

# **Soil and Water Management in the Production Systems of Mafa (Mandara Mountains, North-Cameroon)**

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## **1 Introduction**

The Mandara mountains form a chain of deeply dissected hills rising out of the surrounding plains and reaching a maximum height of about 1,500 m. The soils of the region are generally young and, due to the largely granitic character of the lithography, sandy with a low water retention capacity.

The rainfall regime of the region is unimodal with rainfall occurring between April and October with a maximum in July and August, with an average of between 800 and 1,100 mm per year. Rainfall is highly variable and localized, however. Data of Hiol Hiol (1999) reveal wide differences over short distances, as well as storm intensities of up to 70 mm per hour. Such torrential storms obviously carry a large risk of soil erosion, and very good soil management is required to ensure sufficient infiltration.

Even then, the evapotranspiration rates of 1,750 mm per year on the average indicate that large uncertainties surround the water availability for crop production.

## **2 Structure and type of terraces**

### **2.1 General presentation of terraces of the mafa.**

The terrace, locally called "Medeodeo", is the physical backbone of the mountain farming system. Its major function is retention of soil and water. The typical terrace has a wall of up to 1 metre high, built of stones placed upon each other without binding material, in a way such that maximum fit, density and strength is reached. The average bench width is about 2 metres. Some terraces are as narrow as 30 cm however, and some walls may reach up to more than two metres, especially at the sites where houses are built.

Most terraces have a zero slope or a slight backslope (up to 4 per cent) to ensure water retention. Also the orientation of the top of the walls is usually strictly horizontal, with the farmer adapting the wall tops every year if necessary. Some terraces, probably those that have too much excess water during torrential rain to be retained safely, have a slight inclination leading to perpendicular drainage channel.

### **2.2 Methodology**

The analysis of the terraces was done along a transect. An attempt of determining the type and pattern of terraces was then done. Information gathering comprises of participative diagnosis followed by different measurements.

### **2.3 Types of terraces**

Analysis of the structural parameters of the terraces permits to distinguish different types of terraces whose characteristics are presented in the following paragraph and summarised in Table 1:

**Table 1** Types of the terraces at MANDARA Mountains and their principal characteristics

Type of Terraces	MAFA appellation	Topographic situation	Wall like characteristic	Border characteristics
Hillside terraces of middle to steep slopes	M'dzigala-à	Slopes greater than 10%	Dry stones, height increases with slope	Width of border small and diminishing with slope of landscape
Levelling off terraces	M'belduldenz-e	Break of slopes with slopes < 10% Plateau	Dry stones Height 20cm—60cm	Width of border can attain 10m
Piedmont terraces	Ingaleams	Piedmont with slopes of 0%—10%	Mixture of stones, soil and grass. Height 10cm—30cm	Width of border can attain 20m
Compound terraces	Maralechgaï	Steep hillside slopes	Middle to large dry stones with regular structure Risen height can attain 300cm	The platform supports all the compounds and is often interwoven by small walls bounding terraces which supports a particular production system
Small valley terraces	Guimelther	Small valley with streams	Walls of dry stones can be directly placed at the edge of the small valley or on the edge of the stream. Height of walls of terraces increases with the length slope	The distance between two successive walls increases with the slope of the terrain (2.5m to 4 m at GOURA)
Terraces of bare rock	Zakaprad	Overwhelming rocky foundations  Slope less than 10%	Middle to large dry stones  Heights less than 60 cm, always higher than the surface of the borderline	Larger bench  Transported cultivable soil

### 3 Other techniques of soil management and water economy amongst the Mafa

#### 3.1 Methodology

We have realised an inventory and a technique description for soil management and water economy in a practical way amongst the Mafa. This aspect of the study was carried out along a transect ongoing from GOUZDA-MAJOVE to ZIVER (piedmont- mountains) by using a diagnostic technique with active participation of the population.

#### 3.2 Assessment and description of techniques of soil management and water economy amongst the Mafa of mandara mountains.

##### 3.2.1 Physical structures

The “Guimelther” (Prepared plot of “taro”)

The “Guimelther” is a set of terraces prepared in a small valley for the “taro” cultivation (figure). The word “Guimelther” signifies literally in Mafa “House of taro”. Sometimes one dresses up a wall of dry stones around the plot of “taro” if the water flowing from the stream inside the small valley is very

strong and in this case the plot of “taro” is not built directly at the end of the valley but along the stream slope. A water conduit is then located for the catchment to take water in and out of the plot.

The “Guimnda” (plot of “Souchet”)

This consists of elevated seed plot for the “souchet” cultivation. The seed plot on one hand is surrounded by peripheral drainage and on the other, of a series of small drainage or gutters (figure). These drains have a width of 10 cm to 20 cm and a depth of 25 cm. They help to prevent prolong rhizome/water contact. The surface area of a “Guimnda” varies between 35m<sup>2</sup> to 100m<sup>2</sup> on average. This structure is generally mulched with thorny, grass mat to prevent rodents and birds from destroying it.

Ridging (“Gid-dankali”)

This technique is particularly practised in the valleys on flat areas of mountains, plateau and piedmont where the soil is particularly deep (photo). It consists of building ridges of 50 cm height & 50cm width following the slope. In these ridges are buried all weeds while clearing at the preparation of the land piece. Ridging is exclusively practiced during July, in the farms of soft potatoes by young male adults, but the choice of planting site is the prerogative of the household head.

Stones enbankments

It consists of lines of stones on which are placed grasses and shrubs from the weeding operation. Where stones are rare, grasses and shrubs are simply cut and covered with soil to constitute the enbankment. Neither the height nor the width exceeds 30 cm. The enbankment built on lands of low slope (2% average), serve to retain water in the land piece, diminish the runoff, favour infiltration and attenuate erosion.

### 3.2.2 Biological techniques

Instead of applying chemical fertilisers (robbassara) whose usage is very limited notably because of their prohibitive costs and absence in the markets, the population utilises many procedures to maintain or increase the fertility of their farms.

*Chicken wastes (“Ziwotsack”)*

Poultry is generally kept in the rooms during the night. Their dungs are thus easily collected and stored before being used as fertilisers in farms, especially “\_Guimnda” farm and small gardens around the house.

*The thresh of millet grains “topock-dao”*

The residues coming from the threshing of millet grains are spread around the ridges with a view to fertilise the soil with organic material.

*Kitchen wood Ash (“Mervetw”)*

Wood ash coming from household work are collected and applied in the farms. In some cases they are first mixed with chicken wastes before their application.

*Wood ash obtained following grass burning before farming*

The preparing of the soil is done at the end of the dry season. During this operation, the left residues from previous farming as well as vegetable wastes are burnt. The ash resulting from this burning are heaped up on the land to be cultivated. The population appears to favour this procedure which puts directly nutritive elements at the disposition of the farms. However, mineral elements like nitrogen and sulphur can be lost by volatilization.

*Compost (“ourap”)*

At the beginning of the farming season, essential cattle consists of cows, sheep and often a “cow of case” is kept in the house. The wastes are regularly collected and deposited at a corner of the compound with view to the eventual ultimate usage. The other stamped element is mixed with urine, collected and heaped up in open air for a complete decomposition.

The transport and application at the start of the month of May are done by men, women and children. The compost thereby obtained is applied on the farms in heaps of 15 cm of diameter, spacing of 45 cm of the average.

*Compost produced by termites*

Compost produced by termites is made with the help of a small clay pot filled  $\frac{3}{4}$  way with stalks of sorghum/millet being in decomposition (photo). The filling of the clay pot is completed by bringing in earth. The depth of the clay pot is pierced with a hole and altogether covered with the help of a plastic or

a piece of the clay pot . All these are placed on a termitary in such a way that the end of clay pot hole communicate with the outlet of the termitary. Drawn by the smell of this composition, the termites enter into the clay pot and digest or earth up the cellulose and the lining contained in the stalks of sorghum/millet, thereby giving a compost. Once the stalks of sorghum have completely disappeared, the contents of the clay pot are given to the poultry , especially young chickens, which eat termites and enrich at the same time the compost by their dung and wastes. This mixture is then collected and taken to the farms where it is utilised as fertilisers. This way of fertilising farms is practised by women in the current of the month of April.

*Littering constituted by different leaf drops*

The litter of different leaves and trees left in the farms constitute an appreciable source of organic matter. Trees species used in agroforestry such as the *Faidherbia albida* leaves which fall on the farms. Otherwise, the population break and heap on the surface of their farms, the leaves and stalks of millet.

The weeds not consumed by the cattle are either left at the spoil surface or incorporated into the soil during ridging.

*ANKARA Method*

Slash burning, locally called “Ankara” in the North-West and Western provinces of Cameroon, is an ancient method of managing plant residues during land preparation. It is a farmer’s method of concentrating plant nutrient through spot burning of plant residues, so that high nutrient demanding crops such as cocoyam, tomatoes and maize can be grown. Soil temperature during slash burning influences the benefit derivable from burning.

Flash burning for short periods and at low temperatures, widely practiced by traditional farmers appears to ameliorate the soil pH, the availability of slow release,  $\text{NH}_4\text{-N}$  and could have beneficial effect on crop growth. In contrast intensive burning for longer periods as in piling could have negative effects on crop growth. Excessively high temperatures could affect the physical, chemical and biological properties of the soil.

It is seen by the farmers as a rapid method of releasing plant nutrients lock up in soil organic matter. Maize yield in Ankara beds in the year of preparation are usually 3—5 times higher than those on ordinary beds. In subsequent seasons, yields drop sharply. The practice of intensive burning, such as Ankara , has been demonstrated to be an unsustainable method of land use. It destroys soil organic matter and soil structure thus enhancing soil erosion on the hill slope. The deterioration of soil physical properties and the loss of soil organic matter accompanying Ankara land preparation may lead to rapid leaching loss of N,K, and Mg from the root zone and reduce availability of P. The yield of the second maize crop was limited mainly by inadequate supply of N. A soil management system which guarantees adequate N within the root zone will eliminate the need for Ankara by the farmers. (MEPPE PACKO, 2000). This technique is now under investigation in the study area.

*Contour Grass Strips*

Contour grass strips are ribbon-like bands of grass planted across a slope on the contour to protect the soil against water erosion. Their role is to retard the velocity of runoff, resulting in greater infiltration of water into the soil, and to reduce the sediment transport capacity of the flowing water.

The experiment was carried out at some farmers’ fields of the Mandara mountains where the treatments were assigned at random. The results analysis showed that contour grass strips are found ineffective in the region and not recommended on slopes steeper than 15 per cent with all species tested.

But farmers because of the fodder gained and the less work needed to establish them adopt them. Several species of grass and shrubs are planted for fodder, roofs, fencing and other uses besides the production of food crops.

#### **4 Conclusion**

The terraces represent the physical structure the most spread in the area, the other physical structures are less represented and very localised in space. Moreover, this is a complementary between the physical structures and the biological or agronomic techniques. For example , a terrace plot can receive organic matter as well as it carries agroforestry species and different farming conservation techniques.

On the other hand, the different techniques encountered are multifunctional : the terrace diminishes the soil loss reduces the runoff and increases the water infiltration; the mulching protects plants against predators, fights against erosion, evaporation and the runoff.

All the techniques of soil and water conservation encountered utilise household man power. The head of household is at the centre of decision making concerning the techniques to use and the choice of site.

There is a net division of family labour between the men and the women . In the past, the construction and rebuilding terraces were exclusively reserved to men. Today, it is the women who take care of terraces, rarely assisted by men.

Up till recently, the farming system was almost entirely oriented towards family-level autonomous subsistence, supplying each household the wide variety of products needed for daily life. Recently, because of the need of cash and services, inciting increasing seasonal migration of mountaineers to work in town or agriculture elsewhere. The mountain farming system, however, needs many hands to remain viable.

### References

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