Planning for forestry after Cyclone Bola – a comment

Chris Phillips, Mike Marden, and Donna Rowan

ABSTRACT

Cyclone Bola caused widespread damage to the East Coast of New Zealand in March 1988. FRI's terrain stability zoning system and NWASCO's Land-Use Capability mapping system (LUC) were compared to see which classes contained the greatest number of landslides. The Makomako Block of Tokomaru Forest – 30km² of relatively young pine plantation – was used for the comparison. Both systems showed clear landslide distribution patterns and trends for the different classes identified.

INTRODUCTION

The ability to predict natural hazards is one of the most interesting and rewarding aims of land-use research. If we can predict from our research which sites are likely to be affected by a particular hazard, our role as advisers to land managers is on the way to being fulfilled. Our ultimate aim is to provide managers with the information they need to manage their land successfully.

TERRAIN STABILITY ZONING

The success of the protection planting programme (East Coast Project) launched at Mangatu in 1960 (Taylor 1967) raised fundamental questions about the future management of this forest. Could it be managed as a production forest and still provide protection? How would the trees be harvested? What would be the erosional consequences?

To answer these questions the Forest Research Institute began a study of the local geology and geomorphology in 1976. This initial study (Gage and Black 1979) established that the geomorphic history and the bedrock geology of the region interact to cause differences in slope stability and erosion in different parts of the forest. This information formed the basis of a terrain stability zoning system. Eight Terrain Types were identified. Types 1 to 6 are erosional forms (in descending order of relative stability), and Types 7 and 8 are depositional forms. Types 1, 2, 3 and 4 are the most stable types, causing few erosion problems, and Types 5 and 6 are the least stable terrain types, with the greatest potential for erosion. (Note: Types 2 and 4 are not present in the study area.)

The terrain stability zoning was then applied to other protection/production State forests in the Gisborne-East Coast region. Areas of Tokomaru Forest (Phillips and Pearce 1984a,b; 1986) and Ruatoria Forest (Black unpubl. data) were mapped at a scale of 1:10,000, which was better for making on-ground management decisions than the 1:30,000 scale used for the Mangatu maps. Publication delays and a general reluctance by management to use the information meant that the maps were not widely used at the forest establishment phase. However, the maps have been used to allocate tending regimes to specific areas and for harvest planning. Although this mapping programme had the support of NZ Forest Service management, FRI, and DSIR, it was shelved at the time of the restructuring of the Forest Service.

The authors, Chris Phillips, Mike Marden and Donna Rowan are all with the Forest Research Institute, P.O. Box 31-011, Christchurch.

THE ROLE OF VEGETATION

In March 1988 Cyclone Bola hit the Gisborne-East Coast region. Widespread shallow landsliding and flooding were the result. All types of land-use, from horticulture to forestry, suffered damage (Fig. 1). However, different vegetative covers gave different degrees of protection. A preliminary FRI survey showed that younger exotic pine plantations (one to five years old) or pasture suffered eight times more erosion (number of landslides seen on aerial photographs) than mature native forest and exotic pine plantations over eight years old (Marden and Rowan 1988 unpubl. report). Young pines or pasture suffered two times more soil erosion than established scrub and exotic pines six to eight years of age. This survey endeavoured to select sites with similar geology, soil cover, aspect and slope angle. Thus vegetation cover was the predominant variable. These findings renewed interest in forestry in the area, and the Officials Committee set up to review the East Coast Project recommended that more erosion-prone land should be planted in trees.

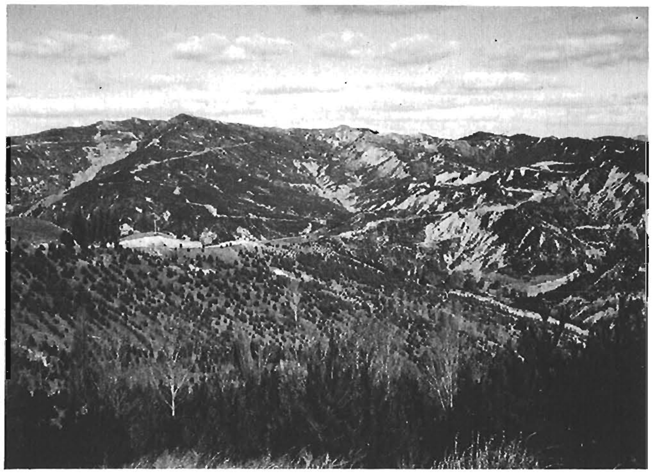

Figure 1. Makomako Block showing landslide damage after Cyclone Bola.

WHERE DO LANDSLIDES OCCUR?

The Makomako block of Tokomaru Forest – 30km² of relatively young (<8 years) pine plantations – was part of the extensive area of damage in the foothills east of the headwater valleys. This block had been zoned for terrain stability (Phillips and Pearce 1984b). The value of zoning for predicting where damage was likely during storms such as Cyclone Bola could be tested by observing which terrain types contained the most landslides. Map overlays of landslides were made from aerial photographs of the damage. When these were placed over maps of the terrain stability type, the number of landslides per terrain type could be counted.

Calculation of the average number of landslides/km^2 from the whole block before and after Cyclone Bola gave a density of 19 landslides/km^2 before Bola and 28 landslides/km^2 after Bola. The greatest density of landslides was found on Type 6, the least stable terrain type (Fig. 2). This type occupies only 13% of the area but contained 45% of the total pre- plus post-Bola landslides (n = 1590). If Type 5 is added, the area rises to 60% and the proportion of total landslides increases to 75%. The densities on the other main types were similar to Type 5; about 30-40 landslides/km^2.

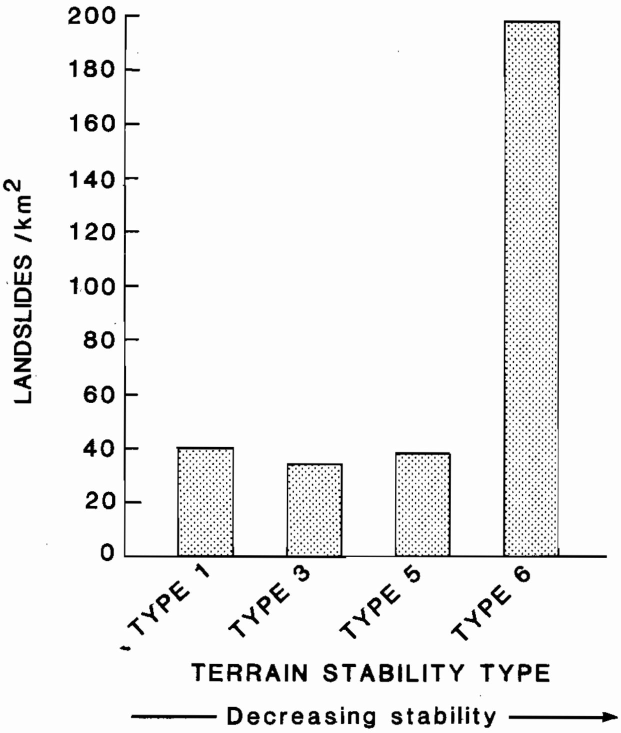

Figure 2. Total (pre-plus post-Bola) landslide densities for Terrain Stability Zoning types, Makomako Block.

A similar exercise was done using the Land-Use Capability mapping system (NWASCO 1975 Sheet N80 and N81). The class with the extreme potential for soil slip erosion (VIIe16) occupied 57% of the area and contained 68% of the total number of landslides and also had the highest slip density (Fig. 3). These figures are similar to those for the combined Terrain Stability Types 5 and 6. However, because the Land-Use Capability mapping is based on a scale of 1:63,360, it cannot be used to identify areas of potential failure to the same degree of accuracy as the terrain stability zoning at a scale of 1:10,000.

Terrain stability zoning therefore, seems a useful predictive tool for managers wishing to identify areas where they should concentrate preventative measures.

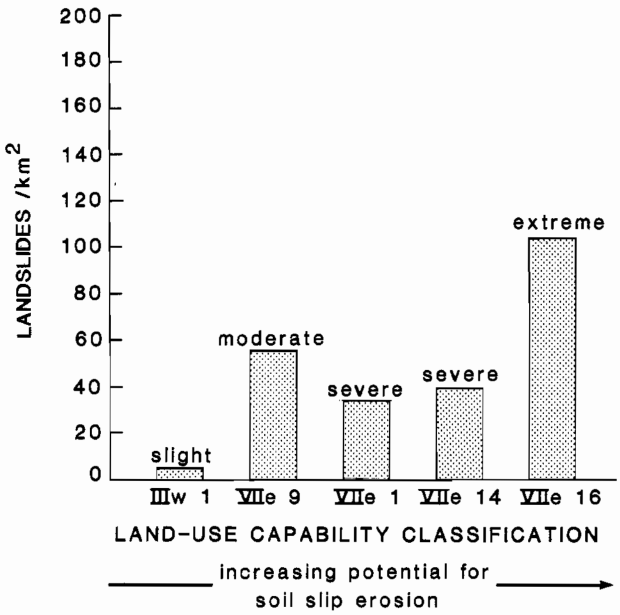

Figure 3. Total (pre- plus post-Bola) landslide densities for Land-Use Capability Mapping classes, Makomako Block. The descriptors, slight, moderate, severe, and extreme, relate to percentage of bare ground eroding at the time of mapping (1975). In our study, no attempt has been made to correlate landslide densities with landslide area for each LUC unit.

REFERENCES

Gage M., Black R.D. 1979. Slope Stability and Geological Investigations at Mangatu Forest. New Zealand Forest Service, Forest Research Institute Technical Paper No. 66.

National Water and Soil Conservation Organisation (NWASCO) 1975. New Zealand Land Resource Inventory Worksheets, N 80 and 81, Tokomaru Bay. NZ Government Printer.

Phillips C.J., Pearce A.J. 1984a. Terrain stability zoning of the Owhena-Mangawhero Block of Tokomaru State Forest. New Zealand Forest Service, FRI Bulletin No. 91.

Phillips C.J., Pearce A.J.. 1984b. Terrain stability zoning of the Makomako Block of Tokomaru State Forest. New Zealand Forest Service, FRI Bulletin No. 92.

Phillips C.J., Pearce A.J.. 1986. Terrain stability zoning of the Pouturu and Huiarua Blocks of Tokomaru State Forest. New Zealand Forest Service, FRI Bulletin No. 109.

Taylor N.H., 1967. Wise Land Use and Community Development. Ministry of Works and National Water and Soil Conservation Organisation.