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Economic Analysis of Commercial *Chawki* Silkworm Production in Tumakuru District of Karnataka

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Abstract: Rearing of young age silkworms up to the second moult is called as *chawki* rearing which plays a vital role in sericulture industry. Commercial *Chawki* Rearing Centres (CRCs) have gained popularity in ensuring successful silkworm rearing. An attempt was made to study economic analysis of commercial CRCs in Pavagada tehsil of Tumakuru district, Karnataka pertained to the year 2017-18 with a view to analyse the resource use pattern and cost & returns by collecting primary data from *chawki* rearers. CRC as a enterprise involve both maintenance of *chawki* mulberry garden and rearing of *chawki* worms. Per hectare cost of cultivation (maintenance) of *chawki* garden and *chawki* rearing in CRC together amounts to Rs. 24.47 lakhs/annum. Return over cost of production was Rs. 9.59 lakhs whereas return per rupee of total cost incurred was Rs. 1.37 indicating that commercial CRCs are economically viable enterprises. CRCs are found to be highly profitable with an overall benefit cost ratio of 1.63.

Keywords: *Chawki* rearing, costs, returns, input use

INTRODUCTION

Sericulture is an agro-based industry involving rearing of silkworms for the production of silk. Sericulture industry provides employment to approximately 8.25 million persons in rural and semi-urban areas in India [CSB, 2017 (1)]. The major activities of sericulture comprise of food-plant cultivation to feed the silkworms and rearing silkworms up to spinning

cocoons (pre-cocoon sector) and reeling the cocoons for unwinding the silk filament for value added benefits such as processing and weaving (post-cocoon sector). In the pre-cocoon sector of the industry, young age (*chawki*) silkworm rearing commercially has gained importance in ensuring successful silkworm crops during the recent years.

Silkworm larval stage, from hatching to spinning is about 23-24 days duration and clearly differentiated into instars by four moults. The first two instars *i.e.*, till the end of second moult, form the young age or *Chawki* and the last two instars form late age. Rearing of young age silkworms up to second moult is called as *chawki* rearing. This stage of larvae requires ideal environmental conditions, tender mulberry leaves and skilled labour. Development of *chawki* larvae make them resistant to diseases and more stress tolerant during later stages of development enabling harvesting of successful cocoon crop [Savithri, 2013 (3)]. Commercial rearing of *chawki* worms helps in increasing cocoon yield, improvement in quality of cocoons, reduction in rearing expenditure and efficient management of labour. *Chawki* worms supplied through *Chawki* Rearing Centres (CRCs) are uniform, healthy and robust with less contamination. Commercial CRCs have already gained popularity in many parts of South India *viz.*, Karnataka, Andhra Pradesh and Tamil Nadu by significant contribution to the development of sericulture.

Sericulture in Karnataka: It is a one of the agro-industry in the state practising since 350 years and total area under mulberry cultivation in the state was 91492 ha (2016-17). Sericulture sector provides employment opportunities for about 10.67 lakh rural, semi-urban people in Karnataka and one hectare of mulberry cultivation provides year round employment in the state. During 2016-17, 9571 metric tonnes (MT) raw silk was produced in the state including 1488 MT of bivoltine silk. Sericulture is mainly spread over in the southern parts of Karnataka and around 460 CRCs were functioning in the state (2017-18) for promoting sericulture. CRCs in Tumakuru district were contributed prominently for silk production in the state and these units are catering to the needs of farmers in Karnataka and Andhra Pradesh also. Hence, an attempt was made to reveal the profitability of the enterprise to benefit large number of farmers for

exploring the opportunities existing in pre-cocoon sector of sericulture besides rearing of silkworms. The specific objectives of the study is to assess the existing pattern of resource use in *chawki* rearing, to estimate cost, returns and profitability of CRCs in Tumakuru district.

MATERIALS AND METHODOLOGY

This study was purposively conducted in selected Tumakuru district of Karnataka. Out of five tehsils in the district, Pavagada tehsil was selected based on highest number of commercial *chawki* rearers and 10 commercial *chawki* rearers were randomly selected with a minimum experience of 3 years in running the enterprise. A interview schedule against set objectives for measuring the variables of the study was first prepared and pre-tested with *chawki* rearers in the non-sample area. The data was collected through personal interview method and analysed with the help of suitable statistical tools. The technique of tabular analysis was employed for estimating the investment pattern of commercial CRC, establishment and maintenance cost of *chawki* mulberry garden, *chawki* rearing, pattern of labour use, yield and return structure of CRC *etc.* Simple statistical tools like averages and percentages were used to compare, contrast and interpret results appropriately. Investment made on rearing house and equipment was amortised using the following formula

$$A - P \frac{r(1+r)^n}{(1+r)^n - 1}$$

In order to know the relative profitability of investment in commercial *chawki* rearing, discounted measures of project evaluation by considering Pay Back Period (PBP), Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) were computed using following formula.

Pay Back Period (PBP): It represents the length of time required for the stream of cash

proceeds produced by the investment to be equal to the original cash outlay *i.e.*, the time required for the project to pay for itself. In the present study, payback period was calculated by successively deducting the initial investment from the net returns until the initial investment is fully recovered.

Net Present Value

The present value represents the discounted value of the net cash inflows to the project. In the present study, a discount factor of 9.5 per cent was used to discount the net cash inflows representing the opportunity cost of capital. It can be represented by-

$$NPV = \frac{B_1}{[1+k]^1} + \frac{B_2}{[1+k]^2} + \frac{B_3}{[1+k]^3} + \dots + \frac{B_n}{[1+k]^n} - C_0$$

$$NPV = \sum_{t=1}^n \frac{B_t}{(1+k)^t} - C_0$$

where,

B_t = Incremental cash flow of the project during the n^{th} year

n = Economic life of the project

k = Discount rate

C_0 = Initial cost of the investment

t = number of years

Benefit Cost Ratio

The Benefit Cost Ratio (BCR) was worked out by using following formula

$$B:C = \frac{\text{Discounted cash inflows}}{\text{Discounted cash outflows}}$$

Internal Rate of Return (IRR)

The rate at which the net present value of project is equal to zero is Internal Rate of Return (IRR) to the project. The net cash inflows were discounted to determine the present worth following the

interpolation technique. The method of interpolation followed is as under:

$$IRR = \text{Lower discount rate} + \text{Difference between two discount rates} \times \frac{\text{Present worth of cash flows at lower discount rate}}{\text{Absolute difference between Present worth cash flows stream at the two discount rates}}$$

RESULTS AND DISCUSSION

The cost of establishing a commercial CRC can be broadly classified into establishment cost and maintenance cost. So, the establishment cost included the costs incurred at the time of planting *chawki* mulberry garden and maintaining upto one year till establishment for providing sufficient leaf to rear *chawki* worms. The total costs of establishment (Table 1) was found to be Rs. 3.89 lakh per hectare of which material costs constituted 19 per cent, labour costs constituted 31 percent and fixed costs including depreciation of rearing house, other equipments constituted 45 percent of total costs invested. Amortised expenditure on rearing house and equipment accounts to 35 percent of total fixed cost.

All the *chawki* rearers have taken up V1 mulberry variety and are involved in commercial rearing of bivoltine *chawki* worms since more than three years. These costs invested during the year of establishment of CRC were considered as the costs incurred during zero year in the study. During this period, farmers maintain the garden by applying fertilizers, manures, chemicals and providing irrigation.

For establishing a *chawki* mulberry garden, investment has to be made on land, planting material, manure and drip irrigation system which constituted the material costs. Besides establishing *chawki* garden, investment has to be made on construction of a rearing house, rearing equipments like plastic trays, PVC rearing stands, feeding stands, plastic basins, room heaters, humidifier, wet and dry thermometer,

Table 1
Establishment cost of mulberry garden and commercial CRC (Rs./ha)
 Variety: V1 Gestation period: 1 year Maintenance period: 14 year Life : 15 years

Sl. No.	Particulars	Units	I year	
			Quantity	Value (Rs.)
I Variable cost				
A. Material input				
1	Planting material	No.	13750	33000
2	Farm yard manure	MT	28	28000
3	Irrigation	acre inch	48	12250
4	Others			2000
A	Sub total		75250 (19%)	
B. Labour input				
1	Land preparation	machine hours	12	8250
2	Planting	mandays	63	20000
3	Manuring	mandays	30	34560
4	Transportation of manure	machine hours	14	9600
5	Weeding	mandays	108	32832
6	Irrigation	mandays	37	11840
7	Miscellaneous			3000
B	Sub total			120082 (31%)
C	Interest on working capital @ 10% per annum			18557
D	Total variable cost (A+B+C)			213889
II Fixed cost				
1	Depreciation			650
2	Rental value of land (prevailing rate)			75000
3	Land revenue			120
4	Managerial cost @10% of working capital			18557
5	Amortized drip structure cost			19655
6	Amortised rearing house and equipment			60758
E	Total fixed cost			174739 (45%)
F	Total cost (D+E)			388628

incubation frames, plastic crates *etc* (Table 2). Initial investment for establishment of a commercial CRC with a rearing house involves expenditure of Rs. 15.70 lakhs (Table 2). Ideal plan for a commercial CRC is to brush 5000 dfls per batch (once in 10

days) and 32 crops/year with total brushing of 1.6 lakhs dfls/annum. A separate *chan'ki* mulberry garden in an area of 2 acres (8 crops/year) would provide 1000 kg to rear 5000 layings per batch from one year after establishment of garden (Sivaprasad, 2015 (4)).

Table 2
Chawki rearing house and equipment of commercial CRC

<i>Equipment</i>	<i>Quantity (No.)</i>	<i>Unit cost (Rs.)</i>	<i>Total cost (Rs.)</i>	<i>Amortised cost (Rs.)</i>
Rearing house for <i>chawki</i> worms (1800 sq.ft.)	1	600	1080000	63372
Plastic rearing trays (2'X 3')	520	480	249600	22449
PVC Rearing stands	6	12000	72000	6476
Incubation frame	100	60	6000	540
Feeding stands	8	200	1600	144
Leaf chopping machine	2	38000	76000	5592
Litter Baskets	10	100	1000	90
Plastic basins	55	20	1100	136
Leaf collecting basket	30	50	1500	337
Brushing net	180	60	10800	5726
Bed cleaning net	320	40	12800	6787
Room heater	4	5600	22400	5032
Humidifier	2	18000	36000	4438
Power sprayer	1	20000	20000	2466
Wet & dry thermometer	3	175	525	546
Sub-Total	1570325	60758		
Drip irrigation	2.5	35000	87500	19655

The maintenance cost of CRC includes *chawki* garden maintenance and rearing of *chawki* worms to supply sericulture farmers. Dfls purchased at Rs. 700/100 dfls constitutes highest (58 %) to the total variable costs followed by human labour engaged (7 %) and disinfectants in *chawki* rearing (7 %), as disinfection of rearing house, surroundings and equipments is very crucial during *chawki* rearing. Application of chemicals, pesticides and fungicides to the garden may have adverse effect on *chawki* worms and hence, pest and disease control measures are undertaken with mechanical and biological control methods only.

It was observed from the table 4 that variable costs contribute to 80 percent of total cost and the total cost of production of 1.60 lakh dfls per annum was Rs. 24.46 lakhs. Majority of the entrepreneurs engaged human labour for all the operations from

brushing, cleaning, feeding, harvesting leaf and transportation to rearing house and packing for distribution on contract basis. Average selling price of 100 dfls is Rs. 2200, thus obtained a gross return of Rs. 35.20 lakhs/annum. Returns over cost of production was Rs. 9.59 lakhs, whereas returns per rupee of total cost was Rs. 1.37 indicating that commercial CRCs were economically viable enterprises and these results are in line with Jayaram *et al*, 2013.

The CRC is a long run enterprise and once initiated it can be run for 15 years as mulberry can be grown upto 15 years. Initial year is investment period and once the garden establishes after one year, *chawki* worms can be reared to full capacity of 5000 dfls brushing per crop. Even from six months after planting, dfls can be brushed to a minimum level depending on the growth of mulberry garden. Cost

Table 3
Total costs of mulberry cultivation (per one hectare) and *chawki* rearing

<i>Sl. No.</i>	<i>Particulars</i>	<i>Unit</i>	<i>Quantity</i>	<i>Value (Rs.)</i>
I Variable cost/working capital				
A. Mulberry cultivation				
1	Farm yard manure	MT	46	46000
2	Chemical fertilizers (NPK and others)	kg.	2613	29575
3	Irrigation	acre inch	52	13271
		mandays	37	11840
4	Manuring	mandays	42	33240
5	Weeding	mandays	53	16896
6	Chemical fertiliser application	mandays	32	10160
7	Pruning	machine hours	7.5	4950
		mandays	17	5440
8	Miscellaneous expenditure	5000		
B. Chawki production				
1	Dfls			1120000
2	Paraffin paper			68000
3	Disinfectants			140000
4	Human labour			141440
5	Others (transportation of <i>chawki</i> , electricity <i>etc</i>)			137071
6	Interest on working capital @10 % per annum			169374
Total variable cost				1952257
II. Fixed cost				
1	Depreciation			658
2	Rental value of land (prevailing rate)			75000
3	Land revenue			125
4	Managerial cost @ 10 % of working capital			169374
5	Risk premium @ 5% of 80% of working capital			71315
6	Amortized drip structure cost			19251
7	Amortized rearing house and equipment (total)			123455
8	Amortized establishment cost			35175
Total fixed cost				494322
Total cost				2446579

and returns of the enterprise are spread over a long period and worthiness of investment should be analysed carefully to enable wise decision making by farmers. Hence, the technique of project evaluation such as payback period, net present value, benefit-cost ratio, and internal rate of return were employed to analyse the investment feasibility of CRC.

The initial investment, maintenance cost and gross return were considered at 9.5 per cent discount rate which represents the opportunity cost of capital. The initial investment on establishment of one hectare of mulberry garden was Rs. 3.88 lakhs, an amount of Rs. 0.90 lakhs for installing drip irrigation, Rs. 10.80 lakhs on construction of rearing house and

Table 4
Costs and return structure of commercial CRC

Sl. No.	Particulars	Value (Rs. in lakhs) Per ha
1	Fixed cost	4.92 (19.3%)
2	Variable cost	19.52 (94.4%)
3	Cost of production	24.47
4	Marketing cost	1.15 (6.0%)
5	Paid out cost (variable cost and marketing cost)	20.67 (80.7%)
6	Total cost of production	25.61
7	Sale price/100 dfls (Rs.)	2200
8	No. of dfls reared per annum	1.60
9	Gross return	35.20
10	Returns over variable cost	15.68
11	Returns over paid out cost	14.53
12	Returns over total cost	9.59
13	Returns per rupee of variable cost	1.80
14	Returns per rupee of paid out cost	1.70
15	Returns per rupee of cost of production	1.44
16	Returns per rupee of total cost (including marketing cost)	1.37

Rs. 5 lakhs on purchase of rearing equipment. Second year onwards a maximum yield of 38 MT/ha/year can be obtained and 1.6 - 2.0 lakh dfls can be reared in a 32 crop schedule (3 crops/month with brushing once in every 10 days and *chawki* leaf of 20 kg/100 dfls). The streams of costs and benefits during establishing period and maintenance period have been annualized at 12 per cent discount rate.

The streams of costs and benefits during establishment and maintenance period (first to fifteen years) have been annualized at 12 per cent discount rate. The pay back period was found to be 3.0 years which is low and indicate that the initial investment can be earned back with a successful management

of the unit. High initial investment is involved in establishing the unit and purchasing dfls for regular brushing besides higher rate of returns. Net present value (NPV) criterion helps to evaluate the benefits accrued and costs incurred during the project life. Pertaining to CRCs in the study area, NPV was calculated by discounting net cash inflows and it is found as Rs. 76.64 lakhs per hectare at 9.5 per cent discount rate. It clearly indicated the economic feasibility and financial soundness of CRCs. Benefit cost ratio is used as another tool for appraising the worthiness of investment and it helps to ascertain the profitability of an enterprise. In commercial CRCs of study area, the initial investment and rearing expenditure on purchase of dfls is very high in the initial years of establishment. The cash inflows exceeded the cash outflows in the later years enabling the entrepreneurs to obtain more profits.

The B:C ratio of 1.63 at 9.5 per cent discount rate has indicated the worthiness of investment on CRCs. Thus, it could be concluded that investment in CRC is economically viable and financially feasible. Internal rate of return is suggested to be very suitable measure for evaluating the profitability of investment on different projects. It is superior over the other measures by considering the reinvestment opportunities of enterprises during the life span. The internal rate of return was 80 per cent. It is the earning power of money invested in CRC during its life span, as IRR was more than the opportunity cost of capital it clearly indicated that investment on CRC is a financially sound and economically viable proposition. Thus, all the four criteria of investment feasibility revealed that investment in CRC is a profitable and financially attractive proposition.

CONCLUSION

Today majority of the farmers brush CRC reared silkworms and many of the enterprises have proven practically as a remunerative enterprise, providing employment to rural youth, helping farmers to have

Table 5
Cash flow analysis of commercial CRC (Rs.)

Sl.No.	Cash outflow	Discounted cash out flow	Cash inflow	Discounted cash inflow	Net cash flow	Discounted net cash flow
1	2905147	275989	1760000	167200	-1145147	-108789
2	1846027	175373	3520000	334400	1673973	159027
3	1897853	180296	3523520	334734	1625667	154438
4	1848014	175561	3523872	334768	1675858	159207
5	1898336	180342	3524577	334835	1626241	154493
6	1999951	189995	3525634	334935	1525683	144940
7	1899462	180449	3527045	335069	1627583	154620
8	1850267	175775	3528808	335237	1678541	159461
9	1901233	180617	3530926	335438	1629692	154821
10	1852361	175974	3533397	335673	1681036	159698
11	1904784	180954	3536224	335941	1631440	154987
12	1855104	176235	3539407	336244	1684303	160009
13	2006558	190623	3542592	336546	1536034	145923
14	2158013	205011	3545780	336849	1387767	131838
15	2158013	205011	3548972	337152	1390959	132141
Total	29981124	2848207	51210754	4865022	21229630	2016815

Table 6
Financial feasibility of investment in commercial CRC

Sl.No.	Particulars	Unit	Value
1	Payback period	Year	5
2	Net present value (@ 9.5% discount rate)	Rs. in lakhs/ ha	76.64
3	B:C ratio (@ 9.5 % discount rate)	Returns per rupee of investment	1.63
4	IRR	percent	80.00

successful cocoon crops with regular crop monitoring and technical assistance. Following scientific method of *chawki* rearing by adopting right packages through the course of *chawki* rearing in maintenance of mulberry garden and ideal micro climatic conditions has excelled the CRC entrepreneurs in the study area.

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