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Research Note

Optimum Cropping Pattern for Sericulture-dominant Farms in Southern Dry Zone of Karnataka

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Abstract

Sericulture is labour-intensive and well-suited to small and marginal farms with surplus labour, especially female labour. Ample labour and a small land-base encourage farmers to practise sericulture as a subsidiary occupation. While income from crop production is seasonal, sericulture provides a year-round income, which is an important incentive for small farmers to take up sericulture. The agricultural production is seasonal, while consumption is evenly spread over the years. Under such circumstances, the planners and policymakers are confronted with the challenge of formulating a suitable agricultural production policy with which the desired growth of agricultural production can be achieved. In the present study, optimum cropping patterns for different categories of sericulturists have been suggested by selecting Siddlaghatta in Kolar and Kollegal talukas in Mysore as study areas. The primary data have been collected using the personal interview method. The deterministic linear programming technique has been employed to work out the maximum attainable returns by small, medium and large farmers through the optimum allocation of various crops, sericulture and livestock (dairy), using the available resources. The model has suggested fewer crops in the cropping pattern of both the areas. The model has also suggested shifting of the cropping pattern from subsistence-dominated crops like ragi to commercial crops like bivoltine sericulture in the Kolar area and crossbreed sericulture in the Musore area. The suggested cropping patterns have increased the gross income in the range of 83.55 to 388.68 per cent in the Kolar area and 2.71 to 10.70 per cent in the Kollegal area.

Key words: Cropping pattern, Bivoltine sericulture, Normative plan, Linear programming technique

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Introduction

In India, the agriculture sector provides livelihood to about two-thirds of its population. Sericulture is a component of many farming systems that are employment-oriented with low investment and shorter gestation period. Sericulture is labour-intensive and is well suited to small and marginal farms with surplus labour, especially female and child labour (Alderman, 1987). In India, sericulture is recognised as an instrument for social and economic transformation of agriculture and occupies an important place in the developmental plans of the country. India produces all the four types of natural silks, viz. Mulberry, Tasar, Eri and Muga and enjoys a monopoly in producing muga silk in the world. The southern states of India contribute 92 per cent to the total national raw silk production. The sericulture enterprise is characterized by low investment and as such small and marginal farmers dominate the enterprise. These farmers maintain an average mulberry garden of one or two acres. Ample labour and a small land-base encourage the farmers to practise sericulture as a subsidiary occupation to agriculture. While income from crop production is seasonal, sericulture provides year-round income, which is an important incentive for the small farmers to take-up sericulture (Banerjee, 1994). Sericulture development fits well in the country's programme of increasing rural employment. It directly helps in increasing the crop production through making funds available for the purchase of essential inputs like seeds, fertilizers, etc. Thus, the contribution of sericulture to the development of national economy is unique. Moreover, sericulture, has now become an important agri-business. The present study was undertaken with the objective of determining optimum cropping pattern for different categories of sericulturists.

Methodology

The study was carried out in the state of Karnataka, as it contributes 65 per cent to the country's raw silk production. Kolar and Mysore districts were selected for investigation as they represent unique methods of practising sericulture in the state. Siddlaghatta taluka in Kolar district and Kollegal taluka in Mysore district were purposively selected based on the concentration of mulberry area. From each of the selected talukas, six villages and 10 farmers from each village were selected at random. Thus, a total of 120 farmers constituted the sample size. The primary data were collected from the selected farmers by the personal interview method using a structured schedule prepared for the purpose. The data collected included the personal details of the farmers' family, crops grown season-wise,

quantity of inputs used for each crop, quantity of each crop output produced, consumed and sold, etc. The farmers were post-classified into small, medium and large categories, based on the standard acres as detailed below:

Small farmers: Owning less than 2.5 acres of irrigated land or less than 5 acres of dry land

Medium farmers: Owning 2.5 to 5 acres of irrigated land or 5 to 10 acres of dry land, and

Large farmers: Owning more than 5 acres of irrigated land or more than 10 acres of dry land.

Two acres of dry land was equated to one acre of irrigated land based on the number of crops grown on these respective lands and was considered as one standard acre.

The Analytical Model

Linear programming technique was used for obtaining the optimal combination for different enterprises followed by the sample farmers. The deterministic linear programming technique was employed to work out the maximum attainable returns by small, medium and large farmers through the optimum allocation of various crops, sericulture and livestock (dairy), using available resources. This technique was chosen because among the various analytical tools available for allocation of available limited farm-resources among alternative enterprises, it is the most powerful and efficient tool for analysis.

Selection of Processes or Activities

During *kharif* season, both under rainfed and irrigated conditions, the principal crops grown and the allied activities undertaken by the sample farmers were groundnut and ragi (under rainfed conditions), paddy, tomato, potato and sericulture (under irrigated conditions). Dairying activity, and fodder availability were also included for large, medium and small farmers.

Objective Function

The objective function for the model in this study was maximization of the annual net returns to owned resources. The gross returns per acre of crop and per unit of allied activity were calculated by using the data of the sample farmers. Paid-out costs such as hired human-labour and bullock-labour, fertilizer, etc. were directly subtracted from the gross returns. For dairying activity, profits were calculated by deducting variable expenses

such as value of fodder, concentrates, and veterinary care from the gross income of dairy activity. The maximization of net returns (profits) was subject to the consumption and resource constraints imposed in the model.

Constraints and Requirements

The followings were the constraints:

- Land available for cultivation was considered only for the *kharif* season.
- Labour was essentially restricted to the availability of family labour. Hiring of labour was allowed through transfer activities in the model, wherever family labour was inadequate.
- Livestock surplus milk was sold to Milk Producers Co-operative Society to supplement family income.
- Consumption activity was included to account for the value of household consumption by linking farm production and output sale.

Activities in the Model

Activities (column vectors) specify the resources, which could be put into various alternative uses. The activities incorporated in the models were: (1) crop, (2) labour hiring, (3) fertilizer consumption, (4) consumption, (5) product and labour sale, (6) fodder availability, (7) working capital, (8) milking animals, and (9) crop activities, viz. groundnut, ragi (RF), ragi (irrigated), paddy, maize, vegetables, tomato, sericulture and dairy.

Results and Discussion

Existing Cropping Pattern and Returns to Family-owned Resources

A. Siddlaghatta Area

The existing cropping pattern along with farm returns are summarized in Table 1. The agricultural year was divided into two periods reflecting two important agricultural seasons in the study area, viz. June-Nov. (*kharif* season) and December-May (*rabi*-summer season). *Kharif* is the main agricultural season in the study area since crops are grown in all the types of lands due to monsoons. During the *rabi* and summer season, crops are grown only in areas with assured irrigation. Crop production was taken up during the *rabi* season only in Siddlaghatta under tank-irrigated land due to paucity of water. In Kollegal, since canal irrigation was available, the farmers were growing the crops during the *rabi*-summer season also.

Table 1. Existing enterprise scheme of sample farmers in Siddlaghatta area

(acres)

Enterprise	Small farmers				Medium farmers				Large farmers			
	Kharif		*Rabi*		*Kharif*		*Rabi*		*Kharif*		*Rabi*	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Dry land												
Ragi	0.88	73.33	-	-	1.36	44.60	0.50	52.63	2.79	42.92	-	-
Groundnut	0.32	26.67	-	-	0.36	11.80	-	-	0.95	14.62	-	-
Tomato	-	-	-	-	0.54	17.70	-	-	0.65	10.15	0.80	41.45
Jowar	-	-	-	-	0.34	11.15	-	-	0.34	5.24	-	-
Eucalyptus	-	-	-	-	0.45	14.75	0.45	47.37	1.76	27.07	1.13	58.55
Total	1.20	100.00	-	-	3.05	100.00	0.95	100.00	6.50	100.00	1.93	100.00
Tank-irrigated land												
Local paddy	0.24	57.14	-	-	0.96	55.49	-	-	0.96	55.49	-	-
Ragi (HYV)	0.18	42.86	-	-	0.77	44.51	-	-	0.77	44.51	-	-
Total	0.42	100.00	-	-	1.73	100.00	-	-	1.73	100.00	-	-
Tubewell-irrigated land												
Mulberry (Bi.)	0.12	14.46	0.12	14.46	0.17	9.95	0.17	10.12	0.42	11.93	0.42	12.17
Mulberry (Multi)	0.41	49.40	0.41	49.40	0.73	42.69	0.83	49.40	0.78	22.16	0.88	25.50
HYV paddy	0.30	36.14	-	-	0.35	20.46	0.31	18.45	0.95	26.99	0.56	16.23
Tomato	-	-	-	-	0.33	19.29	-	-	0.56	15.91	0.26	7.54
Ragi	-	-	-	-	0.05	2.93	0.27	16.08	0.49	13.92	0.94	27.25
Maize	-	-	0.30	36.14	0.08	4.68	0.10	5.95	0.32	9.09	0.39	11.31
Total	0.83	100.00	0.83	100.00	1.71	100.00	1.68	100.00	3.52	100.00	3.45	100.00

Contd.

Table 1. Existing enterprise scheme of sample farmers in Siddlaghatta area — *Contd*

Enterprise	Small farmers	Medium farmers	Large farmers
Dairy animals (No.)			
Crossbred cow	0.45	1.23	2.35
Buffaloes	0.78	0.62	0.67
Total	1.23	1.85	3.02
Farm returns (Rs)			
Gross returns	20989	46950	86000
Family consumption	15529	26632	30246
Returns to family labour	5460	20318	55754

Ragi, a major crop was grown as both pure and mixed crop. It was grown as a mixed crop with field bean, fodder crops and cowpea. Ragi occupied 73.33 per cent, 44.59 per cent and 42.92 per cent of the dry land during the *kharif* season in small, medium and large farms, respectively in Siddlaghatta. High-yielding variety of ragi was grown on 42.86 per cent, 44.51 per cent and 44.51 per cent of the area under tank-irrigated land of small, medium and large farms, respectively, during the *kharif* season. Ragi was not grown during the *rabi* season under the tank-irrigated land. However, it was grown as a mixed crop by medium farmers under the dry land in 52.63 per cent of the area. Groundnut, local tomoto and maize were some of the important commercial crops grown on the dry land during the *kharif* season. The perennial crops occupied 14.76 per cent and 27.07 per cent of the dry land on medium and large farms, respectively. Eucalyptus, mango, sapota, tamarind and guava were mainly grown by the sample farmers on wastelands and these crops were not included in the analysis, as they occupied a non-significant part of the cultivated area.

Local paddy was grown on 57.14, 56.72 and 55.49 per cent of the tank-irrigated land on small, medium and large farms, respectively. High-yielding variety of ragi occupied the remaining 42.86, 43.28 and 44.51 per cent in that order. Under tubewell-irrigated land, mulberry was the most preferred crop. Mulberry leaves form the major input in silkworm rearing. A mulberry garden can be established in 6 months time and there are instances where mulberry gardens have survived for 40 years in the study area. With irrigation facilities available, five crops can be harvested during a year.

Mulberry was grown in 14.46, 9.95 and 11.93 per cent of the total area under small, medium and large farms, respectively, mainly for bivoltine-rearing. The corresponding figures for multivoltine silkworm-rearing were found to be 49.40, 42.69 and 22.16 per cent in that order. The other major crops grown on borewell-irrigated lands were HYV paddy, hybrid tomato, ragi and maize. Paddy and ragi were grown in most of the cases as subsistence crops.

The major farm enterprises taken-up included dairy enterprise with an average of 2 for every 5, 4 for every 5, and 7 for every 3 households number of crossbred cows by small, medium and large farmers, respectively.

The gross returns realised from the existing farm enterprises for the family-owned resources of small, medium and large farmers amounted to Rs 20,989, Rs 46,950,45 and Rs 86,000, respectively. These were Rs 5,460, Rs 26,632, and Rs 30,246 after meeting the family-consumption requirements in that order.

B. Kollegal Area

The existing enterprise scheme of sample farmers from Kollegal area is presented in Table 2. Ragi was the predominant crop being grown in 46.67, 56.31, and 50.91 per cent of the area in small, medium and large farms, respectively under dry land during *kharif* season. Groundnut occupied 33.33, 30.38 and 37.95 per cent and maize 20, 13.31 and 11.14 per cent, respectively under small, medium and large farmers. Excepting large farmers, the dry land during the *rabi* season was kept uncultivated due to lack of water. Large farmers had allocated 26.96 per cent of the area for ragi, 22.55 per cent for groundnut and 50.49 per cent for maize in the dry lands during the *rabi* season.

In the case of tank-irrigated land, local paddy was grown on 63.46, 71.11 and 57.67 per cent of the land on small, medium and large farms, respectively, during the *kharif* season. Ragi was grown under 36.54, 28.89 and 42.33 per cent of tank-irrigated land under small, medim and large farms, respectively during *kharif* season. During the *rabi* season, local paddy was grown in an area of 60.61, 51.43, and 61.48 per cent in small, medium and large farms, respectively. Ragi was grown in 39.39, 48.57, and 38.52 per cent, respectively in these farms.

Mulberry crop occupied 90.91, 88.89, and 81.15 per cent of the tubewell-irrigated area under small, medium and large farms, respectively during the *kharif* season. During the *rabi* season, the area under the same was 100, 95.45, and 89.34 per cent in that order.

Optimum Cropping Pattern and Returns to Family-owned Resources

A. Siddlaghatta Area

A perusal at Table 3 reveals that the farmers had to follow different farm enterprises to accomplish maximization of farm returns to family-owned resources. By following this strategy, small farmers could increase their returns from Rs 5,460 (Table 1) to Rs 26,682, representing an increase of Rs 21,222 per farm by undertaking four farm enterprises instead of eight under the existing plan. The farming system suggested here would require planting of one acre of dry land under ragi during the *kharif* season and the entire tank-irrigated land (0.23) under high-yielding variety of ragi. Mulberry for bivoltine silkworm-rearing was the only crop suggested for the land under tubewell irrigation. The model also suggested maintaining of one crossbred cow and two buffaloes.

Table 2. Existing enterprise scheme of sample farmers in Kollegal area

(acres)

Enterprise	Small farmers				Medium farmers				Large farmers			
	Kharif		*Rabi*		*Kharif*		*Rabi*		*Kharif*		*Rabi*	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Dry land												
Ragi	0.63	46.67	-	-	1.65	56.31	-	-	2.24	50.91	0.55	26.96
Groundnut	0.45	33.33	-	-	0.89	30.38	-	-	1.67	37.95	0.46	22.55
Maize	0.27	20.00	-	-	0.39	13.31	-	-	0.49	11.14	1.03	50.49
Total	1.35	100.00	-	-	2.93	100.00	-	-	4.40	100.00	2.04	100.00
Tank-irrigated land												
Local paddy	0.33	63.46	0.20	60.61	0.32	71.11	0.18	51.43	0.94	57.67	0.83	61.48
Ragi	0.19	36.54	0.13	39.39	0.13	28.89	0.17	48.57	0.69	42.33	0.52	38.52
Total	0.52	100.00	0.33	100.00	0.45	100.00	0.35	100.00	1.63	100.00	1.35	100.00
Tubewell-irrigated land												
Mulberry (Multi.)	0.18	32.73	0.18	36.00	0.63	33.33	0.63	35.80	0.78	31.45	0.78	34.67
Pure Mysore	0.32	58.18	0.32	64.00	1.05	55.56	1.05	59.65	1.23	49.60	1.23	54.67
HYV paddy	-	-	-	-	0.12	6.35	-	-	0.24	9.68	-	-
Ragi	-	-	-	-	0.09	4.76	-	-	0.23	9.27	0.14	6.22
Maize	0.05	9.09	-	-	-	-	0.08	4.55	-	-	0.10	4.44
Total	0.55	100.00	0.50	100.00	1.89	100.00	1.76	100.00	2.48	100.00	2.25	100.00

Contd...

Table 2. Existing enterprise scheme of sample farmers in Kollegal area — *Contd*

Enterprise	Small farmers	Medium farmers	Large farmers
Dairy animals (No.)			
Crossbred cow	0.27	0.34	0.35
Buffaloes	0.38	0.47	0.53
Total	0.65	0.81	0.88
Farm returns (Rs)			
Gross returns	17523	30265	40650
Family consumption	6520	8450	21789
Returns to family labour	11003	22175	18861

Table 3. Normative farm plan for different categories of farmers in Siddlaghatta area for maximization of income

(acres)

Enterprise	Small farmers				Medium farmers				Large farmers			
	Kharif		*Rabi*		*Kharif*		*Rabi*		*Kharif*		*Rabi*	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Dry land												
Ragi	1.00	100.00	-	-	-	-	-	-	-	-	-	-
Local Tomato	-	-	-	-	2.85	100.00	-	-	4.86	100.00	-	-
Total	1.00	100.00	-	-	2.85	100.00	-	-	4.86	100.00	-	-
Tank-irrigated land												
HYV Ragi	0.23	100.00	0.65	100.00	0.65	100.00	-	-	1.34	100.00	-	-
Total	0.23	100.00	0.65	100.00	0.65	100.00	-	-	1.34	100.00	-	-
Tubewell-irrigated land												
Mulberry (Multi.)	-	-	-	-	1.24	92.53	1.24	92.53	-	-	-	-
Mulberry (Bi.)	1.05	100.00	1.05	100.00	0.10	7.47	0.10	7.47	2.95	100.00	2.95	100.00
Total	1.05	100.00	1.05	100.00	1.34	100.00	1.34	100.00	2.95	100.00	2.95	100.00
Dairy animals (No.)												
Crossbred cow	1.00	-	-	-	1.00	-	-	-	4.00	-	-	-
Buffaloes	2.00	-	-	-	4.62	-	-	-	1.00	-	-	-
Total	3.00	-	-	-	5.62	-	-	-	5.00	-	-	-

Contd...

Table 3. Normative farm plan for different categories of farmers in Siddlaghatta area for maximization of income — *Contd*

Enterprise	Small farmers	Medium farmers	Large farmers
Farm returns (Rs)			
Gross returns	42211	75463	132584
Family consumption	15529	26632	30246
Returns to family labour	26682	48831	102338
Per cent increase over existing plan	388.68	140.33	83.55
Number of enterprises			
Normative plan	4	4	3
Existing plan	8	14	13

The model for maximization of gross returns for medium farmers suggested only four enterprises as against 14 under the existing plan. The net returns generated from the suggested farming system worked out to be Rs 48,831 per farm against Rs 22,175 under the existing plan. Thus, the reorganization of enterprises would result in an increase of Rs 28,513 per farm, depicting 140 per cent rise. The enterprises recommended were 2.85 acres of local tomato during the *kharif* for dry land and 2.10 acres of bivoltine sericulture for tube-well-irrigated land. In addition, the model also suggested one crossbred cow.

The results for maximizing returns for large farmers suggested an optimum plan comprising 4.86 acres of local tomato, 1.34 acres of high-yielding variety of ragi, 2.95 acres of mulberry garden for bivoltine silkworm-rearing and two crossbred cows. The plan envisaged net income of Rs 1,02,338 per farm compared to Rs 55,754 under the existing plan. The model estimated a higher income of Rs 46,584 per farm.

B. Kollegal Area

For the small farmers of Kollegal area, the model suggested to take-up groundnut in 0.50 acres, and maize in 0.30 acres during the *kharif* season; 0.20 acres of maize during the *rabi* season on dry land, 0.43 acres of local paddy and 0.10 acres of high-yielding variety of ragi during *rabi* (Table 4) on tank-irrigated land. As far as mulberry is concerned, it was suggested to have 0.53 acres of bivoltine silkworm-rearing on tubewell-irrigated land apart from 0.10 acre of maize. The farm returns from such combination were expected to be Rs18,000 per farm. The results pertaining to the medium farmers suggested cultivation of 1.05 acres of maize on dry land, 0.21 acres of local paddy under tank-irrigation during *kharif*, 0.20 acres of high-yielding variety of ragi during the *rabi* on tank-irrigated land and 0.75 acres of mulberry garden on tubewell-irrigated land for bivoltine silkworm-rearing. The expected returns from the suggested farm plan were Rs 35,000 per farm. It was suggested that the large farmers should take up 0.20 acres of groundnut, and 0.73 acres of maize during *kharif* and 0.60 acres of maize during the *rabi* season on dry land. For tank-irrigated land, 0.60 acres of local paddy during *kharif* and 0.33 acres of HYV ragi during *rabi* have been suggested. Besides, 1.04 acres of bivoltine sericulture on tubewell-irrigated land was suggested which in turn was expected to yield Rs 45,000 per farm.

Conclusions

Different cropping patterns have been suggested for small, medium and large farms both during *rabi* and *kharif* seasons. By following these

Table 4. Normative farm plan for different categories of farmers in Kollegal area for maximization of income

(acres)

Enterprise	Small farmers				Medium farmers				Large farmers			
	Kharif		*Rabi*		*Kharif*		*Rabi*		*Kharif*		*Rabi*	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
Dry land												
Groundnut	0.50	62.50	-	-	-	-	-	-	0.20	21.51	-	-
Maize	0.30	37.50	0.20	100.00	1.05	100.00	-	-	0.73	78.49	0.60	100.00
Total	0.80	100.00	0.20	100.00	1.05	100.00	-	-	0.93	100.00	0.60	100.00
Tank-irrigated land												
HYV ragi	-	-	0.10	100.00	-	-	0.20	100.00	-	-	0.33	100.00
Local paddy	0.43	100.00	-	-	0.21	100.00	-	-	0.60	100.00	-	-
Total	0.43	100.00	0.10	100.00	0.21	100.00	0.20	100.00	0.60	100.00	0.33	100.00
Tubewell-irrigated land												
Mulberry (Multi.)	-	-	-	-	-	-	-	-	-	-	-	-
Mulberry (Bi.)	0.53	84.13	0.53	100.00	0.75	100.00	0.75	100.00	1.04	100.00	0.14	100.00
Maize	0.10	15.87	-	-	-	-	-	-	-	-	-	-
Total	0.63	100.00	0.53	100.00	0.75	100.00	0.75	100.00	1.04	100.00	0.14	100.00
Dairy animals (No.)												
Crossbred cow	1.00	-	-	-	1.00	-	-	-	7.00	-	-	-
Total	1.00	-	-	-	1.00	-	-	-	7.00	-	-	-

Contd...

Table 4. Normative farm plan for different categories of farmers in Kollegal area for maximization of income— *Contd.*

Enterprise	Small farmers	Medium farmers	Large farmers
Farm returns (Rs)			
Gross returns	18000	35000	45000
Family consumption	6520	8450	21789
Returns to family labour	11480	26550	23211
Per cent increase over existing plan	2.71	15.65	10.70
Number of enterprises			
Normative plan	5	3	4
Existing plan	8	9	9

optimum cropping patterns, the farmers could increase their income substantially even with the existing land. It has been suggested to include crops like mulberry in the cropping pattern with bivoltine silkworm-rearing clubbed with dairying to augment the family income. Hence, mulberry should be included in the crop planning whenever such plans are prepared for partly irrigated areas. Further, as sericulture goes very well with the small and marginal farmers, attempts may be made in the planning process to motivate these groups to adopt silkworm-rearing.

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