

Diversification: A Potential Options for Enhancing Economic Viability and ecological Sustainability in Agricultural Production Systems

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Abstract: Diversification in different agricultural production system is achieving great importance due to its capacity to address the climate change related concerns, food and nutritional security related issues as well as health of natural resources such as soil, plant and water. The diversification is also helps in addressing the insect-pest and disease incidences to certain extent there by reducing the dependence on curative methods. Hence overview of diversification for its capability in achieving the economics and ecological goal in broad sense has carry scientific and policy importance. The present overview indicates the major advances in agricultural production system followed by different variant of diversifications in agricultural production system. The diversification of cereal based production system, inclusion of different production system such as organic farming and natural farming, changes in crop establishment and cultivation methods and inclusion of pulses and oilseeds are highlighted at different research forum; while inclusion of break or catch crop or forage crops for enhancing the soil health and exploring vegetables and medicinal and aromatic plants for diversification enhances economic gain out of diversification. The different components of vertical diversification such as agro-tourism, processing and value addition and energy harvesting through solar panels add both ecological and economical edge over the commercial monoculture.

Keywords: Horizontal diversification, vertical diversification, oilseed and pulses, medicinal and aromatic plants, organic farming, natural farming.

INTRODUCTION

In India, the shift from food security to economical, nutritional and ecological security is occurred and occurring. The major precursor for this shift includes significant increase in production of provisional services from agro-ecosystem, changes in demography, increase in awareness and demand for nutritious and safe food, development and adoption of environmental responsive practices and desire to excel on economic front. The growth in agriculture and allied sectors are described in terms of economic and ecological aspect at regional and global scale; hence development and utilization of resources and practices addressing both economical and ecological

goal are top most agenda for development. The recent practices in agriculture and allied sector to achieve this goals are A) development of tailor made fertilizers (nano-fertilizers and coated fertilizers), B) promotion and use of enriched organic manure and biodynamic formulation through natural and organic farming, C) exploring root rhizosphere for development of consortia based biofertilizers, D) shifting crop cultivation zones, F) development and use of mitigation and adaptation strategy for addressing climate change, G) Soil health management practices, H) development of new varieties and plant types such as genetically modified crops, hybrid and high yielding varieties, I) Changing crop cultivation practices such as system of rice

intensification, system of crop intensification and different crop establishment methods, hydroponics, aeroponics, farming system based approach, etc.) J) Identification and use of resource conservation technology in different production system, K) diversification of cropping and / or farming system, L) Development of intensive and energy efficient farming system, M) promotion of entrepreneurship development in different farming activities and allied enterprises, N) Development of low dose agrochemicals for stress management in agriculture, O) Identification and promotion of Indigenous Technical Knowledge, P) Identification and promotion of traditional underutilized crops and their wild relatives, Q) Increase in use of crops biomass in bioenergy production, R) Maximize rainwater harvesting and efficient use of irrigation water, S) energy plantation as well as energy harvesting in barren land through solar panels, T) Alternate agriculture (agroforestry), U) Increase in emphasis on cultivation of medicinal and aromatic plants, V) Policy and institutional support for promotion of post harvest processing and value addition of different agricultural commodity, W) Ecological quantification of production systems, X) Incorporation of precision agriculture principles in different production system, Y) changes in sociological dimensions in production system such as co-operative and corporate farming, farmer producer organization, etc. and Z) large scale acceptance of integrated management system for nutrient, insect-pest disease and weed management.

HORIZONTAL AND VERTICAL DIVERSIFICATION

Among these options use of diversification play an important role considering its potential in achieving economic security, nutritional security, energy security and environmental responsiveness. The diversification can be achieved changing the crops or cropping system, crop cultivation methods or crop establishment methods, one or more crop cultivation practice which is categories as horizontal diversification (Kalaiselvi, 2012; Shahane and Shivay, 2019). The another form of diversification,

vertical diversification is achieved through value addition and processing, addition of entrepreneurship in input production and output processing/ marketing and incorporation of non-conventional options for value addition (agro-tourism, energy harvesting through solar panels, etc.). The diversion of conventional agrochemical based modern production system through natural farming organic farming and different forms of conservation agriculture (such as zero tillage, minimum tillage, etc.) as well as incorporation of different resource conservation technologies in different production systems are more recent options emphasized for diversification.

Diversification of intensive cereals based cropping system are discussed and emphasized most both at research and policy focus due to adverse effect of these cropping system on the natural resources, concerns of pollution and contribution to climate change from such cropping system, changes in the insect-pest and disease scenarios over the years increased need of government support (through subsidies on inputs, interventions of reducing the cost of cultivation and intensive on and above the minimum support price), increase prices of purchased inputs, as well as reducing income per unit area. The rice- wheat cropping system, rice-rice cropping system, sugarcane based cropping system as well as tobacco based cropping system are the major cropping system considered for implementation of diversification programme in India in last decade; while increase emphasis on the natural farming, promotion of organic farming, increase in diet provide other options. Increasing the opportunities for diversification of cereal dominated cropping system through pulses and oilseed cultivation are born out of low production and high market demand, higher prices to pulses and oilseeds, availability of high yield varieties in oilseed such as soybean and mustard, adoption to water stress situation and low fertility requirements. The crops such as sunflower (Reddy and Suresh, 2008; Chauhan are the successful example of diversification of cropping system.

Diversification of cropping systems can be also achieved through incorporation of

concepts such as seed village concept, in-situ conservation of genetic resources, cultivation of exotic vegetables for export, incorporating the polyhouse and shadenets based cultivation of crops/ vegetables during off-season to harvest maximum returns, cultivation of flowers and establishments of nurseries of ornamentals plants in peri-urban area as well as nurseries of vegetables and fruit plants in intensively irrigated area. Diversification can be achieved through farming system approach rather than following cropping system involving few crops. This can be achieved through incorporating the multiple enterprises which are complimentary or supplementary to main crop based enterprises. At the same time, farming system approach provide the opportunities for enhancing the resources recycling and multiple uses of resources and input producing thereby reducing the dependence on purchased inputs. Enhancing the diversification cropping system by introduction of fodder/ forage crop as break crops helps in achieving the several objectives such as reducing crop bounded and crop associated weed, breaking the cycles of insect-pest and disease causing pathogen, increase the opportunity for inclusion of animal based enterprises in the farming system, enriching soil with organic matter thereby enriching the soil fertility and reduce the burden of purchased input. The fodder obtained from Lucerne (*Medicago sativa*), berseem (*Trifolium alexandrinum*), Oat (*Avena sativa*), pearl millet (*Pennisetum glaucum*) and Sorghum (*Sorghum bicolor*) are nutritious and fetch high prices in market due to increase in animal based enterprises in India to meet the growing need of Indian population.

OPTIONS FOR DIVERSIFICATION THROUGH HORTICULTURAL CROPS AND MARKET CHAIN

The diversified forms of the vegetable cultivations such as Kitchen garden, terrace garden, nutritional garden and vertical garden are the potential options to achieve the nutritional security of farm family and income security through reducing cost on purchase of vegetables. At the same time use of traditional vegetable such as different beans (Indian

bean (*Lablab purpureus*), sword bean (*Canavalia gladiata*)), drumstick (*Moringa oleifera*) and grain Amaranthus also helps in diversifying the vegetable cultivations. The cultivation of fruits on farm bund and in backyard garden, promotion of improved early fruiting varieties of mango (Amrapali), banana (grand nain variety), papaya (*Carica papaya*), Guava (*Psidium guajava*), etc. and growing of fruits plants such as ber (*Ziziphus mauritiana*), wood apple (*Limonia acidissima*) and Java plum (*Syzygium cumini*) bring the diversification in agriculture. The medicinal and aromatic plants (MAPs) are the important part of the diversification considering their wider adaptability, high market demand, premier prices and capacity to grow with less resources in dryland and as well as hilly area and marginal lands. Some of the important MAPs are Ghiukumari (*Aloe barbadensis*), Tulasi (*Ocimum sanctum*), Mentha (*Mentha sp.*) and Ashwagandha (*Withania somnifera*). The diversification of farm produce supply chain through different options helps in increasing the farmer share in consumer money. The options for such diversification includes reducing the chain length, organization of farmers-consumer markets, sale of farm produce through self help groups of farmers or village woman groups, small scale processing rather than selling unprocessed farm produce directly to consumers, purchase of farm inputs for entire group of farmers in adhoc mode, increasing the entrepreneurship attitude among the farmers, encouraging the input production in the farm itself and regulation of sale-purchase of farm produce in perfect market with active participation of farmer representative.

CONCLUSION

Therefore the diversification helps in mimic the natural ecosystem due to inclusion of different crops and related enterprises which leads to more sustainable as well as climate resilient system. The diversification of major cereal or commercial crop based production system helps in reducing the burden of natural resources; while diversification of small and marginal farm in farming system mode helps in achieving the nutritional and income security of farm families as a whole. At the same time, vertical diversification

through value addition and processing helps in achieving the self sufficiency and helps to reduce the dependence of farm on processing units. The diversification of cooperative sector through farmer producer organization is helps in bringing more transparency and increase the farmers share in consumer money.

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