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RESEARCH ARTICLE

DEVELOPMENT OF BIVOLTINE SERICULTURE UNDER DROUGHT STRICKEN ZONE OF KURNOOL DISTRICT, ANDHRA PRADESH STATE OF INDIA THROUGH CLUSTER PROMOTION PROGRAMME (CPP)

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ABSTRACT

For Bivoltine sericulture development through Cluster Promotion Programme (CPP) under XII five years plan during 2014-2019 was implemented in Atmakur and Pattikonda clusters under Kurnool District of Andhra Pradesh to sustain India in elevating itself into International market with gradable Bivoltine silk. During the CPP period (2014-19) Bivoltine DFLs distribution was recorded from 1.26 lakh to 2.62 lakh as against the target with a total distribution of 9.42 lakh DFLs against the target of 9.00 lakh with significant level of enhancement from 100.0% to 126.3% with an average achievement of 111.9% over target and exorbitant level over bench mark (0.35 lakh) DFLs distribution under Atmakur cluster. Whereas as the same was 2.06 lakh to 4.60 with a total of 17.88 DFLs as against the 16.30 lakhs target with an average achievement of 106.2% DFLs distribution against the benchmark DFLs distribution (0.45 lakh) before initiation of CPP under Pattikonda cluster. The cocoon yield kg/per 100 DFLs shown marked improvement among both the clusters ranging from 63.84 to 71.88kg/100 DFLs with an average yield of 69.11kg in Atmakur and 66.22kg to 77.62kg /100 DFLs with a mean yield of 73.43kg/100 DFLs compared to the bench mark yield (42kg/100DFLs) under Pattikonda cluster. Further, momentous level of improvement in raw silk production and market value of cocoons was also noticed among the clusters due to CPP implementation (2014-19) indicating that the bivoltone sericulture development was witnessed as a successful venture in developing the Bivoltine sericulture under Kurnool District of Andhra Pradesh. Besides, owing CPP marked level of new mulberry plantation was undertaken among both the clusters contributing to the vertical development of Bivoltine sericulture. CPP implementation in both the clusters not only proved to be a successful venture but also established as a very secured and remunerative farming compared to any other farming. Adoption of sericulture among the clusters under Kurnool District not only enhanced production of gradable Bivoltine raw silk but also generated a ray of hope in improving the socio economic conditions of the sericultural farming community.

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INTRODUCTION

Sericulture is an enterprise taken up by more than 10 million farmers in China today which is the largest silk producer in the world. However, India occupies the 2nd position in silk production and the biggest consumer of raw silk and silk fabrics through which providing employment to millions of people. Sericulture being an agro-based enterprise plays a predominant role in shaping the economic destiny of the rural people and fits very well in India's rural structure, where agriculture continues to be the main industry.

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Out of the 6,38,588 villages in India , sericulture is practiced in about 52,360 villages providing employment to approximately 8.0 million persons in rural and semi-urban areas in India. Among the four varieties of silk produced in India, as on 2012-13, Mulberry accounts for 79% (18715 MT), Tasar 7.3 % (1729 MT), Eri 13.2% (3116 MT) and Muga 0.5% (119 MT) of the total raw silk production of 23,679 MT. In total production of mulberry silk around 90% of silk is coming from traditional crossbreed silkworms, only 12-13% silk is bivoltine silk. Under World Trade Organization (WTO) regime and General Agreement for Trade and Tariff (GATT) with liberalized trade policies, India not only has to increase its silk production but also improve silk quality standards, if it

really wants to be competitive in the world silk market (Savithri and Sujathamma, 2016). Hence, the challenge before the Indian sericulture industry is to orient the production strategies to suit the requirement of both national and international market demand, by developing the gradable levels of bivoltine silk sector. Therefore, production of gradable quality bivoltine silk to project itself in the international market has become the prime agenda of Indian sericulture industry. Several workers 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 were the key acts to achieve the above objective (Himantharaj *et al.,* 2012, Satyanarayana Raju *et al.,* 2014; Sudhakar *et al.,* 2018). Jaishankar and Dandin (2005) emphasised on the Farmers participatory approaches for 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 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 the above 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 were encouraging (Himantharaj *et al.,* 2012, Qadri, 2012, Sudhakar *et al.,* 2018).

The Cluster Promotion Programme (CPP) a novel concept was implemented under XII five years plan during 2013-2019 in India for boosting the bivoltine sericulture development. Central Silk Board (CSB) and Department of Sericulture, Govt. of Andhra Pradesh have jointly organised 178 clusters all over India *i.e.,* 106 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 106 clusters in Southern India 46 clusters were implemented in Karnataka, 28 clusters in Tamil Nadu, 17 clusters in Andhra Pradesh, 9 in Maharashtra, 4 in Madhya Pradesh 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) to be implemented, 13 clusters were preferred to implement in Andhra Pradesh, among which Atmakur and Pattikonda two were selected to implement CPP for the development of Bivoltine sericulture under Kurnool District. Andhra Pradesh Geographically 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. Andhra Pradesh 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 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. Kurnool being one of the biggest Districts of Andhra Pradesh lies between the northern latitudes of 14°54' and 16°18' and eastern longitudes of 76°58' and 79° 34'. The altitude of the district varies from 100 ft above the mean sea level. The terrain here slopes from South to North and it is drained by the river Hundri which joins the river Tungabhadra at Kurnool. The soils in the North Western traversed parts by the river Hundri are black cotton while the South Eastern parts are predominantly pure red & lateritic soils. The Climate of the district is normally good and healthy. January, February and March months are usually pleasant with moderate winds from South-East. April and May are hottest months of the year, during these months the wind shifts to Southwest with increased force and brings welcome showers by the end of May. The normal rainfall of the District is 670.5 mm. Sericulture is an agro based cottage industry consisting of on farm and nonfarm activities. At Present Sericulture is being cultivated in 2770.50 acres in 234 villages of 46 mandals by 1326 farmers in the district. The activity is more predominant in Atmakur, Pamulapadu, Kothapalli, Pathikonda, Dhone, Peapully, Thuggali, Veldurthy, Bethamcherla and Yemmiganur Mandals. The cocoon production ranges from 800-900MT with a market value of about Rs. 28.00 crores per annum. Therefore, with the above profiles of both the states of Telangana and Andhra Pradesh with an anticipated production of beyond 20,000 MT of raw silk from Andhra Pradesh the Cluster Promotion Programme (CPP) was implemented scrupulously under Kurnool District of AP during 2014-2019. The results were encouraging and the same were presented and discussed in the Table 1 and Fig. 1,2,3,4.

MATERIALS AND METHODS

The Cluster Promotion Programme (CPP) was implemented in Atmakur and Pattikonda clusters under Kurnool District, Andhra Pradesh (AP) during XII five year plans 2014-19. 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 before the onset of CPP, a preliminary bench mark survey was conducted jointly by the Scientists of Central Silk Board (CSB) and Dept. of Sericulture (DOS), Andhra Pradesh, among the clusters (Atmakur & Pattikonda) 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. A bench mark survey was also conducted to understand the silkworm races reared, success level of crops, yield levels and economic benefit due to the practicing of sericulture. The bench mark survey revealed that under Atmakur and Pattikonda the farmers were brushing @ 35,000 & 45,000 DFLs of Cross breeds of multivoltine (CB) & negligible quantities of Bivoltine before CPP initiation, cocoon yield was @ 14.7MT & 18.9MT followed by the cocoon yield level per 100 DFLs was @ 42.0kg among both clusters. The bench mark level of average market rate was recorded @ Rs.210/- per kg among the clusters. Basing on the 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 Cluster implementation modalities were imparted among the clusters:

- Both the clusters were operated under the control of South nodal center Regional Sericultural Research Stations (RSRS) of Ananthapur, Andhra Pradesh. A Scientist of CSB and Extension officers of Dept. of Sericulture (DOS) will act as Cluster Development Facilitators (CDFs) and Technical Staff of RECs, CSB as well as the Field functionaries of DOS were implement the CPP activities with closed Co-ordination.
- A Chawki Rearing Centers (CRCs) will be recognized for better technology intervention & healthy chawki worm supply for successful & enhanced crop harvesting by imparting 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.
- The Bivoltine chawki worms were reared at CRC and healthy and robust chawki worms were supplied after joint quality Chawki certification by the coordinating CDFs (Scientist & DOS official).
- Both the CDFs of the respective clusters were suppose to be subject specialists as well as other Technical and field functionaries regularly visiting the farmers mulberry gardens and silkworm rearing crops and extended technical guidelines for quality mulberry leaf production and successful rearing crops.
- Time to time non-performing farmers were identified assessed the reasons for nonperformance, their garden soils were analysis for essential nutrient status (pH, EC, OC%, available N, P & K kg/ha) followed by analysis based amelioration recommendation were extended followed by Soil Health Cards issue too.
- INM modalities were implemented like green manuring 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) to enrich the soil nutrient status for enhanced quality leaf production.
- Under IPM process 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 frequently sensitized on the standard recommended package of practices in mulberry cultivation as well as in silkworm rearing (Dandin *et al.,* 2003)
- 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 such as Group Discussions, Farmers Days, Field Days/ Awareness programmes, Farmers study tours, Film shows, Exhibitions and Farmers skill trainings were conducted under cluster villages and sensitized the farming community on the improved technologies of Bivoltine sericulture for encouragement and boosting the confidence levels on bivoltine silkworm crops.
- The crop performance was monitored constantly and periodically at higher level meetings in regard to the achievements against the targets. Also during 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 among the two clusters viz. Atmakur & Pattikonda 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 and Fig. 1,2,3,4.

RESULTS AND DISCUSSION

After imparting the CPP by involving all the modalities during 2014 to 2019 in a 5 years pan of the period under XII 5 years plan the Bivoltine sericulture sericulture has shoot up to the beyond imagination level and proved to be a boon in increasing and improving the gradable Bivoltine silk production among the clusters viz. Atmakur and Pattikonda but also boost up the socio economic upliftment of the sericultural farming community raising the hopes of their safety and security.

Bivoltine sericulture development in Atmakur cluster: Perusal of the results on improvement of Bivoltine sericulture in Atmakur cluster under CPP from 2014-15 to 2018-19 is depicted in Table 1. Bivoltine DFLs distribution was raised progressively from the bench mark level (0.35lakh) to 1.26 lakh (2014-15), 1.50 (2015-16), 1.80 (2016-17), 2.24 (2017-18), 2.62 (2018-19) with an average distribution of 9.42 lakh DFLs as against the 9.00 with a significant level enhancement of DFLs distribution percentage ranging from 100.0% to 126.3% with an average achievement of 111.9%. The Bivoltine DFLs brushing has shown steadily linier level of achievement from 2014-15 to 2018-19 (Table 1 & Fig. 1). Similarly, the cocoon yield was increased ranging from 70.9MT in 2014-15, 103.6 in 2015-16, 124.7 (2016-17), 156.9 (2017-18) and 173.9MT (2018-19), respectively with a total of 630MT during the CPP period under the cluster contributing an average raw silk production of 89.86 MT. The cocoon yield per 100 DFLs (kg) shown marked improvement ranging from 63.84 to 71.88

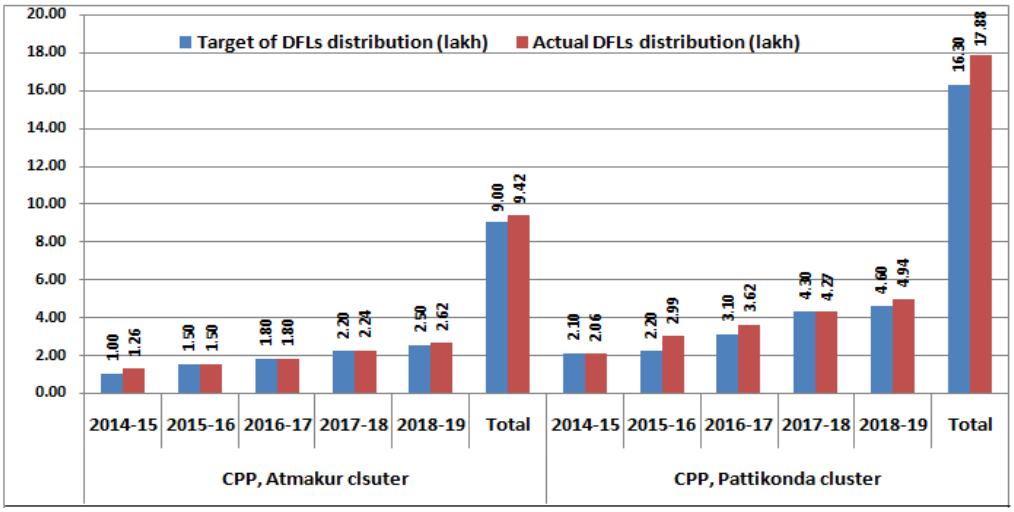

Fig. 1. DFLs distribution against the target under CPP Atamkur and Pattikonda clusters

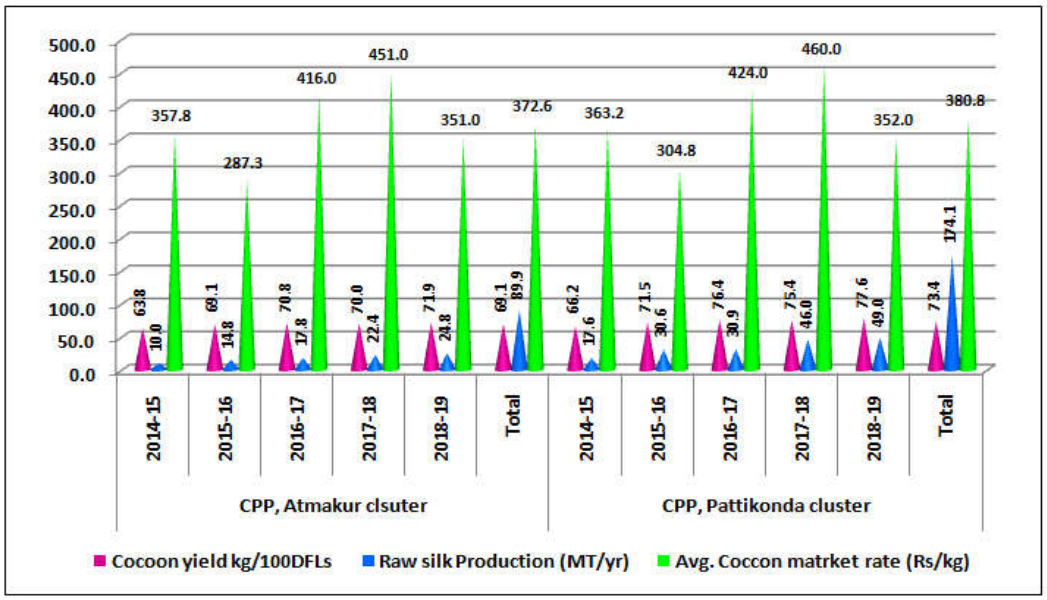

Fig. 2. Performance of Cocoon yield, raw silk production and market rate under CPP at V. Kota.

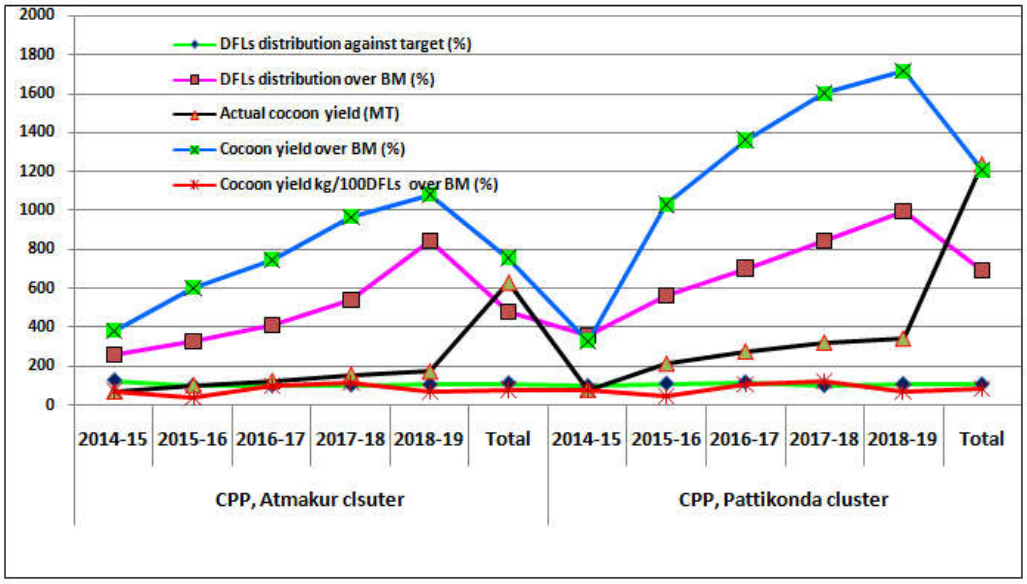

Fig. 3. Percent of DFLs distribution, Cocoon yield, and yield kg/100 dfls under CPP, V. Kota.

Table 1: Distribution of Bivoltine DFLs, cocoon yield, market rate, new plantation and ECPs organized under the clusters during 2014-19 for the development of Bivoltine sericulture under Atmakur & Pattikonda clusters under Kurnool District.

Perticulars	CPP, Atmakuru cluster						CPP, Pattikonda cluster					
	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	Total	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	Total
Target of DFLs distribtn (lakh)	1.00	1.50	1.80	2.20	2.50	9.00	2.10	2.20	3.10	4.30	4.60	16.30
Actual DFLs distributed (lakh)	1.26	1.50	1.80	2.24	2.62	9.42	2.06	2.99	3.62	4.27	4.94	17.88
Actual achievement (%)	126.3	100.0	100.2	102.0	104.9	111.9	97.65	110.0	116.8	99.26	107.3	106.2
Achievement over BM* (%)	260.0	328.6	414.3	540.0	848.6	478.3	357.8	564.4	704.4	848.9	997.8	694.7
DFLs harvested (lakh)	1.11	1.50	1.76	2.24	2.42	9.03	1.86	2.99	3.62	4.27	4.42	17.16
No. of Farmers	424	441	544	718	765	2892	434	952	1040	1121	1432	4979
Actual cocoon yield (MT)	70.9	103.6	124.7	156.9	173.9	630.0	81.5	213.9	276.5	321.8	343.1	1236.8
% increase of cocoon yld. over BM[@]	382.3	604.8	748.3	967.3	1083.0	757.1	331.2	1031.7	1363.0	1602.6	1715.3	1208.8
Yield/100DFLs	63.84	69.07	70.8	69.95	71.88	69.11	66.22	71.53	76.39	75.37	77.62	73.43
% increase of yield over BM[#]	52.00	64.45	68.57	66.55	71.14	64.55	57.67	70.31	81.88	79.45	84.81	74.82
Raw silk Production (MT)	10.0	14.80	17.81	22.41	24.84	89.86	17.57	30.62	30.94	45.96	48.96	174.1
Avg. Matrket Rate (Rs)	357.8	287.3	416.0	451.0	351.0	372.6	363.2	304.8	424.0	460.0	352.0	380.8
Imporvement over BM[$] (%)	70.38	36.81	98.10	114.76	67.14	77.44	72.95	45.14	101.90	119.05	67.62	81.33
New plantation (acres)	93.5	110	135	356	206.5	901.0	66.5	175	232.5	360	213	1047.0
Among No. of farmers	38	65	72	252	119	546	35	85	112	253	114	599
ECPs organised	15	10	7	21	8	61.0	6	8	9	12	9	44.0
Farmers sensitised	364	236	284	1089	337	2310	295	325	339	410	395	1764

BM*= DFLs bench mark level distribution @ 35,000 & 45,000 in Atmakur & Pattikonda before CPP initiation; BM[@]= Bench mark cocoon yield @ 14.7MT & 18.9MT of Atmakur & Pattikonda; 42.0kg/100DFLs; **BM**[#]= Bench mark yield @ 42kg/100 DFLs under Atmakur & Pattikonda clusters; **BM**[$] = Bench mark avg market rate @ Rs.210/- per kg in both clusters.

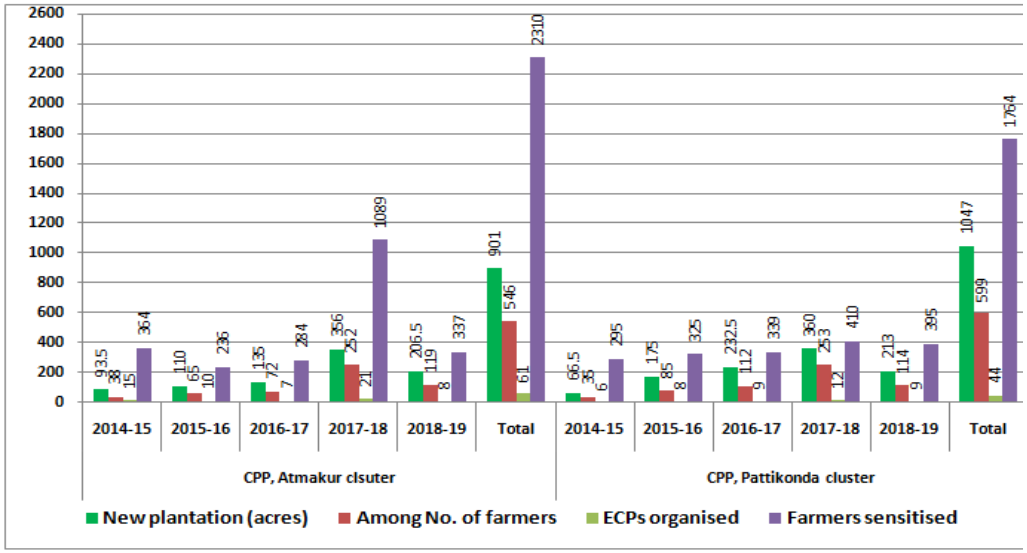

Fig. 4: Sericultural vertical growth through new plantation and sensitization of sericulturists through ECPs organization under CPP, V. Kota.

during 2014-19 with an average yield of 69.11kg/100 DFLs. Compared to the bench mark (BM) level of yield it was recorded 52.0% to 71.14% with 64.55% average yield over the BM. The average market rate of the cocoon was prevailed from Rs. 287.3/- per kg to 451.0/- with an average market value of Rs. 372.6 per kg cocoon. During the period a total of 901 acres of new mulberry plantation was undertaken among 546 farmers under the Atmakur cluster contributing significantly to the vertical development of sericulture in the district. All the above could become possible due to the intensive extension activities such as rearing crop inspections, improvement in hygiene in rearing and maintenance of improved mulberry gardens. During the period a total of 61 extension communication programmes (ECPs) such as Group discussions, Farmers days, Field days, Awareness programmes, Farmer training porgrammes etc. among 2310 farmers sensitizing them on various technical knowhow thereby improving the Bivoltine sericulture (Table 1 & Fig. 2,3,4).

Bivoltine sericulture development in Pattikonda cluster: The Bivoltine sericulture development under CPP in Pattikonda cluster indicated that 2.06 lakh DFLs were distributed against 2.10 lakh target during 2014-15 with 97.65% achievement, 2.99 vs 2.20 during 2015-16 with 110.0%, 3.62 vs 3.10 during 2016-17 with 116.8%, 4.27 vs 4.30 during 2017-18 with 99.26% where as 4.94 vs 4.60 during 2018-19 with 107.3% with a total of 17.88 lakh DFLs brushing as against to 16.30 lakh with a mean achievement of 106.2% during 5 years period of CPP implementation. However, compared to the benchmark level of DFLs distribution CPP implementation has made remarkable improvement in the of DFLs during the period. During the period the cocoon production was enhanced from 81.5MT to 343.1MT with a total of 1236.8MT during the 5 years duration of CPP period (2014-19) contributing of raw silk production ranging from 17.57MT to 48.96MT with a total of 174.1MT during 2014-2019 under the cluster (Table 1 & Fig. 1). Further, the cocoon yield per 100 DFLs (kg) recorded ranging from 66.22kg/100 DFLs to 77.62kg with a mean value of cocoon yield of 73.43kg per 100 DFLs during 2014-2019 under Pattikonda cluster. The cocoon yield was significantly high compared to bench mark yield (42kg/100DFLs) ranging from 57.67% to 84.81% with a mean value of 74.82% during the CPP implementation period (2014-19) under Pattikonda cluster. The average market rate of the cocoon was recorded Rs. 304.8/- per kg cocoon to Rs. 460.0 with a mean value of Rs. 380.8 per kg cocoon during the CPP period. During the cluster promotion period a total of 1047 acres of new V1 mulberry gardens were planted in improved spacings among the 599 farmers under Pattikonda cluster contributing significantly to the vertical development of Bivoltine sericulture. During the period a total of 44 ECPs of various kind as detailed earlier sensitizing 1764 farmers on improved technologies, fine tuning their technical knowhow thereby improving the Bivoltine sericulture (Table 1 & Fig. 2,3,4).

The momentous level increase of DFLs brushing and cocoon yield/100DFLs among the farmers of CPPs under both the clusters of Atmakur and Pattikonda in Kurnool District may be due to the better adoption of critical technologies in imparting recommended manure and fertilizer applications and adopting soil analysis based amelioration methods of their mulberry gardens. The encouraging results in enhanced quality cocoon production is also due to sincere and dedicated efforts of the farming community imparting effective disinfection methods of silkworm rearing houses by the use of improved disinfectants followed by the maintenance of personal hygiene and better rearing management. The results are in agreement with the earlier studies conducted by various workers (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; Himantharaij *et al*., 2012; Sudhakar *et al.,* 2018, 2019).

More over the success of bivoltin sericulture development among both the clusters are also to intensive organization of various extension and communication programmes (ECPs) in each and every village and motivating the farmers to impart improved technologies for anticipated results. The enhances cocoon, raw silk and yield level of cocoons also could become possible due to the increase of mulberry acreage with improved variety (V1) planting in varied spacings and adopting advances and recommended cultivation technologies (Dandin *et al*., 2003). 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 cluster promotion programme period under Kurnool District the 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 of the District. 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. Thus, the success of the programme can be endorsed 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. 5) 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 two clusters (Atmakur & Pattikonda) under the Kurnool District of Andhra Pradesh under the CPP programme during XII five years plan (2014-19) is due to exhaustive adoption of extension and management approaches, rigorous adoption of integrated technologies, percolation of improved technologies through the meticulous organization of various kinds of ECPs among the farming community by the central and state officials and extension 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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