Journal of Environment and Earth Science www.iiste.org
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.5, No.13, 2015

Economic Evaluation and Risk Analysis of Integrated Pest Management (IPM) in Cotton Production in Sindh Pakistan

Sanaullah Noonari (Corresponding author)
Sanaullah Noonari*[1], Ms.Irfana Noor Memon[1], Ghulam Yasin Kalwar[2], Maria Pathan[2]
Aamir Ali Marani[2], Zarmina Memon[2], Riaz Hussain Jamali[2], Amber Pathan[2]
1. Assistant Professor, Department of Agricultural Economics, Faculty of Agricultural Social Sciences, Sindh Agriculture University, Tandojam Pakistan
2. Department of Agricultural Economics, Faculty of Agricultural Social Sciences, Sindh Agriculture University, Tandojam Pakistan

Abstract
Cotton is the important cash crop of Pakistan and a major source of foreign earnings. However cotton crop is facing many problems, such as disease and pest attacks. One way to reduce losses caused by disease and pest attack is the use integrated pest management (IPM) practices. Keeping in view the importance of this technique, the present study analyzed the adoption of IPM along with estimation of risk involved in the adoption process. To estimate the cotton yield, two types of production functions (one for adopter and other for non-adopters) were estimated using the regression analysis. Then estimate of regression models was used further in risk analysis. The results of non-adopters of IPM showed that cost of urea bags, cost of nitro-phosphate bags, cost of herbicide and rainfall were -0.038, 0.00475, 0.301 and 0.164 respectively and all of these significant at 10 percent level. For non-adopters of IPM the coefficient values of seed expenditure, temperature, humidity and spray cost were 0.0035, 0.026,-.0.00093 and 0.00027 respectively. The results of IPM adopters showed that coefficient of temperature, seed expenditure, spray cost, urea cost and rainfall equal to 0.0305,0.100,0.0029,-.000213 and 0.894 respectively and significant at ten percent level. Coefficient values of cost of nitro-phosphate bags, herbicide cost, humidity were 0.00035, 0.100.-0.000671 and -0.000445 respectively.
Keywords: Cotton, IPM, herbicide, evaluation, risk, Coefficient, Hyderabad.

1. INTRODUCTION

Economy of Pakistan is semi-industrialized economy that includes agriculture, textile, chemicals, food processing and other industries. However, agriculture is the backbone of Pakistan's economy. It currently contributes 21.4 percent to GDP. Agriculture generates productive employment opportunities for 45 percent of the country's labor force and 60 percent of the rural population depends upon this sector for its livelihood. It has a vital role in ensuring food security, generating overall economic growth, reducing poverty and the transforming towards industrialization. Accelerated public investments are needed to facilitate agricultural growth through high yielding varieties with resistance to biotic and antibiotic stresses, environment-friendly production technologies and availability of reasonably priced inputs in time, dissemination of information, improved infrastructure and markets and education in basic health care. The use of high yielding varieties, irrigation, fertilizers and pesticides has increased crop productivity five-fold in the past five decades. However, growth has been leveling off in the past two decades. Land and water resources are diminishing there is no option but to increase crop productivity per unit area. There is a need to examine how appreciation of scientific tools to raise biological productivity without ecological costs. Some productivity increase can be achieved through the application of modern biotechnology tools in integrated gene management, integrated pest management and efficient post-harvest management. Biotechnology in agriculture and medicine can be a powerful tool to alleviate poverty and improve the livelihoods of the rural poor (GOP, 2014).

To reduce this loss in cotton, farmers use huge amount of pesticides on this crop. About 54% of total pesticides are used only on cotton, leading to higher cost of its production and deterioration in its quality. In addition to this, less expenditure on pesticide would definitely reduce the cost of production. There is great biotic pressure on cotton crop and greatest threat is from insect and pests. Cotton crop is attacked by many insects/pest and mites. It is estimated that about 20-40% loss is occurring annually due to different pests of cotton. This has resulted in increased use of pesticides. These include development of resistance to pesticides by major insect pests, environmental pollution and problems of health hazards and residues in food chain (Mallah *et al.* 2007).

Cotton contributes 29.8 per cent of the Indian agricultural gross domestic product. World's largest cotton cultivation area 9.42 million hectares (25%) is in India, however, India ranks third (18%) in total cotton production in the world. Hybrid cotton occupied about 70 per cent of total cotton area, which is a significant milestone in Indian cotton scenario. Cotton is cultivated in three distinct agro-ecological regions viz., North, Central and South. Out of total, 21 per cent area is under cultivation in North zone which is 100 per cent irrigated and contributes 25 per cent of the production. The central zone is predominantly rained and occupies more than 56 per cent of the total area but contributing less than 50 per cent of the total production and hybrid cultivation is dominant in this zone (Khadi, 2005).

Integrated Pest Management (IPM) is a common-sense method that builds on practices that farmers have used for centuries, for example, using varieties resistant to pests, altering time of sowing and harvest, hoeing, removing crop residues and using botanical pesticides (e.g. name and tobacco extracts). The name, IPM, goes back at least to the 1960s, hi 1967, FAO defined IPM as 'a pest management system that, in the context of the associated environment and the population dynamics of the pest species. IPM utilizes all suitable techniques in compatible manner to maintain the pest population at levels below those causing economic; injury. It is seeks to reduce pest populations to economically manageable levels through a combination of cultural control (e.g. crop rotation, inter-cropping), physical controls (hand picking of pests, use of pheromones to trap pests), and less toxic chemical controls. On the other hand, it allows the use of chemical pesticides, even synthetic and toxic ones, when there is a need. IPM techniques are specific to the agro-ecological production conditions.

2. OBJECTIVES:

1. To investigate the factors effecting the adoption of integrated pest management (IPM).
2. To estimate the cotton production by IPM-adopters and non-adopters.
3. To estimate the risk involved in cotton production for IPM adaptors and non-adopters.
4. To suggest policy recommendation for profitable cotton production.

3. MATERIALS AND METHODS

The validity, reliability and precision of analytical tool yield scientific results if the study has been rigorously put to scientific methods. A very important and significant thing in conducting any study is to adopt a systematic and appropriate methods and procedures. Then statistical sampling techniques, data collection and application of suitable econometric technique for analyzing data were used. A good presentation of data and dissemination of results leads to successful completion of the study. Without making a right choice for data analysis the impact of study is merely a useless piece of work with no scientific values. The present study was conducted in the rural areas of the' district Hyderabad Sindh in order to measure impact of integrated pest management (IPM) on the cotton yield and the factors affecting the adoption of (IPM).

3.1. Socio Economic characteristic

Socio-economic characteristics determine the status of an individual. For the purpose of the present study, following indicators of socio-economic characteristics have been used.

3.2. Educational Status

Education considered as one of the most important factors Which effect the knowledge, attitude and prestige of an individual to accept the new technology such as integrated pest management (IPM) for cotton production. In the present study education means schooling years that have been spent in school or college for the acquisition of knowledge. It is assumed that farmers with higher education adopt new technology rapidly.

3.3. Farm Size

Farm size has an important effect on the crop production. Larger farm size reduces the variable cost of inputs as well as fixed cost, because of economies of scale.

3.4. Farming Experience

Farming experience has an importance in the crops production. Experienced farmers have more technical knowledge than non experienced farmers. Farming experience is playing on important role in making efficient use of resources.

3.5. Nature and source of data

For evaluating the specific objectives designed for the study, required primary data was collected from selected sample farmers by personal interview method with the help of pre-tested and structured schedule. The data collected from the farmers pertained to the agricultural year 2013-14, which include general characteristics of cultivation related to IPM and non-IPM farmers, general information, size of holdings, cropping pattern followed, inputs used, input prices, output obtained, opinions about extent of adoption of IPM practices and reasons for non adoption of IPM practices.

3.6. Analytical tools and techniques

For assessing quantitatively the objectives and hypothesis outlined for the present study, the following analytical

tools and techniques were employed.
Tabular analysis
Functional analysis
The data collected were presented in tabular form to facilitate easy comparison. The technique of tabular presentation was employed for estimating the socio-economic characteristics of sample farmers such as age and education, size of land holding and costs and returns structure and comparison of IPM and non-IPM farmers. Absolute and percentage forms were used for tabulation of the collected data.

3.7. Functional analysis

3.7.1. Production function analysis

To study resource productivity in IPM and non-IPM farmers, a modified Cobb- Douglas type of production function was fitted. This was done with a view to determine the extent to which the important resources that have been quantified, explain the variability in the gross returns of the IPM and non-IPM farmers and to determine whether the resources were optimally used in these farmers category.

Heady and Dillon (1963) indicated that the Cobb-Douglas type of function has been the most popular of all possible algebraic forms in the farm firm analysis as it provides comparison, adequate fit, computational feasibility and sufficient degrees of freedom. They further indicated that Cobb-Douglas type of function has the greatest use in diagnostic analysis, reflecting the marginal productivities at mean levels of returns. The general form of the function is Y = axibi where, 'xi' is the variable resource measure, 'y' is the output, 'a' is a constant and 'bi' estimates the extent of relationship between xi and y and when xi is at different magnitudes. The 'b' coefficient also represents the elasticity of production in Cobb-Douglas production function analysis.

This type of function allows for either constant or increasing or decreasing returns to scale. It does not allow for total product curve embracing all the three phases simultaneously. Test was conducted to see if the sum of regression coefficients were significantly different from unity. Functions of the following form were fitted for IPM and non-IPM farmers separately.

$Y = a\, x_1b_1 .x_2b_2 .x_3b_3 \ldots\ldots\ldots\ldots\ldots\ldots x_nb_n$

On linearization, it becomes

$\log Y = \log a + b_1\log x_1 + b_2\log x_2 + b_3\log x_3 + \ldots\ldots\ldots\ldots\ldots + b_n\log x_n$

Production function employed for IPM and non-IPM farmers as a whole is given below.

$\text{Log}\,(Y) = \log(a) + b_1\log(x_1) + b_2\log(x_2) + b_3\log(x_3) + b_4\log(x_4) + b_5\log(x_5) + b_6\log(x_6) + b_7\log(x_7) + e_i$

Where;
Y = Gross return in rupees/ha
a = Intercept
x_1= Seed cost/ha
x_2 = Organic manure cost/ha
x_3 = Human labour cost/ha
x_4 = Bullock labour cost/ha
x_5 = Chemical fertilizers cost/ha
x_6 = IPM component/ Plant protection cost/ha
x_7 = Machine labour cost/ha
e_i = Error term
b_i = Elasticity's coefficient of respective inputs and summation of these gives returns to scale

3.8. Returns to scale

The returns to scale were estimated directly by getting the sum of 'bi' coefficients. The returns will be increasing, constant or diminishing based on whether value of summation of 'b_i' is greater, equal or less than unity, respectively.

3.9. Structural break in production relation

To identify the structural break, if any, in the production relations with the adoption of IPM technology in production, output elasticity's were estimated by ordinary least square method by fitting log linear regression was run in combination with the IPM and non-IPM farmers. The pooled regression was run in combination with IPM and non-IPM farmers including IPM farmers as dummy variables one for IPM and zero for non-IPM farmers.

The following log linear estimable forms of equations were used for examining the structural break in production relation.

$\ln y_1 = \ln A_1 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + U_1 \ldots\ldots\ldots(1)$

$\ln y_2 = \ln A_2 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + U_i \ldots\ldots\ldots(2)$

$\ln y_3 = \ln A_3 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + e_3 d + U_1 \ldots\ldots\ldots(3)$

Where,
Subscribes 1, 2 and 3 in above equation represent non-adopter, adopter and pooled regression function with IPM as dummy variables, respectively.
$b_1, b_2, b_3, b_4, b_5, b_6, b_7$ $b_1, b_2, b_3, b_4, b_5, b_6, b_7$, $b_1, b_2, b_3, b_4, b_5, b_6, b_7$
Represent individual output elasticity of respective input variable in equation (1), (2) and (3) 'd' in equation (3) represent dummy variable. If the regression coefficient of dummy variables is significant, then there is structural break in production relations with the adoption of IPM technology.

3.10. Output decomposition model
For any production function, the total change in output is affected by the change in the factors of production and in the parameters that define the function. This total change in per hectare output is decomposed to reflect on adoption of IPM and the change in input levels. The output decomposition model developed by Bisaliah (1977) is used in the study, which is depicted below.
The output decomposition equation used in this study can be written as
ln Y IPM – ln Y NIPM = [intercept IPM – intercept NIPM] + [(b_1– b_1) x ln X_1 NIPM + …………… + (b_7– b_7) x ln X_7 NIPM] + [(b_1 (lnX_1 IPM – ln X_1 NIPM +………… + (b_7 (ln X_7 IPM – ln X_7 NIPM)] …. (5)
The decomposition equation (1) is approximately a measure of percentage change in output with the adoption of IPM in the production process. The first bracketed expression of the right hand side is the measure of percentage change in output due to shift in scale parameter (A) of the production function.

3.11. Concepts related to evaluation of IPM and non-IPM practices
3.11.1. Variable costs
The variable costs include cost of seed, organic manure, fertilizers, wages of human and bullock labour, plant protection components and interest on operational capital at the rate of 7 percent per annum.
3.11.2. Interest on working capital
This was calculated on the entire working cost of the enterprise at the prevailing bank rate interest of 7 percent per annum.
3.11.3. Fixed costs
These include depreciation on farm implements and machinery, interest on fixed capital and land revenue. The measurement and definitions of fixed cost components are as follows.
3.111.4. Interest on fixed capital
Interest on fixed capital was calculated at 11 percent per annum, which is the prevailing rate of investment credit. The items considered under fixed capital are implements and machinery.
3.11.5. Land revenue
Actual land revenue paid by the farmers was considered.
3.11.6. Land rent
The prevailing land rent for agricultural enterprises were imputed for the sample farmers, since all land holdings were observed to be owner operated.
3.11.7. Cost of cultivation
It is the sum of variable costs and fixed costs expressed on per hectare basis.
3.12. Gross returns
Gross returns were obtained by multiplying the total product with its unit value.
3.13. Net returns
Net returns were obtained by deducting the total costs incurred from the gross returns obtained.
3.14. Benefit cost ratio
Benefit cost ratio was obtained by dividing the gross returns by total cost of cultivation.

4. RESULTS
The present study was conducted in District Hyderabad of Sindh. From District Hyderabad five UCs were selected as sample area, consisting of Hatri, Moosa Khatrian, Tando ajm, Tando Hyder and Tando Qaisr to estimate the cotton production, and analysis. Data was collected through questionnaire including general information of the IPM adopters / non-IPM adopters like the education of the respondent, total farm size of the respondent and Farming experience of the respondent .The effect of integrated pest management (IPM) technique on cotton production also determined by using the information of respondent Like Urea bags cost, nitro-phosphate bags cost, spray cost, herbicide cost, seed expenditure and temperature, rainfall, humidity level. After collection and analysis of data the following results were obtained.
In results and discussion of the study included the following:

- Percentages of some independent variables
- Analysis of qualitative variables (Logit Regression Analysis)

- Analysis of qualitative variables (Multiple Regression Analysis)
- Forecasting and Risk Analysis

4.1. Adopters/ Non-Adopters of IPM respondent

Table 1: Distributions of respondent according to adopters and non-adopters of Integrated pest management

Integrated Pest Management (IPM)	No. Respondent	Percentage
Non-Adopters	30	50.00
Adopters	30	50.00
Total	60	100.0

Table-1 shows about the study adopters and non-adopters of IPM techniques respondents were taken. In which the 50 percent respondents were non-adopters of IPM and 50 percent respondents were adopters of Integrated Pest Management (IPM) techniques.

4.2. Socio-economic and demographic characteristics of the farmers

Age, education, size of land holding and source of income are the socio-economic and demographic attributes of the farmers.

4.2.1. Age

Age is an important factor in determine the behaviors of human being. It indicates the ability to do work and attitude f person toward various social and economic aspect of life.

Table 2: Distributions of respondent according to their age group in the study area

Age Group	IPM-Adopter		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Up to 35	07	23.33	04	13.33
36 to 45	11	36.66	18	60.00
Above 45	12	40.00	08	26.66
Total	30	100.00	30	100.00

Table-2 depicts that 07 adopters and 04 non-adopters farmers belonged to age group up 35 years, while about one-third i.e.11 adopters and less than half i.e. 18 non-adopters farmers belonged to age group 36-45 years. About 12 adopters and 08 non-adopters farmers' belonged to age group above 45 years.

4.2.2. Education

Education can be defined as the process of developing knowledge, wisdom and other desirable qualities of mind, character and general competency, epically by the source of formal instruction. It is generally admitted that without education it is pretty difficult to produce good results in very sphere of life. The understanding, inculcation and adoption of new innovation are impossible unless our farming community is educated.

Table 3: Distributions of the farmers according to their education level

Education Level	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Illiterate	5	16.66	4	13.33
Primary-middle	15	50.00	12	40.00
Matric	8	26.66	10	33.33
Collage-University	2	6.66	4	13.33
Total	30	100.00	30	100.00

Table-3 reveals that slightly less than 05 farmers' adopters 04 farmers, non-adopters were illiterate, while about 15 farmer's adopters, 21 farmer's non-adopters were Primary-middle level of education. The 08 farmers' adopters, 10 farmer's non-adopters were matriculation. Only 02 farmers' adopters, 04 farmer's non-adopters were Collage-University education in the study area.

4.2.3. Family Sizes

In human context, a family is a group of people affiliated by consanguinity, affinity, or co-residence. In most societies it is the principal institution for the socialization of children. Anthropologists most classify family organization as matrilocal (a mother and her children); conjugal (a husband, his wife, and children; also called nuclear family).

Table 4: Distribution of the farmers according to their family members

Family Members	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Below 5	13	43.33	06	20.00
5-8	11	36.66	14	46.66
Above-8	06	20.00	10	33.33
Total	30	100.00	30	100.00

Table-4 shows that 13 farmer's adopters, 06 farmers non-adopters had 5-6 family members, 11 farmers adopters, 14 farmers non-adopters had 7-8 family members, 06 farmers adopters, 10 farmers non-adopters had 9 and above family members in the selected area.

4.2.4. Marital Status

Marital status is the condition of being married, unmarried, divorced or widowed. Marriage is a legal contract between people called spouses. In many cultures, marriage is formalized via a wedding ceremony. Widowed this category includes persons who have lost their legally-married spouse through death and who have not remarried. Divorced this category includes persons who have obtained a legal divorce and have not remarried. Single this category includes persons who have never married. It also includes persons whose marriage has been legally annulled who were single before the annulled marriage and who have not remarried.

Table 5: Distributions of respondents according to marital status in the study area

Marital Status	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Single	9	30.00	10	33.33
Married	20	66.66	12	40.00
Divorced	0	0.00	1	3.33
Widow	1	3.33	2	6.66
Total	30	100.00	30	100.00

Table-5 shows that non-adopters there were 30.00% were single marital status, 66.66% were married marital status, and 3.33% were widow. 0.00% was divorced. While in case of non-adopters were 33.33% were single marital status,, 40.00% were married marital status, and 6.66%were widow. Only 3.33% were divorced.

4.2.5. Family Type

Joint family set-up, the workload is shared among the members, often unequally. The roles of women are often restricted to housewives and this usually involves cooking, cleaning, and organizing for the entire family. They are also responsible in teaching the younger children their mother tongue, manners, and etiquette. Extended family defines a family that extends beyond the nuclear family, consisting of grandparents, aunts, uncles, and cousins all living nearby or in the same household. An example is a married couple that lives with either the husband or the wife's parents. The family changes from nuclear household to extended household. A single-family detached home, also called a single-detached dwelling or separate house is a free-standing residential building.

Table 6: Distribution of respondents according to family type in the study area

Family Type	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Joint	14	46.66	16	53.33
Extended	3	10.00	2	6.66
Single	13	43.33	12	40.00
Total	30	100.00	30	100.00

Table-6 shows that adopters there were 46.66% were joint family system, 10.00% were extended family type and 43.33% were single family type. While in case of non-adopters were 53.33% were joint family system, 6.66% were extended family type and 40.00% were single family type.

4.2.6. Farmer Status

A farmer is a person engaged in agriculture, raising living organisms for food or raw materials. A farmer might own the farmed land or might work as a laborer on land owned by others, but in advanced economies, a farmer is usually a farm owner, while employees of the farm are farm workers, farmhands, etc. A tenant farmer is one who resides on and farms land owned by a landlord. Tenant farming is an agricultural production system in which landowners contribute their land and often a measure of operating capital and management; while tenant farmers contribute their labor along with at times varying amounts of capital and management. The rights the tenant has over the land, the form, and measure of the payment varies across systems.

Table 7: Distributions of respondents according to farmer status in the study area

Farmer status	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Owner	14	46.66	16	53.33
Tenant	9	30.00	8	26.66
Owner cum Tenant	7	23.33	6	20.00
Total	30	100.00	30	100.00

Table-7 shows that adopters there were 46.66% were owner ship, 30.00% were tenant farmers and 23.33% were owner cum tenant respondents. While in case of non-adopters were 53.33% were owner ship, 26.66% were tenant farmers, and 20.00% were owner cum tenant respondents.

4.2.7. Agricultural Experience

Table 8: Distribution of the farmers according to their agricultural experience

Agricultural experience(years)	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Up to 10	05	16.66	04	13.33
11-20	10	33.33	11	36.66
Above 20	15	50.00	15	50.00
Total	30	100.00	30	100.00

Table-8 reveals that only 05adopters farmers and 04 non-adopters farmers had up to 10 years of agricultural experience, while most of the respondents i.e. 10 farmers adopters and 11 farmers non-adopters had 11-20 years agricultural experience.15 adopters farmers and 15 non-adopters farmers had above 20 years of agricultural experience.

4.2.8. Farm Size

A farm is an area of land, or, for aquaculture, lake, river or sea, including various structures, devoted primarily to the practice of producing and managing food (produce, grains, or livestock), fibers and, increasingly, fuel.

Table 9: Distributions of respondents according to agricultural farm size (acres)

Agricultural Farm Size	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percentage
Less 5 acres	10	33.33	9	30.00
5-8 acres	8	26.66	7	23.33
8-10 acres	7	23.33	8	26.66
Above 10 acres	5	16.66	6	20.00
Total	30	100.00	30	100.00

Table-9 shows that adopters there were 33.33% were less 5 acres, 26.66% were 5-8 acres, and 23.33% were 8-10 acres farm size. Only 16.66% were above 10 acres farm size while in case of non-adopters were 30.00% were less 5 acres, 23.33were 5-8 acres, 26.66% were 8-10 acres farm size. Only 20.00% were above 10 acres farm size.

4.3. Logistic Regression Model

From qualitative information obtained from the respondent, correlates of adopters/ non-adopters of IPM were determined by employing probabilistic model "LOGIT".

Table 10: Hosmer and Lameshow Test Statistics

Chi-Square	Df	Significance level
2.801	8	.946

The non- significance of the Chi-square indicates that the data fit the model well.

Table 11: Coefficient of independent variables for logistic model

Variables	B	S.E	Wald	Exp(B)
Education	-.160	.238	.453	.852
Farm Size	-.111	.032	12.354	.895*
Farm Experience	1.177	.278	17.948	3.246*
Constant	-5.005	2.414	4.299	.007*

*Shows the significant of Results at 5 percent level.

The results of Logistic model showed that education of farmers and adoption of integrated pest management (IPM) is negatively related. It is found that with one percent increase in the education of farmers, probability of adopting of integrated pest management (IPM) decreases by .852 percent. Reason for this is due to the fact that educated persons have excellent awareness about the new technology of cotton production such as integrated pest management (IPM) but the traditional farmers mostly not quickly respond to the new techniques such as IPM. There is no significant relationship between level of education and adoption of IPM (Grieshop *et al.* 1988).

The results of Logistic model show that farming experience of farmers and adoption of integrated pest management (IPM) is positively related. It is found that with one percent increase in the farming experience of farmers, probability of adopting of integrated pest management (IPM) increase by 3.246 percent. Reason for this is that as the time passes the farming experience of farmer increase with the time and they can better understand the crop conditions, so that the probability of adopting integrated pest management (IPM) increase with farming experience of farmers. The results of this study are similar to samiee *et al.* (2009) results.

4.4. Analysis of Quantitative variables

4.4.1. Results of IPM non-adopters

Table 12: Estimated coefficient of independent variables in non adopters of IPM Model

Independent Variables	Estimated Coefficient of independent variables	T value	Significance
Constant	-42.57	-1.805	- 0.78
Cost of urea Bags	-0.00389	*3.313	0.002
Cost of Nitro-phosphate Bags	0.00475	*3.579	0.001
Seed Expenditure	0.00356	- 0.907	0.370
Temperature	0.02693	1.628	0.111
Rainfall	0.301	*2.221	0.032
Humidity	0.164	*2.511	0.016
Herbicides Cost	-0.00093	-0.308	0.760
Spray cost	0.00027	0.310	0.758

*Significant at 10 percent level.
R square value of model = 0.397
F value of model =3.372

In this study we have used regression analysis to find out impact of different independent variables (Spray cost, Urea cost, Nitro-phosphate cost, Temperature, Rainfall, Humidity, Seed expenditure, Herbicide cost) on the cotton yield of non adopters of integrated pest management (IPM).

The R squares (R) value of the model is 0.397 indicating that 39 percent variation in cotton yield is explained by the independent variables. The F test statistics value of the model is equal to 3.372 which is highly significant at 5 percent .This implies that the estimated production function used in this study is overall statistically significant.

The results of regression analysis shows that cost of urea bags and cotton production are positively related. It is found that with one rupees increase in cost on urea bags, on the average about 0.0038 mounds /acre increase the cotton yield, keeping all the other inputs constant. Results of the analysis are fairly significant at five percent level. The nitro-phosphate fertilizer was found responsible for the vegetative growth of the plant. The results of this study are consistent with the Churahry *et al.* (2009).The results of our study also shows that non adopters use more fertilizer like urea for increases in cotton yield as compared to adopters of integrated pest management (IPM).

The results of regression analysis shows that cost of nitro-phosphate bags and the yield of cotton crop are positively related. It is found that with one rupees increase in the cost on nitro-phosphate bags, on the average about 0.0047 mounds/acre increase in the output of cotton yield, by keeping all the other inputs constant. The coefficient of the nitro-phosphate cost is significant at ten percent. Reason behind as nitro-phosphate usage increases the fertility of soil; increase consistently the cotton crop yield. The results of this study are consistent with results of Baklish *et al.* (2005).

The results of regression analysis shows that seed expenditure and the yield of cotton crop are positively related. The Coefficient of seed expenditure is equal to 0.003568 which significant at ten percent level. It is found that with one rupee increase on seed expenditure, led on the average to about 0.00356 mounds/acre increases in the cotton yield, by keeping all the other inputs constant. The positive singe of variables shows that with the more expenditure on cotton seed, cotton yield increase considerably. The expenditure on seed means use of good quality seed and improved methods of sowing. The importance of seed in the cotton production is widely accepted. It has been proved through various studies that the role of seed in the cotton production is very important. The results of this study are very consistent with Chaudhry *et al.* (2009).The coefficient of this variable is no significant at ten percent level.

The result of regression analysis shows that temperature and the yield of cotton crop are positively related. . It is found that one centigrade increase in the temperature, led on an average to about 0.0267(mounds /acre) increase in the cotton yield, by keeping all the other inputs constant. The coefficient of this variable is no significant at ten percent level. . Reason for this is cotton crop prepared for picking required high environment temperature. The results of this study are consistent with the results of Schlenker and Roberts (2008).

The results of regression analysis show that rainfall and the yield of cotton crop are positively related. It is found that one unit (mm) increase in rainfall, led on the average to about 0.301 (mounds/acre) increases in the cotton yield, by keeping all the other inputs constant. Results of the analysis are fairly positive. Reason for this is due to the fact that increases in cotton yield associated with increase rainfall because the cotton crop need more water requirement for better yield. The coefficient of these variables is fairly significant at ten percent level. The results of this study are consistent with results of Schlenker and Roberts (2008).

The results of regression analysis show that humidity and the yield of cotton crop are positively related. It is found that one unit increase in environmental level of humidity, led on the average to about 0.164 (mounds/acre) increases in the cotton yield, by keeping all the other inputs constant. Results of the analysis are fairly significant at ten percent.

The result of regression analysis shows that herbicide cost and the yield of cotton crop are negatively related. It is found that one rupees increase in herbicide cost, led on the average to about 0.00093 (mounds/acre) decreases in the cotton yield, by keeping all the Other inputs constant. The results of this study are consistent with the results of Rao *et al.* (2007).

The results of regression analysis shows that cost of spray and the yield of cotton crop are positively related. It is found that one rupees increase in spray cost, led on the average to about 0.000270 (mounds/acre) increases in the cotton yield, by keeping all the other inputs constant. The coefficient of this variable is no significant at ten percent. Results of this study are consistent with the Sigh and Satwinder (2007) results which state that without IPM technology the spray cost increase with the increase in cotton yield.

4.5. Results of Adopters of IPM (Integrated Pest Management)

Table 13: Estimated coefficient of Independent Variables of the IPM adopters Model

Independent Variables	Estimated Coefficient of independent variables	T value	Significance
Constant	2.359	0.414	0.681
Temperature	0.0305	* 1.672	0.102
Nitre-phosphate Bags Cost	0.000350	0.488	0.628
Seed Expenditure	0.100	*2.05	0.046
Spray Cost	0.00295	*5.322	0.00
Herbicide cost	-0.000671	-0.308	0.759
Urea Bags Cost	-0.00213	M.844	0.073
Humidity	-0.000445	-0.035	0.972
Rainfall	0.08946	1.882	0.067

* Significant at ten percent level.

R square value of the model is 0.593 which shows that 59 percent variation in the cotton yield is explained by the independent variables. The F test statistical of the model is 7.458 which is significance and indicate that model is fit for analysis. It implies that production function use in this study is overall statistical significant.

The result of regression analysis for the adopters of integrated pest management (IPM) shows that temperature and the yield of cotton crop are positively related. It is found that one centigrade increase in the temperature, on the average about 0.0305 (mds/acre) increases in the cotton yield, by keeping all the other inputs constant. The temperature coefficient equal to 0.0305 and it is significant at ten percent level. The results of this study are consistent with results of Schlenker and Roberts (2008).

The results of regression analysis for the adopters of integrated pest management (IPM) shows that cost of nitro-phosphate and the yield of cotton crop are positively related. . It is found that one rupees increase in the cost of nitro-phosphate bag, on the average about 0.000350 (mounds/acre) increase in cotton yield, by keeping all the other inputs constant. The coefficient of this variable is no significance at ten percent level. The results of this study are consistent with results of Bakhsh *et al.* (2005). Reason for this is due to the fact that integrated pest management (IPM) is new technology in the Pakistan and farmers have not awareness about it so they use more chemical methods like more use of urea and nitro-phosphate for the increase in yield level the cotton crop required normal combination of all nutrients for increase in yield level.

The results of regression analysis for the adopters of integrated pest management (IPM) shows that cotton seed expenditure and the yield of cotton crop are positively related. . It is found that one rupees increase in expenditure on seed, on the average about 0.100 (mounds/acre) than increase in the cotton yield, by keeping all the other inputs constant. The results of analysis are fairly significant at ten percent level. The expenditure on seed means use of good quality seed and improved methods of sowing. The importance of seed in the cotton production is widely accepted. It has been proved through various studies that the role of seed in the cotton production is very important. The coefficient of this study is very consistent with Chaudhry *et al.* (2009).

The results of regression analysis for the adopters of integrated pest management (IPM) shows that cost of spray and the yield of cotton crop are positively related. It is found that one rupees increase in the cost on spray, on the average about 0.002953 (mounds/acre) increases in the cotton yield, by keeping all the other inputs constant. The estimated coefficient is fairly significant at ten percent level. The results of this study are consistent with the Sigh *et al.* (2007).

The results of regression analysis for the adopters of integrated pest management (IPM) shows that cost of herbicide and the yield of cotton crop are negatively related. . It is found that one rupees increase in the cost on herbicide, on the average about 0.000671 (mounds/acre) decreases the cotton yield, by keeping the other entire inputs constant. The coefficient of this variable is non-significant at ten percent level. The coefficient of this study is consistent with the result of Hall (1977). They argue that herbicide expenditure can reduced more effectively with adoption of IPM and yield of cotton increased.

The results of regression analysis for the adopters of integrated pest management (IPM) shows that cost of urea bags and the yield of cotton crop are negatively related. It is found that with one rupees increase in the cost on urea bags, on the average about- 0.00213 (mounds/acre) decreases in the cotton yield, by keeping all the other inputs constant. The coefficient of this variable is significant at ten percent level. Reason for this is due to the fact that integrated pest management (IPM) is new technology in the Pakistan and farmers have not awareness about it so they use more chemical methods like more use of urea and nitro-phosphate for the increase in yield level. But cotton crop required normal combination of all nutrients for increase yield level.

The results of regression analysis for the adopters of integrated pest management (IPM) shows that level of humidity in environment and the yield of cotton crop are negatively related. It is found that with one unit increase in the humidity level of environment, on the average about -0.000445 (mounds/acre) decreases the cotton yield, by keeping all the other inputs constant. The estimated coefficient of this variable is no significant at ten percent level.

The result of regression analysis shows that rainfall and the yield of cotton crop are positively related. It is found that with one mille meter (mm) increase in rainfall, on the average about 0.089 (mounds/acre) increases the cotton yield, by keeping the other entire inputs constant. The estimated coefficient of the variable is fairly non-significant at ten percent level. Reason for this is due to the fact that increases in cotton yield associated with increase rainfall because the cotton crop need more water requirement for better yield. The results of this study are consistent with results of Schlenker *et al.* (2008).

R square of the model = 0.593
F test statistic of the model =7,458

4.6. Forecasting and Risk Analysis

Risk involved in every work of the daily life. In crop production risk is also involved and it affects the farmer attitude. In cotton crop production risk also involved because it requires a suitable combination of fertilizer, pesticides ,other inputs and favorable environmental conditions like temperature and rainfall, humidity .The adoption of new technology integrated pest management (IPM) by the farmers have increased the cotton production. The coefficient of variation cotton production was also calculating by using the following formula.

Coefficient of variation = (standard Deviation / Mean Yield of cotton) X 100

4.6.1. Forecasting and Risk Analysis of IPM-Adopters

Table 14: Simulated mean cotton yield, min mean yield and max mean yield

Years	Mean Yield	Min. Yield	Max. Yield
2010	38.95	22.23	46.29
2011	39.17	23.17	49.80
2012	39.38	18.40	49.33
2013	39.60	25.81	49.64
2014	39.82	25.56	45.92
2015	40.03	22.76	48.35
2016	40.25	24.57	48.63
2017	40.46	22.26	49.50
2018	40.68	20.96	48.32
2019	40.90	21.93	51.10
2020	41.11	23.01	50.78
2021	41.33	23.82	53.08
2022	41.54	23.28	51.92
2023	41.76	20.20	49.87
2024	41.98	17.30	55.33
2025	42.19	12.04	52.76
2026	42.41	22.62	50.36
2027	42.62	16.90	57.14
2028	42.84	15.07	59.75
2039	43.06	19.33	53.58
2030	43.27	15.40	56.29
2031	43.49	13.94	52.20
2032	43.70	16.29	64.16
2033	43.92	19.04	56.72
2034	44.14	3.105	57.59
2035	44.35	13.48	66.43
2036	44.57	14.46	57.21
2038	45.00	13.25	64.03
2039	45.22	12.11	55.30

Table-14 indicates the stimulated mean cotton yield, minimum and maximum yield of IPM-Adopters. The simulating mean cotton yield was increases as we move in the future. The variation in the yield from the mean values was showing the uncertainty over the time period.

Table 15: Stimulated mean cotton yield, Standard deviation and Coefficient of variation of IPM-Adopters

Years	Mean Yield	Standard deviation	Coefficient of Variation
2010	38.95	4.35	11.16
2011	39.17	4.88	12.45
2012	39.38	4.77	12.10
2013	39.60	4.85	12.2
2014	39.82	4.35	10.92
2015	40.03	4.76	11.88
2016	40.25	5.03	12.49
2017	40.46	5.50	13.59
2018	40.68	5.85	14.37
2029	40.90	5.72	13.98
2020	41.11	6.18	15.02
2021	41.33	6.21	15.02
2022	41.54	6.44	15.49
2023	41.76	6.04	14.46
2024	41.98	6.75	16.07
2025	42.19	7.19	17.03
2026	42.41	6.36	14.99
2027	42.62	7.69	18.03
2028	42.84	7.69	17.94
2029	43.06	7.30	16.95
2030	43.27	**7.66**	17.69
2031	43.49	8.25	18.96
2032	43.70	8.35	19.10
2033	43.92	8.36	19.03
2034	44.14	9.15	20.72
2035	44.35	8.81	19.86
2036	44.57	8.81	19.76
2037	44.78	9.43	21.05
2038	45.00	9.77	21.70
2039	45.22	9.59	21.20

Table-15 indicates standard deviation and coefficient of variation of IPM adopters. The coefficient of variation was estimated by using the above formula. The standard deviation increased over the time indicating that uncertain or risk involved increases and the coefficient of variation indicated that forecasted cotton yield fluctuate over the time as we move more and more in the future. The coefficient of variation in table 10 shows that forecasted cotton yield in the near future has smaller coefficient of variation than the far future In other words as the planning horizon increases the coefficient of variation is also increases.

4.7. Forecasting and Risk Analysis of IPM non-adopters

Table 16: Stimulate mean cotton yield, Minimum yield and Maximum yield of IPM Non-adopters.

Years	Mean Yield	Min. Yield	Max. Yield
2010	28.19	12.714	34.984
2011	28.44	12.575	37.636
2012	28.68	-15.632	37.37
2013	28.93	13.804	35.437
2014	29.17	13.263	36.477
2015	29.42	8.516	41.678
2016	29.66	8.558	38.821
2017	29.91	7.311	39.514
2018	30.15	9.504	42.410
2029	30.40	5.574	48.566
2020	30.64	9.876	42.008
2021	30.89	7.159	46.028
2022	31.13	7.599	41.555
2023	31.37	7.093	44.589
2024	31.62	4.441	44.666
2025	31.86	8.761	43.395
2026	32.11	9.44	44.048
2027	32.35	3.879	45.611
2028	32.60	2.783	47.708
2029	32.84	5.574	48.566
2030	33.09	1.456	46.847
2031	33.33	2.858	46.145
2032	33.58	8.577	45.948
2033	33.82	4.373	50.768
2034	34.07	2.453	53.297
2035	34.31	4.339	56.693
2036	34.56	6.134	53.167
2037	34.80	3.697	53.579
2038	35.05	5.313	53.742
2039	35.29	3.641	61.120

Table-16 indicates that forecasted mean cotton yield and minimum and maximum yield < IPM non-adopters. The simulating maximum cotton yield in the table was increase as mo^ in the future and minimum cotton yield were decrease around the mean value of the yield. The variation in the yield from the mean values is showing the risk involved over the time.

Table 17: Stimulate mean cotton yield, Standard deviation and Coefficient of Variation of IPM non-adopters.

Years	Mean Yield	Standard deviation	Coefficient of Variation
2010	28.19	4.931	17.48
2011	28.44	4.974	17.48
2012	28.68	4.743	16.53
2013	28.93	5.143	17.77
2014	29.17	5.505	18.86
2015	29.42	6.603	22.44
2016	29.66	5.754	19.39
2017	29.91	6.710	22.43
2018	30.15	6.394	21.20
2019	30.40	8.909	29.30
2020	30.64	6.337	20.67
2021	30.89	6.800	22.01
2022	31.13	6.870	22.06
2023	31.37	7.072	22.53
2024	31.62	8.041	25.42
2025	31.86	7.448	23.37
2026	32.11	7.398	23.03
2027	32.35	8.293	25.62
2028	32.60	9.155	28.07
2029	32.84	8.909	27.12
2030	33.09	9.204	27.81
2031	33.33	8.794	26.37
2032	33.58	8.414	25.05
2033	33.82	10.059	29,73
2034	34.07	9.963	29.24
2035	3431	11.012	32.08
2036	34.56	10.008	28.95
2037	34.80	10.638	30.56
2038	35.05	10.186	29.05
2039	35.29	11.306	32.03

Table-17 the standard deviation and coefficient of variation of IPM non-adopters *m* presented. As the standard deviation increased over the time consequently the coefficient (variation also increased over the time in the future) .In other words as the planning horizon: increases the coefficient of variation is also increase.

4.8. Comparison of cotton production in IPM adopters and non-adopters

The mean simulated cotton yield is greater in IPM adopters than non-adopters. Similarly the variation in the mean yield is also smaller in IPM adopters than non-adopters, which is reflected in terms of smaller coefficient of variation in IPM adopters than non-adopters. The smaller coefficient of variation also indicates that less risk is involved in cotton production of those farmers which had adopted IPM cotton production practices than non-adopters.

5. DISCUSSION

The research was conducted in District Hyderabad Sindh. Five UCs were selected as sample area, consisting of Hatri, Moosa Khatrian, Tando ajm, Tando Hyder and Tando Qasir to estimate cotton production, Forecasting and Risk analysis, Factors affecting the integrated pest management (IPM). Data were collected through questionnaires including general in formation of respondents like the Education level of respondents, Farming Experience of respondent. Farm size of respondents for evaluates the factors affecting the adoption of integrated pest management (IPM). Information about the temperature, Humidity level, rainfall level, Urea cost, Nitro-Phosphate cost, Herbicides cost and Spray cost for cotton crop was also obtained. Two types of cotton production were estimate, one for adopter of integrated pest management and other for Non-Adopters of IPM. After collection and analysis of data following results were obtained.

The study adopters and non-adopters of IPM techniques respondents were taken. In which the 50.00 percent respondents were non-adopters of IPM and 50.00 percent respondents were adopters of Integrated Pest Management (IPM) techniques.

Age of the respondent is 07 adopters and 04 non-adopters farmers belonged to age group up 35 years, while about one-third i.e.11 adopters and less than half i.e. 18 non-adopters farmers belonged to age group 36-45 years. About 12 adopters and 08 non-adopters farmers' belonged to age group above 45 years.

Literacy status of the respondent is slightly less than 05 farmers' adopters 04 farmers, non-adopters were illiterate, while about 15 farmer's adopters, 21 farmer's non-adopters were Primary-middle level of education. The 08 farmers' adopters, 10 farmer's non-adopters were matriculation. Only 02 farmers' adopters, 04 farmer's non-adopters were Collage-University education in the study area.

The family members in the study area 13 farmer's adopters, 06 farmers non-adopters had 5-6 family members, 11 farmers adopters, 14 farmers non-adopters had 7-8 family members, 06 farmers adopters, 10 farmers non-adopters had 9 and above family members in the selected area.

Marital status in non-adopters there were 30.00% were single marital status, 66.66% were married marital status, and 3.33% were widow. 0.00% was divorced. While in case of non-adopters were 33.33% were single marital status,, 40.00% were married marital status, and 6.66%were widow. Only 3.33% were divorced.

Family type in adopters there were 46.66% were joint family system, 10.00% were extended family type and 43.33% were single family type. While in case of non-adopters were 53.33% were joint family system, 6.66% were extended family type and 40.00% were single family type.

The farmer's status in adopters there were 46.66% were owner ship, 30.00% were tenant farmers and 23.33% were owner cum tenant respondents. While in case of non-adopters were 53.33% were owner ship, 26.66% were tenant farmers, and 20.00% were owner cum tenant respondents.

Agricultural Faming experience is very important for better understanding of crop conditions. It is also very important factor that effect the adoption of new techniques. In this study the categories were formed for the respondents on the bases of their fanning experience only 05adopters farmers and 04 non-adopters farmers had up to 10 years of agricultural experience, while most of the respondents i.e. 10 farmers adopters and 11 farmers non-adopters had 11-20 years agricultural experience.15 adopters farmers and 15 non-adopters farmers had above 20 years of agricultural experience.

Farm size in adopters there were 33.33% were less 5 acres, 26.66% were 5-8 acres, and 23.33% were 8-10 acres farm size. Only 16.66% were above 10 acres farm size while in case of non-adopters were 30.00% were less 5 acres, 23.33were 5-8 acres, 26.66% were 8-10 acres farm size. Only 20.00% were above 10 acres farm size.

The results of Logistic model show that education of farmers and adoption of integrated pest management (IPM) is negatively related. It is found that with one percent increase in the education level of farmers, probability of adopting of integrated pest management (IPM) decreases by .852 percent. Reason for this is due to the fact that educated persons are well awareness about the new technique of cotton cultivation such as integrated pest management (IPM) but the traditional farmers mostly not quickly respond the new techniques such as IPM. So that the probability of adopting integrated pest management (IPM) decease with education level of farmers.

In case of the farm size the results of the Logistic model shows that farm size and adopting of integrated pest management (IPM) are negatively related. It is found that with one percent increase in the farm size of farmers, probability of adopting of integrated pest management (IPM) decreases by .855 percent. The results of Logistic model show that farming experience of farmers and adoption of integrated pest management (IPM) is positively related. It is found that with one percent increase in the farming experience of farmers, probability of adopting of integrated pest management (IPM) increase by 3.246 percent.

In this study we have used regression analysis to find out impact of different independent variables (Spray cost, Urea cost, Nitro-phosphate cost, temperature, Rainfall, Humidity, Seed expenditure, Herbicide cost) on the cotton yield of non adopters of integrated pest management (IPM).

The R squares (R^2) value of the IPM-adopters model equal to 0.397 shows that 39 percent variation in cotton yield was due to independent variables. The F test statistic value of the IPM-Adopters model is equal to 3.372 which is highly significant at 0.005 .This implies that the production function used in this study is overall statistically significant.

Results of integrated pest management (IPM) adopters model shows that the seed expenditure, Nitro-Phosphate bags cost, Urea bag cost, and Spray cost were related to the cotton production positively. Herbicide to cost related the cotton production (IPM-Adopters) negatively. The Temperature, Humidity level and Rainfall also related the cotton yield positively. At ten percent level the cost of urea bags, cost of Nitro-Phosphate bags, rainfall and humidity level were significant for IPM-Adopters cotton production model.

For second model on IPM non-adopters the results shows that R square value of the model is 0.593 which shows that 59 percent variation in the cotton yield is explained by the Independent variables. The F test statistic of the IPM non-Adopters model is 7.458 which is significance at 8 degree of freedom and also indicate that model is fit for analysis. It implies that production function use in this study is overall statistical significant.

Results of integrated pest management (IPM) non-Adopters shows that Cost of Nitro-Phosphate bags, seed expenditure, spray cost, Cost of urea bags were positively related with the cotton yield of Non-Adopters. The Temperature and rainfall were also positively related with cotton yield .The only humidity level of environment and herbicides cost was negatively related with the cotton yield of non-adopters.

Results indicate the simulated mean cotton yield, minimum and maximum yield of IPM-Adopters. The simulating mean cotton yield was increases as we move in the future. The variation in the yield from the mean values is showing the uncertainty over the time period *it* indicates standard deviation and coefficient of variation of IPM adopters .The coefficient of variation was estimated by using the above formula. The standard deviation was increased over the time indicating that uncertain or risk involved increases and the coefficient of variation indicated that forecasted cotton yield fluctuate over the time as we move more in the future. The coefficient of variation shows that forecasted cotton yield in the near future has smaller coefficient of variation than the far future in other words as the planning horizon increases the coefficient of variation is also increases.

Results indicate that forecasted mean cotton yield and minimum and maximum yield of IPM non-adopters. The simulating maximum cotton yield in the table was increase as move in the future and minimum cotton yield were decrease around the mean value of the yield. The variation in the yield from the mean values is showing the risk involved over the time. The standard deviation and coefficient of variation of IPM non-adopters are presented. As the standard deviation increased over the time consequently the coefficient of variation also increased over the time in the future in other words as the planning horizon is increases the coefficient of variation is also increase.

The results of this study show that education of respondents, farming experience of respondents, Farm size of the respondents is factors that affect the adoption of integrated pest management (IPM) technique. The adopters Non-adopters of integrated pest management (IPM) models shows that the adopters are more risk averse as compared the non-adopters of (IPM).The cotton yield of adopters of integrated pest management (IPM) is more as compared to Non-adopters of (IPM).

6. CONCLUSIONS AND RECOMMENDATIONS

According the results of this study some suggestion and policy recommendation are given below:

I. It is concluded that high yield group is more specialized in terms of wheat crop production as compared to medium and low yield groups.
II. It is concluded that fertilizer have a positive impact on yield but the farmers getting low yield were using very less amount of fertilizer because of its high prices.
III. Different factors such as holding size, education, farming experience and farm machinery had positive impact on wheat production or productivity.
IV. Education affects the planning and managerial abilities of farmers in different farm operations. It is concluded that highly educated farmers get more wheat yield as compared to less educated.
V. It is concluded that most of farmers belonged to high yield group were large farmers with holding size more than 25 acres.
VI. It s concluded that farmers having latest farm machinery getting high yield as compared to those which were less mechanized.

Integrated Pest Management Practices in agriculture has significant potential to reduce burden on scarce resources and can be very handy to transit out of extreme poverty and hunger. These crop cultivation approaches which keep a balance between ecological and economic aspects of farm management can the ensure sustainability of the agriculture sector. Thus they make good sense from public policy perspective. Certain recommendations can be made to address the problems faced by adopters of IPM and for their wide spread dissemination of Integrated Pest Management Practice. Those recommendations are as follows:

1. Comprehensive national policy and institutional framework for environmental management without weaknesses in administrative and implementation capacity should be in place so that efforts to resolve the issue of environmental degradation can be made at national level.
2. Government should make strict rules and regulations about recommended use of fertilizers and pesticides. Non-recommended agro chemical should be strictly prohibited by the fanners and there should not be any confusion about social, political, commercial aims.
3. Farmer training programs should be started for the capacity building of farmers about how to make the efficient use of available resources.
4. Framers should be sensitized about environment degradation and climate change through, media especially electronic media i.e. TV, radio. People should feel that they are equally responsible for the ever increasing atmospheric and ground pollution and we have to save our natural resources for the next generations too.
5. Financial support should be provided to cope with high variable cost problem. Short and long term loans at affordable markup can be provided in this regard. Proper cost-share programs should be designed and conducted to encourage IPM Adoption by smaller farm sizes.

6. Special premium prices should be given to the adopters of better farming practices for their wide spread dissemination.
7. Farmer should maintain the full record of all inputs cost that use in cotton crops for each year so that it can help in comparison of different techniques adopted.
8. Government should facilitate the farmers in the provision of necessary inputs for cotton production so that better quality inputs can help the farmers in exploiting the potential yield.
9. Most famers would prefer less volatile yield to more volatile yield, other thing being equal, Standard deviation measures the volatility of yield around the mean yield. The fanners are risk adverse farmers can increase their yield by taking more risk in the future.

References

Blake, G., H. A. Sandier, W, Prober, D. M. and Coggins, C. (2007). An assessment of grower perceptions and factors influencing adoption of IPM in commercial cranberry production Renewable Agriculture and food system.(22): 134-144.

Bary, P. J. (1984).Risk management in Agriculture university of Illions. Western Journal of Agriculture Economics. 24-25.

Brain, H (1994). Yield response and production risk an analysis of integrated pest management in cotton. Western Journal of Agriculture Economics. (10):313-326.

Bakhsh, K., H. Ishtiaq and asif, M, (2005) Factors affecting cotton yield: A case study of sargodha (Pakistan). Journal of Agriculture and Social sciences. 3 3 2-3 34.

Beharell, B., 1981, Farm size, labour-absorption and soil fertility in agricultural development, some methodological issues. Indian J. Agril. Econ., 36 (3): 56.

Chitnis, D. H. and Kothiklane, R. H., 2000, Extension methodology for implementing IPM programme. Maharashtra J. Extn. Edu., 19 (2): 112-116.

Choudhary, R. K., Patel Yogesh and Garg, V. K., 2004, Effect of different insecticide schedule on pest incidence, yield and economics of cotton. Paper presented in the symposium Strategies for sustainable cotton production - A Global Vision: Univ. Agric. Sci., Dharwad.

Christain, B. M., Vyasa, H. V. and Patil, K.F., 2004, Constrains faced by cotton growers. J. Extn. Edu., 11 (1): 13-14.

Cornejo, J. F., E. D. Beach and W. Huang. (1994). the adoption of IPM techniques by vegetables growers in Florid, Michigan and Taxas. Journal of Agriculture. and Applied Economics. (26):158-172.

Chaudrhy, I.S. and M. B. Khan. (2009). Factors affecting cotton production in Pakistan: empirical evidence from Multan District. Journal of Quality and Technology Management.(ll): 91-10091.

Dhawan, A. K., Kumar Tripat and Narula, A. N., 2004, Non insecticidal options for the management of cotton pests. Paper presented in the symposium Strategies for Sustainable Cotton Production- A Global Vision; Univ. Agric. Sci., Dharwad.

Dhawanl, A. K., S. Singh and S, Kumar. (2009). Integrated pest management (IPM) helps reduce pesticide load in cotton. Journal of Agriculture and Science. Technology .599-611.

Dhawan, A.K., A. S. Sohi, M. Sharma, T. Kumar and K. S. Brar, (2004) Insecticide Resistance Management in Cotton. Department of Entomology, Puiijt Agricultural University Ludhiana, India.

Escalada, M. M. and H. Kamai. (1993). Communication and implementation of change in crop protection. In crop protection and sustainable Agriculture Chichester, UK,Wiley.l91-202.

Farkada, B. C, R. D. Ahire, N.R. Patang and P. S. Ahire. (1999). Constraints in adoption of biological pest control in cotton .MAU, Pabhani, India, Journal of soil and crop 9(2); 185-187.

Feder, G., R. J. Jus, and D. Zilbennan (1985). Adpotion of Agricultural innovations in developing countries: A survey. Economics Development and Culture change. : 255-98.

Gaddi, G. M., Mundinamani, S. M. and Patil, S. A., 2002, Yield Gaps, Constraints and potential in cotton Production in North Karnataka - An Econometric Analysis. Indian J. Agril. Econ., 57 (4): 722-734.

Gajanana, T. M., Krishnamurthy, P.K., Anupama H.L. and Raghunatha R., 2004, Integrated pest and disease management in tomato: an economic analysis, Indian J. Agril. Econ., 19 (2): 269-280.

Grieshop, J., J. Zalom, and G. Miya (1988). Adoption and diffusion of integrated pest management innovations in Agriculture. Bulletin of the Entomological Society of America.:72-78.

Greenplate, J. T. (1999). Qualifications of Bacillus thuringensis insect control protion cry Ac overtime in bollgard cotton fruits and terminals. Journal of Economic Entomology. 92: 1379-1383.

Government of Pakistan. (2009). Economic Survey 2009. Economic Advisor's wing, ministry of Finance, Islamabad.

Hillocks, R. J. (2005). Is the role for BT cotton in IPM for small in Africa? International Jounral of Pest management: 51(2): 131-141.

Hearn, G .H. and G. P. Fitt (1992). A future of IPM in cotton, the challenge of integrating new tools to minimize pesticides dependence.75-84.

Hanumanaikar, R. H., Farooq Nimbal and Madhu, S. K., 2004, IPM training - a key for sustainable cotton production. Paper presented in the symposium Strategies for sustainable cotton production- A Global Vision; Univ. Agric. Sci., Dharwad.

Headley, J .C. and Hoy, M. A., 1987, Benefit-cost analysis of an integrated mite management program for almonds. J. Econ. Entomol. 80 (6): 555-559.

Hilli, J. S., Sarojani, J. K., Budihal, R. A. and Halafalimath, S. P., 2004, Adoption of integrated pest management technology in cotton production in Dharwad district of Karnataka state. Paper presented in the symposium Strategies for sustainable cotton production- A Global Vision; Univ. Agric. Sci., Dharwad.

Hurd, B. H., 1994, Yield response and production risk: An analysis of Integrated pest management in cotton. J. Agril .Res. Econ., 19 (2): 313-326.

Haskell, P. T., 1979, Worldwide Socio-economic Constraints to Crop Protection, In: Proceedings of Symposia, IX International congress of plant protection, vol.I, plant protection: Fundamental aspects (Ed. T. Kommedahl), Minneapolis, Burgess, pp.39-41.

Indushekaran, B. S., 1982, An economic analysis of ICDP in Dharwad district: A Study on development programme impact. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.

Iqbal, M. Sumathi, P. and Alagsan, V., 1996, Adoption of IPM practices for cotton by the farmers. J. Extn. Edu,, 64 (4): 1341-1345.

Iqbal, M., M, Azeem and M. Ahmad. (2001). Determinants of higher wheat productivity in irrigated Pakistan. The Pakistan development review (40): 753- *65.*

James, C., 2002. Preview: Global Status of Commercialized Transgenic Crops: 2002. ISAAA Briefs n. 27 Ithaca, New York.

Khadi, B. M., 2005. Cotton scenario and future strategies for increasing cotton Productivity. Paper presented in workshop on "Enhancement of cotton production and quality". 12 November, 2005. Navsari Agricultural University, Surat, Gujarat (India). pp 1- 4.

Kalirajan, K., 1984, Far specific technological efficiency and development policies. J. Econ. Std., 11 (3): 33-35.

Katole, R. T., Bhople, R. S. and Shinde, P. S., 1998, Constraints in adoption of plant protection measures for hybrid cotton. Maharashtra J. Extn. Edu., 17 (3): 349- 351.

Khan, H., Khader Nataraju, M. S. and Nagaraja, G. N., 1998, Economics of IPM on tomato. Paper presented at the first national symposium on Pest Management in Horticultural Crops: Environmental implications and thrusts, Institution of Agricultural Technologists, Bangalore.

Kumarswamy, S., 2007, Crop loss due to pest attack peged at Rs.1.40 lakh crores. Crop Care, 33(4):73-74.

Kunnal, L. B., 1978, Output factor shares and employment effect of technical change in Jowar economy. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.

Kunnal, L. B., Gaddi, M., Olekar, J. N. and Dabali, S. D., 2004, New cotton production technology in Karnataka- An econometric analysis. Paper presented in the symposium Strategies for Sustainable Cotton Production- A Global Vision; Univ. Agric. Sci., Dharwad.

Khunt, K.A. and K. L.Antani (1991). Impact of weather and economic factors an acrage on production fluctuation of cotton .Agricultural institution in India. 46(4): 203-209.

Kalasar, A. P., A. A.Chaudhry, R. D. Ahire and R. S. Banaud. (1999).Correlates of adoption of integrated pest management (IPM) in cotton Mau, Parbhani., India. Journal of soil and crops. 192-194.

Managt, I. S, K. S. Gill, A. Ramash and R. Arora. (1998). Adoption status of integrated pest management (IPM) technology in American cotton in Punjab, Ludhiana, India, India. Journal Economics .25(1); 50-54.

Mathewes, G. A. and J. P. Tunstall. (1994). Insect pest of cotton.Wallingford, CAB internation Masud, S. M, R. Lacewell, C. Robert Taylor and J. Benediet. (1981).

Economic impact of integrated pest management in coastal bean region of Taxas. Southern Journal of Agriculture Economics.

Mayee, C. D. (2003). Annual report of technology invention and scio-economics analysis in cotton-based cropping system for year 2002-2003. Nagpur.

Mallah, G. H. and A. K. Korejo. (2007). Establishment of integrated pest management (IPM) in cotton through farmer field school (FFS) in Sakarnd, Sindh. Pakistan Journal of Botany. (39):693-697.

Norton, G. W, E. Rajotte and V. Gapud. (1990). Paricipation research in integrated pest management: Lesson from the IPM CRSP. Journal of Agriculture. And Hum Resource.

Nabi. M. (1991) Relationship between crop productive and input usage Journal of international development. (8): 68-88.

Prudent, P, S. Loko, D. Deybe. and M. Vaissayre. (2007). Factors limiting the adoption of IPM practices by cotton farmers in Benin: A participatory approach and journal of Agriculture. (43) 113-124.

Haq. Q, T. Ali, M .Ahmad and I. A. Faridi (2007). Conceptual ananlsis of cotton growing community about

pesticides: A case study of district Multan. Pakistan Journal Agricultural Sciences.
Pakissan (2009). Role of cotton in Pakistan. Internet site: http://www.pakissan_com. (Accessed: December 21, 2009).
Perfect, T. J. (1992). Pest management and environment in 2000. CBA international publication.
Pandurangadu, K. and Raju, V. T., 1990, Economics of pesticide use on cotton farms in Guntur district of Andhra Pradesh. Agricultural Situation in India, 45 (7): 467-470.
Patil, B. V., 1992, Sensitivity of field collected Helicoverpa armigera. Pestology, 17 : 19-21.
Pavankumar, K.M., 2007, Economic analysis of IPM technology in redgram cultivation in North Eastern Dry Zone of Karnataka. M.Sc. (Agri.) Thesis Univ. Agric. Sci., Bangalore.
Pawar, A. D., 1995, Integrated Pest Management demonstrations-cum- training in rice and cotton crops. Plant Protection Bulletin, 47 (1-4): 40-72.
Peshin, R. and Kalra, R., 1998, Integrated Pest Management at farmers' level. Man. Dev., 20 (1): 137-141.
Pingali, P.L., 1994, Pesticides and Philippines rice farmer health: A medical and economic analysis. American J. Agril. Econ., 76: 587-592.
Pouchepparadjou, A., Kumaravelu, P. and Achoth Lalith, 2005, An econometric analysis of green technology adoption in irrigated rice in Pondicherry Union Territory, Indian J. Agril. Econ., 60 (4): 660-676.
Pradeedpbabu, B.N., 2006, Economic assessment of integrated pest management technology on groundnut and coconut in Tumkur district of Karnataka. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.
Prasad, H. K. P., 1993, Efficacy of groundnut production in Karnataka: A frontier production function analysis approach. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.
Preeti, N. S., 1998, Economic analysis of arecanut cultivation and its impact on farm economy in Shimoga district, Karnataka. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.
Puri, S. N., 1998, Present status of Integrated Pest Management in India. Paper presented at seminar on IPM, organized by Asian Productivity Organization at Thailand Productivity Institute, Bangkok.
Rajaram, V., Ramamurthy, R. and Krishnadas, D., 2000, Integrated pest management in cotton. Insect Environ., 6 (1): 47-48.
Ramamurthy, K., 1990, Economics evaluation on the impact of integrated pest management on cotton. Annual Report, Central Institute of Cotton Research, Nagpur: 119
Ranjit Kumar and Alka Sing, 2008, Adoption of integrated pest management in Cotton and Paddy. Agril. Econ. Res. Rev., 21 (2):221-226.
Razack, A., 2000, Economic evaluation of integrated pest management (IPM) programme. M.Sc. (Agri.) Thesis, Tamil Nadu Agril. Univ., Coimbatore.
Reichelderfer, K. H. and Bottrell, G. D., 1985, Evaluating the economic and sociological implications of agricultural pests and their control. Crop Prot.., 4 (3): 281-297.
Rola, A. C., Widawsky, D. A., Pingali, P. L. and Hassain, M., 1998, Pests, pesticides and integrated pest management in rice- Impact of rice research. Center for policy and development Studies, University of Philippines, Phillipines, pp. 135-138.
Ridgley, A. M and B. Brush. (1992).Social factor and selective technology adoption: the case of integrated pest management. Human Organization. 367-373.
Rao, C.A. (2000) Growth and efficiency in crop production in Andhra Pardesh. Acharya NGR Agricultural University Hyderabad.
Rao, C.A., M. Srinivasa Rao, P. Naraiah, B, Malathi and Y.V.R. Reddy. (2007). Profitability of cotton on the pest management continuum in Guntur district of Andhra Pardesh. Agricultural Economics Research Review .(20) 273-282.
Shaunk, R. K., R. D. Locewell and I. Norman, (1982). Economic implication of alternative cotton production strategies bull B. Tex. (1420): 25.
Singh, S. and S. Satwinder (2007) Economic Evaluation of Pest Management Technologies for Sustainable Cotton Production in Punjab.Agricuitural Economics Research Review.(20): 77-86.
Saikumar, B. C., 2005, Farming systems in the tank commands of north eastern Karnataka – An economic analysis of Jala Samvardhane Yojana Sangha managed tanks. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad.
Sakhare, M. V. and Kadam, J. R., 1999, Efficiency of Ecofriendly staggered application techniques in management of bollwarms pests of H4 cotton. Maharastra J. Agric. Univ, 24 (2): 170-174.
Sangram, R., 1997, A study on Knowledge and Adoption of Integrated pest management practices by redgram growers of Gulbarga district, Karnataka. M. Sc. (Agri) Thesis, Univ. Agric. Sci., Dharwad.
Sen (1979), Agricultural Economics, Oxford and IBM publishing Co. Pvt. Ltd., New Delhi, 345- 349.
Sharma, A., Saraswat, S. P. and Kumar, R., 1992, Extent of labour utilization in hill-tribe economy. Indian J. Agril. Econ., 47 (3): 432.
Sharma, H. C., 2006, Integrated Pest Management Research at ICRISAT: Present status and future priorities.

International crops research institute for the Semi-Arid Tropics, Patancher, Hyderabad.
Shelke, R. D. and Kalyankar, S. P., 2004, Constraints in transfer of technologies in cotton production, Paper presented in the symposium Strategies for Sustainable Cotton Production- A Global Vision; Univ. Agric. Sci., Dharwad.
Shivaraj, K., 1996, A study on knowledge and adoption level of IPM practices by red gram growers in Gulberga district of Karnataka. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.
Sukhpal Singh and Sathwinder Singh, 2005, Economic evaluation of pest management technologies for sustainable cotton production in cotton belts of Punjab Indian J. Agril. Econ., 20 (3): 77-86.
Schlenker,.W. and M. Roberts. (2008). Estimating the impact of climate change on crop yield.The importance of non-liner temperature effects. Natonal Bureau of Economics Research, 1050, Massachusetts Avenue.
Samiee, A., A. Rezvanfar. and E. Faham. (2009). Factors influencing the adoption of integrated pest management (IPM) by wheat growers in Varamin country, Iran. African, Journal of Agriculture and Resource. (4):491-497.
Tamizhenian, S., 2001, Integrated pest management in paddy production: A resource economic study in Tiruvarur district, Tamil Nadu. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.
Thimmappa, K., 1994, Economics of upland paddy and its competing crops. M. Sc. Thesis, Univ. Agric. Sci., Bangalore.
Udikeri, S. S., Nimbal Farook, Khadi, B. M. and Gajbhiye Hemachandra,2004, Technology intervention for stability and sustainability in cotton production system, Paper presented in the symposium Strategies for sustainable cotton production- A Global Vision; Univ. Agric. Sci., Dharwad.
Venkatashiva Reddy, 2006, A study on knowledge and adoption of integrated pest management practices among vegetable growers of Gadag district in North Karnataka. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad.
Venkatesh Gandi, R. Hanchinal, S. N. Shivamurthy, M. and Shailaja Hittalamani., 2007, Adoption of Integrated pest management Practices among Tomato Growers. Karnataka J. Agric. Sci., 21 (1): 17-19.
Veerapur, 1999, An economic analysis of integrated pest management in cotton in Raichur district, Karnataka. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad.
Vishwanath, V., 1997, Economic analysis of paddy cultivation in Karnataka and its prospects for global competitiveness. M.Sc. (Agri.) Thesis, Univ. Agric. Sci., Bangalore.`
White, F. C. and Wetzstein, M. E., 1995, Market effects of cotton integrated pest management. American J. Agril. Econ., 77 (3): 602-612.
Waller, B, J. Henderson, B. Stinner, and C. Welty. (1998).Matcliing innovations with potential users: A case study of potato IPM practices. Agriculture Ecosystem environment(70) :203-215.
Wetzstein, M. E, W. Mysser, D. Linder, and G. Keith Douce. (1985). an evaluation of integrated pest management with Heterogeneous participation. Western. Journal of Agriculture Economics. (10):344-353.
Whittkar, G., L., H. Biig and V. Utpal. (1995). Restricting pesticide use. The impact on profit by farm size. Southern Agricultural and Applied Economics Association.(2): 352-362.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar