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Review Article

Role of Agricultural Biodiversity in Sustainable Food and Nutrition Security

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Abstract

Agricultural biodiversity results from the interaction between the genetic resources environment and the management systems and practices including multiple cropping and mixed cropping adopted by farming community and are considered much vital for nutrition security. It includes the variety and variability of plants, animals and microorganisms which are necessary to sustain key functions of agro-ecosystems responsible for food production. Diversity of genetic resources can increase farm productivity, maintain and increase soil fertility and check or minimize the adverse effect of pests and diseases. It can also provide farmers with expanded gene pool out of which they could select adaptable populations for changed climatic conditions. Similarly, diversity of diet pattern of people based on different farming systems would be helpful in providing them nutrition security by making available all the essential nutrients in adequate quantities. Moreover, it broadens the composition of diet including major nutrients, micronutrients, vitamins, fiber and minerals essential to keep us healthy. However, agricultural biodiversity and the diverse food production systems are being adversely affected due to disappearance or decline of harvested and unharvested species, varieties, animals and fish breeds. Thus, there appears an urgent need to manipulate and adopt agro-ecosystems which could conserve the biodiversity to the desired extent and at the same time improve sustainable food and nutrition security.

Keywords: Agricultural Biodiversity; Agro-Ecosystems; Sustainability; Nutritional Security

Introduction

The variety of life on earth and its biological diversity is commonly referred to as biodiversity. The number of plants, animals and microorganisms, the enormous diversity of genes in these species, the different ecosystems in the planet such as deserts, rainforests and coral reefs are all part of a biologically diverse Earth. Biodiversity and agriculture are very much related and can benefit greatly from each other.

Agricultural biodiversity commonly called agro-biodiversity encompasses the variety and variability of cultivated plants, animals and microorganisms which are necessary to sustain key functions of the agro-ecosystem, its structure and processes production and food security [1]. It further comprises genetic, population, species, community, ecosystem and landscape components and human interaction with all these. Aquatic diversity is also an important component of agricultural biodiversity. The conservation and sustainable use of local aquatic eco-systems, ponds, rivers, coastal commons by fish folk and small holding farmers is important to the survival of both humans and the environment. The agro-ecosystems with are used for agriculture are determined by three sets of factors

- The genetic resources
- The physical environment
- The human management practices

Most agro ecosystem have been to some extent modified or cultivated by human activity for the production of food and income.

Crop biodiversity and production stability

More diverse ecosystems, with more species or more genetic diversity within species, often have higher overall crop productivity than simpler systems. Multiple cropping can take many different forms and undoubtedly provides benefits in terms of nutrient availability and pest control in order to give a higher production. In Latin America, yield advantage of multispecies cropping ranged from 20% to 60% [2]. In Mexico, one hectare mixture of maize, beans and squash produced as much food as against 1.73 ha of land by growing maize alone. This has been possible due to presence of leguminous crop, reduced attack of pests, diseases and weeds and more efficient use of natural resources [3]. Similar results have been found in China by Zhang and Li in 2003 who reported that one- third of all the cultivated land is used for multiple cropping that produce half of the cereal yield [4]. Abiotic stress can also be alleviated by intercropping. They also showed a 74% and 53% increase in wheat yield with corn and soybeans, respectively. The latter reduces nitrate accumulation in the soil, which reduces application rates and nitrogen loss. On the other hand, genetic diversity also acts within a crop species to boost productivity. It can also reduce risk of crop failure in high stress environments. Studies have suggested that needs and yield stability are some of the reasons why many small farmers continue to grow traditional crop varieties and maintain high levels of genetic and crop diversity throughout the world.

Pest and diseases control through biodiversity

In simpler agricultural systems enhanced resistance to outbreaks of pests and diseases from effective use of both inter and intra-specific diversity provide the main mechanism for increased yield and yield stability. Growing of barley mixtures in eastern Germany and rice mixtures in south-west China have indicated that mixtures with relatively few components which can minimize the severity of disease with impact on yield and yield stability [5,6]. As regards pest control, now a days intergrated pest management (IPM) is advocated in which biodiversity plays an important role. There are reports that 62 IPM projects in 21 developing countries were examined and it was found that in 47 projects, yield increased by 42% while pesticide use declined by 71% [7].

Regulation and ecosystem services support for biodiversity

Agricultural production is governed by a range of regulating and supporting ecosystem services such as nutrient cycling, regulation of water flow and storage, regulation of soil properties and biological populations including pest and disease control. Actually there are multiple ecosystem functions, each of which behave optimally with different species. In this regard maintenance of total system diversity and the use of management practices such as conservation agriculture and mulching results into higher diversity in the production system. In this connection a small column titled 'The next green revolution' which appeared in Times of India dated October 25, 2014 being an example of agro-ecological system diversity may be quoted. It reported that the salination of the water table is one of the biggest reasons behind declining crop yields. But in a remarkable new development, a team of Dutchmen has been watering a potato farm successfully with sea water. Now, several tonnes of these potatoes are making their way to Pakistan to see if they can thrive in sea-water encroached soil. It the experiments work and potatoes adopt to Asian climate, it could transform the lives of not only small farmers in Pakistan and Bangladesh, where flood and sea water intrusion wipe out crops with increasing regularity but also worldwide the 250 million people who live on salt affected soil.

Better nutrition and health through biodiversity

Inspite of our best efforts to combat protein calorie malnutrition, around one billion people in the world still face starvation and one third of the global population suffers one on more of the micronutrient deficiencies, the most important micronutrients being vitamin A, iodine and iron. However, adequate supply of all the nutrients are needed for nutrition security. As regards the estimates of extent of hunger and malnutrition, a joint report on the state of Food Insecurity in the world 2010 from FAO and World Food program says that 925 million people suffer from chronic hunger. Moreover, more overweight and obese than chronically hungry people are there even in developing countries [8]. Fortification and biofortification have been tried to improve the nutrient content of foods. However, agricultural biodiversity appears to be alternate approach. It seeks to broaden the composition of diet to include greater diversity since it provides other nutrients also including fibre besides micronutrients and hence ensuring better health. The results on the beneficial effects of dietary diversity from 11 developing countries indicated strong relationship between dietary diversity and child development. Dietary diversity reduces stunting and malnutrition in children [9]. It has been found that addition of small amounts of animal derived foods in the diet of children

results in marked improvement in nutritional status [10]. In India, the use of minor millets among very poors farmers have shown multiple beneficial impacts on yield, income, profits, the nutritional value of popular snack and breakfast foods and women empowerment, all promoting the cultivation of these crops and their biological diversity on farmer's fields ultimately boosting food and nutrition security.

Losses of agricultural biodiversity

Agricultural Biodiversity is suffering losses due to the fact that more than 90% of crop varieties have disappear from farmer's fields. Half of the breed of domestic animal have been lost and is fisheries, world's many fishing ground are now being fished above their sustainable limits. Many fish population are thus becoming extinct. Loss of forest cover, coastal wetlands and other wild uncultivated areas and destruction of aquatic environment form other losses of agricultural biodiversity [11].

Reasons for the loss of agricultural biodiversity

The important reasons for the loss of agricultural biodiversity include the cultivation of relatively few crop varieties singly and rear a limited number of domestic animal breeds and fish species for more competitive global market. Genetic erosion or loss of genetic diversity including the loss of individual genes and the loss of particular gene complexes such as those manifested in locally adopted landraces, the variety replacement of local varieties or land by improved or exotic varieties and species is reported to be the major cause of genetic erosion in the world. 1950 statistical data show that local varieties accounted for 81% of production, locally produced improved varieties upto 15% and introduced varieties 4%. By 1970s, these figures changed drastically, local varieties only 5%, locally produced improved varieties 91% of production and introduced varieties 4% [12,13].

Measures to enhance agricultural biodiversity

The measures which should be adopted to protect the loss of agricultural biodiversity and at the same time enhance the same include

- Strengthening sustainability in production systems at all levels and improving the conservarion, sustainable use and enhancement of all genetic resources including cultivation of more number of local crop species, rear more number of domestic animals and more number of fish species.
- Improving diversity of agro ecosystems such as landscape and wildlife protection, soil protection and health including fertility, structure and function. Water cycle and water quality, air quality etc.
- Identification and protection of small-scale diverse food production systems which could conserve farmer's varieties of crops and breeds of domestic animals.
- Providing farmers with genepool of traditional crop varieties for selecting suitable ones for varied climatic conditions.
- The composition of diets should be broadened thereby enhancing the dietary diversity providing more food and nutrition security to population.

So, these are the few measures which could be adopted to conserve agricultural biodiversity and provide more food and nutrition security.

Conclusion

Agricultural biodiversity or agro- biodiversity includes variability of plants, animals and microorganisms which are essential to sustain key functions of the agro-ecosystems for support of food production and nutrition security. More diverse ecosystems with more genetic diversity often have higher crop productivity than simpler systems. Multiple cropping provides benefits in terms of nutrient availability and pest control giving higher production. Use of both inter and intra- specific diversity provides the main mechanism for increased yield and yield stability. Maintenance of total system diversity and use of management practices such as conservation agriculture and mulching results into higher diversity in the production system. As regards nutritional security, adequate supply of all the nutrients including vitamin A and desired micronutrients such as iodine and iron are needed. Agricultural biodiversity could be alternative approach which seeks to broaden the composition of diet to include greater diversity. There is observed losses of agricultural biodiversity also because of our declining diverse production systems. The main reason for the loss of agricultural biodiversity include the cultivation of relatively few crop varieties and rearing a limited number of domestic animal breeds and fish species. Certain measures need be adopted to enhance agricultural biodiversity. The important ones include strengthening sustainability in production system at all levels; conservation and enhancement of biological resources, improving diversity of agro-ecosystems; providing farmers with gene pool of traditional crop

varieties and broadening the composition of diets. These measures are most likely to provide food and nutritional security to population.

Bibliography

1. Agricultural Biodiversity: FAO Multifunctional Character of Agriculture and Land: Conference Background Paper No. 1, Maastricht (1999).

2. Altieri MA. "Applying agroecology to enhance the productivity of peasant farming systems in Latin America". *Environment, Development and Sustainability* 1 (1999): 197-217.

3. Vandermeer JH. "Intercropping". In *Agroecology* (Carrol CP, Vandermmer JH and Rosset PM, Editors) Mc Graw-Hill, New york USA (1990): 481-516.

4. Zhong F and Li L. "Using competitive and facilitative interactions in intercropping systems enhances crop productivity and nutrient- use efficiency". *Plant Soil* 248 (2003): 305- 312.

5. Wolfe M., *et al.* "The use of cultivar mixtures for disease control". In *Strategies for the Control of Cereal Disease* (Jenkyn JF and Plumbrt, Editors) Blackwell scientific publications, Oxford UK (1981): 73-80.

6. Zhu Y., *et al.* "Genetic diversity and disease control in rice". *Nature* 406 (2000): 718-722.

7. Pretty JN., *et al.* "Resource- conserving agriculture increases yields in developing countries". *Environmental Science and Technology* 40 (2006): 1114- 1119.

8. Gardner GT and Halweil B. "Unfed and Overfed". The Global Epidemic of Malnutrition, World wateh Institute, Washington D C, USA (2000).

9. Arimond M and Ruel MT. "Dietary diversity is associated with child nutritional status: Evidence from 11 demografic and health surveys". *The Journal of Nutrition* 134 (2004): 2579-2585.

10. Neumann C., *et al.* "Contribution of animal source foods in improving diet quality and function in children in the developing world". *Nutrition Research* 22 (2002): 193-220.

11. Agricultural Biodiversity. "FAO multifunctional character of agriculture and land: Conference background paper no.1 Maastrichet (1999).

12. FAO State of the World's Plant Genetic Resources for Food and Agriculture Prepared for the Leipzig Conference (1996).

13. "Sustainable Agricultural Biodiversity and Agri-ecosystem Functions". opportunities, incentives and approaches for the conservation and sustainable use of agricultural biodiversity. Report of the FAO/CBD Agricultural Biodiversity Workshop, 2-4 December, Rome (1998).