Research Article
Open Access

Integration and commercialization of local varieties under sub-optimal environments for food security, promoting sustainable agriculture and agro-biodiversity conservation

Volume 3 Issue 2 - 2018

RP Singh
Directorate of Seed & Farms, Birsa Agricultural University, India
Correspondence: RP Singh, Directorate of Seed & Farms, Birsa Agricultural University, Kanke, Ranchi-834006, (Jharkhand). India, Email dsfbau@rediffmail.com

Received: October 27, 2017 | **Published:** March 15, 2018

Mini Review

Millennium Development Goals (MDGs) after attaining the success with respect to meet the targeted goals like to reduce extreme poverty, child mortality, hunger etc. in 2015, were replaced by the Sustainable Development Goals (SDGs) adopted at Global level. The objectives of very first goals of SDGs (1 & 2), to end poverty and hunger, achieve food security and improved nutrition, and promote sustainable agriculture signifies the critical role of enhancing adaptation to climate change. The Paris Agreement which has also been adopted in 2015 by 195 Nations underlines the links between safeguarding food security and ending hunger and the impacts of climate change. According to the Paris Climate Change Agreement even if the increase in temperature is restricted to less than 2^0C, adaptation support would be required for developing countries. To meet the ever increasing and diversified food demand, the production needs to be doubled from the available resources which are already under stress. Dry lands cover 40% of the world's land area spread in 55 countries, having 2.5 billion people out of which one third people depend on agriculture. Dry lands having 644 million people who are poorest of the poor with food insecurity, 27% children in sub Sahara Africa and 42% in dry land Asia are malnourished. Climate change could further increase 10% dry land area with the possibility that climatic zones could shift toward poles. More variability and occurrences of short periods of extreme stresses in the form of drought and heat being experienced during the crop growing season. Also, environmental degradation are widespread as many ecosystems may decline or fragment and individual species may become extinct. About 3.8 million km^2 and 790 million people in the world are highly exposed to at least two climate-related hazards, while about 0.5 million km^2 and 105 million people are exposed to three or more hazards. Climate change further increases the exposure to multiple hazards, affecting their magnitude, frequency and spatial distribution.[1] Moreover, Millennium Ecosystem Assessment (MEA) in 2005 assessed that out of the 24 ecosystem services, fifteen are considered to be seriously degraded. On a global scale, over 21% of the yield variability of maize, soybean, rice and wheat change could be explained by the change in variability of the agro-climatic index more specifically, the change in variability of temperatures exceeding the optimal range for yield formation was more important in explaining the yield variability change than other abiotic stresses, such as temperature below the optimal range for yield formation and soil water deficit.[2] Ecological foundation of sustainable agriculture are soil, water, biodiversity, and climate and all are interlinked. Moreover, due to mono-culturing for agricultural intensification, excessive mining of nutrients, declining water table, the soil became hungry as well as thirsty, water is contaminated, air is polluted and biodiversity loss is increasing at an alarming rate and thus jeopardized food security. Ecologists have shown that biodiversity loss results in lower plant productivity, while agricultural economists have linked biodiversity loss on farms with increasing variability of crop yields, and sometimes lower mean yields.[3] Biodiversity is widely understood to occur at genetic, population/species and community/ecosystem levels.

The risks in relation to biodiversity loss are

a) Food security risks (high variability in crop production)

b) Environmental and weather hazards (storms, floods, mudslides etc), and

c) Health risks (risk from infectious diseases, risk of illness due to lack of wild medicinal herbs etc),

d) Type of risk that is associated with degrading ecosystem resilience.[4]

Factors like bio-geophysical, geographical, topographical, irrigation facilities, timely availability of quality seed, inputs and credits, land holdings & farm size, nutritional contents including cooking qualities, economics of production, desirable varietal traits for food, feed and fodder values, tolerance to various abiotic and biotic stresses, and socio-economical condition of the farmers, medicinal & therapeutic uses and season etc determine the choice of a particular kind of variety (modern vs local varieties). The local varieties (LVs) adapted better under marginal and low input environments 'due to their inbuilt resilient mechanisms. Most literature on seed supply systems refers to seeds as either 'modern varieties' (MVs) or 'landraces'. 'Modern variety' is known as a variety that is improved by organized breeding programs and LVs popularly known as landraces, which have never been subjected to a formal plant breeding program. Food and Agriculture Organization of the United Nations defined a landrace as an early, cultivated form of a crop species, evolved from a wild population, and generally composed of a heterogeneous mixture of genotypes.[5] The adoption of MVs among eleven major food crops averaged across all crops increased rapidly during the two decades of the GR, and even more rapidly in the following decades, from 9% in 1970 to 29% in 1980, 46% in 1990 and 63% by 1998.[6] Initially they diffused through the environments best suited for their production, spreading later and unevenly into less favored areas. Landraces continue to be grown in the latter and in regions with lower population densities and limited market linkages.[7] being grown under harsh environmental conditions with low input management (subsistence agriculture), LVs are highly adapted, climate resilient and ever evolving under varied agro climatic conditions therefore dynamic in nature.

Their past contribution is enormous and future use can be enhanced through different three ways,

I. By providing novel gene(s) for enhancing nutrient use efficiency and improving the nutrition quality of staple grains and against various abiotic and biotic resistance/tolerance, for example gene for submergence tolerance in rice has been transferred from a farmer's variety into rice variety 'Swarna' which became megastar variety (Swarna sub-1) in eastern India, similarly Evenson and Gollin[8] reported that while a rice variety released in the 1960s had on an average three landraces in its pedigree, more recent releases have 25 or more, while in wheat the average number of distinct landraces found in bread wheat pedigrees grew from about 20 in the mid-1960s to about 50 in 19901960s,[9] thus breeding programs could alleviate some of the risk of loss in genetic diversity within improved varieties.[10] It could also lead to the incorporation of positive traits into new varieties or breeding populations for more sustainable agricultural production,[11] and therefore these landraces integrated well into formal breeding sector

II. Local crop genetic diversity still exists and in fact MVs have simply replaced landraces as the source of diversity, but have not abolished farmers' breeding. The reason for this development is that farmers often recognize the attractive features of modern varieties, including high yields and novel resistances, but also identify various characters that are not appreciated, especially regarding taste, processing qualities, and resilience under less optimal growing conditions,[12] and

III. While discussing the future of land races/traditional varieties, Pingali[6] stressed upon the coexistence of varieties and landraces of particularly crops may persist where market-based incentives exist. For example, in Asia, traditional varieties are generally of higher quality and fetch premium prices in the market. Basmati rice production has expanded significantly in India and Pakistan, both for domestic as well as export markets. Market based incentives could play a major role in reviving the prospects for under-utilized crops and ensuring there in situ conservation.[6]

Food security depends on the seed security and strong national seed systems are important for enhancing resiliency as seed security has several direct shocks and stress, and reorganize so as to maintain and strengthen seed security. The formal seed sector in any country just cater the need of intensive agriculture by producing and supplying quality seed of major crops and limited number of varieties and thus majority of small farmers in marginal environments still depend on farm saved seed(FSS) leaving a huge gap. The small farmers which constitute the backbone of agriculture in developing countries remain deprived of the quality seed ultimately led to poor yield causing food insecurity and vulnerability to climate change. LVs being climate resilient in addition of having other desirable attributes constitute a major portion of agro-biodiversity which is extremely important not only for adaptation and mitigation to climate change, for future use in crop improvement but also for food & nutritional security of the country. Therefore, their commercialization and integration through formal/semi formal seed sector is of paramount importance and for this the major bottlenecks are regulatory mechanism (registration and certification). Most of the LVs do not meet the eligibility requirements and face difficulty to clear distinctiveness, uniformity and stability (DUS) test and therefore marginalized. To take the full advantage of the rich genetic diversity in the form of LVs an alternative registration and certification system developed by the Food and Agriculture organization of the United Nations known as Quality Declared Seed (QDS) system is advocated to channelize and commercialize LVs using formal system. The QDS is an alternative way to reach small farmers who do not have access to, and so do not use, certified seed for crop production. The QDS system being semi formal and is less costly and less stringent as compared to conventional seed certification with the focus on local seed trade. The purpose of QDS is to offer an alternative, which can be used for those crops, areas and farming systems in which highly developed seed quality control activities are difficult to implement or make relatively little impact. QDS is a relatively open scheme, which meets the needs of farmers in a flexible way but without compromising basic standards of seed quality and therefore may contribute to the wider policy objective of diversifying the seed supply system so that farmers may have more choice. For this reason, the adoption of QDS as a means to improve seed quality in a wider range of genetic material is a positive contribution to maintain genetic diversity and strengthen seed security.

The integration of both formal and informal seed systems is also pre-requisite to compliment the strengths and weaknesses of formal and informal seed system in order to strengthen/improving the seed system's resiliency for adaptation and mitigation to climate change, ensuring food and nutritional security as well as agro-biodiversity conservation.

The types of varieties included under QDS system are

a) Varieties developed through conventional breeding methodologies.

b) Local varieties that have evolved over a period of time under the particular agro-ecological conditions of a defined area, and

c) Varieties developed through alternative plant breeding approaches such as participatory plant breeding.[13]

Moreover, QDS being less ambitious and more incremental can be adopted along with the seed system having stricter standards confirming DUS as preconditions for variety registration and a second tier that establishes a QDS system adopted by various countries. The United Nations Convention on Biological Diversity (CBD) adopted a decision in 2002 "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth." Specifically, the adoption of QDS would give practical effect to Article 5 (Conservation, Exploration, Collection, Characterization, Evaluation and Documentation of Plant Genetic Resources for Food and Agriculture) and Article 6 (Sustainable Use of Plant Genetic Resources) of the International Treaty on Plant

Genetic Resources for food and agriculture (ITPGRFA) and a number of Activities of the Global Plan of Action (GPA) for conservation and sustainable utilization of PGRFA, which deal with relationships amongst plant genetic resources, seed and sustainable agriculture.

Acknowledgement

None.

Conflict of interest

There is no conflict of interest.

References

1. IPCC. Climate change 2014: Impacts, adaptation, and vulnerability. Part B: Regional aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In: Barros VR, Field CB, Dokken DJ, editors. Cambridge, United Kingdom, and New York, NY, USA: Cambridge University Press; 2014:688.
2. Iizumi T, Ramankutty N. Changes in yield variability of major crops for 1981-2010 explained by climate change. *Environmental Research Letter*. 2016;(11):034003.
3. Lanz B, Dietz S, Swanson T. The expansion of modern agriculture and global biodiversity decline: an integrated assessment. *Ecological Economics*. 2018;(144):260–277.
4. Vira B, Kontoleon A. Dependence of the poor on biodiversity: which poor, what biodiversity? Paper prepared for the CPRC International Conference, USA; 2010.
5. FAO. Gene flow from GM to non-GM populations in the crop, forestry, animal and fishery sectors. USA; 2000.
6. Evenson RE, Gollin D. Assessing the Impact of the Green Revolution, 1960 to 2000. *Science*. 2003;(300):758–762.
7. Pingali P. The Green Revolution and Crop Diversity (Chapter 12). Handbook of Agricultural Biodiversity. In: Hunter D, Guarino L, Spillane C, editors, New York: Routledge, USA; 2017.
8. Evenson RE, Gollin D, Santaniello V. Introduction and overview: Agricultural values of plant genetic resources. In: Agricultural values of plant genetic resources. USA; 1998.
9. Smale M. The Green Revolution and wheat genetic diversity: dome unfounded assumptions. *World Development*, 1997;25(8):1257–1269.
10. Smith S, Bubeck D, Nelson B, et al. Genetic diversity and modern plant breeding. In: Ahuja RM, Jain, editors. Genetic Diversity and Erosion in Plants: Indicators and Prevention. *Springer International Publishing*; 2015;55–88.
11. Newton AC, Akar T, Baresel JP, et al. Cereal landraces for sustainable agriculture. A review. *Agronomy for Sustainable Development*. 2010;30(2):237–269.
12. Salazar R, Louwaars NP, Visser B. Protecting Farmers New Varieties: New Approaches to Rights on Collective Innovations in Plant Genetic Resources. World Development. 2007;35(9):1515–1528.
13. FAO. Quality Declared Seed System. FAO Plan Production and Protection Paper 185. Rome; 2006.