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

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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 nitrophosphate bags, cost of herbicide and rainfall were -0.038, 0.00475, 0.301 and 0.164 respectively and all ofthese significant at 10 percent level.

Index terms— cotton, IPM, herbicide, evaluation, risk, coefficient, hyderabad.

1 Introduction

conomy 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 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 II.

Objectives a) To investigate the factors effecting the adoption of integrated pest management (IPM). b) To estimate the cotton production by IPM-adopters and non-adopters. c) To estimate the risk involved in cotton production for IPM adaptors and non-adopters. d) To suggest policy recommendation for profitable cotton production.

III.

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).

4 a) 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.

5 b) 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.

6 c) 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.

7 d) 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.

8 e) 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.

9 f) Analytical tools and techniques

For assessing quantitatively the objectives and hypothesis outlined for the present study, the following analytical tools and techniques were employed.

10 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.

11 g) Functional analysis i. 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. 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.

12 i) 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. (5) The decomposition equation (**??**) 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.

13 k) Concepts related to evaluation of IPM and non-IPM practices i. 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.

14 ii. 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.

15 iii. 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.

16 iv. 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.

17 v. Land revenue

Actual land revenue paid by the farmers was considered.

18 vi. 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.

19 vii. Cost of cultivation

It is the sum of variable costs and fixed costs expressed on per hectare basis.

20 l) Gross returns

Gross returns were obtained by multiplying the total product with its unit value.

21 m) Net returns

Net returns were obtained by deducting the total costs incurred from the gross returns obtained.

22 n) Benefit cost ratio

Benefit cost ratio was obtained by dividing the gross returns by total cost of cultivation.

IV.

23 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)

24 b) 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.

25 i. 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.

26 ii. 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.

27 iii. 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 matriloca (a mother and her children); conjugal (a husband, his wife, and children; also called nuclear family). 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 nonadopters had 9 and above family members in the selected area.

28 iv. 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 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.

29 v. 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 freestanding residential building. 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.

30 vi. 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.

Volume XV Issue VI Version I viii. 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.

31 c) Logistic Regression Model

From qualitative information obtained from the respondent, correlates of adopters/ non-adopters of IPM were determined by employing probabilistic model "LOGIT". The non-significance of the Chi-square indicates that the data fit the model well. 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. 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 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. 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.

32 e) Results of Adopters of IPM (Integrated Pest Management)

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 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

33 f) 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 i. Forecasting and Risk Analysis of IPM-Adopters 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 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. Table-16 indicates that forecasted mean cotton yield and minimum and maximum yield < IPM nonadopters. 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 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.

34 h) 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 nonadopters. 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.

V.

35 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 nonadopters 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 nonadopters 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 nonadopters 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 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 nonadopters. 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 nonadopters 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 nonadopters of (IPM).The cotton yield of adopters of integrated pest management (IPM) is more as compared to Non-adopters of (IPM).

36 VI. Conclusions and Recommendations

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

It is concluded that high yield group is more specialized in terms of wheat crop production as compared to medium and low yield groups. a) 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.

b) Different factors such as holding size, education, farming experience and farm machinery had positive impact on wheat production or productivity. c) 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. d) It is concluded that most of farmers belonged to high yield group were large farmers with holding size more than 25 acres. e) 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.

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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. [1] [2]

[1] Economic Evaluation and Risk Analysis of Integrated Pest Management (Ipm) in Cotton Production in Sindh Pakistan

1

Figure 1: Y = a x 1

1

? Forecasting and Risk Analysis

[Note: taken. In which the 50 percent respondents were non-adopters of IPM and 50 percent respondents were adopters of Integrated Pest Management (IPM) techniques.]

Figure 2: Table 1 :

2

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

Figure 3: Table 2 :

-

Figure 4: Table - 2

3

Education Level	IPM-Adopters		Non-IPM adopters	
	No. Respondent	Percentage	No. Respondent	Percenta
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.

Figure 5: Table 3 :

4

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

Figure 6: Table 4 :

5

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

Figure 7: Table 5 :

6

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

Figure 8: Table 6 :

7

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 owne cum tenant respondents.

vii. Agricultural Experience

Figure 9: Table 7 :

8

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

Figure 10: Table 8 :

9

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.

Figure 11: Table 9 :

10

Chi-Square	Df	Significance	level
2.801	8	.946	

Figure 12: Table 10 :

11

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*

*[Note: *Shows the significant of Results at 5 percent level.]*

Figure 13: Table 11 :

12

d) Analysis of Quantitative variables

i. Results of IPM non-adopters

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

*[Note: *Significant at 10 percent level]*

Figure 14: Table 12 :

13

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.

Figure 15: Table 13 :

14

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			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

Figure 16: Table 14 :

15

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

Figure 17: Table 15 :

16

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

Figure 18: Table 16 :

201517

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

Figure 19: Year 2015 Table 17 :

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