MEASURING THE STEEPNESS OF TEA LAND

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One of the forms to be filled in for the Tea Replanting Subsidy Scheme asks for the approximate gradient of the land that is to be replanted. It is evident from the context that a precise answer is not required—indeed, even over a very small area, the variation in gradient is often too great to permit an answer that is both precise and simple. Nevertheless some of the answers which give figures for gradients are very unlikely to be even reasonably representative. The trouble is that most people, when they estimate the steepness of a slope by the unaided eye, tend to give too high a figure for the steepness. The simple home-made device shown in Figure 1 is intended to enable anyone to measure gradients with enough accuracy for all ordinary purposes.

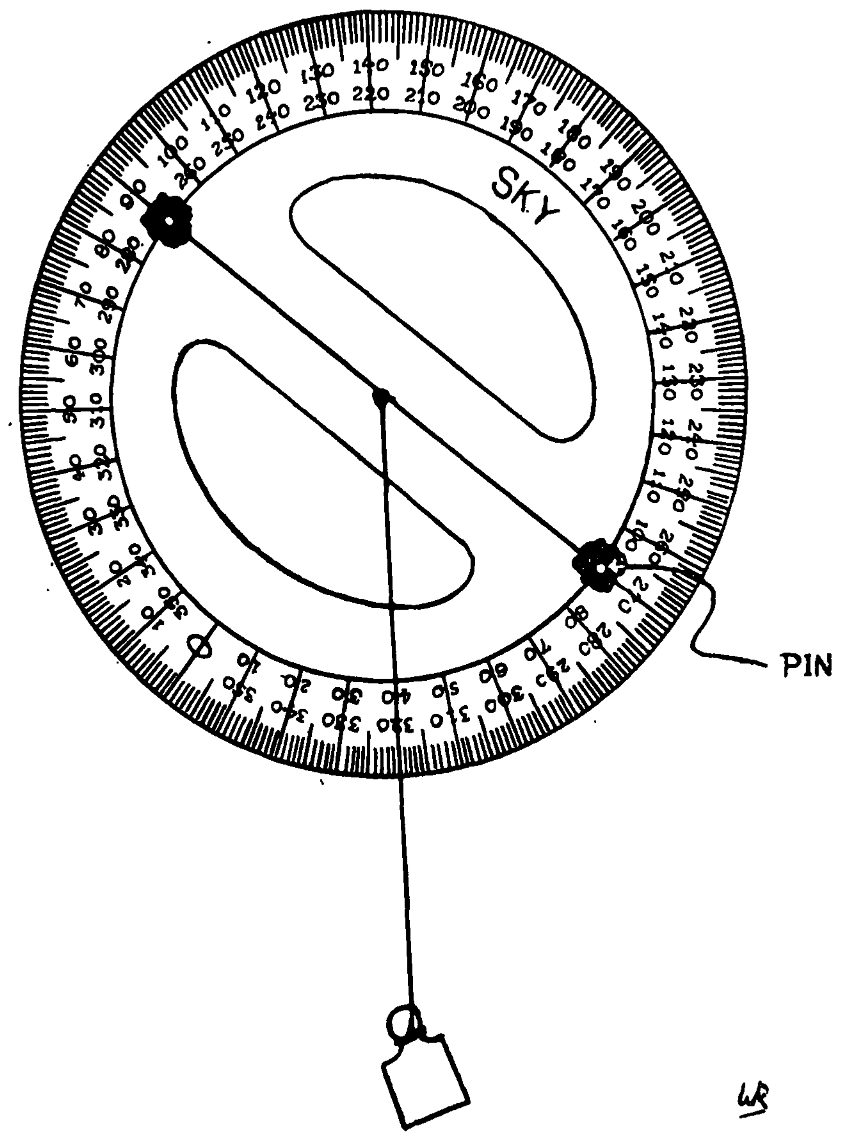

Figure 1. *Device for measuring the steepness of tea land*, made from readily available components. The pins may be stuck into position with sealing wax, but if the protractor is made of 'Celluloid' (cellulose nitrate) take care not to set it alight — it burns explosively.

The protractor, which can be bought from an educational supply shop, need not be of the completely circular type — a half-circular one is satisfactory. Three small holes have to be drilled exactly in line, the outer two for fixing the sighting pins and the middle one for the string and weight which indicate the vertical. The middle one must be at the geometrical centre of the scale. The zero of the scale should be in the centre of the bottom of the scale.

It is easiest to use the instrument—which is a simple kind of klinometer—while standing on a road. Move backwards or forwards until the surface of the land or the tea is visible; then move until the surface just disappears and is represented only as a line. With the eye in this position, bring the klinometer up close to the eye and rotate it until the two pins are in line with the line of the surface. Then fix the string with a finger at the edge of the protractor and read off the gradient at the point where the string crosses the line.

Once it is possible to measure a gradient, it is possible to calculate the probable results of certain activities. Suppose some rather steep patana is proposed for planting up and it is proposed to build a zig-zag cart road up it. The spoil is to be pushed down hill, making an extension of the level line across the road and being spread at diminishing depth all the way down to the next piece of road, in such a way that the gradient is uniform down the steepest route from any point on a road to the next road below it. Suppose the cart road is to be eight feet wide on solid ground—*i.e.* excluding the levelled spoil. Then it is possible to calculate how the slope of the land will be increased (B). It works out as:

$$\frac{64 \tan L}{h^2} = \frac{1}{\tan L} - \frac{1}{\tan B}$$

where L is the original slope and h is the vertical height in feet between the two roads. It is, of course, easier for most people to draw it out to scale and measure up. Anyway, suppose you start with very steep land at 45°, near the turn of the road where the vertical height from the upper road surface to the top of the bank below is only 20 feet, the slope between is increased by the spoil from 45° to 50°. Alternatively, if the spoil is not spread all the way but only over a vertical height of 20 feet, the increase of slope over that height will again be 5°. If, on the other hand, the spoil is spread over 50 feet (vertical), the increase of slope is less than a degree; but subsoil will be put on top of a larger area of land.

If, however, the original slope is a more normal one of 30°, then even when the spoil is spread over only 20 feet of vertical height, the slope is changed by less than 1½°. The amount of spoil is naturally less when the original slope is less.

Some consequences of differences in slope of land are often discussed in our lighter moments. For example, all the larger records on estates are put in terms of plan acres, the projection of the actual surface on to a horizontal plane. The actual area of soil surface is always greater than this plan area. The steeper the slope, the larger is the difference. For example, at slopes of 10°, 20°, 30°, 40° and 50°, a plan acre covers areas of soil surface which are greater by 1½%, 6½%, 15½%, 30½% and 55½%.

Of course, in arriving at a figure for yield per acre, it would be quite impracticable to measure the surface area of soil. All the same, while a steep field has certainly disadvantages, it has an advantage in having a greater area than is reckoned in its yield figures.

The advantages are not all in one direction. For example, if the rain falls always vertically (for simplicity of calculation!) the rainfall per square yard of surface soil on a 40° slope will be only about 76½% of the rainfall on a level square yard.

The relationship with sunshine is more difficult to assess, even leaving aside the complications of lie of land and season. But presumably the maximum radiation would fall on a flat surface parallel to the equator at the same longitude. Since Ceylon is about 8°N of the equator, land sloping down to the south at this angle would get most sunshine. In any case, probably what would be most helpful would be to increase the sunshine when it is weak, at the expense of decreasing it when it is strong, and it seems impossible to choose a lie of land that will do this even for a single day.

Then one thinks about how tea plants should be arranged at planting. If the spacing is measured along the slope, to give a standard number per square yard of slope, then the steeper the slope, the more plants there will be per plan acre. Rain per plant will be less on steep slopes.

Should fertiliser be put in according to plan acreage or soil acreage? This is not really a problem at all if manuring is done according to responsiveness to manure in previous years. But unfortunately responsiveness cannot be routinely estimated for single fields yet, and slopes are essentially characteristic of fields or parts of fields, not of whole estates.

One result of planting on measurements down the slope instead of on the plan is that the contour rows reach the bottom sooner on steep land near ravines than they do on the projecting peninsula, for the peninsula will take more rows. With irregular land, this leads to awkward short rows. An alternative method is to measure the inter-row distance on the horizontal, by means of a horizontal stick and a plumb line. The result of this is that on steep land, the rows look—and are—far apart and each bush has more surface soil. This is a very serious problem in plot trials, when it is important that all plots in a block should be as uniform as possible. But of course, the rows do not converge.

Is there a perfect answer to these problems? If not, are the answers now provided the best ones?