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**Climate Change,
Agriculture and
Food Security**



Midline Household Survey Results **Karnal, Haryana State, India**

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CGIAR Research Program on Climate Change,
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1. Introduction

This midline study was carried out in Karnal district, Haryana (northwestern part of Indo-Gangetic plains), India and was completed under the CCAFS program of the CGIAR and its partners during May – July 2019. Haryana is a landlocked state situated in northern India, constituting 1.4% of the geographic area of the country. It is bounded on the northwest by the state of Punjab and the union territory of Chandigarh, on the north and northeast by the states of Himachal Pradesh and Uttarakhand, on the east by the state of Uttar Pradesh and the union territory of Delhi, and on the south and southwest by the state of Rajasthan. The Karnal district is located at 29° 41' 8.2644" N and 76° 59' 25.9692" E.

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a major research partnership that works in five regions: South Asia, South-East Asia, East Africa, West Africa, and Latin America. When CCAFS began in 2011, baseline surveys were carried out in 21 research sites across 17 countries within these five regions. The surveys were conducted using standardized baseline tools in each site, including a quantitative household survey, a qualitative village study, and an organizational survey.

The baselines were conducted in South Asia in 2012, and in 2019 CCAFS conducted the midterm evaluation surveys, which are being used to compare the current findings with the baseline findings to track the performance of Climate Smart Village (CSV) sites and measure the impact on beneficiaries. With a few improvements, the same standardized tools as used for the baselines were used to carry out the midline evaluation and to ensure comparability with the data collected previously.

The baseline surveys that CCAFS conducted include a household survey, qualitative village study, and organizational survey at two CCAFS sites, i.e., Karnal district in Haryana and Vaishali district in Bihar. To measure the impact of the program, BISA-CIMMYT conducted a midline survey on three different components, i.e. Household Midline Surveys (HMS), Village Midline Surveys (VMS), and Organizational midline surveys (OMS).

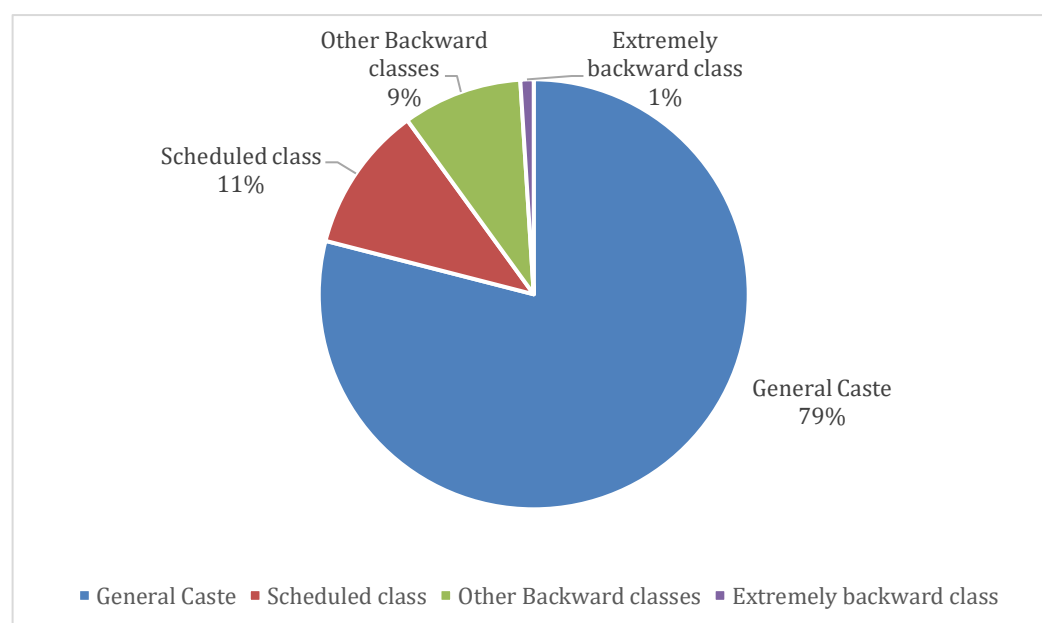
The household questionnaire was translated into the local language Hindi for the enumerators' ease of understanding. The household survey was carried out by a group of enumerators using

the Open Data Kit (ODK) on Android devices using smartphones/tablets. The questionnaire was pre-tested to assess the appropriateness of the language and develop the necessary skill of the enumerators. The Team leader Sanjay Prasad supervised the data collection as per the sampling design mutually developed and agreed within CCAFS, thereby ensuring proper quality control of data in ODK, and conducted some initial processing/analysis of the data and report writing. The name of the study team members and the Field Enumerators are listed in the Appendix.

1.1. Household respondents and type

The survey revisited the original 140 households in Karnal from the CCAFS household baseline survey. All the households covered in the baseline except one (which has migrated) were covered in the midline survey. Both male and female respondents were interviewed for the midline survey. Out of the 139 households, there were 108 male respondents (77.7%), and the remaining 31 respondents were female (23.3%). During the baseline survey, the male respondents were 86% of the total respondents, and 24% were female. In the midline survey the same caste groups defined during the baseline were followed, and as the sample was the same except one household, there was no change in caste composition. Most of the inhabitants in the surveyed villages belonged to the forward caste category (79%), followed by Scheduled Caste, i.e. SC (11%) and Other Backward Caste, OBC (9%) (Fig 1).

Figure 1. Distribution of the surveyed households according to their castes



2. Household demographics

As per the Census of India 2011, the population of Karnal district was 1.5 million, and the female sex ratio was 887 (per 1000 male). The decadal growth of the population is 18.22% during the years 2001 to 2011.

Among the surveyed sample of 139 households, 64.0% of the households have no child below 5 years of age, while 35.9% of the households have one child under 5 years of age, and 12.2% of households have 2 or more children under the age of 5 years (Table 1).

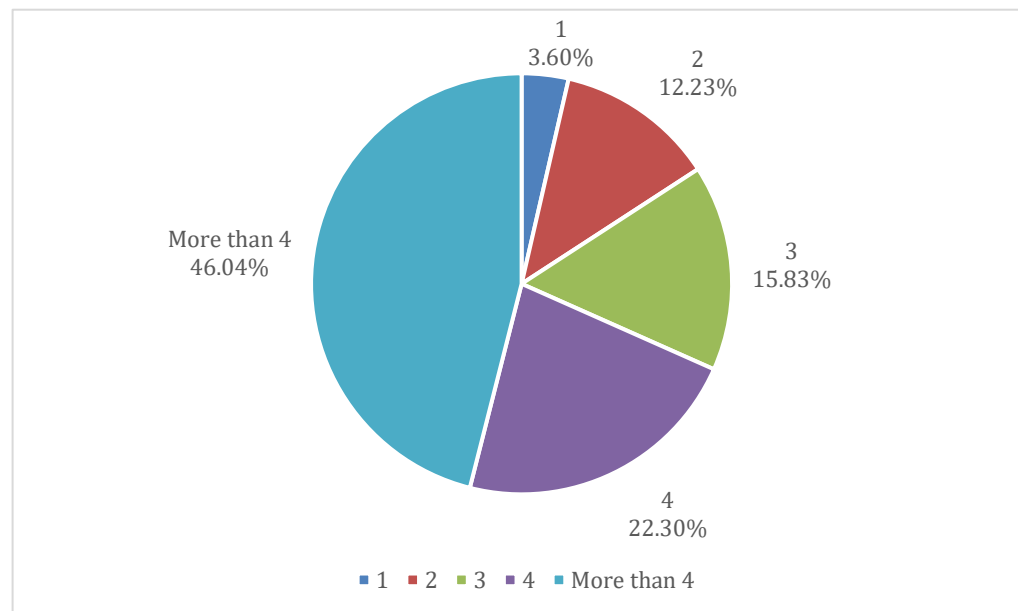
Table 1. Number of children below the age of 5 years in a household

Number of children below the age of 5 years	Number of households	Percentage of households
None	89	64.0
One child	33	35.9
2 or more children	17	12.2

When the analysis is done for households with elderly people (over the age of 60), it is found that 23.74% of households have no elderly member; 76.25% of the households have at least 1 elderly member and only 36.7% of the households have 2 or more elderly people.

Another analysis was done to figure out the number of adults in a household who are in the working-age group, who are neither below 5 years of age nor above 60. Figure 2 explains the number of members between the ages of 5 and 60 in a household. It was found that among the surveyed households, 46.04% have more than 4 members in this age range in a household, 22.30% of households have 4 people in that range, 15.83% have 3, 12.23% of the households have 2 and 3.6% households have just one person in that age range. All of the 139 households have at least one person between 5 and 60 years of age in the family.

Figure 2. Proportion of the number of working age people in a household



2.1. Household size

According to the parameters set during the baseline, a family with less than 5 members (up to 4 members) is considered a small household; usually comprising of a husband, a wife, and their two children. During the midline survey, it was found that 24.46% of the respondents are from small households (1 to 4 family members). Following the parlance of the baseline survey, 58.99% of the households are medium-sized (5 to 8 family members). Also, there are 14.39% of households that have 9 to 12 members in the household. Only three households (2.16%) have more than 12 members (Table 2). If a comparison is made between the baseline, the number of households with small and very large family sizes have gone down, whereas in the other two categories the number of medium and large households have gone up.

Table 2. Distribution of households by size in Karnal

Household size	Number of households	Percentage distribution
1 to 4 (small family size)	34	24.46
5 to 8 (medium family size)	82	58.99
9 to 12 (large family size)	20	14.39
More than 12 (very large family size)	3	2.16

2.2. Education levels

According to the Census of India, the average literacy rate in Karnal in 2011 was 74.73% compared to the state average of 77%. If the literacy rate is compared gender-wise, male and female literacy rates were 81.82% and 66.82%, respectively.

Among the surveyed households, it was found that in 137 households (98.56%), some member had at least formal education, and only 2 respondent households (1.44%) had no one with any formal education.

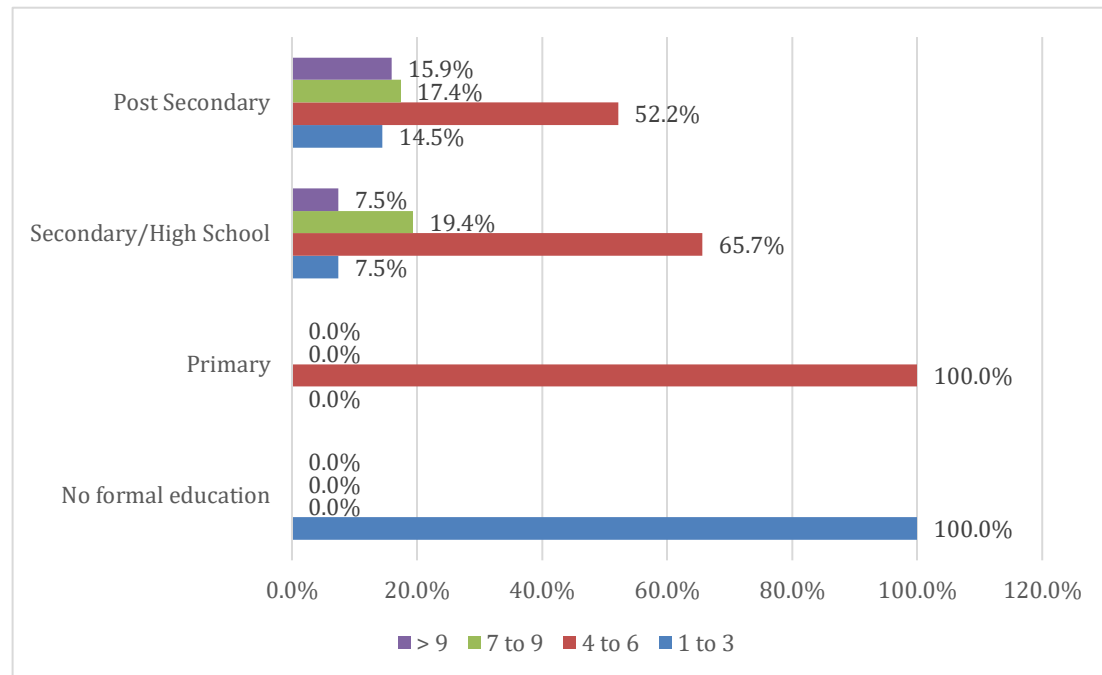
Table 3. Highest levels of education within the households

Highest level of education of any resident household member	Number of households	Percentage distribution
No formal education	2	1.4
Primary	1	0.7
Secondary/High School	67	48.2
Post-Secondary	69	49.6

Among the households in which there is a member with formal education, 49.6% of the households have at least one member who has attended formal education at the level of post-secondary and above; whereas among 48.2% of households there is at least a member who has attained education up to secondary level/ attended high school. However, in just one household (0.7%) the highest level of any member is primary education (Table 3).

The baseline survey pointed out that if we consider the percentage of households that had at least one member having secondary and above education, the figure was 84%, which has increased to 98% in the midline survey results.

Figure 3. Size of household and highest level of education of any member



If we analyze the relationship between household size and the highest level of education attained (Figure 3), we find that in the category of households with at least one member with post-secondary education (n=69), about 16% of households have more than 9 members, whereas 17.5% have 7 to 9 members, 14.5% of households have 1-3 members, and a majority of households (52.2%) have 4-6 members.

In the case of the category where a member has education up to secondary/high school level (n=67) about 7.5% of households have more than 9 members, 19.4% have 7 to 9 members, 7.5% of households have 1-3 members and a majority of households (65.7%) have 4-6 members within a household.

3. Sources of livelihood

3.1. On-farm livelihood sources

Among the 139 surveyed households, 123 households (88.49%) produce agricultural products on farm while the rest 16 (11.51%) do not. As shown in Table 4, the majority (87.05%) of the households operate integrated livestock and agriculture systems (food crops and livestock rearing). Among the surveyed households, 75.54% cultivate food crops, fruits, and

vegetables; whereas 12.95% of the households only rear livestock (only large animals such as buffalo for milk and manure). One household has rented out all its land. As reported in the baseline, there were two families who were doing fisheries, but they are no longer doing it. Most of the production systems in the village are large scale and commercial in nature. Almost three-quarters of the food products produced are sold in the market (103 households out of 105 which produce food crops). Most of the milk produced is for commercial production and is sold in commercial milk collection centers.

Table 4. Percentage of households producing on-farm agricultural products

Produced in the farm	% of households producing on farm	% of households selling
Food crops, fruits, vegetables	75.54	74.10
Livestock and crops	87.05	80.58
Livestock only	12.95	12.95
Other items (fuelwood, honey, manure, timber)	87.05	9.35
All land leased out	0.7	0.7

As shown in Table 5, basmati rice and wheat, which are the main crops of the area, are cultivated commercially and sold at nearby Mandis, such as one located at Taraori. The households retain some portion of the food crops for home consumption. While 75.5% of the households produce food crops, 74.1% sell them in the market. The major fruit products of the area, i.e. mango, guava, and lemon, are consumed at home and are no longer being sold commercially as reported in the baseline study. The 5.8% of households which produce fruits consume them or distribute them among villagers. Also, in the baseline report, there was mention of commercial vegetable cultivation by 28% of surveyed households; the figure has gone down to 17.3%. However, all households which produce vegetables consume them in their households.

As shown in Table 5, large animals (buffaloes and cows) are reared by 82% of surveyed households for commercial milk production and sold in the market. Almost all the households consume milk in their households too. During the midline survey, it was found that the practice of rearing small livestock is no longer a practice. When probed, it was found that there is a lack of grazing land and rearing a small herd is no longer remunerative by employing an adult. For feeding the livestock reared by the households, 66.2% of the

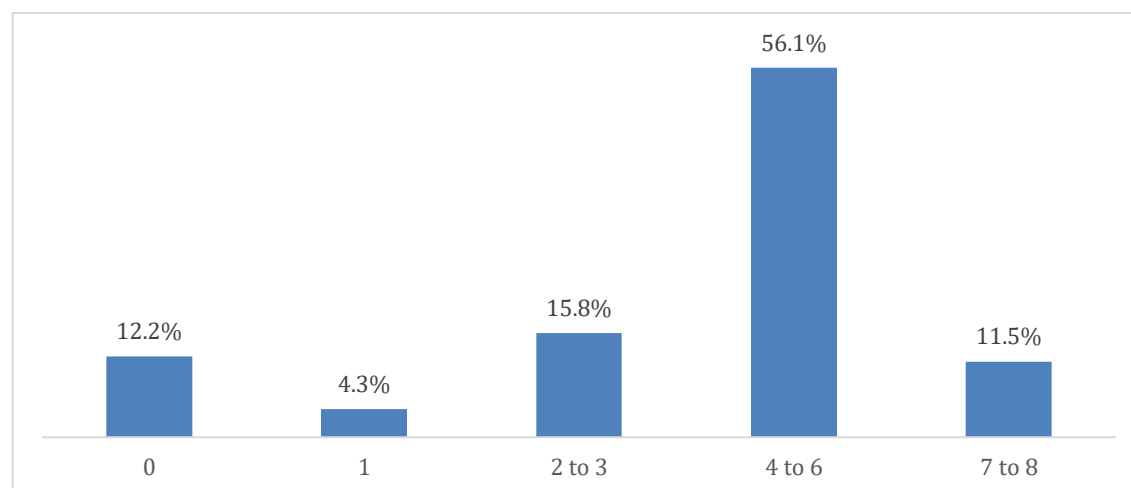
households cultivate fodder crops like clover, sorghum, maize, and berseem. All of the households that grow the fodder use it for their own consumption, but only 2.9% of the households sell it commercially. The byproduct of livestock as manure is produced by 71.9% of the households, used on their own fields by 69.8% of the households, and only 7.2% of the households sell it to others. Households still practice collection of firewood, however, it is mostly used for domestic cooking and is done by 16.5% and consumed by 15.8% of the households. Timber production and other cash crops are minor activities and are done by two and one households respectively.

Table 5. Percentage of households producing on-farm, consuming and selling various agricultural products

Product	% of households producing	% of households selling	% of households consuming
Fodder	66.2	2.9	66.2
Food crop (raw)	75.5	74.1	75.5
Fruit	5.8	0.0	5.8
Fuel wood	16.5	1.4	15.8
Large livestock (cattle, buffalo)	82.0	56.8	33.1
Livestock products (milk, eggs, etc.)	71.9	51.8	69.8
Manure/compost	71.9	7.2	69.8
Other/cash crop (Rubber, sugar cane, etc.)	0.7	0.7	0.7
Timber	1.4	0.7	1.4
Vegetables	25.2	17.3	25.2

As shown in Figure 4, most of the households (94) produced several products on the farm (4 to 9 products). A majority of households, comprising 56.1%, produce 4 to 6 farm products, about 15.8% of surveyed households produce 2 to 3 farm products, while 12.2% do not produce any farm product. The least percentage (4.3%) of households produces just one farm product. The figure of no production was a mere 4% during the baseline. Out of the surveyed households, 17 (12.2%) did not produce any farm item, the major reason being many of the people are migrating to developed countries as revealed in the Focus Group Discussions (FGD) carried out during the Village Midline Surveys.

Figure 4. Percentage distribution of the surveyed households as per the number of farm products produced



3.2. Off-farm livelihood sources

Items such as pulses, cooking oil, and other cereals such as oats and millets are procured for a healthy lifestyle in this highly prosperous area. Among the respondents who are engaged in off-farm livelihoods, 51 households (88%) procure food crops and fodder. This figure was only 7% during the baseline. During the discussion with the households, it was also found that they purchase chemical free food items. Additionally, increases in the herd size of livestock requires them to procure additional fodder from outside.

Table 6. Agricultural products coming from off-farm source

Products coming from off-farm sources	Number of households	% of households
Food crops	40	69.0
Fodder	11	19.0
Fuelwood	1	1.7
Animal and animal products	2	3.4
Manure	2	3.4
Vegetables	2	3.4

3.3. Diversification indices

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

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

Similarly, a commercialization index was made by the total numbers of agricultural products sold 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 123 surveyed households in Karnal which produce items on farm are shown in Table 7. The data show that there is no household that produces more than 8 items (high level of diversification); 64.23% of households produce 5-8 products (intermediate level of diversification) and 30.2% of households produce 1-4 products on-farm (low diversification). Eighteen households (12.8%), however, did not produce any product in the last year.

Among the 123 households, most of the households (57.72%) sell 3 to 5 products, whereas 29.27% sell more than 5 products; only 13.01% households sell 1 to 2 products in the market. This implies that most of the farm production has commercial diversification and intent. Also, higher production diversification has higher commercialization diversification.

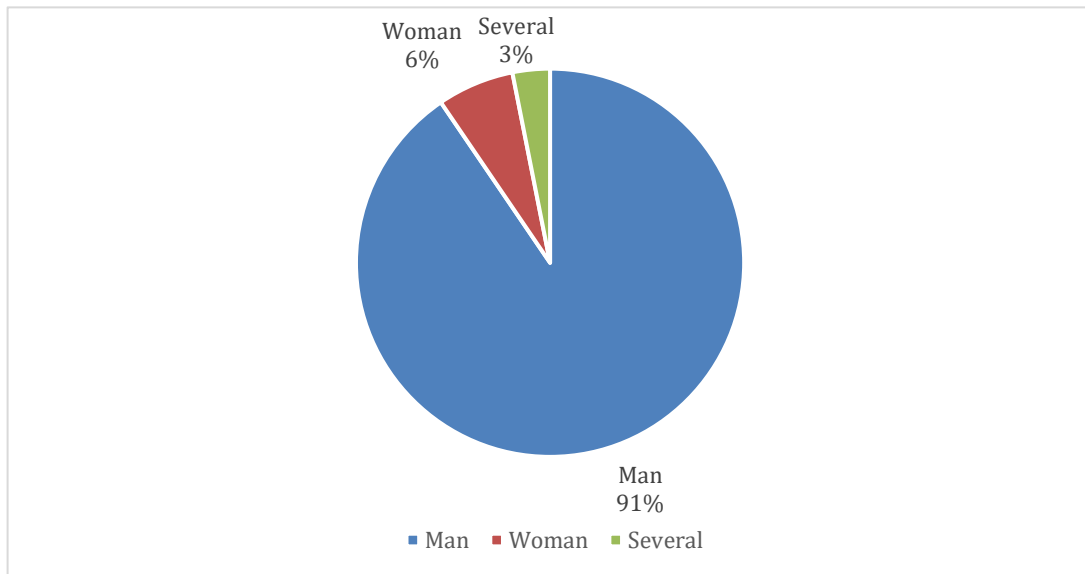
Table 7. Production and Commercialization Diversification Indices

Karnal	Number of households	% of households
Production Diversification		
1-4 products (low production diversification)	44	35.77
5-8 products (intermediate production diversification)	79	64.23
>8 products (high production diversification)	0	0.0
Selling/Commercialization Diversification		
No products sold (no commercialization)	0	0.0
1-2 products sold (low commercialization)	16	13.01
3-5 products sold (intermediate commercialization)	71	57.72
>5 products sold (high commercialization)	36	29.27

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

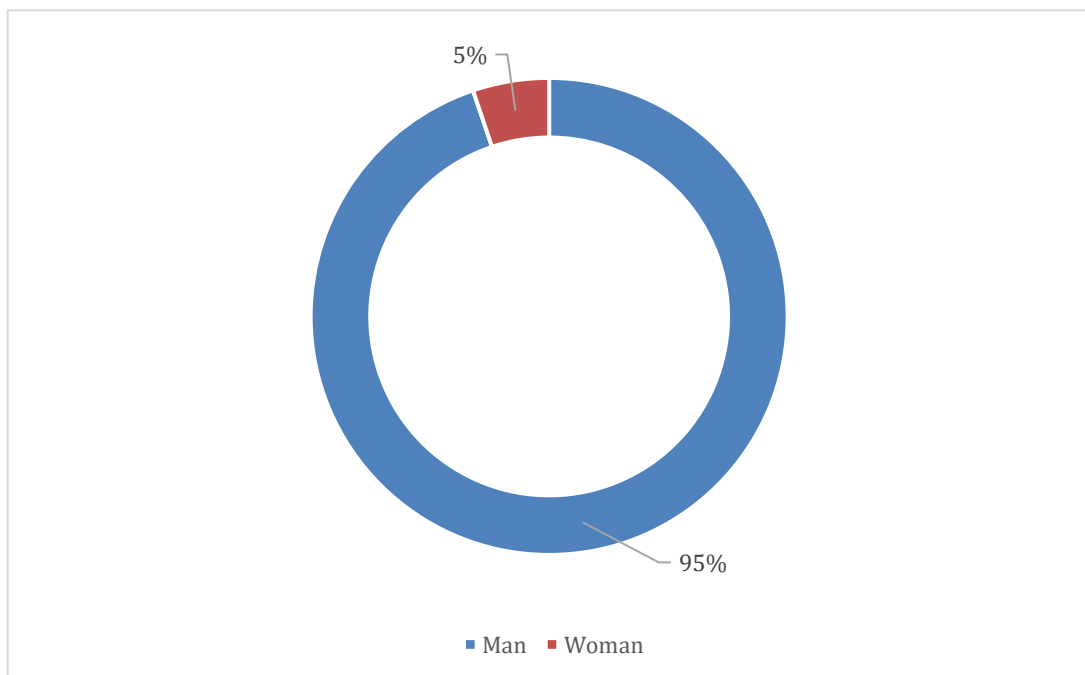
An analysis was done to understand the work division among the household members in the surveyed villages. It was found that for the on-farm activities, in about 90% of the surveyed households males are responsible for farm activity work whereas only 6% of women are responsible for the farm. In about 3% of the households the workload is shared by several members (Figure 5).

Figure 5. Agricultural workload on-farm by gender



A similar case can be seen in the off-farm activities, where a large portion of the off-farm activities are being done by men, and the involvement of women in off-farm activities is negligible (Fig 6).

Figure 6. Agricultural workload off-farm by gender



3.5. Sources of cash in the household

The sources of income in the surveyed households are: employment in off-farm activities, other paid employment, business, remittances, and renting out farm equipment and land.

It was found that in the households the income is always from multiple sources rather than one. Various sources of income bolster the economy and signify the prosperity of the area. As there are various rice mills present in the area, they employ some members of the households. It was found that 36.7% of households earn off-farm income from these rice mills or as contractual workers in nearby cities and in government and non-government jobs.

During the baseline, a mere 9% of surveyed households were engaged on someone else's farm, which has increased to 48.2%. About 46% of the households have income from government or other projects.

Small business and trade are also major sources of income for 33.1% of households in the study. Renting out agricultural machinery like tractors, water pumps, combine harvesters and threshers has decreased as there has been an increase in acquisition of agricultural machinery, which was a major source of income during the baseline.

Remittances are the most important source of income for 54% of households, as there has been increased migration outside of the country (as mentioned above) or to major cities within India. Access to informal credit exists for 29.5% of the households. Access to formal credit sources is now 27.3% (reduced from 44% during the baseline).

Table 8. Sources of cash income other than from own farm

Sources of Income	Number of households	% of households
Employment on someone else's farm	67	48.2
Other paid employment (e.g. Salary)	51	36.7
Business (other than farm products)	46	33.1
Remittances or gifts	75	54.0
Payments for environmental services	1	0.7
Other payment from projects/government, including benefits in kind	64	46.0
Loan/credit from a bank or other formal institution (microfinance, projects/programs, registered group)	38	27.3
Loan/credit from an informal source (moneylender, relative, etc.)	41	29.5
Renting out your farm machinery (e.g. Tractor, thresher, pump, etc.)	6	4.3
Renting out your own land	28	20.1

3.6. Discussion

Karnal is a highly developed agricultural area with very high productivity in both agriculture and livestock. Apart from production, there are several agro-related processing plants to add value to the raw food crops. In Karnal, most of the households produce basmati rice and wheat for commercial purposes. For irrigation, high powered pump sets are used 24/7 for about 60 days in cultivating rice. As most of the households rear large animals, fodder is grown for animals in addition to wheat and paddy by-products (husk, straw among others) being fed to the animals. There is no single respondent who rears small livestock such as goat or sheep. The milk is sold commercially and some partially used for own consumption. The manure is put in the fields. Some fields which have bushes are used as fuel in domestic cooking as well as a cooking feed for the livestock. Most of the villagers have an LPG stove, and the practice of the wood stove is diminishing. There is some dependence on off-farm procurement, which is less and mostly is on food crops and fodder. The production and commercialization diversification indices indicate that there is high commercialization in the area, where households produce 3 to 5 crops (including income from selling milk) and have good access to markets. Although on-farm production is diversified, results also show that there is substantial income from remittances and employment outside the farm. Also, there has been reduced access to formal credit sources.

4. Crop, livestock, land and water management changes

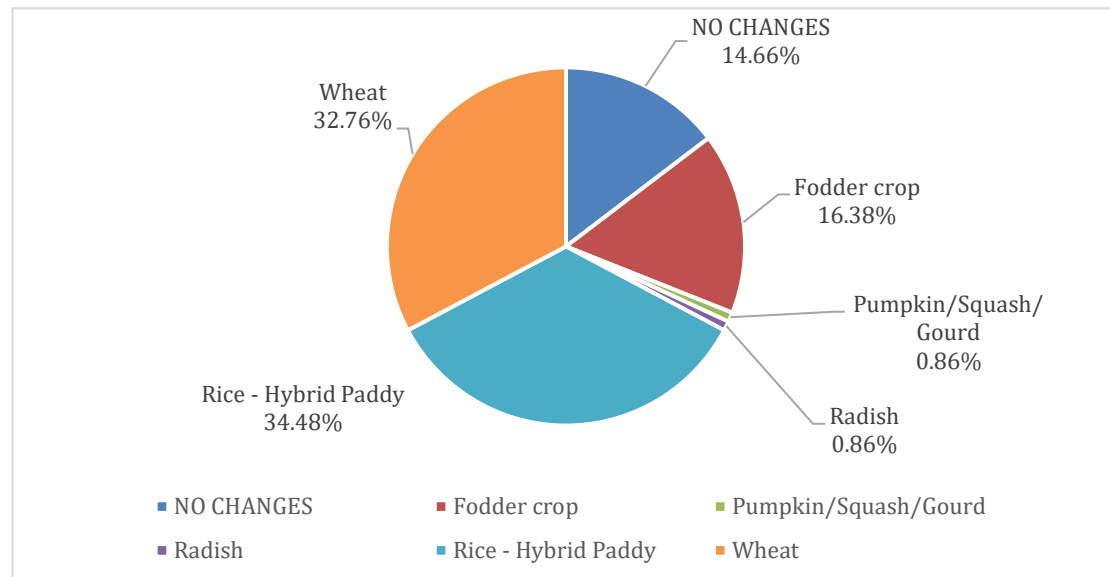
The major crops are rice in Kharif followed by wheat in winter. Some farmers go for vegetables; however, due to the high cost of manual labor they feel discouraged to bring more land under vegetable cultivation.

4.1. Crop-related changes

When the households were asked about their 3 most important crops currently grown by them, the number of respondent households came out to be 116 (n=116). As shown in (Figure 7), hybrid-paddy crops mostly of the basmati variety is the major crop for 34.48%, 32.76%

report wheat as their main crop, 16.38% report fodder crops as their main crop, whereas there has been no change for 14.66% of the households.

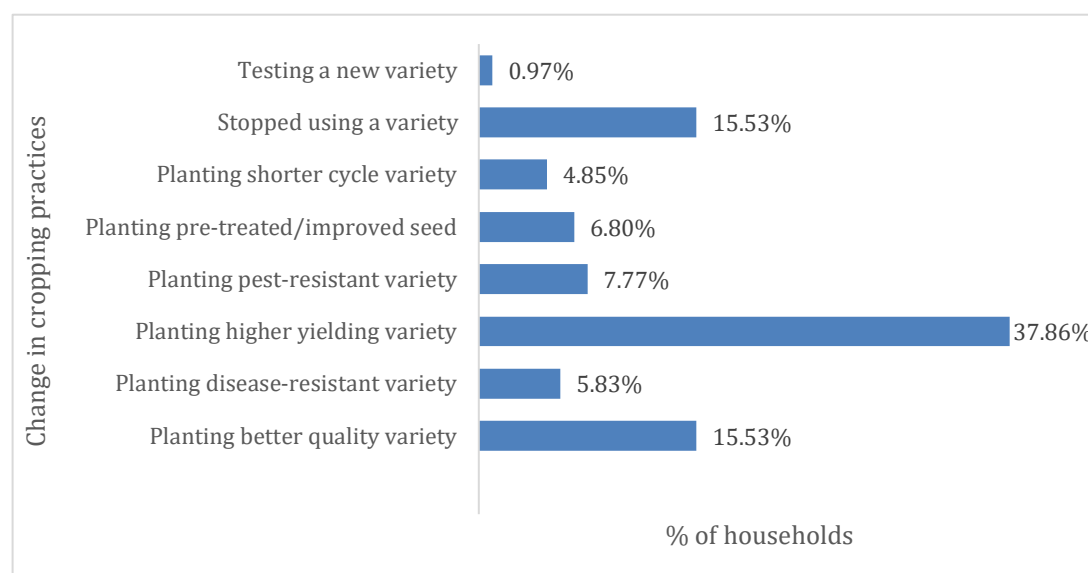
Figure 7. Main crops as per percentage of households cultivating them



Cropping-related changes

For cropping-related changes, analysis was done as to whether households had made one or more changes over the last 7 years. The fundamental changes made are introducing and planting new varieties of crops and planting high yield variety crops (Figure 8). Cropping-related changes have mostly happened with hybrid-rice (96.61%), wheat (84.75%), tomatoes (14.12%), and fodder crops (13.56%). As shown in Figure 7, the major change in cropping practices has been planting a higher-yielding variety (37.86%). It can be inferred that there is a high seed replacement rate in the area, due to awareness of the farmers and the need to sustain productivity. Most of the changes were related to changes in seed variety or treatment. We did not note any change in water or soil management practices over the last 7 years.

Figure 8. Changes in cropping practices



Adopters of new crops/varieties

The survey was followed up by inquiring about the changes they have made to their farming practices over some years and for which crop, and whether they introduced new crops or not. The result from the analysis shows that 74.45% of the surveyed households have not introduced any new crop, whereas the highest percentage of households (13.14%) introduced rice (hybrid paddy) as a new crop, followed by wheat (9.49%) as their new crop, followed by tomatoes (6.57%).

When an analysis was done among the respondent households on whether they are testing any new crop it was found that 93.98% of respondents are not testing any new crops. However, the highest percent (2%) of the households is testing maize as a new crop in the field as a fodder crop. Some farmers are thinking of trying maize but are worried about the market (Table 9).

Table 9. Number of new crops being tested in the surveyed households

New crop testing	No. of Households	% of households
No change	125	93.98
Carrots	1	0.75
Garlic	1	0.75
Maize	3	2.26
Mung beans	1	0.75
Okra	1	0.75

When the analysis was done if respondent households have stopped growing any crop completely, most of them, 76.62% have responded negatively. However, 25.38% of the households have completely stopped growing a few crops in the last 7 years. Some of the crops that are not being cultivated any longer are pulses, sugarcane and millets. A number of households have stopped growing tomatoes (15.38%), followed by okra (4.62%), and onion (3.85%). The primary reason for stopping cultivation of tomato has been the inability to generate market prices out of the tomato cultivation.

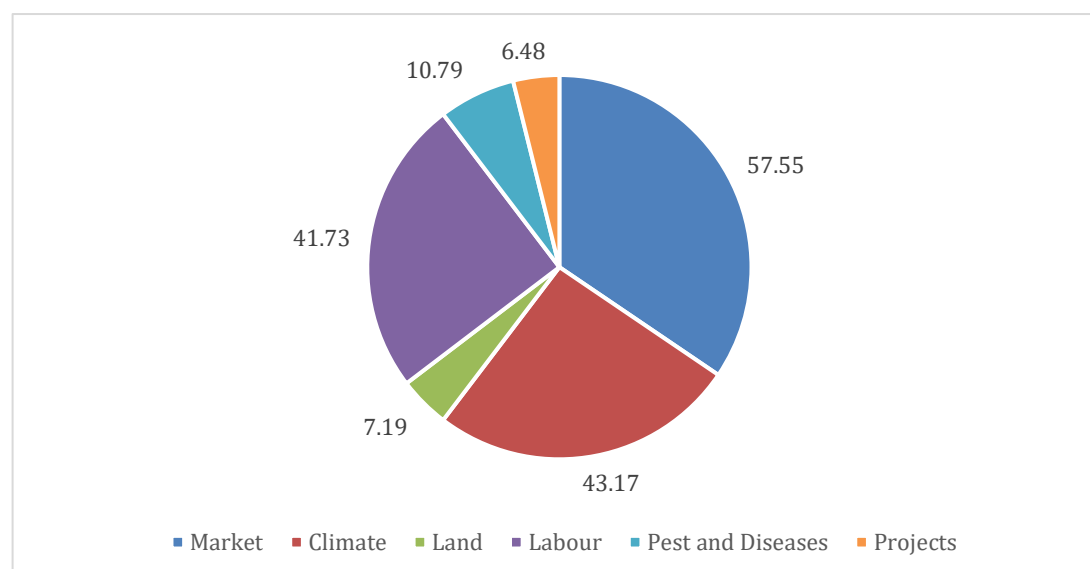
4.2. Reasons for crop-related changes

To understand the changes related to crops, six important reasons were cited by the households for making crop-related changes. The reasons are markets, climate, land, labor, pest and diseases, and government projects. For most households, changes are made due to multiple reasons and their interplay.

Among the 139 respondents, 99 households reported a change (n=99). About 11.11% of the respondents gave 4 or more reasons for the changes related to crops; 35.4% of the respondents cited 3 reasons for the changes; 23.2% cited two reasons; whereas 30.3% provided a single reason for the change.

As shown in Figure 9, the policies of the government regarding agricultural produce and its prices and the market dynamics play the most important role in making cropping related changes. About 57.55% of the households cited market as the major reason behind making cropping related changes. Change in climate is the second most important reason for changes in farming practices as reported by 43.17% of the households. There has been a shortage of labor in the area; laborers used to play a major part in transplanting, intercultural operations, and harvest. There has been a constant shortage of supply of laborers from the poorer eastern states of India, and 41.73% households cited this as the reason. The next major reason identified is attack of pest and diseases, quoted by 10.79% of the households. Decreasing fertility and availability of land is quoted by 7.19%, and lastly government projects, subsidies and Minimum Support Price (MSP) are the reason behind 6.48% of the households to go for a change related to crops.

Figure 9. Reasons for cropping related changes in surveyed households



Market-related changes

When probed further about market-related changes it was found that only three factors are considered by the farmers when changing farming practices (Table 10). These factors are getting a better yield, a better price, and a new opportunity to sell. During the baseline it was reported that there was a well-established setup of procurement with the food corporation of India along with the Agricultural Produce Marketing Committee in the area. Also, a large number of rice mills procure paddy from these local farmers. Previously in the report, it is reported that there exists a well-established presence and network of agriculture input companies. There have been issues of shortages in labor, leading to high mechanization, as well as loss in soil fertility.

Table 10. Market related reasons for changes in farming practices of principal crops

Market related reasons	% of households
Better yield	51.80
Better prices	23.74
New opportunity to sell	35.97

All farming households have adopted hybrid rice varieties (mainly basmati) and high yielding wheat varieties, mainly due to their high yielding potential. About 51.80% of the households are motivated by better yield (Table 10).

The second major reason for the surveyed households to make changes in cropping practices is if there are new opportunities to sell their produce, and 35.97% were of this opinion as to their reason for making changes in farming practices.

About 23.74% of households responded to the better price (i.e. the Minimum Support Price along with the going rate of the produce) as the third major determinant of the decision-making factor related to the market.

Climate-related reasons

Earlier, it was found that 43.17% of the households have made changes in crops or farming practices because of climate related issues. This issue can be further broken down into multiple reasons. As per the midline survey, eight reasons were identified, and those are more erratic rainfall, less overall rainfall, more overall rainfall, later start of rains, more cold spells or foggy days, rains stopped too early, higher temperature over the period of time, and lastly declining groundwater table (Table 11).

Table 11. Weather/Climate-related reasons for changes in farming practices in surveyed villages

Weather/Climate-related reason	% of households
More erratic rainfall	12.23
Less overall rainfall	16.55
More overall rainfall	0.72
Later start of rains	23.02
More cold spells or foggy days	5.04
Rains stopped too early	0.72
Higher temperatures	27.3
Lower groundwater table	34.5

The result from the climate-related reasons reveals that the majority of the households (34.5%) are impacted due to the lower groundwater table. In Pakhana village alone, the groundwater has gone down from 35 feet below ground level, i.e. BGL (in 2000) to 85 feet BGL (in 2019). This compelled farmers to change the engine power of their pump set from 5 HP to 15 HP or in some cases 20 HP. According to the respondents during FGDs, it was found that groundwater is getting polluted as the new industries coming up in and around the village are injecting wastewater into the underground aquifer without any treatment. There are canals in the area, which however are dry except during the monsoon season. Large land

holdings and lack of groundwater recharge and over-exploitation of the aquifers are concerns raised during the study.

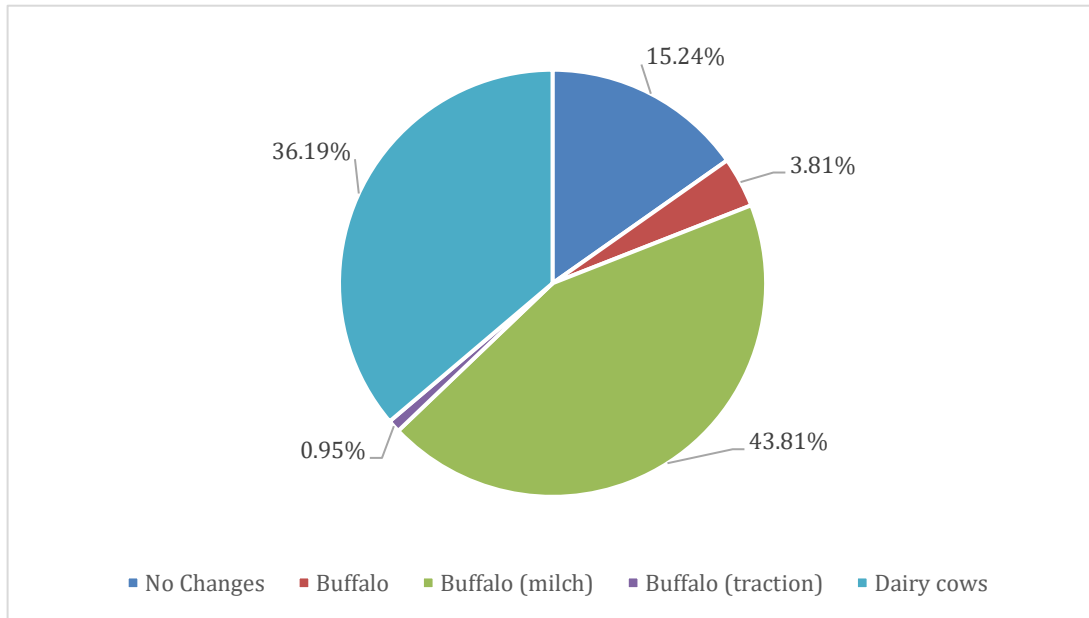
High temperature is mentioned by 27.3% of households as the second major reason for the change in farming practices.

The third major reason cited by the respondents (23.02%) is the late start of the rains which affects the farming practices, as the transplanting has to be done in a certain period, and irrigation is required mainly during the reproductive growth period (RGP) apart from the vegetative growth period (VGP). Another reason for the change in farming practices related to climate is overall less rainfall (16.55%). The respondents reported that recently there has been erratic rainfall, implying the need to exploit the groundwater for crop saving. Erratic rainfall has been cited as one of the reasons by 12.23%.

4.3. Livestock-related changes

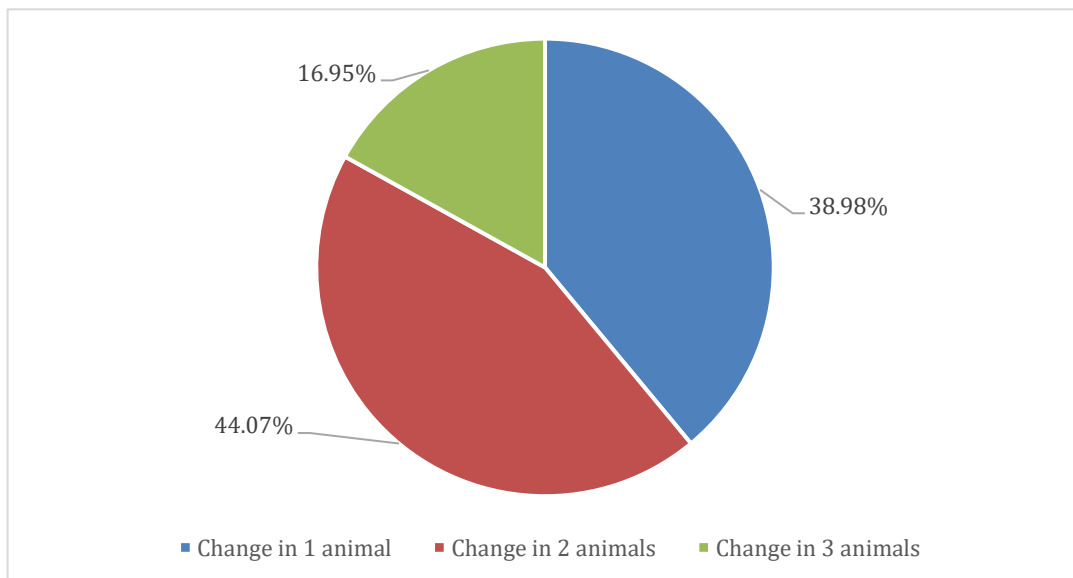
As shown in Table 4, the majority (87.05%) of the households do integrated livestock and agriculture (food crops and livestock rearing). Among the surveyed households, 75.54% cultivate food crops, fruits, and vegetables; whereas 12.95% of the households only rear livestock (only large animals such as buffalo for milk and manure). Livestock is a crucial component of the livelihood, economy generation and complementary resource for crop production. The byproducts of the crops are used as fodder for the livestock and dung in return is used to replenish the nutrients of the soil. Milk is a significant income for the households, and returns are immediate, unlike seasonal crops. This helps the households to have a regular income. The markets are well established, as reported earlier also, the respondent households have discontinued rearing small livestock owing to lack of grazing land. As milk production is other prominent activity apart from agriculture, buffalo (milch) is the most important animal, as shown in Figure 10, and about 44% of the respondents affirmed for the same. Dairy cows are the second most important, where 36.1% of the households said so. In the last 7 years, 15.24% reported no change in their three most important livestock.

Figure 10. Most important livestock



Out of the 59 of the households (n=59) who made some change in their herd of livestock, 38.98% of the household made changes in 1 animal, 44.07% in 2 animals and 16.95% in three types of animals (Figure 11).

Figure 11. Percentage of household making changes in number of livestock

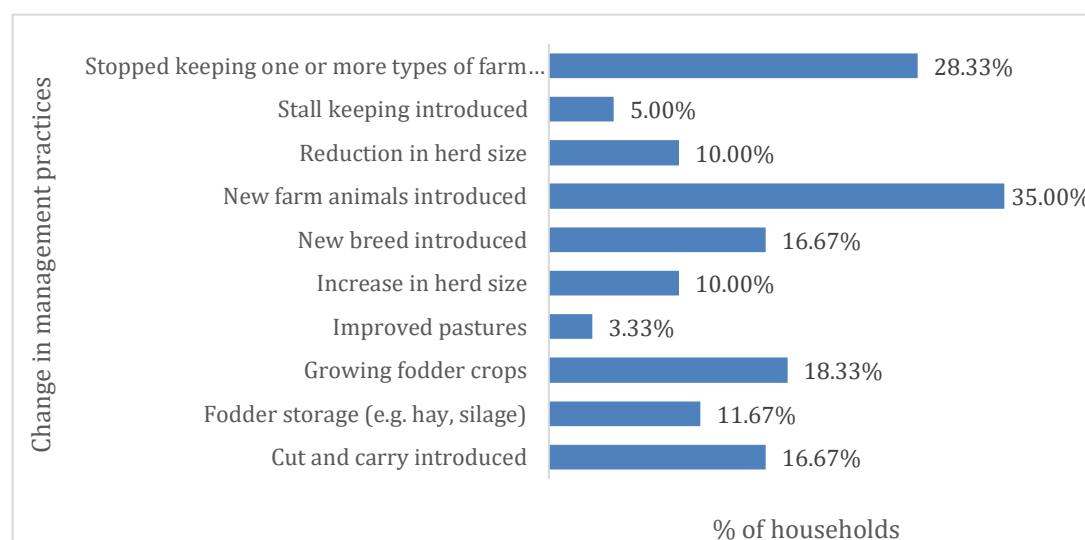


Changes in livestock management or rearing practices

When asked whether the household has made any changes related to the management of livestock practices, there were 93 responses (n= 93). The number of households which have made changes is 60. The major changes took place mainly in terms of introduction of new

farm animals, discontinuation in keeping of one or more farm animals, and introduction of a new breed as shown in Figure 12. About 35% have introduced a new farm animal and 18.28% of the households have stopped keeping one or more than one farm animals. The households which adopted the other practices are: growing fodder crops (11.83%), new breed introduction (10.75%), and introduction of cut and carry method (10.75%), as shown in Figure 12, however, the least percentage (3%) of households have made changes with respect to improved pasture.

Figure 12. Livestock-related changes made by surveyed households



4.4. Adaptability/innovation index

An adaptability/innovation index was defined as the following:

0 = 0 or 1 change made in farming practices over last 7 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 analysis concludes that the adaptability index in Karnal is intermediate as about half (51.1%) of the surveyed households has made 2-10 changes in both crops and livestock species.

Table 12. Adaptability/Innovative index

Number of changes made in last 7 years	Number of households	% of household
0-1 (low)	68	48.9
2-10 changes (Intermediate)	71	51.1
11 or more (High)	0	0

4.5. Discussion

As reported during the baseline study, most of the surveyed households own more than one hectare of land and adopt technologies promoted during the Green Revolution. Farmers have access to inputs like seeds, fertilizers, irrigation, and machinery. The farmers are progressive, and all the major input companies have a presence with an extensive network among the farmers. On land they observed no change in soil quality during the last seven years or so, as revealed during the FGD. They think that their soil is still 'best' for basmati rice production. The principal crops are hybrid paddy rice during Kharif, wheat during Rabi, followed by fodder crops. Some vegetables are grown throughout the year. The major change in cropping practices has been change in the seed variety by the introduction of short-duration, high yielding, disease-resistant better varieties of seeds. There has not been any change in soil and water management practices among the surveyed households. The crop production practices have been more or less the same in last 7 years. The determinant factors in changes related to crops are market, climate, and labor. Markets for sale of agricultural produce is quite vast and advanced in Karnal. There is a support of the government related to the Minimum Support Price (MSP), and therefore Karnal remains the food/ cereal bowl. Because of the high production in the area, various agro-processing industries have now been set up. All farming households have adopted hybrid rice varieties (mainly basmati) and high yielding wheat varieties, mainly due to their high yielding potential. There has been over-exploitation of the aquifers, and the groundwater table is depleting. There has been erratic and low rainfall increasing the dependence on groundwater. Livestock rearing is complementary and an activity which provides regular returns to the farmers. The crops and livestock have a symbiotic relationship. Milch buffalo and dairy cows are the two most important livestock animals in the area. The practice of rearing small livestock has been discontinued among the surveyed households as there is no pasture, and the households do not consider it remunerative. The changes in livestock have been mostly in terms of introduction of new animals. If we consider the adaptability and innovation index, then we conclude that the respondents of Karnal are at an intermediate stage.

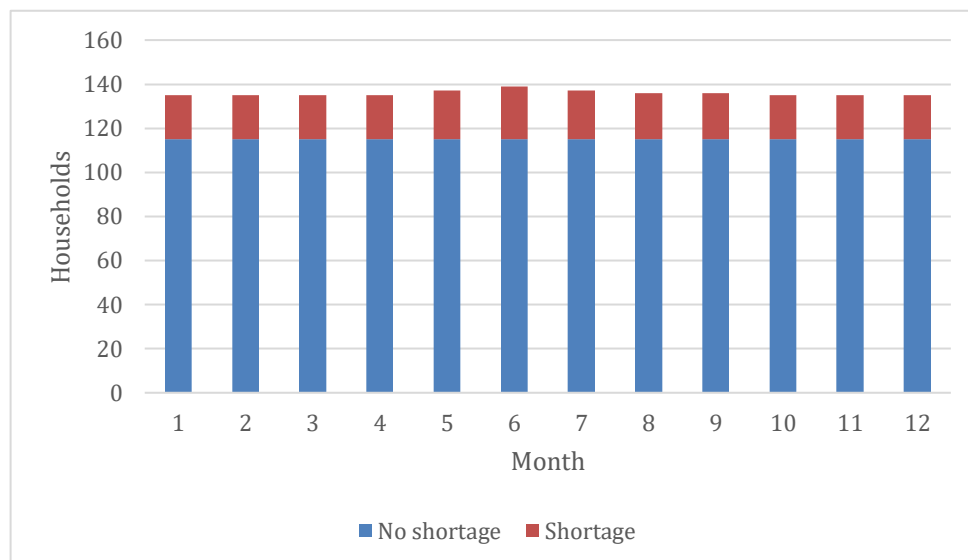
5. Food security

Survey respondents were asked about information regarding the sources of food for their households, including information related to the sources of the food and whether the food came from their own farm or elsewhere (off-farm) for each month of the year.

The results from the survey show that out of 138 respondents (n=138), 83.33% of the surveyed households acquired food from their own farmland throughout the year from January to December. The rest (16.67%) had to depend on food from outside sources.

The households were also asked about the period of the year when they struggled to have an adequate amount of food from any sources. A total of 25 households faced food shortages in at least one month of the year, where an average of 20.8 households faced hunger shortage throughout the year, the maximum number of households facing hunger was 24 which was observed in the month of June (Fig 13).

Figure 13. Hunger/Food shortage months



5.1. Food security index

The food security index is based upon the number of months that the household has difficulty getting food from any source (i.e. from their own farm or stores, gifts, purchases or transfers). For the surveyed households, 82% do not have a hungry period during an average year.

Table 13. Food security index

Percent of households reporting:				
More than 6 hunger months	5-6 hunger months	3-4 hunger months	1-2 hunger months	Food all year round/ No hungry period
13.7	0	0.72	2.88	82.73

5.2. Discussion

Households in Karnal are quite food secure and very few of the survey respondents reported facing food shortages. The result obtained from the midline survey noted an increase in hunger amongst the surveyed households by 17% as compared to the baseline survey conducted 7 years ago. The reported low rate of food insecurity was primarily due to high agricultural productivity in the area due to use of chemical inputs and irrigation coupled with diversified income sources from other livelihood activities to help the population remain food secure throughout the year.

6. Land and water

6.1. Water for agriculture

The two important crops of Karnal, rice and wheat, need irrigation four to six times in the absence of assured rainfall, which is erratic and low at best. The green revolution in the semi-arid region has brought prosperity among the farmers, and they have exploited the natural resources heavily. The groundwater table is going down quickly. The reaction of the farmer has been to install higher-powered pumps to extract groundwater. There is no facility of groundwater recharge. The canal system only runs during the monsoon.

In the analysis, it was found that 70.43% of households have access to an irrigation source, either owned or hired. The bore well (submersible) is the predominant source of irrigation with 70.43% households using it. Almost half of the households have access to water pumps for irrigation purposes as shown in Table 14.

Table 14. Water sources for agriculture on-farm

On-farm agricultural water source	Number of households	% of households
Irrigation	56	40.29
Tanks/infrastructure for water harvesting	1	0.72
Dams or water ponds	1	0.72
Boreholes	81	58.27
Water pumps (other type)	58	41.73

6.2. Land use

Survey respondents were asked about their land ownership (Table 15). About one-fifth of the households have more than five hectares of land, 53.96% of households have 1 to 5 hectares of land, and 25.9% of households belong to the marginal category (less than one hectare of land). Only 6 out of 139 surveyed households use communal land for certain activities. All categories of households used almost all land for crop production. There is no wasted land, but land is getting degraded due to indiscriminate use of chemical inputs. The majority of interviewed farmers (95%) reported they do not have any land available for expansion of cultivation.

Table 15. Total land size accessed by households

Number of hectares of land owned and rented in	% of households
Less than 1	25.90
1 to 5 hectares	53.96
More than 5 hectares	20.14

Communal land

Six of the surveyed households use communal land communal land for grazing, tree cover and crop growing.

Hired machinery and labor

The area is highly mechanized. The earlier abundance of cheap labor from the eastern Indian states has waned over years, which has compelled the farmers to mechanize their operations. However, among the intercultural operations, transplanting is still preferred by manual labor compared to the mechanized ones. Starting from land preparation to harvest and primary processing (dehusking, deseeding among others) machinery is used. It was found that 69.06%

of the households among the 139 respondents use machinery for agricultural operations. The rest of the households (39.94%) are either engaged in off-farm activity or other employment. For the farm operations, 75.54% of the households engaged hired labor, whereas the rest did not. The hired labor includes help in livestock farming.

6.3. Discussion

Karnal has been the epicenter of rural development, demonstrated through the Nilokheri experiment, and has been an intensive area for promotion of the green revolution. The irrigation facility is well developed, with 70.43% of surveyed households having access to an irrigation source; most of the households are depending on bore wells. Most of the farmers (54%) are mid-size farmers having one to five hectares. About one-fifth are large farmers having more than 5 hectares of land. Six of the surveyed households use communal land for grazing, tree cover, and crop growing. The area is highly mechanized, and 69.06% of the households among the 139 respondents use machinery for agricultural operations. The remainder of the households are either engaged in off-farm operations or other employment. For the farm operations, 75.54% of the households engaged hired labor.

7. Inputs and credits

The area is very progressive in agriculture and livestock farming, therefore there is widespread use of modern farming inputs and feed for the cattle. The results from the survey, as shown in Table 16 reveals that about 80% of farmers buy seeds, fertilizers, and pesticides from markets. The government agriculture department, as well as the animal husbandry department, provides seeds and inputs to the farmers for free. Also, many of the agricultural input companies that have a presence in the area do demonstration plots and provide seeds and some other inputs for free. About 81.29% of farm households purchased and used veterinary medicines.

About 18% of households had purchased crop insurance during the last 12 months. This figure was 4% during the baseline survey, signifying the increasing presence of general insurance companies in the area. When inquired about the weather-based insurance, 13% of the households have taken the insurance. During the baseline, this figure was 3%.

Table 16. Purchased input use

Inputs purchased last year	% of households
Improved seed	78.42
Inorganic mineral fertilizer	78.42
Pesticides/herbicides	79.14
Organic fertilizer	25.90
Veterinary medicines	81.29
Credit for agricultural activities	42.45
Crop or livestock insurance	17.99
Was the insurance weather-based?	12.95

7.1. Discussion

There has been increased awareness among the farmers about insuring their crop or livestock. While only 4% had agricultural insurance during the baseline, currently about 18% farmers are using it. Farmers are concerned about the vagaries of weather and have been insuring their crop against it. This is mainly due to the presence and extension services of both government and private players and the focus of the government to push the insurance schemes. The main push factor has been the Pradhan Mantri Fasal Bima Yojana (PMFBY), which was launched during 2016.

8. Climate and weather information

The analysis of the survey data reveals that 77% (against the baseline figure of 85%) of respondents get climate and weather-related information from various sources, including radio, television, government department (agricultural extension), private organizations and community members. Households receive information on extreme events, pest or disease outbreaks, the start of the rains and extended periods of weather information.

8.1. Information recipients in the households

About 68% of the surveyed households (95 households) reported receiving information on weather/climate over the past 12 months.

Table 17 shows the percentage of households receiving weather forecast-related information; about half of the households have access to the information about the rainfall onset. About

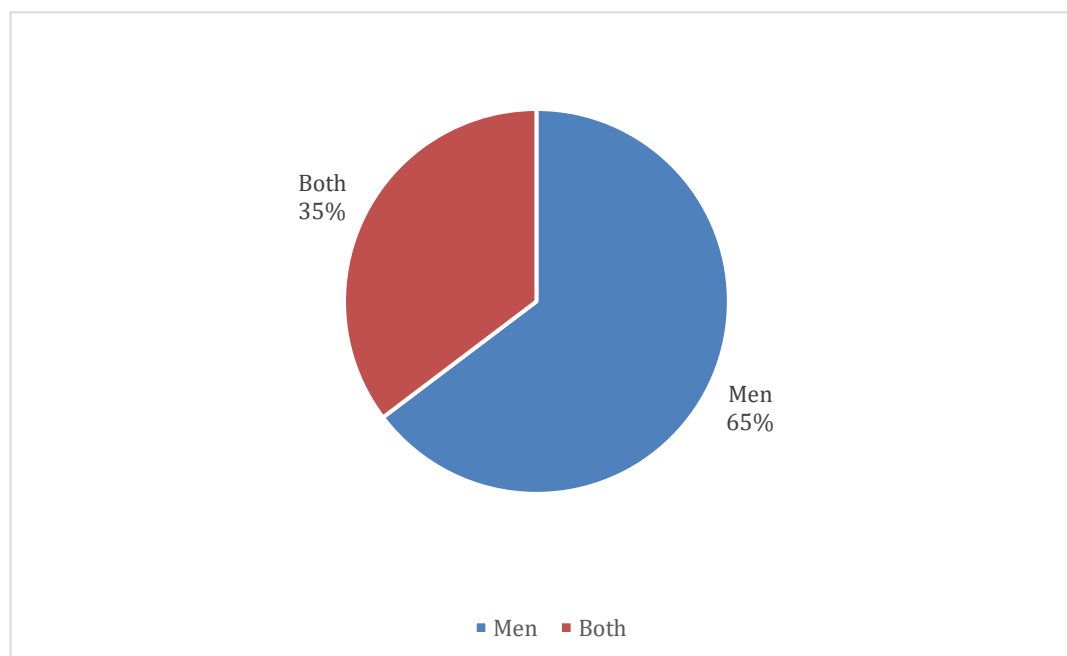
17% to 18% of the households access the information regarding weather forecast for the coming 2-3 months or weather for 24 hours or next 2-3 days.

Table 17. Type of weather-related information received by the surveyed households

Type of weather-related information	% of households
Extreme event	12.23
Pest or disease outbreak	2.16
Start of the rains	51.80
Weather for the following 2-3 months	17.27
Weather for today, 24 hours and/or next 2-3 days	17.99

Both male and female members of the surveyed households get information on weather. However, in most cases, males are the primary recipient of the information from the external sources in Karnal. Sixty-five percent of households reported that the forecast information is received by men only, but there are some households in which both males and females receive weather-related information.

Figure 14. Gender breakdown of different kinds of weather-related information



8.2. Types of weather-related information

Extreme events

All 17 households that reported receiving information related to extreme events said they get this information through television, signifying the spread and popularity of the medium compared to others. While about 59% get weather information on extreme events through the newspaper, about 30% of them get the information on extreme events through friends, relatives or neighbors. About 47.6% of the surveyed population access related information through cell phones (Table 18). Radio is not an important source of information in the surveyed site. When queried about who gets the information in the household, 17 reported that they receive information through someone in the house. In 11 households the information is received by the men only; in 5 households it is received by both men and women; however, in only one household the woman receives the information.

Table 18. Sources of information about extreme events

Source of information on extreme events	% of respondents
Television	100.00
Government agricultural extension or veterinary officers	5.88
Friends, relatives or neighbors	29.41
Newspaper	58.82
Your own observations	17.65
Local group/gatherings/meetings	5.88
Cell phones	47.06
Internet	58.82

Forecasts of the start of the rain

As shown in Table 18, in Karnal television is the main source for the forecast of rains followed by cell phones (81%) and Internet (76.82%). The weather updates are generally fed to the television channels by the Indian Meteorological Department. As most of the households have a TV set, the information is easily accessible. Also, most of the households are progressive farmers, and affordable internet provides information about such forecasts with installed applications in smartphone devices. Newspapers and friends and relatives are the next essential sources of information which were accessed by 25.61% and 34.15% households, respectively. Own observations based on experiences account for 20.7% of the households; Government offices provided the prediction of start of rainfall to only 2% of

surveyed households. Some of the households get such information through local people, particularly during meetings or Satsang (gatherings) in the Gurudwara.

Among the surveyed households, 82 households receive information about the start of the rains. In 57.31% of the cases (47 households among the 82), the information is received by men; followed by 32 households (39%) where information is received by both men and women; and lastly by women only in 2 households (2.4%).

About 36% of households receiving information on the prediction of start of rainfall reported that they obtained cropping advice along with the forecast, however, only 45% of them (18 households) could utilize the advice in changing cultivation practices. Fourteen households reported that they made changes in land management practices, according to forecasts for the start of rainfall.

Table 18. Sources of information on the predicted timing of the start of the rains

Source of information on start of the rains	Number of households	% of household
Television	72	87.80
Government agricultural extension or veterinary officers	7	8.54
Friends, relatives or neighbors	28	34.15
Meteorological offices	1	1.22
Newspaper	21	25.61
Your own observations	17	20.73
Local group/gatherings/meetings	9	10.98
Cell phones	67	81.71
Internet	63	76.83

Change in the farming aspect as a result of the information about the start of the rains

About 59% of the respondents have changed the timing of their farming activities as a result of the information about the start of the rains, followed by change in irrigation (38%) and change in agricultural inputs (seed, fertilizer, pesticides) (24%).

Table 19. Change in farming aspects due to information about the start of the rains

Changed aspects of farming	Number of households	% of households
None	2	5.41
Land management	8	21.62
Crop type	4	10.81
Crop variety	7	18.92
Change in inputs (seed, fertilizer, pesticides)	9	24.32
Use of manure/compost/mulch	5	13.51
Change in timing of farming activities	22	59.46
Irrigation	14	37.84
Changes in the strategy of purchases and sales of produce and inputs	7	18.92

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

In India, the Indian Meteorological Department and local weather stations apprise the local residents about the upcoming weather updates. In the surveyed villages in Karnal, 19% of surveyed households received weather forecasts for the next 2-3 months, and 23% of households obtained weather forecasts for the next 2-3 days.

For the information about the 2-3 months' advance prediction, the most important source of information in providing weather forecasts of the given periods is television (84.6%), followed by cell phones with 65.3%. About 42.3% of the information on 2-3 months advanced prediction is accessed with the help of internet. Newspapers also provide forecast to 34.62% of the respondents (Table 20).

Table 20. Sources of information on 2-3 months advance prediction

Source of information on start of the rains	% of responses 2-3 months
Television	84.62
Government agricultural extension or veterinary officers	3.85
Friends, relatives or neighbors	7.69
Newspaper	34.62
Your own observations	7.69
Cell phones	65.38
Internet	42.31
Other	3.85

Among the surveyed households, 23 reported that someone in the household receives the information about 2-3 months' advance prediction; among these the men receiving the information is highest with 17 households (73.91%); followed by both men and women in 5 households (21.74%); and only in one household is it received only by the women (4.35%).

Information on 2-3-day advanced prediction

For the information about the 2-3 days' advance prediction, the most important source of information in providing weather forecasts of the given periods is cell phone (83.87%), followed by Internet (74.19%), and television (74.19%). About 48% get the information from newspapers, and approximately 42% get the information from their own observations.

However, radio as a source (3.23%) was the least preferred (Table 21).

Among the 28 households which reported the data, in 18 households (64.29%) only men receive the information and in the remaining 10 households (35.71%) the information is received by both men and women.

Table 21. Sources of information on 2-3-day advance prediction

Source of information on start of the rains	% of responses 2-3 day forecast
Radio	3.23
Television	74.19
Friends, relatives or neighbors	38.71
Newspaper	48.39
Your own observations	41.94
Cell phones	83.87
Internet	74.19

8.3. Discussion

The spread of the internet has been the major change from the baseline as people now get the information through their smartphones and internet. As most of the households own televisions, the weather-related information is received through that medium. Generally, males are the prime receiver of the information. Informal networks with friends and neighbors also help people get the information. The major coping strategy has been changing cropping timing. Also, farmers have to depend on groundwater for irrigation. As the area is progressive in agriculture and livestock rearing, the farmers have adequate coping mechanisms. However,

the depleting of groundwater table is a concern given the erratic rainfall. Water harvesting and groundwater recharge are immediate needs.

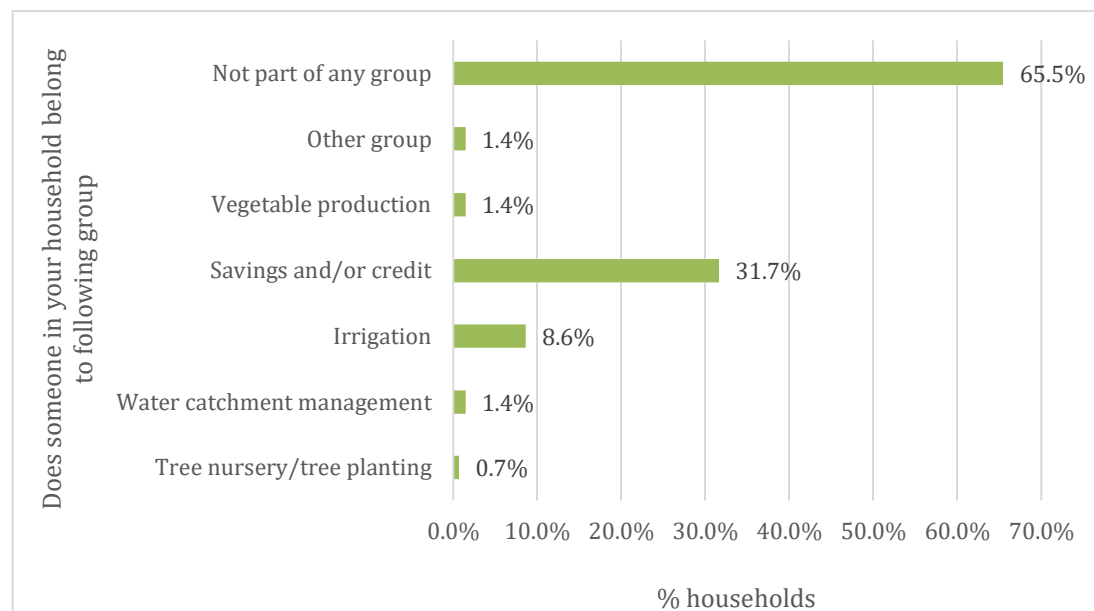
9. Community groups

Community groups are affinity groups, which are formed to perform functions and efforts related to production, marketing, savings and credit, and water use. Sometimes such groups are required to access subsidies/benefits provided by the government.

Out of the 139 surveyed households, members from 48 households belong to any group. There are 36.6% of the households which has only one member having affiliation to a community group, 7.19% of the households have members having affiliation to two community groups, and one household (0.72%) having membership in three community groups.

As shown in Figure 15, 31.7% of the households surveyed belong to savings and credit groups. In the villages, a lot of work has been done by civil society organizations (CSOs) and the Haryana State Rural Livelihood Mission, which has formed Self Help Groups among women. There are 8.6% of the households who are part of community groups on irrigation. About 1% of households are part of the vegetable production groups, water catchment groups, and other groups. One household is part of a tree planting group (0.72%). Gurudwaras in the area are essential institutions which bring the community together; along with religious and spiritual services they take up various important social matters.

Figure 15. Community group membership



9.1. Climate-related crisis

The survey team asked the households whether they have faced any climate-related crises (e.g. flood, drought, frost, tidal surge) in the last 5 years. Forty-eight households (35.25%) reported experiencing a climate-related crisis, while the rest (64.75%) of the households conveyed that they have not felt any climate related crisis in the last 5 years. Six out of the 48 households reported that they received some help in dealing with the crisis

9.2. Discussion

The affiliation with community groups has increased, noting the increased social capital among the people in the area. Most of these community groups are women's Self-Help Groups (SHGs) promoted by CSOs or the Haryana State Rural Livelihood Mission. The other most important affiliation with a community group is in irrigation. Membership in other community groups is insignificant and are related to agriculture. About 35% of the surveyed households had faced a climate-related crisis in the last 5 years, and many of these (42 out of 48) did not receive any help in facing the crisis.

10. Assets

The midline survey repeated the exercise to assess the ownership of different types of assets among the households such as:

- Transport: Bicycle, motorcycle, car, truck
- Energy: solar panel, generator (electric or diesel), battery, biogas digester, LPG
- 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

Similar to the baseline, there has been progress in Karnal in terms of asset ownership. During the baseline, 96% of the households owned more than 4 assets. However, currently 98% of the households own more than 5 items.

As shown in Table 22 about 88% of the households use a motorcycle as their primary means of transport, and about half of surveyed households own a car or truck. Bicycles are still a common mode of transport, owned by 63.31% of households. (Table 22).

Table 22. Ownership of transport assets

Transportation assets	Number of households	% of households
Bicycle	88	63.31
Motorcycle	123	88.49
Car or truck	69	49.64

As shown in Table 23, among production assets, 30.22% of surveyed households have a mechanical plough. As mentioned earlier, pumps and treadle pumps are very common in the area for extraction of groundwater, and 42.45% of households own such equipment. There are 11 households (7.91%) which own threshers. Other production assets are in few numbers among the households.

Table 23. Ownership of various production assets

Production assets	Number of households	% of households
Water pump/Treadle pump	59	42.45
Mechanical plough	42	30.22
Mill (for grinding cereals or oilseeds)	5	3.60
Thresher	11	7.91
Motor powered spraying tank	1	0.72

As shown in Table 24, most of the households (96.4%) have Liquid Petroleum Gas (LPG) connections at home. This was 84% during the baseline, and much has happened after the Pradhan Mantri Ujjwala Yojana, the scheme that ensures free LPG connection to poor households. As reported earlier, the area is prosperous, and 29.5% of the households have a battery (large, e.g. car battery) to be used during power outage. For the same reason, about 8.63% of households own a generator. These households are comparatively wealthy in their village. Solar panels and biogas digesters are not common energy assets in the study area which are present in 5% and 1% of the households, respectively.

Table 24. Ownership of various energy assets

Energy assets	Number of households	% of households
Solar panel	7	5.04
Generator (electric or diesel)	12	8.63
Battery (large, e.g. car battery for power)	41	29.50
Biogas digester	2	1.44
LPG	134	96.40

Survey respondents were also asked about the ownership of information assets, e.g. radio, television, cell phone, computer, and internet. Among these, the TV is the most common asset owned by households (99.28%) households. Only one household among the 139 does not have a television set. The mobile revolution has reached almost every household, and 137 households (98.56%) have it. Most of the households now compared to 2012 have smartphones and cheaper internet tariffs have made internet access possible for 57.55% households. Computers are owned by 28% of the households; however, the popularity of radio is on the decline and is owned by only 2% of households.

Table 25. Ownership of information assets

Information assets	Number of households	% of household
Radio	3	2.16
Television	138	99.28
Cell phone	137	98.56
Computer	39	28.06
Internet access	80	57.55

The ownership of luxury assets is very high among the surveyed households. Almost all the households (98.56%) have a bank account; electric fans are owned by 99.28% of the households. A refrigerator is owned by 93.53% of the households. An air conditioner is owned by 35.25% of the households (Table 27).

Table 26. Ownership of luxury assets

Luxury Assets	Number of households	% of households
Refrigerator	130	93.53
Air conditioning	49	35.25
Electric fan	138	99.28
Bank account	137	98.56

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)

Almost all households possess different assets in the surveyed villages. The majority of households (99.28%) belong to the high asset level category and less than 1% of households are in the intermediate asset category. None of the surveyed households belong to the basic level asset category (Table 27).

Table 27. Asset index of the farm households in Karnal

Number of queried assets	Number of households	% of households
None (basic level)	0	0.00
1-3 (intermediate level)	1	0.72
4 or more (high level)	138	99.28

10.2. Discussion

There has been a progression from baseline to the midline in terms of asset ownership. While during baseline 96% of the households owned 4 or more assets, currently 98% of the households own 5 or more assets. The highest ownership is among the luxury assets. However, this is because of the agricultural production, remittances and the bustling economy of the area.

Appendix

Appendix 1. Study team members

List of enumerators and survey team members

- Anand Keshri
- Dhananjay Kumar
- Dhananjay Kumar Singh
- Kanchan Kargwal (Ms.)
- Rahul Ranjan Puri

All enumerators

- Sanjay Prasad (Team Leader)

Appendix 2. List of villages in Karnal

List of villages covered in the midline

- Pakhana
- Gangar
- Kudak Jageer
- Lalaini
- Shekhanpur
- Dadupur
- Kurali