Technical and Social Issues of Mechanisation in Oil Palm Plantation Industry

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INTRODUCTION

The oil palm industry is currently facing problems of labour shortage and increasing cost of production. In order for it to remain competitive and viable, one of the ways is to mechanise its operations to enhance labour productivity and hence reduce its dependency on labour. According to Baker *et al.* (1973), economic profitability will dictate the level of mechanisation and profitability is influenced by the available technologies.

Plantation mechanisation in Malaysia has been primarily based on imported machinery but of late locally fabricated machines and adoptive technology are being slowly introduced. In some instances, inspite of the needs, mechanisation has been faced with obstacles from technical problems, social issues as well as field conditions, as more and more oil palm is being planted on hilly land.

This paper reviews some of the technical problems and social issues in implementing mechanisation in the oil palm plantations. It is not an exhaustive review of plantation mechanisation but only an indication of the work and thinking now going on.

TECHNICAL PROBLEMS

Technical problems in plantation mechanisation can be looked at from the points of view of field mobility and accessibility, suitability of the machines for the field conditions, agronomic practices and ergonomics. Currently, the issues of field mobility and access are the most important and studies have been conducted to improve machine mobility in estates. The methods used are described below.

Twin Tyres

Wheeled tractors with 4-wheel drive, are widely used in oil palm plantations for in-field FFB evacuation because of their good mobility, speed and low cost. However, a wheeled tractor has little ground contact which somewhat restricts its traction and could lead to severe rutting of the mechanical paths especially in the coastal estates which subsequently will affect the machine productivity. A proper selection of tyres and traction aids will improve the tractor's field mobility and minimise the creation of ruts.

Twin dual tyres provide a larger ground contact area giving better traction and reduces the creation of ruts. On the other hand, it results in lower traction efficiency because of higher rolling resistance. Tyres in a twin tyre system should be in a similar state of wear and inflated to the same pressure. They are best placed about 6-10cm apart to minimise trapping soil in-between.

Floatation Tyre

Floatation tyres, depending on the size, have large 'footprints' in contact with the ground and distribute the load over a larger surface area. It results in lower traction efficiency on soft ground because of higher rolling resistance. If used on 4-wheel drive tractors, it is important to ensure that the rotational ratios of the front and rear tyres are properly matched.

Cage Wheel

Cage wheels can be used to reduce ground pressure and improve traction on soggy ground where rutting is a problem and the traction poor. They give increased drawbar pull on wet cohesive soils but reduced power efficiency due to the high rolling resistance. Cage wheels are normally smaller in diameter than the tyres so that the tractor can travel on hard surfaces without damaging them.

All the above mentioned tyres were tested in a mechanised in-field FFB evacuation system and the results are shown in *Table 1.*

All the tyres and wheels improved the machine's field mobility on soggy mechanical paths in coastal estates during the wet season. Amongst the three items evaluated, cage wheels were the most effective in improving machine productivity. Productivity increased by 35% due to better traction.

There were different problems with mechanised in-field FFB evacuation on undulating and hilly land. On such land, the palms are normally planted on terraces. Terracing commonly used by plantations are wide terrace, double terrace and mechanical terrace (*Figure 1*).

A simulation was done to assess the productivity of mechanised in-field FFB evacuation on wide and mechanical terraces. According to Chew (1997), mechanised FFB evacuation required 78% more time on wide terraces than on straight line planting. For the study, a FFB mini crane-grabber was fitted with an extendable arm for adjustable arm reach.

The results of the study are shown in *Table 2.* Machine productivity on mechanical terrace was 40% more efficient than on wide terrace. The higher productivity was because the machine could collect FFB from both its sides on mechanical terrace as compared to only from one side on wide terrace. Thus, field design and infrastructure layout have great impact on machine productivity.

SOCIAL ISSUES

Guidelines for Successful Implementation of Mechanised In-field FFB Evacuation System

A survey was conducted on estate managements, oil palm harvesters and mini-tractor drivers in oil palm plantations to identify the factors that influence the use of mechanised in-field FFB evacuation in estates. The data were analysed using Pareto Analysis technique.

TABLE 1. TIME MOTION STUDY OF DIFFERENT TYRES AND WHEELS IN A MECHANISED IN-FIELD FFB EVACUATION SYSTEM

Parameter	Conventional tyres	Twin tyres	Floatation tyres	Cage wheels
Ground contact pressure (kg/cm^2)	5.2	3.5	2.2	4.1
Time taken in manoeuvring (min)	26	28	30	26
Time taken in moving on mechanical paths (min)	46	35	38	28
Productivity (t/hr)	1.7 (100%)	2.0 (117%)	1.8 (105%)	2.3 (135%)

Number in parenthesis represents % against conventional tyre

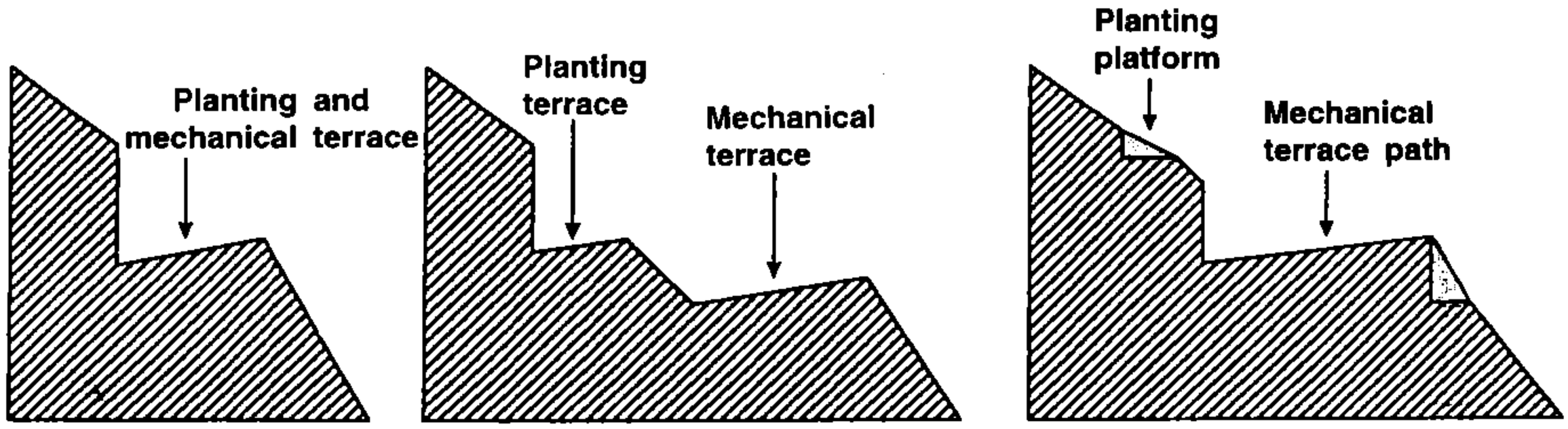


Figure 1. Different terraces used on undulating and hilly land

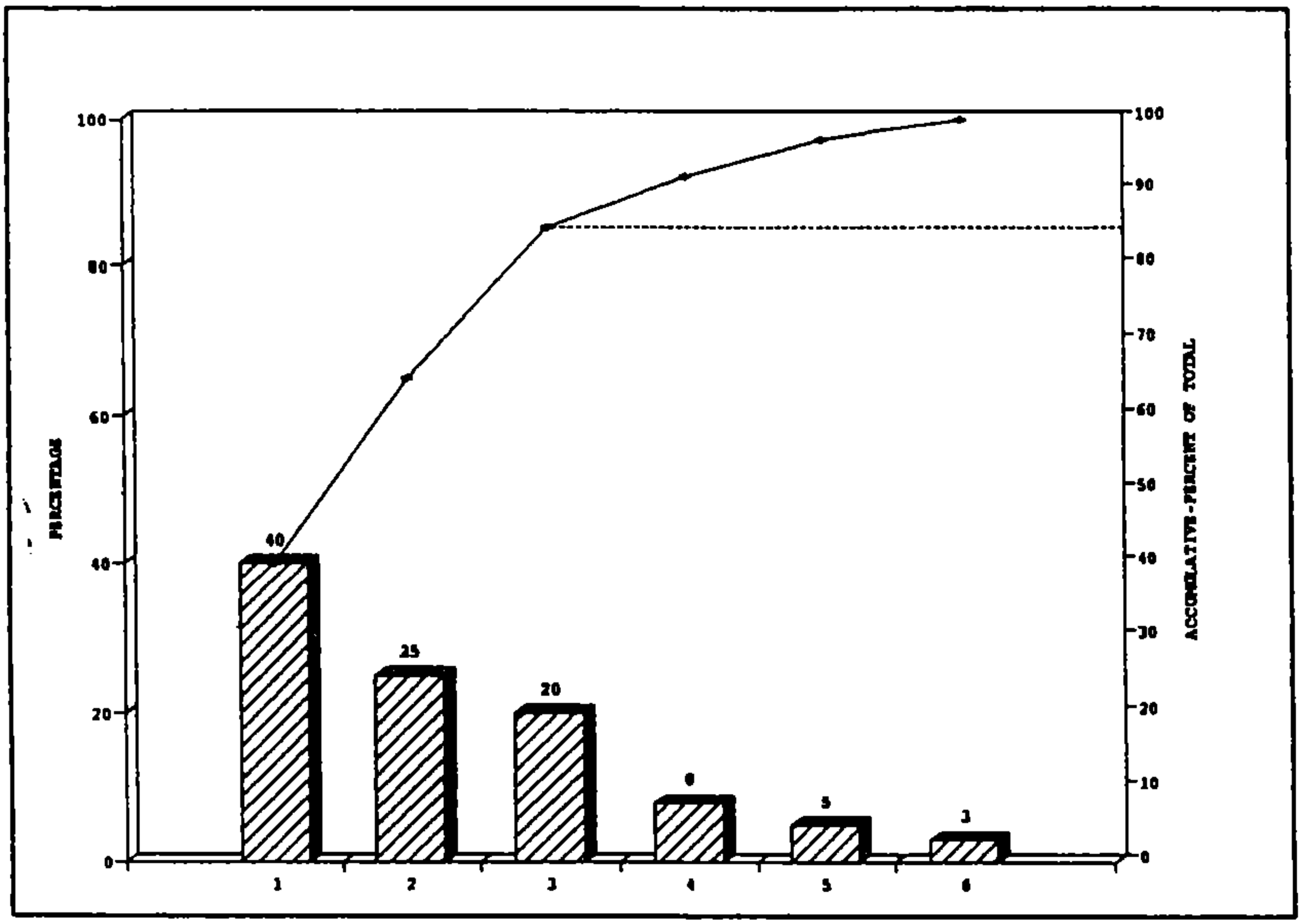
Implementation of Mechanisation

The adoption of new technology has to consider technological viability, economic feasibility and its adaptability to local condition. According to Ruthenberg (1971), changes in the adopted system may either arise within or without the organisation, and may be caused by new technological possibilities or result from a wide and complex range of social and economic factors such as technical progress or changes in human aspiration.

The results of the survey are illustrated in *Figure 2* and show that successful adoption of mechanised in-field FFB evacuation depends on three main factors, *i.e.* commitment from all levels within the organisation, availability of suitable machines and proper land preparation. These three factors constitute 85% of the contributing factors to the successful implementation of mechanised in-field FFB evacuation in estates. The implementation of mechanised in-field FFB evacuation to-date has generally been successful although in some cases the benefits have been somewhat less because of inadequate planning, management and technical support besides other necessary conditions not being met.

TABLE 2. MACHINE PRODUCTIVITY ON WIDE AND MECHANICAL TERRACES

Parameter	Machine productivity	
	Wide terrace	Mechanical terrace
Time taken (min)	60	60
No. of FFB collected	45 (100%)	65 (144%)
No. of palms covered	75 (100%)	105 (140%)



1. Commitment from all levels within the organisation
2. Availability of suitable machine
3. Proper land preparation
4. Reliable back-up services
5. High yield
6. Type of workers

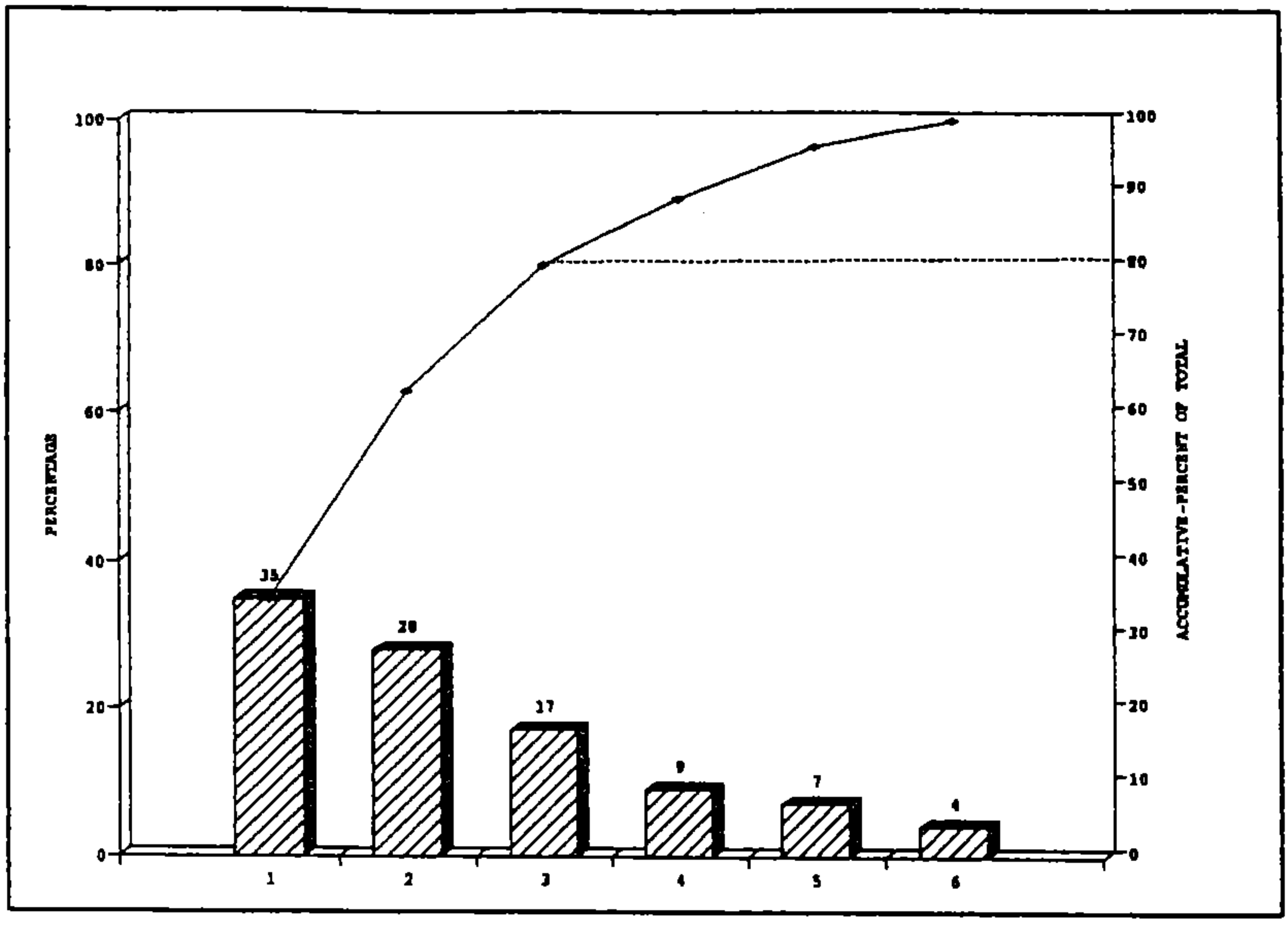
Figure 2. Pareto diagram on factors affecting the successful implementation of mechanised in-field FFB evacuation system

Estate's Acceptance to Mechanisation

The result of the survey on estate acceptance to mechanisation is shown in *Figure 3*. From an estate's point of view, mechanisation is attractive if it achieves the following: (a) overcomes the shortage of workers (b) increases worker productivity, and (c) maintains the desired harvesting interval. These three factors constitute 80% of the attraction to estate acceptance of mechanised in-field FFB evacuation. To achieve the desired result, it is crucial to select suitable machines and the right work methods as described by Sarjit and Loh (1991), Ahmad *et al.* (1993), Kamarudzaman *et al.* (1997), Ahmad and Ahmad Zamri (1996) and Chew *et al.* (1997), besides proper land preparation with appropriate mechanical access.

Workers Acceptance to Mechanisation

The last hurdle to the successful adoption of mechanised in-field FFB evacuation is worker acceptance because they are the ones who will be working directly with the machine. As shown in *Figure 4,* worker acceptance to mechanised in-field FFB evacuation system is influenced by two major factors, *i.e.* its contribution to their better earnings and better working environment. If these two factors prevail, then worker acceptance will be very high. Thus, proper work methods should be adopted to achieve the desired output and according to Chew (1997), an



1. Ease the shortage of workers
2. Increase productivity
3. Desired harvesting interval
4. Better crop quality
5. Minimal soil compaction
6. No overnight crops

Figure 3. Pareto diagram on the willingness of estate to embark on mechanisation

effective method to increase labour and machine productivity is by division of labour and job specialisation.

CONCLUSIONS

The effectiveness of mechanised in-field FFB evacuation can be improved by using the proper tyres such as twin tyres, floatation tyres and traction aids like cage wheels. The improvement is from better mobility in the field which will improve productivity. Mechanised in-field FFB evacuation on hilly areas has better productivity with mechanical terrace against the wide terrace.

The successful implementation of mechanised in-field FFB evacuation system on estates greatly depends on the commitment from all levels within the organisation, the availability of suitable machines and proper mechanical access. The acceptance of mechanised in-field FFB evacuation by the estate will depend on its effectiveness in overcoming the labour shortage, increasing worker productivity and the ability to maintain the desired harvesting interval. Worker acceptance of mechanised in-field FFB evacuation is mainly based on their earning more and an improved working environment.

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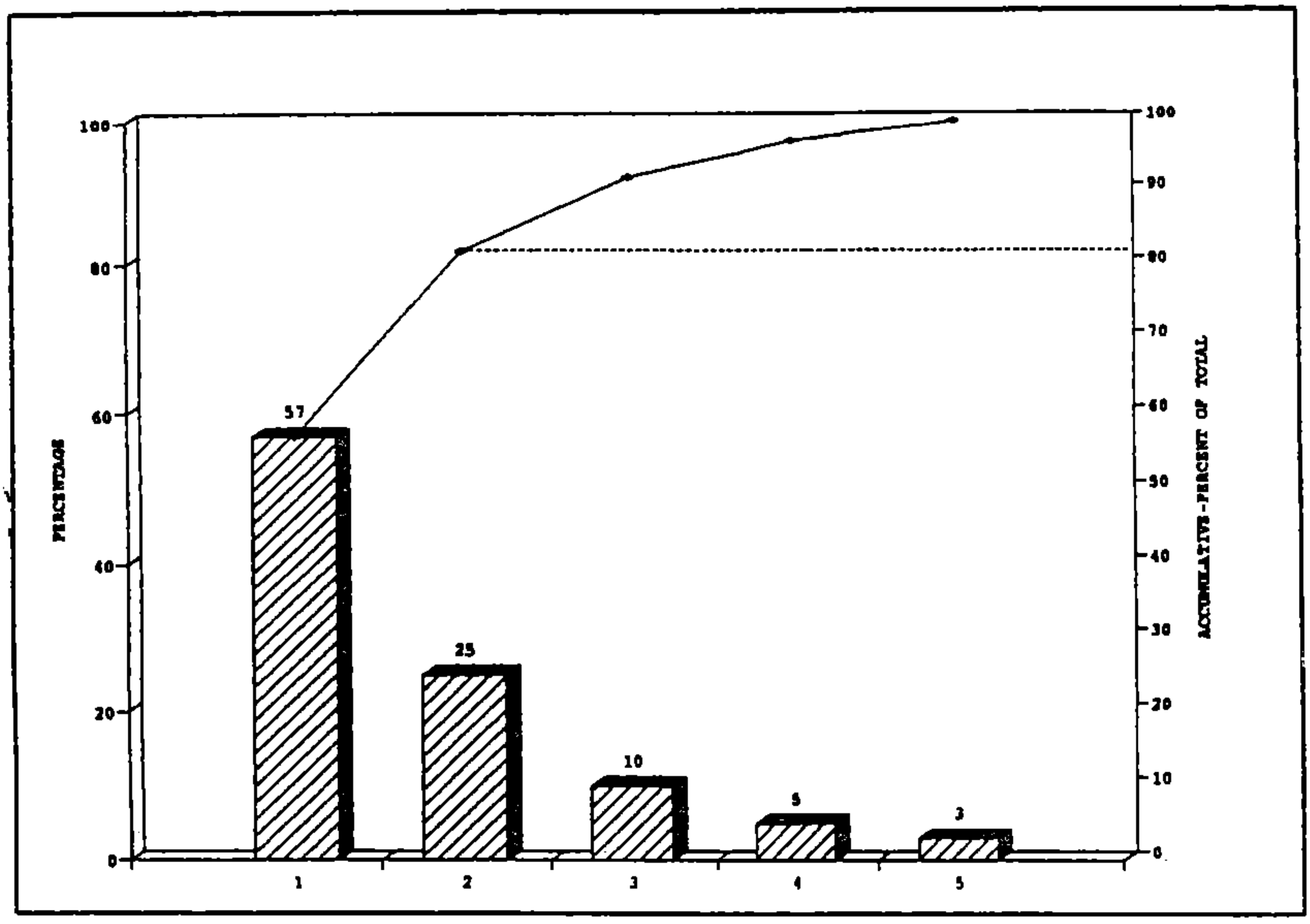

1. Better earning
2. Better working environment
3. Improved working speed
4. Reliable machinery
5. No overnight crops

Figure 4. Pareto diagram on workers acceptance to mechanised in-field FFB evacuation system

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