PASTURE REGENERATION : WITHER HILLS

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The process of natural regeneration of pastures is one on which during the past 20 years there has been a deal of discussion and experimentation, but on which there has, in this country, been little enough action on a practical scale.

As far back as 1922 it was demonstrated by Cockayne that even in dryland areas native pastures would regenerate if given a chalice over a period of four years or so. Other experiments throughout the years have verified that our native grasslands have a remarkable facility for rebuilding themselves if stock, vermin, and fire can be controlled. After all, when the depletion period of 80 to 100 years is considered and contrasted with a regeneration cycle of 4 to 5 years, it becomes apparent that such a facility is a very definite asset to this country. It is true that we have growing evidence of this fact and the time is over-ripe for utilisation of such knowledge on a big scale.

It is doubtful if further postponement of active regeneration work on much of our native grasslands can be allowed for; as is well known, once deterioration reaches rock bottom, the road back is almost impossible. In many of our hill-country areas we are reaching rock bottom to-day.

The Wither Hills Reserve, on which regeneration work started in July, 1944, was such a case. Deterioration and depletion had proceeded to such an extent that active erosion was to be observed all over the area and the results from the work done lend point to former observations. Pasture depletion and even erosion can be stopped and corrected if appropriate measures are taken early enough. We have already postponed application of experimental findings for about 30 years and the problem has become no easier in the meantime. Early application of findings in this connection is therefore, most advisable.

On the Wither Hills Reserve the problem of pasture regeneration was approached not from the plot scale but from the farm angle and all experiments

were as practical as possible and, it was hoped, within the means of farmers.

DESCRIPTION OF COUNTRY

The Wither Hills Reserve of 406 acres lies to the south of Blenheim $1\frac{1}{2}$ miles from the Post Office. The land can be described as medium hill country ranging from the plain to an elevation of 100.0 feet. Slopes which are on an average 15 to 20 degrees become as steep as 30 degrees and there are few flat areas. The land is primarily tussock country and originally was covered with heavy silver tussock and native grasses. So thick was the original cover that, as one early settler put it, "the tussock reached up to the horse's belly," while it is reported in "Old Marlborough" that Maori parties used to cross Cook Strait from the North Island for the purpose, among other things, of collecting the long tussock herbage for thatching of their huts..

So it can be assumed that originally the cover for these areas was adequate and the slopes stable.

LOCAL CONDITIONS

Climatic conditions in the area are relatively mild. The district has an average rainfall of 23 inches and for three-quarters of the year this is reasonably well spread. The remaining quarter is normally very dry and drought, aided by nor'-west winds, is a farming hazard that has to be faced.

The winter months bring severe frosts (on an average 10 degrees) and these occur mainly from May to September. However, these periods of frigidity are offset by mild winter days and are sometimes interspersed by warm spells. Compared with that in more southern regions the winter feed problem is not a particularly severe one, most farmers relying on, hay as the only supplementary feed.

SOILS

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Soils on the Wither Hills are typical of an area of approximately 10,000 acres. They comprise a silt loam of a relatively weak granular structure overlying a sandy loam, which is easily eroded, on a layer of clay subsoil interspersed with stones. Maximum average precipitation is 2 inches in 24 hours, although in excessive storms, which may occur once in 20 years, this precipitation can be doubled.

CONDITION OF AREA WHEN EXPERIMENTS COMMENCED

The area had deteriorated from well-clothed tussock country to a sparse, denuded danthonia cover. In the gullies were odd patches of browntop, while there was an-almost complete absence of any legumes. Most of the danthonia was bared by overgrazing to ground level and over the block there was much bare ground between plants.

The deterioration had proceeded beyond the stage of pasture depletion and actual soil loss was going on in a big way. Most of the grass plants were elevated on small knolls due to the soil being washed away between them, while rills, tunnels and large open gullies were spattered throughout the area. The largest of the gullies was up to 20 feet deep.

Fortunately, on the average, the cutting had not proceeded to this extent. In most cases the damage following the disappearance of pasture cover consisted of small open cuts and bare sheet eroded hillsides. These, however, were very numerous and the soil was dry and very hard.

REASONS FOR DETERIORATION

The reasons for such a state of affairs are not new and can be duplicated to a greater or less degree in many parts of New Zealand to-day. Firstly the original cover was grazed until it was found that firing made the tussocks edible, and this meant a greater sheep carrying capacity. Extensive burning was then indulged in and gradually killed out most of the tussock and-- left an almost pure danthonia sward. And then came the rabbit. As recently as 20 years ago the hills moved with these rodents. It can be stated that while the fires materially assisted in the destruction of the cover, the rabbit was the greater enemy. The rabbit virtually stripped the land clear.

Intensive war was declared on the rabbit, first by the farmers themselves and later by killer boards, until to-day the rabbit is a rarity on these slopes. This work was completed several years prior to the commencement of the experiment, for-which fact the experimenters were duly thankful.

SCOPE AND CONTROL OF WORK

As the regeneration of the area presented a problem of some magnitude and one- on which expert

opinion from many sources was required., a committee representing all departments who could contribute, and practical farmers, was set up by the Soil Conservation Council. This committee comprised Commissioners of Crown Land at Nelson and Blenheim, Instructors in Agriculture at Nelson and Blenheim, Resident Engineers at Nelson and Blenheim, the Director of the Cawthron Institute, District Soil Conservator, Mr E. Edwards, farmer, Takaka, and Mr W. S. Bennett, farmer, Marlborough. Representatives of the Soil Bureau and the Botany Division were also included on the Committee.

PROBLEMS FACING INVESTIGATORS : These can be summarised as follows:—

1. It was necessary to bring the land back into reasonable production.
2. This to be done as speedily as possible owing to the increasing deterioration of both pasture and soil.
3. All work on the area to be essentially practical and, it was hoped, within the means of farmers with similar problems.
4. As most of the slopes were too steep for safe cultivation, the greatly needed extensive cover must be induced by natural means as far as possible.

MEASURES UNDERTAKEN:

1. For the first 16 months after July, 1944, when the area was acquired, complete spelling was practised in order to allow seeding and, it was hoped, re-establishment of native grasses,
2. **This** was followed by moderate **grazing** with cattle, 20 head of two-year-old speyed heifers being given the run of the block for one season.
3. At the same time rabbit control was maintained and what fencing could be obtained was used for subdivisional purposes.

OTHER METHODS TRIED

(a) Surface sowing of areas without any other treatment.

In all 23 plots of various grasses and clovers and mixtures of same- were tried.

These plots were $1\frac{1}{2}$ chain by 1 chain divided into

three sections and all plots were duplicated, one series on the higher slopes and the other lower down. Sowings were pure and mixtures included chewings fescue, lucerne, cocksfoot, permanent pasture white clover, permanent pasture ryegrass, crested dogtail, brown-top, and subterranean clover;

(b) Surface sowing of the same seeds with—

(-1) Superphosphate 2 cwt.

(2) Lime 1 ton.

(3) Superphosphate 2 cwt. and lime 1 ton.

(c) Surface sowing with superphosphate 2 cwt. on prepared ground—

(1) Heavily raked.

(2) Harrowed severely on contour.

(d) Surface sowing of inoculated subterranean clover seed without any other treatment.

(e) Remedial effect of moderate cattle grazing on hill pastures was investigated. The spread of seed through cattle on the hill country from flat seeding areas was also tried.

(f) Pasture furrowing for improved moisture control and better grass growth.

(g) Aerial sowing of inoculated clover seeds following spelling.

(h) Run-off plots to measure effect on moisture retention of regenerated pasture as against heavily grazed grass.

RESULTS

Following the initial spelling, the cessation of burning, and the control of vermin, a remarkable improvement took place. The sparse danthonia grew well, went to seed, and a good covering of seed (probably the first for many years) fell on the whole block. The following autumn on the previously bare country myriads of seedlings were to be seen coming away. These plants re-established and after 16 months' spelling a very noticeable improvement in cover was apparent. Also apparent, however, was the danger of fire. Dry stalks of danthonia covered the property and the risk of accidental burning was very great. In order to cover this risk and utilise the roughage, 20 head of two-year-old cattle were introduced. These cattle were rotationally grazed on the farm which was now divided into five blocks and had no other feed apart from the regenerating danthonia. The only additions supplied were rock salt and water. At

the end of a year these cattle were sold off fat. The number carried was then increased to 43 and the process continued for a further year. -This second mob did equally well and apart from fattening there was a decided improvement in the country due to their use.

While the cattle grazing reduced the fire danger, it also helped to introduce trefoil and later subterranean clover on to the hills; these plants have established, and with continued similar treatment are spreading over the hill country. At the end of the second year of cattle grazing the regeneration of native pastures was most marked and the improved condition of the block could be discerned from many miles away. The *Danthonia* sward had closed up and there was a good medium height cover on the slopes. Sweet vernal was making- its appearance on the lower slopes, blue grass (*Agropyron scabrum*) and odd tussocks were becoming apparent. In addition, many of the previously open guts had healed and become well grassed, while most of the bare soil, except in the excessively large gullies, had been covered. Although sheep are now being run on the area once again in conjunction with cattle, care is being taken to see that plant cover is maintained at such a level that pastures continue on the up-grade rather than in the former declining cycle.

SURFACE SOWING OF AREAS: RESULTS

This work was done in the spring of 1944, repeated in the autumn of 1945, and repeated with modification in the autumn of 1946. Initial sowings done in the spring were not hopeful, but were sown to give some indication of probable result. The result was definite-there was no strike in any plot except odd subterranean clover plants, which soon died.

Accordingly the plots were extended to cover superphosphate and liming and resown the following autumn. In this instance there was an initial strike in almost all plots, although some of the grasses were most difficult to observe owing to the numerous plants of regenerating *Danthonia pilosa* in almost all plots. However, when dry conditions set in these surface sowings- did not persist for any length of time and further, there was no discernible difference with the superphosphate and lime, or with the lime alone. Of all the plots subterranean clover seemed the most hope-

ful, but after getting to the three-leaf stage this went orange and also died.

: In the autumn of 1946, therefore, subterranean clover and the lower fertility demanding grasses like browntop and dogstail only were resown. In addition, the subterranean clover seed was inoculated with soil from an old subterranean clover paddock. Although in this sowing the grasses did little better, subterranean clover persisted throughout the season, seeded, and is still to be seen on these plots. Where this plant was manured and inoculated there appeared to be little difference in growth over the non-manured section.

PASTURE FURROWING

Running of level furrows round the slope was tried over an area of 15 acres. Furrows were laid out at 6 foot vertical and 12 foot vertical intervals. In addition the furrows have zig-zagged outlets 2 chains apart.- In this way water cannot run off the slope with any momentum and is retained in the furrows for use of the grass. The furrows installed very cheaply have done this work most effectively, but as they have been in position only for one year, it is too early to assess their pasture improvement value. It is undoubtedly true, however, that these small channels have arrested the movement of much soil off the slopes and retained moisture.

AERIAL SOWING

So marked had been the success of the natural reseedling and regeneration that a neighbouring farmer with freehold land decided to carry out the same work on a block of 600 acres. Accordingly all stock were taken off the area for 16 months. By then the regeneration had commenced. Having observed the slow rebuilding of the clover on the reserve through cattle and the success attending the inoculation of subterranean clover seed, it was decided to sow the block of rough gullied hill country with-

- 2 lb suckling clover
- 1 lb subterranean clover (inoculated)
- 1 lb white clover.

The block was sown from the air and the total area covered in 1 hour 50 minutes flying time. The cost of transporting and spreading the seed to the farmer was £13 or 5d per acre. The distribution and

spread of seed were excellent and a good strike of subterranean clover and trefoil is now to be seen, although the white clover is not so evident except in the gullies. Records of the growth of these plants are being taken throughout the first season and show great promise.

RUN-OFF PLOTS

A series of plots has been established to test the retentive power of the improved herbage. One series subjected to the previous heavy grazing contrasted with another on the improved native pasture has given readings of up to two-thirds greater retention of moisture. The work in this connection is, however, incomplete and further, it is considered the measuring apparatus is not sufficiently accurate for reliable results. Better equipment is now being installed and consequently the findings to date can be taken only as an indication. These indications, however, are sufficiently interesting to warrant further work in this connection.

SUMMARY-CONCLUSION AND ECONOMICS

While the results of the work to date in the regeneration of these hill slopes is most apparent to the eye and is freely conceded by local farmers, who often are the most difficult to convince, much still remains to be done in the ascertaining of the true experimental differences on the area. This work is under way at present, a full-time technician being employed on the area.

Perhaps a guide to the value of the work which would be of most interest to farmers is the economic angle.

It will be appreciated that the area is firstly an experimental block, but with the success of some of these experiments these have been put into operation on a farm scale and some difficulty was experienced in separating the purely experimental costs from the farm economy.

It has been found that the previous occupier, who carried one ewe to two acres and did no fattening, was making a return exclusive of labour of approximately \$350 per annum. It should be remembered that to achieve this very definite overgrazing was practised.

In the first year of experimentation, therefore,

the loss of production, when the land was completely spelled, meant a debit of £350. In the second season the 20 head of cattle run; which fattened in the one season, gave a net return of £200—a debit then of £150.

In the third season few cattle were sold and sheep were reintroduced in the latter part of this year. The sales of these sheep and cattle were spread over the third and fourth seasons, and the net total for the sheep, lambs, wool, and cattle sold amounted to £1865—an average of \$932 per annum for the two seasons. Further sales have been made this year, but as the season is not complete, these have not been included.

The balance sheet therefore, reads:—

1944-45	Debit	£350
1945-46	Debit	£150
1946-47	Credit	\$935
1947-48	Credit	\$935
1948-49		

It should not be assumed that all the above return was due to natural regeneration, although this is without doubt a major factor. On the lower slopes and the one flat paddock improved pastures have been established by ordinary good farming methods. While such an account of the finances could be misleading because of the very high prices being secured for fat stock during the past few seasons, nevertheless the figures do give some measure of the improvement that has taken place. Further, although at the present time approximately twice the number of stock are being carried as previously, the land is being undergrazed rather than overgrazed as formerly.

So the process of regeneration, while difficult from the financial angle at the start, definitely does pay dividends in a few seasons.

Such findings, which can be duplicated on some farms, are a pointer to future action in the regeneration of our depleted hillsides. It is considered that the time for discussion is passed and action on such lines on a big scale is overdue.