Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 121-127

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 121-127**
Journal homepage: http://www.ijcmas.com

Original Research Article

Evaluation of Farming Systems for Diversification and Sustainability in North *Konkan* Coastal Zone of Maharashtra

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A B S T R A C T

The study was conducted to evaluate farming systems for diversification and Sustainability in north *Konkan* coastal zone of Maharashtra. For the study three districts, nine tahsils, twenty seven villages and251 farmers from Palghar, Thane and Raigad district were selected. The analysis revealed that, among three farming systems bases the comparative higher SVI was noticed case of horticulture based farming system compared to crop based and livestock based farming systems. The system wise comparison of SVI indicated that horticulture in combination with field crops (HFS-I) was comparatively more suitable over other farming systems. The farmers of all the farming systems were having sustainable farm income. Farming systems *viz.* HFS-I and HFS-II were found to be comparatively more sustainable over other farming systems, which indicated, its importance and need to concentrate on these enterprises for making farming systems more sustainable. In *Kharif* season, less crop diversification (HI- more than 0.66) was observed in all the farming systems. In *Rabi* season, more crop diversification (HI- less than 0.48) was observed in all the farming systems except LFS-I. In *Summer* season, less crop diversification was observed in all the farming systems CFS-II followed by HFS-I. In *Summer* season in CFS-I, CFS-II, LFS-I and LFS-II farming system, there were no area under crop. Hence, no crop concentration as well as diversification was observed.

Keywords

Sustainability value index, Diversification, Farming systems, etc.

Introduction

Diversification of farming has been viewed as an important means of sustainable economic transformation, because of its crucial role towards smoothening of income shocks during agricultural downtrends. Diversification can be defined as one agricultural enterprise to another or a larger mix of enterprises considering their likely risks and returns leading to a production portfolio that minimize risks and increases income (Joshi *et al*., 2004). The increasing demand for inputs like fertilizers, irrigation, labour, etc. has to be considered in the long term prospective of its consequence on sustainability of agriculture. The natural resource base of the country is being gradually eroded with technological breakthrough, must be protected from irreversible degradation. In this context diversification in agriculture deserves special emphasis. Sustainable agriculture is one that

contributes to the overall objective of sustainable development that is, to meet the present needs without compromising the ability of future generation to meet their own food needs and related demand from the land. Sustainability could be viewed from two angles, one, preservation of health of land and water resources and secondly production of technological visible and viable crop and livestock enterprises through efficient land and water use, thus conserving environmentally and friendly situations in ecosystems (Kiresur *et al.,* 2010).

Materials and Methods

For the present study three districts namely **1.** Palghar, Thane and Raigad were selected purposively. From each district three tehsils were selected by dividing each district into three zones *viz.* East, central and West. From each tehsil three villages and from each village ten farmers were selected randomly. Thus data were collected from 270 growers. The data was collected by survey method through personal interviews from the farmers, with the help of pre-tested comprehensive schedule specially designed for the purpose.

Identification of farming system

Farming systems were identified on the basis of gross income obtained, by the farmer. The farming systems in the study area were classified as crop base, horticulture base and livestock base. The crop based farming system, consist of the farmers where major income was derived from agronomical crops *viz.* paddy, others cereals and pulses etc. was considered. In case horticulture base farming system major income derived from horticultural crops *viz.* vegetables, orchards and flowers crops etc. was considered. In livestock base farming system major income derived from livestock rearing *viz.* dairy, poultry and goats etc. was considered. It is observed that, incrop based of farming systems, horticulture based farming systems and livestock based farming systems following seven farming systems were followed by the farmers.

i) Crops + Livestock (CFS-I)
ii) Crops + Horticulture (CFS-II)
iii) Crops + Horticulture + Livestock (CFS-III)
iv) Horticulture + Crops (HFS-I)
v) Horticulture + Crop + Livestock (HFS-II)
vi) Livestock + Crops (LFS-I)
vii) Livestock + Crop + Horticulture (LFS-II)

Sustainability Value Index (SVI) in farming system

To know the sustainability of prevailing farming system in the study area Sustainability Value Index (SVI) was calculated using the following formula…..

$$SVI = \frac{ANI - (1.96 * SD)}{MNI}$$

$$CV = \frac{SD}{ANI} X\ 100$$

Where,

SVI = Sustainability Value Index
ANI= Average Net Income
MNI= Maximum Net Income
SD= Standard Deviation
CV= Coefficient of Variation

The standard deviation of ANI is multiplied by 1.96 to form 95% confidence interval. The value of SVI calculated by this formula lies between 0 and 1. A value of SVI near to zero gives that model is not sustainable while a value of SVI near to one gives that model is sustainable (Kiresur *et al*., 2010).

Diversification in farming system

The growth of area under different crops were analyzed through different indices, *viz.* Herfindahl index, Simpson Index and Entropy Index were used for assessing crop diversification.

Herfindahl Index (HI)

It is the sum of square of the proportion of acreage under each crop to the total cropped area and is given by Equation (1):

$$\text{Herfindahl Index (HI)} = \sum_{i=1}^{n} Pi^2 \quad \ldots(1)$$

Where,

Pi - Acreage proportion of the i^{th}crop in total cropped area. As diversification increases, the sum of square of the proportion of activities decreases and so also the indices (HI). The Herfindahl index takes the value of one when there is specialization and approaches zero when there is diversification. Since the index measures concentration; it is transformed by subtracting from one, i.e., 1 – HI. The transformed value of HI avoids confusion on comparing it with other indices (Basavraj *et al.*, 2016).

Simpson Index (SI)

It is the most suitable index for measuring diversification of crops in a particular geographical region and is calculated by Equation (2):

$$\text{Simpson Index (SI)} = 1 - \Sigma Pi^2 \quad \ldots\ldots\ldots(2)$$

Where,

Pi = Ai / Σ Ai is the proportion of the i^{th} activity in acreage.

If SI is near zero, it indicates that the zone or region is near to the specialization in growing of a particular crop and if it is close to one, then the zone is fully diversified in terms of crops (Basavraj *et al.*, 2016).

Entropy Index (EI)

It is a direct measure of diversification having a logarithmic character and is given by Equation (3)

$$\text{Entropy Index (EI)} = \sum_{i=1}^{N} Pi * \log(1/Pi) \quad \ldots(3)$$

Where, Pi represents acreage proportion of the i^{th} crop in total cropped area. The Entropy index increases with diversification. The Entropy index approaches zero when the farm is specialized and Pi equals one (perfect specialization) and takes a maximum value when there is perfect diversification. The upper limit of Entropy Index is determined by the base of logarithms and the number of crops. The upper value of the index can exceed one, when the number of crops is higher than the value of the logarithm's base, and it is less than one when the number of crops is lower than the base of logarithm (Basavraj *et al.*, 2016).

Results and Discussions

Sustainability value index in different farming systems

Enhance agriculture production for the growing population and at the same time to maintain natural resources for the future generations, sustainability approach deserves important place in the policy decisions. In this regards, an attempt has been made to assess the sustainability of existing farming system the study area. For estimating Sustainability Value Index of different farming systems per farm gross income was considered. Sustainability Value Index for different Crop based farming systems was

presented in Table 1. Under crop based farming system, CFS-III possess comparatively higher SVI (0.121) followed by CFS-I (0.102) and CFS-II (0.086). This trend was noticed due to the farmers were growing field crops in combination with horticultural crops and livestock, which was responsible for stabilizing income. Sustainability Value Index for different Horticulture based farming systems are presented in Table 2. Under horticulture based farming system, HFS-I possess comparatively higher SVI (0.161) followed by HFS-II (0.157). This trend was noticed due to the larger area of horticultural in combination with crops which was responsible for stabilize income. Sustainability Value Index for different Livestock based farming systems was presented in Table 3. Under livestock based farming system, LFS-II possess higher SVI (0.143) followed by LFS-II (0.104). This trend was noticed due to the farmers were rearing livestock in combination with field crops and horticultural crops, which was responsible for stabilized income. Among three farming systems bases the comparative higher SVI was noticed in case of horticulture based farming system compared to crop based and livestock based farming system. The system wise comparison of SVI indicated that horticulture in combination with field crops (HFS-I) was comparatively more suitable over others farming systems.

Diversification in Different Farming Systems

Diversification serves as a sole source of combating risk against climate and vagaries. Crop diversification in the India is generally viewed as a shift from the traditional grown less remunerative crops to more remunerative crops. Crop diversification ensures security for food, nutrition, income and employment to a wider section of the society and hence, has a significant bearing on GDP of the nation. Gopalappa (1996), have reported that, there was scope to increase income through crop diversification. Acharya *et al.*, (2011), based on his study Crop diversification in Karnataka: An economic analysis, have reported that crop diversification contributed to increase cropping intensity, commercialization of farming and higher employment. The results of diversification in farming system are presented in Table 4. The Harfindahl index would decrease with increases in diversification. The results (Table 4) indicated that, in *Kharif* season higher crop concentration were (1.00) observed in LFS-II followed by CFS-II, CFS-I, HFS-II, LFS-I, HFS-I and CFS-III. In case of CFS-III, it was observed to be lowest Harfindahl index (0.66) at the same season Simpson and Entropy Index were 0.34 and 0.26 respectively. It indicated that this farming system was less diversified. It is also observed from the table in case of LFS-II was completely concentrated. It was indicated that, farming systems in study area were less diversified in *Kharif* season. The Simpson index would increases with increases in diversification. The results indicated that, In *Rabi* season higher crop diversification were observed in HFS-II (0.79) followed by LFS-II, CFS-III, HFS-I, CFS-II, CFS-I and LFS-I. In case of HFS-II, it was observed to be lowest Harfindahl index (0.21) in the *Rabi* Season whereas Simpson and Entropy Index were 0.79 and 0.71 respectively. It indicated that, this farming system was comparatively diversified. Similarly LFS-I was found to be comparatively concentrated than other farming systems followed in study area. In *Summer* season crop concentration were observed in CFS-II, HFS-I and HFS-II the farming system. In case of HFS-I it was observed to be Harfindahl index (0.63) whereas Simpson and Entropy Index were 0.37 and 0.24 respectively. It indicated that, this farming system was less diversified in

summer season. It is also observed from the table HFS-II was completely concentrated (Harfindahl index 1) than other farming systems followed in study area. It was observed that, in summer season most of the farming systems were found to be less diversified. In case of perennial crop complete crop concentration were observed in HFS-II and LFS-II (Harfindahl index is 1). CFS-II, CFS-III and HFS-I were found to be diversified. In case of HFS-I it was observed to be Harfindahl index (0.63) while Simpson and Entropy Index were 0.37 and 0.24 respectively. It indicated that this system was less diversified. It is also observed from the table HFS-III was found to be concentrated (Harfindahl index 1) than other farming systems followed in study area. In case of CFS-I and LFS-I as there were no crops Harfindahl index as well as Simpson index were zero. It indicated that, there was no crop concentration as well as no diversification was observed.

Table.1 Sustainability value index for different crop based farming systems

(Per farm)

Sr. No.	Particulars	CFS-I	CFS-II	CFS-III
1	Maximum Net Income (Rs.)	70728	217000	92680
2	Average Net Income (Rs.)	35292	63219	43604
3	Standard Deviation	14886	20992	16513
4	Sustainability Value Index	0.086	0.102	0.121

Table.2 Sustainability value index for different horticulture based farming systems

(Per farm)

Sr. No.	Particulars	HFS-I	HFS-II
1	Maximum Net Income (Rs.)	727160	325028
2	Average Net Income (Rs.)	227170	172724
3	Standard Deviation	56090	62163
4	Sustainability Value Index	0.161	0.157

Table.3 Sustainability value index for different livestock based farming systems

(Per farm)

Sr. No.	Particulars	LFS-I	LFS-II
1	Maximum Net Income (Rs.)	796980	622178
2	Average Net Income (Rs.)	173153	262834
3	Standard Deviation	45936	88599
4	Sustainability Value Index	0.104	0.143

Table.4 Indices for diversification of area for different farming systems

Sr. No.	Farming System	Season											
		Kharif			*Rabi*			*Summer*			Perennial		
		HI	SI	EI	HI	SI	EI	HI	SI	EI	HI	SI	EI
1	**CFS**												
i	CFS-I	0.86	0.14	0.13	0.48	0.52	0.34	0.00	0.00	0.00	0.00	0.00	0.00
ii	CFS-II	0.96	0.04	0.04	0.34	0.66	0.50	0.60	0.40	0.00	0.50	0.50	0.40
iii	CFS-III	0.66	0.34	0.26	0.29	0.71	0.62	0.00	0.00	0.00	0.41	0.59	0.43
2	**HFS**												
i	HFS-I	0.74	0.26	0.22	0.31	0.69	0.64	0.63	0.37	0.24	0.63	0.37	0.24
ii	HFS-II	0.83	0.17	0.15	0.21	0.79	0.71	1.00	0.00	0.00	1.00	0.00	0.00
3	**LFS**												
i	LFS-I	0.80	0.20	0.17	0.63	0.37	0.29	0.00	0.00	0.00	0.00	0.00	0.00
ii	LFS-II	1.00	0.00	0.00	0.25	0.75	0.60	0.00	0.00	0.00	1.00	0.00	0.00

In conclusion, the farmers of all the farming systems were having sustainable farm income. Farming systems *viz.* 1) HFS-I, 2) HFS-II were found to be comparatively more sustainable over other farming systems. Which indicate that, its importance and need to concentrate on these enterprises for making farming systems more sustainable. In *kharif* season less crop diversification (HI- more than 0.66) were observed in all the farming systems. In *Rabi* season comparatively more crop diversification (HI- less than 0.48) were observed in all the farming system except LFS-I. In *Summer* season less crop diversification were observed in all the farming system CFS-II followed by HFS-I. In *Summer* season in CFS-I, CFS-II, LFS-I and LFS-II farming system, as there were no crops Harfindahl index as well as Simpson index were zero. It indicated that, there were no crop concentration as well as no diversification was observed.

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