CLIMATE CHANGE MITIGATION THROUGH CONSERVATION AGRICULTURE IN PAKISTAN: CRITICAL ANALYSIS

***Saleem Ashraf[1], Muhammad Iftikhar[2], Ghazanfar Ali Khan[2], M. Athar Javed Khan[3] & Hammad Raza[2]**

[1]In-Service Agricultural Training Institute, Sargodha, Pakistan

[2]Institute of Agricultural Extension and Rural Development, University of Agriculture Faisalabad, Pakistan

[3]Department of Continuing Education, University of Agriculture Faisalabad, Pakistan

Corresponding Author: Email: saleem1828@gmail.com

***ABSTRACT*:** *earth and already causing inclusive impacts from melting glaciers, and rising sea levels increasing the probabilities of natural risks like flooding due to extreme rainfall. If these trends persists and hasten in struggling country like Pakistan, might cause significant risks to essential natural resources for survival as major chunk of population is agriculture dependent but poor, food insecure and victimized to hunger. Farmers are exploiting natural resources to feed their families resultantly; they are increasing the concentration of CO_2 and greenhouse gasses. It's time for Pakistan to take some actions to combat climate change. Pakistan can significantly limit the damage and loss caused by climate change through implementing environment friendly techniques among farming communities such as Conservation agriculture to promote climate smart agriculture.*

Key Words: Conservation Agriculture, climate change, resource conservation

1. INTRODUCTION

The existence and occurring of climate change in the world has been acknowledged; future change is also inevitable that's why we will have to adapt to these changes [1,2]. Furthermore, future impacts and adaptation necessities will be reliant on the necessity and effectiveness with which mitigation measures are executed [3]. For instance, Australia has significant vulnerability to the changes in temperature and rainfall projected over the next decades to 100 years [4]. Pakistan is also vulnerable to the climate change as Pakistan stands on 3rd among the top 10 worst vulnerable countries. Pakistan is blend of poor to rich population but poor population is more which is heavily dependent on farming. These poor people are more vulnerable to external shocks including droughts, natural disasters floods, earthquake affecting their livelihood assets. To reduce this vulnerability mitigations strategy can do better. IPCC [1] described climate change adaptation as "adjustments in human and natural systems in response to actual or expected climatic variation, with a view to moderating harm or exploiting beneficial opportunities is an area of growing concern and engagement for many developing countries".

Conservation agriculture is one of the most viable mitigation strategies to reduce the climate change impacts. Conservation Agriculture is to conserve, improve and make more efficient use of natural resources through integrated management of soil, water, crops and other biological resources. Pakistan is low income country where almost half of the population is living below the poverty line. Literacy rate is below the mark and these people are already victims of deprived resources. Farmers don't seem to be aware of climate change neither the efforts from public sector are seen in this perspective [5]. So, climate change is a major challenge how we will cope with its drastic impacts for longer term. In addition what will be the future of farmers who are going to be victimized? It is also fact that these farmers still didn't enjoy the resilience after being struck by disastrous flood.

Climate Change and Agriculture

Climate change known no boundaries and it is also uncertain. The impacts of climate change are widespread around the globe either its developed country of developing. Agriculture is the sector having enough contribution in economic development of any country. In monetary terms, agriculture represents less than 2 percent of GDP in high -income countries, and 2.9 percent for the world as a whole. It is more important for low-income countries, amounting to almost one-fourth of GDP in the least developed countries In addition; agriculture is also the most climate sensitive industries with outdoor production processes that heavily depend on particular levels of temperature and precipitation [6].

Temperature, rainfall and precipitations are the indicators of climate change and a variation of these indicators is harmful for the agricultural productivity. Rising greenhouse gas emissions raise changes in rainfall patterns, river flows and temperature, resultantly the food availability may decline because of lower production [7]. Calzadilla *et al*. [8] narrated that under both optimistic and pessimistic scenarios of future emissions, the many effects of climate change could together cause food production to fall 0.5 per cent by the end of this decade, and 2.3 per cent by the 2050s. as a result food prices will increase while availability will decrease. By midcentury, staple food like cereals grains, sugarcane and wheat re predicted to be roughly 40% more expensive than the countries being safe from climate change [7].

Above mentioned facts show that almost entire world is vulnerable to the climate change but no one know which country and when. Moreover, no one knows the vulnerability context. But most of the countries in the world are preparing to mitigate the climate change through diversified production practice sand new technologies. It's also pretty clear that all the countries are not doing equally but doing under their resources imitations. Like the other countries of world Pakistan is also under threat of climate change. Center of International and Security Studies at Maryland USA, stated Pakistan as one of the high risk fragmented economies at risk: "Piecing together publicly available data about Pakistan, it is clear that climatic changes disturb the social and political equilibrium of a society by either creating new fault lines in the social, political, or ethnic landscape of that society, or by exacerbating existing ones".-

Pakistan has faced devastating monsoon floods for the last three years, including the worst in its history in 2010 when catastrophic stream killed millions of people and caused damage of millions in agricultural sector. An increase in the mass balance of the Karakoram glaciers, a phenomenon unique in the Himalayan region, has substantially reduced water flows in the Indus River basin. The pattern of rainfall throughout the country has varied widely, and the duration and intensity of the summer season has increased. Result of the change in rainfall patters is that now it rains consecutively instead of in intervals as it usually occurs some years ago. This consecutive rainfall is more dangerous to the agriculture. Global Climate Risks Index (2013) depicted that Pakistan stands on the 8th rank as most vulnerable to the climate change. Last year's Pakistan was on same rank and still is on 8th rank which shows the poor performance of policies and mitigation strategies. In 2010, Bangladesh was on 1st position but now is on 4th rank depicting their extended efforts toward climate mitigation. Bangladesh is also low income country story so, is role model for Pakistan to mitigate the climate change. When we talk about the only 2011, Pakistan is the 3rd most vulnerable country to climate change indicating the need of some strategic planning and mitigation strategies.

Conservation Agriculture: Mitigation Strategy

Conservation agriculture (CA) generally states to keep the resources safer for long term benefits. Moreover, CA is also defined as reduced soil disturbance and permanent soil cover combined with crop rotations as a more sustainable cultivation system for the sustainable future. Baker *et al*. [9] described that "Conservation tillage is the collective umbrella term commonly given to no-tillage, direct-drilling, minimum-tillage and/or ridge-tillage, to denote that the specific practice has a conservation goal of some nature. Usually, the retention of 30% surface cover by residues characterizes the lower limit of classification for conservation-tillage, but other conservation objectives for the practice include conservation of time, fuel, earthworms, soil water, soil structure and nutrients. Thus residue levels alone do not adequately describe all conservation tillage practices." At present, farmers are more inline toward excessive tillage operation for the sake of maximum return. In fact, it wrong as they are deteriorating the natural resources badly. Figure 7 explains the detailed negative impacts of excessive tillage practices on land. Sainju *et al.* [10] also illustrated that form the past several decades, excessive agricultural practices including intensive tillage, excessive fertilization to enhance production has resulted in the severe degradation of not only soil but also of environment. In addition, it has increased erosion and nutrients leaching in ground water. Moreover, during performing these practices release of green house gases such as carbon dioxide (CO_2) and nitrous oxide (N_2O), cause global warming in the atmosphere by oxidation of soil organic matter. Consequently, environment friendly management practices that should have capability to sustain yields and soil properties are needs. Conservation Agriculture is most viable option in this perspective.

Conservation agriculture is the possible solution for resilience. Major reason of being major reason is "in conservation agriculture farmers don't need any new technology or new practices. They just have to focus on their existing resources and they have to use these resources judiciously for the longer term benefits. Some benefits of the conservation are mentioned here which support the need of conservation agriculture as mitigation strategy against climate change. The improved production practices under framework of conservation agriculture, such as, conservation tillage, cover cropping, crop rotations and reduced application rate of N fertilization show promising results to boost soil and water qualities. Through these practices mentioned above soil Carbon and Nitrogen storage can be sustained while reduced soil erosion and N leaching from the soil profile to the surface and groundwater without significantly altering crop yields as compared with conventional tillage, no cover cropping, and full rate of N fertilization [10]. Increased yield, reduced cost of production including time and money [11], water conservation, better protection to soil surface, enhanced fertilizer efficiency (10-15%) in the rice-wheat system, reported increased release of nutrients with time because of more active microbial active and nutrient recycling [12[, weed control [13, 14]), weed suppression through biological agents [15, 16 17, 18 19], soil sustainability [20] and potential to raise level of soil organic matter are major benefits of conservation agriculture.

Despite of these benefits adoption of conservation agriculture is lower. Derpsch [21] argued that CA is knowledge intensive and complex system to learn and implement. It cannot be reduced to simple standard technology and thus pioneers and early adopters face many hurdles before the benefits of conservation agriculture can be reaped. Some effective technologies and dissemination may work for long term benefits. Pieri et al. [22] proposed scaling up of conservation agriculture requires dynamic harmonized enabling policies and institutional support to producers and supply chain service providers.

CONCLUSION AND RECOMMENDATIONS

Climate is changing evolving major threats and no one can deny from it. No one is certain about the impacts of climate change. Agriculture, mainstay of various nations is exposed to climate change. Local farmers of Pakistan are struggling against the malicious climate change. Phenomenon is affecting the likelihood of farmers. For the resilience farmers need adaptations of conservation agriculture to revise our resources and document secures future. Badly deteriorated natural resources are depleting. Conservation agriculture put message on the board that "uses the land according to its capability for longer term benefits". This will not only save cost of production but also will boost the productivity. In addition, it will help to mitigate the climate change impacts through practices like reduced tillage,; this will control soil deterioration and reduce gas emissions from automobiles used for mechanization. Judicious use of other inputs like water, fertilizers, insecticides/pesticides and production practices will strengthen the position. Farmers have resources they just need capacity building. Re-research should be focused instead of new research. The needs of the small farmers should me prime focus. Following suggestion are made on the basis of discussion

- There is dire need to popularize in real what climate change is and what is vulnerability. This awareness will change the mind of farmers
- There is need to raise awareness among farmers about conservation agriculture as mitigation strategy against climate change
- Capacity building of farmers is necessary and in this regard, strong interaction of agronomy and agricultural extension is necessary to disseminate conservation agriculture properly and effectively
- Capacity building of institutes is also needed to work seriously for the climate change mitigation. In this regard, public sector should accomplish partnership with various agencies
- Pakistan has energetic youth and potential for development. So, especially in agricultural universities young agri. graduates should be trained and educated about climate change so that they may play their role in changing the attitude of farmers in surroundings.

REFERENCES

1. IPCC, 'Climate change 2007 - the physical science basis - contribution of Working Group I to the Fourth Assessment Report of the International Panel on Climate Change.' (Cambridge University Press: Cambridge) (2007c).
2. IPCC, 'Climate change 2007 - impacts, adaptation and vulnerability - contribution of Working Group II to the Fourth Assessment Report of the International Panel on Climate Change.' (Cambridge University Press: Cambridge) Climate change adaptation in Australian primary industries 41. (2007).
3. Howden SM, Soussana JF, Tubiello FN, Chhetri N, Dunlop M, Meinke HM. Adapting agriculture to climate change. *Proceedings of the National Academy of Sciences* **104**, pp. 19691-19696 (2007).
4. Hennessy K, Fitzharris B, Bates BC, Harvey N, Howden SM, Hughes LSJ, Warrick R. (2007), Australia and New Zealand. In 'Climate change 2007 - impacts, adaptation and vulnerability - contribution of Working Group II to the Fourth Assessment Report of the International Panel on Climate Change'. (Eds ML Parry, OF Canziani, JP Palutikof, PJ van der Linden, and CE Hanson) (Cambridge University Press: Cambridge) (2007).
5. Asharf, S. and M. Iftikhar. (2013). Mitigation and adaptation strategies for climate variability: a case study of cotton growers in the Punjab, Pakistan. *Int. J. Agri. Ext*. **01(01)**: pp. 30-35 (2013).
6. Ackerman, F. and Stanton, E.A. Climate Impacts on Agriculture: A Challenge to Complacency? Synapse Energy Economics, Cambridge, Massachusetts. (2012).
7. Roberts, F., Climate models predict hard times ahead for global food production. The carbon brief, Online available http://www.carbonbrief.org/blog/2013/08/climate-models-predict-hard-times-ahead-for-global-food-production/ (2013).
8. Calzadilla, A., K. Rehdanz, R. Betts, P. Falloon, A. Wiltshire and R. S. J. Tol. *Climate change impacts on global agriculture. Climatic Change: **120**:pp.357–374. DOI: 10.1007/s10584-013-0822-4* (2013).
9. Baker, C.J., K.E. Saxton, and W.R. Ritchie. No-tillage Seeding: Science and Practice. 2nd Edition. Oxford, UK: CAB International. (2002).
10. Sainju, U.M., W. F. Whitehead, B.P. Singh. Agricultural Management Practices to Sustain Crop Yields and Improve Soil and Environmental Qualities., *The Scientific World Journal*, **3**, pp. 768-789 (2003).
11. Hobbs, P.R., and R.K. Gupta. Problems and challenges of no-till farming for the rice-wheat systems of the Indo-Gangetic Plains in South Asia. In R. Lal, P. Hobbs, N. Uphoff, and D.O. Hansen (eds.), Sustainable Agriculture and the Rice-Wheat System. Columbus, Ohio, and New York, USA: Ohio State University and Marcel Dekker, Inc. Pp. 101-19. (2004).
12. Carpenter-Boggs, L., P.D. Stahl, M.J. Lindstrom, and T.E. Schuma-cher. Soil microbial properties under permanent grass, conventional tillage, and no-till management in South Dakota. *Soil Till. Res*. **71,** pp. 15-23 (2003).
13. Steinsiek, J.W., L.R. Oliver, and F. Collins. Allelopathic potential of wheat (Triticum aestivum) straw selected weed species. *Weed Science* **30**:pp. 495-97 (1989).
14. Jung, W.S., K.H.Kim, J.K. Ahn, S.J. Hahn, and I.M. Chung. Allelopathic Potential of rice (Oryza sativa L.) residues against Echinochloa crus-galli. *Crop Protection* **23**: pp. 211-18 (2004).
15. Kennedy, A.C. Soil microorganisms for weed management. Journal of Crop Production **2**: pp. 123-38 (1999).
16. Roldan, A., F. Caravaca, M.T. Hernandez, C. Garcia, C. Sanchez-Brito, M. Velasquez, M. Tiscareno. No-tillage crop residue additions, legume cover cropping effects on soil quality characteristics under maize in Patzcuaro watershed (Mexico). *Soil and Tillage Research* **72**: pp. 65-73 (2003).
17. Alvear, M., A. Rosas, J.L. Rouanet, and F. Borie. Effects of three soil tillage systems on some biological activities in an Ultisol from Southern Chile. *Soil and Tillage Research* **82**: pp. 195-202 (2005).
18. Riley, H.C.F., M.A. Bleken, S. Abrahams en, A.K. Bergjord , and A.K. Bakken. Effects of alternative till age systems on soil quality and yield of spring cereals on silty clay loam and sandy loam soils in cool, wet climate of central Norway. *Soil Tillage Research* **80**:pp. 79-93 (2005).
19. Diekow, J.,J. Mielniczuk, H. Knicker, C. Bayer, D.P. Dick, and I. Kogel-Knabner. Soil C and N stocks as affected by cropping systems and nitrogen fertilization in a southern Brazil Acrisol managed under no-tillage for 17 years. *Soil and Tillage Research* **81,** pp. 87-95 (2005).
20. Kendall , D.A., N.E. Chin, D.M. Glen, C.W. Wi ltshire, L. Winstone, and C. Tidboald. Effects of soil management on cereal pests and their natural enemies. In D.M. Glen, M.P. Greaves, and H.M. Anderson (eds.), Ecology and Integrated Farming Systems: Proceedings

of the 13th Long Ashton International Symposium. Chichester UK. NewYork: Wiley Press. Pp. 83-102 (1995).

21. Derpsch, R. Critical Steps in No-till Adoption. In: T. Goddard, M.A. Zoebisch, Y.T. Gan, W. Ellis, A. Watson and S. Sombatpanit (eds)No-Till Farming Systems. Special Publication No. 3 (pp. 479–495). .

Bangkok: World Association of Soil and Water Conservation (WASWC) (2008).

22. Pieri, C., Evers, G., Landers, J., O'Connell, P. and Terry, E. No-till farming for sustainable rural development. *Agriculture and Rural Development Working Paper*. *Washington*, DC: World Bank (2002