
ROLE OF SOIL AND WATER CONSERVATION IN GRASS- LAND PRODUCTION

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In this paper I would like to move away a little from the usual lines of grassland discussion and consider for a while other aspects apart from strain, manures, and grazing management.

I would not like it to be thought that I underrate these factors. Far from it. As one who served his time in the early maze of seed, certification and as the perpetrator of numerous manurial trials (not always reported on promptly, I must agree), I think I can claim to have a full appreciation of these factors. But there are other aspects of grassland production-some of them major ones which bear investigation and discussion. The one I propose to discuss is some effects of water on grass, on grass production and soil, on our sloping lands.

SUMMARY

In the first place I think I should be quite frank and outline to you what I am attempting to show so you can assess the ideas for yourself. Maybe you will agree completely with the ideas in this summary -in which case this will be a record short session. But if not, I would like to elaborate the separate items before coming to a conclusion at which I trust you will also be able to arrive. I propose to illustrate the work with slides as I go through and would like you to see a short film illustrating new practices on easy sloping land.

My Assertions, therefore, are:

1. Past progress in grassland production has been along specific lines and has been mostly applicable to flat or easy sloping lands.

2. Progress in the extension of these ideas has been fairly limited even **on** the flat land, and there is room for greater concentration on the problems of sloping lands, as it is from these lands that future production will come.

3. We have assumed that what applies to grass production on flat lands necessarily is correct on sloping country. I think this is wrong.

4. We have not taken into account sufficiently (if at all) the factor of slope and its attendant problem, the run-off of water.

5. Run-off (or the lack of conservation of water) from farm lands can have major effects on grass, soil, and production on both the hills and the flats.

6. There are some present practices which, in the light of run-off problems, are wrong.

7. New practices which are designed to cope with the problem are necessary for the continued increasing welfare of New Zealand grasslands.

These bald assertions are the basis of my talk and as you all may not agree, I will take the first point and elaborate a little.

1. Progress to date in Grassland production has been along specific lines, as follows:-

- (a) Have a good strain of seed-Certified seed.
- (b) Sow a suitable mixture: Ryegrass, white clover, red clover, cocksfoot ; good clover content is an essential.
- (c) Adequate and correct manurial programme : lime, superphosphate, molybdenum.
- (d) Maintain good grazing management.

This advice, admittedly in its simplest terms, with local variations, forms the basis of sound grassland production. It works well, as can be testified to by thousands who have tried it. It has raised production appreciably. On the other hand, it was developed on flat lands. This is reasonable in view of past methods of cultivation and the fact that it is natural to take on the easiest land first. Again, the steeper country posed almost 'insuperable' difficulties in the spreading of manures. All these factors have now been overcome. The easiest land has been covered (in part at least), new tractors and plant make hill country development' feasible and economic, and the

aeroplane has solved the manurial and seeding problems. These latter developments have come so speedily that some of their real effects are difficult to judge, but large-scale development of our steeper lands is now possible, and in fact is already on the way. This may be just as well, for it comes at a time when it is most needed.

2. Progress has been fairly slow in the past. There is room for greater concentration on the problems of sloping lands, as it is from these lands that further production will come.

In this matter it is wise to get the perspective right in the question of relative area.

New Zealand has $1\frac{1}{2}$ million acres of alluvial flats, part of which only is in first-class pasture.

New Zealand has 42 million acres of occupied sloping land.

New Zealand has a rapidly rising population demanding ever higher standards of living.

As I pointed out, by no means all of the $1\frac{1}{2}$ million acres of alluvial flats is in first-class pasture (most of it could be), while on the sloping lands the surface is barely scratched. In effect real progress in this direction over the last 20 years leaves much to be desired. The knowledge has been there, but the application of that knowledge has been slow. On the other hand this very fact makes the possibility of doubling and trebling production relatively easy. During the next 10 to 20 years production will have to be doubled or trebled if we are even to maintain our living standards of today. Therefore; owing to the small amount of flat land, this increase must of necessity fall heavily on our sloping lands. It behoves us then to have a sound knowledge of the principles of grassland production on sloping lands.

3. Are the principles of Grassland production for flat land sufficient on sloping country?

We have had a very comforting thought about this in the past to the effect that what works on the flat is of course all right for the hills.

If we had any small doubts due to the system not working out quite correctly, we have consoled ourselves with the thought that once we get the hills into grass everything will be all right anyway.

In this connection may I tell you of a well-known

agriculturist's experience with his child. The child came home with a problem with which he thought his father was most able to cope. In his social studies he was asked: "What would you do with a paddock recently sown down to grass, but which, during a heavy rain, was severely rilled?"

Dad's answer was brief, to the point, and authoritative: "Plough up and resow of course."

Teacher's ruling : "Wrong! The paddock should be contoured."

I agree.

It is still true that you cannot correct an error by repeating it. I wish to point out that what works on flat land in grass establishment is not necessarily correct on hill or sloping land.

In Canterbury, Marlborough, and Nelson I have observed that rilling of newly sown pastures or crops on sloping land is more the rule than the exception after heavy rains. Before this happens other less noticeable movements take place. I will touch on these later so brief mention only is made of them here.

- (a) Uneven distribution of moisture.
- (b) Sheet wash ; sealing of soil pores.
- (c) Removal of lime, manures, and seed.

4. These effects are caused by the major difference, the factor of slope and its attendant problem, run-off of moisture.

On the flat land there is no such problem, and I think this difference in environment must be followed by a difference in practice if we are to get the best out of the establishment and utilisation of hill pastures. To date this problem has been largely overlooked in grassland circles. In view of the present circumstances, the need for permanent higher production, and the consequent necessity for stability on both hill and flat lands, this run-off factor can no longer be ignored.

5. This run-off problem has major effects on unprotected grassland.

Already I have shown you some of the more obvious scars with which I have no doubt you are all familiar. I might point out here that the extent of this soil loss may have escaped many of us because of the habit of the farmer in speedily recultivating the

marked paddock. Also I mentioned minor, or at least not so obvious, effects that escape almost unnoticed.

There are:-

- (a) **Lack of moisture:-**Because moisture runs off rapidly, very soon the hills become dry and production suffers from lack of moisture. Grasses and clovers thin out and production drops. In North Canterbury estimates of bare ground in improved pastures sometimes exceeded 20 per cent. This was to be found mostly near the top third of the hill. I point out that there is no production from bare ground. This ground is then very liable to soil removal in rain, thus adding to the decline of the pasture. May I add a question or two here also?
- (b) **Removal of Lime and Manures :-**If rain is sufficiently heavy to remove soil from a paddock, what happens to our readily soluble lime, superphosphate and molybdenum ? How much hard cash do those waters flowing from your paddocks contain? We have consoled ourselves here with the thought that manures are locked in the soil. Yes, we may well be locked in a motor car, but if it runs over a cliff it does not help us any. It seems reasonable to think that your lime and superphosphate can well go down the drain if there is sufficient soil movement to muddy the creek. And, as you will agree, there very often is.
- (c) **Differential Moisture:-**Due to lack of control of moisture we find the hill to be dry and the base sodden. The paddock is "too wet to graze," despite the fact that only a very small proportion is really overloaded with water. If that small amount of sodden land could be relieved of its water and this spread over the reasonably dry remainder, there would be no need to exclude stock.
- (d) **Overall decrease of production:-**If the water factor is withheld in this way, it should follow that production will suffer due to this cause. Later I will show that in fact this is

correct as after the correction of this factor a 25 per cent. increase in production occurs.

Factors such as these, though not particularly noticeable, nevertheless have a big bearing on farming operations and some present practices markedly assist in increasing run-off to the detriment of all concerned.

6. Present practices which have a bad effect on soil and water conservation.

- (a) **Burning:** Soil conservation people seem to be very concerned about burning, but I can assure you they are not blind to the necessity of burning under some circumstances. In brief, where burning is used as a tool for the production of superior, permanent pasture they would agree, but disagree heartily with burning often and hard merely to get a green bite. In one, the practice is used positively, in the other negatively. The main reason that soil conservators are not happy about negative burning is that this increases run-off terrifically.

Infiltrometer Measurements : Effect of Burning.

		Infiltration Rate
Upper Wairau	Burnt forest	0.5in. per hour
Upper Wairau	Unburnt forest	7.0in. per hour

Run-off Plots (Wither Hills) : Effect of Burning.

	Years		Average Readings	Av. % Silt
				by Vol.
Danthonia: 1948-50	Burnt Plot	21	gals. . . .	4.8
	Unburnt	4	gals. , . .	1.5

From these separate types of measurement it can be seen that burning has a major effect. on hill slopes; on the water run-off, and on the soil it carries. Heavy rain on a burnt slope, therefore, means transport of plant nutrients and manures and consequently decreased vigour of the cover. Need I point out also that on the flat lands a decrease in production can come about after burning of the hills. If less than a third of a watershed is burnt, the flats have to cope with a 70 per cent. increase in creek and river flows. . Very often this means flooding on the flats and a double loss thus occurs. It is for this reason that competent conservation authorities like to see some control of burning, for we cannot afford to have continued extensive burning of our sloping lands.

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- (b) **Present Cultivation Practices:** Any cultivation practice which channels the water downhill is wrong. This is a strong statement, and I make it advisedly, for experience both here and overseas has shown this to be correct. It is a truth that numerous New Zealand farmers have yet to learn. Cultivation of this kind, that is up-and-down cultivation, (a) Increases run-off, which can lead to manure, lime, and soil loss. (b) Decreases moisture available to grass. (c) Lowers production by $\frac{1}{4}$. (d) Decreases availability of paddock to grazing.

These facts are borne out by the results of production trials at Adair, South Canterbury,.

Season	Production increase due to contouring % increase	
1952-53	24.9	The trials are a contrast between grass growth on a contoured as against a non-contoured area.
1953-54	28.4	

Infiltrometer trials (Adair farm) showing increase of run-off due to this type of cultivation.

	Infiltration Rate in. per hour
(a) Over-cropped area cultivated up and down	. 0.45
(b) Rotational cropping cultivated up and down	. 0.84
(c) Strip cropping (contour cultivated) (rotational crop)	. 1.0
(d) Graded banks (contour cultivated) (rotational cropping)	. 1.7

These results speak for themselves.

Overgrazing, whether by farm stock or pests, is probably more rife than is imagined, especially when dry conditions prevail. Its effect on grass is well known, but this also can be translated into moisture loss.

Infiltrometer Measurements :

	Overgrazed	Native	Spelled 8 weeks
	in. per hour		in. per hour
Wither hills	0.23	0.65
Moutere gravels	0.5	1.5

Here again we find that the very factor, dryness, which generally causes the action of overgrazing, is enhanced by its practice.

Type of Pasture: He who is happy to leave his hills in native pasture not only loses production; he also loses water and adds to the burdens below.

Infiltrometer measurements show :

	in. per hour
Wither Hills native unimproved (not contoured) pasture	0.5
Improved and contoured	1.79

All these practices are rife in New Zealand today and it takes very little imagination to appreciate the cumulative effect of such practices on our hill grasslands and on the production from our flats. When these practices combine to any major extent we can only expect bigger floods on the flats and a progressive depreciation on the hills.

7. But there are practices now tried and tested which can mitigate these effects and in the long run give higher production to the hills and security to the flats.

Among these are :-

- (a) Pest control, through which the problem of overgrazing is overcome.
- (b) Control of burning, through which riotous run-off is avoided and a further product, beef production, added to our sheep lands.
- (c) Promotion of contour cultivation and contour structures. By this means large soil, water, and fertility losses from sloping land are avoided and usable production is increased.
- (d) Construction of waterways (grassed) which lead excess water off paddocks to disposal areas.
- (e) Construction of stock ponds using excess moisture not required by pastures. Water is thus retarded and used.
- (d) Provision of better pastures for improved infiltration, less damaging run-off, and higher pasture production.
- (g) Discharge regulating dams for slow let-down of water after excess rains.

All these are measures which have been tried out with success in New Zealand. They are practical. coupled with existing good practices, they mean bet-

ter returns and a healthier, more productive farm. They also mean added protection to the community against the results of lack of soil and water conservation. Too often this has meant disastrous flooding.

In closing may I ask a question of farmers in the audience? Your products are composed mostly of water. Have you, on your farm, ever considered ways and means of utilising to the full all the water that is available, or do you merely try to get rid of it as quickly as possible ?

In other words do you practise soil and water conservation? I trust that I have shown that you should.