CHAPTER – I

EXECUTIVE SUMMARY

1.1 Introduction

The Thirteenth Finance Commission (TFC) of the Government of India has allocated financial assistance to the states based on Ecosystem services and the Bio-diversity value of the state Forest resources to undertake activities contributing to the protection and conservation of the forests resources in each state. Accordingly the state is recipient of Rs 255 cores/annum for the period of five years and has implemented number of activities during 2009-2013 for the programs approved by the state Empowered committee. The activities include creation of plantations, maintenance of plantations, and infrastructure development of the department.

1.2 Activities under TFC evaluated

1. Plantations

Under Thirteenth Finance Commission plantations raised outside the regular schemes like eviction of encroachment areas, Gap area, logged area and medicinal plantations have been raised and maintained by investing the funds from 13th finance commission. In all 480 plantations have been raised under different models during 2009-13. Out of them 50 plantations under different models have been sampled and evaluated.

2. Boundary consolidation and soil moisture conservation work

Under Thirteenth Finance Commission the funds are used for taking up the boundary consolidation works of the natural forests. The forest vulnerable for the encroachments are is identified and the boundary consolidation work is taken-up. The SMC and Boundary works have been sampled and evaluated.

3. Building Works and Maintenance

It is observed that, that the substantial funds of Thirteenth finance commission fund have been utilized for the creation of infrastructure including construction of new buildings and the maintenance of the old buildings. Though the maintenance and repairs works are difficult to be verified, using the records and proxy evidences the works have been evaluated.

4. Vehicles and Equipments

It is also observed that, Thirteenth finance commission funds have been used for the vehicles purchases and equipments purchases.

5. Wildlife works

The Thirteenth Finance Commission funds has been utilized for the protection of wild life by undertaking works like desilting of tanks, salt lick creation, soil and moisture conservation works, elephant depredation camps and similar habitat improvement works.

6. Nursery

Thirteenth finance commission funds have been used substantially for the production of quality seedlings at nursery and research stations.

1.3 Plantation Evaluation Results

Under TFC, many different models of plantations have been raised and maintained. For the purpose of differentiating the variations and success rates in the models, analysis has been done model wise and results are discussed separately.

1.3.1 Maintenance of Plantations (encroachment evicted/ Plant)

The TFC plantations were evaluated in Belgaum, Gulbarga and Dharwad Circles and the findings are presented here.

Survival Rates

The survival rate of the plantations maintained in different models has shown 72.25%. The mean height varied between 1.19-6.15 meter for different models of plantations. The mean Collar diameter also varied between 1.1-15 cm across divisions.

Belgaum: In Belgaum division two plantations were evaluated and found that the survival rate was 62 in a three year plantation and 80.6% in a second year plantation. The low survival in the third year plantation where Acacia and cashew are the major species is a major concern. Acacia and Cashew are very hardy species which can perform better under adverse conditions.

Gokak: In Gokak the 2 ha plantation was not planted but only the SMC work was taken up.

Gulbarga: In Gulbarga division the plantation was done in the gap area with Pongamia and Glyricidia species. The survival rate was 68.88 after three years of plantation is quite reasonable.

Bidar: The plantation done in Encroachment evicted area in Bhimkoda was found to have 95% survival where the Glyricidia was the main species.

Dharwad: In Dharwad in 124 ha the teak plantation has been raised in the gap areas. The survival is 49% which is very low for the teak species in Dharwad climatic conditions. Teak should not have been planted in the gap areas where the species can't tolerate the shade.

Bagalkot: The species like Hardwickia and Thespesia have shown 77% survival in a second year plantation.

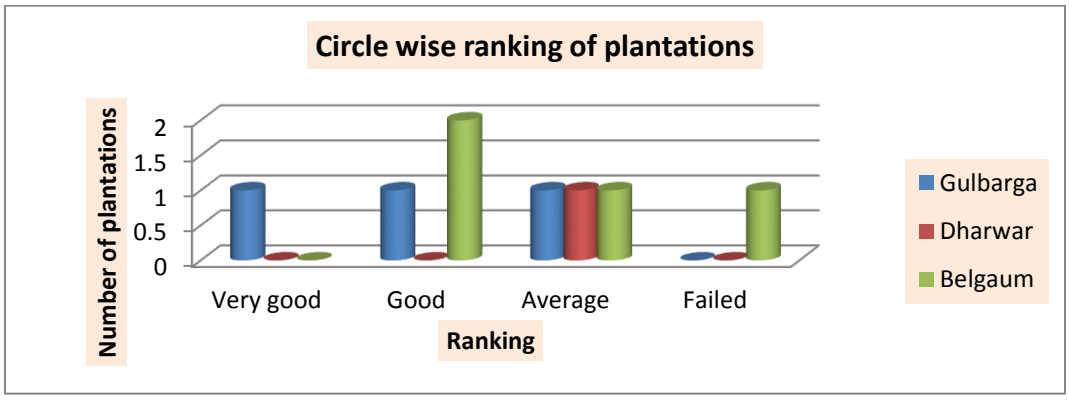
1.3.2 Circle wise ranking of plantations

The plantations have been ranked based on the survival rates and the results are tabulated below.

1. **Table showing the circle wise Ranking of plantation**

Circle	Very Good	Good	Average	Failed
Gulbarga	1	1	1	0
Dharwad	0	0	1	0
Belgaum	0	2	1	1
%	12.5	37.5	37.5	12.5

Fig.1 showing the circle wise Ranking of plantation



Gulbarga: Gulbarga plantations were found better than Belgaum and Dharwad. The planting of Glyricidia has ensured higher success rate.

Dharwad: The plantation raised in Dharwad (sampled plantation) was found with 49% survival for teak species. The low survival rate for teak is due to shade effect in the gap plantation.

1.3.3 Advance work and raising plantations

The new plantations have been raised under the TFC in Belgaum, Dharwad and Gulbarga circles. The evaluation of these plantations for survival rate, mean height, mean collar diameter. After evaluation of the plantations the results are tabulated below.

Year	Division	Extent	Location	Species	Survival rate	Mean height (m)	Mean (cm)
2011-12	Belgaum	25	Ambadgatti	Acacia	95	5.7	7.1
2011-12	Belgaum	5.80	Chinchanwadi				
2011-12	Belgaum	10	Watra	Embelica, Acacia	73	4.5	4
2011-12	Gulbarga	20	Guggalwadi				
2012-13	Belgaum	50	Godalkundargi	Cashew, Neem	90	0.6	0.74
2012-13	Belgaum	50	Chapoli	Bamboo, Terminalia	71	1	0.45
2012-13	Bagalkot	25	Gandal	D sissoo, A latifolia	85.39	2	.6
2012-13	Bidar	25	Ubdal	Advance work			

The survival rate: The survival rate varies between 73 to 85.91 in different divisions. The height was found varying from 0.6-4.5 meters. The Belgaum plantation was found to have the mean height of 4.5 meters which can be attributed to good rainfall.

Belgaum division: Belgaum division plantations have shown very high survival rate of 95 and 90% which is due to planting of Acacia, cashew and Neem which are locally well suited to soil and climatic conditions. In one plantation the survival is 71% where hardwood species has been planted along with bamboo.

Bagalkot: Bagalkot division has shown very good survival rate of 85.39% where *Dalbergia sissoo* has been planted up which is drought tolerant and highly adaptive.

Bidar: The advance work in Bidar was found to be as per the sanctioned estimate.

Species wise survival in different divisions

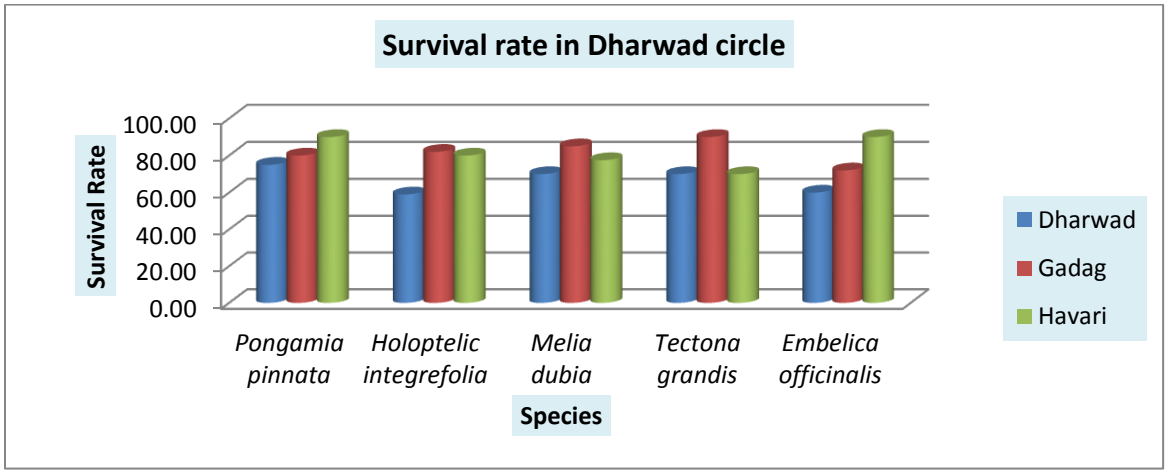
The species wise survival in different models has been represented circle wise for illustration.

In Dharwad circle *Pongamia pinnata* was shown 81.67% survival followed by *Melia dubia* with 77.50 survivals. The weighted average is 76.70%.

3. Table showing survival Rate of different species in Dharwad circle

Species	Divisions			Mean
	Dharwad	Gadag	Haveri	
Pongamia pinnata	75.00	80.00	90.00	**81.67**
Holoptelic integrefolia	59.00	82.00	80.00	**73.67**
Melia dubia	70.00	85.00	77.50	**77.50**
Tectona grandis	70.00	90.00	70.00	**76.67**
Embelica officinalis	60.00	72.00	90.00	**74.00**
Mean	**66.80**	**81.80**	**81.50**	**76.70**
Sem±	**2.7 (b/w species) AND 4.3 (b/w divisions)**			
Cd@5%	**18.5 (b/w species) AND 22.2 (b/w divisions)**			

Fig.2 Showing the survival Rate of different species in Dharwad circle



4. Table showing survival Rate of different species in Gulburga circle

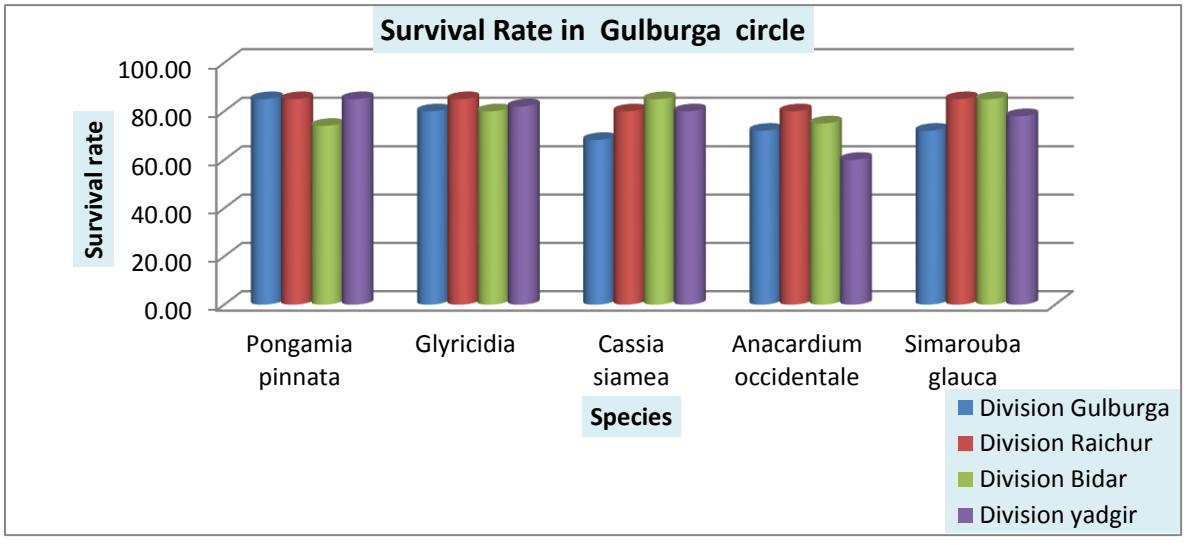
Species	Divisions				Mean
	Gulbarga	Raichur	Bidar	Yadgir	
Pongamia pinnata	85.00	85.00	74.00	85.00	82.25
Glyricidia	80.00	85.00	80.00	82.00	81.75
Cassia siamea	68.20	80.00	85.00	80.00	78.30
Anacardium occidentale	72.00	80.00	75.00	60.00	71.75
Simarouba glauca	72.00	85.00	85.00	78.00	80.00
Mean	75.44	83.00	79.80	77.00	78.81
Sem±	**2.7 (b/w species) AND 3.18 (b/w divisions)**				
Cd@5%	**11 (b/w species) AND 11.9(b/w divisions)**				

In Gulbarga circle the most common species planted are Glyricidia, Pongamia, *cassia siamea* and Simaruba. In few plantations *Hardwickia binata* and *Azadirachta indica* have also been planted. The species wise survival analysis was done through two ways ANOVA and the results are presented in the table above.

It is found that Pongamia was found to have highest survival rate of 82.25 % across divisions followed by Glyricidia with 81.7%. Simaruba was found to have the survival rate of 80%.

Overall mean survival was 78.81 for all the species across all division indicating good success of the plantations in the initial years.

Fig. 3 showing the survival Rate of different species in Gulburga circle

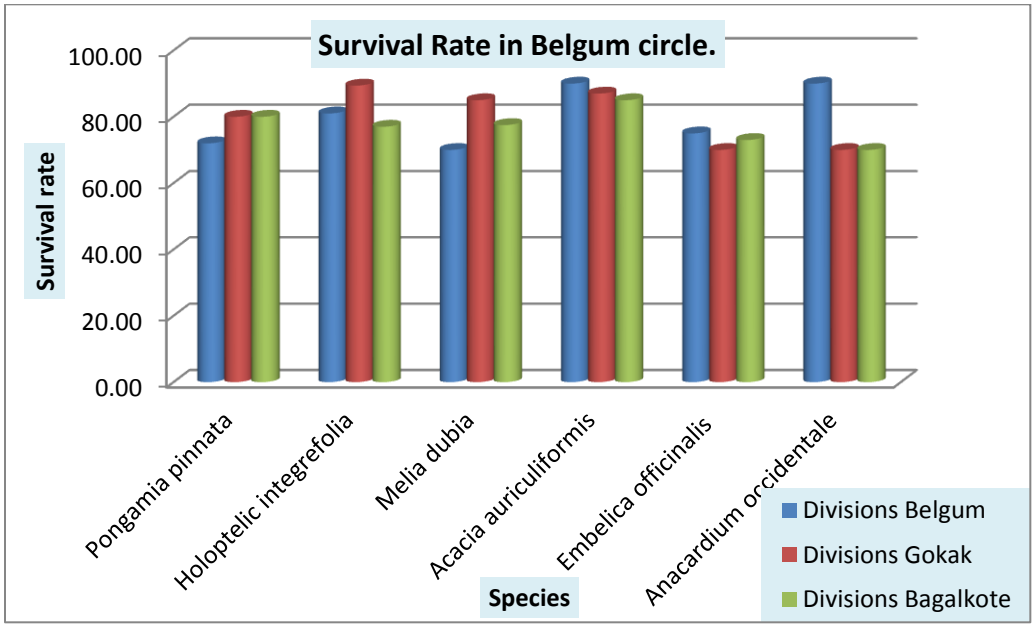


5. Table showing survival Rate of different species in Belgaum circle

Species	Divisions			Mean
	Belgaum	Gokak	Bagalkote	
Pongamia pinnata	72.00	80.00	80.00	77.33
Holoptelic integrefolia	81.00	89.40	77.00	82.47
Melia dubia	70.00	85.00	77.50	77.50
Acacia auriculiformis	90.00	87.00	85.00	87.33
Embelica officinalis	75.00	70.00	73.00	72.67
Anacardium occidentale	90.00	70.00	70.00	76.67
Mean	79.67	80.23	77.08	78.99
Sem±	**2.5 (b/w species) AND 4.30 (b/w divisions)**			
Cd@5%	**14.7 (b/w species) AND 17.7 (b/w divisions)**			

In Belgaum the most common species planted are Pongamia pinnata followed by *Holoptelic integrefolia* and Acacia auriculiformis. The other common species planted are *Cassia siamea, Anacardium occidentals and Azdirachta indica*. When the survival rates were analyzed through ANOVA it was found that Acacia auriculiformis had 87.33% survival followed by Holoptelic with 82.47%.

Fig.4 showing the survival Rate of different species in Belgum circle



Productivity projection:

The productivity projection was attempted to assess the future potential growth of the plantations. The mean annual increment of the diameter was found to vary between species to species and division to division.

Acacia auriculiformis: The diameter increment was 3.3 cm/year in Belgaum and Yadgir. This indicates a possibility of trees attaining 30 cm diameter at the end of 10 years. The basal area of 7-10 m2/ha/ at 10 year rotation. The height increment is 1 meter per year. At the age of 10, the mean height would be varying between 7-8 meter. The expected biomass would be 70-80 cum/ha. This is the most conservative estimate. Using Acacia as an indicator species the mean productivity of slow growing species could be in the range of 5-6 cum/year.

Holoptelic integrefolia: This is a native species which has been taken as indicator species to project the productivity. The mean annual increment of the diameter is 3.3cm/year. The mean height is 0.8 cm/year. The volume production would be in the range of 5-8 cum/year.

1.4 Building maintenance and repairs

Belgaum: The Building maintenance at the cost of Rs 10.0 lakhs is very high. The repairs should not exceed 10% of the capital cost. The quality is good according to the evaluation officer. However he could not verify the documents.

Yadgir: In Yadgir the new office building has been done with good facilities like visitor's room, staff rooms and the store rooms. The quality is very satisfactory.

1.5 Wild life protection

Anti-poaching camps: The anti-poaching camps in Gulbarga, Gadag, Haveri and Belgaum were found effective.

Yadgir: The need to have protection camps is to be justified in places like Yadgir and Bidar.

1.6 Equipments purchase

Equipments supply like Tranquilizing guns and capital investment on nursery are very essential works. However the Tranquilizing gun has not been even used once indicate the lack of priority in using very limited funds available in the department.

1.7 Boundary consolidation work

Haveri: In Haveri, the boundary consolidation works were inspected at one location and found that the work was as per the specification and effective.

Dharwad: In Dharwad division the boundary consolidation work was tested and found correct as per the specifications. In one location at Kalghatgi, 2.12 km CPT has been done which is very effective. In another location CPT has been done in 2 km length which is found to be effective.

Raichur: In Raichur the boundary consolidation work has been done in 2 km length and the CPT is found to be effective as reported by the evaluation staff.

Bidar: In Bidar division the Boundary consolidation work has been taken-up for a length of 2 km.

1.8 Productivity Estimation

The productivity of plantations by the 10^{th} year of the plantation age could vary from 5-6 m2/ Ha of basal area in drier areas and 8-10 m2/ ha in good rainfall areas. IN Gulbarga and Dharwad the productivity is low and may vary between 4-6 M2/ha at the 10 year age given the present growth rate and the soil conditions.

1. Soil and moisture conservation works: Under TFC soil and moisture conservation works were evaluated in different divisions. The works are effective in many divisions and were found essential to conserve the soil and moisture and to improve the site conditions.

2. Survey and demarcation: Survey and demarcation works have been verified for physical examination and results are discussed in main report.

3. Building works and maintenance: Building works and maintenance works have been assessed and discussed in the maintenance in main report.

4. Wildlife works: The works taken-up in the wildlife areas were evaluated and the results are discussed in the main report. The works in wildlife areas include Building maintenance, survey and demarcations and vehicles and equipments. The physical verifications have been done and quality has been assessed.

1.9 Impact Assessment of the Program Against Objectives

The Thirteenth Finance Commission was implemented with an objective to improve the forest protection and conservation .Plantations maintenance work. Substantial amount has been invested in the plantation maintenance. The evaluation has shown that the plantations are showing good signs of survival and growth potential which would go a long way in achieving the objectives of the scheme.

(1) **Increase in the green cover**: One of the main objectives of the TFC is to achieve the area under forests and to enhance the green cover. The raising of the plantations have contributed towards the increase in the green cover and the area under the forests.

(2) **Bio-diversity value**: The species chosen in each plantation are limited to very few (less than 10) and therefore there is a limitation of the plantations in achieving the objectives.

(3) **Productivity of the plantations**: The productivity has been assessed by measuring the growth parameters. The overall increment in the height is around 0.75 meter/annum and

the collar diameter is about 1 cm which is moderate as compared to the growth rates on better soils and high rainfall areas. The extrapolation of the growth parameter will give us approximately 8 cm diameter (DBH) and 6 meter height at the end of 8 years for the fast growing species. The mean basal area will be around 10 m2/ha/ at 10 year. And it may take 40 years to cover the canopy.

(4) **Climate change mitigation**: The productivity of the plantation at the rate of 10 m2 /basal area with a mean height of 6 to 7 meter will give approximately 5 to 6 m3/year in the drier areas and 10 to 12 m3 /ha/year in high rainfall areas. This rate of productivity can sequester on an average 2 tons of carbon/ha/year.

(5) **Employment generation**: The investment on compensatory plantation has generated (70% plantation cost is labour cost) employment in the rural areas. The 70% of cost of raising plantation goes for employment.

(6) **Investment on non-plantation works**: More than 40% of the funds under this scheme has been done on the infrastructure like buildings, Roads, and equipments to strengthen the departmental capacity. This has been difficult to relate to the benefits.

1.10 Recommendations

1) The TFC must allocate funds according to the formula suggested by the TFC based on the forest cover and ecological service of each Circle/division as the criteria. Why TFC invest on raising fresh plantation as its objective is to protect and safeguard the natural forests, wildlife and mitigation of degradation impacts and on the climate change aspects.
2) The plantation models like eviction of encroachment, gap areas, logged areas and the maintenance of older plantations (maintaining 8 year old eucalyptus plantation?) was like hair splitting. An investment guidelines based on the TFC must be drawn up before making allocation of funds.
3) 3, Investment on new fire line formation and fire protection was not verifiable. However, the internal monitoring for the annual works must be done as most of the operations may be either not required or redundant.
4) The choice of species may be rationalized based on the site requirement by focusing on the native species than Acacia auriculiformis.
5) The activities under TFC are too many resulting in very thin spread of investment which may not have desirable impact on the departmental programs. It should focus much on the compensatory plantations by spending 70% investment and rest on the natural forests management.
6) Expenditure on the building maintenance and vehicles should not be a major activity.

7) The investment on the research and wildlife is inadequate needs to be balanced.
8) The natural forests, bio-diversity conservation, enrichment planting and research programs needs to be given priority.
9) **Plantation size**: Many compensatory plantations have been raised are very small in size (less than 5 ha). This may not be viable to maintain and protect. It is better to aggregate the smaller units into a viable size of at least 10 ha to raise plantations.
10) The plantation on degraded sites must be well defined as in many places well stocked areas have been planted up.
11) The site clearance for raising plantation was noticed in some areas which needs to be avoided.
12) **Choice of species**: The species choice was very mechanical and there was no effort to match the sites.
13) *Acacia auriculiformis* is planted as core species in many compensatory plantations in high rainfall areas which may be completely avoided. Native species mix is the best option.
14) The SMC works are done very unscientifically. A guideline may be necessary to design and structure the works by estimating the quantum of water that could be impounded is to be done. The contour maps are to be used to locate the structure. The planning processes to regulate the SMC works are necessary.
15) The protection measures were not effective in many places. It is essential to provide maintenance provisions for five years so that the purpose is well achieved.
16) The plantation care and maintenance needs to be done for minimum five years. The investment must be done to ensure success of the plantations.
17) TFC must set a very successful model of plantation through innovations and higher investment as there is no cap on the unit cost.
18) Three year assessment is too early to judge the success. There should be five years interval evaluation twice to make a meaningful evaluation.
19) The internal evaluation needs to be strengthened and the database must be established to monitor the changes.

CHAPTER – II

INTRODUCTION

The Thirteenth Finance Commission of the Government of India has allocated financial assistance to the states based on Ecosystem services and the Bio-diversity value of the state Forest resources to undertake activities contributing to the protection and conservation of the forests resources in each state. Accordingly the state is recipient of Rs 255 cores for the period of five years and has implemented number of activities during 2009-2013 for the programs approved by the state Empowered committee. The activities include creation of plantations, maintenance of plantations, and infrastructure development of the department.

2.1 Objective of the Program

1. The funds are provided by the finance commission as an incentive to the states in recognition of the ecological services provided by the forests at the national and global level.

2. The funds are to be used as per the formula suggested to different divisions in accordance with the forest cover to take- up works related to conservation and protection

3. The infrastructure and development of the department to strengthen the capacity of department to address conservation issues

2.2 Funding:

Funds are provided by the TFC for five years. The total outlay is Rs 225 cores per annum for the period of five years.

2.3 Models of works in the program

Plantations:

Under the 13th Finance commission plantations raised outside the regular schemes like eviction of encroachment areas, Gap area, logged area and medicinal plantations have been rising and maintained by investing the funds from 13th finance commission.

Boundary consolidation and soil moisture conservation work:

Under Thirteenth Finance Commission the funds are used for taking up the boundary consolidation works of the natural forests. The forest vulnerable for the encroachments are is identified and the boundary consolidation work is taken-up.

Building works and maintenance

It is noticed that the substantial funds of Thirteenth finance commission fund has been utilized for the creation of infrastructure including construction of new buildings and the maintenance of the old buildings.

Vehicles and Equipments

It is also observed that, Thirteenth finance commission funds have been used for the vehicles purchases and equipments purchases.

Wildlife works

The Thirteenth Finance Commission funds has been utilized for the protection of wild life by undertaking works like desilting of tanks, salt lick creation, soil and moisture conservation works, elephant depredation camps and similar habitat improvement works.

Nursery

Thirteenth finance commission funds have been used substantially for the production of quality seedlings at nursery and research stations.

2.4 Evaluation Objectives of Thirteenth Finance Commission

The Thirteenth Finance Commission work has been awarded for the evaluation work in two units of the State. Each unit is composed of group of circles comprising of 11 divisions in each Unit. The following objectives have been listed as the Terms of Reference.

A) Physical verification

- To measure the extent to which the works were carried out for each of the schemes.

B) Impact assessment

- To measure the efficiency and effectiveness of the schemes

C) Gaps in implementations

- To identify the key issues and gaps in implementation and recommendations which could improve the quality of implementations

CHAPTER – III

SAMPLE WORK

The data was grouped into activities like plantation, Fire protection, Building maintenance, Survey and Demarcation, Equipments and vehicles, SMC. In each year the data was sorted out into divisions. Using probabilistic sampling method 10% sampling was done. It was further ensured to cover at least one activity in each Range.

6. Table showing the number of samples selected for evaluation under Thirteenth Finance commission (TFC) unit 3

Sl. No.	Activities	Total activities				Samples selected			
		10-11	11-12	12-13	Total	10-11	11-12	12-13	Total
1	**Plantations**	34	88	64	**186**	4	11	7	**22**
2	**Building Construction and Maintenance**	20	26	12	**58**	2	3	1	**6**
3	**Survey and Demarcation**	21	7	55	**83**	2	1	6	**9**
4	**Vehicles and Equipments**	0	5	24	**29**	0	1	3	**4**
5	**Nursery**	4	0	1	**5**	1	0	1	**2**
6	**Wild life protection**	17	20	29	**66**	2	2	3	**7**
	Total	**96**	**146**	**185**	**427**	**11**	**18**	**21**	**50**

Fig. 5 showing the numbers of activities done between 2009-10 to 2012-13 in Thirteenth Finance commission (TFC) Unit 1.

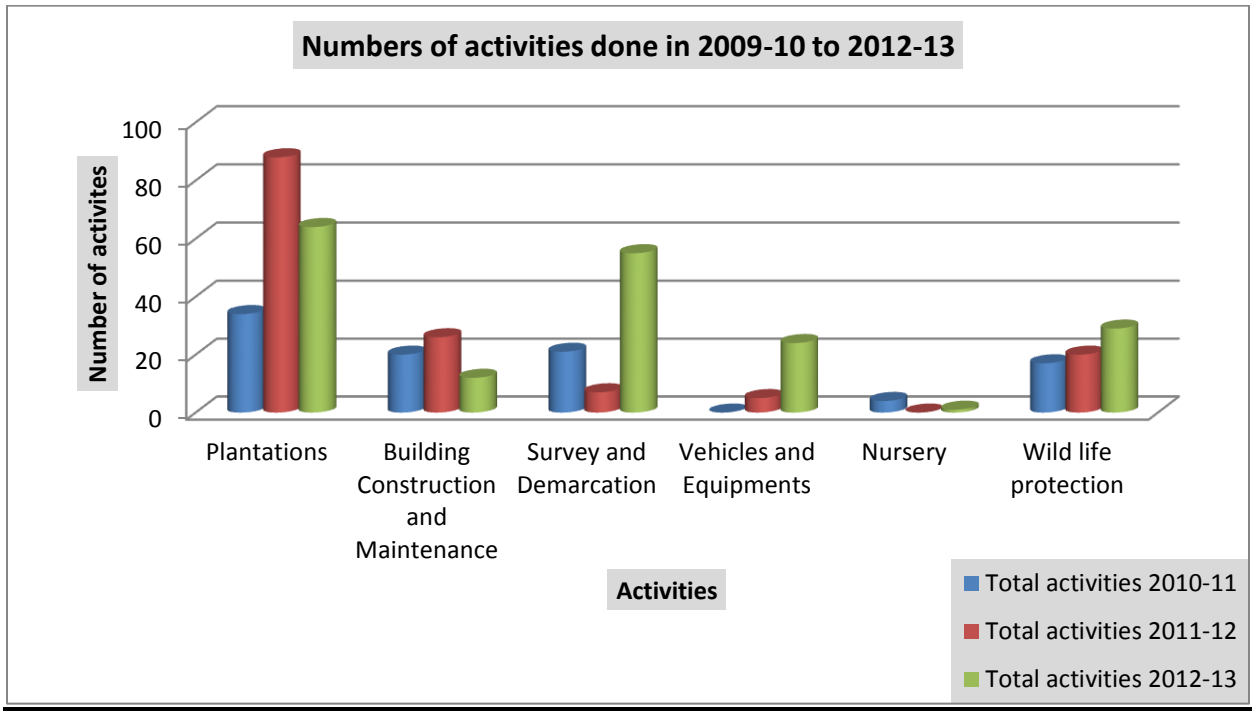
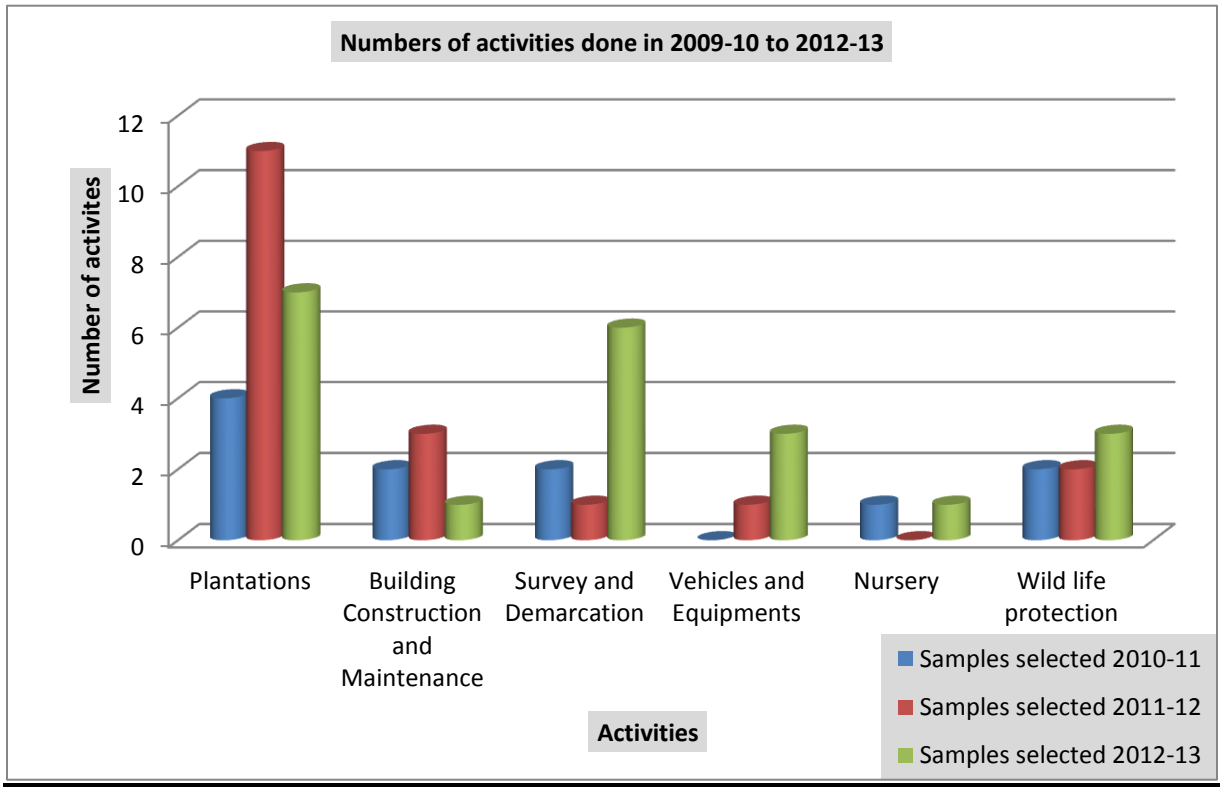


Fig.6 showing the numbers of Samples selected for evaluation in Thirteenth Finance commission (TFC) Unit I



CHAPTER – IV

MATERIAL AND METHODS

The present work was carried out to evaluate the forestry work done under Thirteenth Finance commission (TFC), during the year 2009-10 to 2012-13 in unit - I. Details of material used and methodology followed and observations recorded during the course of investigation are detailed here under.

4.1 Evaluation methods and techniques

4.1.1 Plantations

Evaluation method: as per the terms of reference, 10 % of total numbers of plantations were randomly selected from each division and in each year. The selected samples were later evaluated with 2% intensity. For every 5 ha of plantation one sample plot of 0.1 ha was randomly selected using GPS to measure parameters like height survival rate, collar diameter and vigor of the plantations. The general observations were also selected with respect to biodiversity, soil moister conservation work.

Procurer to select plots in plantations

The plantations were divided in to 5 ha gird on the map. Depending on the size of the plantation the number of sample plots was selected as follows.

(1) <5 Ha - one sample plot
(2) <10 Ha - two sample plot
(3) <15 Ha - three sample plot
(4) < 20 Ha - four sample plot
(5) >20 Ha – one sample plot for every 5 Ha
(6) Sample plot size – 1000 m^2 (31.62 m × 31.62 m)
(7) GPS point: please record the GPS point.

Selecting 0.1 ha in 5 ha gird: In a 5 ha gird the plots are divided into 7*7 rows and columns .as shown in fig below. Further the procedure to select plots for deferent size plantation is given well in advance as shown in below.

1	2	3	4	5	6	7	7
2							
3							
4							
5							
6							
7							

1) 5 ha	-4th row	6th Colum - (1 sample plot)
2) 10 ha	-3rdrow	7th Colum – (I and 2 sample plot)
3) 15ha	-2nd row	2ndColum (1, 2 and 3 sample plot)
4) 20 ha	-5th row	4thColum (1, 2, 3and 4 sample plot)
5) 25 ha	-1strow	6th Colum (1, 2, 3, 4 and 5 sample plot)
6) 30 ha	6th row	3rdColum (1, 2, 4, 5 and 6 sample plot)

Regarding virtual demarcation of sub plots of 0.1 Ha, one need not physically divide the subplots on the ground. For example 4throw 6th Colum means we take 31 × 4 meters (124 meters) from the corner main plot to the point on 4th row and then from the marked point, measure 6×31 meters to reach the 6th Colum (horizontally). Follow same procedure for all other rows and columns.

Measurements

a) **Survival counts**:
The total number of plants planted in the sample plot of 0.1 ha was manually counted by counting the pits/trenches. Later the plants surviving were counted to calculate the survival %.

b) **Height:**

In each sample plot height was measured for 2% of the total plants using the calibrated pole or the tape.

c) **Collar diameter**:
The collar diameter was measured for those plants which were measured for the height in cm. (girth was measured and converted to diameter).

d) **Counting the natural plants in the area :**

The plants that were found naturally were counted for the purpose of bio-diversity.

4.2 Fire protection

Fire line Formations was physically checked and Fire Protection work is difficult to verify. But using proxy methods like alter Fire protections were effective or not.

4.3 Boundary consolidation

The GPS was used to record the perimeter. Randomly the measurements can be recorded. The quality of the work regarding the effectiveness may be recorded as Good. Satisfactory, Poor with any other field observations.

4.4 Vehicles and Equipments

Vehicles and equipments verified through frequency of use, checking the stock book, brand/company, Check log book.

4.5 Wildlife works

The quality of the work for its effective use or abandoned and its impact on the objective was recorded. Verification of the wildlife crimes caught by the camp personnel in the corresponding year, Increase or decrease in the crimes in the corresponding year was recorded and Salt licks are difficult to verify but use proxy indicators if any like pits or animal sighting records if available as they are maintained in the parks.

4.6 Building works and maintenance

The quality and usefulness was the criteria to judge the work of building maintenance and for the roads physical quantity like length, width and depth at random places was measured.

4.7 SMC works.

Soil and moisture conservation works are physically verified and later assessed for the quality of the work. The impacts are assessed through vis.

CHAPTER - V

ANALYSIS AND EVALUATION RESULTS

Under the 13th Finance Commission many assets creation and protection works have been taken up in the department in different divisions to meet the objectives of forests conservation and development. The works included plantation raising, maintenance of older plantations and protection works. The evaluation of these works and their resulted are presented under different tables below.

5.1 Maintenance of plantations (Encroachment Evicted areas/gap plantation/logged area)

Under 13 th Finance commission maintenance of plantation raised under different schemes in previous years was one of the important activity on which substantial amount of funds has been invested. The works taken-up under this scheme in Belgaum, Gulbarga and Dharwad circles were evaluated and the results are presented here.

6. Table showing the survival rate, mean height and mean collar diameter of the plantations in different divisions

Year	Division	Extent (Ha)	Location	Species	Survival Rate	Mean height (m)	Mean CD (cm)
2010-11	Belgaum	5	Watra FS 13	Cashew, Acacia	62	4.5	4.5
2010-11	Gokak	2	Yogikolla	Agave	0	0	0
2010-11	Gulbarga	25	Chincholi	Pongamia, Acacia	68.88	1.2	1.1
2010-11	Belgaum	15	Golihalli	Acacia	80.6	5.3	1.85
2011-12	Yadgir	25	Wadanahalli				
2011-12	Bidar	30	Bhimalkheda	Glyricidia	95	1.5	1.34
2011-12	Dharwad	124	Kalkeri	Teak	49.6	6.15	15
2011-12	Bagalkot	20	Gulabal	Thespesi, Anjan	77.27	1.19	2.5

5.1.1 Survival rate

The survival rate of the plantations maintained in different models has shown 72.25%. The mean height varied between 1.19-6.15 meter for different models of plantations. The mean Collar diameter also varied between 1.1-15 cm across divisions.

Belgaum: In Belgaum division two plantations were evaluated and found that the survival rate was 62 in a three year plantation and 80.6% in a second year plantation. The low survival in the third year plantation where Acacia and cashew are the major species is a major concern. As the Acacia and Cashew are very hardy species which can perform better under adverse conditions.

Gokak: In Gokak the 2 ha plantation was not planted but only the SMC work was taken up.

Gulbarga: In Gulbarga division the plantation was done in the gap area with Pongamia and Glyricidia species. The survival rate was 68.88 after three years of plantation is quite reasonable.

Bidar: The plantation done in Encroachment evicted area in Bhimkoda was found to have 95% survival where the Glyricidia was the main species.

Dharwad: In Dharwad in 124 ha the teak plantation has been raised in the gap areas. The survival is 49% which is very low for the teak species in Dharwad climatic conditions. Teak should not have been planted in the gap areas where the species can't tolerate the shade.

Bagalkot: The species like Hardwickia and Thespesia have shown 77% survival in a second year plantation.

Key findings:

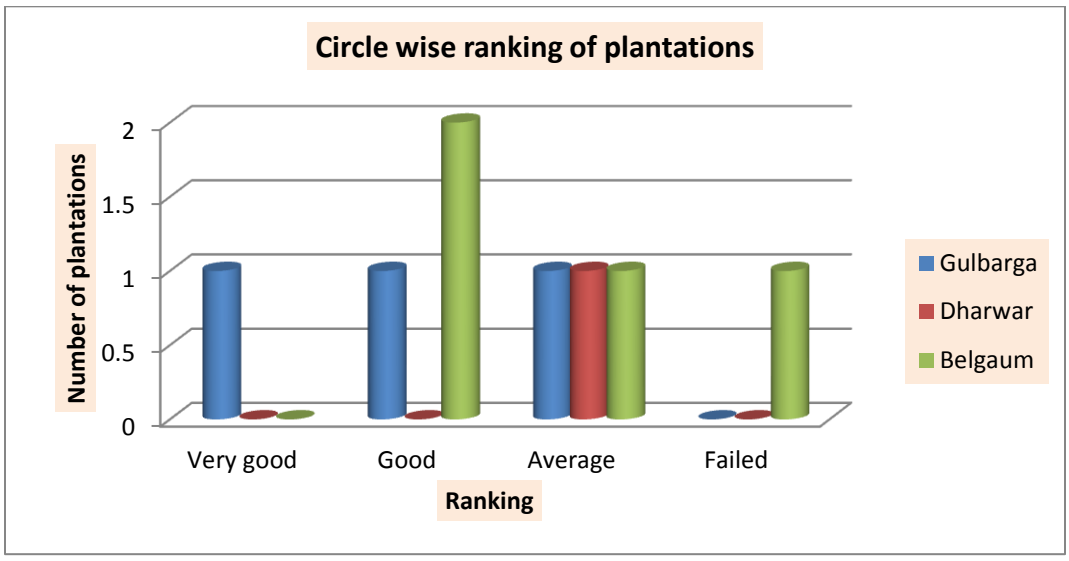
1. The gap plantations have shown very poor survival rates compared to logged areas.
2. Planting Acacia and teak in the gaps may be avoided as the survival rate is very low.
3. Belgaum and Dharwad have shown very low survival rate compared to Gulbarga.

5.1.2 Circle wise ranking of plantations

7. Table showing the circle wise Ranking of plantation

Circle	Very Good	Good	Average	Failed
Gulbarga	1	1	1	0
Dharwad	0	0	1	0
Belgaum	0	2	1	1
%	12.5	37.5	37.5	12.5

Fig.7 Showing the Ranking of plantation circle wise



Gulbarga: Gulbarga plantations were found better than Belgaum and Dharwad. The planting of Glyricidia has ensured higher success rate.

Dharwad: The plantations raised in Dharwad (sampled plantation) were found with 49% survival for teak species. The low survival rate for teak is due to shade effect in the gap plantation.

5.2 Advance work and raising plantations.

The new plantations have been raised under the TFC in Belgaum, Dharwad and Gulbarga circles. The evaluation of these plantations for survival rate, mean height, mean collar diameter. After evaluation of the plantations the results are tabulated below.

8. Table showing the survival rate, mean height and mean collar diameter of the plantations (2011-12) in different divisions

Year	Division	Extent	Location	Species	Survival Rate	Mean height (m)	Mean (cm)
2011-12	Belgaum	25	Ambadgatti	Acacia	95	5.7	7.1
2011-12	Belgaum	5.80	Chinchanwadi				
2011-12	Belgaum	10	Watra	Embelica, Acacia	73	4.5	4
2011-12	Gulbarga	20	Guggalwadi				
2011-12	Belgaum	50	Godalkundargi	Cashew, Neem	90	0.6	0.74
2011-12	Belgaum	50	Chapoli	Bamboo, Terminalia	71	1	0.45
2011-12	Bagalkot	25	Gandal	D sissoo, A latifolia	85.39	2	.6
2011-12	Bidar	25	Ubdal	Advance work	-	-	-

5.2.1 Survival Rates

The survival rate was found varying between 73-85.91 in different divisions. The height was found varying from 0.6-4.5 meters. The Belgaum plantation was found to have the mean height of 4.5 meters which can be attributed to good rainfall.

Belgaum: Belgaum division plantations have shown very high survival rate of 95 and 90% which is due to planting of Acacia cashew and neem which are locally well suited to soil and climatic conditions. In one plantation the survival is 71% where hardwood species has been planted along with bamboo.

Bagalkot: Bagalkot division has shown very good survival rate of 85.39% where *Dalbergia sissoo* has been planted up which is drought tolerant and highly adaptive.

Bidar: The advance work in Bidar was found to be as per the sanctioned estimate.

5.3 Plantation raised in Gap and logged area

Under TFC, new plantations have been raised in the to gaps and logged areas to increase the green cover. The new plantations have been raised mainly in the forests lands after logging and in the natural gaps. These plantations were selected randomly using pro presented in the probabilistic sampling methods and the survival rates, mean height and mean collar diameter were calculated. The results are presented below.

9. Table showing the survival rate, mean height and mean collar diameter of the plantations in different divisions

Year	Division	Extent	Location	Species	Survival Rate	Mean height (m)	Mean (cm)
2011-12	Dharwad	130	Siddanabhavi	Pongamia, Bamboo, Mango	88.32	0.9	1.2
2011-12	Gadag	45	Hirewadatti				
2012-13	Dharwad	100	Kumbarganavi				
2012-13	Gadag	40	Hirewadatti	Pongamia, Thespehasia	89	0.75	0.68
2011-12	Bagalkot	25	Shirur				
2012-13	Belgaum	20	Nagargali	Advance work	5000 pits; 3.5 km		Good

Dharwad: In Dharwad the raising plantation in the gap area has shown 88% survival where Pongamia and bamboo has been planted.

Gadag: In Gadag the raising of the plantation in gap area with species like Pongamia and The species has shown 89% survival with the modest growth of height and girth. The expected productivity is between 5-8 m2/ha after 10 years.

Belgaum: In Belgaum the advance worked area in 20 ha was inspected and was found as per the specifications. The brushwood fencing was done for 3.5 km length which is on higher side of the perimeter.

5.3.1 Species wise survival in different divisions

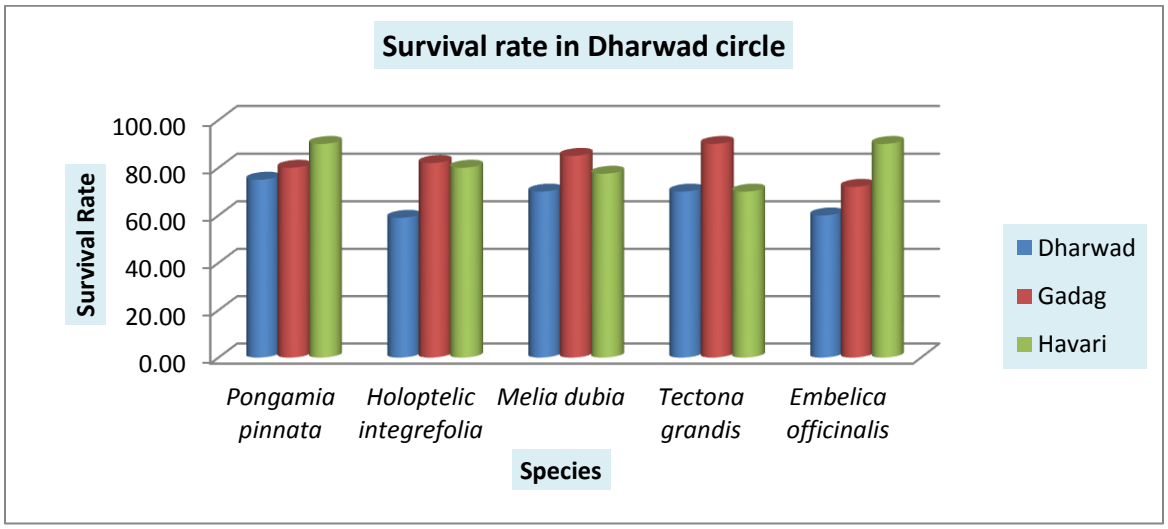
The species wise survival in different models has been represented circle wise for illustration.

In Dharwad circle *Pongamia pinnata* was shown 81.67% survival followed by *Melia dubia* with 77.50 survivals. The weighted average is 76.70%.

10. Table showing survival Rate of different species in Dharwad circle

Species	Divisions			Mean
	Dharwad	Gadag	Haveri	
Pongamia pinnata	75.00	80.00	90.00	**81.67**
Holoptelic integrefolia	59.00	82.00	80.00	**73.67**
Melia dubia	70.00	85.00	77.50	**77.50**
Tectona grandis	70.00	90.00	70.00	**76.67**
Embelica officinalis	60.00	72.00	90.00	**74.00**
Mean	**66.80**	**81.80**	**81.50**	**76.70**
Sem±	**2.7 (b/w species) AND 4.3 (b/w divisions)**			
Cd@5%	**18.5 (b/w species) AND 22.2 (b/w divisions)**			

Fig.8 Showing the survival Rate of different species in Dharwad circle



11. Table showing survival Rate of different species in Gulburga circle

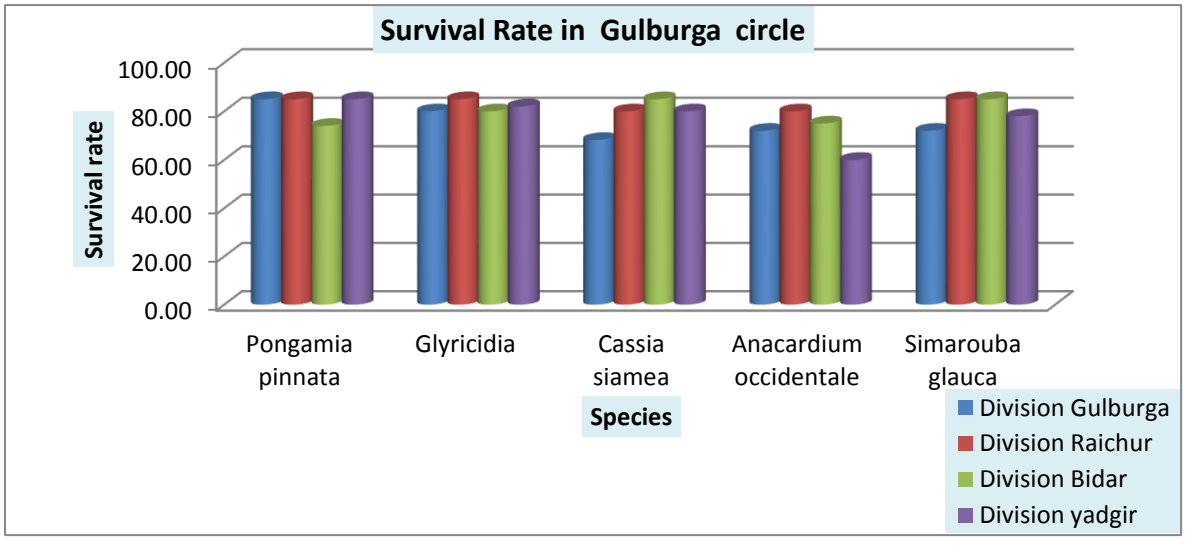
Species	Divisions				Mean
	Gulbarga	Raichur	Bidar	Yadgir	
Pongamia pinnata	85.00	85.00	74.00	85.00	82.25
Glyricidia	80.00	85.00	80.00	82.00	81.75
Cassia siamea	68.20	80.00	85.00	80.00	78.30
Anacardium occidentale	72.00	80.00	75.00	60.00	71.75
Simarouba glauca	72.00	85.00	85.00	78.00	80.00
Mean	75.44	83.00	79.80	77.00	78.81
Sem±	**2.7 (b/w species) AND 3.18 (b/w divisions)**				
Cd@5%	**11 (b/w species) AND 11.9(b/w divisions)**				

In Gulbarga circle the most common species planted are Glyricidia, Pongamia, *cassia siamea* and Simaruba. In few plantations *Hardwickia binata* and *Azadirachta indica* have also been planted. The species wise survival analysis was done through two way ANOVA and the results are presented in the table above.

It is found that Pongamia was found to have highest survival rate of 82.25 % across divisions followed by Glyricidia with 81.7%. Simaruba was found to have the survival rate of 80%.

Overall mean survival was 78.81 for all the species across all division indicating good success of the plantations in the initial years.

Fig. 9 showing the survival Rate of different species in Gulburga circle

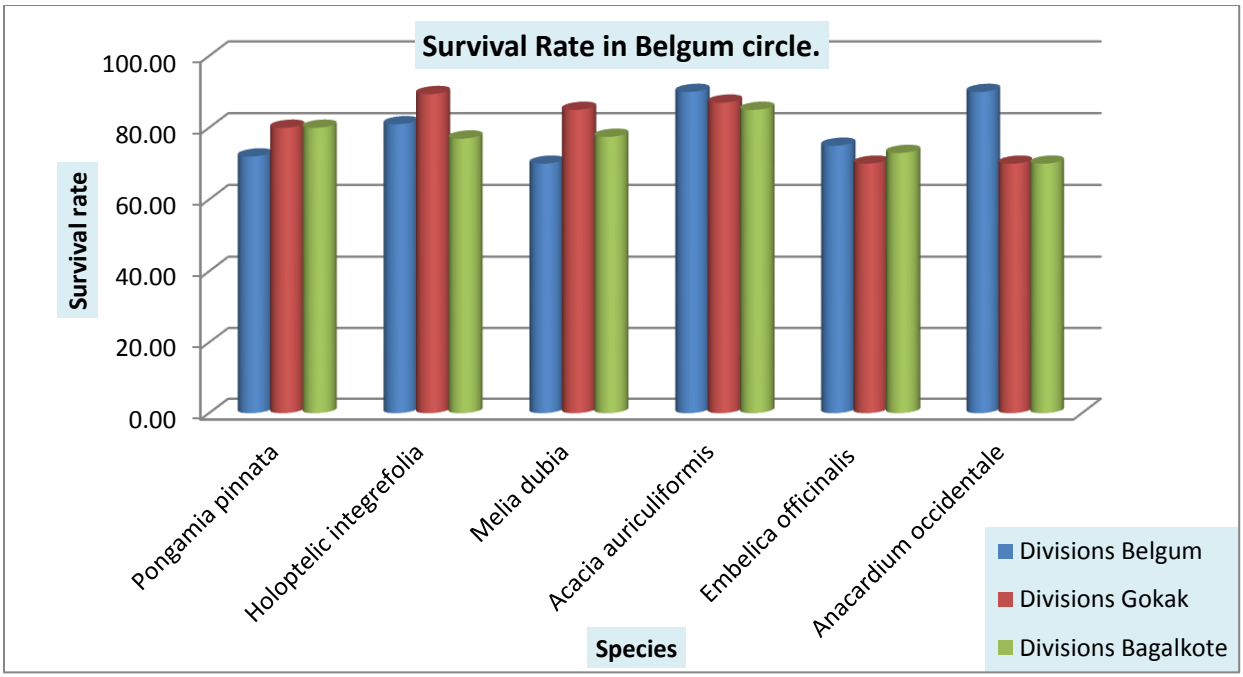


12. Table showing survival Rate of different species in Belgaum circle

Species	Divisions			Mean
	Belgum	Gokak	Bagalkote	
Pongamia pinnata	72.00	80.00	80.00	77.33
Holoptelic integrefolia	81.00	89.40	77.00	82.47
Melia dubia	70.00	85.00	77.50	77.50
Acacia auriculiformis	90.00	87.00	85.00	87.33
Embelica officinalis	75.00	70.00	73.00	72.67
Anacardium occidentale	90.00	70.00	70.00	76.67
Mean	79.67	80.23	77.08	78.99
Sem±	**2.5 (b/w species) AND 4.30 (b/w divisions)**			
Cd@5%	**14.7 (b/w species) AND 17.7 (b/w divisions)**			

In Belgaum the most common species planted are Pongamia pinnata followed by *Holoptelic integrefolia* and Acacia auriculiformis. The other common species planted are *Cassia siamea, Anacardium occidentals and Azdirachta indica*. When the survival rates were analyzed through ANOVA it was found that Acacia auriculiformis had 87.33% survival followed by Holoptelic with 82.47%.

Fig.10 showing the survival Rate of different species in Belgaum circle



5.3.2 Productivity projection

The productivity projection was attempted to assess the future potential growth of the plantations. The mean annual increment of the diameter was found to vary between species to species and division to division.

Acacia auriculiformis: The diameter increment was 3.3 cm/year in Belgaum and Yadgir. This indicates a possibility of trees attaining 30 cm diameter at the end of 10 years. The basal area of 7-10 m2/ha/ at 10 year rotation. The height increment is 1 meter per year. At the age of 10, the mean height would be varying between 7-8 meter. The expected biomass would be 70-80 cum/ha. This is the most conservative estimate. Using Acacia as an indicator species the mean productivity of slow growing species could be in the range of 5-6 cum/year.

Holoptelic integrefolia: This is a native species which has been taken as indicator species to project the productivity. The mean annual increment of the diameter is 3.3cm/year. The mean height is 0.8 cm/year. The volume production would be in the range of 5-8 cum/year.

5.4 Building Construction and Maintenance

13. Table showing the quality of the Building Construction and Maintenance Activities under TFC between 2010-11 to 2012-13

Year	Division	Work	Specifications	Amount	Remarks
2010-11	Gulbarga	Staff quarters	Stair case repairs	20000/	Work done as per specification
2010-11	Dharwad	Construction and repair	Not visited	20000/	
2011-12	Belgaum	Maintenance of FRH at Londa	Changing roof doors	10.00 lakh	Work done. Bathroom tiles, sheets, wall constructions
2011-12	Yadgir	Construction of District forest office	New office building with office facilities.	20.0 lakhs	Work done. Well maintained with good facilities
2011-12	Gadag	Repairs of Rest house	Changing the slabs in kitchen, cupboards	80,0000	Work done

Belgaum: The Building maintenance at the cost of Rs 10.0 lakhs is very high. The repairs should not exceed 10% of the capital cost. The quality is good according to the evaluation officer. However he could not verify the documents.

Yadgir: In Yadgir the new office building has been done with good facilities like visitor's room, staff rooms and the store rooms. The quality is very satisfactory.

5.5 Wildlife Protection

Under TFC the wild life area management works have been undertaken. The works includes establishment and maintenance of forest protection camps.

14. Table showing the quality of the Wild life protection Activities under between 2010-11 to TFC 2012-13

Year	Division	Work	Specifications	Amount	Quality	Remarks
2010-11	Gadag	Fire protection camp	One camp	1,60000	Work done	Effective
2010-11	Haveri	Anti-poaching camp	One camp	1,06000/	Work done	Effective
2011-12	Belgaum	Forest protection camp	One camp	1,30000/	Work done	Effective
2011-12	Gulbarga	Protection camp	One camp	1,00000/	Work done	Effective
2012-13	Dharwad	Camp	One camp			No documents/ signs of proof
2012-13	Yadgir	3 watchers	Anti-poaching camps	2,000,000/	Work done	
2012-13	Bidar	2 watchers	Protection camps	1,000,00	Work done	

Anti-poaching camps: The anti-poaching camps in Gulbarga, Gadag, Haveri and Belgaum were found effective.

Yadgir: The need to have protection camps is to be justified in places like Yadgir and Bidar.

5.6 Vehicles and Equipments

Unser 13th Finance commission substantial amount has been invested on the purchase of vehicles and equipments. The pattern of investment on the vehicles and equipments are presented in the table below.

15. Table showing the quality of the Vehicles and Equipments Activities TFC between 2010-11 to 2012-13

Year	Division	Work	Specifications	Amount	Remarks
2011-12	Belgaum	Tranquilizing guns	High tech product	3,000,00/	Was not used
2012-13	Gokak	Broad band	BSNL	8000/	Used
2012-13	Bijapur	broadband	BSNL		
2012-13	Haveri	Maintenance of two wheelers	-	20,000/	Being used

Tranquilizing guns: The tranquilizing guns purchased in Belgaum are not used .May be there was no occasion to use them.

5.7 Nursery Works

Under TFC substantial amount has been invested on the nursery works. The two samples of nursery work done at Jamkandi in Bagalkot and Gokak evaluated and results are presented here.

Gokak: In Gokak, a bore-well has been installed in the nursery. The bore well is functioning well.

Bagalkot: In Bagalkot in Kattikere nursery the barbed wire fencing has been done for 750 meters. And the work is rated as very effective.

5.8 Survey and Demarcation

Under the 13 the Finance commission substantial amount has been invested on the boundary demarcation work has been executed. The investment pattern on this works over the years is given in the table below.

16. Table showing the quality of the Survey and Demarcation Activities under TFC between 2010-11 to 2012-13

Sl. No.	Year	Division	Activity	Range	Location	Physical Quantity	Field Measurement	Remarks
1	2010-11	Gokak	Boundary Consolidation Works including CPT	Gokak	Gada Fs. No. 715, 755	4 km	3.52 km 1*1.5*1	Effective
2	2010-11	Raichur	Boundary Consolidation Works Including CPT	Manvi	Kachapur	4 km	4 km 1*1.5*1	Effective
1	2011-12	Dharwad	Boundary Consolidation Works including CPT		Baichawad (Kotemani to Baichawad road) Bl.No.II	2 km	2 km	Effective
1	2012-13	Belgaum	Boundary Consolidation Including D-Line	Nagargali	Merda Sy. No. 9, 12, 15	1.00 Km	1 km 1*1.5*1	Effective
2	2012-13	Belgaum	Boundary Consolidation Including D-Line	Khanapur	Jamboti, Kalmani Sy. No. 97, 305,	2.50 Km	2.2 km 1*1.5*1	Effective
3	2012-13	Dharwad	Boundary Consolidation Works including CPT	Kalghatagi	Kudalagi Bl.IV, Fsy.No.51	2.125 km	2.1 km	Effective
4	2012-13	Haveri	Boundary Consolidation including D-line clearances CPT	Hanagal	Haralakopp	4.38 km	4.384 km	Effective
5	2012-13	Raichur	Boundary Consolidation Works Including CPT	Deodurga	Bandegudda	4 km	4 km 1*1.5*1	Effective
6	2012-13	Bidar	Boundary Consolidation Works Including CPT	Bidar	Bombulagi	2 km	2 km 1*1.5*1	Effective

Haveri: In Haveri, the boundary consolidation works were inspected at one location and found that the work was as per the specification and effective.

Dharwad: In Dharwad division the boundary consolidation work was tested and found correct as per the specifications. In one location at Kalghatgi 2.12 km CPT has been done which is very effective. In another location CPT has been done in 2 km length which is found to be effective.

Raichur: In Raichur the boundary consolidation work has been done in 2 km length and the CPT is found to be effective as reported by the evaluation staff.

Bidar: In Bidar division the Boundary consolidation work has been taken-up for a length of 2 km.

Key findings

The boundary consolidation works are taken as piece works of 2-4 km length depending upon the availability of funds. It is advisable to take and complete the work at one goes so as to ensure complete protection. Instead of thinly spreading the resources on vast areas it is advisable to take-up the works for complete consolidation.

CHAPTER – VI

OBESERVATIONS AND IMPACT ANALYSIS

The Thirteenth Finance Commission was implemented with an objective to improve the forest protection and conservation .Plantations maintenance work. Substantial amount has been invested in the plantation maintenance. The evaluation has shown that the plantations are showing good signs of survival and growth potential which would go a long way in achieving the objectives of the scheme.

1. **Increase in the green cover**: One of the main objectives of the TFC is to achieve the area under forests and to enhance the green cover. The raising of the plantations have contributed towards the increase in the green cover and the area under the forests.
2. **Bio-diversity value**: The species chosen in each plantation are limited to very few (less than 10) and therefore there is a limitation of the plantations in achieving the objectives.
3. **Productivity of the plantations**: The productivity has been assessed by measuring the growth parameters. The overall increment in the height is around 0.75 meter/annum and the collar diameter is about 1 cm which is moderate as compared to the growth rates on better soils and high rainfall areas. The extrapolation of the growth parameter will give us approximately 8 cm diameter (DBH) and 6 meter height at the end of 8 years for the fast growing species. The mean basal area will be around 10 m2/ha/ at 10 year. And it may take 40 years to cover the canopy.
4. **Climate change mitigation**: The productivity of the plantation at the rate of 10 m2 /basal area with a mean height of 6 to 7 meter will give approximately 5 to 6 m3/year in the drier areas and 10 to 12 m3 /ha/year in high rainfall areas. This rate of productivity can sequester on an average 2 tons of carbon/ha/year.
5. **Employment generation**: The investment on compensatory plantation has generated (70% plantation cost is labour cost) employment in the rural areas. The 70% of cost of raising plantation goes for employment.
6. **Investment on non-plantation works**: More than 40% of the funds under this scheme has been done on the infrastructure like buildings, Roads, and equipments to strengthen the departmental capacity. This has been difficult to relate to the benefits.

CHAPTER – VII

RECOMMENDATIONS

1. The TFC must allocate funds according to the formula suggested by the TFC based on the forest cover and ecological service of each Circle/division as the criteria. Why TFC invest on raising fresh plantation as its objective is to protect and safeguard the natural forests, wildlife and mitigation of degradation impacts and on the climate change aspects.

2. The plantation models like eviction of encroachment, gap areas, logged areas and the maintenance of older plantations (maintaining 8 year old eucalyptus plantation?) was like hair splitting. An investment guidelines based on the TFC must be drawn up before making allocation of funds.

3. Investment on new fire line formation and fire protection was not verifiable. However, the internal monitoring for the annual works must be done as most of the operations may be either not required or redundant.

4. The choice of species may be rationalized based on the site requirement by focusing on the native species than Acacia auriculiformis.

5. The activities under TFC are too many resulting in very thin spread of investment which may not have desirable impact on the departmental programs. It should focus much on the compensatory plantations by spending 70% investment and rest on the natural forests management.

6. Expenditure on the building maintenance and vehicles should not be a major activity.

7. The investment on the research and wildlife is inadequate needs to be balanced.

8. The natural forests, bio-diversity conservation, enrichment planting and research programs needs to be given priority.

9. **Plantation size**: Many compensatory plantations have been raised are very small in size (less than 5 ha). This may not be viable to maintain and protect. It is better to aggregate the smaller units into a viable size of at least 10 ha to raise plantations.

10. The plantation on degraded sites must be well defined as in many places well stocked areas have been planted up.

11. The site clearance for raising plantation was noticed in some areas which needs to be avoided.

12. **Choice of species**: The species choice was very mechanical and there was no effort to match the sites.

13. *Acacia auriculiformis* is planted as core species in many compensatory plantations in high rainfall areas which may be completely avoided. Native species mix is the best option.

14. The SMC works are done very unscientifically. A guideline may be necessary to design and structure the works by estimating the quantum of water that could be impounded is to be done. The contour maps are to be used to locate the structure. The planning processes to regulate the SMC works are necessary.

15. The protection measures were not effective in many places. It is essential to provide maintenance provisions for five years so that the purpose is well achieved.

16. The plantation care and maintenance needs to be done for minimum five years. The investment must be done to ensure success of the plantations.

17. TFC must set a very successful model of plantation through innovations and higher investment as there is no cap on the unit cost.

18. Three year assessment is too early to judge the success. There should be five years interval evaluation twice to make a meaningful evaluation.

19. The internal evaluation needs to be strengthened and the database must be established to monitor the changes.