

Role of Modern Management Techniques for Improving Productivity in Afforestation Programme

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NEED FOR AFFORESTATION

1981. F.A.O. report on Forest Resources of Tropical Asia¹ clearly warns the countries about the grave consequences arising out of excessive deforestation leading to increased frequency of floods, scanty rainfalls, erosion of soil, heavy siltation of dams built at enormous expenses and other changes in microclimate of the region. In short, a progressive depletion of the country's ecological bank. The present land mass in the country has a forest coverage of hardly about 17% against an accepted healthy forest coverage of about 33%. To make matters worse, our requirement of forest resources in years to come is not going to remain stagnant at the present level of consumption. On the other hand, the consumption pattern, as can be seen from the Table 1, is estimated to go up by 34% for wood and 64% for bamboo by the year 2000². In other words, we would be requiring about 3000 lakh m³ of wood against an

actual consumption of 2155 lakh m³ in the year 1980. Likewise, total requirement of bamboo for industrial and non industrial usage would be about 70 lakh tonnes as against 43 lakh tonnes of bamboo felled during the year 1980. Therefore, there is not only an urgent need to preserve our remaining forests, but also to take effective steps to promote afforestation programmes from the point of maintaining ecological stability and meeting long term needs of human requirements of fuel wood, timber, pulp wood, bamboo, etc.

It is basically with this aim of bringing 33% of the country's geographical area under forest coverage and to improve the eco-environment that the Seventh Five-year Plan envisages an afforestation programme of 50 lakh hectares of land per annum³.

TYPES OF AFFORESTATION PROGRAMMES

Afforestation programmes may broadly be classi-

TABLE—1
NATIONAL REQUIREMENT OF WOOD AND BAMBOO
(Figures in lakhs)

Category	Consumed in 1980	% Ttotal	Requirement in 2000 AD	% Total	Additional requirement	% Increase
Fuel wood (m ³)	1886.00	87.5	2250.00	78	364	19
Timber (m ³)	227.20	10.5	407.55	16	240	106
Pulp Wood(m ³)	41.75	2.0	176.95	6	135	32.3
	<u>2154.95</u>	<u>100</u>	<u>2894.50</u>	<u>100</u>	<u>739</u>	<u>34</u>
Bamboo for non industrial requirement (T)	21.9	49	34.59	49	13.50	64
Bamboo for Pulp and Paper Industry (T)	21.65	51	35.46	51	13.81	64
	<u>42.74</u>	<u>100</u>	<u>70.05</u>	<u>100</u>	<u>27.31</u>	<u>64</u>

*Sirpur Paper Mills, Sirpur-Kaghnagar.

fied into the following categories depending on the primary objective for which they are created⁴.

- 1 — Afforestation for commercial purposes
- 2 — Afforestation for protection
- 3 — Afforestation for forest reclamation
- 4 — Afforestation for community development
- 5 — Afforestation for recreational purpose

Afforestation for Commercial Purposes

The main objective of the afforestation programme under this category is meant for commercial usage. Afforestations under this head may be further subdivided into:

- (i) Plantation of major plant species for non-industrial use such as teak, sal, devdar, indigenous pines, etc.
- (ii) Plantation of plant species raised for providing raw material for feeding wood-based industries like pulp and paper, rayon, matchwood, plywood, hardwood and particle board, katha, sports goods, musical instruments, handicraft, rosin, turpentine, etc.
- (iii) Plantations of other economically important plant species such as rubber, cashew, spices, etc.

Afforestation for protection

Main objective of creating these forests is for the protection of soil and vegetation from the harmful effects of natural elements such as wind, rain, sea, water, salt spray, etc.

Afforestation for forest reclamation

Under this category may be included the forests raised on barren and/or denuded waste lands on which the tree cover has deteriorated or totally disappeared as a result of past mismanagement and abuse, excessive salinity of the soil and/or excessive alkalinity of the soil.

Afforestation for Community Development

These are woods usually raised on non-forest lands with the main objective of meeting the bonafide domestic requirements of small timber, fuel and fodder

required by the rural community of private owners on whose holdings such plantations are raised. Such plantation may also take the form and shape of small tree belts around individual field boundaries to act as wind breakers.

Afforestation for Recreational Purpose

This category includes forests raised for purely bio-aesthetic and recreational purposes on the foreshore lands of dams and reservoirs and the lands around large lakes, archaeological monuments, etc.

NEED FOR MODERN MANAGEMENT IN AFFORESTATION PROGRAMME

An afforestation programme or project comprises of large number of activities which have to be spread over a large tract of land involve large number of people and money. Further, many of the activities need to be completed in time due to the influence of seasonal factors. Given unlimited time and money, this should not pose any problem, since activities not completed in one season could be postponed to the next season. However in practice, there exists strict time and monetary constraints for such project programmes. Under these circumstances, it is only by the application of modern management techniques that the inter-related complex problems of planning, scheduling, organising, execution and controlling of all the activities of the afforestation programme can be accomplished within the stipulated time and budgetary limits.

SPECIFIC MODERN MANAGEMENT TECHNIQUES APPLICABLE IN AN AFFORESTATION PROGRAMME

Whatever may be the type of afforestation programme, adoption of some of the following modern management techniques in some form or the other becomes essential.

Objective and Data collection

Objective should be clearly defined. Consistent and quantitative. The data collected should aid in the formulation of realistic courses of action, to allow for the most optimum course of action to be evaluated and hence ultimately facilitate decision making. The data required will be as follows:

1. Resources data
2. Operational data
3. Utilisation data
4. Socio-economic data
5. Institutional data

The Appraisal

The appraisal stage in the planning of an afforestation project is the most critical because it leads directly to the decision making which commits large sums of money and expenditure of energy to a particular course of action. Once investment in the chosen course of action has commenced, it becomes difficult to reverse the decision, should it prove unsatisfactory for any reason. It is therefore essential that the decision to go ahead with the project by a particular course of action should be based on the best possible data and the fullest study of all the relevant factors. The steps to be taken for appraisal are :

- (i) Identifying alternate courses of action for attaining the objectives of the project.
- (ii) Analysing various alternatives to ascertain inputs requirements of resources, with their costs and resultant outputs associated with them.
- (iii) Testing courses of action against the project constraints to ensure that none are violated.
- (iv) Comparing the various alternatives using the project criteria to ascertain which one is likely to give the most optimum results.
- (v) Presentation of the selected alternatives in the form required for authorisation and financing.

Operational Planning—Prescriptions

This stage is concerned with planning the actual implementation of the chosen course of action from the time the actual work actually commences with an approved budget. One of the major activities in this stage is network analysis, followed by forecasting of future requirements and marshalling of resources.

Network Analysis in an afforestation programme

With complex tasks such as a large afforestation project, it is too much to expect that the programme/project can be completed on time without a constant

monitoring of the progress of each of the component activities. This monitoring of progress is virtually impossible without some technique which enables the co-ordinator/manager to condense the whole project to some simple form and represent the component parts graphically so that all the inter-relationships can be viewed at a glance.

The activities which are involved in an afforestation programme are.

- a) Recruit staff
- b) Land survey
- c) Land allocation
- d) Acquire machines and equipments
- e) Training of staff and operators
- f) Construction of access routes
- g) Building construction
- h) Allotments
- i) Establishment of nurseries
- j) Raising planting material
- k) Vegetation clearance
- l) Ploughing
- m) Planting
- n) Replanting of failures
- o) Fertilising
- p) Weed control
- q) Brasting
- r) Drainage maintenance
- s) Thinning
- t) Fire protection
- u) Road maintenance

Afforestation Project Management

A well planned project is more likely to succeed than an ill-planned one, but no amount of planning can guarantee success if the subsequent management and control is inadequate. In an afforestation, management, programming, execution and control form a circular sequence.

Programming : Plans and specifies the work to be done

Execution : Implements the programme

Control : Compares actual with planned achievement and in so doing, provides the basis for programming the next time period

Projects Organisation

The project must be organised in such a way that locations in the forest can be readily identified and records can be kept of the work that has been done at particular place. The proposed forest area should be divided up territorially into compartments which should be permanently marked on the ground and on maps. The optimum size of a compartment depends on the intensity of management but should rarely be less than 15 Ha and preferably not more than 100 Ha. A large afforestation project should be divided into blocks to match the capabilities of the supervisor.

Having highlighted some of the modern management techniques in brief, let us see how they can be made use of in an afforestation programme by means of a hypothetical example as illustrated below.

Hypothetical Example of raw Material Estimation for 60000 TYP Paper Mill with network analysis

This is clearly a case of commercial afforestation programme. We must next ask as to what exactly the results expected from this programme.

We find that a new paper mill with a production capacity of 60000 TPY of papers proposes to raise forest based raw materials for conversion into its end product, i.e. paper.

Once the objective is clearly defined, the next step is the compilation of sufficient and reliable data. The objective in our hypothetical case becomes "designing afforestation programme capable of generating desired quantity of forest based raw material suitable for conversion into pulp on a sustained basis". Data collection and compilation should now encompass all the phases of the above object such as suitability of various types of bamboo/woods vis-a-vis their yield and conversion costs, recommended spacing, maturing time, etc.

After the build up of the data bank, the stage is set for preparing various alternative courses of action with detailed estimates of time, money and expected returns. The various alternatives are then to be evaluated by cost benefit analysis and the alternative offering the most optimum solution within the constraints of availability of resources like land and finance, is then selected.

A typical working in our hypothetical case would be something like following.

Estimation of forest based raw material requirement for a paper mill of capacity 60,000 tonnes per annum.

The following assumptions are made.

1. For the production of paper and board, the raw material consists of bamboo and mixed hardwoods in the ratio of 60:40.
2. Utilisation of waste paper, rags, etc other than forest raw materials will be about 20% of the production.
3. For the production of one tonne of paper and board, 2.8 tonnes of dry forest raw material is required.
4. Green cut bamboo contains 25% moisture by weight.
5. Green cut wood contains 30% moisture and 15% bark by weight.

Estimation of Raw Material requirement (based on dry weight basis)

1. Installed capacity of Mill	60,000 TPY
2. If 20% waste paper, rags, etc. used paper production from forest raw material will be	48,000 TPY
3. Forest raw material requirement (considering 1 tonne of paper = 2.8 T of FRM)	1,34,400 TPY
4. Bamboo requirement (60% total requirement assumed)	80,640 TPY
5. Hardwood requirement (40% of total requirement assumed)	53,760 TPY

The plantation should be grown as far as possible close to the mills at productive areas where improved soil and growing conditions are prevalent. Planting of fast-growing species with shorter rotations of suitable provenances with better inputs in the shape of fertilisers, irrigation and soil operations will result in much better yields.

Bamboo species suitable for semi-arid regions is *Dandracalamus strictus* and eucalyptus and su-babul (IP. 1...IP. 1) are most suitable for hardwood plantation.

Spacing and yield

Most optimum spacing has been selected for this afforestation to plant bamboo and wood plantation.

	Spacing	No. of plants per Ha	Cutting cycle	Yield/ Ha per cut
1. Bamboo (unirrigated)	2M×2M	2500	3 Yrs (after 8 Yrs of planting)	20 T
2. Hardwood, eucalyptus and Su-babul (unirrigated)	3M×0.75M	4400	8 Years	40 T
3. Hardwood Eucalyptus and Su-babul (irrigated)	3M×0.75M	4400	6 Years	80 T

Note :—The above yield is with moisture, bamboo contains 25% moisture and wood contains 30% moisture with 15% bark. This high yield from bamboo and wood will be available only from good seeds, proper nutrition and care.

Land requirement for afforestation

- Bamboo plantation area (without irrigation)
Aim : To raise 80,640 TPY of bamboo
Yield : 20 T/Ha with 25% moisture in each cut, maturing time 8 years, cutting cycle 3 years

$$\begin{aligned} \text{Weight of green bamboo needed} &= \frac{80,640}{0.75} = 1,07,520 \text{ T} \\ \text{Plantation area needed} &= \frac{1,07,520 \times 3}{20} = 16,128 \text{ Ha} \end{aligned}$$

For planting bamboo 16,150 Ha of land will be required.

- Wood plantation area (without irrigation)
Aim : To raise 53,760 TPY of wood
Yield : 40 T/Ha with 30% moisture and with 15% bark. cutting cycle 8 years

$$\begin{aligned} \text{Weight of green wood needed} &= \frac{53,760}{1-(0.3+0.15)} = 97,750 \text{ T} \\ \text{Wood plantation area needed} &= \frac{97,750}{40} \times 8 = 19,550 \text{ Ha} \end{aligned}$$

- Wood plantation area (with irrigation)
Aim : To raise 53,760 TPY of wood
Yield : 80 T/Ha with 30% moisture and 15% bark and cutting cycle 6 years

$$\begin{aligned} \text{Weight of green wood needed} &= 97,750 \text{ T} \\ \text{Wood plantation area required} &= \frac{97,750 \times 6}{80} = 7,332 \text{ Ha} \\ \text{Irrigated wood plantation required would be} &= 7,340 \text{ Ha} \\ \text{Total area needed for raising plantation for 60,000 TPY paper and board will be :} & \\ \text{For bamboo plantation} &= 16,150 \text{ Ha} \\ \text{For wood plantation (unirrigated)} &= 19,550 \text{ Ha} \\ \text{Total} &= 35,700 \text{ Ha} \end{aligned}$$

If it is for irrigated wood plantation, total area required will be 23,490 Ha.

YEARWISE PLANTING PROGRAMME

Sl. No.	Years	Bamboo Plantation Ha	Wood Plantation Unirrigated Ha	Wood Plantation (If irrigated) Ha
1.	1	5384	2444	—
2.	2	5383	2444	—
3.	3	5383	2444	1224
4.	4	—	2444	1224
5.	5	—	2444	1223
6.	6	—	2444	1223
7.	7	—	2443	1223
8.	8	—	2443	1223
		16150	19550	7340

- I) Cost of bamboo planting per Ha at the present level including land rent, insurance, etc. Rs. 5,200
- II) Cost of wood planting per Ha (unirrigated) Rs. 10,000
- III) Cost of wood planting per Ha (irrigated) Rs. 15,000
- IV) Treated effluent for irrigation will be available only after two years of mill execution.

for the start up to planting in the first year of afforestation programme is done.

The list of activities and time of completion in months is given below and on this basis work is done.

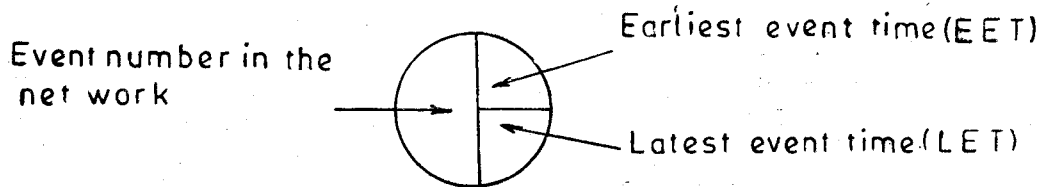
Activity	Time (month)
A) Recruitment (Supervisory and Labour)	2
B) Land Survey	1
C) Land allocation	4
D) Acquire machines	3
E) Training	3
F) Roads laying	5
G) Buildings	5
H) Allotments	1
I) Nurseries	2
J) Raising plants	3
K) Vegetation clearing	2
L) Ploughing	2
M) Planting	2

Network Analysis

An afforestation project is composed of a large number of activities which are spread over a big tract of land and involve a large number of people. Many of the activities which must be carried out in order to complete the project are very much dependent on correct timing, because of the influence of seasonal factors. For such complex projects, an analysis is carried out early in the operational planning stage. The principle of the analysis is that all activities in the project are identified and/or plotted on a time scale. Activities that can proceed simultaneously are plotted in parallel, but activities which are dependent on others are plotted in series with each other. The analysis thus gives a clear indication of the timing of different activities, and the term CRITICAL PATH is used to refer to the one which represents the shortest possible time for doing the work. Activities lying on critical path therefore need special attention to ensure that they are completed on time, to allow the remaining work to proceed. An effort has been made to make network of the afforestation project, and critical path identification

Note : For the purpose of time analysis, we will divide each circle denoting an event into three.

The float is defined as the amount of time in the parts of the net work which do not lie on the critical path and by which the start and finish of the activities can vary without affecting the overall time of operation⁵.



Total float in this project: $TF = (LET) - (FTT) - (AT)$
 Activity time

From the above formula we obtain :

Activity	Calculation (LET-EET-AT)	Total float
A	2-0-2	0
B	7-2-3	2
C	8-3-1	4
D	5-2-3	0
E	8-5-3	0
F	14-8-5	1
G	13-8-5	0
H	15-14-1	0
I	16-14-2	0
J	19-16-3	0
K	17-14-2	1
L	19-16-2	1
M	21-19-2	0

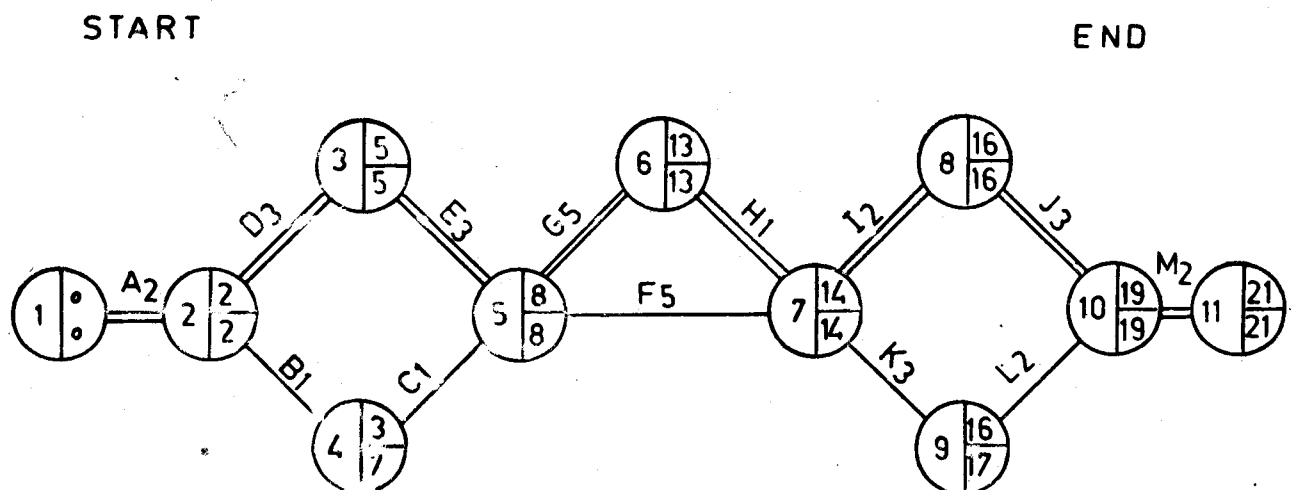
These total float values are shown with each activity in the network as following (in circle figures). The activity A, D, E, G, H, I, J and M have a zero total float each. This means that any delay in starting of these activities will delay the completion of the project correspondingly. These activities are called "CRITICAL ACTIVITIES" and the continuous path from START to END connected by the critical activities is called the 'CRITICAL PATH'.

The critical path is shown in double lines in the diagram.

The afforestation project co-ordinator will pay special attention to the critical activities to ensure that no delay occurs. Another point to be noted here is that since afforestation programme is a seasonal one and the activity of nursery, i.e. seeding should be done in November December months only, and planting work should be done as soon as the rains commence. Planting work should be over by June-July and accordingly the other activities have to be adjusted. Any delay in this will be a loss of one year, which will be a setback to the afforestation programme. Counting from the start to end, the critical path will be the longest in terms of time taken by activities on the path and the total activity time on critical path will always be equal to the shortest project duration from recruiting the staff to the plantation which works out to be a period of 21 months time.

CONCLUSION

To achieve the National objective of meeting the present and future shortfall of forest raw material, for a balanced ecosystem and for a clean environment, rapid afforestation programmes have got to be taken up. If the application of modern management as mentioned in this article are implemented right from the project planning to the harvesting, maximum benefits in shortest time and with lowest costs are likely to be obtained with most optimum inputs along with the generation of employment potential to the



rural masses. However, the afforestation programme faces two major obstacles. One is land ceiling act. No private plantation of more than 15-30 Ha is permitted. The other one is obtaining the financial resources for such afforestation projects. In those regards, the Government should come forward to lease the required land on long term basis for such projects and also provide long term loans at reasonable interest rates for such afforestation programmes.

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REFERENCES

1. The state of India's Environment 1982, A Citizen's Report, Centre for Science and Environment, New Delhi, Page No. 33.
2. Report of the raw material committee by Development Council. Paper, Pulp & Allied Industries, Page No. 28.
3. Categories of Man-made Forests in India. their Scope and Potentialities by M A Rashid, Paper presented at the Symposium of Man-made Forests in India. F.R.I., Dehra Dun 1972
4. Forests and the Paper Industry, The Hindu Editorial, 15th April 1985.
5. Text Operations Research by R K Gupta Network Analysis. Publishers : Krishna Prakashan Mandir, Meerut-2.