# Soil-water and conservation tillage practices in Lesotho: Experiences of SWACAP.

*by*

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***Abstract***

*The paper highlights the experiences of the Soil and Water Conservation and Agroforestry Programme (SWACAP) between the period 1989 and 1998. Several sources of information have been used to compile this paper including: special studies, reports, discussions as well as evaluation papers. SWACAP was a government intervention programme to encourage conservation in agricultural production in the northern districts of Lesotho. The programme also initiated Agro-forestry research and policy co-ordination in the rest of the country. The programme was jointly funded by the Lesotho government and the International Fund for Agricultural Development (IFAD).*

## 1. Introduction

Lesotho like all countries has experienced various axes of economic growth since independence. By 1994, Lesotho was still classified as the least developed country by the World Bank, with an average Gross National Product of USD 700. In the same year, the industrial sector, including the contribution from construction and building of the Lesotho Highlands Project, made up for the 42% of the GNP. Of this, 15% came from manufacturing, while the tertiary sector accounted for 46%.

Soon after independence, the GNP grew at the rate of 8% and this allowed for a significant growth of the public sector. However the 1980's saw a growth decline due to reduced domestic production, especially in agriculture, alarming public expenditure and high inflation which ended the decade in a budget deficit of 20%. The structural adjustment programme embarked upon between 1990 - 1993 stabilised the situation and yielded a surplus equivalent to 3.6% of GNP in 1994.

This growth however does not seem to have reached the social sector because poverty still threatens 55% of the farming households who are below the poverty line. Miners' retrenchment, rising unemployment, drought of the 1990's, were the biggest contributors to the declining socio-economic situation. Political instability exaggerated the context by delaying any measures to mitigate this dull scenario.

Since 1991, Lesotho has articulated policies on poverty alleviation, employment generation, income distribution, planned population growth and durable economic development. From 1996, there has been strong effort at various sectoral levels to develop strategies and programme actions that would implement these policy goals. One can still conclude that, all is not well in Lesotho regarding the economic and social conditions. Perhaps a strengthened agricultural sector could contribute towards alleviating or mitigating the two most threatening consequences of unemployment and poverty.

### 1.1 Agriculture in Lesotho

The contribution of the agriculture sector towards the GNP stood at 12% in 1994, following a drop from 50% in the seventies. Livestock (wool and mohair) dominated the sector with 50% share and the crops accounted for 40%. The majority (60%) of the population relies on agriculture for employment and it directly supports a little over half of the country's people. Exports have dropped from 25% in the mid-1980s to 16% in 1994. In normal years, Lesotho imports 25% of its foodstuff.

More than 80% of the country is rangeland, 67% of which, is highland at more than 1, 800 meters above sea level. In general there is biomass dis-equilibrium on both rangeland and in cropping areas due to the heavy burden from increasing numbers of humans and livestock, both of which are exacerbated by natural phenomenon. Arable land has decreased from 14% in the '70s to 9% in the 1990s and is still falling. Crop production is dominated by mono-cropped maize (80% of planted hectares), followed by sorghum, wheat, peas and beans. Yields are declining despite the increasing use of fertilizers. Yields are at half the level in l970s. Lesotho's production is at 1/3,


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compared to the neighbouring Republic of South Africa (Ministry of Agriculture, 1994).

Average land holdings are 1.3 ha. Landlessness on the other hand has increased from 13% in 1976 to 25% in 1986. Land allocated is inheritable and has become a means of security. Although there are some large scale farms, small-scale farming dominates with maize, the staple food, being grown on 80% of the area under cultivation (Bureau of Statistics, 1994). The yields have been declining despite the increased use of fertilizer, with long term averages of 400 kg/ha for maize. Several factors are responsible, but it is interesting to note that crop populations are usually lower than the optimum. Draft animals are a limiting factor as well as implements with a result that many fields are planted late in November, December and sometimes in January.

**Table 1: Effect of tillage systems on on-farm maize yield (kg / ha) during the 1992 / 93 summer season.**

| Tillage Systems | Poka | Qoqolosing | Mopeli | Sheeshe | Hlalele | All the 25 trials |
|---|---|---|---|---|---|---|
| Standard control | 1453.4 | 1024.6 | 1183.9 | 1610.3 | 550.8 | 1123.6 |
| Rip line planting system (treatment) | 2239.0 | 1619.1 | 2159.8 | 2220.8 | 994.0 | 1834.2 |
| F- value | 43.89** | 14.88** | 254.16** | 43.89** | 22.6** | 159.91** |
| LSD at 5% level (kg /ha) | 517.1 | 549.7 | 215.3 | 355.6 | 391.0 | 192.7 |

Because of the social structure that has developed over the years; that of the absence of men in 63% households; agricultural activities especially those relating to ox-drawn implements are undertaken by boys. Relatives, volunteers in the village; or in the worst case a hired male may also assist.

Historically, agriculture enjoyed a large share of the public resources (30%); but now it has been reduced to 8%. Consequently, the sector relies on foreign donor aid accounting for 45% of the budget, but that is also decreasing. (IFAD, 1997).

In 1997, ASIP (Agricultural Sector Investment Programme) was introduced. The planning process for this initiative was started around 1995, coming to fruition in 1998. The overall strategy of ASIP was to commercialise agriculture into a competitive sector, responsive to market signals. Related sub- strategies are:

- Further development of market reforms;
- Privatization and deregulation to curtail state involvement in agriculture;
- Land reform and improvement of the natural resource base;
- Diversification of agricultural base embracing a switch into higher value of horticultural crops, intensive livestock production and promotion of rural non- farm activities;
- Reorientation of agricultural support services towards sub sectors where Lesotho has competitive advantage.

### 1.2 Climate and soils

Lesotho has sub-tropical to temperate climate of warm, wet summers and cold dry winters. During the months of December and January, sometimes including February, there is a dry hot spell. This is usually fatal since it may happen when crop flowering occurs or fruit setting is being initiated. Rainfall has become erratic since 1990 and also un-seasonal. On the whole the drought phenomenon seems to have become a constant rather than an occasional incident. Rainfall ranges from 500 mm in the southern lowlands to 1,000 mm per year in the north-eastern highlands. The most typical rainfall character is that of short duration but high intensity. Frosts are common and are as indeterminate as hail storms; but generally occur between May and September. It is


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tempting to classify Lesotho as semi-arid. In relation to climate it has been said that crop farming is an especially risky business in Lesotho.

The two commonest soils are derived from the basalt and sand stones or shale in areas above and below 1,750 m respectively. The mollisols (basalt derived) are fairly deep with loamy texture and are moderately fertile. The alfisols (sand stone derived) on the other hand are typified by a coarse top layer with fine clay underneath. They are highly erodible due to the hard pan that reduces rainfall infiltration. These encourage piping and are therefore responsible for the gully formation that forms the southern lowlands landscape (Robinson, 1995).

**Table2: Effect of Tillage Practices and Low - input (250 kg / ha) During the 1994 /94 Summer Season**

| Name of Cluster | Farmer's Control | Rip-line System | Rip-line System + Liming at Planting |
|---|---|---|---|
| (1) Khabos | 773.5 | 2484.0 | 3583.0 |
| (2) Peka | 971.0 | 1155.0 | 1873.5 |
| (3) Ha Mphele | 1871.5 | 3283.0 | 3823.5 |
| (4) Linotsing | 1388.8 | 2803.2 | 4016.9 |
| (5) Ramapepe | 1469.0 | 3548.8 | 3832.6 |
| (6) Pitseng | 1007.1 | 2459.6 | 2997.6 |
| Mean | 1246.8 | 2622.3 | 3354.5 |
| % increase over control | - | 110.3 | 169.0 |

Topography varies from gentle, to moderately steep in the lowlands. The combination of the topography, the soil types and rainfall intensifies as do poor management which is responsible for the observed accelerated erosion.

Seven of the ten Benchmark soils are acidic with pH of 5 or less and have very little organic matter (Conservation Division, 1979). Current recommendations on liming range between 2 and 20 tons/ha (Badaamchian, 1991). Sheet erosion has devastated soil fertility , and in many cases the top soil is no longer there.

### 1.3 The SWaCAP project

SWaCAP's main goal was to promote conservation based agricultural production systems within a framework of client demand and extension approach. The specific objectives were to:

- Promote soil and water conservation measures as the normal part of agricultural activities in a way that it increased farm productivity, food production and family income;
- Establish agro-forestry research capability to contribute to the development of ecologically sound agricultural production systems.
- Create an effective agricultural extension service based on the client demand principles.
- Monitor and co-ordinate the soil and water


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conservation policies, programmes and projects of the Ministry of Agriculture (IFAD, 1988)

SWaCAP's clients and beneficiaries were to be the poorest of the poor as defined by IFAD, the co-sponsor of the programme. These were defined to be households that satisfy a number of criteria mentioned below:

- Households with land but lacking labour for cultivation;
- Households with smaller that average land holdings;
- De jure and de facto female headed households and
- Landless households.

This definition encompassed 85% of the rural population and did not clearly leave out households with external or even off-farm income generation activities, with or without land. Consequently the programme attempted to develop a working definition and after a series of interviews with rural people and workshops, three categories were set to define the poor (Ministry of Agriculture, 1991).

**Table 3: Responses to Fertilizer Treatments in Maize (kg/ha) in 1992/93. Village based farmer's group**

| Treatment | Peka | Qoqolosing | Mopeli | Sheesba | Hialele | Average |
|---|---|---|---|---|---|---|
| Control | 1798 | 889 | 1010 | 1470 | 518 | 1011 |
| NPK + LAN | 2357 | 1696 | 1899 | 2047 | 883 | 1706 |
| NPK + Manure | 2304 | 1381 | 2108 | 2230 | 841 | 1719 |
| **Average** | 2153 | 1322 | 1672 | 1916 | 747 | |

**Table 4: Maize Yields (kg/ha) Comparing Fertilizer and Tillage Treatments (1992/93)**

| Treatment | Control | Rip-line | Rip-line + Lime C/ | Mean |
|---|---|---|---|---|
| Control | 513 | 857 | 892 | 754 |
| T2 A/ | 955 | 1460 | 2118 | 1511 |
| T3 B | 975 | 1660 | 2280 | 1638 |
| Average | 814 | 1325 | 1763 | 1916 |

A/ V NPK (100 kg/ ha 3.2.1.(25)
B/ NPK (100 kg/ha 3.2.1.(25) + 1 t/ha manure
C/ Dolomite (250 kg/ha)

The discriminatory nature of this definition of beneficiaries within the framework of client demand extension service rendered this targeting impractical. Consequently the Programme worked with farmers that showed interest. However to avoid putting the poor into further disadvantage, the programme developed and promoted technologies which by design were not attractive to the well-to-do farmers.h.

Category 1: Household with the following three features:
- one field or less
- 2 cattle or less
- no external salaried income

Category 2: Female managed household with no external or salaried income, including the following:
- widows
- unmarried mothers
- divorced mothers who did not live at home and did not provide any financial support.

Category 3: Household managed by a disabled person or an elderly person with no external or salaried income.

**2. The development of conservation farming concepts**

It has been mentioned in other parts of this


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paper that poor soils combined with unpredictable weather conditions cause frequent and more failure of agricultural production than any other factor. Biomass dis-equilibrium occurs on both range and crop lands. This is partly due to the heavy populations of both animals and humans on a limited area. The rampant use of stover as wood fuel implies that there is no organic matter recycling. During farmer interviews, it was also established that other key constraints were, inadequate moisture for crops during the growing season; high cost of inputs (inorganic fertilizers and hybrid seeds), and late planting due to inadequate (few & poor in health) draft animals or tractors.

Although several other soil and water conservation measures were implemented within the programme this paper discusses the tillage technology in the form of "rip-line system" as it was later to be known.

The rip line system was developed to conserve water in-situ and make it available over a longer time. Alongside the rip-line system development, tied ridges and no-till or minimum tillage were experimented with the farmers. The experiments were conducted on-farm, with a participative farmer approach. The tied ridges and minimum tillage techniques were soon rejected although the farmers acknowledged their usefulness. Reasons were that they interfered with crop cultural management operation like weeding and weed infestation was too much to eradicate. It will be noted that herbicides were not incorporated in trials due to the low investment potential of the technology users.

**Table 5: Maize yields (kg/ha) comparing fertilizer and tillage treatments (1993/194)**

| Set of on-farm trials | Control | Rip-line | Rip-line + Lime C/ |
|---|---|---|---|
| Set 1 | 1022 | NA7 | 2218 |
| Set 2 | NA | 2636 | 2736 |
| Set 3 | 1274 | 2735 | 3499 |

Note: 100 kg/ha NPK 3.2.1.(25) given as basal treatment.
c/ Dolomite (250 kg/ ha)

**Table 6: Sunflower seed yields (kg/ha) under two tillage systems and five fertilizer treatments**

| Treatment | Normal Tillage | Rip-line Tillage | Difference |
|---|---|---|---|
| Control | 648 | 904 | 256 |
| Manure A/ | 612 | 1209 | 597 |
| NPK B/ | 743 | 1322 | 579 |
| NPK + manure | 903 | 1729 | 826 |
| NPK + LAN c/ | 942 | 1439 | 491 |
| Average | 770 | 1321 | 551 |

A/ 2t /ha
B/ 100 kg/ha 3.2.1.(32)
C/ lime Ammonium Nitrate 100 kg/ha


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A number of trials and demonstrations were undertaken between 1989 and 1994 (IFAD 1997). Between 1990 and 1994 more that 200 trials were conducted in rip line planting and crop nutrition management. The intention was to conserve water by breaking the plough pans which were forming or had formed at about 15 cm depth. At the same time, it was important to develop a low cost package that would achieve soil amelioration at the same time. Farm yard manure was applied to the rip-line before or during planting. The results of these trials are shown in Tables 1 through 6.

Farmers further improved the technology by double ripping. After the last cultivation operation a ripper was run between the rows to harvest the important rain in December through February.

By 1993 it was clear that the benefits of the rip-line system was indisputable and that the technology was vastly superior to that which the farmers were using; the conventional mouldboard plough. The technology was extended to test sunflower, beans, sorghum and groundnuts which gave positive performance. The plant nutrition management that was running concurrently and whose results are in the Tables, also included application of agricultural lime. All in all, the farmers who assisted in the development of this ripping tine (attached to the plough beam) acknowledged the reduced amounts of lime use & manure when applied on the rip-line rather than when broadcasted, as was the practice.

## 3. Discussion and lessons learnt

### 3.1 Soil type

It is important to determine which pan is in existence on the farm. A soft plough pan situation can be corrected by using the ripper. However the hardpan such as found on the duplex soils would be hard and thick and would need a tractor hauled subsoiler. Three distinct situations were identified in the utilization of the ripper:

- a relatively infrequent situation of light soils with modest plough pan where farmers had sufficient draft power,
- the more common situation of suitable soils but insufficient animal draft power; and
- a common situation where soils were heavier and the plough pan was well developed. Here, draft animals were simply not feasible.

### 3.2 Animal power

It was found that it is actually easier to hire animals for ploughing, planting and cultivating than for ripping. The reason as advanced by the women especially, was that ripping seemed to stress animals more than the other operations. Secondly ripping was done in the spring as part of the land preparation operation. Due to the dry hard ground after the moisture-free winter, the fields had to be ploughed, followed by ripping and application or no application of manure. The condition of animals was usually too poor to handle the ripper, even in a ploughed field.

### 3.3 Gender sensitivity

Culturally the use of ox-drawn farm implements is not a domain for women. However they could hoe, weed, harvest, thresh and store the grains. In Lesotho where female managed households make 63%, women will consider redefining their role under these circumstances since producing food remains a pressing challenge. An experience that was recorded with the female participating group of Ha Rakoloi was an interesting one. After learning the use of the ripper and control over the animals for the operation, they recommended the following:

- oxen move fast and so may not be good for women who will have to run after them;
- horses move fast, especially because they are used as singles;
- mules when used single, are as fast as the horses but slower when used in pairs;
- donkeys are slow and appropriate, however they require a lot more training.

The development of the use of the donkey was however “hampered” by a MoA policy which restricted the keeping of these animals on range.

### 3.4 Labour requirement

Four distinct operations had to happen in order to establish a crop under the rip-line system:


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a) Ploughing had to be done.
b) Rip lines were then drawn and manure was not applied in the rip-line.
c) Planting was done with or without application of manure.
d) Manure was applied as a distinct operation.

### 3.5 Availability of manure

The coupling of farmyard manure to the technique discouraged adoption, especially by those who could not access the manure or have a transportation problem to the fields. However although it was labour intensive it may not have been advantageous to ignore manure application which helped restore the structure and infiltration potential of the soil. There was need to carefully understand the farmer's position.

### 3.6 Institutional support

The programme was perceived as an external activity which was even contradicting the long standing "beliefs", practices and policies of the Ministry. The issue of the use of farm yard manure and donkeys was foreign, which were believed to be taking the farmers into the dark ages. The institutional resistance was very high. Secondly the curriculum for training of extension workers did not include this technology and even in the refresher training programmes it was not included. The dissemination vehicle was unprepared to promote this system which they were not fully acquainted with. The linkage between the programme and the manufacture entrepreneurs was totally lacking. Consequently the supply of the implement became a major problem and contributed tremendously to its reduced adoption.

### 3.7 The type of farmer

The rural disadvantage usually did not have time to experiment. This resulted in reduced participation especially as many of them had to borrow animals for the operations. They also preferred to try technologies that produced quick results. Experimenting or even demonstrations with farmers could also develop fatigue and could unconciously block their innovativeness.

### 3.8 Packaging the technology

Like all products the messages, packages, practices, techniques and technologies need to be disseminated, paying full cognizance that farmers are not uniform. A standard message may not reach the desired effect. It is important to know the farmers involved and to build on tradition. The future is based on the present and it is important to know the technologies and techniques in existence already. It is important for the promoter to be a step ahead of the users.

Finally, from SWaCAP experinces it is hoped that others are encouraged to consider the environment around us and how it can influence our well being and conservation tillage in order that interventions are meaningful for those they are intended for.

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