**Research Article**

# DEVELOPMENT OF BIVOLTINE SERICULTURE IN ANDHRA PRADESH AND TELANGANA STATES OF INDIA THROUGH CLUSTER PROMOTION PROGRAMME (CPP)

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**ABSTRACT**

**To elevate India in to International market with gradable silk the Cluster Promotion Programme (CPP) was implemented under XII five year plans during 2014-2019. Out of 102 clusters in Southern India 17 clusters were distributed to Andhra Pradesh (13) and Telangana States (4). The clusters under AP scattered in Atmakur & Pathikonda under Kurnool district; Penukonda, Hindupur, Madakasira and Kalyanadurgam under Anantapur district; Palamaner, V. Kota and Chittoor under Chittoor district; Giddalur under Prakasham district; Guntur and Vijayawada under Guntur & Krishna districts, Bhimadole under West Godavari district where as Chebrolu under East Godawari district. Similarly 4 clusters under TS spread over Bhongir and Suryapet under Nalgonda district; Metpalli under Karimnagar district where as Zaheerabad under Sanga Reddy district to implement CPP scrupulously for the development of Bivoltine sericulture. During five years period the impact of CPP was noticed in the Andhra Pradesh (AP) & Telangana State (TS) as that, in AP 382.13 DFLs were distributed against the target of 351.50 lakhs with an achievement of 112.61% increase. Yield of cocoon for 100 DFLs was enhanced to 71.07kg as compared to the bench mark yield (42.50kg) with 67.22% increase. In case of Telangana state (TS), 42.44 lakhs DFLs were distributed as against the target of 39.65 lakhs with 106.58% improvement. Cocoon yield was raised to 67.09kg/100 DFLs with 57.67% improvement over benchmark yield. Further, 370 DFLs were harvested among 1,43,467 farmers with 28,478.4MT cocoon generating 3,899.3MT raw silk fetching an average market rate of Rs. 366.9 in AP. In case of TS 38.92 DFLs were harvested among 13,711 farmers with 2,655.1MT cocoon generating of 379.3MT raw silk enticing an average market value of Rs. 345.13. The above findings witness that CPP implementation in both the states (AP & TS) not only proved to be a successful venture but also established as a very secured and remunerative farming compared to any other farming. Further, adoption of sericulture among the sates not only contributed significantly in generating gradable Bivoltine raw silk but also generated a ray of hope in improving the socio economic conditions of the sericultural farming fraternity.**

## INTRODUCTION

The annual raw silk production of India has reached a peak level of 23,060 MT in the year 2011-12. However, there is a short fall of 5,700 MT of raw silk production considering the actual domestic requirement in the country. Moreover, about 90% of the mulberry raw silk produced in the country is of cross breed silk which is rather non-gradable in quality. Therefore, production of gradable quality bivoltine silk has become the prime agenda of Indian sericulture industry (Himantharaj *et al.*, 2012, Satyanarayana Raju *et al.*, 2014; Sudhakar *et al.*, 2018). Jaishankar and Dandin

(2005) emphasised on the effective extension communication mechanisms, percolation of cost-effective technologies that fit well into the region and followed by the better interaction and involvement of Scientists, extension and field functionaries towards the end users to identify, assess and find a solution to a problem. These kind of participatory approaches will definitely results in achieving the anticipated targets. In this direction many extension approaches such as Catalytic Development Programmes (CDP), Institute Village Linkage Programmes (IVLP) and Technology Validation and Development Progarmmes (TVDP) have adopted by the Central Sericultural Research and Training Institute (CSR&TI), Mysore was adopted this ideal concepts in sericulture for the transfer of technologies to the farmers from time to time with the support of State Sericulture Department and the results were encouraging (Sreenivas *et al*., 2010). Among them cluster development approach is one such approach, which is holistic, information based and participatory extension mode with Research-Extension-Farmer (R-E-F) linkage. This approach was effectively implemented in the farm of five year plans during 2008-13 for large scale promotion of bivoltine sericulture in India particularly in Southern major silk producing regions and the results was encouraging (Himantharaj *et al.,* 2012, Qadri, 2012, Sudhakar *et al*., 2018).

The Cluster Promotion Programme (CPP) was implemented under XII five year plan during 2013-2019 in India for boosting the bivoltine sericulture development, the Central Silk Board (CSB) and state sericulture department, have jointly organised 174 clusters all over India *i.e.,* 102 clusters in 5 states of Southern zone, 45 in 5 states of North-western zone, 11 in 3 states of Central Western Zone, 7 in 3 states of Eastern zone and 9 in 8 states of North Eastern zone, respectively. Out of 102 clusters in Southern India 46 clusters were implemented in Karnataka, 28 clusters in Tamil Nadu, 17 clusters in Andhra Pradesh, 4 in Maharashtra whereas 2 in Kerala with an anticipated 167.06 lakh DFLs brushing and generate 1920MT of bivoltine raw silk. Among 17 clusters of Andhra Pradesh (AP) and Telangana States (TS), 13 clusters were preferred to implement in all the nook of AP such as Atmakur & Pathikonda under Kurnool district; Penukonda, Hindupur, Madakasira and Kalyanadurgam under Anantapur district; Palamaner, V. Kota and Chittoor under Chittoor district; Giddalur under Prakasham district; Guntur and Vijayawada under Guntur & Krishna district, Bhimadole under West Godavari district where as Chebrolu under East Godawari district. In case of Telangana State 4 clusters were selected such as Bhongir and Suryapet under Nalgonda district; Metpalli under Karimnagar district where as Zaheerabad under Sanga Reddy district to implement CPP meticulously for the development of Bivoltine sericulture.

Andhra Pradesh Geographically, it was located along the east coast of the country bordering by the Bay of Bengal, South by the Madras state, West by the Mysore and Hyderabad state and Northern side of the state was bounded by the Orissa and Madhya Pradesh. It had an area of 63,608 square miles. Present the state consists with 23 districts with three distinct economic regions namely Coastal Andhra comprising of nine districts, Rayalaseema comprising four districts whereas Telangana region is a former princely state of Hyderabad comprises ten districts. However, in the recent past the state has been alienated in to two states as Andhra Pradesh and Telangana. Topographycally state is on high level giving a picture of Deccan Plateau situating towards the Eastern Coast. Most of the rivers flow through the eastern plains and finally confluences the Bay of Bengal not benefitting for irrigation, The total population of the state (as per 1991 Census) is 6,65,08,008 dependent on agriculture. The State is blessed with many congenial agro-climatic conditions most suitable for agriculture and the crops are grown practically around the year such as Rice, wheat, jowar, bajra, maize, ragi, pulses, groundnuts, castor, sesamum, oil seeds, cotton, mulberry, tobacco, sugarcane and chillies are the principal crops grown in the State. Sericulture is ideally suited to a predominantly agricultural State like Andhra Pradesh. The main concentration has been in the Rayalaseema region of the State, where climatic conditions are favourable for this industry, Andhra Pradesh produces both mulberry and tasar silk. Though Andhra Pradesh achieved significant place in the development of sericulture but also falls under non-traditional state for sericulture. Telangana is situated in the central stretch of the Eastern sea board of the Indian Peninsula consisting of largest area with 44,300 square miles. The Deccan Plateau is drained with two major rivers Godavari and Krishna with 69 & 79% catchment area followed by other 11 minor rivers. Telangana having 4256 farmers spread over 31 districts practicing sericulture from the decades still the state falls under non-traditional zone for sericulture. The state records with 42°C as high temperature during summer with an average temperature of 22-23°C with little humidity. Along with sericulture with subsistence of agricultural crops such as rice, corn, millet, pulses, cotton, sugar cane too will be cultivated beside sericulture. Therefore, with the above profiles of both the sates anticipating beyond 20,000 MT of raw silk from Andhra Pradesh and above 2,000 MT raw silk from Telangana state, the Cluster Promotion Programme (CPP) was implemented scrupulously. The results were encouraging and the same were presented and discussed in the Table 1,2,3 and Fig. 1 & 2.

## MATERIALS AND METHODS

Though the Cluster Promotion Programme (CPP) was implemented in Andhra Pradesh (AP) and Telangana states (TS) during X and XI five plans but X plan was not uniformly implemented in all the clusters. Hence, under XII five year plan from 2014-2019 CPP was meticulously

imparted among both the states for the development of bivoltine sericulture. For the implementation of CPP Among 17 clusters of AP and TS, 13 clusters were preferred to implement in Atmakur & Pathikonda under Kurnool district; Penukonda, Hindupur, Madakasira and Kalyanadurgam under Anantapur district; Palamaner, V. Kota and Chittoor under Chittoor district; Giddalur under Prakasham district; Guntur and Vijayawada under Guntur & Krishna districts, Bhimadole under West Godavari district where as Chebrolu under East Godawari district. Similarly In case of TS 4 clusters were selected such as Bhongir and Suryapet under Nalgonda district; Metpalli under Karimnagar district where as Zaheerabad under Sanga Reddy district to implement CPP scrupulously for the development of Bivoltine sericulture. In the CPP approach in each cluster group of villages and conventional sericultural families located nearby were selected and adopted to have areas/mass effect of the improved technologies incorporated under the programme so that the activities are manageable easily with the limited technical (Scientist & Technical staff) and extension field functionaries jointly by the active involvement of local stake holders. Under this programme, contiguous villages within the radius of around 20-30km are selected to save time and money on transport and to facilitate closer monitoring and interactions of scientist as well as field functionaries with cluster farmers and to ensure good and anticipated results. One village or a cluster of villages located nearby is selected such way that as far as possible eligible farmers of villages/cluster of villages are covered under the CPP (Sathyanarayana Raju *et al*., 2014; Sudhakar *et al*., 2018).

Initially, a preliminary bench mark survey was conducted jointly by the Scientist and Dept. of Sericulture (DOS) among the both states (AP & TS) to understand the status of mulberry area, variety, spacing, rearing house and rearing facilities to quantify the requirement of farmers and also funds to meet the farmers requirements. Basing on survey the assistance is provided to the farmers through Catalytic Development Programme (CDP) to strengthen the facilities, encourage and motivate the bivoltine sericulture farming under the cluster. For effective implementation of the cluster activities the following steps were imparted:

- All the 17 clusters in Andhra Pradesh (13) and Telangana State (4) were operated under the control of South nodal center Regional Sericultural Research Stations (RSRS) of Ananthapur, Andhra Pradesh and RSRS, Mulugu, Telangana. The Scientist as Cluster Development Facilitator (CDF) and Technical Staff of RECs were implemented the CPP activities with closed Co-ordination of extension officers of Dept. of Sriculture (DOS) as another CDF and their field functionaries of both states.
- A localized Chawki Rearing Centers (CRC) were recognized for better technology intervention, followed by the proper training to the entrepreneur at CSRTI, Mysore and required financial assistance was extended under CDP to provide inputs support and service to the cluster farmers.
- For silkworm rearing of the farmers, chawki worms were reared at CRC and healthy and robust chawki worms were supplied after joint quality Chawki certification by the co-ordinating Cluster Development Facilitators (CDFs) - Scientist and DOS official.
- Both the CDFs of respective CPPs were subject specialists as well as other Technical and field functionaries regularly visited the farmers mulberry gardens and silkworm rearing crops and extended technical guidelines for quality mulberry leaf production and successful rearing crops.
- Points in time non-performing farmer garden soils were analyzed for their soil reaction (pH & EC) and nutrient (OC%, available P & K) parameters, basing on the soil analysis amelioration recommendations were served so as to improve their garden soils for enhanced quality leaf production.
- Every year during monsoon green manuring was promoted among the CPP farmers gardens through the supply of leguminous family plant seeds such as sunhemp, dhaincha, cow pea, pigeon pea, chick pea, horse gram green manure seeds depending on the availability (@ 8kg/ac to sow during monsoon) under INM to enrich the soil nutrient status.
- Biological control agents to control Tukra (with *Cryptolaemus montrouzieri*) and Leaf roller (with *Tricogramma chilonis*) as IPM components to minimize the leaf loss due to the above pests.
- Biocontrol agents of *Nesolynx thymus* to control Uzi menace for silkworm crops.
- The farmers were motivated for indenting and rearing bivoltine as well as improved double hybrid races in all the seasons in a year and rearing performance data were collected after each rearing crop.
- The farmers were encouraged to undergo various kinds of trainings as imparted at the main institute as well as other training centers of state and central Govt.
- Besides, various kinds of ECPs as enlisted in the Table 1 were conducted under cluster villages to educate the farmers on various improved technologies for encouragement and boosting the confidence levels in rearing bivoltine silkworm crops.
- The crop performance was monitored constantly and periodically at higher level meetings in regard to the achievements against the targets.
- During the CPP progress review meetings the performance of the respective clusters as against the targets were assessed, depending on their performance necessary target alterations will be made.

- Study tours organized to understand the adoption levels of sericulture technologies and interaction with progressive formers at field level.

The impact of CPP implementation for 5 years from 2014-2019 under AP and TS among 17 clusters impact study was conducted to analyze the brunt of CPP on cocoon production, quality and economic gain of the sericulturists were assessed and the results are presented in Table 1,2,3 and Fig. 1,2,3.

## RESULTS AND DISCUSSION

Before initiation of the Cluster Promotion Programme (CPP) in both the states (AP & TS) a bench mark survey was conducted meticulously during 2011-13 to assess the initial status of existence of bivoltine sericulture and the technical knowhow of the mulberry and sericulture farming in and around the AP & TS clusters. Survey revealed that both bivoltine and cross breed (CB) silkworm rearing was existing in the cluster to a limited level. The bench mark survey revealed that the average disease free laying (DFLs) brushing was ranging from 35,000 to 45,000 with a meager level of cocoon yield of 42.5kg/100dfls with a meager market value of Rs. 226/- per kg indicating the uneconomic and not a feasible venture of adopting sericulture by the farming community. After imparting the CPP by involving all the modalities during 2014 to 2019 for 5 years during the XII five year plan the sericulture has shoot up to the beyond expected levels and proved to be an effective and economically viable venture for the socio economic upliftment of the sericultural farming community raising the hopes of their safety and security. Five years efforts in implementing the bivoltine sericulture in AP among 13 clusters and TS in 4 clusters were presented in the Table 1,2,3 and Fig. 1,2,3.

**Table 1. Bivoltine disease free layings (DFLs) distribution and cocoon yield among the clusters in Andhra Pradesh (AP) & Telangana states (TS)**

| Clusters | DFLs distribution | | | Cocoon yield | |
|---|---|---|---|---|---|
| | DFLs Target (Lakh) | Achievement (Lakh) | % of achievement | Kg / 100 DFLs | Increase over BM (%) |
| A. Andhra Pradesh State: | | | | | |
| Atmakuru | 11.60 | 12.45 | 108.4 | 69.78 | 64.19 |
| Bhimadole | 13.30 | 10.15 | 89.29 | 67.52 | 58.87 |
| Chebrolu | 17.90 | 18.57 | 104.4 | 73.68 | 73.36 |
| Chittoor | 11.80 | 14.53 | 148.0 | 72.98 | 71.72 |
| Giddaluru | 16.05 | 17.25 | 107.7 | 69.17 | 62.75 |
| Hindupur | 30.20 | 34.87 | 116.7 | 69.99 | 64.68 |
| Kalyandurg | 22.00 | 25.25 | 124.7 | 71.92 | 69.22 |
| Madakasira | 45.35 | 53.65 | 123.82 | 71.35 | 67.88 |
| Palamaneru | 62.00 | 68.74 | 118.62 | 71.08 | 67.25 |
| Pathikonda | 16.30 | 17.88 | 106.20 | 73.43 | 72.78 |
| Penukonda | 17.40 | 21.18 | 117.56 | 72.52 | 70.64 |
| V. Kota | 76.50 | 78.13 | 101.63 | 73.33 | 72.54 |
| Vijayawada | 13.70 | 12.51 | 93.25 | 67.83 | 59.60 |
| TOTAL | 351.50 | 382.13 | 112.61 | 71.07 | 67.22 |
| B. Telangana State: | | | | | |
| Bhongir | 8.70 | 9.05 | 101.55 | 67.64 | 59.16 |
| Metpalli | 8.75 | 10.10 | 114.82 | 63.14 | 48.59 |
| Suryapet | 10.60 | 11.40 | 108.42 | 69.78 | 64.19 |
| Zaheerabad | 11.60 | 11.89 | 101.52 | 67.81 | 59.55 |
| TOTAL | 39.65 | 42.44 | 106.58 | 67.09 | 57.87 |

*BM= Bench mark yield was assessed among all the CPPs and taken the mean value as 42.5 kg/100 dfls.

It was observed that the Bivoltine DFLs distribution under 13 clusters of AP was significantly varied. The distribution of DFLs was ranged from 10.15 lakhs to 78.13 lakhs as against the DFLs 11.60 to 62.00 lakhs targeted. Higher no of DFLs were brushed in V. Kota cluster (78.13) as against the 76.50 lakhs followed by Palamaneru (68.74 vs 62.00), Madakasira (53.65 vs 45.35), Hindupur (34.87 vs 30.20), Kalyandurga (25.25 vs 22.00), Penukonda (21.18 vs 17.40),

Chebrolu (18.57 vs 17.90), Pathikonda (17.88 vs 16.30), Giddaluru (17.25 vs 16.05), Chittoor (14.53 vs 11.80), Vijayawada (12.51 vs 13.70), Atmakuru (12.45 vs 11.60) however, least no of DFLs were distributed in Bhimadole (10.15 lakh) against the target of 13.30 lakhs. The achievement of DFLs brushing against the target was ranged from 89.29% to 148.0%. Significantly higher level of achievement in DFLs distribution was noticed in Chittoor with 148.0%. Significant level of increase in cocoon yield was recorded in Chebrolu with 73.68kg whereas least was recorded with 67.82kg/100 dfls. Percent increase of yield over benchmark level was noticed maximum in Chebrolu with 73.60% whereas least in Bhimadole (58.87%). In case of Telangana Zaheerabad recorded highest number of DFLs distribution (11.89lakh) as against the target of 11.60 lakhs followed by Suryapet (11.40 vs 10.60), Metpalli (10.10 vs 8.75), whereas least was noticed in 9.05 against the targeted DFLs of 8.70 lakhs. The achievement of DFLs brushing was ranged from 101.52% to 114.82% recording highest in Metpalli cluster. Cocoon yield was recorded higher in Suryapet with 69.78kg/100 dfls followed by Zaheerabad (67.81), Bhongir (67.64) and least was in Metpalli with 63.14kg/100 dfls. The achievement of cocoon yield was recorded maximum in Suryapet with 64.19% and least was in Metpalli with 48.59%. Overall performance of DFLs distribution in Andhra Pradesh (AP) was recorded as 382.13 against the target of 351.50 lakh with 112.61% achievement followed by a cocoon yield of 71.07kg/100 dfls. Whereas Telangana State (TS) recorded 42.44 lakh DFLs distribution against the target of 39.65 lakh DFLs with 106.58% achievement followed by 67.09kg/100 dfls yield (Table 1 & Fig. 1).

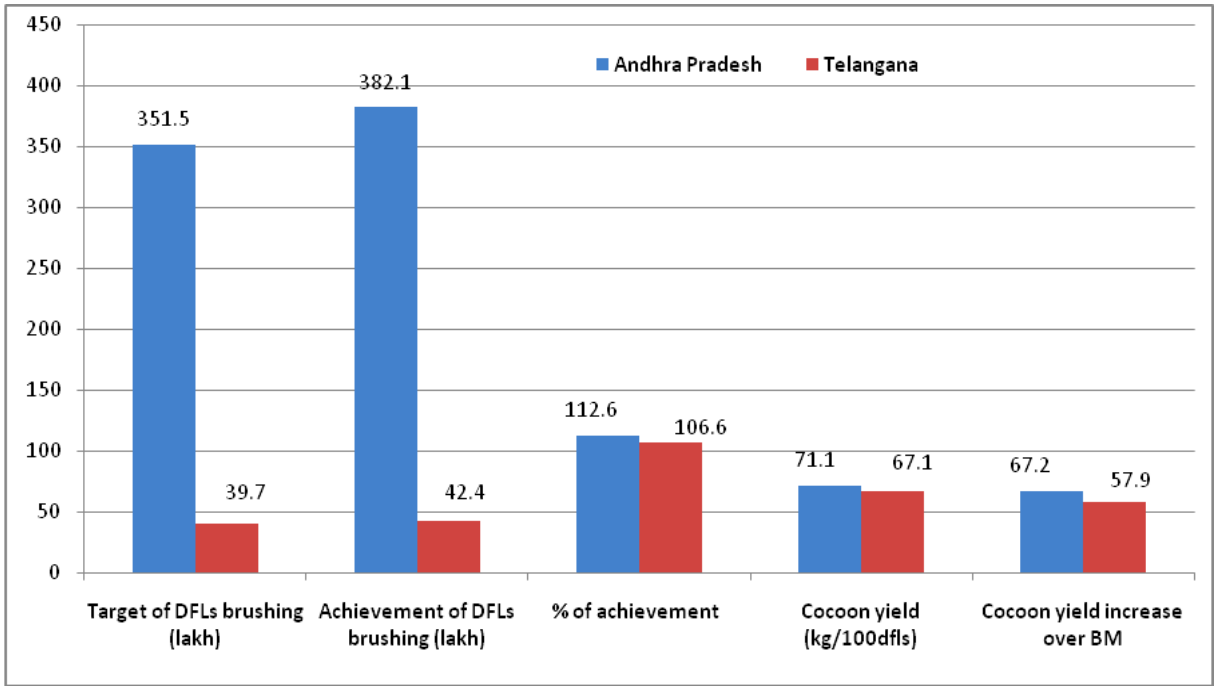


**Fig. 1. Performance DFLs brushing and Cocoon yield among the CPPs under AP & TS**

The increase of DFLs brushing and cocoon yield/100DFLs among the farmers of CPPs under both the states AP and TS may be due to the better adoption of critical technologies in imparting recommended manure and fertilizer applications and adopting soil analysis based amelioration of their mulberry gardens and effective disinfection of silkworm rearing houses by the use of improved disinfectants such as Asthra & Serifit followed by the personal hygiene and better rearing management and the results are in agreement with the earlier studies conducted (Jaishankar and Dandin, 2005; Himantharaj et al., 2007; Sreenivas et al., 2009). This study is also corroborated with the similar study conducted by other Scientists in various clusters (Sreenivas et al., 2010; Himantharai et al., 2012; Sudhakar et al., 2018, 2019).

Cocoon yield among 13 clusters under AP was ranged from 559.8MT to 5851.6MT contributing the raw silk production ranging from 89.86MT to 684.9MT. Maximum cocoon yield and raw silk production was contributed by Madakasira (5851.6 & 835.9MT) followed by V. Kota (5566.4 & 581.6MT), Palamaneru 4794.0 & 684.9MT), Hindupur (2522.3 & 360.3MT), Kalyandurg (1773.7 & 253.4MT). Rest of the clusters were recorded at par with each other cluster in the range of 559.8 & 89.86MT in the ascending order of the CPPs Atmakur, Bhimadole, Vijayawada, Chittoor, Giddaluru, Pathikonda, Chebrolu and Penukonda. Moreover, bivoltine cocoons generated by the CPP adopted farmers among the clusters fetched higher market price during the CPP implementation period compared to the onset of CPP implementation.

**Table 2. Bivoltine DFLs harvesting, raw silk production and average market rate among the clusters under the states AP & TS**

| Clusters | DFLs harvestd (Lakhs) | Among farmers (No.) | Total cocoon yield (MT) | Raw silk production (MT) | Average market rate (Rs/kg)) |
|---|---|---|---|---|---|
| A. Andhra Pradesh State: | | | | | |
| Atmakuru | 9.03 | 2892 | 559.8 | 89.86 | 372.6 |
| Bhimadole | 9.77 | 3923 | 664.3 | 94.91 | 297.3 |
| Chebrolu | 17.43 | 5146 | 1289.1 | 184.2 | 328.2 |
| Chittoor | 13.78 | 5286 | 1035.5 | 148.0 | 369.8 |
| Giddaluru | 16.63 | 4846 | 1039.9 | 167.9 | 381.9 |
| Hindupur | 34.79 | 12727 | 2522.3 | 360.3 | 378.8 |
| Kalyandurg | 24.27 | 10216 | 1773.7 | 253.4 | 374.3 |
| Madakasira | 53.65 | 19449 | 5851.6 | 835.9 | 382.4 |
| Palamaneru | 66.13 | 29606 | 4794.0 | 684.9 | 370.7 |
| Pathikonda | 17.16 | 4979 | 1096.5 | 174.1 | 380.8 |
| Penukonda | 20.06 | 9002 | 1458.7 | 209.7 | 380.2 |
| V. Kota | 75.26 | 30537 | 5566.4 | 581.6 | 373.0 |
| Vijayawada | 12.03 | 4858 | 826.6 | 114.5 | 315.6 |
| TOTAL | 370.0 | 1,43,467 | 28,478.4 | 3,899.3 | 366.9 |
| B. Telangana State: | | | | | |
| Bhongir | 8.89 | 2971 | 605.7 | 86.5 | 337.7 |
| Metpalli | 9.86 | 3429 | 659.8 | 94.3 | 333.7 |
| Suryapet | 12.23 | 4089 | 868.8 | 124.1 | 353.6 |
| Zaheerabad | 11.2 | 5295 | 768.8 | 109.8 | 346.4 |
| TOTAL | 38.92 | 13,711 | 2,655.1 | 379.3 | 345.13 |

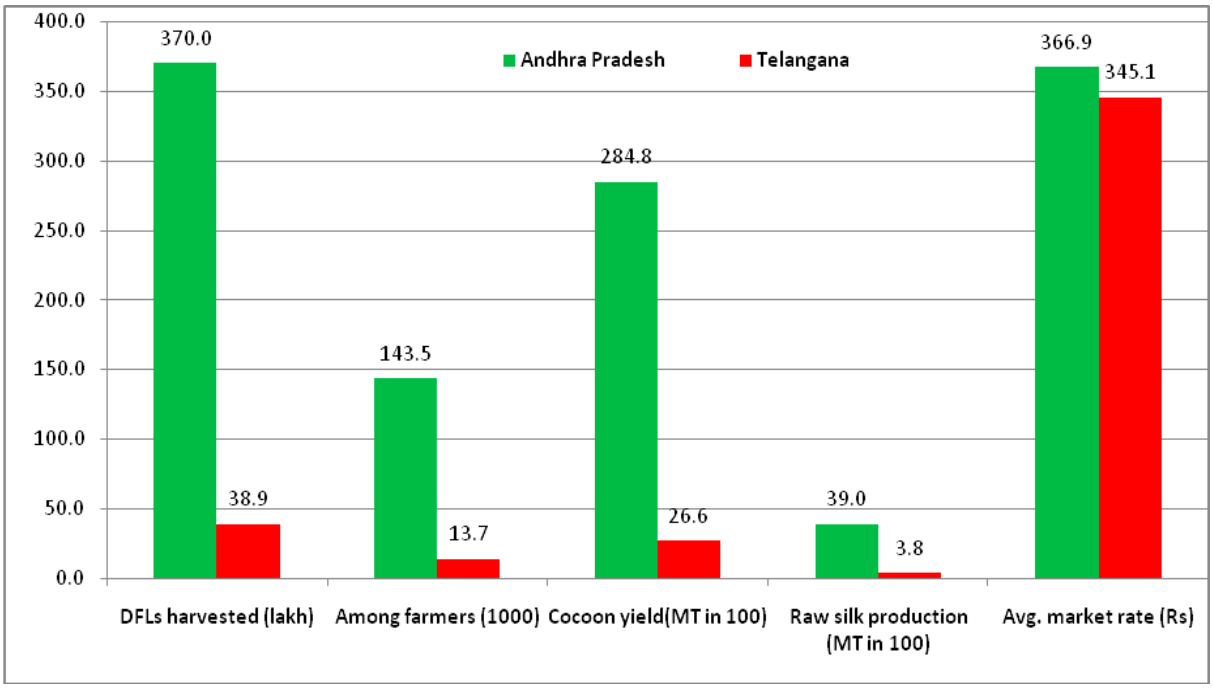


**Fig. 2. Bivoltine cocoon harvesting, raw silk production and average market rate of the clusters under AP & TS states**

Average market rate was recorded ranging from Rs. 297.3 to 382.4 with an average market rate of Rs. 366.9. During the 5 years period Madakasira was recorded highest market rate with Rs. 382.9 out of all the clusters. In case of Telangana State (TS) higher cocoon yield and raw silk production was noticed in Suryapet cluster (868.8 MT & 124.1 MT) followed by Zaheerabad (768.8 & 109.8), Metpalli (659.8 & 94.3Mt) and least was in Bhongir cluster (605.7 & 86.5MT). Average market rate of cocoon was ranging from Rs. 333.7 to 353.7 with maximum rate in Zaheerabad with Rs. 346.4. Among both the states AP recorded with an average DFLs brushing of 370 DFLs among 1,43,467 sericulturists with 28,478.4 MT cocoons generating 3,899.3MT raw silk with an average market rate of Rs. 366.9 among 13 clusters. Whereas Telangana (TS) recorded 38.92 DFLs harvesting among 13,711 farmers with 2,655.1MT cocoon with 379.3MT raw silk achieving an average market rate of Rs. 345.13 out of 4 clusters (Table 2 & Fig. 2).

**Table 3. New mulberry plantation undertaken among clusters and organization of ECPs for sensitization of sericulturists on improved technologies for the development of bivoltine sericultuere in AP & TS**

| Clusters | New mulberry plantation (Acres) | Among the farmers (No.) | ECPs organised (No.) | Sensitizing of Sericulture farmers (No.) |
|---|---|---|---|---|
| A. Andhra Pradesh State: | | | | |
| Atmakuru | 791.0 | 481 | 61 | 2310 |
| Bhimadole | 546.0 | 301 | 49 | 2870 |
| Chebrolu | 1196.0 | 384 | 46 | 2556 |
| Chittoor | 348.0 | 156 | 67 | 3322 |
| Giddaluru | 541.5 | 247 | 41 | 2159 |
| Hindupur | 1102.0 | 744 | 58 | 4260 |
| Kalyandurg | 1328.0 | 1012 | 64 | 3952 |
| Madakasira | 2797.0 | 1580 | 72 | 4229 |
| Palamaneru | 2402.0 | 1741 | 58 | 3286 |
| Pathikonda | 872.0 | 514 | 18 | 734 |
| Penukonda | 1352.0 | 1306 | 58 | 3085 |
| V. Kota | 3340.0 | 2527 | 66 | 10452 |
| Vijayawada | -- | -- | -- | -- |
| TOTAL | 16,615.50 | 10,993 | 658 | 43,215 |
| B. Telangana State: | | | | |
| Bhongir | 194.3 | 100 | 106 | 4329 |
| Metpalli | 582.8 | 305 | 70 | 3686 |
| Suryapet | 826.5 | 592 | 77 | 3517 |
| Zaheerabad | 271.3 | 194 | 53 | 2322 |
| TOTAL | 1874.90 | 1191 | 306 | 13854 |

The results of the study are in conformation with the earlier studies conducted by several workers in CPP implementation in various locations under different states (Singh *et al.,* 1998; Himantharaj *et al.,* 2011, 2012; Sudhakar *et al.,* 2018, 2019). Due to intensive efforts such as imparting integrated nutrient management (INM) to improve farmers garden soils through green manuring by sowing sunhemp (*Crotolaria juncea*), dhaincha (*Sesbania bispinosa*), cowpea (*Vigna unguiculata*) and horse gram (*Macrotyloma uniflorus*) etc. in monsoon crops, use of integrated pest management (IPM) through the supply of biological control agents such as lady bird beetles (*Scymnus coccivora* and *Cryptolaemus montrouzieri*) for tukra and *Trichogramma chiloins* for leaf roller to enhance quality mulberry leaf production.

Whereas, biocontrol agents of *Nesolynx thymus* to control Uzi menace during silkworm rearing and Asthra and Serifit as effective rearing bed disinfectants for newly evolved silkworm rearing crops were played a major role in preventing the silkworm rearing crops failures and contributing in producing enhanced quality cocoon as detailed in Tables.

The improved rearing technologies popularized among the farming group also resulted in minimizing the cocoon

melting percentage. Again it is proved that generating awareness on improved rearing technologies among the cluster farmers resulted in prevention of silkworm rearing crops and reduction of defective cocoon percentage leading to enhanced quality cocoon production.

During the CPP implementation period among the two states under 17 clusters new mulberry plantation was under taken among the clusters for the horizontal expansion of Bivoltine sericulture development. Under Andhra Pradesh (AP) among the 13 clusters 16,615.5 acres of new V1 mulberry plantation was undertaken among 10,993 farmers, whereas 1,874.9 acres plantation was imparted among 1,191 farmers under Telangana State (TS) during the XII five year plan. Further, the sericultural farmers were sensitized due to the organization of various kinds of extension and communication programmes (ECPs) such as group discussions, farmers days, field days, awareness programmes, exhibitions, film shows skill training programmes and sensitized the farming community skills on various improved technologies involved in mulberry plantation and silkworm rearing. During the period in AP 658 ECPs of above detailed were organized and sensitized a huge number of sericultural farmers (43,215) on improved technologies under 13 clusters for the development of Bivoltine sericulture. Similarly, under TS more than 306 ECPs were organized and sensitized around 13,854 sericulturists for improving their Bivoltine sericultural practice (Table 3 & Fig. 3, 4).

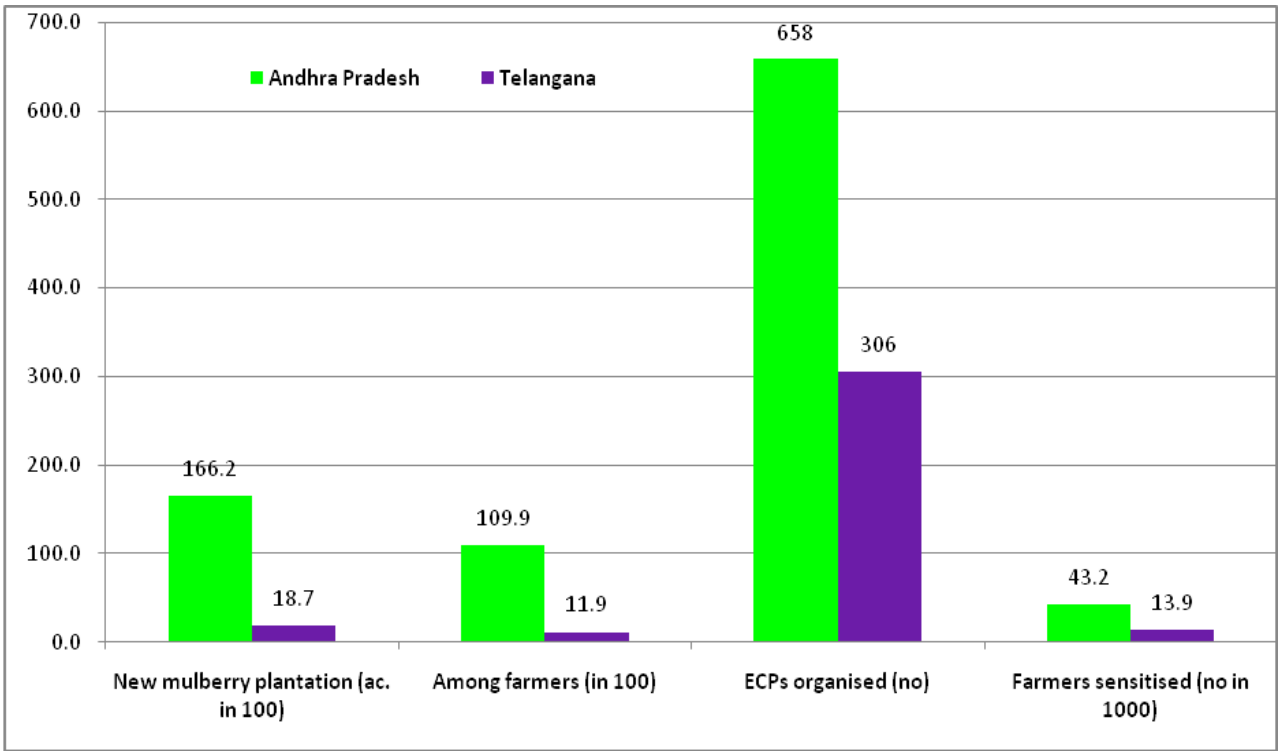


**Fig. 3. Undertaking of new mulberry plantation and organizing of ECPs among farmers to sensitize on improved technologies for the Bivoltine sericulture development among AP & TS**

During the cluster promotion programme period under AP and TS cluster farmers were motivated in under taking new mulberry plantation, rearing house construction, infrastructural facilities of rearing and mulberry garden establishment by supporting under various Govt. subsidized programmes such as Catalytic Development Programme (CDP), State Sericulture Development Programme (SSDP), Mahathma Gandhi National Rural Employment Generation Programme (MGNREGA), Rashtriya Krishi Vicas Yojana (RKVY) and Prime Minister Krishi Sichayee Yojana (PMKSY) and several central Sector Schemes (CSS) etc. During the programme period under XI and XII five year plan farmers have undertaken new mulberry plantation with high yielding mulberry varieties like V1 and G4 in varied geometries such as paired row [(3'x2')5'], 3'x3' and 4'x4' in lowbush form and wider spacings like 6'x3', 8'x4' and as 10'x10' spacing in tree form with partial irrigation or micro irrigation (drip irrigation) conditions to combat with the prevailing drought stricken conditions in Andhra Pradesh and Telangana states. During the CPP programme significant improvement in socio-economic conditions of the seri-farming community was noticed. The programme supported the farmers in adoption of bivoltine sericulture, earning encouraging money, investing the same for sericulture up-liftment, purchasing land, vehicles, jewels, house hold articles, improved children education, conducting respectable rituals and becoming self sufficient in repayment of long pending borrowed loans.


**Fig. 4. Sensitization of sericultural farmers on various improved technologies during ECPs organized under Andhra Pradesh and Telangana States**

Thus, the success of the programme can be attributed to co-ordinated and close working of different organizations involved in sericulture development such as REC, CSRTI, Mysore, National Silkworm Seed Organization (NSSO), Central Silk Technological Research Institute (CSTRI), Bangalore and State Sericulture Department at gross root level as well as higher level for common cause. Further, the cluster approach helped in succeeding in pooling the resources such as man power, money, and infrastructural facilities *etc*., for conducting extension programmes effectively. The CPP offered how best the limited resources could be effectively utilized for promotion of bivoltine sericulture. Intensive ECPs undertaken under the states and active participation of the sericultural fraternity (Fig. 3,4) are helped the farmers to accept and adopt the improved technologies and achieve the anticipated and encouraging results in improving bivoltine cocoon yield levels significantly (Himantharaj *et al.,* 2012; Vindhya *et al*., 2012; Sathyanarayana Raju *et al*., 2014*;* Sudhakar *et al.,* 2018, 2019).

## CONCLUSION

Therefore, with the above findings the study can be accomplished that the improvement among the 17 clusters under AP and TS under the CPP programme during XII-five year plan (2014-19) is due to intensive adoption of extension and management approaches, effective adoption of integrated technologies, percolation of innovative technologies through the organization of various kinds of ECPs among the farming community by the central and state officials and extension field functionaries efforts. This approach is with suitable refinement can be adopted elsewhere in the sericulture areas of the country to ensure higher rate of adoption of technologies, higher returns from sericulture and promotion of bivoltine sericulture during future course of time. Further, it is essential to continue the intensive bivoltine promotion programmes of this kind in future in the new clusters established under CPP so as to make our country self sufficient and self reliable in quality bivoltine silk production thereby projecting India as one of the potential bivoltine silk producers at international market with gradable quality of raw silk.

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