhua associated with traditional varieties was their unavailability. 24 and 18 percent of the farmers in Sitamarhi and Bhabhua respectively complain about unavailability. Distribution of HYV seeds is regulated through the market by the government. No such facilitating mechanism exists in case of traditional varieties. Thus, the reason for this comparative drawback is apparent. Another point to be noted is that 4 percent of the farmers in Sitamarhi feel that the traditional varieties do not have any inherent drawbacks. They seem to be happy with the yield as well as availability.

In Palamau, as seen in table 4.2, all the farmers who were surveyed felt that the traditional varieties pose no drawback. Farmers over here did not grow HYVs and were thus, not in a position to make a comparative assessment. Though all the farmers in Palamau felt that the traditional seed varieties had no drawbacks, 14 percent amongst them complained of unavailability. These 14 percent farmers did not see unavailability as a problem or drawback associated with the seed as such but rather the fault of the ‘system’, which has not cared to solve this problem by systematising and building a proper channel via which traditional varieties could be sold/distributed.

Loss of Traditional Varieties and Direction of Agricultural Developments

Over the years, the farmers have seen the replacement of traditional varieties of crop, rice in particular in the cases where the study was conducted, with HYVs. They have also experienced the environmental and any other changes that may have come about on account of this shift. Thus, it is important to understand as to how they see this change in the over all perspective. Do they perceive this as a positive change?

Table 4.3: Farmers' opinion as to whether loss of Traditional Variety is a negative development for agriculture

Districts	Opinion		
	Yes (in %)	No (in %)	Not sure (in %)
Sitamarhi	72	8	20
Bhabhua	54	0	46
Palamau	96	0	4

Table 4.3 represents the farmers' opinion as to whether loss of traditional variety is a negative development for agriculture as a whole. The picture that emerges is strongly in favour of the view that loss of traditional varieties is a negative development for agriculture. In Sitamarhi, Bhabhua and Palamau, 72, 54 and 96 percent of the farmers respectively are of this opinion. In Sitamarhi and Bhabhua, this opinion is on account of their lived experience when they have seen the HYVs slowly replacing traditional varieties on the field. They have also been able to experience the changes that have taken place on account of this shift and been part of the process where chemical fertiliser and pesticide use started taking place and increased over the years. They have even seen the changes that have taken place in the soil and the new pests that have emerged and become dominant. On the other hand, the negative developments for agriculture that the 96 percent of the farmers from Palamau are referring to are not on account of their lived experience where they have seen the changes that have taken place with HYVs replacing traditional varieties. It is more a reflection of their apprehensions about the HYV gained from what they have either observed in other districts where HYVs are grown or from the stories they have heard from others who have some knowledge of these other districts. Their more or less complete reliance on traditional varieties and the fact that the overwhelming proportion of farmers do not see any inherent drawbacks in these varieties

of their region also adds to their negative opinion about development that have led to loss of traditional varieties.

In Sitamarhi and Bhabhua, 20 and 46 percent of the farmers respectively are not sure if loss of traditional varieties of seeds is any kind of a negative development for agriculture or not. This lack of surety may be out of initial euphoria at the high yield gained from HYV package technology. It could also be on account of insufficient opportunity to assess and form an opinion in this regard. However, since they did not answer a blatant 'no' to this question, it shows that they have been able to observe certain changes of which they are not sure. In Palamau, only 4 percent of the farmers were unsure if loss of traditional variety was a negative development for agriculture. In Sitamarhi, 8 percent of the respondents were of the opinion that loss of traditional variety was not a negative development for agriculture. They probably believed that the change has been for the good and what was gone was probably inferior to what they had at present.

Comparative Advantages of Traditional and HYVs

Over the years, on account of their practical experience, farmers have a good idea about the various advantages and disadvantage both traditional and HYVs possess. They are in the best position to assess the comparative advantage and disadvantage between traditional and HYVs. The types of advantages may be classified into that which is present on the field while cultivating the crop and that, which is present off the field. The discussion that follows looks at both these aspects.

Figure 4.2

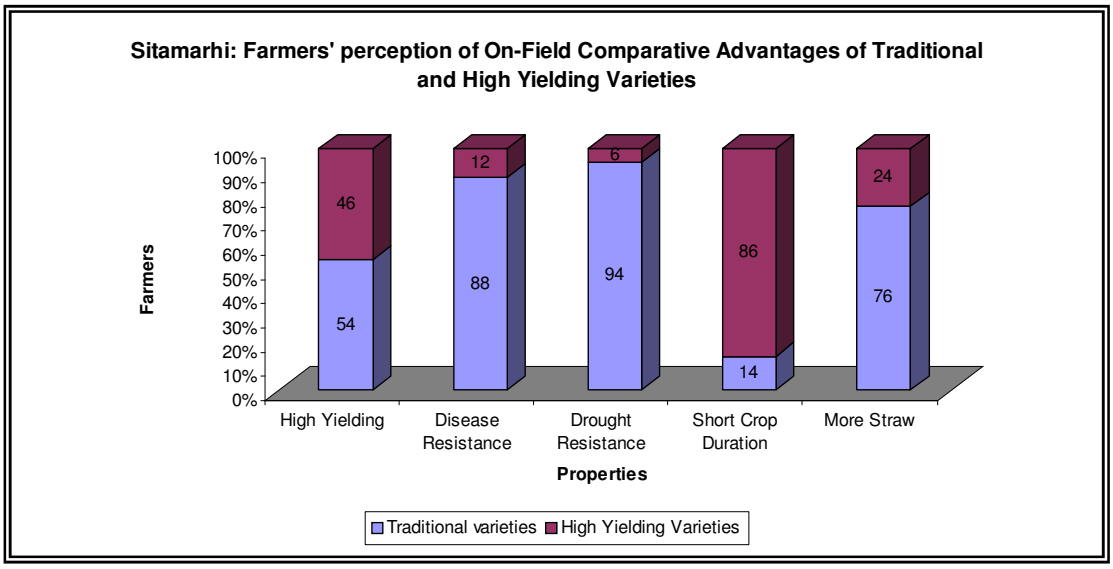


Figure 4.2 shows the farmers' perception of on-field comparative advantages of traditional varieties and HYVs in Sitamarhi. On-field here refers to the traits or properties that are present while the crop is being cultivated and till the time it is harvested. Here, we observe that 54 percent of the farmers feel that the traditional variety gives higher yield. Similarly, 88, 94, and 76 percent of the farmers are of the opinion that traditional varieties are more disease resistance, drought resistance and provide more straw respectively, as compared to the HYVs. Disease and drought resistance are some of the most important properties that farmers look for in a variety. Disease resistant varieties require less of pesticides and fungicides leading to reduction in the overall expenditure of the farmer. More straw provide more fodder to the cattle that the farmer usually owns or provide the farmer the opportunity to sell straw to other farmers or in the market and make some extra money. In Sitamarhi, the only on-field comparative advantage that the HYV has over the traditional variety is the short duration required in its cultivation. As many as 86 percent of the farmers lent their support to this opinion. This is of tremendous benefit to the farmers as the number of days saved this way could be utilised to grow another crop or provide labour in some other field to earn extra income or invest time elsewhere for any other economic or non-monetary gains.

Figure 4.3

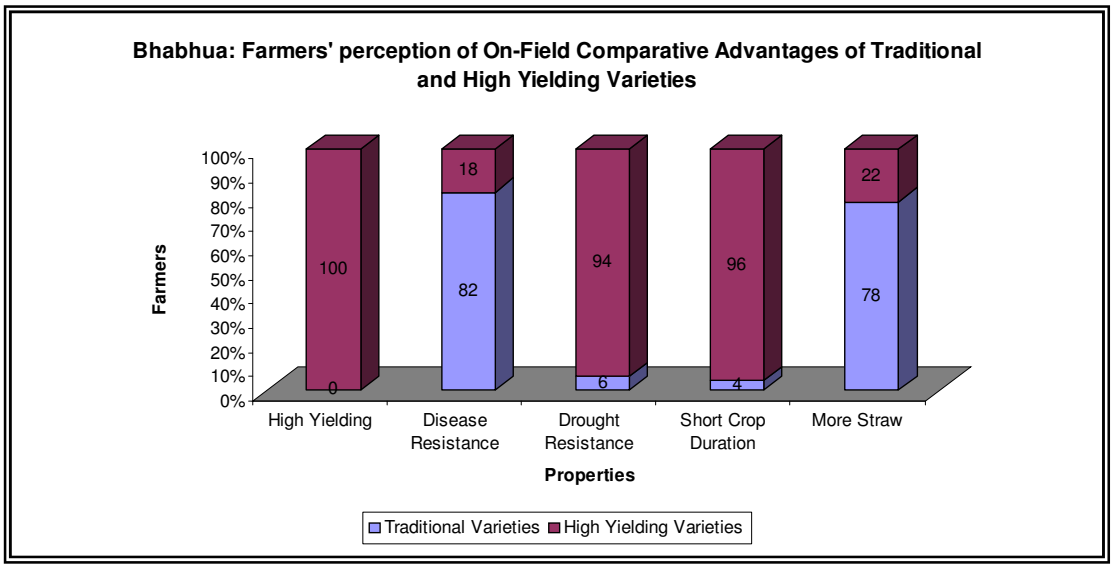
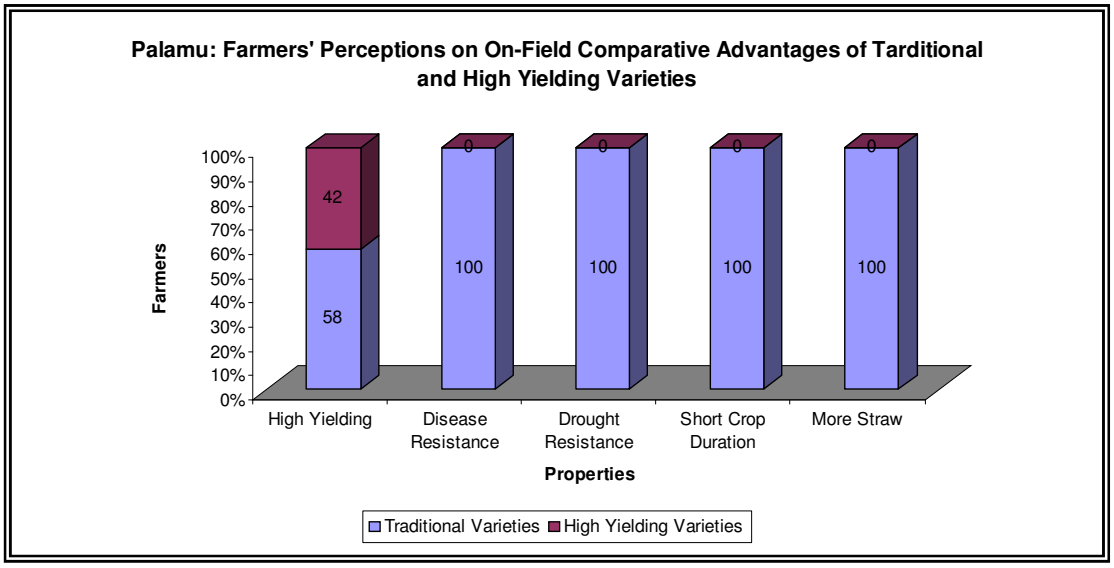


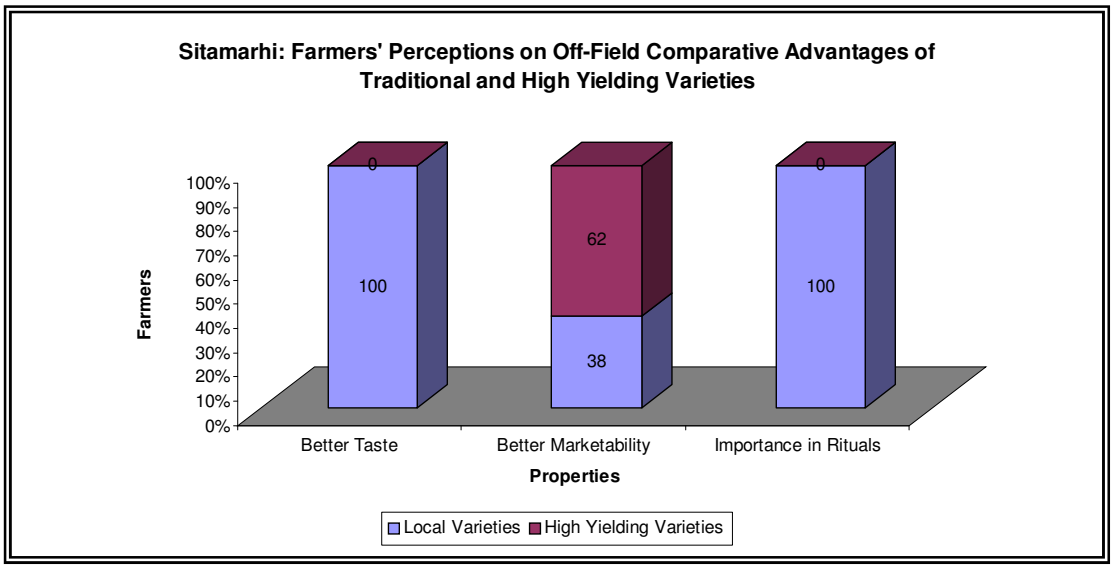
Figure 4.3 shows the perception of farmers on the on-field comparative advantages of traditional and HYVs of crops in Bhabhua. Unlike in the case of Sitamarhi where most of the farmers were of the opinion that traditional varieties gave higher yield, here all the respondent farmers reported that the yields of the HYVs were higher. They were also of the opinion that HYVs were more drought resistant and required shorter crop duration as compared to the traditional varieties. As high as 94 and 96 percent of the farmers endorsed their views in favour of greater drought resistance and shorter crop duration respectively in the case of HYVs. Thus, HYVs with the comparative advantages in terms of higher yield, greater drought resistance and shorter crop duration becomes a natural choice for the farmers of this district. However, traditional varieties score over the HYVs in terms of disease resistance and for producing or providing more straw. 82 percent of the farmers were of the opinion that traditional varieties are more disease resistant and 78 percent of the farmers reported that traditional varieties provided more straw. Thus, the choice as to what variety to grow, in terms of on-field properties is dependent on the trade-offs between yield, disease resistance, drought resistance, crop duration and volume of straw produced.

Figure 4.4



As discussed earlier, the case of Palamau is different as compared to Sitamarhi and Bhabhua. This being a rain fed area, farmers have had limited to no exposure to HYVs of seeds. Figure 4.4 shows that majority of the respondent farmers, i.e., 58 percent are of the opinion that yields of traditional varieties of rice are higher. However, a significant proportion, i.e., 42 percent think otherwise and are of the opinion that the HYVs of rice give higher yields. Otherwise, as seen in the figure, 100 percent of the respondents in each of the other case, which include drought resistance, pest resistance, crop duration and amount of straw produced, are of the opinion that the traditional varieties possess the comparative advantage.

Figure 4.5



On referring to off-field comparative advantages, we are basically dealing with properties that are of significance after the crop has been harvested. Here, these properties include taste, marketability and importance in rituals. Figure 4.5 shows the farmers' perceptions on off-field comparative advantages of traditional and high yielding varieties in Sitamarhi. Here, 62 percent of the respondent farmers are of the opinion that the HYVs have better marketability than the traditional varieties. This is probably because of the fact that the government, by offering a minimum support price or purchasing the produce via the Food Corporation of India is supporting cultivation of HYVs of crops. These supports are however not extended to the traditional varieties thereby leaving them severely disadvantaged. The traditional varieties taste better and are of greater importance in rituals and this opinion had the endorsement of all the respondents in Sitamarhi.

Figure 4.6

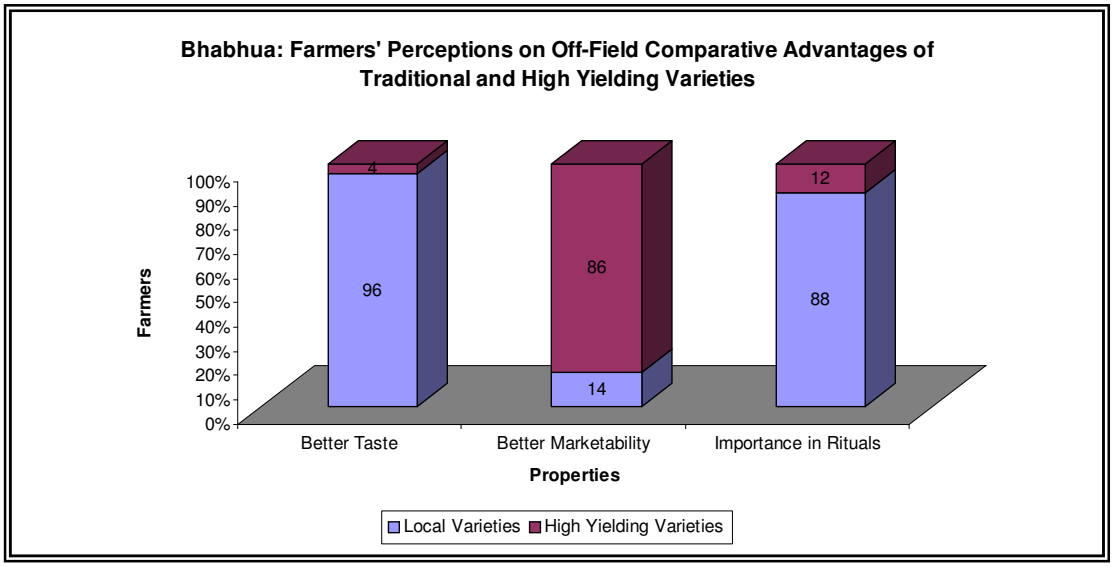


Figure 4.6 shows the perception of farmers on off-field comparative advantages of traditional and HYVs in Bhabhua. The picture that emerges is not too different from that which emerged in Sitamarhi. Here too, the biggest problem related to traditional variety produce seems to be marketability and the reason is exactly the same as in the case of Sitamarhi. 86 percent of the farmers are of the opinion that HYVs have the advantage of better marketability. As for the advantage with relation to taste and importance in rituals, traditional varieties have been rated higher by 96 and 88 percent of the farmers respectively. Importance in rituals is on account of the fact that these practices are themselves traditional in nature. For example, rice required in particular rituals have to be of a particular sub-variety and these are usually traditional varieties. Since the use of such varieties is an intrinsic part of the customs and traditions, it is not replaceable by HYVs. Since religion, rituals, traditions and customs play a very significant role in the life of an Indian in general, the attachment of traditional seed varieties to this is of great relevance.

Figure 4.7

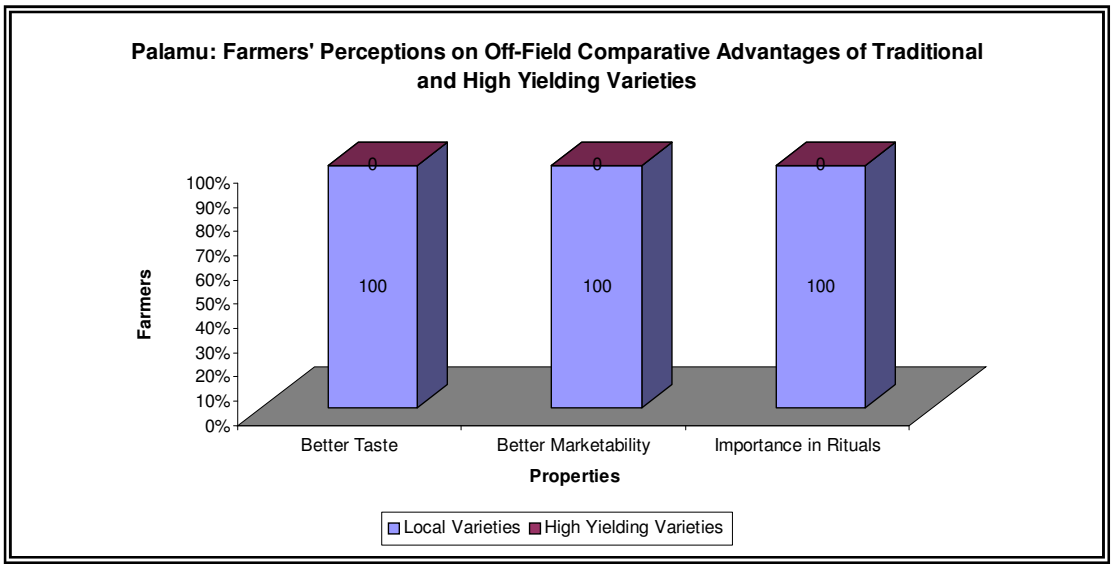


Figure 4.7 shows the perception of farmers on off-field comparative advantages of traditional and high yielding varieties in the district of Palamau. Here, with hardly, if any, HYV varieties being grown, the opinion of farmers is completely in favour of the traditional varieties. All the respondents are of the opinion that traditional variety taste better, have better marketability and are more important for rituals.

Are Farmers Open to Growing Traditional Varieties?

Having looked at the numerous dimensions of cultivating Traditional and HYVs of crops and analyzed the farmers' opinions regarding the comparative advantages of traditional and HYVs, we now need to know if the farmers are at all open to growing traditional varieties. An understanding of this is significant for planning the path ahead in efforts to save genetic diversity.

Table 4.4: Farmers in Principle open to Cultivating Traditional Varieties

Districts	Response		
	Yes	No	On small Portion of Land
Sitamarhi	78	8	14
Bhabhua	36	4	60
Palamau	96	0	4

As seen in table 4.4, only very small proportions of farmers are not open to cultivating traditional varieties at all. In Sitamarhi, 8 percent of the respondent farmers, and in

Bhabhua, 4 percent of the respondent farmers make up for those who fall in this category. In Sitamarhi, 78 percent of the farmers are open to growing traditional varieties on their fields. Another 14 percent of the farmers are open to growing traditional varieties on a portion of the land under them. This inclination in favour of traditional varieties of crops, primarily rice in this case, is possibly on account of the fact that this is a flood prone area and farmers, over the years and on account of their experience, have come to realise that traditional varieties are better suited to withstand water logging. As discussed earlier, most of them also feel that the traditional varieties are more pest, disease and drought resistant and produce more straw. Thus, the potential of taking to cultivating traditional variety here is strong. However, this is not an indication of the fact that all conditions and facilities remaining constant, they would probably start growing traditional varieties in the near future.

In the case of Bhabhua, 36 percent of the farmers are open to growing traditional varieties on their fields whereas as many as 60 percent of the farmers are open to growing traditional varieties on a small portion of their land. Bhabhua being an irrigated region is extremely suitable for cultivation of HYVs. Despite this, if a large proportion of farmers are open to growing traditional varieties, even if it is only in a small portion of their fields, it is possibly because of the qualities like greater disease resistance and more straw that are present in them. It is also possibly a reflection of the fact that they have observed physical changes in their soil, water and kinds of pests that are present since they started cultivating HYVs extensively. As analysed earlier, a very large section of the farmers in this district do not see loss of traditional varieties as a positive development in agriculture and they possibly realise the significance of having genetic diversity by growing traditional varieties. However, as mentioned earlier, this is not an indication of the fact that with all conditions and facilities remaining constant, they would probably start growing traditional varieties in the near future.

The case of Palamau is different. With traditional varieties being the most suitable in its environmental conditions, 96 percent of the farmers are willing to grow them in their land where as 4 percent of the farmers are open to growing this variety in a small portion of

their land. Unless HYVs are designed to suit rain fed areas or artificial irrigation facilities are developed in this district, farmers will prefer traditional varieties to the HYVs over here.

Incentive Measures

It is difficult to articulate and pinpoint the kind of compensations and measures that the farmers might desire. Therefore, farmers were asked very indirectly about the types of amenities and services they would prefer to 'mitigate the loss' on account of growing traditional varieties of crops. In other words, what opportunity cost would have to be incurred by the state or any other institution in its effort to promote biodiversity, if farmers in these regions were to grow traditional varieties of crops? These should be some kind of agreeable pursuits that will impart social pleasures in some form on the farming communities of these districts. After screening the responses of farmers in this regard the following points emerged that the farmers desired as incentive measures:

Table 4.5: Incentive Measures desired by Farmers

➢ **Availability of water in required quantity and time**
➢ **Adequate power supply**
➢ **Road communication**
➢ **Health care facilities**
➢ **Education facilities**
➢ **Adequate price support measures**
➢ **Supply of genuine seeds, fertilisers and pesticides**
➢ **Extension services**
➢ **Availability of seeds**
➢ **Market facilities for the traditional varieties**

- ***Availability of water in required quantity and time***: Unavailability of water is one problem that the farmers face very often. To provide some kind of minor irrigation facilities would be of great help for them. Adequate water supply will also result in

better yield of traditional varieties which can partially compensate for the better yield performance of the HYVs.

- ***Adequate power supply:*** Power failure is a very frequent phenomenon in most of the villages. Assured supply of power can be expected to be a great motivating factor for farmers.
- ***Road communication:*** Road conditions of most of the villages are pathetic and during the rainy seasons travelling becomes a menace. It creates a lot or problems for the farmers to communicate with the nearby markets. Thus, to improve the socio-economic condition of the farmers, improvement of road communication is very much essential.
- ***Health care facilities:*** It was observed that most of the villages were deprived of modern health care facilities. No primary health care centres were seen to be fully functional in any of the villages. This is an extremely sensitive area that needs attention. Providing genuine health care facilities would really be an effective motivating factor for them. In view or the high infant mortality rate and high incidence of poor health or death of the mothers at the time of childbirth in these districts, health care facility is more essential than HYVs.
- ***Education facilities:*** In many villages, not even a primary school was seen to be existing. Farmers had an understanding of the significance of educating their children. Thus, this could form an important incentive. Besides, providing education to adults, in this case farmers, would provide an opportunity to educate them about the significance of bio-diversity.
- ***Adequate price support measures:*** Due to their poor economic status, the farmers do not have the bargaining power. On account of their subsistent level of existence, they try to sell of their products as quickly as possible. Besides, they do not possess adequate storage facilities and have to sell their agricultural produce at the price the middlemen or the buyer is willing to offer. Under these circumstances, adequate price support measure for traditional varieties of crop produce will go a long way in providing some form of security to the farmers and promoting cultivation of traditional varieties of crop.

- ***Supply of genuine seeds, fertilisers and pesticides:*** As there is no organised agency for supply of traditional varieties, some bogus companies take advantage to run some fraudulent business of traditional seeds and cheat the farmers. Similar is the case for fertiliser and pesticides for which the farmers have to incur double loss. Firstly, they have to bear the expenses for these materials, and secondly, it reduces their productivity. Therefore supply of genuine seed, fertiliser and pesticide is very much essential to gain the confidence of the farmers.
- ***Extension services:*** According to the farmers, they have been totally deprived of the extension services as no extension worker has ever visited their fields. Thus, they are not updated about recent market news and agricultural developments. The need for efficient provision of this service seems to be high.
- ***Availability of seeds:*** One of the crucial lacunas related to traditional seed varieties is the lack of an organised seed market or selling agency. All the agricultural universities, research institutes and the private seed companies are focussing on the production of high yielding varieties only. Therefore, the farmers have to depend completely on their own harvests for the seeds of traditional varieties. In case of any calamities or disasters the farmers cannot find any alternative source for cultivating traditional varieties of crop the following year and ultimately opt for the modern HYVs. Therefore, it is necessary to build up an alternative seed source for the traditional varieties.
- ***Market facilities for the traditional varieties:*** The poor communication facility of the villages poses a barrier to the efficient marketing of their agricultural produce. Lack of proper transportation facility, warehousing facility and well-regulated local *mandi* or market is a big drawback that traditional variety, and for that matter all varieties grown in these areas encounter. Removal of such drawbacks or provision of such infrastructure may allow the farmers to overlook the benefit of higher yield in the HYVs and they could possibly be convince about growing traditional varieties as these facilities might offset the losses in terms of yield.

Conclusion

The observations made in this chapter could be broadly summarised as follows:

- Most farmers are nostalgic about the traditional varieties that were grown in their region in the past or the traditional varieties that have been replaced by the HYVs over the years. They regret the fact that this has happened.
- The farmers are of the opinion that there is a need for local seed banks.
- In Sitamarhi and Bhabhua, the districts where HYVs are grown, farmers are of the opinion that the biggest drawback related to traditional varieties are its low yield as compared to the HYVs and the lack of its easy availability. In Palamau where hardly if any HYVs are grown, farmers do not have complaints against the traditional varieties as such thought they too complain about the problems related to its availability.
- Most farmers are of the opinion that loss of traditional varieties is a negative development for agriculture. However, there is a substantial section who are not sure if this loss is a negative development or this loss has actually been a positive development for the farming community resulting in the overall development of agriculture.
- Both traditional as well as HYVs have their own set of comparative advantages and disadvantages depending on the kind of agro-climatic region they are grown in, especially in terms of yield and drought resistance. In general, HYVs fare better in terms of yield, duration or time needed in cultivation and marketability where as Traditional varieties are better off in terms of production of straw, disease resistance, taste and for rituals.
- Most farmers are open to cultivating traditional varieties of crops, though it may only be on a small portion of their entire land under cultivation.
- If for the sake of protecting genetic diversity and reaping all the other advantages associated with it, farmers are to be convinced about growing traditional varieties, incentive measures have to be provided so that it offsets the financial loss, if any, incurred by farmers in the process.