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## Stakeholders perception about environmental and health hazards of genetically modified crops in Punjab

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**Abstract**

This paper investigates the perception of various stakeholders about environmental and health hazards of the genetically modified crops and foods. A total of one hundred and fifty respondents were selected for the study which comprised of 120 farmers selected from two highly producing districts of Punjab in terms of GM crops along with twenty extension personnel and ten research scientists. Findings of the study revealed that majority of farmers, extension personnel and research scientists rejected perceived environmental and health hazards. Correlation analysis revealed that age, farm experience and innovativeness contribute significantly and linearly to the perceived environmental and health concerns of farmers. The multiple regression analysis determined the contribution of factors like mass media exposure, extension contacts, progressiveness and risk orientation in diminishing the environmental and health concerns, more concretely with how much amount. Therefore, modern techniques in agriculture need to be well targeted in accordance to the socio-psychological and socio-personal factors of farmers.

**Keywords:** Perception, GM crops and foods, correlation, multiple regression analysis

**Introduction**

Agriculture which has always been saviour of human civilization is facing enormous challenges in twenty first century. In order to feed ever increasing population more food and fibres need to be produced with stagnating labour force to contribute for the all-round development in developing countries keeping in mind the sustainability. At present human population is 7.5 billion which is estimated to reach 9.5 billion by 2050, food supply needs to be increased by 70 per cent. Thus, food supply and security is turning into an undeniably critical need for the world including India. Genetic engineering (GE) has the potential to address some of the major challenges of our time, including food security, climate change adaptation, and environmental sustainability. Genetically modified organisms (GMOs) can be defined as organisms in which the genetic material (DNA) has been altered in a way that doesn't occur naturally by mating or natural recombination. The technology is regularly called as "modern biotechnology" or "gene technology", sometimes also "recombinant DNA technology" or "genetic engineering". It enables desired genes to be transferred from one creature then on to the next, also between non-related species (Anonymous 2015a) [4]. The introduction of genetically modified (GM) crops has been a noteworthy innovative progress to world agriculture over the recent couple of decades. It has been found that technology has the prospective to not just enhance global food yields but also can lead to sustainable development. At the same time, genetic engineering in agriculture has encountered fierce resistance by various ideological groups and powerful corporations and governments. Despite of the fact, GM crops have been acknowledged in many developed nations, they have by and large not been generally welcomed in Europe and Japan. Agriculturists in the United States (USA) have grasped GM crops whereas disappointed with the vulnerability of marketing GM crops (Chern et al 2002). Instabilities about customer acceptance have expanded in many parts of the world, somewhat because of varying dispositions. Consumer organizations, environmentalists and some non-governmental organizations have expressed concerns about food safety and spreading fear in the psyches of producers and consumers regarding GM crops.

The expanding development of GM crops has raised extensive worries regarding food security, ecological impacts and financial issues. From the food and health viewpoint, the fundamental concerns are identified with possible toxicity and allergenicity of GM foods. Concerns about ecological dangers including the effect of introgression of the transgenes into the natural landscape, impact of gene flow, effect of non-target creatures, development of pest resistance and loss of biodiversity are increasing. Adoption of GM advances has likewise evoked a range

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of social and ethical concerns about confining access to genetic resources and new advances, loss of traditions (for example, saving seeds), private sector's imposing business model and loss of income of resource poor farmers. The scientific proof concerning the environmental and health impacts of GMOs is as yet rising, however so far there is no decisive data on the conclusive negative effects of GMOs on health or on the environment. Nevertheless, public perceptions about GMOs in food and agriculture are divided with a tendency toward avoiding GM food and products in many developed and developing countries (Anonymous 2010) As the Food and Agriculture Organization, has properly stated "science cannot declare any technology completely risk free. Genetically engineered crops can reduce some environmental risks associated with conventional agriculture, but will also introduce new challenges that must be addressed. Society will have to decide when and where genetic engineering is safe enough" (Anonymous 2004) [2]. Arguments both for and against the development and utilization of the genetically modified (GM) crops are differed and there is a wide agreement that evaluation ought to occur on a case-by-case premise before genetically modified food is conveyed to the market.

Various studies have been conducted to verify these concerns. Gandhi and Jain (2016) [10] studied on "Farmer's perception on various features of Bt. cotton" and found that lesser pest incidence was reported by 89.00 % and an equal number of farmers expressed advantage with expenditure on pesticides and addressing environmental concerns in Andhra Pradesh, India. In the study conducted at Gujrat state of India, all the sample farmers expressed no adverse impact of Bt. cotton on other adjoining crops, insect population, livestock, human health and soil health. On the contrary, owing to relatively lower use of pesticides, Bt. cotton is found more health friendly than non-Bt. cotton. A 90 days sub-chronic oral toxicity study carried out by Mahyco (2009) [16] on Sprague Daley rats which reveals that there was no adverse effect on body weight gain and average food and water intake of rat which consume Bt. Brinjal for 90 days. This study revealed that there were no biological differences between allergic response to all transgenic and non-transgenic brinjal hybrids. Anunda (2014) [5] in the study conducted on various stakeholders of Kenya concluded that various factors those influence individual attitudes and foster change in their perception towards acceptance of GM crops and foods are safety and benefits to society. When people reject GM crops, crucial factors are their concern with regard to adverse effects on wildlife and the environment, and fear about unknown risks of GM foods. It is interpreted that Kenyans, are not yet convinced about safety of GM crops for human consumption. In addition, as people believe that GM foods are likely to pose health risks than non-GM foods and they are uncertain or undecided about accepting or rejecting them. The result

showed that the cognition of risk/benefit perceptions of GM crops and foods has a significant impact on people's acceptance/rejection of the products. In another study conducted by Zakaria et al (2014) [20] in Ghana by employing Q-methodology and Likert scale revealed that farmers were concerned about possible risks associated with the cultivation of GM crops which were environmental risks, health risks, and market risks, as well as potential failures of government policies designed to safeguard the interest of consumers and producers.

### Materials and methods

Perception is the process by which impressions, feelings about GM crops are formed by means of a sensory operation in terms of human health (nutrition, allergy, toxicity), animal health (toxicity, feed), ecological effect (gene erosion, gene contamination and soil degradation) etc. The perceived environmental and health hazards of GM crops were measured on three point continuum i.e. strongly agree, agree, disagree with corresponding weightage of 3, 2 & 1 respectively. Stakeholders can be defined as farmers, extension personnel and research scientists who were affected by adopting GM crops. The study was conducted in the Malwa region of Punjab purposively because genetically modified crop in the form of Bt. cotton was introduced in this region of Punjab. In Malwa region, two districts with highest acreage under transgenic crops viz. Bathinda and Fazilka were selected. Then from each of the selected districts, 3 blocks were selected randomly. A sample of 120 farmers drawn randomly, with 10 farmers from each of the 12 selected villages selected through simple random sampling technique. This study also comprised of extension personnel and research scientists. Ten extension personnel from state department of agriculture and KVK/FASS were selected from each of the two districts. Similarly, ten research scientists from Punjab Agricultural University, Ludhiana were also considered as part of the study. Thus, 120 farmers, 20 extension personnel and 10 research scientists who aggregated to total of 150 respondents were included in the study. In order to measure perception, a modified perception scale was used. The data were collected through self-structured interview schedule. The statistical analysis of data was done through spearman's correlation method and multiple regression analysis.

### Results and Discussion:

#### Perception of farmers towards environmental and health hazards of GM crops

Perception of farmers towards environmental and health hazards also play a critical role in acceptance of technology. The perception of farmers related to different aspects of environmental and health hazards of GM crops among farmers are presented in table 1.

**Table 1:** Distribution of farmer according to their perceived environmental and health hazards towards GM crops. (n=120)

S. No.	Statements	A	UD	DA	MS
<b>A. Human and animal health hazards</b>					
1.	The farmers/laborers suffer from itching, red eyes and swollen faces after working long hours in the field of Bt. Cotton	0 (0)	0 (0)	120 (100)	1
2.	Bt. cotton farmers can develop allergic reactions and not to the non- Bt. hybrids or desi cotton.	0 (0)	0 (0)	120 (100)	1
3.	The GM foods are more toxic / carcinogenic than conventionally grown foods.	35 (29.16)	54 (45)	31 (25.83)	2.04
4.	Feeding of Bt. seed cake has toxic effect upon animals like abortions, infertility.	3 (2.5)	6 (5)	111 (92.5)	1.1
5.	There is chances of Bt. protein entering human food chain through milk and meat	4 (3.33)	8 (6.66)	108 (90)	1.13
6.	Transgenic foods are believed to be unpredictable and quite dangerous for health.	79 (65.83)	15 (12.5)	26 (21.66)	2.44
7.	There might be problem in digestive system after consumption of transgenic food.	47 (39.16)	45 (37.5)	28 (23.33)	2.15
<b>B. The Environmental hazards</b>					
8.	There will be threat to genetic diversity by spreading of transgenic crops.	35 (29.16)	34 (28.33)	51 (42.5)	1.86

9.	Toxic residues of GM crop cultivation are left in soil, water sources and air lead to many problems.	32 (26.66)	39 (32.5)	49 (40.83)	1.85
10.	Genetically modified Bt. toxin can themselves give rise to invasive weeds.	65 (54.16)	37 (30.83)	18 (15)	2.39
11.	GM crop cultivation leads to emergence of new pests and diseases other than to which it is resistant.	63 (52.5)	35 (29.16)	22 (18.33)	2.34
12.	There is concern about capability of genetically modified organisms to escape and introduce engineered genes into wild population.	30 (25)	31 (25.83)	59 (49.16)	1.75
13.	Massive use of Bt. toxin in crops can affect the beneficial insects.	12 (10)	25 (20.83)	83 (69.16)	1.40
14.	Insects can quickly develop resistance to Bt. toxin.	34 (28.33)	23 (19.16)	63 (52.5)	1.75

With mean perception score of 1.0, all the farmers (100%) had disagreement to the perception that after working for long hours on the field of Bt. Cotton they suffer from itching, red eyes and swollen faces and entire sample of farmers (100%) disagreed to the statement that Bt. Cotton farmers can develop allergic reactions. Almost all (92.50%) of farmers disagreed that feeding of Bt. seed cake has toxic effect upon animals like infertility, abortion etc. About 90 per cent of farmers disagreed that, there is chances of Bt. protein entering human food chain through milk and meat. 69.16 per cent of farmers with mean perception score of 1.40 disagreed that massive use of Bt. toxin in crops can affect beneficial insects. Just more than half of the farmers (52.50 %) had disagreement that insect can quickly develop resistance to Bt. toxin. Slightly less than half (49.16 %) of the farmers disagreed that there is concern about capability of genetically modified organisms escaping into wild population.

With mean perception score of 2.04, 45 per cent of farmers were undecided about whether GM crops are more carcinogenic than conventional bred crops. As much as 65.83 per cent of farmers agreed that transgenic foods were more unpredictable and quite dangerous to health. More than half (52.5%) of farmers agreed that GM crop cultivation leads to emergence of new pests. Around 54.16 per cent of farmers agreed that genetically modified Bt. toxin can give rise to invasive weeds. In the issue of toxic residues of GM crop left on soil water and air leading to many problems, about 40.83 per cent of farmers disagreed to it while 32.50 per cent were undecided about it. 42.50 per cent of farmers disagreed to the fact that there will be threat to genetic diversity upon spread of transgenic crops. Around 39.50 per cent of farmers agreed that there might be problem in digestive system upon consumption of transgenic food while 37.50 per cent of farmers were undecided to this.

### Overall perception of farmers towards perceived environmental and health hazards of GM crops:

The perception of farmers related to different aspects of

environmental and health hazards of GM crops were presented in table

**Table 2:** Distribution of farmers according to their overall perception regarding environmental and health hazards of GM crops. (n=120)

S. N.	Category	Frequency	Percentage
1.	Disagree (14-25)	69	57.5
2.	Undecided (26)	10	8.33
3.	Agree (27-38)	41	34.16

According to table 2, perception of farmers towards environmental and health hazards ranged from scores of 14 to 38. As a result farmers having scores of 14 to 25 were classified as unfavourable, farmers obtaining score of 26 as neutral and total score between 27 to 38 were classified as favourable. Majority of the farmers viz. 57.50 per cent disagree the perceived environmental and health hazards aspects of GM crops. On the other hand 34.16 per cent of farmers had agreed to these perceived environmental and health hazard aspect of GM crops. Only 8.33 per cent of farmers were undecided to these perceptions about genetically modified crops. It is concluded that perceived health and environmental risks were moderate and most of the farmers rejected concerns about such risks. Similar findings was also reported by Aerni (2005) in study conducted at Phillipines and Mexico.

### Perception of extension personnel towards environmental and health hazards

The perception of extension personnel related to different aspects of environmental and health hazards of GM crops are presented in table.

**Table 3:** Distribution of extension personnel according to their perceived environmental and health hazards towards GM crops (n=20)

S. No.	Statements	A	UD	DA	MS
<b>A.</b>	<b>Human and animal health hazards</b>				
1.	The farmers/laborers suffer from itching, red eyes and swollen faces after working long hours in the field of Bt. Cotton	0 (0)	1 (5)	19 (95)	1.1
2.	Bt. cotton farmers can develop allergic reactions and not to the non- Bt. hybrids or desi cotton.	1 (5)	2 (10)	17 (85)	1
3.	The GM foods are more toxic / carcinogenic than conventionally grown foods.	3 (15)	11 (55)	6 (30)	1
4.	Feeding of Bt. seed cake has toxic effect upon animals like abortions, infertility.	0 (0)	10 (50)	10 (50)	1
5.	There is chances of Bt. protein entering human food chain through milk and meat	1 (5)	5 (25)	14 (70)	1
6.	Transgenic foods are believed to be unpredictable and quite dangerous for health.	1 (5)	15 (75)	4 (20)	1.2
7.	There might be problem in digestive system after consumption of transgenic food.	1 (5)	8 (40)	11 (55)	1.1
<b>B.</b>	<b>The Environmental hazards</b>				
8.	There will be threat to genetic diversity by spreading of transgenic crops.	3 (15)	7 (35)	10 (50)	1.4
9.	Toxic residues of GM crop cultivation are left in soil, water sources and air lead to many problems.	0 (0)	3 (15)	17 (85)	1
10.	Genetically modified Bt. toxin can themselves give rise to invasive weeds.	1 (5)	8 (40)	11 (55)	1.3
11.	GM crop cultivation leads to emergence of new pests and diseases other than to which it is resistant.	7 (35)	12 (60)	1 (5)	1.2
12.	There is concern about capability of genetically modified organisms to escape and introduce engineered genes into wild population.	7 (35)	12 (60)	9 (45)	1.1
13.	Massive use of Bt. toxin in crops can affect the beneficial insects.	2 (10)	11 (55)	7 (35)	1
14.	Insects can quickly develop resistance to Bt. toxin.	4 (20)	5 (25)	11 (55)	2

With mean perception score of 1.1, about 95.00 per cent of extension personnel disagreed that farmers suffer from itching, red eyes and swollen faces after working long hours in the field of Bt. cotton. On the statement that farmers can develop allergic reactions to Bt. cotton and not to non Bt.

hybrids or desi varieties, an overwhelming number (85.00 per cent) of extension personnel disagreed to it. Almost half (50.00 per cent) of the extension personnel disagreed that animals upon feeding of Bt. seed cake suffer from abortions, infertility where as another half (50.00 per cent) of extension

personnel were undecided about it. Almost two-thirds (70.00 per cent) of extension personnel disagreed that there is chances of Bt. protein entering human food chain through milk and meat whereas 25.00 per cent of extension personnel were undecided to this. More than half (55.00 per cent) of extension personnel disagreed on the perception that there might be problem on digestive system upon consumption of transgenic foods while 40.00 per cent of extension personnel were undecided about it.

Around 85.00 per cent of extension personnel disagreed that toxic residues of GM crop left in soil, water can lead to many problems while 15.00 per cent of them were undecided to it. More than half (55.00 per cent) of the extension personnel disagreed to the statement that GM crops cultivation can give rise to invasive weeds while 40.00 per cent of extension personnel were undecided about it. About half (50.00 per cent) of extension personnel disagreed that there will be any threat to genetic diversity upon spread of transgenic crops while 35.00 per cent were undecided about it and rest 15 per cent agreed to it. More than half (55 per cent) of extension personnel agreed that insects can develop resistance to Bt. toxin quickly while 25.00 per cent of extension personnel were undecided about it. Around 60.00 per cent of extension personnel were undecided to the statement that GM crops cultivation will lead to new pest and diseases other than to which it is resistant while 35.00 per cent of extension personnel agreed to this. More than half (60.00 per cent) of extension personnel were undecided about the concern of capability of genetically modified organisms to escape into the wild population while 35.00 per cent of extension personnel agreed to it. Slightly more than half (55 per cent) of extension personnel were undecided that massive use of Bt. toxin may affect beneficial insects while 35.00 per cent of extension personnel disagreed to it. About two thirds (75.00 per cent) of extension personnel were undecided about the transgenic foods being unpredictable and are quite dangerous to health, while 20.00 per cent of extension personnel disagreed this.

#### Overall perception of extension personnel towards environmental and health hazards of GM crops:

Extension personnel who are the link between research institutes/universities and farmers have perception about technology in accordance with experiences, knowledge and ground level problems and feedbacks. Distribution of extension personnel according to perception related to different environmental and health hazards of GM crops is presented in table 4

**Table 4:** Distribution of extension personnel according to their perceived environmental and health hazards regarding GM crops. (n=20)

S.N.	Category	Frequency	Percentage
1.	Disagree (17-25)	15	75.00
2.	Undecided (26-27)	2	10.00
3.	Agree (28-36)	3	15.00

A critical examination of table 4 revealed that 75.00 per cent of extension personnel had unfavourable perception of environmental and health hazards while 15.00 per cent of extension personnel had favourable perception towards it. Only 10.00 per cent of extension personnel had neutral perception towards environmental and health hazards

#### Perception of research scientists towards environmental and health hazards of GM crops.

The perception among research scientists towards environmental and health hazards of GM crops is presented in table 5. All the research scientists disagreed to the statements that Bt. cotton farmers can develop allergic reactions, GM food are more carcinogenic, feeding of Bt. seed cake has toxic effect upon animals, there is chances of Bt. protein entering human food chain through milk and meat, toxic residues of GM crops left in soil, water and air can lead to many problems and massive use of Bt. toxin can affect beneficial insects. Almost all (90.00%) of the research scientists disagreed to statements that farmers can suffer from itching, red eyes and swollen faces after working long hours in field of Bt. cotton, capability of genetically modified organisms to escape into wild population and there might be problem in digestive system upon consumption of transgenic food.

As much as 80.00 per cent of research scientists disagreed to statements that GM crop cultivation can give rise to other pests and diseases other than to which it is resistant and transgenic food are unpredictable and quite dangerous to health. Slightly less than two-third (70.00%) of research scientists disagreed on the issue that genetically modified Bt. toxin can give rise to invasive weeds while 30.00 per cent of them were undecided about it. Another 70.00 per cent of research scientists disagreed that there will be threat to genetic diversity upon spreading of transgenic crops while 20.00 per cent of them were undecided about it. More than half (60 per cent) of research scientists were undecided about the statement that insects can quickly develop resistance to Bt. toxin while about 20 per cent of them disagreed and rest 20.00 per cent agreed to this.

**Table 5:** Distribution of research scientists according to perceived environmental and health hazards of GM crops. (n=10)

S. NO.	Statements	A	UD	DA	MS
<b>A.</b>	<b>Human and animal health hazards</b>				
1.	The farmers/laborers suffer from itching, red eyes and swollen faces after working long hours in the field of Bt. Cotton	0 (0)	1 (10.00)	9 (90.00)	1.1
2.	Bt. cotton farmers can develop allergic reactions and not to the non- Bt. hybrids or desi cotton.	0 (0)	0 (0)	10 (100)	1.0
3.	The GM foods are more toxic / carcinogenic than conventionally grown foods.	0 (0)	0 (0)	10 (100)	1.0
4.	Feeding of Bt. seed cake has toxic effect upon animals like abortions, infertility.	0 (0)	0 (0)	10 (100)	1.0
5.	There is chances of Bt. protein entering human food chain through milk and meat	0 (0)	0 (0)	10 (100)	1.0
6.	Transgenic foods are believed to be unpredictable and quite dangerous for health.	0 (0)	2 (20.00)	8 (80.00)	1.2
7.	There might be problem in digestive system after consumption of transgenic food.	0 (0)	1 (10.00)	9 (90.00)	1.1
<b>B.</b>	<b>The Environmental hazards</b>				
8.	There will be threat to genetic diversity by spreading of transgenic crops.	1 (10.00)	2 (20.00)	7 (70.00)	1.4
9.	Toxic residues of GM crop cultivation are left in soil, water sources and air lead to many problems.	0 (0)	0 (0)	10 (100)	1.0
10.	Genetically modified Bt. toxin can themselves give rise to invasive weeds.	0 (0)	3 (30.00)	7 (70.00)	1.3
11.	GM crop cultivation leads to emergence of new pests and diseases other than to which it is resistant.	0 (0)	2 (20.00)	8 (80.00)	1.2
12.	There is concern about capability of genetically modified organisms to escape and introduce engineered genes into wild population.	0 (0)	1 (10.00)	9 (90.00)	1.1
13.	Massive use of Bt. toxin in crops can affect the beneficial insects.	0 (0)	0 (0)	10 (100)	1.0
14.	Insects can quickly develop resistance to Bt. toxin.	2 (20.00)	6 (60.00)	2 (20.00)	2.0

**Overall perception of research scientists regarding perceived environmental and health hazards of GM crops:**

Research scientists' perceptions were mainly in line with their own research aptitude. Perception of research scientist also forms the important part of study. The distribution of research scientists according to their overall perception about environmental and health hazards of GM crops is presented in table 6

**Table 6:** Distribution of research scientists according to their overall perception regarding environmental and health hazards of GM crops (n=10)

S.N.	Category	Frequency	Percentage
1.	Disagree (14-17)	8	80.00
2.	Undecided (18)	1	10.00
3.	Agree (19-22)	1	10.00

**Relationship of profile characteristic of farmers with their perceived environmental and health hazards:**

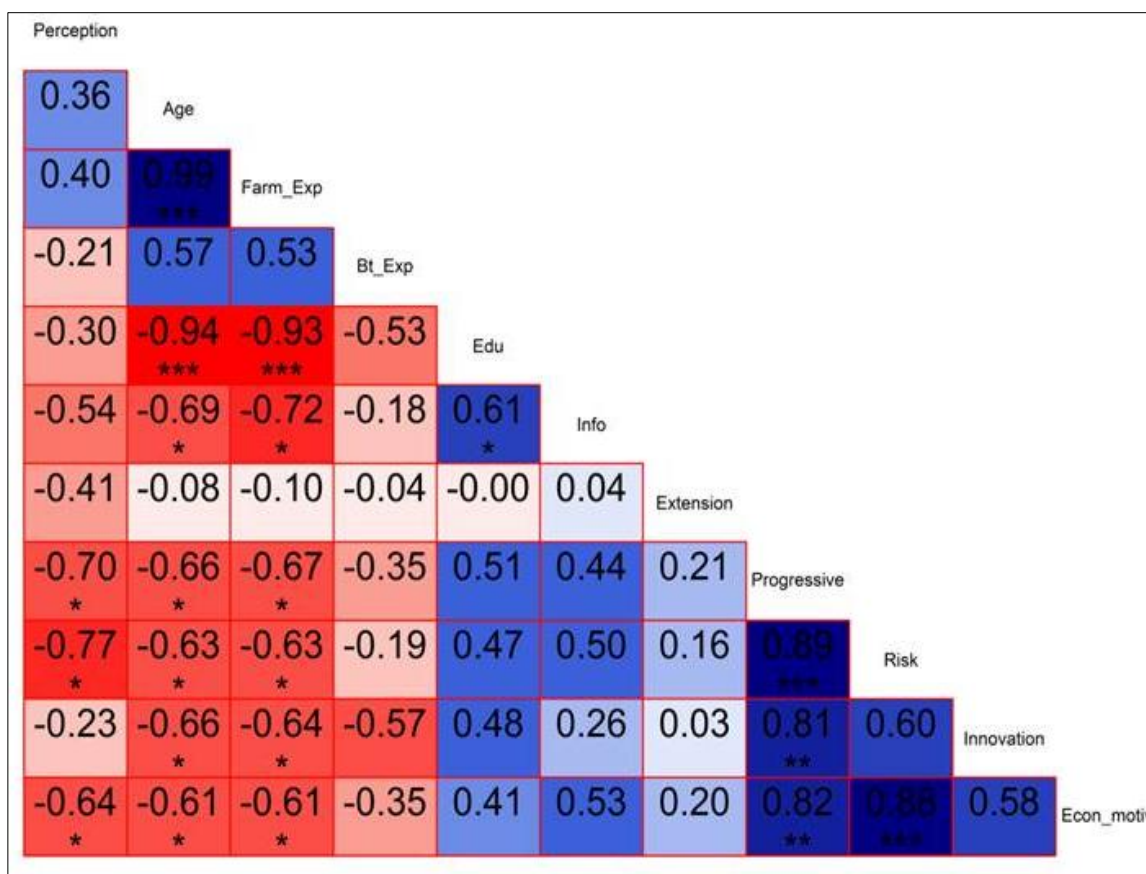
According to table 7, it is clearly evident that out of 10 independent variables, nine of the variables had shown a significant linear relationship about perceived environmental and health hazards about different aspects of GM crops. Strong positive correlation with the perceived environmental and health hazards was observed in case of risk orientation,

progressiveness, extension contacts, innovativeness, mass media exposure and education. Variables like education, mass media exposure, extension contact, progressiveness, risk orientation shows negative relationship with perceived environmental and health hazards.

**Table 7:** Correlation of socio-personal characteristics of farmers with perceived environmental and health hazards of GM crops.

S. No.	Independent Variables	Value r
1	Age	0.130
2	Farm experience	0.190***
3	GM experience	-0.223
4	Education	-0.083***
5	Mass media exposure	-0.241*
6	Extension contacts	-0.206*
7	Progressiveness	-0.408***
8	Risk orientation	-0.411**
9	Innovativeness	0.0591***
10	Economic motivation	-0.257

Maximum independent variables show negative correlation coefficient towards perceived environmental and health hazards which implies that with every increase or decrease in these variables there is decrease in perception levels towards GM crop



**Fig 1:** Correlogram showing degree of correlation among variables towards perception

A glance at the correlogram revealed that most of the variables show negative relation as perception about environmental and health hazards tends to decrease with these variables.

**Determinants of factors affecting the perception of farmers about environmental and health hazards of genetically modified crops by multiple regression analysis.**

To delve further and have concrete idea about the factors

affecting perception of farmers about genetically modified crops, multiple regression analysis is carried out. The data pertinent to table 8 clearly revealed that progressiveness, risk orientation, innovativeness, mass media exposure, extension contacts, education and farm experience were statistically significant.

**Table 8:** Multiple regression analysis for the factors affecting the perception of farmers towards genetically modified crops

S. No.	Independent Variables	Dependent Variables	B	S.E.	t-statistics
	Intercept	Perception	46.877	6.337	7.3969***
1	Age		0.0518	0.0721	0.7186
2	Farm experience		0.0647	0.0667	0.9700***
3	GM experience		-0.3737	0.1209	-3.0901
4	Education		0.5386	0.3676	1.4651***
5	Mass media exposure		-0.2884	0.2880	-1.0014*
6	Extension contacts		-0.3038	0.1811	-1.6774*
7	Progressiveness		-1.1508	0.2578	-4.4632***
8	Risk orientation		-0.3420	0.1531	-2.2336**
9	Innovativeness		0.4608	0.0964	4.7767***
10	Economic Motivation	0.2106	0.1974	1.0665	

\*\* Significant at 0.01 level, B: Regression co-efficient, S.E: Standard error

With every increase in one units of perceived environmental and health hazards there is decrease in mass media exposure, extension contacts, progressiveness and risk orientation by 0.28,0.303, 1.150 and 0.342 units respectively.

### Conclusion

India, which is having second largest population in the world have to address concerns related to food security, climate change and rising disease-pest incidence. In order to tackle these challenges, genetically modified crops provides a great solution. There are various traits of GM crops lined up for commercialization. This study, which examines the factors affecting perception of the various stakeholders about perceived environmental and health hazards of genetically modified crops, was conducted in Malwa region of Punjab, which is the predominant GM crop growing region of India. Study was carried out by self-structured interview schedule. The results show that the higher mass media exposure, more extension contacts, progressiveness and greater risk orientation of cultivators who are producing genetically modified crops in the form of Bt. cotton plays important role in favourable response towards GM crops i.e. rejecting the perceived environmental and health hazards of GM crops. These GM crops in order to be properly accepted needs well targeted approach in accordance with socio-psychological factors and proper bio safety tests and field trials need to be carried out by govt. agencies as private companies suffer from trust deficit. Based on these findings it is clear that policies regarding GM crops must be based on open and honest debate involving all stakeholders and decision should be based on credible scientific information.

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