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Agrochemical and Agricultural Sustainability: A case study of Pakistan

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Abstract: Sustainability in food and fiber production is worth important for the increasing population all over the world. Since the start of Green Revolution era, agrochemicals such as fertilizers, weedicides and pesticides have been used in abundance. Initially, the use of pesticides was such a beneficial that its use increased year by year throughout the last 20 years. Although, this development contributed a lot in boosting agricultural production by intensive cropping and cultivation of high yielding varieties of agriculture crops production but it has caused hazards for the flora and fauna around the Globe. Such factors caused a stress over the natural resources along with the increase in water and air pollution. In the prevailing situation of environmental degradation and depleting value of natural resources, there is big need that the researchers and scientist should develop and follow technologies for sustainable use of natural resources. This research has focused the methods, use of agrochemicals and productivity of agricultural crops based on increased inputs of agrochemicals. Primary data was collected with the help of structured questionnaire and secondary data was collected from Food and Agriculture Organization and Federal Bureau of Statistics, Pakistan. The results revealed the empirical evidences that there is enormous increase in the use of agrochemical but resultantly there is negligible increase in the productivity of crops. Most of the farmers are not using the sustainable methods of weed and pest control, instead, using much of the chemicals, which adversely affected the productivity and quality of the product. The study suggests and recommends policy makers for efficient management and sustainable use of farm-inputs to maximize the productivity in this era of comparative advantage in the world.

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1. Introduction

The green revolution era emerged during the first half of twentieth century in the developed world whereas the similar developments in under developed countries took place in the late twentieth century. Under such development, food and fiber security was one of the the major objectives. To enhance the productivity and efficiency of agricultural farming, use of agrochemicals was the major tool. The technologies of crop production were based on the use of pesticides, weedicides, herbicides, and inorganic fertilizers. Although the use of pesticides and other agrochemicals were meant to enhance the productivity through controlling the pest and crop diseases, unfortunately, its use has been proved to be harmful not only to humans but also to all kinds of living beings. These harmful effects that may be caused by the use of agrochemicals may include; birth defects, environmental pollution, poisoning, acute toxicity and cancer (Environmental Layers, 2011). Additionally, the harmful effect of agrochemicals may lead the affected ones to asthma, lungs cancer, or even to death in severe cases. In the recent studies on major rivers and streams, pesticides were detected more than 90% of the time in water, in more than 80% of fish sampled, and in 33% of major aquifers (Gilliom et al., 2011). Pesticides are one of the 15 leading causes of impairment of streams. Significant numbers of fish and bird kills have resulted from the legal application of pesticides, with millions of fish and birds estimated to die from pesticides exposure every year (Pimenatal et al., 1992; Williams, 1993). Many birds have been disappeared due to use of agrochemicals, while use of pesticides is increasing year by year. While talking on the holistic dimensions of sustainable agro-ecological systems, Srivastva et al. (2016) has stated some critical finding of his research. The researchers have stated that the inefficient and short-sighted agricultural management during the era of green revolution has detrimental effects on agricultural soils, productivity, efficiency, and multi-functionality. It is, therefore, top-down as well as bottom-up approach of soil management is needed. In addition to this, agricultural practices based on local knowledge and perspectives are much important to enhance the productivity as well as efficiency of the agricultural farms.

Use of pesticides and other agrochemicals came into practices by the agricultural farmers in Pakistan after 1980. In Pakistan, in year 1980 was 906 metric tons of pesticides were used and it increased to 5519 metric tons in year 1992 (Tariq, 2002). The data and facts about use of agrochemicals show that there is enormous increase in use of pesticides every year. On the other hand, agriculture scientists and researchers are suggesting many solutions to control the use of these agrochemicals. It is hot issue of the time to focus on sustainable agriculture with reducing the use of agrochemicals as well as reducing the use of non renewable natural resources. In this realm, most of researchers have suggested to adopt the organic agriculture instead of use of agrochemicals. At the same time local knowledge and practices are also important to solve the issues locally. Agriculture farming is big complex of decisions and activities along with involvement of a number of resources. In general, agriculture farming is based on profit oriented business with use of plenty of resources. The farmers or farm managers focus how to pool up the resources used in the agriculture farm and how to follow the most profitable technologies so that they might get a bumper crop to earn maximum profit. But they don't consider the sustainability of the natural resources. As a result most of the natural resources are going to be depleted. On the other hand when we talk about the sustainable agriculture, we focus the sustainable use of our natural resources while getting the maximum outputs of the agriculture farm. In this case we focus the use of renewable resources at its maximum and we reduce the use of non renewable resources.

From year 1990 to year 2009, the total agriculture area in Pakistan has been increased by 340 thousand hectares (1.31%), but total arable land has decreased by 54 thousand hectares (0.26%). In the same period, the agriculture area equipped with the irrigation system has been increased by 4471 thousand hectares i.e. there is 28.43 % increase in the agriculture area that is equipped with the irrigation. This change has a greater impact on demand of all type of resources. In the irrigated zone, cotton crop is the major agrochemicals demanding crop. During the period 1990 to 2005, on the average, annually 13% of the total cropped area in Pakistan was cultivated with cotton crop. During this period, total cropped area in Pakistan increased by 1050 thousand hectares. The share of cotton crop in this increase was almost 56.58% as increase in the cotton cultivated area was 594.1 thousand hectares. Keeping in mind all these aspects, the study was conducted to assess the present methods of weed and pest control in the selected area.

2. Sustainable Agriculture

2.1. Pests and crop disease management for sustainable agriculture

The suppression, containment, prevention and eradication of pest insects are beneficial in most of the cases of sustainable pest control when the various tactics are applied on an area wide basis. Sterile insects and natural enemies, both the tactics are complementary and in some cases synergistic and their combined use have not yet found a practical follow up. Ionizing radiation is very suitable, effective and safe way to produce sterile insects. Both of these tactics have minimal negative effects on the environment (Verysen and Robinson, 2011).

Ervin and Welsh (2010) described that since mid of 1990; Genetically Engineered (GE) crops have swept across the nations' landscape to now half of our crop land. These crops may be classified into two types i.e. Insect Resistant (IR) and Herbicides Resistant (HR) crops. Most of IR crop contain toxin from a soil dwelling bacterium *Bacillus thuringiensis* (BT) that is lethal to larvae of particular species of moth, butterflies, flies and beetles (Lepidoptera and Diptera), but this toxin is harmless to humans, animals and/or types of other insects not susceptible to toxins. The toxin is effective only when a susceptible insect feeds on the IR plant. While in HR crops is engineered to reduce the use of herbicides; can be used to kill many types of weeds without harming the major crop. Most of HR crop varieties have been engineered to be resistant to herbicide Glyphosate. Glyphosate kills most plants without substantial effects on animals, soil and/or water quality. Since 1996, most of the soybean, corn and cotton crops varieties have been incorporated with the IR and HR traits and this accounted for about 80% of soybean, corn and cotton crops in the United States in 2009. The question is, whether these GE crops are compatible with the sustainable agriculture or not. Hubbel and Welsh (1998) described the three scenarios of increasing levels of compatibility of GE crops with the sustainable agriculture:-

1. The first and lowest level, characterized by mono-cropping and socio-economic concentration, reduces the most harmful agriculture chemicals in the agriculture farming system. The prominent example is HR crops, such as glyphosate resistant.
2. The second level includes the crops that help the farmers' transition away from the intensive chemical use i.e. IR crops, which are capable to produce the biological insecticides, can replace the

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application of harmful chemicals. The BT cotton exemplifies this scenario. However, these crops cannot be fully sustainable because of gene flow and pest resistance buildup remains persistent to challenges. In some cases these crops have become the part of integrated pest management, as they can be used to transition to and even can support more biologically complex farming systems (Carriere et al., 2004).

3. The third level can be designed with the GE crops to promote an integrated pattern of sustainable agriculture development with maximum use of natural biological cycles in the farming system, close nutrient cycles within the farm, and by reducing the need for external inputs such as fossil fuel based energy and fertilizers. Major examples may include the crops that reduce the water requirements, fix part or all of their own nutrients and stimulate the natural plant defenses against the pest and diseases.

Ervin et al. (2010) added another requirement for this level, which addresses socio-economic equity criteria i.e. social issues, might include innovations easily accessible to all types of farmers. The fitness costs associated with resistance to BT crops are expected to delay the evolution of resistance in the insects. HR crops will be more sustainably deployed if they are embedded in integrated weed management with strong and outward extension linkages to farmers and backward linkages to research institutions (Frisvod & Reeves, 2010). By integrating the diversity of ecological services within a multi-objective arable crop production framework, we can produce goods and services economically (Petit et al., 2010).

Legrand et al. (2010) focused on the biological pest control by predatory arthropods such as Carabid (*Pterostichus melanarius*) in various cropping system. If farms and carabid beetles are to coexist, cropping practices must spare the first larval instars and this depends on the farming calendar, the intensity of cropping practices and presence of shelter zones. Maintaining and managing uncultivated habitats such as margins and/or grassy strips are thus as crucial for carabid beetles as managing cultivated fields. Additionally, integrated management and direct drilling are the best crop management methods whereas organic management is lesser effective at the field level because it needs many soil tillage to compensate chemical weeding. Akbar et al. (2011) has deliberated the issue of weed control in rice. The researchers found that hand pulling and mechanical hoeing are better methods of weed control than using the herbicides.

2.2. Herbicides Management for Sustainable Agriculture

Mobility of some of the herbicides appears to be at its large during the earlier infiltration event. Therefore, after its application, if rain or irrigation occurs shortly or if herbicide is applied by chemigation, deeper movement of these herbicides is expected. Absorption of significant portion of herbicide takes time and it does not occur when water is moving through the soil. Once the water stops, absorption of herbicide takes place and it is irreversible (Radcliffe et al., 1990). Worsham (1990) described the weed management strategies as: crop rotation; crop competitions; cultivation and seedbed preparation; herbicides; use of allelopathic cover crops; use of genetically altered crops. Crop rotation is effective method in future perspective. With crop rotation the chances of weeds germination are reduced, whereas cultivation and seedbed preparation methods ensure the elimination of perennial weeds. A considerable degree of early season weed control can be achieved by use of certain winter cover corps. 13 out of 18 “worst weeds” have been reported to produce allelochemicals that reduce crop growth and also crop yield (Worsham, 1990). Non chemical methods of weeds control are; weed management by agronomic method, mechanical weed control, thermal weed control, and biological weed control. The problem faced for non-chemical weed control may be many such as non-chemical weed control compared with the chemical weed control is considered as less cost effective, as it requires repeated treatments and is more labor intensive. Besides this, non-chemical weed control does not have a proper definition of the efficiency of the weed control methods and there is a lack of standardized description of the experiments to make it comparable for each weed control method (Wei et al. 2010). Khaliq et al. (2011) conducted an experiment with use of lesser doses (25, 50 and 75% of label doses) of herbicide (sufonylurea) to control weeds in wheat (*Triticum aestivum* L.) fields of Punjab, Pakistan. Below labeled doses were effective in suppressing the total weeds density by 72-95% and wheat yield was increased by 22 to 48%, while label dose of iodo-mesosulfuron improved yield by 53%. Iodo-mesosulfuron at 25 and 50% of the label dose inhibited grass weeds by 43% and 64%. Wheat yield by reduced herbicides doses (50 and 75%) were not different with that of label doses. Economic analysis revealed that the maximum marginal rate of return was 50% of the label doses of herbicides. Therefore, reduced dose of herbicides can be effective tool in minimizing the use of herbicides and reducing the

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production cost of wheat without compromising the yield of wheat crop.

Sustainable Agriculture and Social Issues

Despite a great progress in shape of increase in agriculture productivity, hundreds of millions of people remain hungry and malnourished. Further hundreds of millions eat too much, hence wasting food, or consume the wrong sorts of foods and it is making them ill. According to FAO (2016), up to one third of the food is spoiled and/or squandered rather it is being consumed by the needy people. Moreover, environment is polluted and degradation of soil and water seems to accompany many of the agricultural systems. Over the last two or three generations, successful agricultural systems have been developed largely based on industrial principles. Such systems produce more yield and productivity than ever before, but such system looks only efficient if the harmful side effects such as; the use of fossil fuels, the loss of soil health, the damage to biodiversity, the pollution of water and air, the harm to human health caused by agricultural pesticides on food and in the environment, and the development of antibiotic-resistant bacteria in large scale animal production facilities are ignored (Pretty, 2009).

3. Research and Methodology

3.1. Secondary Data Collection

Secondary data about the use of agrochemicals, area cultivated with the six major crops including cotton, total production and obtained yield was accessed from the Food and Agriculture Organization, Federal Beauro of Statistics, Pakistan and Department of Plant Protection, Ministry of Agriculture and Livestock, Pakistan. Simple calculations were made by using the MS-Excel and Graphs were drawn to have the meaningful results.

3.2. Primary Data Collection

In order to study the farmers practices to control the crops diseases and weeds in crops, primary data was collected from one union council of District Dera Ghazi Khan, Punjab, Pakistan. The area selected is densely populated and it is equipped with the canal irrigation system as well as farmers' personal tube well to draw water from the ground. Data was collected through personal meetings with the farmers. In total, 100 respondents were contacted. The respondents were asked about different perceptions of farmers regarding farming practices and methods of weeds and pest controls. The data collected was tabulated in the MS-Excel sheet to analyze it. Simple arithmetic calculations were made to have the beneficial results.

3. Results and Discussion

3.1. Trend of Agrochemicals applications in Pests, Plant Diseases and Weeds management in Pakistan:

The agrochemicals use in agriculture in Pakistan is increasing year by year. In year 1990, total insecticides, herbicides and fungicides and bactericides consumed were 4331, 640 and 327 tons respectively. In the year 2001, use of these insecticides and herbicides increased to 10611 and 1030 tons respectively; there is an average increase of 570.91 and 35.46 tons per year respectively. But the use of fungicides and bactericides collectively has been reduced by 98 tons and on the average there is a decrease of 9 tons approximately per year (FAOSTAT, 2011).

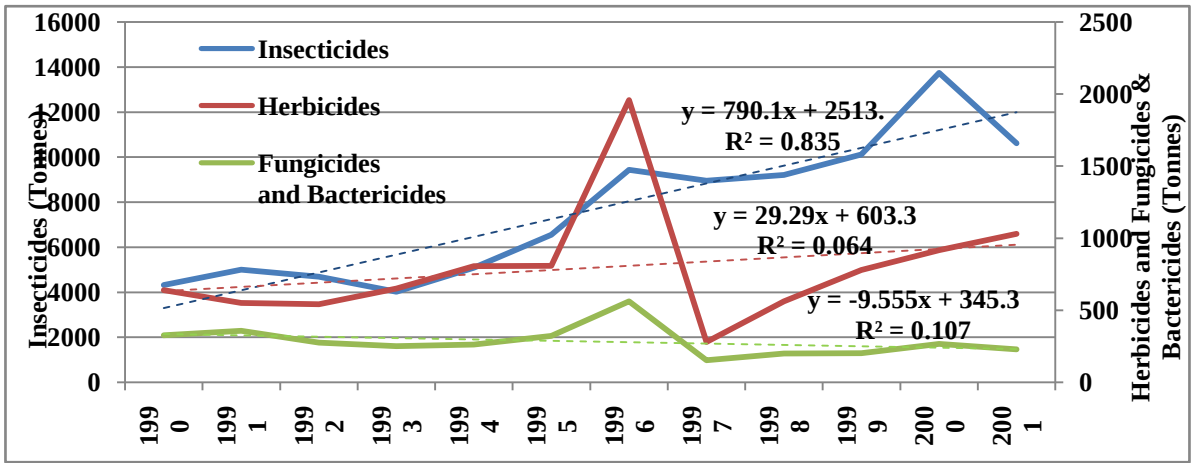

Fig.1 Use of Agrochemicals in Pakistan.Source: FAOSTAT, 2011.

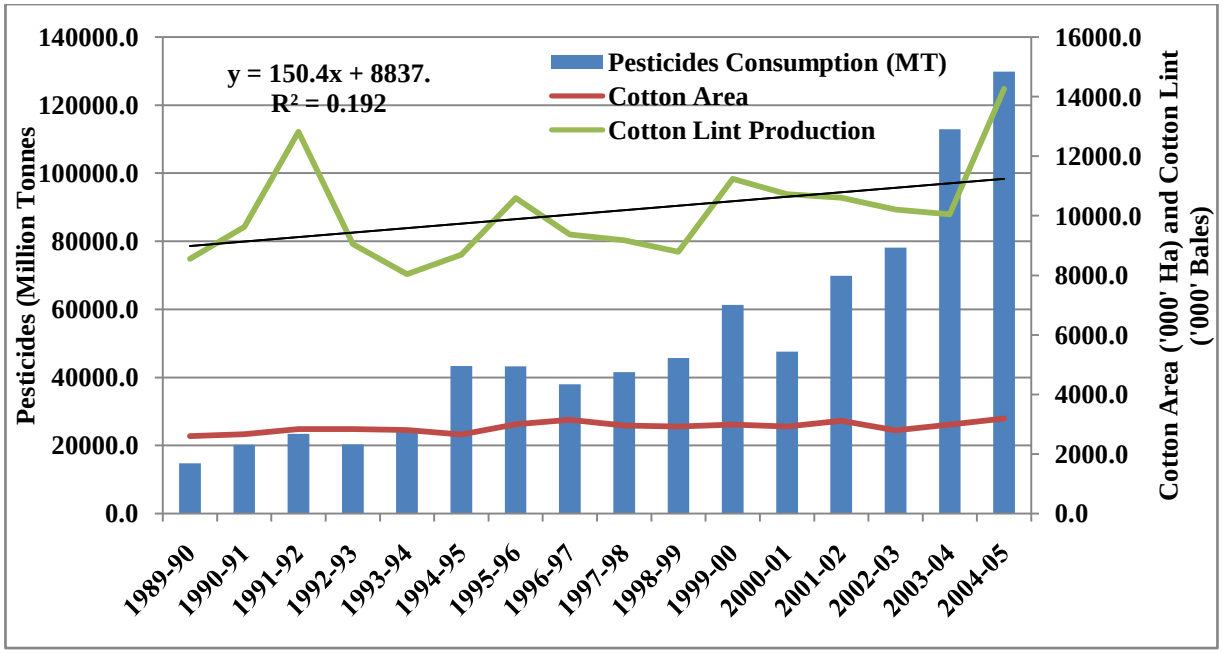

Fig. 2. Pesticides consumption and production of cotton lint. Source: FAOSTAT and Federal Bureau of Statistics, Pakistan.

Most of the pesticides used in Pakistan are insecticides (74%), herbicides (14%), fungicides (9%), acaricides (2%) and fumigants (1%) (Khan, 1998). In Pakistan, the major use of pesticides is for cotton (60%), rice (7%), cereals (4%), and sugarcane (2%). Rest (i.e. 27% of the total pesticides is used for crops other than cotton, rice, cereals and sugarcane (Kang, 2013). Fig. 1 shows the year wise information regarding the use of agrochemicals in Pakistan. The primary vertical axis shows the total insecticides in tons while the secondary vertical axis shows the total herbicides, fungicides and bactericides in tons.

4.1. Cotton Production and Use of Agrochemicals

Fig. 2 describes the use of pesticides for cotton production, area cultivated with the cotton crop and average yield of cotton lint from year 1990 to 2005 in Pakistan. In year 1990 total consumption of pesticides was 14773 million tons, total area cultivated with cotton was 2598.5 thousand hectares and total cotton lint produced was 8559.8 thousand bales (1 bale of cotton is equal to 375 pounds) with an average yield of 5600 hectograms per hectare.

In year 2005 total consumption of pesticides was 129.86 x 10^3 MT, total area cultivated with cotton was 3192.6 thousand hectares and total cotton lint produced was 14265.2 thousand bales with an average yield of 7600 hectograms per hectare. Therefore, from year 1990 to year 2005, there was an increase in total consumption of pesticides as 115.12 x 10^2 MT, increase in total area cultivated with cotton was 594.1 thousand hectares and increases in total cotton lint production was 5705.4 thousand bales. On the average, from year 1990 to year 2005 there was increase in cotton cultivated area as 37.13 thousands hectares per year and there was increase in cotton lint production as 356.59 thousand bales per year and consumption of total pesticides increased on the average as 7195 MT per year. Increase in the use of total consumption of pesticides can be due to increase in area cultivated with the cotton crop as well as by its intensive use for each hectare of the cotton. If we see the percent increase in the total area cultivated with cotton crop and increase in total pesticides consumption, there is a big difference i.e. from year 1990 to year 2005; increase in area cultivated with cotton is about 22.86% but during the same period increase in use of total pesticides is 780.84%. It means that on the average every year there is an increase in cotton cultivated area as 1.43% and increase in pesticides is as 48.80%, whereas increase in the cotton lint yield is 2.23% per year (Fedral Beauro of Statistics, 2011). The information described above is shown in the Fig. 2. The primary vertical axis shows the total consumption of pesticides in million tons and the secondary vertical axis shows the total area cultivated with cotton in thousand hectares and total cotton lint production in thousand bales.

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4.2. Benefit versus Loss in Agriculture

Now let us take a view of total increase in area cultivated and yield gained from all six major crops (sugarcane, wheat, rice, fiber crops including cotton, maize and vegetables) that form the major picture of agriculture in Pakistan. In Pakistan, 80 to 90 % of the agrochemicals are used for production of cotton crop and rest 10 to 20% of agrochemicals are used for other crops (Khooharo et al., 2008).

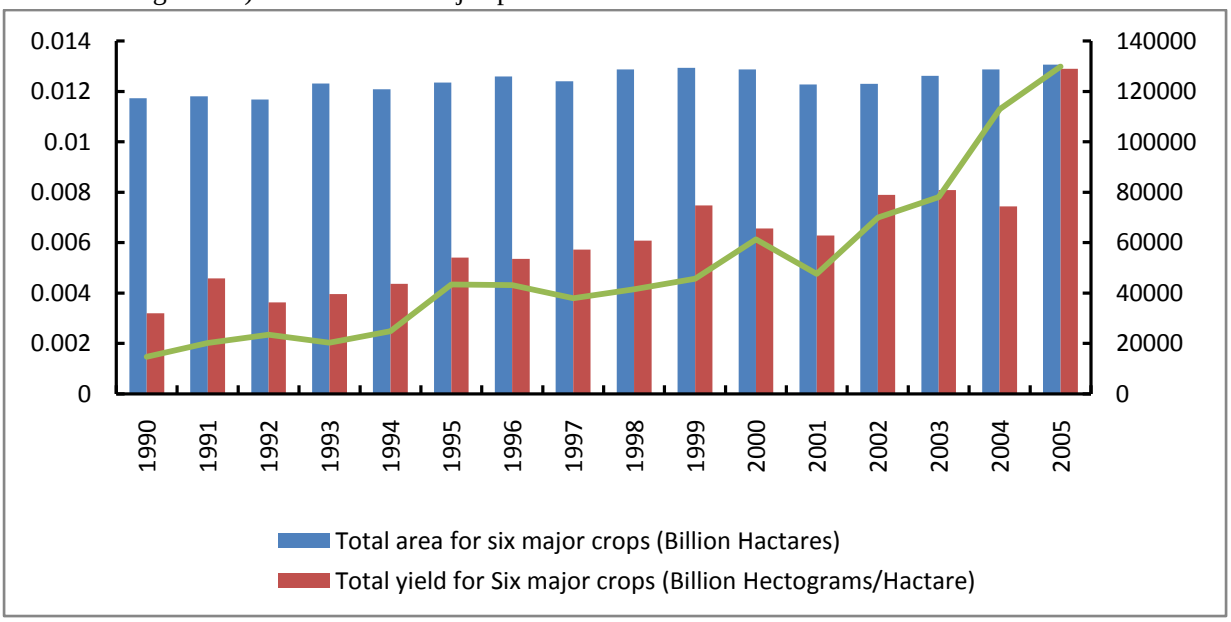

Fig. 3. Consumption of pesticides for six major crops. Source: FAOSTAT and Federal Bureau of Statistics, Pakistan.

Fig. 3 shows the information about the total area cultivated with the six major crops collectively and total yields of all the six major crops along the primary vertical axis and pesticides used along secondary vertical axis from year 1990 to year 2005. Total area cultivated with the all six major crops increased by 11.38% from year 1990 to year 2005 and the total yield of all the six major crops collectively increased as 303.17% in the same period. While the use of pesticides in Pakistan increased by 780.84%. So on the average the increase in total cultivated area with six major crops is 0.71% annually, and increase in yield of all the six major crops is 18.95% annually but the increase in use of pesticides is 48.80% annually (Federal Beauro of Statistics, Pakistan, 2011). It cannot be concluded from this information that the increase in yield is due to more use of pesticides. Possibly more use of pesticides had been needed to control the pests and diseases of crops resulting in increase of yield but the important thing is that whether we are getting more by loosing less or oppositely getting lesser and losing greater? Fig. 3 gives the answer to this question.

4.3. Weed Control

Weeds are considered as the big competitor of crop plants which get nutrients from the soil parallel to the crop plants. Even in some case weeds absorb more soil nutrients as compared to the major crop. In both cases weeds cause loss of nutrients as these plants have no economic value. Weeds cause damage to main crops plant in many dimensions. In addition to soil nutrients competition, weeds compete for sunlight, water, oxygen, carbon and even they occupy more space than the main crop. Therefore, the density of the crops is decreased as compared to required density in any unit area. Some of the weeds plants cover the major crop plants and cause shadow over the crop plants and cause unavialability or reduced access the sunlight. Similarly some of the weeds climb up the crop plants and the crop plant is suppressed and bowed down due to weight of the weed plants. So, all these factors cause the crop plants weaker and weaker. The decreased density of crop plants as well as weak growth of the crop plants (in existence of weeds) causes a loss in crop production. In svere cases this loss may reach up to 100%. For detail, please see the studies by Hakim et al. (2013) and Mobeen et al. (2014).

4.4. Methods of Weed Control

Methods of weed control used may depend on the crop cultivated, type of land, methods of irrigation, and socio-economical factors of the farmers. Soil of

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the study area is silt loam. Depending on the soil and the crops itself, different sowing methods can be followed such as broadcast, drill, and spot placement and sowing in lines. Farmers in the study area are following a number of sowing methods. The farmers shared that these methods of sowing are very important to get maximum germination of crop seed and to control the weeds as well as to cope with the water needs of the crop. In the study area four major crops (sugarcane, wheat, rice and cotton) were sown. Taking wheat first, respondents shared that they prefer broadcast to cultivate crop as compared to drill sowing because by broad casting followed by flood irrigation of water causes earlier seed germinatation as compared to that of drill sowing. Wheat is cultivated on 96% of the total cultivated area and 88% is the area where cotton was sown in the last continuous cropping season. Cotton is harvested during October-November, consequently, farmers have the chance to sow the wheat crop in December which is the ending period for sowing of wheat. Therefore, wheat plants need a fast germination and fast growth to get its full strength. That is the reason; farmers sow wheat crop by broadcast method instead of any other. To have a look in detail, please see the studies by Hakim et al. (2013) and Mobeen et al. (2014).

Farmers in the study area, sow the cotton seed on the furrows; as less water is needed for irrigation and it is also helpful in controlling the weeds. Although farmers use weedicides in the start at the time of sowing to control the weeds germination but mostly weeds grow in the later time even farmers have used weedicides in the start. They control these weeds mechanically by hoeing or by ploughing between the rows of the cotton plants. In case if they sow cotton seed by broadcast method, it is not favorable for controlling the weeds as well as saving water because they have to do flood irrigation. Similarly, if they sow cotton seed by drill, it is good for controlling the weeds by mechanical methods but it needs flood irrigation so it needs plenty of water. It is easier also to spray the pests controlling chemicals by tractor in case of sowing on furrows.

Similarly, the respondents shared that they sow the sugarcane sets on one or both sides of the furrows or in between the furrows. It has similar benefits as that of cotton with reference to irrigation of water and controlling the weeds by mechanical methods.

In the study area, farmers sow the rice crop by transplanting the seedlings. First farmers prepare the seedling on the seed beds and when it is ready for transplantation, they uproot the seedling and sow in the rice field in standing water. In this case they don't have any concepts to sow the rice plants in rows; they just plant the rice seedlings at some specific distances. Farmers in the study area were asked with the question; how they control the weeds in their crops? Respondents were provided with the options as: preventive control; cultural control; chemical control; biological control; and mechanical control. Most of the farmers were indifferent with the concepts of preventive control, cultural control and biological controls of weeds. 100% of the respondents shared that they do chemical control as well as mechanical control of weeds. Farmers shared that they use mostly chemicals to stop the weeds germination and sometimes after the germination of weeds but in earlier stages of crop growth. The methods of chemical application depends on the crop as well as the type and availability of the chemicals. Although the chemical method is helpful to control weeds before germination and even after germination but this control does not last long. The weeds germinate and grow out after some time. Farmers shared that the germination of weeds and their growth even chemical has been used, depends also on the number of irrigation and type of irrigation system. In cotton and sugarcane crops when plants are grown up to one or two feet height, they do hoeing manually or by tractor. The purpose of this hoeing is to control the weeds as well as to make the soil porous and aerated. As they irrigate after hoeing the weeds germinate and grow up again. These weeds grown are then controlled by the mechanical methods. Farmers control these weeds by labor with the use of spade and in case of cotton they also use rigger plow in between the rows of cotton plants. In case of sugarcane weeds are controlled mechanically by using spade, while in case of rice crop weeds are pulled out by hand in standing water. It can be concluded here that 100% of the farmers are using indigenous methods of weed control by hoeing, ploughing by riggers between the ridges of plants and by hand picking. Additionally, 13% of the farmers also do crop rotation as it is helpful to control the weeds too.

4.5. Pest and Plant Disease Control Methods

Cotton crop is one of the major crops which are extremely attacked by the pests and diseases throughout its cultivation time and it needs to control the pests and diseases from its initial stages of growth to the end harvesting season. The methods of pests and disease control may include; biological controls, elimination of breeding grounds, poisoned bait, field burning, hunting, insect traps, poison or chemical

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sprays, sterilization, destruction/uprooting of infected plants and rodents repellents. As our main purpose of the study was to explore the indigenous methods of pests and disease control locally in the study area; respondents were asked the questions; how they control these pests and other diseases of the crops? All the possible options, described above, were shared with the respondents through questionnaire. The farmers were following chemical sprays and insect traps for pest/disease control. Out of hundred respondents, 100% shared that they use chemical for spray as well as mechanical pest control and only 17% respondents shared that they also use traps to get rid of the pests. No biological or some other mechanical control of diseases and pests were being followed by the respondents.

4. Conclusion

Conclusively, cotton cultivated area increased by 22.86% from the year 1990 (2598.5 thousand hectares) to year 2005 (3192.6 thousand hectares). Statistically, from 1990 to 2005, there is 2.23% annual increase in the cotton lint yield but the annual increase in pesticides use for cotton crop is 48.80%. On the other hand total area cultivated with the all six major crops increased by 11.38% from year 1990 to year 2005 and the total yield of all the six major crops collectively increased as 303.16% in the same period. While the use of pesticides in Pakistan increased by 780.84%. So on the average the increase in total cultivated area with six major crops is 0.71% annually, and increase in yield of all the six major crops is 18.95% annually but the increase in use of pesticides is 48.80% annually. From this finding it be concluded that the increase in yield is much lesser than the increase in the use of pesticides. Secondly, in general, increase in the yield is not contributed only by the pesticides because advancement in technology also has contribution in the higher yields. Therefore, the contribution of pesticides in six major crops yield will be lesser if the researchers include the technological advancement.

It was found that the farmers are not using the sustainable practices to control the weeds and pest of the crops. The empirical evidences showed that all of the farmers use the chemicals in large and mechanical controls in small. Farmers adopt mechanical or cultural control methods only when they are not capable to use the weedicides i.e. they consider the weedicides as 1st and prior option to control the weeds. Moreover, pesticides and weedicides are not used based on accessing the actual needs but it is used in hap hazardous way. All of the farmers do spray without following the rules of spraying the pesticides. They don't do pest scouting and they do spray with some specific interval of time, mostly once in a week, but if disease does not control then the farmers even do spray twice in a week. Most of the farmers do spray as 14 times in a cotton growing season. Such type of attitude of the farmers is also linked with the pesticides dealer and non availability of credit to buy the chemicals. The dealers sell the product to the farmers based on their self interest..

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