Frequent inspection is necessary in order that any minor damage, such as local breaks, accumulations of silt in the terrace furrows, etc., may be detected and rectified before more extensive damage results. In order to reduce the costs of inspecting and maintaining the 2,500 miles odd of terrace completed to date, selected Native labourers have been appointed, each of whom is responsible for the inspection of approximately two thousand acres of land reclaimed by terracing. They repair all minor faults and attend to plantations, etc., and any serious damage to terrace systems is reported. In addition, they instruct the people in the correct method of ploughing between terraces. When a reclaimed area is eventually handed over to the people, who will then be responsible for maintaining the works in that area, the maintenance labourers will be retained for one year to work in co-operation with the chief and people.

TRACTION AND PLANT.

(1) Animal Traction.

Oxen are used for the construction of small gully banks, the cutting of openings in terraces in pasture areas, and as an adjunct to power plant in the various other phases of construction.

It has been found that the minimum number of oxen, consistent with efficiency, is thirty oxen per district when ample grazing is available, or thirty-six per district when grazing is scarce. The additional number will allow of the oxen being rested in rotation.

(2) Plant.

Heavy plant purchased during the year:—

4 Caterpillar D6 tractors.

Heavy plant previously purchased:—

3 Caterpillar RD4 tractors.

1 Caterpillar No. 22 tractor.

4 Fowler 4/40 tractors..

2 Caterpillar No. 22 graders.

1 Caterpillar No. 33 grader.

4 Sawyer Massey Imperial 16 graders.

Ploughs:

After extensive trials of various makes of plough, a Ransome's Solotrac T.S.I.E. plough was purchased last year for each district.

Harrows:

Ransome's flexible steel harrows and Parmiter chain harrows continue to prove satisfactory for the smoothing of terrace banks after construction.

Ditchers:

The ditcher in general use for terrace construction in Basutoland is the improved Eaton ditcher.

Graders:

The Caterpillar graders continue to prove satisfactory, but it has become evident that the No. 33 grader is a far more

suitable machine than the No. 22 for use behind the Caterpillar RD4 tractor on the arduous work of terrace construction in this country.

The Sawyer Massey Imperial 16 graders are doing excellent work behind the Caterpillar D6 tractors.

Tractors:

The three Caterpillar RD4 tractors continued to do good work during the year. Repair expenditure showed a slight increase over that for last year. A complete engine overhaul of two of the machines was carried out in February.

Repair expenditure on the Caterpillar No. 22 tractor also showed an increase; its fuel and oil consumption, however, remained remarkably steady.

In August a Caterpillar D6 tractor was obtained on trial and carefully prepared tests were caried out at Peka. A comparative trial was held between the Caterpillar RD4 and No. 22 grader combine and the Caterpillar D6 and Sawyer Massey Imperial 16 grader combine. The latter definitely proved the more efficient unit for terrace construction in this country. The most valuable figure obtained from the trial was that construction of the standard terrace with the D6 and Imperial 16 combine was 0.2 shillings per 100 yards of bank less than with the RD4 and No. 22 grader combine. This figure is based on the total running costs which include costs of fuel and oils, estimated repair expenditure, depreciation of plant, and wages of plant operators. It is thought that this saving is on the low side as the D6 had not been fully run-in at the time of the trial and a generous allowance was made for repair expenditure, but even at this figure a saving of approximately £90 per tractor unit per year will be effected in the costs of construction.

As a result of the trials four Caterpillar D6 tractors were purchased.

Fuel Consumption and Running Costs:

Caterpillar RD4 tractors:

Total number of hours worked by the three tractors during the year	4,725 hours.
Mean fuel consumption (Diesel Fuel)	1.36 gallons per hour.
Mean running cost (fuel, oils, repairs, overhaul expenditure, etc.)	3.80 shillings per hour.
Mean total cost (inclusive of depreciation, but exclusive of wages of plant operators)	4.95 shillings per hour.

Caterpillar No. 22 tractor:

Total number of hours worked by the tractor during the year	1,419 hours.
Mean fuel consumption (petrol)	1.44 gallons per hour.
Mean running cost (fuel, oils, repairs, overhaul expenditure, etc.)	3.98 shillings per hour.
Mean total cost (inclusive of depreciation, but exclusive of wages of plant operators)	4.62 shillings per hour.

The mean running costs given above agree closely with those for last year.

The running costs of the Caterpillar D6 tractors are not given owing to the short period for which these machines have been employed in the territory.

IRRIGATION.

Owing to the outbreak of war, all work connected with the proposed construction of six irrigation schemes has been suspended.

GENERAL.

(1) **Survey.**

A check survey of all areas reclaimed by terracing up to the end of September, 1938, was made by the Surveyor. The figure given in last year's report for the total area reclaimed, which was compiled from District Officers' returns, agreed sufficiently accurately with the actual figure given by the survey that adjustment was unnecessary.

(2) **Publications.**

The first of a series of articles entitled "What the Agricultural Department is doing in Basutoland," written by the Engineer, was published in the October issue of the Teachers' Magazine of the Basutoland Education Department. The articles briefly outline the aims of the nine principal schemes being carried out by the Agricultural Department, and emphasise the benefits that the people will receive from the schemes. It is hoped that by the publication of these articles, the native teachers will receive and will impart to the children a fuller understanding of the policy of the Department, and that this will greatly assist in furthering the progress of the various schemes by obtaining closer co-operation of the people.

(3) **Visitors.**

His Excellency the High Commissioner inspected the soil conservation works in the Pack Saddle area in January.

In June, His Grace the Duke of Devonshire paid a short visit to Matsieng and inspected a portion of the works in that area.

In addition, numerous other visitors, several of whom represented other dependencies, were shown over the soil conservation works during the year and studied the methods employed.

(4) **Conference.**

The Annual Conference of the Agricultural Department was held in Maseru on the 26th September, 1939.

The Conference proved extremely valuable and various measures were advocated whereby soil conservation work in the territory would be facilitated.

The economic aspect of reclamation by terracing was discussed, and it was agreed that as sufficient demonstration work on excessively steep and severely eroded catchment areas had been completed in all districts, terrace construction would, in future, be confined to the valuable, extensively cultivated, rolling country, suffering from sheet and incipient gully erosion, which

could economically be reclaimed by terracing. Excessively steep, eroded catchments will be disposed of on the most economic lines by pasture management, tree planting in beaconed areas, etc.

Other principal measures agreed on by the Conference have been mentioned earlier in this report.

(5) Re-allocation of Lands.

Re-allocation of cultivated lands on the Mohales Hoek Reserve was undertaken during the year. After a survey had been made, a plan of the Reserve was prepared dividing it into areas that could safely be cultivated without danger of erosion and into areas that should be reserved for grazing. A complete and convenient lay-out of the area that could safely be cultivated was prepared, individual lands being marked out between terraces. The lands, all of which had been taken away from native landholders, were then re-issued in accordance with the layout, while surplus cultivated lands on excessively steep slopes were retired to pasture.

The action taken at Mohale's Hoek, in addition to benefiting the Reserve and the landholders concerned, will undoubtedly prove of great value to the soil conservation scheme as a whole by providing a striking demonstration of the benefits of the scheme.

Contour Ploughing.

The important part played by correct methods of cultivation in preventing soil loss are shown by experiments carried out in the United States of America, at Bethany, Missouri. The experiments, which extended over a period of three years, revealed that with ordinary methods of straight line ploughing soil loss amounted to 68 tons per acre, whereas with contour cultivation soil loss was reduced to 19 tons per acre. Where contour cultivation was supported by terraces, the loss of soil was only 2 tons per acre.

In this country terrace construction, assisted by propaganda and demonstration work, has resulted in contour ploughing between terraces being generally practised. Rare cases have occurred where fields have been ploughed up and down the slope with resultant injury to terraces. Thus in cultivated areas which have been terraced, soil loss has been reduced to a very small figure.

Terrace systems in Basutoland, however, have not been designed to withstand exceptionally high intensities of rainfall, as it was evident at the outset that it would be more economical to repair terrace systems occasionally than to construct systems which could withstand very exceptional storms. Any measure which would advantageously affect the permanence of terrace systems and increase their water handling capacity was, therefore, of major importance; and, of the various measures investigated, contour ploughing to a definite system was found to be by far the most valuable.

Numerous systems of contour ploughing have been investigated in order to determine the method that will have the greatest effect in increasing the stability of terrace systems and in reducing the loss of soil and water to a minimum by altering the ground conformity between terraces. Any system considered had to be simple in order that it might be easily understood and carried out by the native people.

Investigation work is continuing, but the following system appears the most effective and is being advocated to the people:

Considering an area between two standard narrow-base terraces, ploughing is commenced at a distance of five paces from the edge of the main furrow of the lower terrace, and a strip thirty feet wide is contour ploughed in a clockwise direction to form a plough bank which thus runs parallel with and at a distance of five paces from the edge of the furrow of the lower terrace. A strip of thirty feet was decided on as being sufficiently wide for convenience in ploughing and yet narrow enough to allow of the construction of the plough bank at a fixed distance from the terrace to be gauged reasonably accurately. The remaining area is then divided and contour ploughed. The manner in which this is divided and the number of divisions is unimportant provided that the uppermost strip is ploughed so that the earth is thrown against the backslope of the upper terrace.

By means of this system of ploughing, the width and capacity of the terrace furrows and the stability of the terrace banks are gradually increased by each ploughing. Successive ploughing by this system will also tend to build up a ground conformity between existing narrow base terraces which will eventually resemble a bench terrace with a slightly hollow bed and a long, sloping face. Where the ground slope is constant and the terraces parallel, the grade of the so-called bench terrace will approximate closely to that of the narrow base terraces between which it has been formed.

The plough bank, constructed in the first place five paces from the edge of the main furrow of the narrow-base terrace, will gradually be built up by successive ploughings and will form a lip to the bench terrace with a crest appreciably higher than the bed of the bench. This bank, or lip, will hold back extremely large quantities of water on the so-called bench terrace and will prevent erosion of the bench. The danger of waterlogging, which in any case is not a very real one in this country, will be avoided as the bench terraces will be on grade and any water which is not absorbed will be disposed of at the outlet of the narrow base terraces.

Tests are being carried out by alternately ploughing and consolidating earth with a heavy roller in order to determine the rate with which the ground conformity will be changed by successive ploughings.

The general and immediate adoption of this system of contour ploughing is of the utmost importance in order that the permanence of terrace systems in cultivated lands may be assured and that water and soil losses may be reduced to an absolute minimum.

PROGRESS OF WORK.

At the commencement of soil conservation work in the territory numerous difficulties existed, several of which appeared insurmountable. A large scale programme was to be started of work embracing numerous principles and methods of procedure, concerning which little applicable information could be obtained from any source. The programme was to be carried out under conditions that varied greatly and whose effect on the work could not be accurately foreseen.

By the end of 1936, sufficient staff had been appointed for the work to be carried out on the scale anticipated.

The clear-cut policy of the Department and the thorough organisation of the staff, prevented any serious mistakes being made at the outset of work. The valuable co-operation given by the various other departments and by the Paramount Chief, greatly assisted in overcoming many of the initial difficulties and in furthering the progress of the work.

More efficient methods of procedure were evolved as time went on as a result of experience gained and of the intensive investigation that was made in all phases of erosion control.

The suspicion with which any new work in a native area is greeted by the people has gradually given way to a feeling of confidence which is growing as the benefits of the work become more apparent.

Thus, all phases of erosion control are now being carried out more smoothly and with greater efficiency. Numerous difficulties still remain, but measures are being taken to overcome or circumvent them.

In the three years since the commencement of work nearly 42,000 acres of land have been reclaimed by terracing, 1,590 acres have been protected by fencing, over 404,000 trees have been planted and 64 large dams, with a total full supply capacity of approximately one hundred million gallons, have been constructed. In addition, large numbers of grass inlets and meadow strips have been established and many hundred of thousands of yards of terrace has been planted or sown to valuable grasses.

These are the visible results of the work completed in the three years of which the benefits have already become apparent, but the figures do not show the great amount of work that has been done in testing various methods of construction, in determining the most efficient power plant, in carrying out trials with numerous varieties of trees and grasses and in investigating many other aspects of soil conservation, nor do they show the progress that has been achieved in obtaining the goodwill and co-operation of the native people.

PART III.

FINANCIAL STATEMENT.

The sum of £160,223 from the Colonial Development Fund became available on the 1st October, 1936, for anti-soil erosion work in this territory.

Revenue for the year	£139
Expenditure for the year	£23,358

The above expenditure includes the amount expended on the purchase of plant.

The period covered by this report is from the 1st October, 1938, to the 30th September, 1939.

PART IV.

LEGISLATIVE CHANGES.

During the period under review there have been no legislative changes affecting soil conservation work in the territory.

(Signed) E. R. ROBERTS,
Engineer to Agricultural Department.