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Development of Horticulture Based Cropping Systems for Livelihood Security of Small and Marginal Farmers

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SUMMARY

Today horticulture involves intensive culture of fruits, vegetables, ornamentals, herbs and other high value speciality crops but fails to optimize farmer's benefit. Intensive horticultural systems are often based on optimising the productivity of monocultures. In those systems, crop diversity is reduced to one or very few species that are generally genetically homogeneous, the planting layout is uniform and symmetrical, external inputs are often supplied in large quantities and such systems are widely criticised today for their negative environmental impacts. In multispecies cropping systems in the same piece of land in a right sequence by optimally maintaining the space and time may often be considered as a practical application of ecological principles based on biodiversity, plant interactions and other natural regulation mechanisms thereby proves their superiority in all-round benefit of farmer as well as the environment. Thus, this article addresses those questions, reviews concepts suitable for use in dealing with multispecies systems in horticulture based cropping systems to popularize it as an income doubling approach from same piece of land in a sustainable manner.

INTRODUCTION

Nowadays horticulture involves intensive cultivation of fruits, vegetables, ornamentals, herbs and other high value speciality crops. This has possible because of the diverse agro-climatic condition, enormous biodiversity, and wide variation in soil fertility, large cultivable land area in the geographical boundary of India. Horticulture crops as components of farming system play significant roles in the livelihood of farm families in terms of nutrition, employment and income security. When farmers integrate allied enterprises rationally, the synergistic interactions of them have a greater effect from the same size of land. The role and nature of involvement of component enterprises including horticulture crops within farming systems assume greater importance in spearheading the agricultural growth and income of individual farm families (Swaminathan, 2005). Horticultural crops are known individually to contribute food, nutrition, income and employment from a small piece of land for small farmers (Ponnusamy *et al*., 2011). Its effect is phenomenal when it is understood from cropping system and farming system perspectives. So, in the present context to meet the rising demand of increasing population with ever-decreasing cultivable land, along with detrimental effect of global warming and polluted environment it is utmost important to grow more quality food with the implementation of precession horticulture utilizing eco-friendly inputs. The present study was conducted to understand the contribution of horticulture based farming system in providing the sustainable livelihood and influencing techno-socio-economic characteristics of farm families.

Diversification of present cropping pattern coupled with development of suitable technology packages is the need of the day to cope with the ever-increasing demand for diversified products and assured income. In recent years, Agri-Horticulture systems (i.e. integration of fruit trees with the agricultural crops) are recognized as an important agroforestry system for improving the productivity, reducing the risk in agriculture with additional employment and sustainable use of resources (Mirjha and Rana, 2016).

Need of multispecies systems in Horticulture

Seventy per cent of the world small farms are in China and India. This two countries account for 193 (47 %) and 93 million (23 %) small farms out of 404 million small farms in the world. Small farms are more diversified in nature. Out of 92 million farm households falling under marginal farm category having < 1 ha as operational holding size, 70 % of the farmers are having the area of below 0.50 ha. As per estimates, in India, more than 95 % holdings will be under the category of small and marginal holders by 2050 (Nimbolkar *et al.*,

2016). In future, the availability of land for cultivation will be a major impendent due to rapid urbanization, hydroelectric projects, dams and rivers, highway roads and also there is a degradation of fertile land due to soil erosion (120.72 million ha), soil salinity and water logging (about 8.4 million ha) (Hegde *et al*., 2015). Horticulture based farming systems may often be considered as a practical application of ecological principles based on biodiversity, plant interactions and other natural regulatory mechanisms (Sau *et al*., 2017).

Crop diversification is the desired strategy for agricultural growth in any farming community. Sustainable horticulture seeks to at least use nature as the model for designing agricultural systems. Horticulture items like fruit and vegetables are play a key role in these efforts, particularly for smallholder farmers, as average farm size has declined over time and higher returns per hectare are needed to improve the living standards of a growing population.

Feasibility of Space and Time Utilization with Horticultural Crops

Horticultural crops especially fruits and plantation crops are perennial in nature and long pre-bearing period (Mango, Coconut, Areca nut, Cashew). Crops have wider spacing and are tall growing eg: Coconut (7.5 × 7.5m, 15-20m ht.), Areca nut (2.7 × 2.7m, 15-20m height), Oil palm (9 × 9m, 10-15m height). Canopy cover is very slow, took years together and more than 60-70% inter space is not effectively utilized (Mango, Sapota, Coconut, Areca nut). Crop geometry and rooting pattern among perennials and annual crops could be compatible without any adverse effect on main crops (Arecanut, Cocoa, Banana, Ginger, Turmeric and Pineapple). Some crops are shade loving and tolerance to dripping of rain drops and high humidity (Banana, Cocoa, Turmeric, Ginger, Pineapple and Pepper). There are a good number of horticultural crops which are the good source of bio-mass and by-products which are easily recyclable and decomposable (Cocoa, Coconut, Areca nut, Cashew, Tree spices, Turmeric, Ginger, Mango and Guava). Many crops encompass different harvesting time and period which facilitates for sustainable income (Banana, Cocoa, Coconut, Arecanut, Pineapple, Ginger and Turmeric). Suitability or tolerance to prevailing micro–climatic condition (Black pepper, Cocoa, Pineapple, Tree spices, Heliconia, Marigold, Jasmine (Hegde *et al*., 2015).

Advantages of the Space and time Utilization Approach

Mixing species can influence product quality, although different processes may interfere. In coffee (*Coffea arabica* L.) based agroforestry systems in Central America, shade due to timber or shade trees promotes slower and more balanced filling and uniform ripening of berries, thus yielding a better-quality product than a monoculture of un-shaded plants (Muschler, 2001). Nutrient use efficiency of the individual crops in an intercrop is mostly lower than their respective sole crops. However, the cumulative nutrient use efficiency of an intercropping system was in most cases higher than either of the sole crops (Chowdhury and Rosario, 1994). Multispecies systems may increase soil cover, root presence in the topsoil and obstacles to run-off on the soil surface, hence decreasing soil erosion, having a positive impact, on a watershed scale, on the water quality of rivers, and on the intensity of floods (Swift *et al.,* 2004) Multispecies systems can sequester carbon over pure crop stands. There is reduction of insect/mite pest populations due to the diversity of crops grown and reduction of plant diseases because the distance between plants of the same species is increased due to the planting of other crops between them, alteration of more beneficial insects especially when flowering crops are included in the cropping system, increase of total farm production and profitability and reduction of weed population through allelopathy and efficient crop production (Magaguda *et al.,* 1979).

Gomez-Rodriguez *et al.* (2003) reported that intercropping with marigold as a trap crop induced a significant reduction in tomato early blight caused by *Alternaria solani.* Beside these advantages, this multi-cropping system also beneficial for providing partial guaranty against market glut of single commodity; growing crop according to market demand; maintaining an ecological balance, creating several secondary outputs from the system, and generating higher income per unit area with ensuring food, nutrition, and income security to the farmers (Chundawat, 2014) and regular employment also (Thomas *et al.,* 2011).

Examples of some successful multi-cropping models in horticulture based cropping systems are summarized in Table1.

Table 1: Successful model of multi-cropping approach in horticulture based cropping systems

Cropping system/sequence	Place of report	Remarkable outcome of the system	Reference
Coconut + Cocoa + Banana + Moringa + Pineapple	AICRP, Aliyarnagar	This cropping system with 75 % NPK + organic recycling with vermicompost recorded highest nut yield of 182 per palm and highest net income (Rs. 3.80 lakhs per ha) and B:C ratio (2.71).	Nimbolkar *et al.*, (2016)
Coconut + cocoa + lime + banana + drumstick	AICRP, Arasikere	With all physical and chemical quality of coconut, this system recorded net income of Rs. 2, 94,810 per hectare compared to mono crop (Rs. 68,200/ha).	Roy *et al* (2001)
In an area of 1 ha 150 coconut (7.5 X 7.5 m) + black pepper (1.25 m away from coconut base –150 vines) + cocoa (2.5 m between 2 rows of coconut – 525 plants) + pineapple (1-2 m in the rows, two rows of pineapple-4900 plants)	Coastal region of southern state of India	This model recorded higher yield of coconut (20%) and net returns compared to mono cropping of coconut, besides enhancing soil fertility due to recycling of byproducts.	Khan and Krishnakumar (2002)
Mango+ cowpea+ Indian mustard	Todapur Research Orchard of Horticulture Division, IARI, New Delhi	This system recorded significantly highest values of system productivity, gross returns, net returns and benefit: cost ratio during both the crop seasons	Mirjha and Rana (2016)
Mango + Phaseolus acutifolius cv, "Frijol Escumite" + Cajanus cajan (Pigeon Pea)	Mango orchards in the Soconusco, Chiapas, Mexico	The biomass of Cajanus cajan and Phaseolus acutifolius (Frijol Escumite) and their incorporation to the ecosystem produced positive effects on the quality and yield of mango. Likewise the intercropping of mango with Cajanus cajan or Phaseolus vulgaris influences the insect diversity in these systems.	Agreda *et al.* (2006)
Mango+ mandarin / Egyptian clover + date palm	Madhya Pradesh	These systems could be used for the higher net return per unit area and also to combat desertification in sandy soil in arid lands regions.	Abouziena *et al.* (2010)

Mango+ cowpea (Kharif) + bengal gram (Rabi)/ Mango+ pigeon pea + tomato	East Coast Region of Tamil Nadu	First system gave maximum productivity per hectare whereas second system came up with maximum monetary returns.	Baghel *et al* (2003)
Coconut + Black pepper + Banana + Elephant Foot Yam	Arid regions of Rajasthan	This system considered as the most suitable intercropping system in coconut based on the feasibility, marketability, soil health and economic viability	Thivruvarssan *et al*. (2014)
(Aonla+ ber + cluster bean+ fennel), (Aonla + bael + cluster bean + Coriander), (Aonla + khejri + cluster bean + ajowain)	Arid regions of Rajasthan	These systems were reported as sustainable and remunerative under the arid ecosystem	Hare Krishan *et al*. (2013)

CONCLUSION

Mixing of crop species in horticulture based cropping systems may lead to a wide range of benefits that can be assessed by short-term (increase in crop yield and quality) and long-term (agroecosystem sustainability) benefits as well as societal and ecological sustainability (recreation, aesthetics, water and soil quality, enrichment of biodiversity etc.). The horticulture based multi-cropping systems not only give additional return to the farm families but also generate additional working days for rural youths in a sustainable manner.

REFERENCES

Abouziena HFH, Elham Z, Abd El-Motty, Youssef RA, Sahab AF. Efficacy of intercrroping mango, mandarin or Egyptian clover plants with date palm on soil properties, *rhizhosphere microflora* and quality and quantity of date fruits. *Journal of American Science.* 2010; **6**(12):230-238.

Agreda FM, Pohlan J, Marc J, Janssens J. Effects of Legumes Intercropped in Mango Orchards in the Soconusco, Chiapas, Mexico. In: *Conference on International Agricultural Research for Development,* 2006, 1-6.

Baghel BS, Tiwari R, Gupta N. Productivity and profitability of mango based intercropping system under rainfed agro-climatic conditions of Madhya Pradesh. *South Indian Horticulture.* 2003; 52(1-6):1-4.

Chowdhury MK, Rosario EL. Comparison of nitrogen, phosphorous and potassium utilization efficiency in maize/mung bean intercropping. *Journal of Agricultural Science.* 1994; 122(2):193-199.

Chundawat BS. Intercropping in orchards. In: Advances of Horticulture. Fruit crops. Eds. Chadha, K.L. and Pareek, O.P. Malhotra Publishing. House, New Delhi, 2014; 2:763-775.

Gomez-Rodriguez O, Zavaleta-Mejia E, Gonzalez- Hernandez AV, Livera-Munoz M, Cardenas- Soriano E. Physiological and morphological adaptations in tomato intercropped with *Tagetes erecta* and *Amaranthus hypochondriacus*. Revista Fitotecnia Mexicana. 2003; 30(4):421-428.

Hare Krishan, Singh IS, Bhargava R, Sharma SK. Fruit based cropping systems for sustainable production. ICAR News. 2013; 9(2):9.

Hegde NK, Vijayakumar BN, Pushpa P. Importance of multistoried cropping systems in Horticulture. In: Winter school on multistoried cropping system and canopy management in horticultural crops from 28th Sept. to 18th Oct. 2015, College of hort. Sirsi, Karnataka, 2015, 10-13.

Khan HH, Krishnakumar V. Spices in coconut based cropping system. In: Proceedings of the National Seminar on Strategies for increasing production and export of spices, Calicut, 2002, 1-17.

Magaguda GT, Haque I, Godfrey W, Fendu I, Masina GT. Intercropping studies in Swaziland: Present status and future projections. Proc. *Intl. Workshop on intercropping, Hyderabad,* India, 1979, 98-104.

Mirjha PR, Rana DS. Yield and yield attributes, system productivity and economics of mango *Mangifera indica* based intercropping systems as influenced by mango cultivars and nutrient levels. *Indian Journal of Agronomy*. 2016; **61**(3):307-314.

Muschler RG. Shade improves coffee quality in a suboptimal coffee-zone of Costa Rica. Agroforestry Systems. 2001; 85:131-139.

Nimbolkar PK, Awachare C, Chander S, Husain F. Multistoried Cropping System in Horticulture-A Sustainable Land Use Approach. *International Journal of Agriculture Sciences*. 2016; **8**(55):3016-3019.

Ponnusamy, K., Shukla, A.K. and Moharana, G. 2011. Determinants of adoption of horticultural crops in backyard gardens. Prog. Hort. 43:328-31.

Roy S, Raj S, Choudhury M, Dey SK, Nazeer MA. Intercropping of banana and pineapple in rubber plantations in Tripura. *Indian Journal of Natural Rubber Research*. 2001; **14**(2):152-158.

Sayan Sau, Sukamal Sarkar, Arindam Das, Saikat Saha and Pallab Datta Space and time utilization in horticulture based cropping system: an income doubling approach from same piece of land. *Journal of Pharmacognosy and Phytochemistry*. 2017; **6**(6): 619-624.

Swaminathan, M.S. 2005. Science and India's Agricultural Future. The Hindu, pp. 10.

Swift MJ, Izac AMN, Van Noordwijk M. Biodiversity and ecosystem services. Are we asking the right questions? *Agriculture, Ecosystems & Environment*, 2004; 104:113-134.

Thomas G, Krishnakumar V, Maheshwarappa HP, Bhat R, Balasimha, D. Arecanut based Cropping/ Farming Systems. Central Plantation Crops Research Institute, Kasaragod ICAR, 2011, 138.