Emerging Technologies for Sustainable Farming

Harjinder Singh

Assistant professor (Department of Economics)

Gujranwala Guru Nanak Khalsa College

Ludhiana, Punjab, India

Abstract:

The main purpose of this paper is to study the current and future world agricultural scenario and discuss some of the emerging threats to world food production and how technologies can help in farming getting sustainable. In coming 50 years farming is likely to face multiple challenges in form of feeding the ever increasing population around the world, climatic changes affecting etc. To face such challenges farming needs to adopt new technologies which can lessen the use of inputs but at same time increase production of food grains. In the past agricultural output was increased with intensive cultivation, making more and more use of inputs like water, chemical fertilizers. Some of the new technologies like soil and Water sensors, Satellite imaging, vertical farming, Precision farming, use of drones, AI and Data analytics are revolutionizing farming sector.

Keywords: Agriculture, Policies, Data, Technologies, Sustainable,

INTRODUCTION:

The population of world is multiplying day by day but food grains production in many countries is already at optimum level. Many countries in Africa, Asia and other parts of the world are in danger of food crises. Wheat and rice is staple food crop in many countries and these two crops are consumed in large quantities in almost all the countries of the world. Most of the wheat is grown and supplied by Russia and its neighboring country like Ukraine. In Asia, India is biggest producer of wheat and rice but is importer of many crops such as oil seeds and many other food crops. Smaller countries like Israel are using very modern technology in agriculture and growing crops which earlier were unthinkable in countries in this region. In past 50 years to increase the production many countries including India began to use external inputs like inorganic fertilizers, intensive cultivation and growing crops in areas which are not suitable for particular area. In India northern state like Punjab and Haryana are facing water crises as result of using huge quantity of water to grow paddy. This has led to depletion of underground water table in these states. In 1960s the inputs methods resulted high yields per hectare production and productivity in most of the agriculturally rich states like Punjab, Haryana and utter Pradesh. In short span of time the production of grains especially Rice and wheat doubled. In later stages of history these areas faces the harmful consequences of land degradation, soil health problem, declining of ground water level and reduction in food quality Similarly , Many Countries in south America are growing Avocado and Pineapple which they export to North America and many countries of the Europe . A kilo Avocado needs 2000 liters of water. Avocados have a particularly high carbon footprint: two avocados were found to release 846.36g of CO_2 emissions in 2017. The food is produced in tropical climates, but eaten in a multitude of countries around the world. Pineapples need very large amounts of pesticides, about 20kg of active ingredient per hectare per cycle. The soil is sterilized; biodiversity is eliminated. Fourteen to 16 different types of treatment are typically needed, and many have to be applied several times. They use chemicals that are dangerous for the environment and human health. This paper examines the issues which is important to current state of agriculture and suggest some of the new technologies adopted by many countries around the world. The world is already on the verge of facing severe crises regarding food which can affect many countries around the world. With adoption of new technologies such as drip irrigation, new and improved seeds, better forecasting of climate, effective price prediction and Use of satellites and drones, Data analysis can revolutionize the food production. Sustainable development goals are part of the important agenda of every country and sustainable agriculture too can be helpful with use of new and improved technologies used in agriculture. Sustainable agriculture offers many benefits. In particular, the food can be healthier because smaller amount of pesticides and fertilizers are used, no hormones are used to raise the animals, and, since the food is grown in the vicinity, it can be delivered to the end user fresher. Sustainable agriculture can also help to save from harm and preserve the environment by helping to conserve topsoil, improve water quality, protect local biodiversity, and trim down waste. Last but not least, sustainable agriculture can potentially help enhance quality of life as it provides customers wider access to better turn out, and can help to make possible the economic viability of family farms.

Methodology

Methodology plays a vital role in the representation and expression of factual knowledge in a systematic and synthesized manner. Discipline is synthesis not by its subject matter but by its methodology is a key to re presentation, expression and analysis of the field work. The data for this study is based on secondary sources. The data has been collected from books, both published and unpublished research article, journals. The present study is analytical in nature.

The development of new technologies must be a two-way process: some technologies may develop from the bottom up, and others will be the product of cutting-edge scientific knowledge. The scientific establishment has to recognize this complementarity and

develop mechanisms to incorporate local and indigenous knowledge into scientific knowledge. The recognition and incorporation of indigenous knowledge are especially important in the developing nations, where the development of new technologies relevant to farmers' needs is critical to achieve the increase in agricultural productivity necessary to maintain even a subsistence income for their rapidly growing populations. It is also in these countries that some of the richest sources of indigenous knowledge exist and the linkages between the scientific research establishment and local farmers have been weakest. A key challenge facing researchers, policy-makers, and local leaders is to devise strategies which would promote initiative and entrepreneurship among farmers to facilitate the bottom-up portion of the technology development process, as well as to encourage researchers to recognize and integrate local knowledge in their research agenda. Strategies which accomplish these goals will result in the development of superior technologies, technologies that more precisely target pests and diseases. The need for medicines and pest control agents in agriculture is not likely to disappear any time soon, however. Technological advances in the science of pest control are expected to continue to produce chemical control agents that over time are at least as effective in controlling pests as the ones they replace, but which are also less toxic, less persistent and less mobile through the soil. The greater application of monitoring and knowledge-based systems, aided by reductions in the costs of electronic sensors and computers, should also enable farmers to be more economical in their use of pest control agents, especially insecticides: applying them only when and where necessary, rather than according to predetermined dosages and schedules.

Technologies that administer nutrients more efficiently.

Farmers have traditionally relied on two main practices to supply nutrients to root zones: manuring and burning. Inorganic fertilizers allowed the separation of crop production from animal husbandry, restored fertility to depleted soils, and contributed to the development of livestock production based on grain and other feed ingredients. Research into the specific needs of particular crop-soil combinations and livestock have led over the years to more scientifically formulated fertilizers and feeds. Wider application of technologies that administer fertilizers only at the times and in the amounts needed can be expected to increase crop yields further while reducing leaching and runoff of nutrients

Technologies that disseminate knowledge.

Historically farmers relied on their own experience and that of their neighbors with regard to adopting “good farming practices”. Advice and information from publicly funded agencies and agro-food industries is increasingly focused on environmental effects. The Internet provides further developments in the dissemination of information on sustainable technologies.

Technologies that administer water more efficiently.

Many of the technologies still used for irrigating crops are as old as civilization itself. The problem — today just as in ancient Mesopotamia — is that conveying water through open channels and furrows is wasteful: much of the water evaporates before it reaches the root zone.

The type of policies that impact adoption of new technology for sustainable farming are:

Agricultural policies may include encouraging increasing output and adoption of new environmental friendly crops.

Trade policies related to marketing of crops and using technologies which may help in easing trade and better marketing.

Structural policies including scale, size of farm and specialization.

Research and Development policies which may include training, education and extension.

Much of the recent debate has been on the kind of incentives and disincentives that policies should give. For example, if it is not profitable for a farmer to adopt environmentally sustainable technology, should the government encourage farmers with financial incentives? This question can also been explored in the context where environmentally sustainable management practices contribute to positive externalities in agriculture (e.g. enhance biodiversity). These issues give rise to a whole new paradigm — including debates on the joint links between agricultural production and environmental outcomes and public good aspects of agriculture — in that technologies have to serve both for increasing the efficiency of production and the environmental performance.

Factors affecting the adoption of technologies:

Farmers will be encouraged to adopt appropriate technologies for sustainable farming systems if the dissemination of information is efficient. There is a paradox here one must bear in mind, however. On the one hand, experience in other sectors undergoing the transition to less polluting or more resource-conserving practices shows that it is inefficient for governments to be too prescriptive. Those environmental policies that set performance standards, as opposed to forcing the use of particular technologies, tend to encourage innovation of a sort that lowers the cost of achieving a given result. Yet when a really important, useful technology comes along there may be an interest in encouraging its quick adoption. At that point, it is too late to start educating the educators, the extension agents and others responsible for explaining to farmers the merits of the technology. The adoption process involves an interrelated series of personal, cultural, social and institutional factors, including the five stages of: awareness, further information

and knowledge, evaluation, trial, and adoption. Characteristics of a technology, such as simplicity, visibility of results, usefulness towards meeting an existing need and low capital investment promote its eventual adoption and should be considered when transferring any technology.

Sustainable land use Empirical studies on the impact of agricultural policies and structural adjustment on the sustainability of land use are not conclusive. Some authors argue that price reforms will encourage soil depletion, while others claim a positive effect on farmers' investment in soil conservation activities (Barrett, 1991, provides a summary of the arguments). These different opinions on the relationship between prices and soil degradation originate from differences with respect to the specification of discount rates and relative risk aversion. Moreover, market imperfections may hinder the transmission of higher output prices towards the farm household level. For a comprehensive analysis of the impact of changes in relative prices on agricultural resource allocation, four different potential response reactions can be distinguished:

(i) **Area expansion (extensification),** It can be increase in area under new crops that can bring more income to the farmers such as floriculture, fruits and oil seeds

(ii) **Increased input use (intensification),** It is known as increase in agricultural production per unit of input such as labor, time, cash, fertilizers and seed. Intensification when makes more efficient use of inputs is more critical when environmental problems or social issues are involved.

(iii) **Technological change (input substitution),** agriculture in many area around the world make more use of land to increase production but use of land even in most agricultural state in India i.e. Punjab is already at optimum level or smaller countries like Israel don't have enough land for agricultural . In this case more use of other factors is made instead of land to increase production.

(iv) **Crop choice adjustment (output substitution),** Climate changes is biggest emerging threat to agricultural in world and to fight with such factors it is required that correct Crop choice is cultivated .

A distinction should be made between adjustment of recurrent costs (productivity enhancing investment) and investment in fixed assets to prevent further soil deterioration (i.e. terraces, windshields, etc.). Supply response reactions to changing relative prices are usually analyzed from the perspective of substituting fertilizers for reduced availability of nutrients from natural sources due to soil loss. Alternative approaches treat natural soil fertility as a function of capital and/or labor investment in conservation measures. Both factors tend to be scarce, especially in African agriculture. Soil mining practices appear to be a recurrent phenomenon and promotion of sustainable land use requires complementary strategies for selective intensification and productivity-enhancing soil conservation measure.

Technologies:

Information and communications technologies for extension services ICTs can improve the quality, reach and efficiency of extension services. For example, a pilot trial of the Avaaj Otal mobile agricultural advisory services for Gujarat-based cotton farmers reduced distribution costs from $8.5 to $1.13 per farmer per month (UNCTAD, 2015). The potential benefits of ICTs do not necessarily.

Sharing plant genetic resources Public investment in breeding programmes and support for local seed systems that allow the diffusion of locally adapted genetic material, which farmers would have the right to freely save, exchange and market, is a good example of the need for public investment in research and technology diffusion .

Increase investments in agricultural R&D at the global and national levels National and global R&D for agricultural development can tangibly impact productivity and the quality of inputs. The constantly changing ecological, environmental, and biodiversity contexts requires continuous research and development to produce inputs and disseminate knowledge that maximizes agricultural yields while safeguarding the environment.

Conclusion:

Food insecurity is concerning many countries and regions around the world. Some of the most vulnerable countries are in Africa and South Asia. Large number of people in these countries are living below poverty line and at great risk to starvation. Many countries like India achieved self-sufficiency due to successful programmes like green revolution but that too to limited extent and limited crops. The diffusion of technology in agriculture can increase food grains production by limiting the wastage of precious inputs like water and application of costly fertilizers and pesticide. Mobile phone which has revolutionize the communication technology has great potential to be used as main tool in application of technology. Small-scale producers are using apps, text messages, and radios to access information and advice on a range of subjects including weather conditions, production practices, and input and sale prices. Innovative new uses of the technologies are emerging all the time, including apps that manage the sharing of farm machinery and transport, virtual marketplaces, and access to financial services. Other technological measures like use of IOT can help in automation of farm machinery which can save precious time and ensure efficient application of inputs. The target of feeding the world population of 9.1 billion by 2050 can be realized by making agriculture more technologically advanced and self-sustained.

References:

(1) Adhiguru P. and Devi, S.V. ICT in Indian Agriculture, Learnings and way ahead. Int. J. of Ext. Edu.; 2012; 8:1-4

(2) D. Ramesh and B. V. Vardhan, "Data Mining Techniques and Applications to Agricultural Yield Data," International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, no. 9, pp. 3477-3480, 2013.

(3) D. Tsiolias, et al., "Big Data and Agricultural Supply Chains: Opportunities for Increased Food Security," Proceedings of the Homburg International conference of Logistics (HICL), vol. 22, pp. 331-354, 2015.

(4) Feder G, Just RE and Zilberman D Adoption of agricultural innovations in developing countries: a survey. Economic Development and Cultural Change 33: 255–298, 1985

(5) Gebbers, R. and V.I. Adamchuk , Precision agriculture and food security. Science 327 pp. 828–830, 2010

(6) Hornborg, A. The power of the machine: Global inequalities of economy, technology, and environment. Walnut Creek, CA; Oxford: AltaMira Press, 2001

(7) K. M. Arjun, "Indian Agriculture- Status, Importance and Role in Indian Economy," International Journal of agriculture and Food Science Technology, vol. 4, no. 4, pp. 343-346, 2013.

(8) National Policy for Farmers, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India. P. 15. 2007

(9) Shalendra, K.C. Gummagolmath and Sharma P. ICT Initiatives in Indian Agriculture- An Overview, Ind. J. of Agri. Eco. 2011; *66 (3).*

(10) S. Pongnumkul, et al., "Applications of Smartphone-Based Sensors in Agriculture: A Systematic Review of Research," Journal of Sensors, vol. 2015, pp. 1-18, 2015.

(10) Y. Edan, et al., "Automation in Agriculture," Springer Handbook of Automation, pp. 1095- 1128, 2009.