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WATER SHORTAGE, LOW CROP YIELD AND FOOD SECURITY: THE CASE STUDY OF PAKISTAN

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Abstract

The objective of this research paper is to investigate the causes of water shortage, low crop yields and food crisis in Pakistan, using time series data from 1991 to 2019 to predict the behavior of corps production and food security in future. Crop yield was dependent variable whereas water availability, precipitation, seed, fertilizer and pesticides were used as independent variables. Various statistical techniques such as Descriptive statistics, ADF Test, Correlation Matrix, ARDL Model, Bound Test and Error Correction Model to analyze the data. The findings of study show that all independent variables except precipitation have positive relationship with crop yield. The comparison of the results of ARDL and ECM Models shows that the variables like water, seed, fertilizer and pesticides have more significant and positive relationship with crop yield in the short run than in the long run.

Keywords: Water; Precipitation; Seed, Fertilizer; Crop Yield; Pesticides.

Type of study: Original research Article

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1.INTRODUCTION

1.1: Background Study: -

Water is a valuable for human being, animal and plants. It is used as a public and private good which has multiple utilization such as domestic, industrial and agriculture etc. For the potential productivity gains at the farm and basin level, quantity and quality are important. An analysis can be made between those measures which increase water by increasing crop yield to meet the need of rapid increasing population, Pakistan is a developing country that depends mainly on agriculture sector. Agriculture is a single largest sector, its contributing to GDP is more than 21% and it employs 44% workforce. Pakistan is facing severe water shortage due to inefficient irrigation system and over exploitation of groundwater, inadequate storage capacity and surface and groundwater contamination have collectively impacted on quantity and quality of water. Decline in water availability, which would lead to shifts in crop rotation and changing sowing and harvesting patterns since long, lead to reduce in production of the country's main cash crop, decline cereal production in South Pakistan up to 20% and also reduction in the production of minor agriculture crops in Northern Belt. One of major contribution of agriculture productivity increasing is precipitation factor which is the main source of water in Pakistan. Annual precipitation increased by 25% across Pakistan over the last few decades. Precipitation increased mostly in hilly areas. Among these areas are Coastal region and western Baluchistan Plateau, where precipitation actually has declined. Heavy precipitation occurs during the presence of high temperature due to floods and droughts. Pesticides is defined as using of pests for crop to get maximum yield. Pesticides square measure

substances that square measure meant to manage pests. The term chemical includes all of the weed killer. Pesticides which might embrace insect growth regulators to enhance crop yield. Another input which is used to increase crop yield is fertilizer. Fertilizer are main inputs which is used in agriculture to achieve high yield. Mostly fertilizers such as nitrogen, potassium phosphorus, Urea and DAP are used in agriculture sector. One of the main inputs of increasing crop yield is seed. Seed is the important element which is used for high production and if certified seed is used it will enhance agriculture production. Access to improved seed ensures food security and prosperity of the farmers.

1.2 Main Research Problem

The main research problem is this research study is "Water shortage and its impact on crop yield in Pakistan. As low crop yield and declining water resources are two main problems of Pakistan's agriculture sector, the authors have intended to investigate their causes in order to understand the problem and suggest their possible solution in the form of recommendations.

1.3 Objective of Study

The main objectives of this study are the followings: -

- To study current situation of water and other inputs availability for cultivation of different crops in Pakistan.
- To analyze how water shortage affects the crop yield in Pakistan.
- To study the strategies of small, medium, long term land holders to cope with water shortage problem
- To analyze water scarcity in short, medium, and long run and its effects on crops yield.

- To examine the relationship between use of water, fertilizer, seed and pesticides with crop yield.

1.4 Scope of Study

This study provides evidence to the research community that how much water availability and other inputs are causing decline in crop yield. This study provides a significant pathway to understand the impacts of water shortage, perception, seed fertilizer, pesticides on the crop yield. This study will facilitate to develop a strong understanding of current and potential effect of water shortage that will affect the agriculture of Pakistan. This understanding of low crop yield and water shortage is crucial because it allows decision makers to devise policies in such a way that enhance water availability and other inputs that are core need for enhancing crop yield. The findings of this study will be useful for all developing countries which are facing low crop yield and water shortage.

2.Analysis of relevant Studies

Bastiaanssen (2004) stated that water has main role to increase the yield of major crops. Hugh Turral (2006) investigated the relationship between water and rice by using transplanted techniques and direct dry seed method if the water is short than those method which are used to increase crop productivity. Shafique (2009) explored the positive impact of water management on agriculture output by studying various factors deemed necessary to enhance crops. Haider (2010) analyzed the relationship between precipitation and crop yield in Pakistan. He said that changing pattern of rainfall shows the reduction in crop yield because Pakistan is water stress country. It production depends on other climate for more yield. Januja (2011) examined the precipitation

pattern which caused the reduction in major crops such as wheat yield and cotton in Pakistan. Siddiqui (2012) used the precipitation variable for the major crops but findings of study show overall insignificant result. Baksh (2012) studied the relationship between temperature and precipitation with rice -wheat crop pattern. The results show the negative relation of temperature with precipitation. Hussain (2012) stated that water availability has positive impact on the production of agriculture. He took the rice crops as a crop yield and disclosed that its productivity will be increase as the water availability be increased. Khan (2013) analyzed the relationship between climate factors including precipitation and water with wheat. The findings of this study show negative impact of precipitation on wheat. Aslam (2021) analyzed agriculture productivity and its constraints in Pakistan. He also examined the yield gaps of give major crops, wheat, cotton, rice, maize and sugarcane. He pointed out that Pakistan current average yield of wheat, cotton, rice, maize and sugarcane is 2.26, 1.87, 2.88, 1.77 and 48.06 tons per hectare, respectively against 6.80, 4.30, 5.20, 9.20 and 300 tons per hectare potential yield of wheat, cotton, rice, maize and sugarcane of these crops. He stated that there is a yield gap of 67, 57, 45, 81 and 84 % between average and potential yield of wheat, cotton, rice, maize and sugarcane, respectively and current average yield of these crops 70, 53, 61, 82 and 60%, respectively lower than the average yields of world average. He suggested to adopt new technology and efficient cultivation methods to increase crop yield. Kiani and Tahmeena (2018) found the negative relationship between precipitation and yield of wheat crop due to changing monsoon pattern of rainfall. Abbas (2018) revealed overall positive impact of water availability on crop yield because it clearly shows that water is the core input for, crop yield. If water shortage occurs, production of crop

will decline. Mahmood (2020) said that all Asian countries including Pakistan showed the variations in crop yield due to climate factors. The findings of this study show that there is negative impact of precipitation on changing pattern of weather in crop yield. His focus of the study was the yield of rice, wheat and maize crops in Pakistan. Khan (2021) disclosed that Pakistan is spending huge money on the import of agricultural products. He further revealed that Pakistan spent more than US$ 7.5 billion on the import of food items during from July 01,2020 to May 30,2021 (11 months). The main items include wheat, sugar, palm oil and pulses which were imported to meet the gap between supply and demand of these items. The increase in the import bill of food items have also brought negative effects on trade balance because share of food items in total import bill was reached15.8 percent in 2021 as compared to 12 percent in 2020. He also disclosed that in budget 2021-2022 Pakistan has made substantial allocation for increasing per acre yield, reducing wastage and enhancing storage capacity of food items.

All of the above quoted studies reveal that water is the main input which plays a key role in increasing crop yield. Other inputs are also important but no crop can be grown without water. So, this is the main variable which must be focused to make this study distinct from other studies on the same topics.

3 Data and Methodology

3.1 Data and Sources

There are two types of data which is used in the research. These are primary and secondary data. This has used secondary data. The secondary data was collected from Pakistan Economic Survey (various issues), World Development Indicator, Federal Seed certificate and Registration Department,

National Fertilizer Development Corporation and Metrological Department of Pakistan.

3.2 Sample of study-period

The sample of this study are five inputs like water, seed, fertilizer, pesticide and precipitation, which were selected through convenience sampling technique. The sampling period of this study is from 1991-2019.

3.3 Selected Variables

To examine the effect of water shortage on agriculture output, different variables such as water availability, precipitation, Crop yield in thousand tones, Fertilizer in thousand tones, Seed in metric tons, Pesticides in thousand tones are used. Crop yield is the dependent variable while all other variables are independent variables. The symbol of variables and their descriptions are given below

- WA=Water availability
- P=precipitation
- CY =Crop yield
- SE=Seed
- FZ=Fertilizer
- PS=Pesticides

3.4 Explanation of Variables

3.4.1 Water availability

Water plays a vital role in cultivation and crop yield. Approximately 95% of Pakistan's economy used water to meet basic need of food such as drinking water, cultivation of crop, industrial sector and agriculture sector.

3.4.2 Precipitation

Precipitation is characterized as the quantity of water obtained from clouds by condensing atmospheric. Water vapors that fall under gravity. There are numerous sources of precipitation which include the rain, snow, melt hail, sleet and drizzling in the morning.

3.4.3 Fertilizer

A fertilizer is any material of natural synthetic origin that is applied on plant or soil to increase the efficiency of giving crop yield and strengths the parts of plant.

3.4.4 Pesticides

Pesticides is that infection which reduce the diseases that affect crop yield. Pesticides are usually used to destroy the infection disease of crops to improve the quantity of crop yield.

3.4.5 Seed

Seed is the important element which is used for high production. Certified seed play important role in agriculture production. Access to improved seed ensures food security and prosperity of the farmers.

3.4.6 Crop yield

All production of agriculture inputs which is basic need of human life for survival of life. Crop yield has the main effect on production.

3.4.6 Econometric Model: -

To analyses relationship between Crop yield and water availability, the following model is specified as

$$CP = Bo+B1(WA)+B2(P)+B3(SE)+B4(FZ)+B5(PS)+Ut \ldots$$

Where:

Crop yield is a dependent variable while Water availability, precipitation, Seed, Fertilizer and Pesticides are explanatory variables.

- B_1 = parameter of water availability
- B_2 = parameter of perception
- B_3 = parameter of seed
- B_4 = parameter of fertilizer
- B_5 = parameter of pesticides
- Ut = error term

4: Results

4.1 Descriptive Analysis

The descriptive analysis is used to check the nature of the normality of data. In this study we learn about the mean, median, maximum value, minimum value, JB value, Probability of the variables, standard deviation, kurtosis and skewness of the variables. Table 1 explains the descriptive data statistics used for estimation. ARDL test is applied which show that all the variables are normally distributed. This showed the mean of crop yield is 43613.66 with standard deviation of 29845.74. The median of CY is 30150.00, maximum and minimum value of CY are 117950.0 and 20633.50. The probability of Crop yield lies in 0.0050 which shows the significant result. The mean of Fertilizer is 19071.43 with standard deviation of 3721. 097.The median of FZ is 19000.00, maximum and minimum value of FZ are 25000.00 and 14000.00. The probability of FZ lies in 0.304 which shows the significance of result. The result of descriptive statistics is shown in Table 1.

Table 1

Result of Descriptive Statistics

	CY	**FZ**	**WA**	**SE**	**PS**	**P**
Mean	43613.66	19071.43	817428.6	2184.729	3530.032	1460.714
Median	30150.00	19000.00	897500.0	999.0000	2517.500	1400.000
Maximum	117950.0	25000.00	1260000.	6134.000	7442.600	2500.000
Minimum	20633.50	14000.00	380000.0	847.5000	1973.400	500.0000
Std. Dev.	29845.74	3721.097	320607.0	1838.414	1893.662	451.6138
Skewness	1.458334	0.237084	-0.118103	0.981298	1.121866	0.411818
Kurtosis	3.738445	1.652729	1.376919	2.308597	2.496635	3.508397
Jarque-Bera	10.56097	2.379970	3.138551	5.051455	6.168990	1.092984
Probability	0.005090	0.304226	0.208196	0.080000	0.045753	0.578977
Sum	1221182.	534000.0	22888000	61172.40	98840.90	40900.00
Sum Sq. Dev.	2.41E+10	3.74E+08	2.78E+12	91253693	96820855	5506786.

Source Authors Calculations

4.2 Correlation Analysis

Correlation coefficients are used to measure the strength of linear relationship between two variables. It shows the extent to which two variables are linearly related. If the correlation coefficient is greater than zero, it shows a positive relationship between variables. The correlation coefficient values range is -1.0 to 1.0. In other words, values cannot exceed to 1.0 or be less than -1.0, If the value is less than zero it called the negative correlation If the

correlation coefficient indicates the zero value that shows there is no correlation between the variables. The correlation analysis results are shown in Table 2.

Table 2

Correlation Analysis

Variables	CY	WA	FZ	SE	PS	P
CY	1.00000	-	-	-	-	-
WA	0.691627	1.00000	-	-	-	-
Fz	0.757309	0.819656	1.00000	-	-	-
SE	0.856179	0.709443	0.733479	1.00000	-	-
PS	0.902179	0.703677	0.708628	0.971885	1.00000	-
P	0.015176	-0.000544	0.065646	-0.050979	-0.010241	1.00000

Source Authors Calculations

4.3 ADF's Unit Root Test

ADF unit root test is used to check the stationarity among the selected variables. If the coefficient of variables has ""spurious regression "problem than the assumption of BLUE is not satisfied. To remove the problem of this, ADF test is used to check the lagged value of F statistics to probe the stationarity which contain the lagged values of dependent variables to control autocorrelation dilemma in the residuals. To check the stationarity and non-stationarity level, unit root test is applied. This test also helps check and detect the order of integration of each variable in the model. There are many methods such as ADF, PP and DF etc. But this study has used the Augmented Dicky Filler (ADF) test. The result of ADF test is shown in Table 3.

Table 3:

Result of Unit Root Test

Variables	**Level**			**1st difference**		
	intercept	**T $ I**	**None**	**Intercept**	**T $ I**	**None**
WA	-	-	-	-5.0760 P(0.0004)*	-5.0153 P(0.0023)	-4.5319 P(0.0001)
P	-4.6502 P(0.0009)*	-4.5682 P(0.005)	2.294 P(0.08)	-	-	-
PS	-	-	-	-7.7430 P(0.000)	8.55183 P(0.000)*	-2.4665 P(0.0158)
FZ	-	-	-	-10.482 P(0.000)*	10.269 P(0.000)	-10.486 P(0.000)
SE	-	-	-	-4.6545 P(0.010)	4.8925* P(0.002	-4.1146 P(0.002)
CY	2.6888 P(0.090)	2.603 P(0.07)	3.5217 P(0.090)	-	-	-

Source: Authors Calculations

The results in table 3 shows that variables are stationers at different level so we can use ARDL approach to analyze the data.

4.4 ARDL Approach

ARDL Model is used to determine the long run relationship between the "water availability, precipitation, seed, fertilizer and pesticides and crop yield". There are many co-integration techniques, these techniques depend upon the selection of order of integration. ARDL is used when order of all integrated variable is not the same that is I (0), I (1), OLS techniques is used when the

order of integration of all variables is at the same level such as I (0). Engle Granger co-integration technique is used when all the variables are integrated of I (1). The main objective of ARDL is to determine long run relationship between dependent and independent variables. The result of ARDL Model is shown in Table 4

Table 4

Results oof ARDL Analysis

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
WA	0.010216	0.003161	3.231726	0.0232
FZ	1.321487	0.270762	4.880615	0.0046
SE	9.773857	3.420452	2.857476	0.0355
PS	25.144135	3.175702	7.917661	0.0005
P	-0.481481	1.024190	-0.470109	0.6581
C	-3100.716440	5163.494675	-0.600507	0.5743

Source Authors Calculations

The data in the table 4 shows that all independent variables except precipitation have positive relationship with crop yield. For example, if one unit of water availability is increased it will likely to increase crop yield by 10 percent in the long run. Similarly, if one unit of fertilizer availability is increased it will likely to have positive impact on crop yield by 1321 percent. Seed has significant impact because if one unit of quality seed is increased it will likely to increase crop yield by 97.7 percent in the long run. Pesticide is another significant input. If one unit of pesticides increases, it will likely to increase crop yield by 25.14 percent. However, precipitation has negative relation with crop yield and the results show if one unit increases in

precipitation it will likely to cause decrease in crop yield by 48.14 percent in the long run. Thus, the results show that precipitation has negative significant relation with yield while seed, pesticides and fertilizers have strong positive relation with crop yield. Although water also has positive relationship with crop yield, yet is impact is not significant effect as of seed, pesticides and fertilizers on crop yield. These findings of this study also support the results of. Januja (2011) and Kiani, Tahmeena (2018) and Mahmood (2020) who also had the similar findings in their studies.

4.5 Bound Test

This study used Bound Test to confirm the results of ARDL model which has shown the existence of relationship between variables like crop yield, water availability, precipitation, Fertilizer, seed and pesticides in the long run. The null hypothesis, which states that there is no relationship between the variables, is rejected and the alternative hypothesis is accepted. The alternate hypothesis states that all independent variables have long run effect on dependent variables. The F-statistics was applied to compare whether calculated value are greater than lower bound and upper bound values at the significance of 1%, 2.5%, 5% and 10% level. F-statistics distribution is non-standard irrespective of where variables are stationers at I (0) and I (1). These values are mixture of two sets, one set is I (0) and other set is I (1). The results of Bound Test clearly indicate that calculated value of F-statistics is 3.5095, which is greater than the lower bound value which are 3.79,4.18,4.68 at 5%,2.5% and 1% significance level, pinpointing the existence of long run relationship between variables. The result of Bound Test is shown in Table 5.

Table 5:

Results of Bound Test

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	3.5095	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source Authors Calculations

4.6 Error Correction Model

Error correction model is used to check the short run co-integration between variables. This technique was applied first by Sargan in 1964. Basically, this model is used to check deviation from equilibrium level and speed pf adjustment from one period to another period. The results of Error Correction Model are highlighted in Table 6.

Table 6

ECM Correction Model

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(CY(-1))	3.447647	0.682609	5.050688	0.0039
D(WA)	0.361453	0.090350	-4.000573	0.0103
D(WA(-1))	-0.250131	0.080627	-3.102338	0.0268
D(WA(-2))	0.127354	0.031967	3.983977	0.0105

D(FZ)	0.791445	0.778991	-1.015987	0.3562
D(SE)	43.063032	15.304551	-2.813740	0.0374
D(SE(-1))	47.173754	13.541779	3.483571	0.0176
D(PS)	29.406158	5.908163	4.977209	0.0042
D(PS(-1))	-71.179600	17.987013	-3.957277	0.0108
D(PS(-2))	19.494236	2.984939	6.530865	0.0013
D(P)	17.749591	6.317015	2.809807	0.0376
D(P(-1))	4.607576	2.424408	1.900495	0.1158
D(P(-2))	14.716289	5.642256	2.608228	0.0478
CointEq(-1)	-0.235545	0.581282	-7.286554	0.0008
Cointeq = YP - (0.0102* WA +1.3215*PS. +9.7739*SE + 25.1441*FZ				
-0.4815*P -3100.7164)				

Source Authors Calculations

Table 6 presents the short run results of Error Correction Model. Crop yield was dependent variable whereas water availability, pesticides, fertilizer, seed and precipitation were independent variables of this study. The short result of ECM model reveals that water availability has positive and significant impact on crop yield because as the water increases the crop yield will also increase and if water availability for irrigation is decreased the crop yield will also decrease in the short run. It showed that water plays an important role in in production of different crops and their per acre yield. The coefficient value of water availability shows if one unit increases in the water availability it will likely to increase crop yield by 36.14 percent in the short run while it was just 1.02 percent in the long run. It means the positive impact of water availability is immediate and more significant in the short run vis-à-vis in the long run. Similarly, the impact of Fertilizers, Seeds and Pesticides also significant on

crop yield in the short run. These results also consistent with the findings of Bastiaanssen (2004) which states that water has positive impact on crop yield but precipitation has negative relation with it due to changing pattern of monsoon. The results of this study are also consistent with the findings of shafique (2009), Siddiqui (2012) Amjad (2014) who explored the relationship between water management and crop yield and analyzed the impact of water availability, precipitation on yield of major crops such as rice, maize and wheat and other minor crops.

6 Discussion

In this study the authors have analyzed the water shortage and its impact on crop yield in Pakistan. As agriculture is a big sector of the economy and its share in GDP is more than 21 percent so the decline in crop production also has negative impact on other sector of the economy as well as on unemployment. The basic objective of this study was to examine the relationship between water availability (WA), seed (SE), Fertilizer (FZ), Pesticides (PS) and precipitation (P) with crop yield (CY). Water is the basic element for the higher yield of production. The secondary data relating to the period from 1991-2019 was used. The data was collected from different sources such as Pakistan Economic Survey (various issues), World Development Indicator, Federal Seed certificate and Registration Department, National Fertilizer Development Center and Metrological Department of Pakistan. The sample of the study was agriculture sector of Pakistan. The correlation analysis results show that all variables have positive correlation with crop yield but precipitation has negative correlation with it. The ADF test results show that the variables of this study were stationers at different level

so the authors can have used ARDL approach for analysis of data and to determine long run relationship between variables. Bound test was also used to confirm long run relationship. Error correction model was applied to check short run relationship with variables and speed of their adjustment from current period to next period. The comparative analysis of ARDL Model, Bound Test and Error Correction Model (ECM) show that water, seed, Fertilizer and pesticides have significant impact on crop yield more in the short run than in the long run. However, the impact of precipitation was found positive in the short run but negative in the long run-on crop yield. These results also support the economic theories relating to positive impact of water, seed, fertilizer and pesticides and also match with the findings of Aslam (2016), Mehmood and Fatima (2020) and Khan (2021).

7. Conclusion and policy implications

Pakistan is an agro-based economy and more than 60 percent population depends upon it for employment while the whole textile sector depends upon it for supply of raw material. Similarly, agriculture products are providing food security to fast growing population. As textile share in the country export is more than 60 percent so one can assess the key role of agriculture sector in Pakistan's economy. Aslam (2016) disclosed that there is significant yield gap of 67, 57, 45, 81 and 84 % between average and potential yield of wheat, cotton, rice, maize and sugarcane, respectively. If the level of current Pakistan's average yield of wheat, cotton, rice, maize and sugarcane is compared with international average yield we found that the yield of these crops is 70, 53, 61, 82 and 60%, respectively lower than world average yields. So Pakistan agriculture productivity is lower than world agriculture productivity and, moreover, Pakistan is not exploiting the potential of crop

yield because there is a wide gap between existing yield and potential level of crop yield. Pakistan is facing problem of low crop yield due to non-availability of irrigation water, quality seeds, fertilizer and pesticides in required quantity. Another constraint noted during this study is that the most of the agriculture inputs like fertilizers, seeds and pesticides are not available at normal prices at the time of cultivation of crops and the farmers have to purchase these inputs at higher prices. As crop yield has direct relationship with these inputs and their unavailability have posed serious threat to Pakistan's food security. It has been noted that Pakistan's food import bill during 11 months of 2021 was around $7.550 billion, which was 53.98 percent higher from the corresponding period of 2020. Pakistan imported mainly sugar, wheat, palm oil and pulses to meet the shortfall in domestic production of these crops. It reveals how Pakistan's food security is vulnerable due to falling yield of different crops. Thus, Pakistan must pay attention on the availability of inputs at subsidized prices by providing fiscal inventive to farmers through fixing prices of cash crops so that they take keen interest in enhancing the output of crops. New agriculture technology and efficient use of inputs as well as reducing their wastage are necessary steps to be taken to enhance productivity of agriculture products and enhancing yields of different crops. In this way, Pakistan can save billions of US dollars annually and attain food security in future.

This study has numerous policy implications which are stated in the following:

The availability of irrigation water is decreasing year after year and it is affecting crop yield. It forces Pakistan to import food items of billions of UD dollars every year. The Government of Pakistan should take immediate policy decision to expand water reservoir capacity of existing dams and construct

new dams to meet the growing need of irrigation water and electricity. Fertilizers, Seeds and Pesticides are vital inputs for agriculture productivity. Pakistan has been facing problems of low-quality seed, toxic fertilizers and pesticides. The use of substandard seeds, fertilizers and pesticides has been affecting crop yield negatively. The Government should focus on improving quality of seed, fertilizers and pesticides and their availability at subsidized prices. Moreover, the farmers get low prices of their crops due to exploitation of middle man. It is suggested that the role of brokers should be removed and support prices should be announced for each crop before their cultivation so that the farmers can cultivate them without any fear of loss. The main cause of low crop yield in Pakistan is that majority of the farmers are illiterate and they do know modern agriculture methods and technology. They do not have sufficient financial resources to purchase latest agriculture machinery and equipment. It is suggested that introduce new agriculture technology and make arrangement for training of farmers how to use it. Pakistan should study the technology being used in other developing countries where crop yield is high in order to enhance yields of different crops. In order to make availability of water for cultivation more tube wells should be installed and government should provide subsidy to poor farmers

7.1 Contribution of study

This research study contributes into the existing body of knowledge in different ways. First it has highlighted the close relationship between irrigation water, seeds, fertilizers and pesticides with crop yield. It also highlighted the fact that crop yield cannot be improved without the availability of these key inputs in required quantity so the policy makers must realize the situation. Second, this study revealed that Pakistan has been spending more than eight

billion US dollar every year on the import of food items. By increasing crop yield and productivity of agriculture products valuable foreign exchange can be saved and trade deficit be reduced. This situation demands immediate action on the part of policy makers to focus on the food security of the country and reducing growing import bill of food items. Third, the findings of this study are useful for all countries facing similar problem of the shortage of agriculture input, low agriculture productivity and water shortage. They can reap benefits from the policy implications of this study. Fourth, population growth rate is very high and more than sixty percent population is attached with agriculture sector which is the major source of employment for the labour force. So the development of agriculture sector should be given top priority to reduce the level of unemployment from the country. Fifth, the prices of agriculture inputs and food items are rising all over the world due to disruption in the supply chain due to Covid-19 pandemic and every country is facing high inflationary pressure. This situation demands the increase in the output of food items in order to create harmony and peace in the world otherwise food-deficit countries will have to face huger, unrest, killing, sickness and war like situation as the world is facing due to Russia-Ukraine war.

7.2. Limitations and suggestions for further Study:

The major limitation of this study is a sample of five crops and data of 30 years. The sample size and period of study may be extended. In this study the authors have only studies the impact of water, seed, fertilizer, pesticide and precipitation. Other researcher can measure the impact of technology on crop yield. This study did not measure the impact of prices of agriculture inputs and output on crop yield. Other researchers can include this variable into their

study to determine their positive or negative effect on crop yield and behavior of farmers.

Data Availability statement

The data used in the findings of this study will be available on request from Corresponding author.

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