CHAPTER 3

AGRICULTURAL AND ENVIRONMENTAL CHALLENGES FACED BY FARMERS

There are many problems that a farmer has to confront in carrying out agricultural activities. Some of them are discussed below:

AGRICULTURAL PROBLEMS FACED BY FARMERS:

(1) LACK OF RESOURCES: Agriculture requires resources such as capital, seeds, equipments, machinery etc but unfortunately not every farmer has hands on resources required in the farming and he has to suffer. Cardinal resources for agriculture are as following;

(a) Seeds: Seed is an indispensable input required in agricultural production. For realizing the optimum crop yield, it is essential to have good quality of seeds. A good harvest needs a good quality seed. It is very important to assure that the good quality seeds are available to the farmer. Unfortunately, distribution of good quality seeds is not up to the mark specially to the small and marginal farmers. Due to the exorbitant prices of market rates mostly farmers are compelled to use the inferior quality of seeds which in turn leads to a substandard produce.

(b) Lack of mechanisation: Agricultural implements and machinery are a crucial input for efficient and timely agricultural operations, facilitating multiple cropping and thereby increasing production. In most parts in our country agricultural operations are still carried out manually with the help of conventional tools and implements like sickle, wooden plough etc. Many agricultural activities such as ploughing, sowing, weeding, harvesting, threshing, irrigating to name a few are still done manually with the age-old techniques and implements. Using such old implements and techniques not only requires an ample amount of time but it also leads to wastage of labour and lower yields per capita labour force. Mechanization of the agricultural operations to avoid wastage of labour force and making farming convenient and efficient is the need of the hour.

(c) Inadequate storage facilities: In India, Food Corporation of India (F.C.I.), the Central Warehousing Corporation (C.W.C.) and State Warehousing Corporation are among the principal agencies engaged in warehousing and providing storage facilities in the rural areas. These agencies help in building up buffer stock, which can be further used for distribution in the market as and when a need arises. In spite of these agencies, storage facilities are inadequate in some parts of the country. With these conditions, farmers are left with no choice but to sell their produce instantly after harvesting, such distress sale makes the entire venture inefficacious.

(d) Inadequate transport: At present, there are lakhs of villages in our country which are not well connected with main roads or with main market centres located in the city. Most of the roads in these villages are Kutcha (bullock- cart roads) roads which become inoperative in the rainy season. It is very important that each and every village is well connected with the main centre with cheap and efficient means of transportation. Until the villages are not well connected, the farmers cannot carry their produce to the main market and are forced to sell it in the local market at lower prices (Mondal, 2017).

(2) LACK OF KNOWLEDGE: Many farmers in rural areas do not have access to updated information on how to grow food efficiently and economically. Along with equipping the farmers with the physical resources, improving their knowledge of utilizing and applying new technologies, effective techniques can also increase the level of production considerably. (Rosegrant & Cline, 2003). Education is the means through which farmers witness not only surge in the income, but it also helps in augmenting the sources which can assist the farmer in agricultural process and hence, increase the sustainability of agricultural practices. Feder, Lau, and Slade (1987), showed that the Training & Visit system of agricultural extension implemented in India resulted in "a high probability of at least an acceptable rate of return to intensified

extension". Analysis of their study brings out the fact that education helps in improving the management of the farm rather than upgrading to new inputs.

(3) LACK OF FINANCIAL ASSISTANCE: Capital is the first and foremost requirement to carry out any trade. With the advent of new technology, it has become even more capital-intensive agriculture. Since many of the farmers in our country are small and marginal farmers, they are bound to borrow money for carrying out the agricultural activities. The main suppliers of money to the farmer are the money-lenders, traders and commission agents who charge high rate of interest and purchase the agricultural produce at very low price. Though there are banks, cooperatives and other such institutions which provide farmers with low interest loan facilities, however, farmers look forward to local money lenders, commission agents for raising the loan. These moneylenders charge excessive high rate of interest. The farmers contemplate over taking the loan from these moneylenders only to avoid the paper work and other formalities involved in other institutions (Suman, 2017).

(4) LACK OF MARKET CHANNELS: The Indian Council of Agricultural Research defined agricultural marketing as involving three functions (1) Assembling (2) Processing and (3) Distribution. Marketing is the process which involves transferring the agricultural products from producers to consumers. There are various challenges and hindrances concerning agricultural marketing in India such as unregulated market, lack of storage facilities, lack of information system and lack of organization of farmers. Due to lack of such situation, many farmers are compelled to carry on the distress sale of their produce soon after the harvesting, to the middlemen in order to meet their commitments and pay their debt. However, given the storage facilities, farmers would be able to store their produce and sell it on remunerative price (Suman, 2017).

(5) PROBLEMS RELATED TO IRRIGATION: Irrigation is an essential component for the agricultural process. Unfortunately, there are vast areas in our country which are left unirrigated due to its erratic and uncertain climatic conditions. Hence, it is crucial to take note of the irrigation facilities present in

our country. There are various ways through which farmers can irrigate their farms such as ground water irrigation, canal irrigation, rainfall etc. An assured supply of the irrigation is the key for the sustained progress of the agricultural production. However, over-irrigation or faulty irrigation has its own implications. Intensive irrigation lead to the sharp rise in sub-soil water level which further results into water-logging, soil salinity and alkalinity. Over irrigation leads to water-logging which decreases the soil productivity. In case of water-logging, excess water causes water table to rise and as water evaporates salt present in water is left behind in the soil, making the soil saline. This is called salinization of the soil which makes soil unsuitable for cultivation as it become difficult for plant to absorb water from the soil. The problem of salinization is more intense in arid and semi-arid regions as these regions are prone to intensive irrigation, higher rates of evaporation and lower amount of rainfall to wipe out the salts accumulated in the soil.

(6) NEED FOR PRICE STABILISATION: The Agricultural Cost and Price Commission is the authority in India to decide the aspects of price policy, such as Minimum Support Prices (MSP), Procurement Prices (PP), Issue Prices of Food-Grains (IPF). Price fluctuations may spell a disaster in both scenario of either rising or falling of prices. In case of surge in the prices, the consumers suffer and in the event of price plunging inflict huge loss to the farmers and also discourage the farmer to grow the same crop in subsequent year (Suman, 2017).

ENVIRONMENT RELATED PROBLEMS:

Some of the environmental challenges faced by farmers are as follows: -

(1) SOIL DEGRADATION: Soil degradation pertains to deterioration of potential productivity of soil as result of various anthropogenic actions and in-actions. It entails decline in performing and regulating environment functions. (Young, 1998). There are various forms of soil degradation which includes soil erosion, loss of fertility, deforestation, contamination of water resources and pollution of air etc. (Pathak, 2010). Though the problem of soil degradation has been there since the inception of cultivation of soils. However, the situation has aggravated

in recent years; the main reason being the growing population and increasing pressure on the soil (Aulakh et al., 2015).

(2) CLIMATE CHANGE: Climate change is important in determining the agricultural production. Climate change refers to changes in the climate observed over time. It is accompanied by the alteration in the composition of global atmosphere and variability in natural climate (IPCC, 2007). The food production works under the confluence of various biotic and abiotic factors. Therefore, slightest change in the climatic conditions bear huge ramifications in the agricultural production. Carbon dioxide is greenhouse gas responsible for the growth and development of the plant. On the other hand, increase in the amount of carbon dioxide can significantly increase the temperature globally. The combined increase in temperature and variability of rainfall would considerably affect food production. Some studies indicate a probability of 10-40 % loss in crop production in India with increase in temperature by 2080–2100 (Aggarwal, 2008). IPCC has projected that by the end of the 21st century, rainfall over India will increase by 10-12 percent with more frequent and heavy rainfall days while the mean annual temperature will rise by 3-6°C (IPCC, 2014). In countries like India, the problem of climate change could be catastrophic as farmers here are not well equipped with the technological and financial capability to adapt and mitigate the climate change. India's surface temperature has increased by 0.3 °C to 0.08 °C per decade. Lately, the climate change has been followed by increased incidence of natural calamities such as droughts, floods, cyclones and heat waves (Goswami et al., 2006). Such disastrous events can cause a decline in the agricultural output, aggravating the problems of food insecurity and rural poverty (Birthal et al., 2014).

(3) WATER POLLUTION: Water pollution can be defined as deterioration of original characteristics of water by addition of any contaminants rendering unfit for human consumption and supporting biotic life. Pollution in the water sources occurs when pollutants are discharged into the water bodies directly or indirectly without being adequately treated and removing harmful substances. Agriculture is the main source of water pollution as practices followed in

cultivation affect the quality of ground water to a large extent. Intensive cultivation and extensive irrigation of crops leads to leaching of harmful chemical substances present fertilizers and pesticides. Leaching is the process which involves seepage of chemical present in the pesticides and fertilizers into the ground water causing ground water pollution. Irrigation run-off from the field, indiscriminate application of fertilizers and pesticides in the field and negligent disposal of industrial and domestic waste are recognized as significant source of water pollution (Agrawal et al., 2010).

(4) OVERUSE OF CHEMICAL FERTILISERS AND PESTICIDES:

(a) Pesticide usage: Pesticides (insecticides, fungicides and herbicides) are used to eliminate the harmful insects, microorganism and other pests from the crops to check the crop losses due to pest attack, diseases and weed competition. However, pesticides are designed to kill all the organism comes in contact with. It implies that pesticides do not only kill targeted organism, they also kill other non-targeted organisms. Efficiency rates of pesticide application are very low. Some studies estimate that less than 0.1% of pesticide applied to crops actually reach the intended pest. The remaining pesticide accumulates in the surface of soil and further it may filter into ground water and pollute the water table. Pesticides residue present in the soil may harm the other organisms such as earthworms, fungi, bacteria that are beneficial for the soil. Exposure of pesticides to the domesticated livestock and other biodiversity can also prove to be toxic (Rajendran, 2003).

(b) Chemical fertilizer usage: Fertilizers can be defined as supplements derived from nitrogen (N), phosphorous (P), potassium (K), calcium, magnesium and other micro nutrients to enhance the per area yield of the crop and hasten the growth. Fertilizers can be classified as organic and inorganic. Organic fertilizers are those which constitute natural products constituting decayed or partially decayed organic contents and green manure. These fertilizers are bio-degradable, Whereas, inorganic fertilizers are derived from synthetic means making them non-biodegradable (önder

et al., 2011). Fertilizers have helped the farmers in hastening the growth of crops and in increasing the yield. They have played a major role in bringing the green revolution and making our country self-sufficient in grains and accomplishing the task of import substitution policy of the nation. However, indiscriminate application of these fertilizers results into adverse implications on soil fertility, water quality, greenhouse gas emissions. Average fertilizers efficiency is around 30 to 50 percent which means that a large amount of fertilizers is left unabsorbed and accumulates in the soil. These nutrients can get transferred in eco system in many ways. A high amount of nitrogen fertilizers can lead to soil acidification, a condition which results into toxic level of aluminium and manganese and reduction in the proportion of essential nutrients. Rainfall and surface run off can also lead to leaching of nitrogen accumulated in soil making ground water contaminated. Discharge of excessive nitrogen in adjacent water bodies can also lead to state of eutrophication (excessive nitrogen concentration) resulting in algal blooms, depletion of oxygen level in that water body and killing of biotic life, leading to creation "dead zone". Nitric emissions also contribute to air pollution by formation of smog, ozone and acid rain (Killebrew et al., 2010)

(5) IMPROPER IRRIGATION: Irrigation is very crucial in agriculture without which agriculture cannot sustain. However, it is very important to irrigate the crop in right amount and on right time otherwise it is futile. Inadequate irrigation can cause crop failure. On the other hand, excess irrigation can cause environmental problems including rising salinization, soil erosion and so on.

(6) MONOCULTURE: Monoculture is a component of agriculture intensification in which single crop is cultivated in the same field. Farmers are adopting monoculture in lieu of economic gains and market requirements. Nonetheless, monoculture impacts the environment in an adverse manner. Monoculture provides a narrower range of habitat than polyculture fields, resulting in reduced population of bees, flies, birds, moths which provide pollinating and pest controlling service to the crops. As a result of this, monoculture is more susceptible to insect infestation which increases its

dependency on pesticides than polyculture. Monoculture has also altered the cultivation periods as it leads to continuous cropping without keeping the land fallow and rotation with other crops to manage soil fertility. Without the adequate soil fertility management, soil eventually develops nutrient deficiencies and results into decline in soil fertility in consequent years (Killebrew et al., 2010).

(7) DEPLETION AND CONTAMINATION OF GROUND WATER: Ground water is considered contaminated when amount of certain pollutants increase beyond the prescribed limits for drinking (Report of the Inter-Ministerial Group for 'Arsenic Mitigation', Ministry of Water Resource, GOI, 2015). Contaminants found in ground water include arsenic, fluoride and iron which are geogenic in nature. Apart from that other contaminants are bacteria, phosphates and heavy metals which are anthropogenic, that is, humans are responsible for such contamination from their activities such as agricultural practices, domestic sewage and industrial pollution (Planning Commission, 2013). The reason of contamination is pollution created by landfills, septic tanks, leakage of underground tanks and overuse of fertilizers and pesticides. It is estimated that nearly 60% of districts in India face issues of either unavailability of ground water or bad quality of ground water (Planning Commission, 2013). It is pointed out that power subsidies provided in agriculture are mainly responsible for decline of water levels. As in 2009, 89% of extraction of ground water was for irrigation and 11 % for domestic and industrial use (Annual Report 2013-14, Ministry of Water Resources).

After discussing the problems faced by the farmers in general we shall focus on the problems faced by the respondents (selected farmers) of the study.

VARIOUS PROBLEMS FACED BY RESPONDENTS:

During the various stages of agricultural process. a farmer encounters various issues and challenges. An effort was made to note the agricultural and environmental problems confronted during the course of agriculture process. In the following section researcher tried to take note of the problems related to agriculture and environment, followed by health challenges faced by the farmer in agriculture. Table 3.1 deliberate on the agriculture and environmental issues of the respondents.

Table 3.1

Distribution of respondents on the basis of problems faced by the respondents

Various problems faced*	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
AGRICULTURE RELATED PROBLEMS							
Depletion of ground water	129 (86.0%)	12 (80.0%)	141 (85.5%)	77 (74.8%)	12 (100.0%)	89 (77.4%)	**230 (82.1%)**
Overuse of pesticides and fertilizers	86 (57.3%)	13 (86.7%)	99 (60.0%)	61 (59.2%)	11 (91.7%)	72 (62.6%)	**171 (61.1%)**
Loss of productivity	54 (36.0%)	6 (40.0%)	60 (36.4%)	68 (66.0%)	11 (91.7%)	79 (68.7%)	**139 (49.6%)**
Lack of resources	18 (12.0%)	4 (26.7%)	22 (13.3%)	5 (4.9%)	0 (0.0%)	5 (4.3%)	**27 (9.6%)**
ENVIRONMENT RELATED PROBLEMS							
Late onset of monsoons	94 (62.7%)	3 (20.0%)	97 (58.8%)	46 (44.7%)	0 (0.0%)	46 (40.0%)	**143 (51.1%)**
Uneven and unpredictable rainfall	95 (63.3%)	3 (20.0%)	98 (59.4%)	24 (23.3%)	2 (16.7%)	26 (22.6%)	**124 (44.3%)**
Contamination of water sources	28 (18.7%)	7 (46.7%)	35 (21.2%)	47 (45.6%)	11 (91.7%)	58 (50.4%)	**93 (33.2%)**
Damage from extreme climate like heavy rain fall, hail stones	39 (26.0%)	4 (26.7%)	43 (26.1%)	19 (18.4%)	8 (66.7%)	27 (23.5%)	**70 (25.0%)**
Water pollution and overuse of chemical fertilizers etc.	41 (27.3%)	1 (6.7%)	42 (25.5%)	17 (16.5%)	8 (66.7%)	25 (21.7%)	**67 (23.9%)**
Damage to human health due to overuse of pesticides, fertilizers	34 (22.7%)	4 (26.7%)	38 (23.0%)	16 (15.5%)	7 (58.3%)	23 (20.0%)	**61 (21.8%)**
Loss of bio-diversity	11 (7.3%)	0 (0.0%)	11 (6.7%)	1 (1.0%)	1 (8.3%)	2 (1.7%)	**13 (4.6%)**

*Multiple responses table.

Table 3.1 elucidates the problems encountered by the respondents in agricultural activities. Among the agricultural related problems, depletion of ground water was considered as the major problem faced by 230(82.1%) respondents. A large proportion, 171(61.1%) respondents considered overuse of pesticides and fertilisers as an agricultural issue. As many as 139(49.6%) respondents believed loss of productivity as the challenge in agriculture. A very small proportion, 27(9.6%) respondents believed that it was lack of resources which act as a challenge for

farmers. Looking at problems related to environment, the majority of respondents, 143(51.1%) envisaged late onset of monsoon as impediment in the agriculture, followed by nearly half of the total respondents 124(44.3%) who ascertained uneven and unpredictable rainfall as a restriction, while 93(33.2%) respondents considered contamination of water resources as a hurdle for growth of crops. A small proportion, 70(25%) respondents view damage from extreme climate like heavy rainfall, hailstones as hindrance in agriculture, and 67 (23.9%) respondents recognized water pollution and overuse of chemical fertilisers as block in growth and production of crops. Only 13(4.6%) respondents admitted that loss of bio-diversity acts as a major agricultural problem. From this table, it is evident that primarily depletion of ground water, overuse of pesticides and fertilisers, late onset of monsoons, loss of productivity were the chief reasons for the respondents which act as impediment in the process of agriculture. Problem of Depletion of ground water is more prominent in Jandiala block with 141(85.5%) respondents considering it is an impediment while loss of productivity impacted more in Ajnala block as 79(68.7%) respondents admitted. Respondents of Jandiala block, that is 22(13.3%) faced the problem of lack of resources more in comparison to Ajnala block which accounts to only 5(4.3%) respondents. As many as 58 (50.4%) respondents from Ajnala block acceded that water was contaminated in comparison to those in Jandiala block where 35(21.2%) respondents believed that water was contaminated. As many as 97(58.8%) respondents of Jandiala block admitted that there was late onset of monsoon. On the other hand, 46(40%) respondents of Ajnala block felt that monsoon was late. Lastly, uneven and unpredictable rainfall was observed more by the respondents of Jandiala block, that is, 98(59.4%) than those in Ajnala block, 26 (22.6%). These problems can be attributed to many reasons such as improper irrigation facilities, indiscriminate and excessive use of fertilisers, dependence on monsoons for irrigation and detrimental effects of reckless use of fertilisers.

HEALTH CHALLENGES FACED BY THE FARMERS:

Agriculture like any other occupation exposes humans with different kinds of health hazards. Many of the chemicals such as pesticides, inorganic fertilizers can produce harmful effects on the health of human beings. The aggregate health impacts of exposure to various agrochemicals can be in range of chronic diseases and severe health conditions like cancer, respiratory, neurological, reproductive and developmental disorder.

Approximately 355,000 people die each year all over the world because of unintentional acute poisonings. Two-thirds of these deaths occur in developing countries such as India where such poisonings are associated with acute exposure and or improper use of toxic chemicals and pesticides present in occupational and domestic environments (Rakesh et al. 2013). Continued use and inappropriate application techniques of chemicals in agriculture reveals the potential to harm the soil and health of the farmers, as these chemicals percolate to ground water and polluting it. During harvesting season, threshing of crops results into high level of organic dust making farmers susceptible to many health hazards. (Gandhi et al. 2012). Apart from that, low socio-economic status also aggravates the situation rendering farmers unable to access health care facilities. (Mobed et al. 1992). The respondents in the study were, therefore, asked whether they faced any health challenges as a result of working in the field.

Table 3.2
Distribution of respondents on the basis of facing Health problems

Farmers facing health problems	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Yes	140 (93.3%)	13 (86.7%)	153 (92.7%)	93 (90.3%)	10 (83.3%)	103 (89.6%)	**256 (91.4%)**
No	10 (6.7%)	2 (13.3%)	12 (7.3%)	10 (9.7%)	2 (16.7%)	12 (10.4%)	**24 (8.6%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

Table 3.2 enumerates responses of farmers who have encountered problems with respect to health. A majority of respondents 256 (91.4%) acceded that they experienced health related problems while carrying out agricultural processes and only 24 (8.6%) respondents stated that they did not face any issue regarding health. From the table, it is observed that respondents in both the blocks seem to be facing problems in health as, 153 (92.7%) respondent from Jandiala block highlighted that they suffered from health problems despite having more sustainable agricultural practices than Ajnala block and 103 (89.6%) respondents from Ajnala block claimed that they were facing problems regarding health. Respondents accepted that there is increase in the incidence of the diseases and health issues not only among the laborers' who work in the field but also among the residents in vicinity who were indirectly exposed to the chemicals used in agriculture.

Table 3.2.1

Distribution of respondents on the basis of health problems faced with respect to education, age and size of land holding

	Health problem faced		
	Yes	**No**	**Grand Total**
Education			
Illiterate	56 (21.9%)	4 (16.7%)	**60 (22.6%)**
Literate	12 (4.7%)	2 (8.3%)	**14 (5.3%)**
Primary	70 (27.3%)	3 (12.5%)	**73 (27.5%)**
Secondary	42 (16.4%)	4 (16.7%)	**46 (17.4%)**
Higher Secondary	28 (10.9%)	1 (4.2%)	**29 (10.9%)**
Graduation	44 (17.2%)	8 (33.3%)	**52 (19.6%)**
Any other*	4 (1.6 %)	2 (8.3%)	**6 (2.3%)**
Total	**256 (91.4%)**	**24 (8.6%)**	**280 (100.0%)**
Age (in years)	Yes	No	
25-35	52 (20.3%)	11 (45.8%)	**63 (23.8%)**
35-45	88 (34.4%)	9 (37.5%)	**97 (36.6%)**
45-55	93 (36.3%)	3 (12.5%)	**96 (36.2%)**
55-65	20 (7.8%)	1 (4.2%)	**21 (7.9%)**
65 and above	3 (1.2%)	0 (0.0%)	**3 (1.1%)**
Total	**256 (91.4%)**	**24 (8.6%)**	**280 (100.0%)**
Size of land holding			
Marginal (<1 hectare)	10 (3.9%)	3 (12.5%)	**13 (4.9%)**
Small (1-2 hectares)	17 (6.6%)	1 (4.2%)	**18 (6.8%)**
Semi-medium (2-4 hectares)	55 (21.5%)	7 (29.2%)	**62 (23.4%)**
Medium (4-10 hectares)	103 (40.2%)	9 (37.5%)	**112 (42.3%)**
Large (10> hectares)	71 (27.7%)	4 (16.7%)	**75 (28.3%)**
Total	**256 (91.4%)**	**24 (8.6%)**	**280 (100.0%)**

Table 3.2.1 indicates the health problems related to various indicators. Higher proportion of primary level educated respondents, that is, 70 (27.3%) mentioned having health problems, followed by 56 (21.9%) respondents who were illiterate. 8 (33.3%) respondents who were graduates did not mention any health problems faced while practicing the agricultural activities. Higher proportion of respondents, 93 (36.3%) were of 45-55 years age category who mentioned health problems being faced, followed by 88 (34.4%) respondents of 35-45 age bracket. Probably because respondents of these age group are more in number and therefore incidence of health problems are reflected more due to their numerical strength. There was higher proportion of 11 (45.8%) respondents of 25-35 years age category who said that they did not face any health challenges while practicing agriculture. The reason could be that they belong to relatively younger age group and are less susceptible to adverse impacts. They have also devoted comparatively less time in agriculture activities than respondents of older age and may not identify any health impact as of now. In terms of size of land holdings, it was found that a higher proportion of respondents, that is 103 (40.2%) who mentioned facing health problems were having medium size land holdings, followed by 71 (27.7%) respondents having large size land holdings.

Table 3.3

Distribution of respondents on the basis of reasons for Health problems

Causes of health problems	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Overuse of chemical fertilizers and pesticides	91 (60.7%)	7 (46.7%)	98 (59.4%)	57 (55.3%)	3 (25.0%)	60 (52.2%)	**158 (56.4%)**
Water and soil pollution	37 (24.7%)	5 (33.3%)	42 (25.5%)	28 (27.2%)	2 (16.7%)	30 (26.1%)	**72 (25.7%)**
Climate change	7 (4.7%)	0 (0.0%)	7 (4.2%)	1 (1.0%)	0 (0.0%)	1 (0.9%)	**8 (2.9%)**
Over use of chemical fertilizers, pesticides and Water & soil Pollution	4 (2.7%)	1 (6.7%)	5 (3.0%)	5 (4.9%)	5 (41.7%)	10 (8.7%)	**15 (5.4%)**
Over use of chemical fertilizer, pesticides and Climate Change	1 (0.7%)	0 (0.0%)	1 (0.6%)	2 (1.9%)	0 (0.0%)	2 (1.7%)	**3 (1.1%)**
Did not face health problems	10 (6.7%)	2 (13.3%)	12 (7.3%)	10 (9.7%)	2 (16.7%)	12 (10.4%)	**24 (8.6%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

Respondents were further inquired about factors responsible for the health problems. Table 3.3 overlays the probable reasons which can be ascertained to the health problems associated with the agricultural processes. The main cause of health problems according to a large proportion of respondents was overuse of chemical fertilizers and pesticides as 158(56.4%) farmers acceded to this fact. As many as, 72(25.7%) of farmers admitted that water and soil pollution can be accredited to the health concerns. A small proportion of 15(5.4%) respondents agreed that it is the overuse of chemical fertilizers, pesticides in addition to water and soil pollution which cause the health hazards to the people, 8(2.9%) farmers believed that climate change is responsible for the health challenges. Furthermore, only 3(1.1%) farmers considered that overuse of fertilizers and pesticides in conjunction with climate change results in health problems. More respondents of Jandiala block considered overuse of chemicals such as pesticides and fertilisers as the major reason for health problems (98 (59.4%) respondent from Jandiala block admitted in comparison to 60 (52.2%) respondent of Ajnala block). whereas water and soil pollution were found to be more prominent reason for health problems in Ajnala block, that is, 30(26.1%) respondents said so as compared to Jandiala block where, 42(25.5%) respondents mentioned this.

Table 3.3.1

Influence of the level of education on health problems of the respondents

Causes of health problems						
	Overuse of chemical fertilizers and pesticides	**Water and soil pollution**	**Climate change**	**Over use of chemical fertilizers, pesticides and Water & soil Pollution**	**Over use of chemical fertilizer, pesticides and Climate Change**	**Total**
Education						
Illiterate	40 (25.3%)	13 (18.1%)	1 (12.5%)	1 (6.7%)	1 (33.3%)	**56 (21.9%)**
Literate	7 (4.4%)	4 (5.6%)	0 (0.0%)	1 (6.7%)	0 (0.0%)	**12 (4.7%)**
Primary	42 (26.8%)	25 (34.7%)	0 (0.0%)	3 (20%)	0 (0.0%)	**70 (27.3%)**
Secondary	25 (15.8%)	14 (19.4%)	0 (0.0%)	3 (20%)	0 (0.0%)	**42 (16.4%)**
Higher Secondary	16 (10.1%)	8 (11.1%)	1 (12.5%)	2 (13.3%)	1 (33.3%)	**28 (10.9%)**
Graduation	25 (15.8%)	7 (9.7%)	6 (75%)	5 (33.3%)	1 (33.3%)	**44 (17.2%)**
Any other*	3 (1.9%)	1 (1.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**4 (1.6%)**
Grand Total	**158 (61.7%)**	**72 (28.1%)**	**8 (3.1%)**	**15 (5.9%)**	**3 (1.2%)**	**256 (100%)**

Table 3.3.1 points out the Influence of education on the health issues faced by the respondents. Among those respondents who mentioned that reason of their health problems was overuse of chemical fertilizers and pesticides, a higher proportion of respondents, that is, 42 (26.8%) were educated upto primary level followed by 40 (25.3%) respondents who were illiterate. Higher proportion of respondents educated upto primary level, that is, 25 (34.7%) mentioned water and soil pollution as the cause of health problems. Majority of 6 (75%) respondents who mentioned climate change as the reason of health problem were graduates. It may be noted that respondents who were illiterate or even educated upto higher secondary level were cognizant of the ill effects of chemicals and how chemicals are impacting the water and soil. This implies that education has a bearing on the health problems of the respondents.

METHOD OF APPLYING CHEMICALS IN THE FIELD:

It is imperative to understand the application method of chemical as they have repercussions on the health of the person who is applying these chemicals. Rampant use of pesticides leads to considerable health and environmental threats. Farmers are at the apex of the risk as they are prime polluters and victims of pollution. According to World Health Organization (WHO) and the United Nations Environment Program, approximately 20,000 workers die due to exposure of such chemicals every year, with estimated poisoning rate of two to three per minute. Majority of workers dying are from developing countries (WHO 2004, Dasgupta et al., 2005). Knowledge of hazards is crucial for preventing acute and chronic poisoning among the workers. Incorrect beliefs can worsen the workers capacity to protect themselves and take measure to reduce risks of pesticides (Koh et al., 1996).

Table 3.4

Distribution of respondents on the basis of method of applying chemicals

Application method	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
With bare hands	112 (74.7%)	14 (93.3%)	126 (76.4%)	77 (74.8%)	11 (91.7%)	88 (76.5%)	**214 (76.4%)**
Wearing gloves	6 (4.0%)	1 (6.7%)	7 (4.2%)	9 (8.7%)	1 (8.3%)	10 (8.7%)	**17 (6.1%)**
Through sprayer	32 (21.3%)	0 (0.0%)	32 (19.4%)	17 (16.5%)	0 (0.0%)	17 (14.8%)	**49 (17.5%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

Table 3.4 reveals that a large proportion, 214 (76.4%) respondents apply chemicals with their bare hands without wearing gloves, followed by 49 (17.5%) respondents who apply chemicals through sprayers. A very less proportion of respondents, 17 (6.1%) apply chemicals wearing gloves. It is observed from the table that, almost equal proportion of respondents from both the blocks apply chemicals with bare hands constituting 126 (76.4%) and 88 (76.5%) respondents in Jandiala block and Ajnala block respectively. On the other hand, a higher proportion of respondents from Jandiala block apply chemicals through sprayers which accounts to 32 (19.4%). Among the villages there was more proportion of respondents in Manawala village, 32(21.3%) who apply chemicals through sprayer than in any other village. Surprisingly, none of the respondents from Dhirakot and Kotli jimmat singh village are found using sprayer, whereas less proportion of the 17 (16.5%) respondents use sprayer in Panj garain wala village. Synthetic fertilizers can poison people and pets if they are inhaled or accidentally ingested. Touching the chemicals such as fertilizers may cause skin irritation, and ingesting it may be poisonous. Nitrates are the ingredients that cause the poisoning. On further enquiry it was informed that none of the farmers wear face masks while applying fertilisers which makes them vulnerable to side effects of inhaling fertilisers/pesticides.

Table 3.4.1

Influence of the level of education on the methods used in applying chemicals in the field

	Chemicals application			
	With bare hands	**Wearing gloves**	**With sprayers**	**Total**
Education				
Illiterate	51 (23.8%)	3 (17.6%)	6 (12.2%)	**60 (23.4%)**
Literate	14 (6.5%)	0 (0.0%)	0 (0.0%)	**14 (5.5%)**
Primary	57 (26.6%)	5 (29.4%)	11 (22.4%)	**73 (28.5%)**
Secondary	41 (19.2%)	2 (11.8%)	3 (6.1%)	**46 (18%)**
Higher Secondary	25 (11.7%)	0 (0.0%)	4 (8.2%)	**29 (11.3%)**
Graduation	25 (11.7%)	6 (35.3%)	21 (42.9%)	**52 (20.3%)**
Any other*	1 (0.5%)	1 (5.9%)	4 (8.2%)	**6 (2.3%)**
Total	**214 (76.4%)**	**17 (6.1%)**	**49 (17.5%)**	**280 (100%)**

Table 3.4.1 indicates method of chemicals application of respondents with respect to their educational qualification. Data points out that among the respondent who applied chemicals with bare hands higher proportion of respondents that is, 57 (26.6%) were primary level educated, followed by 51 (23.8%) respondents who were illiterate. While who mentioned using gloves, higher proportion of respondents 6 (35.3%) among them were graduates. Higher proportion of respondents who mentioned using sprayers for chemical application were also graduates, that is, 21 (42.9%). It highlights the effect of education on how a respondent uses the chemicals. It shows that educated person is well acquainted with the ill effects of directly applying the chemicals and the precautions to be taken while applying these chemicals on field.

EFFECTS OF EXCESSIVE APPLICATION OF CHEMICAL FERTILIZERS AND PESTICIDES OBSERVED BY THE RESPONDENTS:

Fertilizers are the substitutes added to the soil for replenishing its requirement of essential nutrients in the growth of the plant. However, continued exposure to certain fertilizers and its inappropriate application can result into health disorders. There are many studies which indicate that exposure to certain pesticides act as a significant risk factor in many chronic diseases, including cancer, neurodegenerative diseases such as Parkinson and Alzheimer's. In addition to this, there are also circumstantial evidence which prove that pesticide exposure is associated with disruption in the immune system and hormone imbalances (Greenpeace report, 2015). The respondents were further asked about the effects of overuse of chemical or synthetic fertilisers and pesticides on their lifestyle.

Table 3.5

Distribution of respondents on the basis of Effects of overuse of fertilizers and pesticides

Effects of overuse of fertilisers and pesticides	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Increased use of medicine nowadays	47 (31.3%)	4 (26.7%)	51 (30.9%)	37 (35.9%)	5 (41.7%)	42 (36.5%)	**93 (33.2%)**
Adverse impact on yield	26 (17.3%)	1 (6.7%)	27 (16.4%)	21 (20.4%)	2 (16.7%)	23 (20.0%)	**50 (17.9%)**
Enter food chain through water and soil pollution	30 (20.0%)	1 (6.7%)	31 (18.8%)	17 (16.5%)	1 (8.3%)	18 (15.7%)	**49 (17.5%)**
Weakening and depletion of soil	22 (14.7%)	5 (33.3%)	27 (16.4%)	19 (18.4%)	2 (16.7%)	21 (18.3%)	**48 (17.1%)**
Its overuse cause disease	20 (13.3%)	3 (20.0%)	23 (13.9%)	8 (7.8%)	2 (16.7%)	10 (8.7%)	**33 (11.8%)**
Causes cancer and other disease	5 (3.3%)	1 (6.7%)	6 (3.6%)	1 (1.0%)	0 (0.0%)	1 (0.9%)	**7 (2.5%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

Table 3.5 depicts the ramifications of overuse of chemical fertilizers and pesticides on respondents. It can be derived from the table that most of the respondents, that is, 93(33.2%) believed that with the overuse of chemical fertilizers and pesticides they have observed increased use of medicines in recent times. It means that they have encountered more health diseases now and for that intake of medicines have increased in recent times. A small proportion, 50(17.9%) respondents account decrease in the yield as the result of overuse of fertilizers. As many as, 49(17.5%) respondents admitted that fertilizers and pesticides enter the food chain through water and soil pollution and contaminate the food by adding the pollutants to the food and depleting the nutrients present in the food crops. A very small proportion, 48(17.1%) respondents consider weakening and depletion of soil as the result of excessive use of chemical fertilizers and pesticides. 33(11.8%) respondents regarded the overuse of the fertilizers and pesticides as the cause of many other diseases and only 7(2.5%) respondents consider that excessive use of fertilisers and pesticides lead to cancer and other hazardous diseases such as brain haemorrhage etc. It was observed that there was not much difference of opinion in both the blocks regarding the effect of fertilizers and pesticides. Respondents from both the blocks depict the same problems with respect to application of fertilizers.

VIEWS ON CHANGES OBSERVED IN CLIMATE:

Any alteration in the climate bear huge ramifications on agriculture, as agriculture operate in consonance with the climatic conditions. Change in the climate does not only bring change in the environment but it impacts the agriculture and the people associated with the agriculture to a great extent. In order to determine the changes observed in the climate by the respondents, they were inquired about the range of changes observed in the climate in the past 10 years because climate is not which changes daily it may take years to observe a perceptible change in climate so 10 years was taken as reference period. The following section presents the analysis of the responses gathered by the researcher from the respondents in determining the changes in the climate.

Table 3.6

Distribution of respondents on the basis changes observed in climate

Changes observed in the climate	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Yes	144 (96.0%)	15 (100.0%)	159 (96.4%)	91 (88.3%)	12 (100.0%)	103 (89.6%)	**262 (93.6%)**
No	6 (4.0%)	0 (0.0%)	6 (3.6%)	12 (11.7%)	0 (0.0%)	12 (10.4%)	**18 (6.4%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

From the glimpse of Table 3.6, it is reflected that a high proportion of respondents 262 (93.6%) observed that there was change in the climate. Most of the respondents agreed on the fact that they felt some changes in the climate during the past 10 years (10 years has been considered as years of reference in this study). On the other hand, only 18 (6.4%) respondents felt that there was not much change in the climate in comparison to the preceding years. There was also consonance in regard to responses from the two blocks. The majority of respondents from both the blocks, that is, 159(96.4%) of Jandiala and 103(89.6%) of Ajnala block agreed that there were some changes in the climate in the past few years. However, interestingly, none of the farmers from Dhirakot village from Jandiala block and Kotli jimmat singh village from Ajnala block said that they felt any changes in the climate with respect to 10 years in the past. Reasons for not observing any change in the climate could be attributed to unknowingness of respondents or the disregard of respondents towards the environment conditions prevalent in the region.

Table 3.6.1

Distribution of respondents on the basis of changes observed in climate with respect to education, size of land holding and age

	Changes in climate													
	Manawala		Dhirakot		Total		Panj garain wala		Kotli jimmat singh		Total		Total	
	Yes	No	Yes	No	**Yes**	**No**	Yes	No	Yes	No	**Yes**	**No**	**Yes**	**No**
Education														
Illiterate	25 (17.4%)	0 (0.0%)	3 (20%)	0 (0.0%)	28 (17.6%)	0 (0.0%)	25 (27.5%)	4 (33.3%)	3 (25%)	0 (0.0%)	28 (27.2%)	4 (33.3%)	**56 (21.4%)**	**4 (22.2%)**
Literate	4 (2.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (2.5%)	0 (0.0%)	7 (7.7%)	2 (16.7%)	1 (8.3%)	0 (0.0%)	8 (7.8%)	2 (16.7%)	**12 (4.6%)**	**2 (11.1%)**
Primary	37 (25.7%)	2 (33.3%)	6 (40.0%)	0 (0.0%)	43 (27%)	2 (33.3%)	24 (26.4%)	1 (8.3%)	3 (25%)	0 (0.0%)	27 (26.2%)	1 (8.3%)	**70 (26.7%)**	**3 (16. %)7**
Secondary	23 (16%)	1 (16.7%)	4 (26.7%)	0 (0.0%)	27 (17%)	1 (16.7%)	15 (16.5%)	2 (16.7%)	1 (8.3%)	0 (0.0%)	16 (15.5%)	2 (16.7%)	**43 (16.4%)**	**3 (16.7%)**
Higher Secondary	21 (14.6%)	1 (16.7%)	1 (6.7%)	0 (0.0%)	22 (13.8%)	1 (16.7%)	5 (5.5%)	0 (0.0%)	1 (8.3%)	0 (0.0%)	6 (5.8%)	0 (0.0%)	**28 (10.7%)**	**1 (5.6%)**
Graduation	29 (20.1%)	2 (33.3%)	1 (6.7%)	0 (0.0%)	30 (18.9%)	2 (33.3%)	14 (15.4%)	3 (25%)	3 (25%)	0 (0.0%)	17 (16.5%)	3 (25%)	**47 (17.9%)**	**5 (27.8%)**
Any other*	5 (3.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (3.1%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1%)	0 (0.0%)	**6 2.3**	**0 (0.0%)**
Total	**144 (96.0%)**	**6 (4.0%)**	**15 100%)**	**0 (0.0%)**	**159 (96.4%)**	**6 (3.6%)**	**91 (88.3%)**	**12 (11.7%)**	**12 (100%)**	**0 (0.0%)**	**103 (89.6%)**	**12 (10.4%)**	**262 (93.6%)**	**18 (6.4%)**
Size of land holding														
Marginal (<1 hectare)	4 (2.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (2.5%)	0 (0.0%)	6 (6.6%)	0 (0.0%)	3 (25%)	0 (0.0%)	9 (8.7%)	0 (0.0%)	**13 5(48.2%)**	**0 (0.0%)**
Small (1-2 hectares)	7 (4.9%)	1 (16.7%)	3 (20%)	0 (0.0%)	10 (6.3%)	1 (16.7%)	6 (6.6%)	1 (8.3%)	0 (0.0%)	0 (0.0%)	6 (5.8%)	1 (8.3%)	**16 (6.1%)**	**2 (11.1%)**
Semi-medium (2-4 hectares)	37 (25.7%)	1 (16.7%)	1 (6.7%)	0 (0.0%)	38 (23.9%)	1 (16.7%)	13 (14.3%)	7 (58.3%)	3 (25%)	0 (0.0%)	16 (15.5%)	7 (58.3%)	**54 (20.6%)**	**8 (44.4%)**
Medium (4-10 hectares)	57 (39.6%)	2 (33.3%)	7 (46.7%)	0 (0.0%)	64 (40.3%)	2 (33.3%)	40 (44%)	2 (16.7%)	4 (33.3%)	0 (0.0%)	44 (42.7%)	2 (16.7%)	**108 (41.2%)**	**4 (22.2%)**
Large (10> hectares)	39 (27.1%)	2 (33.3%)	4 (26.7%)	0 (0.0%)	43 (27%)	2 (33.3%)	26 (28.6%)	2 (16.7%)	2 (16.7%)	0 (0.0%)	28 (27.2%)	2 (16.7%)	**71 (27.1%)**	**4 (22.2%)**
Total	**144 (96.0%)**	**6 (4.0%)**	**15 100%)**	**0 (0.0%)**	**159 (96.4%)**	**6 (3.6%)**	**91 (88.3%)**	**12 (11.7%)**	**12 (100%)**	**0 (0.0%)**	**103 (89.6%)**	**12 (10.4%)**	**262 (93.6%)**	**18 (6.4%)**
Age (in years)														
25-35	40 (27.8%)	2 (33.3%)	4 (26.7%)	0 (0.0%)	44 (27.7%)	2 (33.3%)	14 (15.4%)	3 (25%)	0 (0.0%)	0 (0.0%)	14 (13.6%)	3 (25%)	**58 (22.1%)**	**5 (27.8%)**
35-45	43 (29.9%)	2 (33.3%)	5 (33.3%)	0 (0.0%)	48 (30.2%)	2 (33.3%)	37 (40.7%)	5 (41.7 %)	5 (41.7%)	0 (0.0%)	42 (40.8%)	5 (41.7%)	**90 (34.4%)**	**7 (38.9%)**
45-55	49 (34%)	2 (33.3%)	5 (33.3%)	0 (0.0%)	54 (34%)	2 (33.3%)	33 (36.3%)	4 (33.3%)	3 (25%)	0 (0.0%)	36 (35%)	4 (33.3%)	**90 (34.4%)**	**6 (33.3%)**
55-65	11 (7.6%)	0 (0.0%)	1 (6.7%)	0 (0.0%)	12 (7.5%)	0 (0.0%)	6 (6.6%)	0 (0.0%)	3 (25%)	0 (0.0%)	9 (8.7%)	0 (0.0%)	**21 (8%)**	**0 (0.0%)**
65 and above	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.6%)	0 (0.0%)	1 (1.1%)	0 (0.0%)	1 (8.3%)	0 (0.0%)	2 (1.9%)	0 (0.0%)	**3 (1.1%)**	**0 (0.0%)**
Total	**144 (96.0%)**	**6 (4.0%)**	**15 100%)**	**0 (0.0%)**	**159 (96.4%)**	**6 (3.6%)**	**91 (88.3%)**	**12 (11.7%)**	**12 (100%)**	**0 (0.0%)**	**103 (89.6%)**	**12 (10.4%)**	**262 (93.6%)**	**18 (6.4%)**

As indicated from the Table 3.6.1, among the respondents 262 who observed changes in the climate, 70 (26.7%) respondents who were educated upto primary level, followed by 56 (21.4%) respondents who were illiterate and 47 (17.9%) respondents who were graduates admitted change in climate. It indicates that climate change was observed by majority of respondents regardless of their education level. Although among the blocks, there were higher proportion of illiterate respondents, that is, 28 (27.2%) from Ajnala block who happened to observe climate change in comparison to 28 (17.6%) illiterate respondents from Jandiala block. In terms of respondents according to farm size higher proportion of respondents admitting change in climate were of middle farm size category, that is, 108 (41.2%), followed by 71 (27.1%) respondents who were large farm size holders. Respondents of middle age category, that is, 35-45 years and 45-55 years were in higher proportion who observed change in climate, that is, 90 (34.4%) of each category, followed by 58 (22.1%) respondents of 25-35 years of age bracket.

CHANGES IN THE CLIMATE OBSERVED BY THE RESPONDENTS:

Respondents who affirmed the change in the climate were further inquired about what kind of changes they have observed. Table 3.7 presents the data revealing the various changes that respondents encountered.

Table 3.7

Distribution of respondents on the basis of changes in the climate observed

Changes in climate* observed	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Change in temperature	128 (85.3%)	12 (80.0%)	140 (84.8%)	95 (92.2%)	12 (100.0%)	107 (93.0%)	**247 (88.2%)**
Change in rainfall pattern	131 (87.3%)	14 (93.3%)	145 (87.9%)	86 (83.5%)	11 (91.7%)	97 (84.3%)	**242 (86.4%)**
Change in cropping pattern	58 (38.7%)	1 (6.7%)	59 (35.8%)	29 (28.2%)	4 (33.3%)	33 (28.7%)	**92 (32.9%)**
Change in cropping cycle	49 (32.7%)	4 (26.7%)	53 (32.1%)	16 (15.5%)	2 (16.7%)	18 (15.7%)	**71 (25.4%)**
Changes in average yield	37 (24.7%)	3 (20.0%)	40 (24.2%)	18 (17.5%)	6 (50.0%)	24 (20.9%)	**64 (22.9%)**
Change in time period of pest attack	57 (38.0%)	0 (0.0%)	57 (34.5%)	5 (4.9%)	1 (8.3%)	6 (5.2%)	**63 (22.5%)**
Increased occurrence of natural calamities	46 (30.7%)	1 (6.7%)	47 (28.5%)	6 (5.8%)	4 (33.3%)	10 (8.7%)	**57 (20.4%)**
Changes in migration period of birds	13 (8.7%)	0 (0.0%)	13 (7.9%)	2 (1.9%)	0 (0.0%)	2 (1.7%)	**15 (5.4%)**

*Multiple response table

Table 3.7 shows the changes observed by the respondents. It is evident from the data that the majority of farmers of 247 (88.2%) percent believed that there was a change in temperature. A large proportion of farmers, 242 (86.4%) also agreed that there was change in rainfall pattern, followed by 92 (32.9%) respondents who observed change in cropping pattern which means the proportion of area under various crops at a point of time. The cropping patterns of a region are closely influenced by the geo-climatic, socio-cultural, economic, historical and political factors. It is quite clear from the data that mono-cropping is practised in these blocks. One fourth of the respondents 71(25.4%) said there was change in cropping cycle (It is the life cycle of the crops from seeding to harvesting stage). Due to change in temperature and rainfall pattern there was change in cropping cycle also as they observed change in germination of seed and due to late onset of monsoon or due to some other natural calamity observed because of climate change there was some change felt in cropping cycle. As many as 64(22.9%) respondents said that there was change in average yield, 63 (22.5%) respondents observed change in the period of pest attack due to change in temperature and cropping cycle. One fifth proportion of respondents, that is, 57(20.4%) declared increase in occurrence of natural calamities such as hailstones, drought. A small number of respondents 15(5.4%) felt there was change in migration period of birds. These observations of respondents were based on their experience of past 10 years which they had observed in the climate and environment. These observations reflect how well respondents are aware of their environment and changes therein. It was observed from the table that there was a higher proportion of respondents in Jandiala block who mentioned changes in cropping pattern that is, 59 (35.8%), while 53 (32.1%) respondents observed changes in cropping cycle and increased occurrence of natural calamities was observed by 47(28.5%) respondents, and change in time period of pest attack by 57(34.5%) respondents, as compared to Ajnala block, whereas there were more proportion of respondents who believed that there was change in temperature in Ajnala block, that is, 109 (94.7%) as compared to 140 (84.8%) respondents from Jandiala block. These

changes could be the reason of climate change such as global warming and change in atmosphere and physical conditions, as the climate change and its impact in the different parts of the world, is bound to occur.

FARMERS OBSERVATION OF CHANGE IN THE YIELD OF THE CROPS:

Changes in the yield are observed by dint of change in the climatic conditions. Change in 1-degree Celsius temperature may reduce the yield of rice and wheat crops by 3 to 10% in the state (TERI Report, 2015). In order to assess the change in the yield of the crops in this area, respondents were asked whether they have experienced any change in the yield. Further those respondents who responded in affirmative manner were asked about the what change they have observed.

Table 3.8

Distribution of respondents on the basis of observed changes in the yield

Observed changes in the yield	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Yes	136 (90.7%)	12 (80.0%)	148 (89.7%)	96 (93.2%)	10 (83.3%)	106 (92.2%)	**254 (90.7%)**
No	14 (9.3%)	3 (20.0%)	17 (10.3%)	7 (6.8%)	2 (16.7%)	9 (7.8%)	**26 (9.3%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

A cursory look at the Table 3.8 shows that there was a preponderance of the respondents, that is, 254(90.7%) mentioning the change in the yield, although a small proportion of respondents, that is, 26(9.3%) did not observe any change in the yield of the crops. The table also highlights that 148 (89.7%) respondents of Jandiala block stated that they had observed some changes in the yield in the previous 10 years and only 17(10.3%) respondents did not observe any changes in yield in the past few years. On the other hand, 106(92.2%) respondents of Ajnala believed that there were some changes in the yield during the past 10 years and only 9(7.8%) respondents responded that there was no change in yield as compared to previous years' yield.

Table 3.8.1

Distribution of respondents on the basis of changes observed in yield with respect to education, size of land holding and age

	Change in yield													
	Manawala		Dhirakot		Total		Panj garain wala		Kotli jimmat singh		Total		Total	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Education														
Illiterate	23 (16.9%)	2 (14.3%)	3 (25%)	0 (0.0%)	26 (17.6%)	2 (13.3%)	26 (27.1%)	3 (42.9%)	1 (10%)	2 (100%)	27 (25.5%)	5 (55.6%)	**53 (20.9%)**	**7 (26.9%)**
Literate	4 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4 (2.7%)	0 (0.0%)	7 (2.7%)	2 (28.6%)	1 (10%)	0 (0.0%)	8 (7.5%)	2 (22.2%)	**12 (4.7%)**	**2 (7.7%)**
Primary	34 (25%)	5 (35.7%)	4 (33.3%)	2 (66.7%)	38 (25.7%)	7 (46.7%)	24 (25.7%)	1 (14.3%)	3 (30%)	0 (0.0%)	27 (25.5%)	1 (11.1%)	**65 (25.6%)**	**8 (30.8%)**
Secondary	22 (16.2%)	2 (14.3%)	4 (33.3%)	0 (0.0%)	26 (17.6%)	2 (13.3%)	17 (17.6%)	0 (0.0%)	1 (10%)	0 (0.0%)	18 (17%)	0 (0.0%)	**44 (17.3%)**	**2 (7.7%)**
Higher Secondary	20 (14.7%)	2 (14.3%)	0 (0.0%)	1 (33.3%)	20 (13.5%)	3 (20%)	5 (5.2%)	0 (0.0%)	1 (10%)	0 (0.0%)	6 (5.7%)	0 (0.0%)	**26 (10.2%)**	**3 (11.5%)**
Graduation	28 (20.6%)	3 (21.4%)	1 (8.3%)	0 (0.0%)	29 (19.6%)	3 (20%)	16 (16.7%)	1 (14.3%)	3 (30%)	0 (0.0%)	19 (17.9%)	1 (11.1%)	**48 (18.9%)**	**4 (15.4%)**
Any other*	5 (3.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (3.4%)	0 (0.0%)	1 (1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	**6 (2.4%)**	**0 (0.0%)**
Total	**136 (90.7%)**	**14 (9.3%)**	**12 (80.0%)**	**3 (20.0%)**	**148 (89.7%)**	**17 (10.3%)**	**96 (93.2%)**	**7 (6.8%)**	**10 (83.3%)**	**2 (16.7%)**	**106 (92.2%)**	**9 (7.8%)**	**254 (90.7%)**	**26 (9.3%)**
Size of land holding														
Marginal (<1 hectare)	3 (2.2%)	1 (7.1%)	0 (0.0%)	0 (0.0%)	3 (2%)	1 (6.7%)	5 (5.2%)	1 (14.3%)	2 (20%)	1 (50%)	7 (6.6%)	2 (22.2%)	**10 (3.9%)**	**3 (11.5%)**
Small (1-2 hectares)	7 (5.1%)	1 (7.1%)	2 (16.7%)	1 (33.3%)	9 (6.1%)	2 (13.3%)	6 (6.3%)	1 (14.3%)	0 (0.0%)	0 (0.0%)	6 (5.7%)	1 (11.1%)	**15 (5.9%)**	**3 (11.5%)**
Semi-medium (2-4 hectares)	36 (26.5%)	2 (14.3%)	0 (0.0%)	1 (33.3%)	36 (24.3%)	3 (20%)	18 (18.8%)	2 (28.6%)	2 (20%)	1 (50%)	20 (18.9%)	3 (33.3%)	**56 (22%)**	**6 (23.1%)**
Medium (4-10 hectares)	51 (37.5%)	8 (57.1%)	6 (50%)	1 (33.3%)	57 (38.5%)	9 (60%)	39 (40.6%)	3 (42.9%)	4 (40%)	0 (0.0%)	43 (40.6%)	3 (33.3%)	**100 (39.4%)**	**12 (46.2%)**
Large (10> hectares)	39 (28.7%)	2 (14.3%)	4 (33.3%)	0 (0.0%)	43 (29.1%)	2 (13.3%)	28 (29.2%)	0 (0.0%)	2 (20%)	0 (0.0%)	30 (28.3%)	0 (0.0%)	**73 (28.7%)**	**2 (7.7%)**
Total	**136 (90.7%)**	**14 (9.3%)**	**12 (80.0%)**	**3 (20.0%)**	**148 (89.7%)**	**17 (10.3%)**	**96 (93.2%)**	**7 (6.8%)**	**10 (83.3%)**	**2 (16.7%)**	**106 (92.2%)**	**9 (7.8%)**	**254 (90.7%)**	**26 (9.3%)**
Age (in years)														
25-35	40 (29.4%)	2 (14.3%)	2 (16.7%)	2 (66.7%)	42 (28.4%)	4 (23.5%)	16 (16.7%)	1 (14.3%)	0 (0.0%)	0 (0.0%)	16 (%)15.1	1 (11.1%)	**58 (22.8%)**	**5 (19.2%)**
35-45	39 (28.7%)	6 (42.9%)	5 (41.7%)	0 (0.0%)	44 (29.7%)	6 (35.3%)	39 (40.6%)	3 (42.9%)	4 (57.1%)	1 (50%)	43 (40.6%)	4 (44.4%)	**87 (34.3%)**	**10 (38.5%)**
45-55	47 (34.6%)	4 (28.6%)	4 (33.3%)	1 (33.3%)	51 (34.5%)	5 (29.4%)	34 (35.4%)	3 (42.9%)	2 (28.6%)	1 (50%)	36 (34%)	4 (44.4%)	**87 (34.3%)**	**9 (34.6%)**
55-65	9 (6.6%)	2 (14.3%)	1 (8.3%)	0 (0.0%)	10 (6.8%)	2 (1.8%)	6 (6.3%)	0 (0.0%)	3 (42.9%)	0 (0.0%)	9 (8.5%)	0 (0.0%)	**19 (7. 5%)**	**2 (7.7%)**
65 and above	1 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	1 (14.3%)	0 (0.0%)	2 (1.9%)	0 (0.0%)	**3 (1.2%)**	**0 (0.0%)**
Total	**136 (90.7%)**	**14 (9.3%)**	**12 (80.0%)**	**3 (20.0%)**	**148 (89.7%)**	**17 (10.3%)**	**96 (93.2%)**	**7 (6.8%)**	**10 (83.3%)**	**2 (16.7%)**	**106 (92.2%)**	**9 (7.8%)**	**254 (90.7%)**	**26 (9.3%)**

In the above Table 3.8.1 data reveals that those who have observed change in yield, higher proportion of respondents were of primary education level, that is, 65 (25.6%), followed by 53 (20.9%) respondents who were illiterate. A small proportion, 48 (18.9%) respondents were graduates. A large proportion of middle farm size, 100 (39.4%) respondents were seen admitting change in yield. Those who have observed change in yield, higher proportion of respondents were of middle age category that is, 35-45 years and 45-55 years, each that is, 87 (34.3%) respondents respectively.

The 254 (90.7%) respondents who answered in the affirmative to the above question, were further asked whether the changes in the yield were positive or negative.

Table 3.8.2

Distribution of respondents on the basis of change in the yield

Change in yield observed	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
Yield has increased	38 (27.9%)	6 (50.0%)	44 (29.7%)	11 (11.5%)	0 (0.0%)	11 (10.4%)	**55 (21.7%)**
Yield has decreased	98 (72.1%)	6 (50.0%)	104 (70.3%)	85 (88.5%)	10 (100%)	95 (89.6%)	**199 (78.3%)**
Total	**136 (53.5%)**	**12 (4.7%)**	**148 (58.3%)**	**96 (37.8%)**	**10 (3.9%)**	**106 (41.7%)**	**254 (100%)**

Table 3.8.2 reveals that a higher proportion, 199 (78.3%) respondents admitted that yield had decreased over the years. Further, as many as 55 (21.7%) respondents stated that there was increase in the yield of the crop. In Jandiala block 104 (70.3%), respondents said that there was a decrease in yield while in Ajnala block decrease in yield was highlighted by a higher proportion, which is 95 (89.6%). It shows that most of the farmers observed decrease in yield of crops due to climate change and other such environmental factors. The increase in the yield may be accounted to increase in the use of fertilisers which is harmful for the soil fertility in the long run. A large proportion of farmers of Ajnala block admitted that yield had decreased over the years. Decrease of the yield may be attributed to loss of fertility of soil due to excessive use of chemicals. The soil of villages of Ajnala block was losing its fertility and farmers responded that they could not grow anything on this land without applying fertilisers like urea and adding gypsum to the soil because mostly soil in this area is alkaline with lower infiltration capacity. This makes cultivation difficult as water gets stagnated in wet season and soil become as hard as rock during dry season

so much so that even ploughing becomes difficult. They are not using organic farming techniques as compared to the villages of the Jandiala block.

Table 3.8.3

Influence of educational level and age on changes observed in the yield

What change observed				
	Yield increased	**Yield decreased**	**No change observed**	**Grand Total**
Education				
Illiterate	5 (9.1%)	48 (24.1%)	7 (26.9%)	**60 (22.6%)**
Literate	1 (1.8%)	11 (5.5%)	2 (7.7%)	**14 (5.3%)**
Primary	14 (25.5%)	51 (25.6%)	8 (30.8%)	**73 (27.5%)**
Secondary	11 (20%)	33 (16.6%)	2 (7.7%)	**46 (17.4%)**
Higher Secondary	6 (10.9%)	20 (10.1%)	3 (11.5%)	**29 (10.9%)**
Graduation	14 (25.5%)	34 (17.1%)	4 (15.4%)	**52 (19.6%)**
Any other*	4 (7.3%)	2 (1%)	0 (0.0%)	**6 (2.3%)**
Grand Total	**55 (19.6%)**	**199 (71.1%)**	**26 (9.3%)**	**280 (100.0%)**
Age (in years)				
25-35	21 (38.2%)	37 (18.6%)	5 (19.2%)	**63 (22.5%)**
35-45	15 (27.3%)	72 (36.2%)	10 (38.5%)	**97 (34.6%)**
45-55	17 (30.9%)	70 (35.2%)	9 (34.6%)	**96 (34.3%)**
55-65	2 (3.6%)	17 (8.5%)	2 (7.7%)	**21 (7.5%)**
65 and above	0 (0.0%)	3 (1.5%)	0 (0.0%)	**3 (1.1%)**
Total	**55 (19.6%)**	**199 (71.1%)**	**26 (9.3%)**	**280 (100.0%)**

Table 3.8.3 indicates changes observed in the yield by the respondents with respect to indicators of education and age. It can be observed that those respondents who stated increase in yield were both graduates and educated upto primary level, that is, 14 (25.5%) respondents respectively. Whereas, higher proportion of respondents, that is, 51 (25.6%) educated upto primary level said that yield has decreased, followed by 48 (24.1%) respondents who were illiterate also mentioned decrease in yield. When it comes to age, higher proportion of respondents, that is, 17 (30.9%) of 45-55 years age category said that yield has increased. On the other hand, higher proportion, 72 (36.2%) respondents of 35-45 years of age mentioned decrease in yield.

DEPTH OF WATER SOURCE FOR IRRIGATION ADOPTED BY RESPONDENTS:

Farmers use tubewells or submersible pump for irrigating the crops. Tubewells are either electricity driven or run on diesel. There is a serious problem of irrigation in these villages because of depletion of ground water level. Farmers are compelled to dug the bore of their tubewells deeper in the ground to take out the water as the water availability is receding in the upper level of ground water. Most of the farmers are unaware of the fact that water pumped from such depth is unfit for consumption and irrigating the crops with that water has huge ramifications on the overall health of the soil, crops and the people who will consume these crops. Substantial quantities of uranium, mercury and other heavy metals had been found in the samples of groundwater in Punjab by environmentalists who claim the rampant use of pesticides, fertiliser and other chemicals responsible for the contaminated groundwater (The Hindu, 2012). According to a report by Central Ground Water Board (CGWB, 2014), out of 22 districts of Punjab, 13 are affected with arsenic in groundwater. The concentration of arsenic in these areas ranged from 0.01-0.39 mg/l. Amritsar district detected arsenic above the permissible limit, that is, (0.05mg/l). The occurrence of Arsenic in ground water is mainly in the depth range of 20-100m.which comes in the intermediate aquifer level (CGWB, 2014). Thus, the researcher asked the respondents regarding the depth of their tube wells installation and effect of this on their agricultural activities.

Table 3.9

Distribution of respondents on the basis of Depth of Tube well/Submersible pumps for Irrigation

Depth of tubewell	Jandiala block			Ajnala block			Total
	Manawala	Dhirakot	Total	Panj garain wala	Kotli jimmat singh	Total	
10-20 meters	1 (0.7%)	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.4%)**
20-30 meters	2 (1.3%)	2 (13.3%)	4 (2.4%)	1 (1.0%)	0 (0.0%)	1 (0.9%)	**5 (1.8%)**
30-40 meters	1 (0.7%)	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.4%)**
40-50 meters	12 (8.0%)	10 (66.7%)	22 (13.3%)	4 (3.9%)	0 (0.0%)	4 (3.5%)	**26 (9.3%)**
50 meters and above	134 (89.3%)	3 (20.0%)	137 (83.0%)	98 (95.1%)	12 (100.0%)	110 (95.7%)	**247 (88.2%)**
Total	**150 (53.5%)**	**15 (5.3%)**	**165 (58.9%)**	**103 (36.7%)**	**12 (4.2%)**	**115 (41.1%)**	**280 (100%)**

From the above Table 3.9, it becomes evident that the majority of farmers, that is, 247 (88.2%) in this area had tubewells dug deep upto more than 50 meters into the ground. Only 26(9.3%) respondents had tubewells in between 40 to 50 meters of depth and 5(1.8%) respondent had tubewells between 20-30 meters of depth and only 1 respondent each had tubewells 10-20 meters and 30-40 meters deep. The respondents from Jandiala block were having varied responses in comparison to Ajnala block. While a higher proportion of respondents from Ajnala block, that is, 110 (95.7%), had tubewells dug 50 meters and above depth in comparison to 137 (83%) respondent from Jandiala block, but only 4 (3.5%) respondents had tubewells in between 40-50 meters deep as compared to 22 (13.3%) respondents from Jandiala block and there were none of the respondents in Ajnala block who had tubewells in 10-20 meters or 30-40 meters deep whereas Jandiala block had one respondent in each category. The depth of tubewell indicates the quality of water available to farming. Leaching of nutrients in the ground water add the nutrients in the ground water some nutrients which are helpful while some organic and inorganic substance contaminate the water like arsenic, fluoride, nitrates etc. when asked about the depth of water source respondents narrate that "*Paani aanda hi naii hai kuch saal baad hor dunga krna hi penda hai..pta te hai pani ganda hai par ki kriye*" (water is not there, after some year we have to dug deep for fetching water, what else we can do). It shows that though they were aware of the fact that water from which they are irrigating their crops is not fit for use and consumption but they had no choice. It also indicates the receding aquifer level of ground water.

Table 3.9.1

Distribution of respondents on the basis of depth of tubewell/submersible with size of land holding

		Farm Size					Total
		Marginal Holdings (<1 hectare)	**Small Holdings (1-2 hectares)**	**Semi-medium Holdings (2-4 hectares)**	**Medium Holdings (4-10 hectares)**	**Large Holdings (10> hectares)**	
Depth of tubewell/ submersible pump	**10-20 meters**	1 (10%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.4%)**
	20-30 meters	0 (0.0%)	2 (11.1%)	3 (5.1%)	0 (0.0%)	0 (0.0%)	**5 (2%)**
	30-40 meters	0 (0.0%)	1 (5.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	**1 (0.4%)**
	40-50 meters	3 (30%)	1 (5.6%)	2 (3.4%)	11 (7.9%)	9 (16.7%)	**26 (10.2%)**
	50 meters and above	6 (60%)	14 (77.8%)	54 (91.5%)	128 (92.1%)	45 (83.3%)	**247 (96.5%)**
Total		**10 (3.6%)**	**18 (6.4%)**	**59 (21.1%)**	**139 (49.6%)**	**54 (19.3%)**	**280 (100.0%)**

Table 3.9.1 represents relation of farm holding with the depth of tubewell in the farm. Data reveals that only one respondent having tubewell in 10-20 meters depth was marginal farmer. Only small and semi-medium farmers were having tubewell at 20-30 meters depth while only small farmers were found to have tubewell at 30-40 meters depth. Surprisingly, higher proportion of marginal farmers were having tubewell at 40-50 meters depth which accounts to 3 (30.0%). Probably because marginal farmers had only one source of irrigation and in order to fetch more water they kept on deepening the tubewell in comparison to other farmers who have more than one source of irrigation. A higher proportion of middle size farmers, that is, 128 (92.1%) were found having tubewell at the depth of more than 50 meters.

SUMMARY:

Thus, it can be concluded that though there are multifarious problems a farmer faces in agricultural process but in terms of agricultural and environmental problems in the study region, depletion of ground water is more pronounced followed by, overuse of chemicals such pesticides and fertilizers, late onset of monsoon and uneven as well as unpredictable nature of rainfall due to changing environmental conditions. Problem of contamination of water was more pronounced in Ajnala block in comparison to Jandiala block whereas, more respondents reported uneven and unpredictable pattern of rainfall as major constraint in Jandiala block in comparison to Ajnala block.

In terms of health issues, majority of respondents admitted facing health challenges. Further, it was found in the study that respondents aged 45 to 55 years reported to have health problems in higher proportion in comparison to other age groups. Overuse of chemicals such pesticides and fertilisers along with water and soil pollution was found major cause of health problems cited by respondents.

When it comes to method of applying chemicals in the field majority of respondents were found applying chemicals with their bare hands. Higher proportion among them were educated till primary level or were illiterate. As mentioned by respondents effects of overuse of chemicals such as pesticides and fertilizers led to increased use of medicines and adverse impact on yield. Majority of respondents also

found change in climate with higher proportion of illiterate respondents observing the change. As far as the changes observed, majority of respondents reported to have observed changes in temperature, followed by rainfall patterns and cropping pattern.

In terms of change in yield, majority of respondents admitted change in yield and on further inquiry they reported that yield had decreased over the years. Respondents who were aged 35 to 45 years mentioned decreased yield in higher proportion. Majority of respondents were found having tubewell at the depth of more than 50 meters with higher proportion of them having medium and large size land holdings.