DRAFT, HB

Watershed management
Manual for training in watershed management

In a first time the best learning effect but also the best effect on environment is obtained with clear and simple approaches and technics.
The technics for start are:

i) small stone dams and stone lines
ii) medium size stone dams and check dams
iii) small water spreading weirs.

All these measures, in correct application, favor growth of natural vegetation. This is one objective of the watershed measures, because only the combination of dry stones (simple mechanical protection) with vegetation assure the durability of the measures.
Thus, the biological protection is included into the approach.

Figure 1: dry stone measures favoring growth of natural vegetation. Only the combination vegetation and mechanical measures is sustainable.

DRAFT, HB

1. Technics:

1.1 Technic one: small stone dams or stone rows:

It is efficient, to construct small stone dams by eye, the dam should be constructed at right angle to the water flow. No need, to build exactly a long the counter line. The dam will create a small terrace and the head of the dam will be the new counter line.
A small stone dam is getting larger with increasing erosion risk (silty soil, important runoff, slope, increasing height …). Important for a good erosion control is a good soil cover by the dam (figure 2).

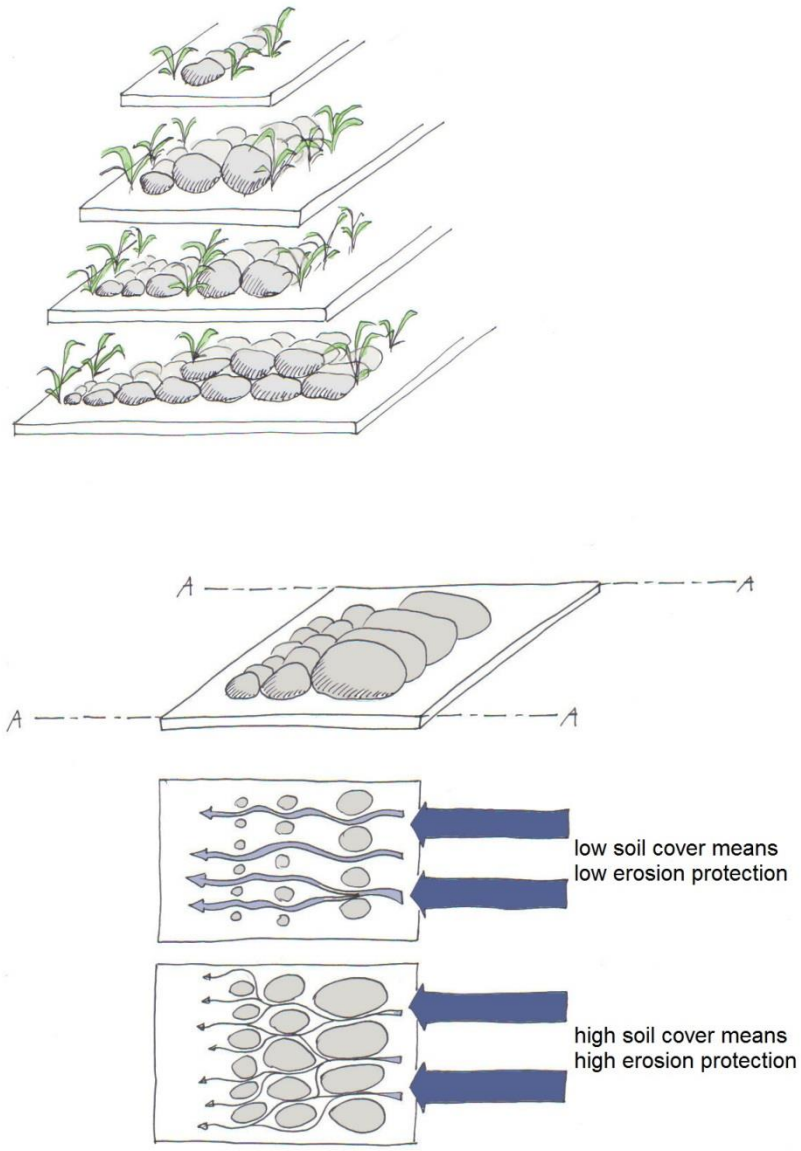


Figure 2: width of the dam is increasing with increasing erosion risk (upper part). Better the soil cover by the dam, better the effect to reduce water velocity and erosion risk (lower part).

1.2 Technic two: stone dams

With increasing height of the dam, more runoff water will be retained. A non-horizontal head of a dam leads to water concentration in the lower parts, which increases the risk of dam failure. That is the reason, to recommend the construction of higher dams (40-70 cm) with the help of a horizontal line. The line can be fixed by means of a water-level (mason's level) or an optical level.
Figure 3 shows the line and the different construction steps. An excavation is only needed for the base line of stones at the foot of the dam. Small stones and gravel at the base creates a good soil cower. The cover of the dam with big stones assures a good stability.
Figure 4 shows a masonry wall with a stone protection. This is an alternative to a pure stone dam.

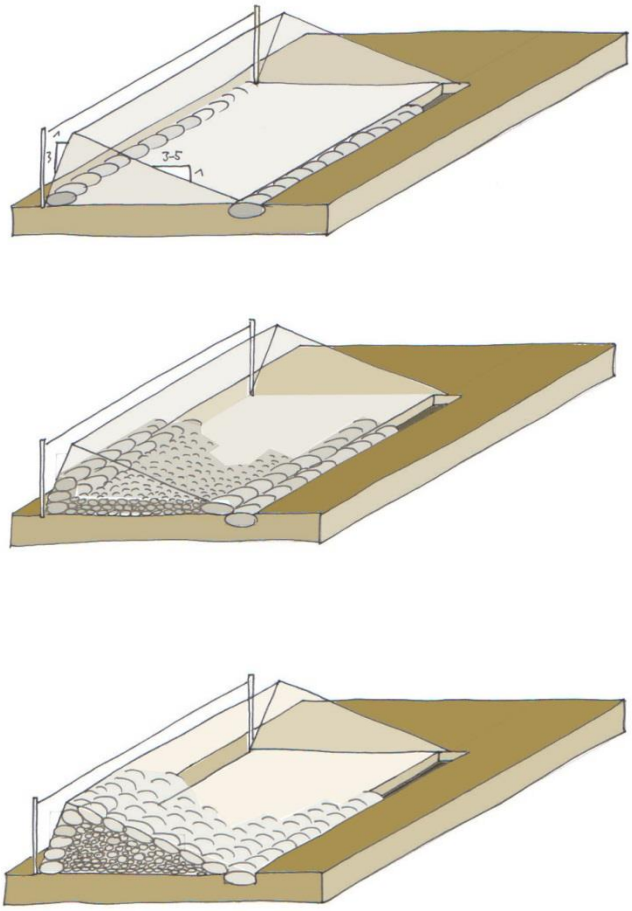


Figure 3: construction steps of a middle size stone dam.

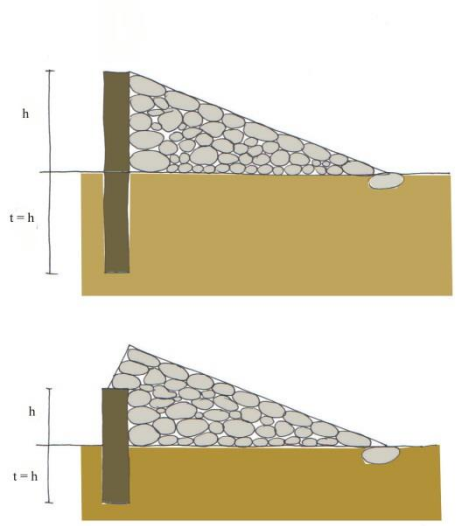


Figure 4: stone dam reinforced by a masonry wall is an alternative in difficult conditions to a pore stone dam.

1.3 Technic three: small water spreading weir

In deeper gullies or in silty-sandy soils a small masonry water spreading weir is recommended (*figure 5*). The wings can be in dry stones or in masonry. The calming up of the weir is possible with a water level or an optical level.

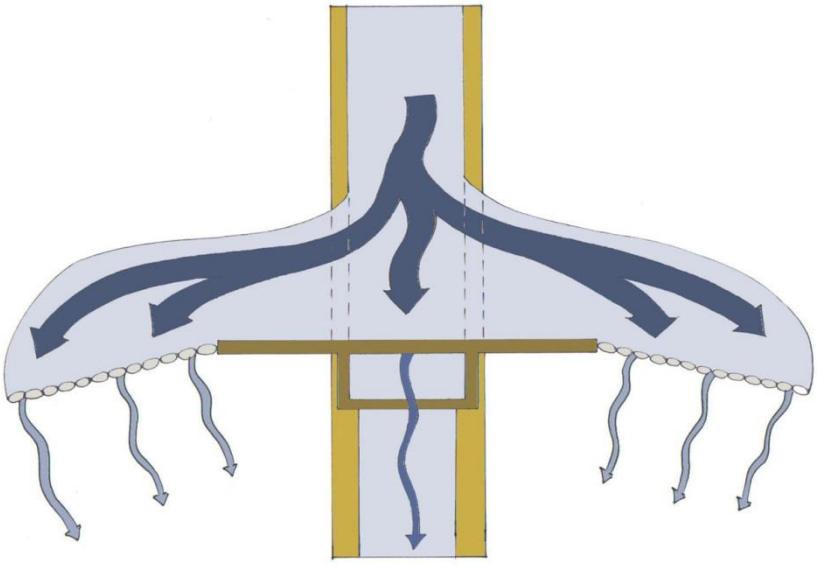
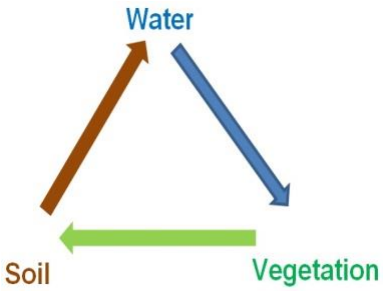


Figure 5: small water spreading weir.

2. Approach

2.1 Reflection on environmental dynamic and drought resilience

The appropriate approach is related to the environment state and dynamic.
Measures for natural resource management have an impact to all resources: water, vegetation and soil (*figure 6*), or they have no effect.



The biomass is more or less proportional to the available soil water.
Soil needs organic matter (vegetation) for aggregation.
Soil water content is high in a aggregated soil and decrease by soil degradation.
A high water retention capacity corresponds to a good water management in favor of the vegetation.

Figure 6: interaction of the natural resources.

Figure 7 shows the environmental spiral, the downward spiral of degradation and the upwards spiral of rehabilitation or regeneration.
In the upper part, the rate of degradation is quite slow; a natural rehabilitation is often possible. Degradation is not evident to recognize. Good indicators are decreasing yields, decreasing biomass and biodiversity.
In the lower part, the degradation rate is strongly increased. Natural regeneration is normally no more possible.
The appearance of gully erosion is indicator of begin of the accelerated degradation.
Figure 8 shows the essential of the ecological spiral in terms of drought resilience.

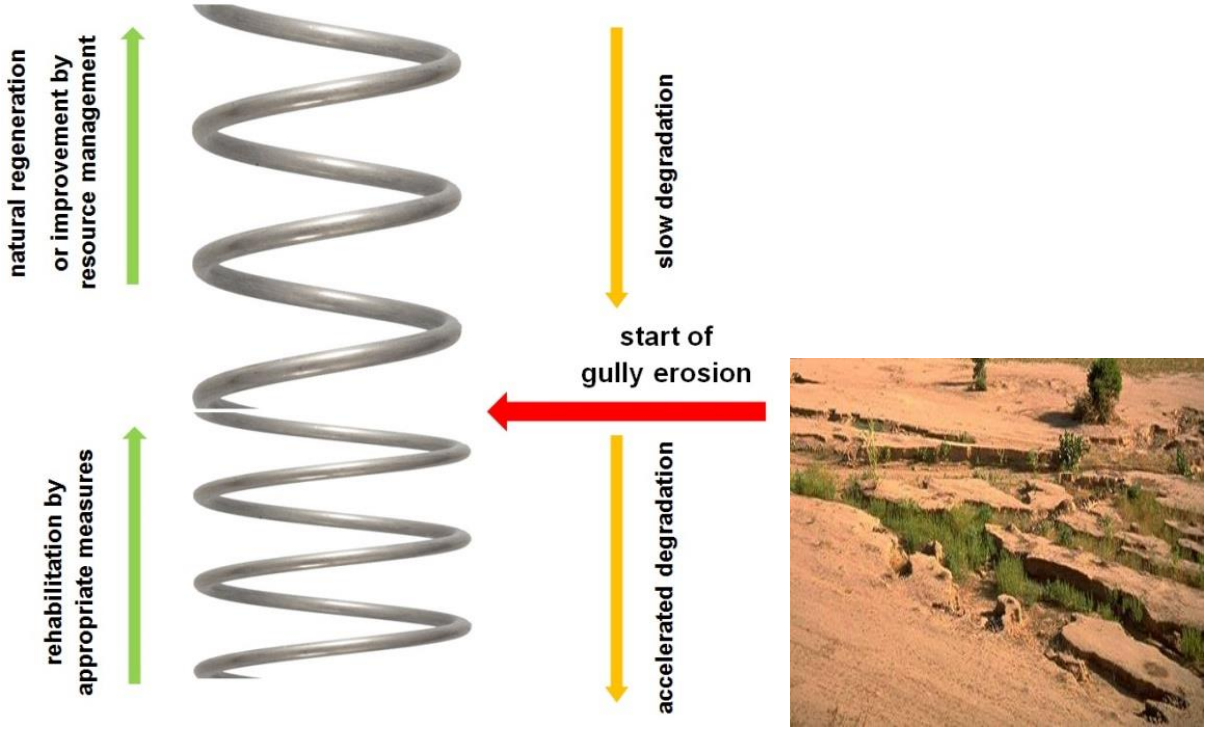


Figure 7: ecological spiral of degradation and rehabilitation/regeneration. The appearance of gully erosion marks the change from low to accelerated degradation.

level	degradation	drought resilience	indicators	dynamic
1	sustainable NRM	average to good	constant or increasing yields or biomass, intact biodiversity	low or no dynamics, increase of yields / biomass is possible with appropriate measures
2	slow degradation	low	decreasing yields or biomass and biodiversity	partly regeneration in years with good climatic conditions is possible
3	accelerated degradation	no resilience, droughts increase acceleration of degradation	appearance of gully erosion	acceleration and extension of the concerned area, no natural rehabilitation, rehabilitation needs man-made interventions

Figure 8: levels of degradation and drought resilience

The transition from low degradation to accelerated degradation can be seen in the appearance of gully erosion:
For the environment the drainage effect of the gully erosion is initially and generally more harmful than soil erosion. This accelerated drainage is equivalent with an accelerated degradation of all natural resources. Figure 9 shows this drainage effect.

Figure 9: drainage effect by gully erosion

The conclusions we draw from this fact, concern a big scale environmental protection and the strengthening of drought resilience.
Conclusions are the following:

1. Control of gully erosion has first priority.
2. Stop low degradation has secondary priority.
3. Improvement of NRM in sustainable conditions has third priority.

2.2 Basic approach for catchment areas

The recommended basic approach is:

To stop and to inverse all gully erosion in the catchment (with the simplest possible measures).

This is indicated by theory of degradation, but also by experiences. Local people will confirm the approach also. In Gariro for instance, people told that the effect of degradation by gully erosion is difficult to explain, it is like day and night. Thus, the effects of the erosion control measures will inverse all degradation effects, not only the gully erosion.
In other words, the working approach is simple. But the inherent effects are highly complex. In a first step the accelerated degradation is stopped and turned into a low degradation. In a second step, the runoff water spreading increase infiltration. The available water increase biomass and the organic matter improve soil structure. Thus the ecological spiral is turned on the upwards.
This dynamic leads to a level of sustainable NRM.