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ETHICS: ENSURING FOOD SECURITY IN THE ERA OF CLIMATE CHANGE

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The present research covers topics such as global policy options for food security; and existing policy frameworks by the government of Pakistan and national bodies or organizations working for the cause of biosafety, biosecurity in the country. The ethical need to establish effective strategies related to country's preparedness to tackle issues like climate change, poverty and food security is emphasized.

Keywords: *ethics, food security, climate change.*

Introduction

To make it prosper, Pakistan has to work on three major areas: innovation, agriculture and industry. Biotechnology based innovations play an important role in sustainable economic growth. Cutting edge biotechnologies can be used both for the good of humanity and/or for the hostile applications which raises the Dual Use Research Concerns (DURC) about Biotechnology. However, unprecedented increase in population of developing countries like Pakistan needs some kind of "Gene Revolution" to cater the need of the society. Pakistan's altitude ranges from 0 to 8611 m, and is blessed with splendid mountain ranges (Hindu-Kush, Himalayas), vast deserts and forests, numerous climatic zones, all contributing to a fascinating and unique biodiversity, yet the country faces numerous issues including food security.

Decline of biodiversity in developing country is another major issue which will result in reduction of basic ecosystem services. Rich biodiversity areas serve as a major source pool of pathogens. Scientists agree that the loss of biodiversity increase infectious disease transmission among human, animals and plants.

Pakistan has progressed significantly in the different disciplines of life sciences evidenced by the doubling of HEI's, research publications, PhD enrollments etc. Over the past few years. Some of the bioterrorism events has raised alarms for regulating various life sciences technologies. Considering the recent progress in biotechnology, and the potential of DURC, tighter regulations are needed to prevent any misuse. For a country like Pakistan, where the major chunk of economy and GDP comes from agricultural resources, bioterrorism can be a serious threat. An event could bring a serious negative impact on the agro based economy. Therefore agricultural biosecurity becomes fundamental for the country to progress. Benign research in the life sciences has massive potential to be misused, either intentionally or unintentionally. The rapid growth in biotechnology in recent years has offered great benefits globally, but as one of the most rapidly-growing areas of science in the early 21st century, it brings security risks that must be recognized and addressed effectively. Internationally there is an increased interest in the concept of biosecurity at the state and inter-state level, it is yet to manifest in significant activity at the level of the practicing life scientist. Rather, activity on the ground remains limited with many in the life science community perceiving this as an irrelevant or less relevant topic. It is noteworthy to mention the premier role of Pakistan against terrorism on national and global fronts. Therefore, one cannot ignore the bioterrorism threats to the country which is already actively dealing with conventional forms of terrorism.

To address such issues we have to analyze global as well national policy systems including Sustainable Development Goals (SDGs) and organizations like Pakistan Academy of Sciences. Research organizations should work on the issues through research, partnership, and training. This will help in achieving sustainable increases in agricultural productivity and its nutritional quality ultimately leading to better income to the people.

To meet these challenges, the organizations have to play its due role by emphasizing on quality manpower, scientific infrastructure, and cost-effective research. Towards this end, the Government needs to ensure an environment conducive to innovation, ear-

ly stage support system, and investment incentives. The Researchers have also to bridge the gap between researchers, policy makers and agro-based industrial sector through change managers, technological advancement and by encouraging entrepreneurial culture.

Unfortunately, the policy response to food security issues has not been in line with natural resource management. Efforts made so far have been focused on increasing productivity through genetically-modified crops, extensive use of fertilizers and pesticides, and by increasing cultivable land. All these efforts and inputs have adversely affected the agro-biodiversity and degraded the ecosystems.

Scientists prefer only the glamorous aspects of science like Biotechnology or Nanotechnology and they are seldom exposed to the'reality' of rural areas. The real issue is: how does science cater to the poor? We have to look for options as to how the technology could be applied in less fanciful ways to benefit the planet: to produce heat-tolerant coral reefs, pollution-sensing soil microbes. The present work covers topics such as global policy options for food security; and existing policy frameworks by the government of Pakistan and national bodies or organizations working for the cause of biosafety, biosecurity in the country. The ethical need to establish effective strategies related to country's preparedness to tackle issues like climate change, poverty and food security is emphasized.

"Green" and "Evergreen Revolution" concepts

In early green revolution period (1960–1980) Pakistan increased the agriculture trade up to 4.3% per year. In this period some new high yielding dwarf and semi-dwarf varieties of wheat rice and other major crops were produced that showed better performance in the extreme environmental conditions. The resulted varieties showed better growth in the extreme high temperature areas of Baluchistan and Sindh. The wheat yield has increased from 7.7 billion rupees in 1959–1960 to 15.5 billion rupees in 1969–1970. The poverty rate decreased several fold in this period. After that the green revolution undergoes decline condition due to resource degradation, uses of poor conventional farming techniques and lack of proper policy and its implementation for sustainable agriculture.

It is expecting that the rise of country population will be from 20.7 million in 2018 to 240 million by the year 2035. The "green revolution" concept has changed to "evergreen revolution" by combing the molecular plant breeding with the modern biotechnologies. The availability of food and optimum nutrients amount is not possible with conventional techniques. So, the new genetically engineering methods were used to produce more genetically modified products in country. The evergreen revolution era brought many benefits in food sector. Scientists from diverse fields worked in collaboration, and developed multiple genetically engineered crops against biotic and abiotic stresses and for other multiple purposes.

Genetically modified (GM) crops in Pakistan: benefits or threats to food security

Currently Pakistan is ranked seventh in *Bt* crop growing countries and total of 2.9 mha land of country is under cultivation of *Bt* crops. The biosafety commission of Pakistan had approved 32 *Bt* cotton varieties and 119 genotypes are under evaluation step. These varieties are used against a single insect resistance or used as stacked trait (multiple traits). Some varieties showed resistance against broad range of insects and viruses. The *Bt* cotton varieties showed better yield in all four provinces of Pakistan. The *Bt* cotton was very famous among the farmers and cultivated about 97% of cotton cultivated areas. Currently Pakistan has developed *Bt* maize crop against herbicide resistance and grown about 1.2 mha, that produced approx 5 m tons of maize. Several others genetically modified (GM) crops like tomato, wheat, rice, maize has been produced against heat, drought and salinity stresses. The commercialization of these crops and poor consumer response are the two major problems to GM crops. Now Pakistani scientists started working for developing new golden rice varieties, to minimize the blindness problems in children's with no or minimal deficiency of Vit A.

These genetically engineered products are no doubt, hold promise as a means to provide maximum benefits to all living organisms. As the time went on, various social, political, environmental and technical issues related to these technologies took their birth in country. These technologies have produced many problems especially in food security, environmental safety, effects on both targeted and non targeted organisms, use of toxic selectable marker genes, cross pathogens resistance, etc. It can affect non-GM crop by horizontal gene transfer mechanism and disturb its morpho-biochemical and physiological processes. The development of genetic engineering and bioscience technologies also raised of production of toxic pathogens that could directly affect the agriculture sector of any country especially Pakistan. The economic growth of Pakistan is correlated with agriculture, and it fulfills 20% of our GDP. If such new types of toxic mutant virus/pathogen comes to our environment so they could badly affect our agriculture

and other living organisms including human being. Some people believe that these GM crops may fail to resist altered climatic conditions; the food security threat might be increased. The other public concern is if GM crops fail to resist altered climatic conditions; the food security threat might be increased. The other major public concern is that it may loss of seed variety and diversity. So there is a need to develop some new modified GM crop being no ethical or the marker issue. So, it will be useful if we develop some marker free transgenic *Bt* crop in country against multiple purposes.

The developed world has developed some new transgenic plants against change of climate conditions by using novel genetic engineered technique CRISPR (clustered, regularly interspaced, short palindromic repeat) /Cas (CRISPR-associated protein). The CRISPR/Cas9 is a user-friendly system for the production of transgenic plants with counteracting harmful effects from climate change and ensures future food security for increasing population in Pakistan. However, CRISPR/Cas9 technology is not significantly used in Pakistan for further genetic modification in several important tropical plants against both biotic and abiotic stresses, for the yield and quality improvements.

Agriculture and climate change in Pakistan: problems and solutions

Wheat, rice, maize, sugarcane and cotton are the major crops of Pakistan that contribute 23.85 % of the value added in overall agriculture and 4.66% of GDP. The other minor crops contribute 2.15% of overall GDP. The change in climate condition of Pakistan receives negative impact on country economy; more adversely affecting the growth and production of both major and minor crops. In areas where the only source of irrigation is rain water, high temperature and low rainfall are serious threats to crop adaptation. Northern and Southern regions of Khyber Pakhtunkhwa (KP) are drastically effected due to negative impact of extreme temperature and precipitation conditions in Punjab, Pakistan during 2015–2016. As a result decrease in production was found in these major crops i.e. wheat 1.9%, maize 5% and sugarcane 8%. The 5.71 % and 15.26 %, reduction in crop production was observed due to increase in precipitation (during September-October) by 5% and 15% respectively. The affect of elevated temperature was found more severe than precipitation.

The lack of proper policy, management, inter-disciplinary team work, research-practice, and science-policy are some gaps that affect country food security. The other major problem is the uncertainties and not knowing about the future climates. So, there is a need to follow certain modern culture practices to minimize the challenges to food security. There is need to adopt coping strategies like to change crop sowing date with respect seasonal variations, change in harvesting dates, used of short duration genotypes, cultivation of adopted heat and drought tolerant varieties, change in fertilizer practices, change in cropping pattern, etc. It is also important to copy some of the novel strategies used in neighboring countries like India, Bangladesh and Afghanistan having almost same climate conditions. All these strategies may minimize the negative effects of climate change on crop adaptation. The miss-regulation regarding the import and export of major crops need to be controlled. In the past the trader mafia including the ministers and others parliamentarians exported maximum wheat crop for own benefits, not for consumers benefit. In 2018 sugar mills mafia including high influential politicians has become curse for the millions of poor sugarcane growers of the country. So, it is the responsibilities of government to take strict action against these mafias and to raise the income of small farmers to enhance agriculture growth in country.

The natural disaster and military operations in Pakistan affected the agriculture production and balanced food supply to the people. The 2010 floods in Pakistan affected about 4.5 mln people, two-thirds of whom were from agriculture sector. Massive number of farmers lost their land and their expected income. Many people died due to unavailability of balanced nutrients uptake, and majority of them were children. The military operation against "Tehrek Taliban Pakistan (TTP)" started in 2009. About three mln people were affected from this operation. Majority of poor people were from Malakand agency, Khyber Pakhtunkhwa (KP) and from the Federally Administered Tribal Areas (FATA) which left their homes and villages due to security reasons. In these aforementioned areas, agricultural practices are the main source of livelihood. Their cultivated lands, fruit gardens of peach, apricot, date palm, orange were highly affected. Majority of their livestock died due lack of food supply. Ultimately, the quantity and quality of food consumption reduced, and food insecurity and malnutrition increase, particularly among the most vulnerable households. These pressures reduce households' purchasing capacity, restrict access to food, deplete savings, force the sale of vital productive assets and erode livelihoods. Majority of internally displaced persons (IDPs) have started returning home, yet they continue to struggle to obtain food. After winning the operation and by defeat of Taliban, the situation is now totally controlled. But the affected areas still

need more support to the poor farmers from both government and other private agencies. There is a need to raise awareness in peoples of Pakistan where natural disaster, terrorism and food security are some major problems. The changing climate has caused tremendous floods over the past years in Pakistan, hampering the agriculture and food productivity. A good policy regarding changing climate and water storage can go a ling way in Pakistan for achieving the food security.

Pakistan has rich diversity of plants, weather, rocks, soil conditions and water resources. The country progressed in last few decades in agriculture sector. But still it is important to use the modern technologies to promote evergreen revolution in country to promote the yield and overall production of both major and minor crops. Strict biosafety regulation needs to be set up in country to promote the safe use of GM crop with no social, cultural, environmental and socio-economic issues. The private sectors should work in all areas of seed testing, production, multiplication, processing and to promote value addition livestock industry and diversification of livestock products. Transformations are needed if Pakistan is to remove the ills of planning and mental corruption that have seeped into the system. The disaster risk management policies need to be introduced to face the disaster due to change in environmental condition. But still more than one-forth people of Pakistan are living below the poverty line. More dams' construction and modern irrigation systems need to be adopted to face water shortage problem. So, it is the responsibility of individual, government, non-governmental organization and policy makers to choke a coherent strategy to deal with the food security issues in the country, which is already facing complicated issues of terrorism, natural disasters, global warming, climate changes and others like corruption and poverty.