Migration Letters

Volume: 21, No: S9 (2024), pp. 484-497

ISSN: 1741-8984 (Print) ISSN: 1741-8992 (Online)

www.migrationletters.com

Innovative Agricultural Research Policy Learning And Development: A Case Study Of Agricultural System For Technology Transfer In Pakistan

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Abstract

Present research study aimed to understand the significance of agricultural research and need for innovative agricultural research policy to streamline the global objective of sustainable agricultural development and technology transfer through research based extension system. The study highlighted major weaknesses in agricultural research system without policy implications and suggested important factors to be focused in innovative agricultural research policy. The need for innovative agricultural research is inevitable for transforming the existing research culture. The study attempted to address major agricultural research related issues in Pakistan at national level for formulation of comprehensive agricultural research policy according to the needs of all stakeholders for sustainable agricultural development. This study was conducted at national level and all four provinces, federal capital (Islamabad), Gilgit-Baltistan and Azad Jammu & Kashmir (AJK) were selected as study area for data collection. The 24 districts were selected using proportionate sampling and from each district 10 researchers were interviewed. The total sample of the study was 240 respondents. Four responses were considered incomplete. Hence, the final s[1]ample size for quantitative analysis was 236 researchers as respondents. In addition, 10 researchers from the capital, Islamabad were selected for qualitative data analysis. A comprehensive and detailed questionnaire was prepared for each major objective of the study with thorough discussion of the agriculture extension experts. The data were analyzed by using SPSS in order to obtain the desired results. The major conclusions of the study were that current agricultural research system has been failed to transform the existing research culture on modern foundation. Competencies of researchers on innovative ideas in current research system were not up to the mark. Therefore an innovative agricultural research policy must be developed for technology transfer to the farmers to fulfill the future demands of agriculture sector especially related to resource conservation, resource utilization, climate change adaptation and food security.

Keywords: *Agricultural Research, Policy, Sustainable development, technology transfer*

1. Introduction

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Nearly 128 million people of Pakistan resides in villages. Exports of agriculture commodities and agriculturally based products strengthen the international relations and helps to formulate a strong foreign policy. In this way it becomes a big source of foreign exchange as well. Pakistan's trade balance has never been encouraging in the past history. export of raw cotton was 7.5% of the total exports of Pakistan in 1991-92, it dropped to nearly 1% of the total country's exports in the year 1994 and 1995 when this crop was hit by cotton leaf curl virus and worst weather condition. Statistics plead that except the years of depressed cotton production due to some unavoidable situations, it has been single largest agricultural export commodity (Govt. of Pakistan, 1996). Agriculture sector, which covers a major chunk in Pakistan's GDP, with the passage of time due to different unaddressed factors, its contribution is declining. This is resulting in decrease in exports of the country (Govt. of Pakistan, 2016).

Agriculture policies include the tools and mechanism for improving the agriculture sector for the betterment of the society without compromising farmers' interests (Govt. of Egypt, 2009). In most of the countries of the world, such policies are interlinked with the policies of different other sections of economy. Discussion are in process, these days for how these inter related processes looks to be occur in a specific country, in order to illustrate it, the experiences of some developing, a big portion of population is still trying to meet the basic needs for increasing the income which results in an increased food demand due to lacking of clearly stated agriculture policy (Roe, 1987).

Government has focused on developing agricultural research institutions during the late 1990s without focusing on trainings, skills and competencies of research staff (PARC, 1997). Similarly management, control and proper utilization of available research resources have remained a concerning point throughout. Hence agricultural research system could not deliver and has been weakening its productivity both in terms of quality and quantity (World Bank, 1990). Importance for agricultural research has increased in recent decade which has sensed the need for agricultural research transformation on modern lines. It has also persuaded policy makers to review the research policy and also develop as comprehensive and applicable research policy in countries which still doesn't have any proper strategy to transform agricultural research setup (Beintema and Stads,2008).

1.1 Statement of the problem:

The agriculture sector in Pakistan has been facing many challenges since last decade (Govt of Pakistan,2018). Though agriculture is a provincial subject, however, at national level federal ministry of food security has main role in provision of guidelines to the provinces on sustainable agricultural development. The production of agricultural sector is largely dependent and closely related with suitable climatic conditions. Therefore, the agricultural production is highly associated with the weather conditions, temperature and floods precipitates etc. consequently, these factors affect the progress of the country as well as prices of different products, agricultural productivity and eventually the country's economy. Being agro-based economy if Pakistan is to control and manage changing climate, international agricultural market demands and to feed growing population, sustainable and consistent agricultural development in future is much essential. Agricultural policy provides the way towards achieving ultimate sustainable development. In traditional policy development, when community members are excluded from policy making process, everyone loses: without proper feedback channels, policymakers may never realize how or why a policy is not achieving the desired results. Ordinary citizens often lack the tools or knowledge to get involved in policy decisions (GSPP, 2015).

Though food security policy exists since 2018 but this is top to bottom oriented in nature. Which may not reflect the perceptions, opinions and needs of different stakeholders of agriculture system across the country. Government of KPK has developed agricultural policy

but Pakistan being an agriculture-based country is in need of long term and sustainable needs based national agricultural policy which will be helpful for managing agriculture related issues over a long period of time. Since the last five years, no significant increase in utilization of uncultivable land has been observed (Pakistan Bureau of Statistics, 2018). Promoting all related people participation in policy making and planning is therefore fundamental to democracy and the delivery of quality outcomes for all the stakeholders. It also contributes to the development of effective, strong and inclusive local institutions (Siwach and Malik, 2017).

1.2 Importance of the study:

To meet the ever-growing food demand for such an increasing population, a needs based policy is much necessary. The basic purpose of the this study was to make everyone aware regarding the scope of the needs based agricultural policy for attainment of sustainable development. The significance of well prepared plan of work in increasing sustainable agricultural production and their role in environmental protection is being acknowledged if compared with the previous many years (Farooq et al., 2007). It is well determined reality that farming and agricultural development are inter-related terms.

Absence of competent technology transfer system, poor support services and outdated pattern of marketing has declined the effect of agricultural research. Therefore benefits associated with latest and innovative research practices could not reach to the farmer (UN, 1983). God-gifted natural resources are being extensively utilized throughout the world. Consequently, natural resources are decreasing and will end soon if such careless and lavish utilization of resources continued for longer period. Hence developed countries are putting special emphasis on the needs based agricultural policy to enhance sustainable agricultural development particularly in developing world like Pakistan where no such type of policy exists previously. This research study was therefore planned to assess the significance of needs based innovative agricultural research policy for sustainable development in Pakistan.

1.3 Research Objectives

The study was planned based on following major objectives

- To explore the contribution of current agricultural research system in devising innovative agricultural research policy
- To assess the impact of comprehensive agricultural research policy as perceived by the respondents
- To explore the role of agricultural research policy in setting innovative trends in agricultural research for technology transfer

1.4 Literature Review

Farooq et al. (2007) explained that the looking at the future view of agriculture, it is evident that this sector has to give more output to the people and should not compromise over the most basic responsibility which is securing food for local inhabitants and also include reducing poverty, futuristic management of existing natural resources, protecting our environment etc. But unluckily, this most prime sector of agriculture has now being greatly underestimated for its role in development. The current agricultural land can never be regarded as it is giving according to its level of strength. Inappropriate utilization of resources is very much criticized in situations when barren and unutilized land is decided to brought under use. Land on large scale is producing below potential in Indus-basin region because of shortage of water and continuously fluctuating economy which is mainly caused due to giving more attention to potentially low and unnecessary lands. Several infrastructure problems and hurdles due to lack of clearly stated policy are among the main causes of generating negative effects system of

cropping. For example, establishment of a sugar mill in an area then people will grow more sugarcane without taking care of cropping scheme to avoid organic depletion in land which will result in making land waterlogged.

The World Fact Book (2011) report showed that similar to the other developing countries, the population of Pakistan is also increasing. The migration from rural areas to urban localities is also increasing. The population growth rate of Pakistan is 1.6%, while cities are growing at 3.1% which is indicating that migration from rural to urban areas is 1.5%. Proper technology dissemination and technology adoption can play very important role in increasing the agricultural production to cope with the challenge of growing population. Policy reforms are required in countries like Pakistan to strengthen the technology dissemination and technology adoption.

Govt. of Pakistan (2013) found that forest in Pakistan covers 4.224 million hectares, 5.2% of the total land area of 87.98 million hectares which has slightly shown an increase. Over 150,000 ha of former forestlands, since converted for non-forestry purposes have also reduced the forest cover. With the population growth, forests are under increasing demand for watershed regulation and subsistence uses including firewood and grazing. Pakistan has a network of 225 protected areas, covering an area of 9,939,480 ha which is 11.5% of the total land area. Pakistan's network of 225 protected areas (PA) consists of 19 national parks, 99 wildlife sanctuaries, 96 games reserves and 16 unclassified. About 5700 species of flowering plants are recorded in Pakistan. Deforestation is causing severe damage to natural ecosystem hence laws and principle along with policy interventions can make deforestation under control.

Presley (2014) recommended that financial incentives for conservation practices should be a priority for policymakers drafting agriculture legislation. In more recent decades, progressive suggestions recommend coupling conservation practices and crop support programs. Although conservation funding has been cut significantly in the recently passed 2014 Farm Bill, the bill does include an agreement requiring farmers to engage in conservation compliance practices in order to receive federal crop insurance support, a measure agreed upon by both conservation and agriculture organizations. Majority of farms are already in compliance with existing conservation plans. This requirement may result in more farmers being exposed to conservation practices, and environmental improvements in critical areas.

Food and Health Bereau Hong Kong (2014) reported that the local agricultural industry has been proved to be on declining trend because Hong Kong is taking many important steps for making itself a well known economic state with industrialized and urbanized financial system. The market oriented strategies and policies has led the country towards improvement in the provision and compensating the requirement for country made agricultural products. If it continued further and no serious attention is paid by the developing nations by developing sustainable policies and strategies then a time will come that local agricultural industries will start declining.

Prestamburgo and Prestamburgo (2016) reported that at community level as well as at institutional level environmental change is considered a high priority matter. All efforts are made to investigate and advance the solution related to global emergencies, increasing demands for renewable source of energy, technological innovation and energy-saving system and environmental sustainability of natural resources and land. This worldwide effort play

significant role in increasing agro-energy production systems in terms of production system. agricultural research system must be made strong enough to cope with changing climate.

Govt. of Pakistan (2016) stated that seed plays a key role in crop production and it has great importance in improving quality as well as quantity of crops. A quality seed provides sound base in average crop yields for agricultural production and food security. FSC & RD has taken several policy initiatives during 2015-16. National seed policy is in the process finalization. At ministry level draft was prepared and department made consultation in collaboration FAO. A working group was constituted, that is comprised of both public and private seed sector for incorporation of the input of stakeholders. The draft has been finalized by the working group and ready for final approval.

2. Methodology

2.1 Study area:

This study was conducted at national level and all four provinces, federal capital (Islamabad), Gilgit-Baltistan and Azad Jammu & Kashmir (AJK) were selected as study area for data collection.

2.2 Sample selection:

The 24 districts were selected using proportionate sampling and from each district 10 researchers conveniently available were interviewed. The total sample of the study was 240 respondents. Four responses received were considered incomplete. Final sample size was 236 researchers as respondents. In addition, 10 researchers from the capital, Islamabad for qualitative data analysis through focus group discussion. A comprehensive and detailed questionnaire was prepared with thorough discussion of the agriculture extension experts. The data was analyzed by using SPSS in order to obtain the results.

2.3 Reliability of the instrument:

The reliability of the instrument was checked by using Cronbach alpha (r). The content and face validity of interview schedule was checked by the different field related experts. There suggestions were incorporated to improve the interview schedule. For qualitative data collection from the officials of the federal capital, interview guide was prepared containing important and relevant questions for collecting opinion of the professionals. Reliability coefficient value Cronbach alpha (r) of each interview schedule was calculated by taking sample of twenty professionals which is given below.

Interview schedule related to	Cronbach's Alpha	N of Items
Innovative agricultural research policy development	0.784	133

3. Findings

Demographics: Demographics related to age of the researcher depicted nearly 22.03% of the professionals were lying in the age category of 31 to 35 years which shows that sampled professionals were quiet mature and could give reliable information on the topic. However, education profile of the researchers depicted a large majority (82.20%) of the sampled

professionals had completed their masters or 18 years of education. Similarly more than half of the researcher were not satisfied with present system of agricultural research and were sensing the need for comprehensive agricultural research policy. A large majority of the researcher replied to the question that is there exist any monitoring and evaluation mechanism for evaluating or monitoring the research projects within current system? A high majority (42.8%) of the professionals told that external monitoring and evaluation system of the research projects is available to some extent whereas 28% of the professionals also told that no external monitoring and evaluation system of the research projects exists.

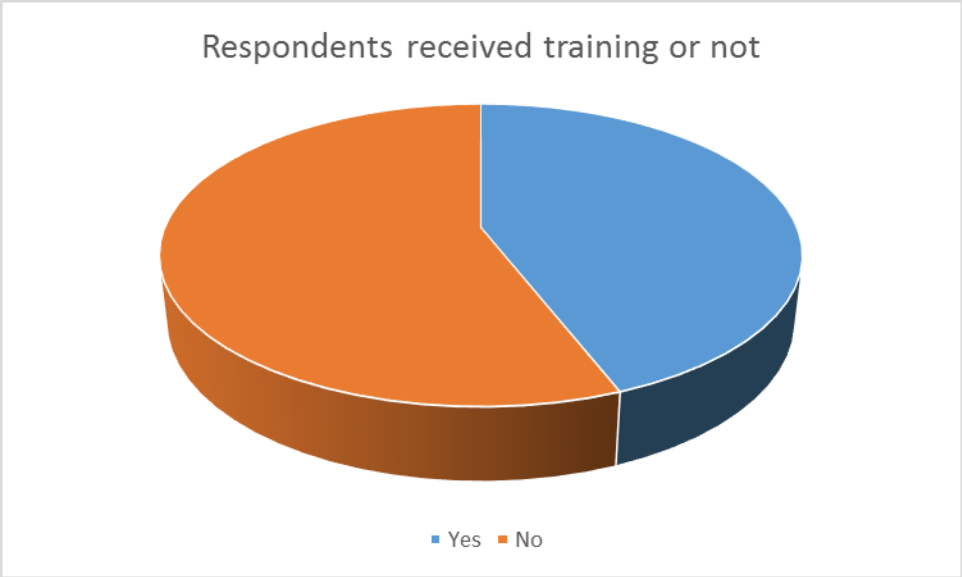

Figure 1: Pie chart showing percentage of researchers whether they have received any profession related training or not
(Orange color depicts percentage of respondents who have not received any training related to research whereas blue color represents percentage of respondents who have received training related to their field research).

Researchers when asked about if they have received any training related to research recently or not then more than half of the professionals told that they haven't received any type of training related to agricultural research while 41.1% of the professionals told that they have received training related to the research.

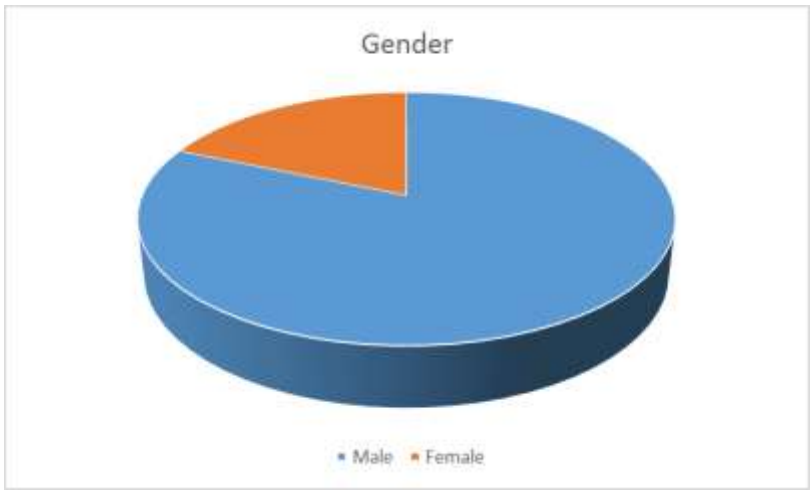

Figure 2: Pie chart showingpercentage of researchers according to their gender
(Orange colour depicts percentage of respondents who were females whereas blue colour represents percentage of respondents who males.)
The pie chart given above shows that a large majority of the respondents in the sample were males however some representation of females was also present.

Perceived impact of national agricultural research policy
After demographical information, the next question was related to impact of national agricultural research policy. Different research related practices were enlisted and sampled professional were instructed to rate each item on 5-point likert type scale. Data explaining this concept is tabulated below in table.

Table 1. Distribution of professionals according to their response regarding perceived impact of national agricultural research policy

Item	Mean	Standard Deviation	Rank
Improved research practices	3.02	0.956	10
Conducting Solution oriented research	3.07	1.051	9
Research evaluation skills of researchers	3.27	0.867	5
Gaining farmers' confidence	3.27	0.999	5
Poverty reduction	3.19	0.985	7
Promoting quality research	3.38	0.855	3
Improving mean production of agriculture products	3.52	0.920	1
Maximum Resource utilization of research institutes	3.30	1.070	4
Appointing versatile research staff	3.26	1.267	6
Focusing equally on each ecological zone for research	3.01	1.246	11
funds allocation to the research institute	2.99	1.113	12
Inputs based research	3.19	0.987	7
Environmental issues	3.48	1.012	2
On CPEC (China-Pakistan Economic Corridor)	3.02	1.097	10
Conducive Environment/Facilities	2.87	0.780	15
Provision of basic research facilities on the research site	2.97	0.884	13
Improvement in researcher's official status and pay structure	2.90	1.055	14
Improving inputs cost management skills	3.08	1.069	8

Scale: very high=5, high=4, medium=3, low=2, very low=1
The above given table depicts that according to perception of professionals, the highest impact of national agricultural research policy can be on improving mean production of agriculture products. This received the mean value of 3.52 and standard deviation of 0.920. the impact of national agricultural research policy on environmental was rated second by the professionals with mean score of 3.48 and standard deviation value of 1.012. Impact of national agricultural research policy on promoting quality research was rated third with mean score of 3.38 and

standard deviation of 0.855. Impact of national agricultural research policy on maximum Resource utilization of research institutes was rated fourth with mean score of 1.070.
The above given table confirms that agricultural research policy if developed can have high level impact on overall agricultural research system, this will not only upgrade the research culture in Pakistan but also increase the farmers trust on agricultural researchers through developing highly productive researches. Hence it is need of the day to develop highly impacted agricultural research policy.

Qualitative Analysis: Regarding impact of agricultural research policy, a senior scientific officer endorsed the quantitative data clearly and said that;

"Agricultural research policy will have very high impact on mean production of agricultural products. These products are highly dependent on research. research policy will also have high impact on addressing the environmental issues and promoting quality research by focusing each part of the country equally".

Role of agricultural research policy in setting innovative trends in agricultural research system

Respondents were inquired about the role of agricultural research policy in setting new trends in current agricultural research system. Data explaining this concept is shown in table.

Table 2. Role of agricultural research policy in setting new trends in current agricultural research system

Research trends in	Mean	Standard Deviation	Rank
Research approaches	3.13	0.947	4
Research evaluation	3.13	1.050	4
Research planning	3.05	1.090	5
Ensuring research ethics	2.93	0.952	6
Utilization of limited resources	3.44	0.767	1
Technology adoption	3.32	0.962	2
Selection of latest research methods	3.27	1.171	3

Scale: very high=5, high=4, medium=3, low=2, very low=1

The above given table shows that role of agricultural research policy on utilization of limited resources received the top ranking with mean score of 3.44 and standard deviation score of 0.767. role of agricultural research policy in technology adoption was rated second with mean score of 3.32 and standard deviation of 0.962. The table further depicts that professionals rated role of agricultural research policy in selection of latest research methods at third position with mean score of 3.27 and standard deviation value of 1.171. Complete set of data depicted in table confirms that role of agricultural research policy in transforming traditional research approaches is very much crucial. The table also depicts that role of agricultural research policy in setting new trends in research approaches as well as in research evaluation mechanism both were ranked 4th with mean score of 3.13 and standard deviation values of 0.947 and 1.050 respectively. Role of agricultural research policy in setting new trends in research planning were ranked fifth with mean score of 3.05 and standard deviation value of 1.090. role of agricultural research policy in setting new trends in ensuring research ethics were ranked 6th with mean score of 2.93 and standard deviation value of 0.952.In the light of above conclusions

it can inferred that agricultural research policy can play a very important role in addressing the looming threats in the country. Hence agricultural research policy highly needed for setting innovative trends in agricultural research system,

Contribution of current agricultural research system for innovative agricultural development and technology transfer

Respondents were inquired about the contribution of current agricultural research system to agricultural development. Data explaining this concept is given below in table.

Table 3: Contribution of current agricultural research system to agricultural development activities as perceived by professionals

Contribution in	Mean	Standard Deviation	Rank
Gaining farmers' trust	3.00	0.989	3
Equipping researchers with latest research approaches	2.51	0.822	22
Researchers quality of trainings	2.92	0.842	5
Transforming traditional research practices	2.82	0.634	12
Agricultural development of Pakistan	2.88	0.827	8
Dealing with food insecurity research	2.87	0.838	9
Dealing with climate change/biodiversity research	2.77	0.997	15
Technology adoption research	2.94	0.802	4
Research planning skills	3.00	0.817	3
Research evaluation skills	3.06	0.712	2
National resources management research	2.89	0.863	7
Natural resources conservation research	2.72	0.958	18
Research for transforming tradition agriculture to technology based advanced agriculture	2.79	1.062	14
Giving rewards to researchers for best performance	2.47	1.017	23
Providing financial benefits to researchers	2.37	0.943	24
Problem solving research for local farming community	2.73	0.909	17
Research for promoting sustainable agricultural practices	2.86	0.903	10
Research for improving living standard and livelihood	3.42	4.026	1
Research for protecting the environment	2.79	0.907	14
Research for meeting future challenges	2.75	1.065	16
Rural development research	2.71	0.999	19
Livestock and dairy development	2.72	0.932	17

Poverty reduction	2.91	0.870	6
Research for adoption of precision agricultural practices	2.83	0.942	11
Improving researchers' working potential	2.80	0.805	13
Research for minimizing land degradation	2.69	0.847	20
Research for reclaiming of barren land	2.67	0.950	21

Scale: very low=1, low=2, medium=3, high=4, very high=5

The table depicts that contribution of current agricultural research system for innovative agricultural development remained low to medium which depicts flaws in current agricultural research system. Contribution of current agricultural research system in developing research for improving living standard and livelihood was rated highest (between medium to highest) with mean score of (3.42) and standard deviation value of 4.026. Contribution of current agricultural research system in developing research evaluation skills was rated second highest but mean value remained around medium level (3.06). Contribution of current agricultural research system gaining farmers' trust and developing research planning skills both were rated third highest but mean value remained at medium level (3.00) While contribution of current agricultural research system in technology adoption research was rated fourth highest but mean value remained below medium level (2.94). Contribution of current agricultural research system in Providing Financial benefits to researchers were ranked the most least and remained around low level with mean score of 2.37. The above results show that contribution of current agricultural research system in agricultural development remained between medium to low level tending more towards lower level. This depicts that current agricultural research system needs to be changed and replaced with organized strategies and policy reforms to improve contribution of agricultural research in overall agricultural development in Pakistan.

According to field professionals, role of current agricultural research setup in national resources management and conservation remained medium to low. This depicts that there still exists potential to upgrade and improve the working in this sector. Though there are different organizations working on resource conservation in the country like Global G.A.P., PARC, FAO etc. But it may not fulfil the field requirements. This may be the reason why field professionals were not satisfied with the role of current agricultural research setup in resources conservation and management. The results are in line with the observations by Pardey, (1991) who reported that agricultural research policy is a very significant component of economic development. Therefore it needs to be transformed with the changing research trends. A comprehensive research policy can improve the agricultural productionon modern lines. Thereforeagricultural research development can also enhance the living standard of stakeholders especially the end users (farmers).

Qualitative Analysis: Answering to a question, a Senior Scientific Officer from National Agricultural Research Council (NARC) replied:

'Current agricultural research system has low to medium role in agricultural development. If agricultural research is to play its role up to its potential, then agricultural research system must be transformed. Current system is not allowing any professional researcher to work according to its potential. Therefore researchers are working hard in this system but output is not as it should be."

Role of agricultural research policy in setting innovative trends in agricultural research development

Agricultural research policy is helpful in facilitating the stakeholders in visualizing the future developmental aims and different approaches tobe adopted in achieving those aims. Therefore traditional agricultural research systemhas been met with a lot of criticism because of being low funded and poor management (Nagy and Quddus, 1998).

Table 4: ANOVA

	Df	SS	MS	F	Significance F
Regression	1	3.023	3.023	12.698	0.000
Residual	234	55.706	0.238		
Total	235	58.729			

The analysis of variance suggest that agricultural research policy increases its role in setting new trends in agricultural research. Current status of agricultural research system cannot contribute much to increase agricultural production at present or in future (Nagy and Quddus, 1998).

Table 5: Regression Coefficients

	Coefficients	Standard Error	t Stat	P-value
Intercept	2.013	0.131	15.370	0.000
Role of agricultural research policy in setting innovative trends in agricultural research policy and development	0.020	0.006	3.563	0.000

Agricultural research has greater role in agricultural development. Research is the main pillar because it develops new practices, technologies and improve agricultural productivity. But unfortunately connection between agricultural research and agricultural development is very weak. There are different reasons for this but apart from this, there is need to strengthen this linkage through strengthening agricultural research from traditional and below potential output of allied departments to empowering them with skill, finance and access to required technology (Lele et al., 2010).The agricultural research policy has to increase its role in setting new trends in agricultural research in order to transform the current agricultural system.

DISCUSSION

Agricultural research plays a very vital role in achieving sustainable development (UNHR, 2020). All the advancements in agriculture sector are due to various research practices going on in the field. It is very important that current agricultural research system have to be transformed in order to cope with the continuously emerging future challenges. The policy researches are constantly urging to prioritize economic equality and needs based policies focusing marginalized communities (UNHR, 2020). However, present system of research development lacks policy implementation in reality. In addition, present research system has been failed to set new and future focused innovative trends in agriculture sector.

At present, we are met with little success in achieving Sustainable Development Goals (SDGs). Every minor policy based improvement in research system can result inpromoting innovative trends and also contributing to best practices for inclusive development in agricultural research system.

Climate change is a well known reality and its consequence has left very negative impact on agricultural production. But there is need to maintain already marginally successful research practices so that current ongoing system may not go down in output. It will be unbearable for many of the inhabitants on earthswho are already under severe food insecurity situation. Therefore there is need to make agricultural research change its methods and approaches for addressing the unbearable consequences if they get worst (Minde and Nyaki, 2016).

Conclusions:

It was also concluded from the results that there is need for comprehensive innovative agricultural research policy for technology transfer at national level keeping in view the current status of agricultural research in the country and to meet the growing demand of high quality agricultural research at international level. Researchers were not satisfied with the present system of performance assessment in the department. Agricultural research policy can have high impact on improving mean production of agricultural products, controlling environmental issues and promoting quality research. Similarly role of agricultural research policy in resource utilization, technology adoption and selection of latest research methods was much vital. Current research setup has been failed to contribute to agricultural development in Pakistan. Limited funds for researchers, regular framework of researchers' appointment and climate change were highest constraints to agricultural development in Pakistan.

Recommendations:

An organized framework of performance assessment of professionals in agriculture research must be developed for smooth functioning and increasing quality of services. Research policy can help in developing innovative research ideas. These innovative ideas if put into practice in the field can transform the agriculture system through strong technology transfer mechanism. Similarly, while planning agriculture related projects or programs, in depth surveys must be conducted for getting an insight regarding the overall situation of the targeted area.

Conflict of interest: All the authors showed no conflict of interest among each other on any of the aspect of research work.

Acknowledgement:

The contribution of each of the mentioned authors is acknowledged. Their collective efforts helped in completing this research work.

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