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Economics of major cropping sequences in Pune district of Maharashtra

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Abstract
Agricultural production constitutes the single largest economic activity in India. In view, it was decided to undertake a study viz., "Economics of major cropping sequences in Pune district of Maharashtra" objectives to identify different cropping sequences, to estimate per hectare cost and return of major cropping sequences. Besides this, income and expenditure pattern of sample farmers adopting major cropping sequences were studied. The constraints in adoption of major cropping sequences in Pune districts were also examined.

The present study was based on the primary data of 90 cultivators for the year 2013-14 spread over the six randomly selected villages of three tahsils. From each selected village, 15 cultivators, 5 from each size group viz., small, medium and large were randomly selected. Thus, total sample consisted of 30 farmers each of small, medium and large size groups.

Out of existing sixteen cropping sequences three major cropping sequences viz., Pearl millet-Coriander-Rabi Onion cropping sequence (CS-I) is the dominant cropping sequence which is adopted by 21 farmers followed by Pearl millet-Rabi Sorghum (CS-II) by 20 farmers and Cauliflower-Rabi Potato-Fenugreek (CS-III) by 18 farmers, were selected for present study.

The average per hectare cost of cultivation was highest in cropping sequence III (₹236774.42), followed by cropping sequence I (₹179574.88) and cropping sequence II (₹ 63398.97). The average per hectare yield and gross income were less in cropping sequence II (37.47 qtl and ₹66622.58) as compared to cropping sequence I and III (320.81 and 433.47 qtl and ₹292129.08 and ₹410648.64), respectively. This has resulted into higher B: C ratio (1.73) in cropping sequence III as compared to cropping sequence I (1.63) and cropping sequence II (1.05).

Highest annual income produced in crop production by cropping sequences I was Z179450.72 followed by income produced by cropping sequences II and III in crop production were 252465.28 and Z171105.68, respectively. In all, six variables included in income function have jointly explained 76.00 per cent, 75.00 per cent and 73.00 per cent variation for cropping sequence I, II and III, respectively. The variables viz., number of earners (X_1) was significant at ten per cent level in all cropping sequences. Number of milch animal was significant at five per cent level in cropping sequence I and III, but it was non-significant in cropping sequence II. Area under vegetable and gross irrigated area was highly significant at one per cent level in cropping sequence I while it was significant at five per cent level in cropping sequence II, but it was non-significant in cropping sequence III.

Highest annual expenditure spends on cropping sequences III was 2315695.60 per farm which have major contribution by crop production and livestock activity (31.25 and 22.56 per cent share, respectively). Expenditure spends on cropping sequences I and II are 2298761.18 and 2241850.69, respectively.

Keywords: major cropping, Pune district, Agricultural production constitutes

Introduction

Indian agriculture is characterizing by 70 per cent rain fed crop. In other words only 30 per cent of the total cultivable land is brought under irrigation. However, the proportion of irrigation is only to the tune of 13 per cent for the state of Maharashtra. With the increase in area under irrigation and the availability of shorter duration varieties of different crops, the scope for increasing the cropping intensity through cropping sequence is continuously increasing. But, the agricultural sector in many developing countries like India could not move ahead because of large number of physical, natural, economical, social, political and human factors. (Mishra and Puri, 2001) [4].

There is the way to increase agriculture production on the small or marginal unit of the farming is to increase the productivity per unit and area. This may be achieved by breeding efficient crop varieties and by improving management practices like fertilizer use, weed and

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paste control, irrigation application, cropping sequences, cropping system etc.

Cropping Sequence can be defined as growing of two or more crops in sequence on the same piece of land in an Agricultural year (Reddy, 2000) [8]. Depending on the number of crops grown in the year, it is called as double, triple and quadruple cropping involves two, three and four crops, respectively.

Methodology

For the completion of present study both types of data i.e. primary as well as secondary were required. Macro level data were obtained from the records of Government office such as Agriculture, Animal's husbandry, Co-operatives, etc. The micro level data were obtained by personal interview from the selected 90 sample families for the year 2013-14.

The primary unit of sample was tahsil and the record of revenue as well as department of agriculture was referred for the same. The village, being the secondary unit of sample, randomly two villages was selected from each tahsil by listing them in ascending order, having maximum cropped area. The tertiary and ultimate unit of sample was the farmer. The list of the farmers having the cropped area were prepared from revenue record of villages and were categorized into three size groups on the basis of the operational holdings viz.,

holding size below 1.00 ha., 1.01 ha. to 2.00 ha. and above 2.01 ha. were designated as small, medium and large size groups, respectively. Then, thirty cultivators were selected randomly from each size groups. Thus, the total sample consisted of 90 farms.

Estimation of income function

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e_u$$

Where,

Y = Annual total family Income (₹)
a = Intercept
X_1 = Number of Earners (Number per family.)
X_2 = Number of Mulch animal (Number per family.)
X_3 = Area under Vegetables
X_4 = Area under cash crops
X_5 = GIA (Gross Irrigated Area) in hectare
X_6 = GCA (Gross Cropped Area) in hectare
b_i's = Regression coefficient
e_u = Error term

Results and Discussion

Table 1: Existing cropping sequences observed on farm of sample farmers

S. No.	Cropping Sequences	Small	Medium	Large	Total N=90	Percent
		Group				
1	Pearl millet-Coriander-Rabi Onion	8	6	7	21	23.33
2	Green gram-Rabi Sorghum	4	6	3	13	14.44
3	Pearl millet-Wheat-Summer Groundnut	1	2	5	8	8.88
4	Green gram-Rabi Onion	-	2	5	7	7.77
5	Black gram-Gram	4	1	6	11	12.22
6	Groundnut-Rabi Potato-Fodder Jowar	3	5	5	13	14.44
7	Pearl millet-Rabi Sorghum	6	7	7	20	22.22
8	Maize-Wheat- Summer Pearl millet	-	4	5	9	10.00
9	Maize-Rabi Sorghum-Chili	5	4	3	12	13.33
10	Onion-Wheat-Watermelon	3	2	3	8	8.88
11	Tomato-Coriander- Fenugreek-Cluster bean	1	1	6	8	8.88
12	Tomato-Fodder Jowar	2	2	2	6	6.66
13	Tomato-Wheat-Cabbage	2	5	2	9	10.00
14	Capsicum-Marigold-Tomato	2	2	3	7	7.77
15	Cauliflower-Rabi Potato –Fenugreek	4	6	8	18	20.00
16	Onion-Coriander-Fenugreek-Summer Groundnut	3	1	4	8	8.88

The information given in above table, existing sixteen cropping sequences three were select as major cropping sequences viz., Pearl millet-Coriander-Rabi Onion cropping sequence (CS-I) is the dominant cropping sequence which is adopted by 21 farmers (23.33 per cent) followed by Pearl

millet-Rabi Sorghum (CS-II) by 20 farmers (22.22 per cent), Cauliflower-Rabi Potato-Fenugreek (CS-III) by 18 farmers (20.00 per cent). These cropping sequences were selected on the bases of per cent to the total number of sample cultivar.

Table 2: Per hectare costs and return of major cropping sequences (₹)

S. No.	Particular	I	II	III
1.	Total cost			
	i) Cost 'A'	100767.23	42165.39	147291.60
	ii) Cost 'B'	154857.35	54157.69	225314.40
	iii) Cost 'C'	179574.88	63398.97	239403.60
2	Profit at			
	i) Cost 'A'	191361.85	24457.19	263836.30
	ii) Cost 'B'	137271.73	12464.89	185813.50
	iii) Cost 'C'	112554.20	3223.61	171724.30
3.	Production (qtl)	320.81	37.47	433.43
4.	Gross income	292129.08	66622.58	411127.90
5.	B:C ratio			
	i) Cost 'A'	2.90	1.58	2.79
	ii) Cost 'B'	1.89	1.23	1.82
	iii) Cost 'C'	1.63	1.05	1.72

The cropping sequence wise cost and returns of major cropping sequence in Pune region are presented in Table 2. At overall level, the gross income of cropping sequence-I, II and III were ₹ 2, 92, 129.08, ₹ 66,622.58 and ₹ 4, 10, 648.84, respectively. In cropping sequence-III, the average per hectare cost 'C' was ₹ 236774.42, while it was ₹ 179574.88 in cropping sequence I and ₹ 63398.97 in cropping sequence-II. The output-input ratio revealed that the cropping sequence-III was more profitable, which shows output-input ratio as 1.73 followed by 1.63 in cropping sequence-I and 1.05 in cropping sequence-II.

Table 3: Per farm average annual income of farm families ₹ ()

S. No.	Particular	Cropping Sequences		
		I	II	III
1	Crop production	179450.72 (46.28)	52465.28 (21.83)	171103.68 (46.64)
2	Livestock	99061.90 (25.55)	110100.0Z (45.80)	104333.33 (28.44)
3	Wages	15476.19 (3.99)	11425.00 (4.75)	9455.56 (2.58)
4	Service/Business	57409.52 (14.80)	38340.00 (15.95)	40566.67 (11.06)
5	Loan	36380.95 (9.38)	28050.00 (11.67)	41388.99 (11.28)
7	Total Income	387779.28 (100.00)	240380.28 (100.00)	366848.23 (100.00)

(Figures in the parentheses indicate percentage to the total income)

Highest annual income produced by cropping sequences I (₹ 3, 87, 779. 28) which have major contribution by crop production and livestock activity (46.28 and 25.55 per cent share, respectively). Income produced by cropping sequences II and III are ₹ 2, 40, 380.28 and ₹ 3, 66, 848.23, respectively.
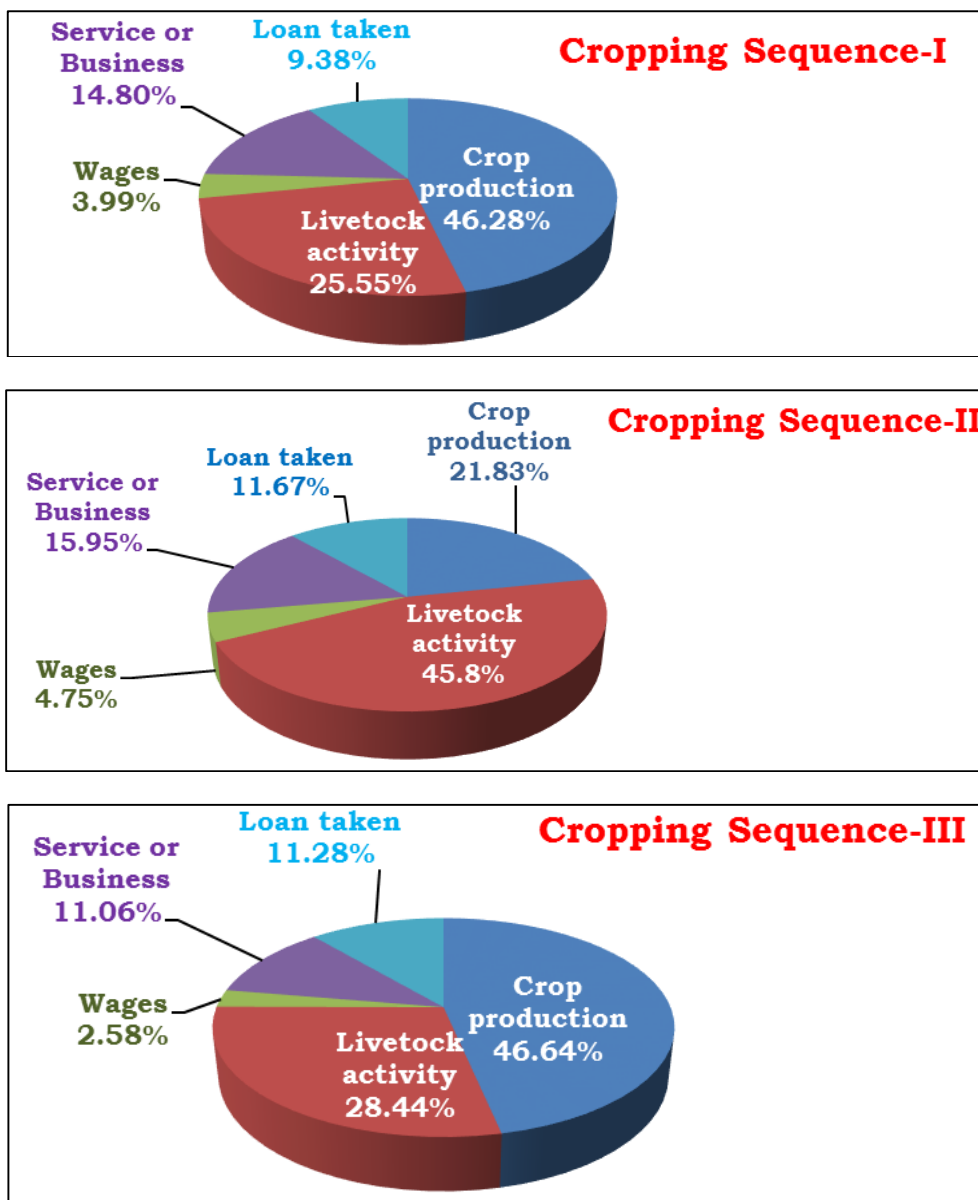

Fig 4: Average annual income of farm families.

Table 4: Regression analysis of income function

S. No.	Particular	Cropping Sequence		
		I	II	III
1.	Sample size	21	20	18
2.	Constant (a)	195301.056	79081.96	131628.57
3.	No. of Earners (X_1)	43698.83* (21231.30)	22816.79* (11230.01)	43141.57* (21852.93)
4.	No. of Milch animal (X_2)	28141.40** (11270.35)	5857.15 (4335.68)	92.6335** (12244.45)
5.	Area under Vegetable (X_3)	67309.81*** (21345.44)	50845.28** (18201.52)	33759.4 (131282.1)
6.	Area under Cash Crop (X_4)	199211.20 (294222.12)	124625.97** (49393.69)	3708.44* (1800.04)
7.	Gross Irrigated Area (X_5)	42101.56*** (22.4795)	56684.27** (20843.31)	253746.6 (151424.3)
8.	Gross Cropped Area (X_6)	8075.70 (66150.92)	30892.49 (17306.44)	45716.75*** (14923.38)
9.	R^2	0.76	0.75	0.73

(Figures in the parentheses are the standard errors of the respective regression coefficient)
(*, ** and *** indicate significance at 10, 5 and 1 per cent level).

The results of income function of three cropping sequences indicate that in all, six variables included in income function have jointly explained 76.00 per cent, 75.00 per cent and 73.00 per cent variation for cropping sequence I, II and III, respectively. The variables viz., number of earners (X_1) was significant at ten per cent level in all cropping sequences. Number of milch animal was significant at five per cent level in cropping sequence I and III, but it was non-significant in cropping sequence II. Area under vegetable and gross irrigated area was highly significant at one per cent level in cropping sequence I while it was significant at five per cent level in cropping sequence II, but it was non-significant in cropping sequence III.

Table 5: Per farm average annual expenditure. (₹)

S. No.	Particular	Cropping Sequence		
		I	II	III
1	Crop production	110310.28 (36.92)	49926.69 (20.64)	98656.00(31.25)
2	Livestock activity	54450.00 (18.23)	63387.50(27.21)	71225.00(22.56)
3	Family expenditure			
	a)Food consumption	38944.40 (13.04)	36100.00(14.93)	40298.70(12.77)
	b)Education	32789.90(10.98)	30305.00(12.53)	33522.10(10.62)
	c) Health	10292.70(3.45)	12355.00(5.11)	15313.40(4.85)
	d) Other	8163.10(2.73)	8609.50(3.56)	10885.50(3.85)
5	Business Expenditure	27080.90(9.06)	21175.00(8.76)	25526.80(8.09)
6	Land Development	7463.50(2.50)	9327.50(3.86)	8060.50(2.55)
7	Other	9266.40(3.10)	10664.50(4.41)	12207.60(3.87)
8	Total Expenditure	298761.18(100.00)	241850.69(100.00)	315695.60(100.00)

(Figure in parentheses is the percentage to the total)

Highest annual expenditure spend on cropping sequences III (₹ 3,15,695.60) per farm which have major contribution by crop production and livestock activity (31.25 and 22.56 per cent share, respectively). Expenditure spend on cropping sequences I and II are ₹ 2, 98, 761.18 and ₹ 2, 41, 850.69 per farm, respectively.

Table 6: Constraints in adoption of major cropping sequences

S. No.	Constraints	Cropping Sequences		
		I N=21	II N=20	III N=18
	Constraints in Crop production			
1.	High wage rate	3 (14.28)	4 (20.00)	5 (27.80)
2.	Shortage of Labour	11 (52.36)	11 (55.00)	8 (44.48)
3.	Non availability of seed or planting material at time	7 (33.32)	10 (50.00)	9 (50.04)
4.	High cost of fertilizer	10 (47.60)	11 (55.00)	10 (55.60)
5.	Shortage of water in summer	13 (61.88)	13 (65.00)	11 (61.16)
6.	Electricity failure or irregular supply of electricity	11 (52.36)	12 (60.00)	10 (55.60)
7.	Lack of technical assistance	5 (23.81)	4 (20.00)	4 (22.24)
	Constraints in Marketing			
8.	High transportation charges	10 (47.60)	11 (55.00)	8 (44.48)
9.	High price fluctuations	11 (52.36)	5 (25.00)	8 (44.48)
10.	High marketing cost	9 (42.84)	8 (40.00)	4 (22.24)
11.	Lack of market intelligence	8 (38.08)	7 (35.00)	9 (50.04)
	Financial Constraints			
12.	Scarcity of own funds	8 (38.08)	7 (35.00)	4 (22.24)
13.	Lengthy process of loan sanction in bank	6 (28.56)	7 (35.00)	5 (27.80)
14.	No easy access for credit	7 (33.32)	7 (35.00)	3 (16.68)

(Figures in the parentheses indicate percentage to the total number of farmer)

In Table 6. Show that the scarcity of water in summer, irregular supply of electricity with low voltage, high wage rate and non- availability of input (i.e. planting material, manures, chemical fertilizer and pesticides etc.) are the major problem faced by farmer in adoption of major cropping sequences. During marketing, the problem faced by the farmer high transportation cost, high price fluctuation, high marketing cost and lack of market intelligence.

Conclusions
1. In Pune district out of sixteen cropping sequences, three major cropping sequences selected.
2. 2.The output-input ratio revealed that the cropping sequence-III was more profitable, which shows output-input ratio as 1.73 followed by 1.63 in cropping sequence-I and 1.05 in cropping sequence-II.
3. As regard the income, the major source of income in cropping sequence I and III was crop production while in cropping sequence II the major source of income was livestock activity Income level was benign highest in cropping sequence I than remaining two cropping sequences.
4. The proportion of crop production expenditure in total expenditure was higher in case of cropping sequences I and III. In case of cropping sequence II livestock activity contributed major share in expenditure compare with remaining two cropping sequence expenditure on livestock activity. Total annual expenditure in cropping sequence III was highest than cropping sequence I and cropping sequence II.
5. Scarcity of water in summer is major constraints in adoption of cropping sequences, Electricity failure/ Irregular supply of electricity second most important constraints.

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