# PRACTICAL METHODS TO PREVENT SOIL EROSION

**Francis Daink and M. Baiga.**
Technical and Field Services Branch, Department of Agriculture & Livestock, P.O. Box 417, KONEDOBU, NCD, Papua New Guinea.

***ABSTRACT***

*Agriculture production can be sustained on a long-term basis if the soil, water and forest on which it is based are not degraded. In recent years, growing population has increased cultivation and moved onto marginal lands prone to erosion. Erosion makes it more difficult for roothold, nutrient uptake, and makes soil less able to retain water which results in decline of productivity.*

*To use land to our advantage, we must begin to identifying simple, less expensive and practical methods of preventing soil erosion. Soil retention fences have been very effective traditional methods in some parts of Papua New Guinea, and with modification by use of contour planting, cover crop, deep ripping the prevention method be more effective. However the method used in one area may not apply significantly or achieve meaningful results and may have to be remedied to suit the local needs that are based on availability of materials and most important prevailing features.*

***KEYWORDS:*** *Soil erosion, shifting agriculture, soil fertility, soil retention method*

## INTRODUCTION

In an undisturbed plant community most of the nutrients circulate between plants and the soil. Therefore, the environmental functions are in a balanced state. But this natural cycle of nutrient exchange is broken when man or other natural events like fire, storm or landslide disturbes the environment.

Man's continued agricultural practises has contributed much to soil erosion. The clearing of land exposes the top soil to natural elements such as wind, sun and water. Where there is no plant cover, the top soil is dried up by the sun. It then is blown off by the wind and washed off by rain water. Also, repeated short fallow shifting cultivation uses up soil nutrients and crop yield eventually decreases.

The problems associated with soil erosion and soil nutrient depletion are related. Therefore, this paper outlines practical methods that farmers in Papua New Guinea (PNG) could use to prevent serious soil erosion problems.

## AGRICULTURAL SYSTEMS IN PNG

More than 85% of the PNG population practises subsistence agriculture, and is the biggest industry in existence in rural areas. Most of these subsistence farming are under shifting cultication interspaced with short periods of fallow. The fallows usually consist of perenial herbs, followed by grasses and woody plants.

Vegetation cover is usually burnt when clearing land for agriculture and is sometimes considered the main activity contributing to the loss of forest vegetation cover in PNG. Soil erosion as a result follows, especially on slope land throughout PNG. About 30 tonnes of soil was found to be lost through rain water on slope land due to land clearing in the Simbu Province, and severe erosion on bare slopes more than 20 meters long in other highlands provinces (Humphries 1984).

In the Gazelle Peninsula soil erosion is accelerated on slopes of 29° if the garden is clean-weeded (removing of weed debris and soil bared).

## PREVENTION OF SOIL EROSION

Traditional methods and their modified versions can be used to prevent severe soil erosion. These include:

1. logs, fence, walls along contour
2. control of vegetation cover
3. terracing
4. moulding
5. ditching

## SHIFTING CULTIVATION

This is a method of agriculture that has been adopted in many tropical and temperate countries. In PNG most subsistence agriculture is under a system of shifting cultivation.

The system essentially consists of clearing/cutting and burning the forest and subsequently planting successive batches of annual crops on the cleared area. The same piece of land can be used for several years or a short period of time as the farmer desires. The land is usually kept in production for as long as a worthwhile yield is obtainable. When production starts to decline the farmer shifts to a new area. The abandoned area grows to secondary vegetation and later to forest at which time the process is repeated.

There are certain conditions that attest to why the system has been sustainable and they emphasize the fact that through shifting cultivation by subsistence farmers, certain things are achieved. These include:

a). Maintenance of soil fertility - forms of crop rotation
b). Nutrients which have leached to lower levels are recycled or pulled up by deep rooted plants and stored in plant tissues.
c). Long term fallow systems control pest and diseases build up.
d). No over cultivation.
e). Minimise erosion.

## TYPICAL GARDEN PATTERN IN PNG

Subsistence shifting cultivation is nowadays practiced on mountain slopes that have steepness ranging from lowest of 20-25° to the highest gradient at 50-60°. Gardening practices on such slopes has come about forcefully because all available flat land is under perennial cash crops, especially coffee, tea, cocoa, coconut, oil palm, rubber and livestock.

Traditionally, the selection of garden sites, clearing, burning, cultivation and planting occur in the sequence of events in the gardening pattern of the area. Normally after clearing and burning the farmer lays smaller logs both vertically and horizontally to make rectangular pattern of blocks of almost equal spacing (Fig 1) to either allocate or subdivide land between members of the family or to allocate for specific crops. By doing so, the people do not see or even realise that they are actually preventing serious soil erosion, but they believe by having this little rectangular areas, they would estimate or calculate the progress or speed a man can work in a day - probably to calculate man-days.

## PREVENTING SOIL EROSION

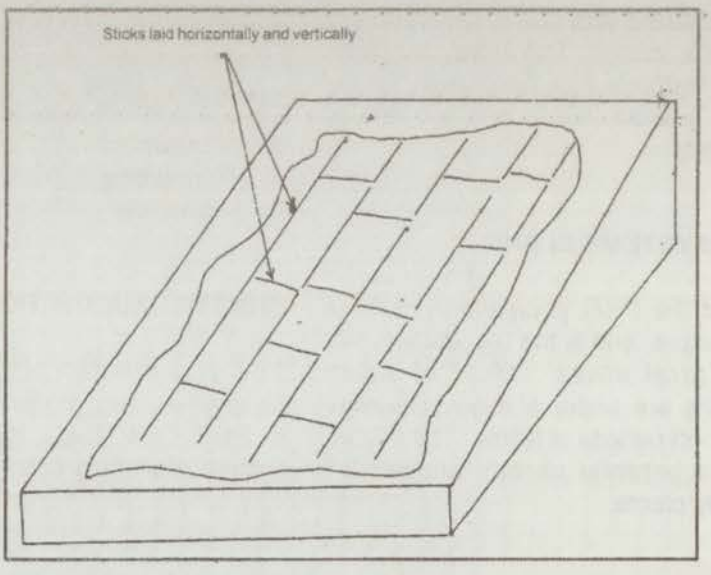
Agriculture within PNG, especially the vast rural sector, is traditionally based on some system of shifting cultivation. In such shifting cultivation the farmers are easing many problems that could arise from intensive type of gardening. The advantages of shifting agriculture are: -

a). Maintenance of soil fertility in form of crop rotation.
b). Minimise soil erosion.
c). No over cultivation.
d). Pest and disease control.

However, there are also disadvantages encountered in the shifting cultivation type of agriculture.

a. Large areas of land are needed.
b. Burning is frequent - destroys organic matter.
c. Population increases leads to over-use of land (short fallow).

*Figure 1.* **Typical garden site on mountain slope.**

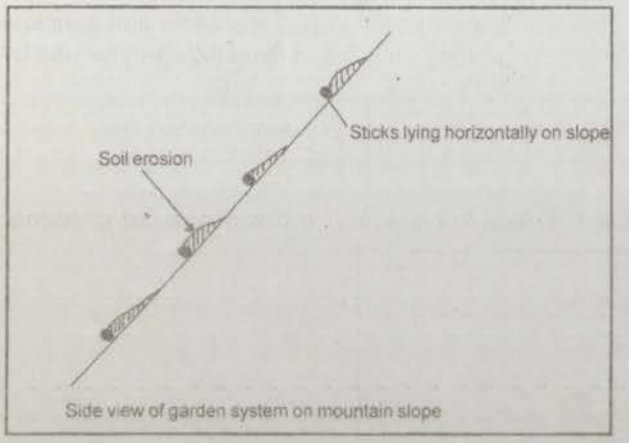


d. Erosion may be a problem as steep slopes are cultivated.

## STEEP SLOPE CULTIVATION

Although people cultivate whatever portion of arable land on steep slopes of mountainsides is available, they have practiced some form of soil erosion prevention long since. As they lay the vertical and horizontal logs on cultivated garden area; those that lay across the slope stop soil from washing away (Fig 2). This is actually seen in gardens where the soil has been retained behind these logs.

***Figure 2.*** **Preventing serious soil erosion problems.**




However, not all soil washed down by water is prevented from being lost. In some places some logs do not touch or lay perfectly on the ground, therefore about 50-70% is still washed down-slope. Nevertheless, some additional soil erosion prevention methods can be imposed and practiced by farmers if accepted and adopted into their gardening system. How to improve the present method?

## TO IMPROVE PRESENT SITUATION

In addition to the current gardening practices the farmers should adopt other acceptable methods in order to improve and retain the rich topsoils being removed by water.

One of the better and most effective systems would be that practiced in Chimbu Province, where small "fences" or "Giu" are constructed across the slope. These fences are seldom more than 9 to 12 inches (22.5 to 30.0 cm) high and after one gardening cycle, are generally fully sedimented on the upslope side of fence by topsoil, thereby proving their effectiveness (Fig 3).

## OTHER METHODS OF PREVENTING SERIOUS SOIL EROSION

Apart from the simple methods of preventing soil erosion currently used by the farmers and the slightly more improved methods used in the Simbu Province, there are some other practices which can be adopted.

Other possible methods of slowing down soil erosion could be as illustrated in (Fig 4).

a. Plant perennial crops on sloping land possibly with a legume cover crop/or pasture in between.
b. On the hillsides plant on contour.
c. Possibly all subsistence farming should be on flat lands.
d. Banks (ridges-mounds) constructed across slope to slow down rate of flow of water.
e. "Deep Ripping" if necessary, to soak in water and prevents run-off of water on soil surface.

***Figure 3.*** **Small retention fences build across slopes.**

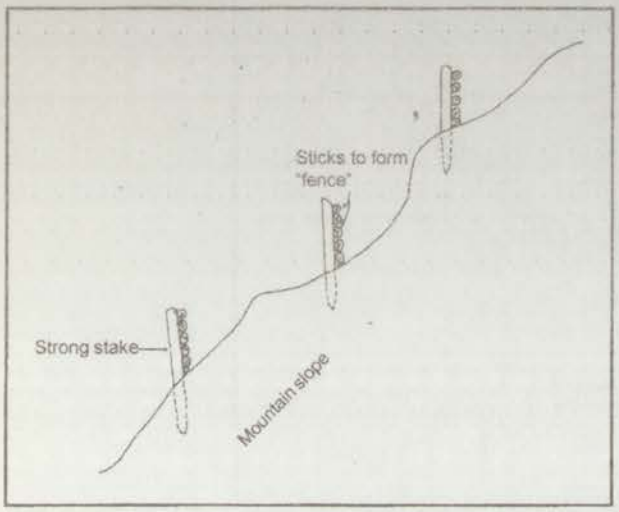
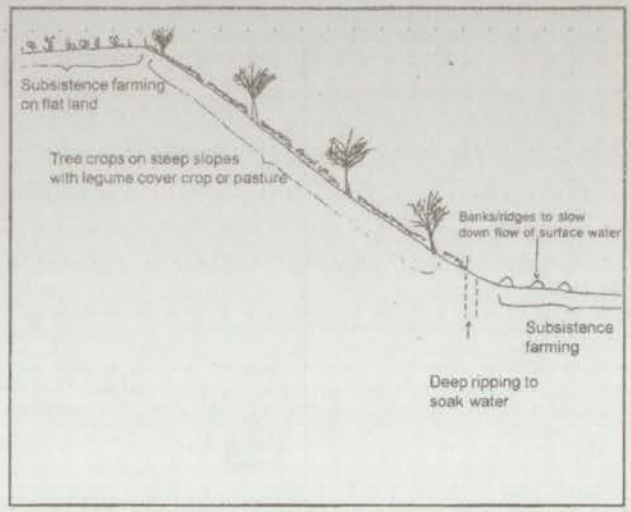



***Figure 4.*** **Other means of preventing soil erosion.**



## RECOMMENDATION AND CONCLUSION

Those subsistence farmers who face problems in maintaining the present gardening system would obtain greatest benefit from the available good land by adjusting to the methods recommended below.

The major problem areas faced by these farmers could be:

a. Land shortages due to clearing virgin forest for gardens.

b. Having fairly short fallow periods.

c. Limited area for either:
   - subsistence farming
   - perennial cash cropping.

d. Now forced to garden on slopes of mountains.

The farmers will make best use of whatever available land they have by cropping both annual and perennial crops on one piece of land (Fig 5 and 6).

i.e. On mountain slopes the perennial crops be planted on contour leaving sufficient space, about 15-20 metres in between each contour of perennial crop. The inter-row areas can then be utilised for annual crops gardening on rotation basis. Topsoil, which tends to be washed down will be trapped by the rows of permanent tree crops. In this way the soil will not be fully depleted and soil fertility is retained. Legume crops will also return nitrogen to soil if cultivated in the inter-row during resting periods.

With such practices the soil will be better conserved since:

1. Perennial crops will hold soil firmly by their vigorous root system.

2. Shade tree such as leucaena and gliricidia provide shade and fixed nitrogen for use by both crops.

***Figure 5.*** **Contour planting of tree crop with sufficient space in between contour for food gardens.**

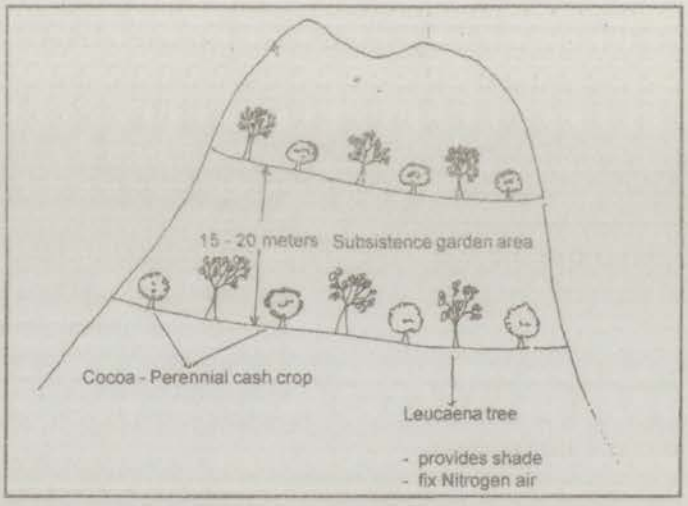
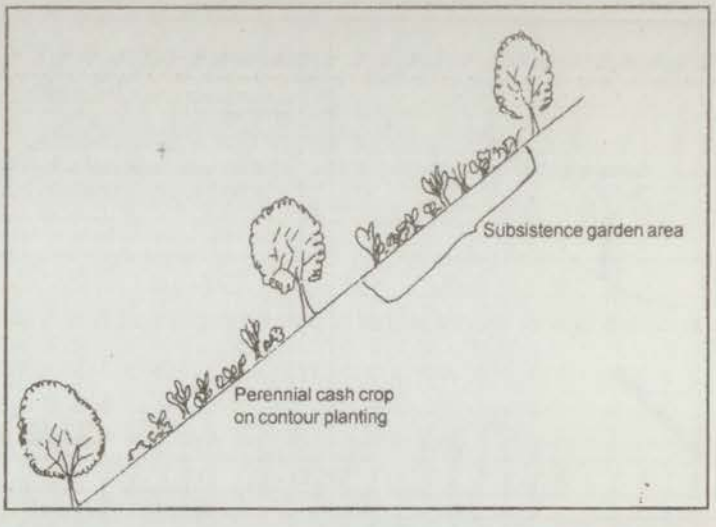



***Figure 6.*** **Side view of intercropping on mountain slope.**



3. From one cropping area of land cash income can be obtained from tree crops while farmer lives off the subsistence crops.

## REFERENCE

**HUMPHREYS G.S** (1984). *The Environment and Soils of Chimbu Province, P*apua New Guinea with Particular Reference to Soil Erosion, Research Bulletin No.35 Department of Primary Industry, Port Moresby.