

## **Program Evaluation and Review Technique (PERT) in Agriculture**

**Lawanrisha Lyngdoh<sup>1</sup> and Ravinder Kaur Dhaliwal<sup>2</sup>**

### **ABSTRACT**

Under large scale agricultural projects, the managers are challenged with a task to coordinate various activities together. The process of planning incorporates a countless number of details to develop a realistic schedule and monitoring the progress of any project. The Indian agriculture over the years has evolved from simple technologies to complex establishment of projects which requires precise planning, coordination, implementation by the agricultural managers. These days, a huge amount of investment is sanctioned to develop agriculture for achieving higher productivity. To attain sustainable development, techniques must be used for careful allocation of resources and time management. There is a good scope of integration of the agro-food chain with the global market and keeping the importance of food safety, environmental issues and the growing demand for food. The policies made are directed to compete with the international quality and quantity and achieving sustainability goals. For this purpose, the farmers, policy makers and various stakeholders have to make complex choices in developing projects under a tight budget with a specific time frame.

**Keywords:** Agricultural project, program evaluation, review technique and time management

### **INTRODUCTION**

During the last few decades, there has been advancement in the development of new technologies with the development of new scientific ideas and concepts. The advantages of these technologies have penetrated to all corners of the globe which have improved their living standards and have also set a demand for improved technologies. This has also led to the growth of different small and large projects which requires efficient use of time and resources and interaction of interdisciplinary activities so as to execute and complete the projects within a given time frame to achieve results with a desired quality and quantity in an economic manner. Program management or programme management is the process of managing several related projects, often

with the intention of improving an organization's performance. In practice and in its aims it is often closely related to systems engineering, industrial engineering, change management and business transformation. Project is a temporary endeavor involving a connected sequence of activities and a range of resources, which is designed to achieve a specific and unique outcome and which operates within time, cost and quality constraints and which is often used to introduce change. Examples are constructing houses, factories, shopping malls, developing military weapons system, launching satellite systems, construction of oil pipelines, developing and implementing new computer systems and introducing new products into the market. It is observed that some projects are critical as their delay in their starting time will delay its completion time.

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<sup>1</sup>PhD Research Scholar and <sup>2</sup>Professor, Department of Extension Education, Punjab Agricultural University, Ludhiana-141004, Punjab

Therefore it is important to apply project management techniques in such cases. Project management is the application of a collection of tools and techniques to direct the use of diverse resources towards the accomplishment of a unique, complex, one time task within time, cost and quality constraints (Tamrakar, 2013). The management of such activities can be problematic since some activities must be executed in a sequence order. The success of project management includes the decision making and analytical thinking of the managers for a systematic approach in the implementation of a project right from the planning stage to its accomplishment. Many different techniques and tools have been developed to support better project planning and these tools are used seriously by a large majority of project managers (Fox and Spence, 1998). For many years, two of the most popular approach to project management has been the Critical Path Method (CPM) and the Program Evaluation and Review Technique (PERT). The last has been used as a tool for project management for over four decades. It consists of planning, designing and implementing a set of activities to accomplish a particular goal or task (Mouhoub *et al.* 2011). Kelly of Remington-Rand and Walker of Dupont developed the CPM in the 1950s to assist in scheduling maintenance shutdowns of chemical processing plants and PERT was developed shortly after the US Navy manage the development of the Polaris missile (Haga and O'keefe, 2001). While CPM manage projects with deterministic times, PERT is a technique used in projects that has task with stochastic times (Campos *et al.* 2003). PERT and CPM techniques were successfully used to generate the time in which activities should be completed in a startup and how they actually depend on each other. These techniques showed that the actual time taken is more than the calculated time because of certain delays that go against the circumstances (Chatwal, 2014).

### **Background of Program Evaluation and Review Technique (PERT)**

PERT is a time event network analysis system in which the various events in a program or project are identified with a planned time established for each

(Wehrich *et al.* 2013). Kelly of Remington-Rand and Walker of Dupont developed the CPM in the 1950s to assist in scheduling maintenance shutdowns of chemical processing plants and PERT was developed shortly after the US Navy manage the development of the Polaris missile (Haga and O'keefe, 2001).

### **Characteristics**

It is an event oriented, which means:

1. It indicates a significant point in the project.
2. It is the start or completion of a job.
3. It does not consume time or resources.

### **Importance of PERT**

1. It helps necessitates the preplanning.
2. It increases the harmony and coordination.
3. It usually predicts and determines the troublesome items.
4. It specifies and segregates the responsibilities
5. It refines the thoughts and increases the knowledge of user about related subjects and their relative importance in whole operation.
6. It attracts the management attention to those activities which may face problems or seems to be associated with them.
7. It specifies the optimum start and finish points of each activity in the operation.
8. It facilitates the possibility of readjusting of the project for new conditions.
9. It facilitates the reporting and instructing procedures.
10. It is most suitable tool for presenting the organizational chart and their relation.
11. It shows the relation between activities.
12. It is adjustable and updatable.
13. Changing and modifying the program in new and unprecedented situations will accomplish easily.

(Chatwal, 2014)

**Weakness of PERT**

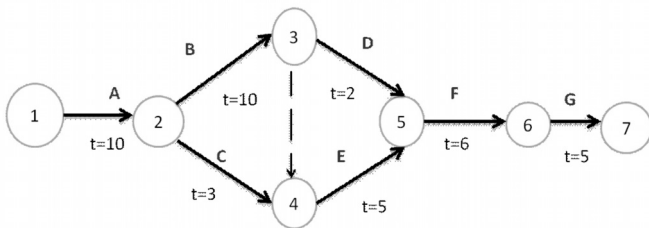
1. Emphasis on time and not on cost.
2. Not useful when program is ill-defined and no reasonable “guesstimates” of schedule can be made.
3. Requires analytical and technical thinking of managers.
4. Software expertise is need when it comes to large programs using winQsb software.

(Wehrich *et al.* 2013)

**A hypothetical example on orchard establishment**

Assuming that area is one hectare, the manpower for each activity is available in abundance; seedling purchased is one year old.

**Table 3: Backward Pass: (LF and LS)**



**Figure 1**

**Table 1: Description of activities with assumed duration**

Activity	Activity name	Duration(t) in days	Preceding activity	Succeeding activity
A	Site selection	10	None	B, C
B	Land preparation	10	A	D
C	Variety Selection including stock selection	3	A	E
D	Layout	2	B	F
E	Purchasing of required inputs	5	C	F
F	Planting (including pit preparation, manure and planting seedling)	6	D,E	G
G	Irrigation	5	F	None

**Table 2: Forward Pass: (ES and EF)**

Activity	Value of ES	Value of EF (ES+t)
A	ES=0	=0+10=10
B	EF of A =10	=10+10=20
C	EF of A=10	=10+3=13
D	EF of B=20	=20+2=22
E	EF of C=13	=13+5=18
F	Latest of EF time of predecessor activity= EF of D (22)	=22+6=28
G	Latest of EF time of predecessor activity= EF of F (28)	=28+5=33

Hence the minimum completion time based on using normal time of the project is 33 days

\*\*ES = Earliest Start and EF =Earliest Finish

Activity	Value of LF	Value of LS
G	LF=33	=33-5=28
F	LF of activity G (24)	=28-6=22
E	LF of activity F(22)	=22- 5=17
D	LF of activity F (22)	=22-2=20
C	LF of activity E (18)	=18-3=15
B	LF of activity D (20)	=20-10=10
A	Earliest of LS for the succeeding activities= LS of activity C (in this case)=10	=10-10=0

\*\* LF= Latest Finish and LS= Latest Start

**Table 4: Calculation of Total Float (TF)**

Activities	Total Float (LS-ES)
A	=0-0=0
B	=10-10=0
C	=15-10=5
D	=20-20=0
E	=17-13=4
F	=22-22=0
G	=28-28=0

\*\* LS= Latest Start and ES= Earliest Start

From the above it is seen that only activities C and E

have slack periods (not zero). Other activities A, B, D, F and G do not have any slack (zero), hence they are on the critical path.

**Table 5: Calculation for Free Float or Free Slack (FF or FS)**

FF= ES times of activity’s successor activity and EF times of the activity in question.

Activities	Value of FF
A	=Earliest of ES of B or C)- EF of A=10-10=0
B	= (ES of D) – (EF of B)=20-20=0
C	= (ES of E) – (EF of C)=13-13=0
D	= (ES of F) – (EF of D)=22-22=0
E	= (ES of F) – (EF of E)=22-18=4
F	= (ES of G) – (EF of F)=28-28=0
G	There is no successor activity. Hence FF=0

\*\*ES= Earliest Start and EF Earliest Finish

All jobs having Total Float do not necessarily have Free Float. In the example, the activity C have Total Float of 5 day, but does not have any Free Float.

For the calculation of mean activity time, we assume

**Table 6: Summary of calculations**

Event	Activity	Duration (t)	ES	EF	LS	LF	TF	FF	Critically
1-2	A	10	0	10	0	10	0*	0	Critical
2-3	B	10	10	20	10	20	0*	0	Critical
2-4	C	3	10	13	15	18	5	0	
3-5	D	2	20	22	20	22	0*	0	Critical
4-5	E	5	13	18	17	22	4	4	
5-6	F	6	22	28	22	24	0*	0	Critical
6-7	G	5	28	33	28	33	0*	0	Critical

\*\*ES= Earliest Start, EF Earliest Finish, LS= Latest Start and LF= Latest Finish

**Table 7: The activities of project schedule**

Activity	Activity name	Duration (t) in days	Optimistic time (a)* assumed	Most likely time (m)* assumed	Pessimistic time (b)* assumed	Mean activity time (a+4m+b)/6	Standard deviation(b-a)/6(For PERT)
A	Site selection	10	3	6	12	6.5*	1.5
B	Land preparation	10	5	7	13	7.5*	1.333
C	Variety Selection including stock selection	3	1	2	3	2	0.166
D	Layout	2	1	1	4	1.5*	0.333
E	Purchasing of required inputs	5	2	4	7	4	0.833
F	Planting (including pit preparation, manure and planting seedling)	6	3	4	9	4.5*	1
G	Irrigation	5	2	3	8	3.5*	1

Minimum completion time using PERT method is23.3 days

the optimistic time (Least time a), Pessimistic time (maximum time b) and the most likely time (m) which will give us a rough idea of the time it will take for the major activities involved in the project. By using the formula:

$$t = (a+4m+b)/6$$

We can find the time taken to perform each activity and the total time taken. This is the theoretical time involved in setting up the project.

From the hypothetical example of establishing an orchard we can conclude that the minimum completion time, based on using normal time is 33 days and by using PERT is 23.5 days, respectively. Hence, we can clearly see that by using PERT we can estimate an early probability date for the completion of the project. The highest standard deviation value is of activity A which implies the wider the spread of the values from the mean activity time.

## CONCLUSION

In today's time, we can say that techniques of scheduling like PERT can come in handy for efficient use of resources and time by which we can obtain maximum productivity. Even though PERT has many benefits, but its main drawbacks in Indian Agriculture context is that it requires an analytical knowledge and a technical expert to explain its uses, procedures and advantages to the farmers and in this case, it becomes a problem to understand the complex process among the rural farmers. Also most farmers in India are small and marginal and hence will not find PERT very useful to them. Due to the lack of work and literature in the application of CPM and PERT in Indian agriculture, we can conclude that there may still exist a wide gap in technology to be applied in real world situation. The application of PERT can be very useful in farming as most Indian farmers have limited resources, time and can be used as one of the tools to transform the existing traditional and subsistence into business oriented agriculture. PERT can be initially applied in decision making and scheduling of farm operations like: orchard establishment, livestock management, integrated farming, construction of poly houses and green houses and for other agricultural projects to enhance efficiency and profitability of the farm. PERT can also be used in planning and implementation of various extension projects like campaign, training, demonstrations, etc. Therefore, it is up to the policy makers to emphasize deeper into such techniques to improve farming in the country. The extension system and scientist has the potential to take up research on such topics and to apply it on the farmer's fields to enhance the agricultural productivity.

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