

REPORT

OF

Committee Appointed to Investigate

EROSION IN VICTORIA

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APPOINTED TO INVESTIGATE
EROSION IN VICTORIA

THE HONOURABLE THE MINISTER OF LANDS.

The Committee appointed to report on the question of soil erosion in Victoria, after careful consideration of information available regarding the experience of other countries and full investigation into the problem in this State, has now the honour to submit the conclusions formed as a result of its inquiries.

It must be recognised that erosion is a process of nature which has been taking effect through countless ages, probably ever since the creation of the world, but certainly long before the white race inhabited this continent. Fertile valleys as discovered by pioneer settlers were originally formed by natural forces - the soil being washed from the surrounding hills and deposited in the intervening ravines during the ages preceding civilisation. By this relentless process of levelling the surface of the earth, nature has been slowly but surely fulfilling the biblical prophesy that "every valley shall be exalted and every mountain and hill made low".

A clear distinction must, however, be made between erosion which occurs under natural conditions and that which results from human occupation. Though the same forces operate in both cases there is a vital difference in their rate of action and their economic results.

There is no doubt that, since the occupation of this country by human beings, and more particularly, since the advent of the white man, the erosive action of nature has been greatly accelerated. This was only to be expected when a new country was being rapidly developed, and its natural resources exploited in order to support the increasing population - without regard being paid to the menace of accelerated erosion which was not then appreciated. It is with this artificial increase in the rate of erosion and its economic consequences that the report deals.

Even a brief survey of the histories of other countries shows that soil erosion is not merely an academic problem, but an active economic danger. In years past huge tracts of land in various parts of the world, e.g. in China, which were once fertile areas supporting large populations, have by the loss of their soil, become non-productive wastes. In more recent years France, Italy and other European countries, have spent enormous sums in combating erosion. Russia has, for many years past, been engaged on an extensive programme of soil conservation. Serious erosion problems have also arisen in Kenya, Tanganyika, and other parts of Africa.

Probably the most widely known example, however, is that of the United States of America, where a recent survey showed that 70% of the country had suffered to a greater or less degree from one form or other of erosion. It is claimed that, of the total of 1,000,000,000 acres, areas totalling some 200,000,000 acres - more than three times the size of Victoria - have diminished over a much larger area. In that country the Federal Government has found it necessary to embark on a vigorous campaign for erosion control, involving vast expenditure. The lesson for us is obvious, as the greater part of the United States has been settled only 50 to 100 years longer than Australia, and although the conditions are not altogether the same, they are sufficiently similar to warn us that, unless we take care, our losses may before long be as serious, proportionately, as those of the United States are now.

In Australia, little attention has been given to erosion until recent years. The Western Australian and South Australian Governments found it necessary to pass legislation dealing with sand drift, but New South Wales has led the way as regards the general control of erosion. In that State, after inquiry by a Ministerial sub-committee, a Soil Erosion Committee consisting of officers from various Departments was formed and has carried out valuable investigation work in connexion with the problem throughout the State. The Department of Agriculture in New South Wales has done effective work in advising landholders in methods of erosion control, and the subject has also been taken up there recently by some of the banks and financial institutions.

In addition, the Department of Agriculture has undertaken experimental work at the mallee Research Station with a view to evolving practical methods for controlling sand drift.

There has not, however, been any concerted and systematic action towards the prevention and cure of erosion for the State as a whole, although the Australian Natives' Association and other bodies have been active in directing public attention to the need for such action.

From an economic point of view, the State is directly interested in protecting its utilities on which millions of public money have already been expended. Unless the rapid siltation of the national reservoirs is checked, it will only be a comparatively short period before new storages will be required at further great expense. In order to keep open water channels, roads, and railways, large sums are expended annually, and increased costs in this direction will be inevitable unless and drift and water erosion can be checked.

Indirectly the State revenue is being affected by the deterioration of privately owned land due to erosion and siltation on valuable flats, both of which materially reduce production and so depreciate the value of the affected land.

The Committee is convinced that the necessity for curtailing the ravages of erosion is of such paramount importance to the welfare of the State, both directly and indirectly, as to justify a policy of soil conservation being undertaken under Government direction.

TYPES OF EROSION

Broadly speaking, soil erosion, as it exists in Victoria, may be divided into three distinct types; viz:

1. Water erosion in three different forms -
 - (a) Sheet erosion;
 - (b) Gullying;
 - (c) Stream erosion
2. Land slides
3. Wind erosion

Foreshore erosion is not included in the foregoing list, being outside the scope of this Committee's inquiries in view of the fact that action towards its control has already been instituted.

Sheet erosion, which is the gradual washing away of surface soil, is the most insidious because it develop unobtrusively and is not generally recognized until the surface soil has disappeared and gullying has commended.

The remaining types are so obvious that they are recognizable at any time even by the uninitiated. Gullying, i.e. erosion which has caused gullies or small canyons to develop, and stream erosion are to be seen in almost every part of Victoria, whilst landslides are confined principally to the steeper parts of the State, particularly in South Gippsland. Wind erosion, except in minor instances, is a problem which affects only the Mallee districts. The Sand Drift Committee dealt exhaustively with this question in its report of 17th March, 1933, and we concur generally with the views expressed in that report. It is apparent, however, that further experimental work might be undertaken with advantage, together with a widespread educational campaign before legislative measures are introduced.

CAUSES OF EROSION

Whilst accelerated erosion throughout the State is undoubtedly due, in a great measure, to the removal of the soil's original vegetative cover, it is apparent that there are many contributing causes. Appended is a short summary of the main factors which, in our opinion, have contributed to a greater or less extent towards bringing about the present unsatisfactory position. These, however, are not necessarily to be taken as being set out in their order of importance.

- (1) Cleaning of natural cover from the slopes without providing for the growth of adequate pasture or other vegetative cover in lieu thereof. Many examples may be found throughout the State, particularly in North-East and Upper Goulburn districts, where sheet erosion is often evident. There, little attempt appears to have been made by landholders to develop pastures, not only as a substitute for the original vegetative cover, but to increase the carrying capacity of their land.
- (2) Overgrazing - After a long spell of dry weather, land which has been overstocked can offer no resistance to wind or to heavy rainstorms, as the soil is then devoid of all covering and is thus particularly susceptible to erosive action. Examples may be seen almost everywhere, particularly in districts of low or spasmodic rainfall.

In Victoria there is abundant evidence of damage due to soil erosion and to what may be termed its by-product - siltation - which, from an economic point of view, is often the greater evil. Whilst the position does not appear to be as yet quite so desperate as some published statements might lead us to believe, it is, nevertheless, a serious one requiring immediate attention. The losses caused by erosion in Victoria are, in the aggregate, already very costly, and there are ample indications that they are rapidly increasing. It is an undeniable fact that, once erosion begins, its action, like a high rate of compound interest, increases at an alarming rate. With erosion, as with disease, prevention and remedial work be undertaken at the earliest possible moment. The problem is one of great economic importance, as, besides the direct decrease in productivity due to the loss of soil, erosion of an area of land may adversely affect other properties, as well as roads, railways, and water supply provisions. These secondary effects are often more serious than the original soil loss, and would in themselves justify action being taken to combat erosion.

Whilst it is apparently beyond human powers to prevent soil erosion entirely, there is every reason to believe, in view of the results already obtained in other countries and even in this State, that preventive measures, intelligently applied can materially retard accelerated erosion and so safeguard the future productive capacity of the State. While some alteration is advisable in many of the methods of land utilisation now employed, this need not necessarily decrease production to any material extent, for generally speaking, methods which combat erosion and increase production. The question resolves itself into the correct type of utilisation of each area of land by methods suitable to its natural characteristics so that the greatest production may be obtained with the least damage and loss.

It would be a grave mistake to accept the experience of other nations are being altogether applicable to Victoria, as such things as climatic conditions, geological formations and the entirely different types of trees and other vegetation must be taken into consideration. While we can learn much from other countries of the general principles of erosion control, we must work out our own methods of practical application.

Contrary to popular belief, due to the constant reiteration of the theory that soil erosion is due solely to "denudation of timber", the Committee is unanimously of opinion that there is no single cause which can be held to be responsible for setting up of erosion in Victoria, neither is there one sovereign remedy which can be adopted as the solution of the problem.

In the final analysis the real cause of most erosion can be attributed to the mistreatment by man of the soil and other natural resources in his endeavour to collect from them the greatest return in the shortest time. To be fair to the landholder, however, the greater amount of damage is done unwittingly or, at least, because of his lack of knowledge of how to prevent or correct erosion.

Although it is not generally known, the problem has already been attached to some extent in Victoria, apart altogether from the valuable foreshore protection work not being carried out. Firstly, the State Rivers and Water Supply Commission, in conjunction with the Public Works Department, has subsidized, out of money provided by the Rivers and Streams Fund, erosion preventive work in many streams, and has supervised the carrying out of the work. The results obtained are most satisfactory, but as the income of the fund is only about £8,000 per annum, it will be readily understood that, so far, it has not been possible to undertake extensive works of this nature. The revenue of the Rivers and Streams Fund is derived from the rentals received by the Lands Department from the licensing of water frontages under the provision of the Local Government Act.

Secondly, a close co-operation between the State Rivers and Water Supply Commission and the Lands Department has resulted in certain areas in catchments being withheld from settlement altogether or, alternatively, being made available subject to special restrictive conditions drawn up by expert officers of the Commission and the Department in collaboration.

Thirdly, the Forests Commission has taken active steps to prevent bushfires, which are an important factor in setting up conditions favourable to erosion, and has carried out beneficial reforestation.

Fourthly, efforts have been made by some landholders in the State to control erosion on their properties and also by various municipal and other authorities to protect their works. Some of these attempts have been very successful, but in other cases the methods adopted have not been the most effective due to lack of knowledge of the subject.

- (3) Depredation by rabbits - In addition to setting up conditions similar to overgrazing by eating down the grass, shrubs, &c., rabbits cause an immense amount of damage by burrowing into the banks of streams and gullies, thus making them more readily susceptible to severe water erosion. Numerous examples of the latter may be seen in the North East and other parts of the State.
- (4) Surface mining - This has been responsible for much damage, particularly in gullies and along the banks of streams, where serious erosion and siltation have resulted from the opening up of the ground by fossickers and others. Many examples are to be seen in the central part of Victoria.
- (5) Bushfires - Extensive damage occurs as the result of bushfires, the causes of which, as set out in the annual report of the Forests Commission, are many and varied. Following a severe fire, heavy rain before new growth is established will set up serious erosion. A striking example of this may be seen in the Bunyip River catchment. Many outbreaks of fire are said to be due to deliberate burning in order to promote growth of grass. This practice often defeats its objective in that, eventually, either dense scrub will choke out the grass or the top soil will be washed away altogether.
- (6) Unwise methods of cultivation - Ploughing up and down the slopes, which is a common practice, is responsible for much damage. During heavy rain the furrows act as water channels and carry the topsoil away, greatly reducing the productive value of the cultivated slopes. Where the subsoil is friable, furrows are liable to develop into gullies, thus cutting paddocks into awkward shapes and ultimately covering the lower land with barren silt. Numerous instances of this be found in the State, e.g. Wychitella. In some districts, excessive farrowing increase the risk of wind erosion.
- (7) Clearing natural vegetation from the banks of streams - Especially when cultivation follows, this greatly facilitates the action of the stream in eating away its banks, and should not be encouraged. Examples of damage resulting from this practice may be found throughout the State. The upper Cann River is a notable instance.
- (8) Injudicious draining of natural swamps and cutting through bends in streams - Careful investigation by experts should be made into all such proposals as the accelerated velocity of the stream may cause serious erosion. Eaglehawk Creek, near Traralgon, and Sheep Pen Creek at Caniambo furnish striking examples of injudicious draining of swamp country.
- (9) Road and railway construction works - It is a common thing throughout the State to find serious erosion caused by the drainage methods adopted in the past in the construction of roads, and, to a lesser extent, railway embankments. A classic example of the former may be found on the Sunbury road, near Bulla, where the drainage from a small well-grassed depression was turned many years ago beneath the road through a culvert measuring 24 inches by 18 inches. Although the flow of water so concentrated was small it has now scoured a gully 1,000 feet in length, p to 55 feet in depth, and over 100 feet in width through the adjoining land, resulting in approximately 100,000 cubic yards of material being washed into the river nearby. Near the high railway embankment at Elphinstone, an immense gully has developed where erosion is being accelerated apparently by the drainage of water from the embankment. Table drains alongside road formations often scour badly even in flat country.

- (10) Breaks in the surface of a slope such as those caused by stock tracks, wheel tracks, drains and snigging of logs by timber getters. These have the effect of concentrating the flow of stormwater and thus often develop into gullies which cause serious damage.
- (11) Landslides other than those caused by earthquakes are usually brought about by a too rapid change in the relationship between rainfall, soil, slope and vegetation, which results in the cohesion of the soil being lowered beyond the point of stability. Notable instances of this were to be seen in the South Gippsland hills after heavy rains of November and December, 1934. Another cause is the pressure of water trapped in a porous stratum beneath a relatively impermeable soil. This is apparently what happened at Myer's Creek, near Healesville, in October 1937.

REMEDIAL AND CONTROL METHODS

Because of the small amount of attention hitherto given to erosion in Victoria, co-ordinated information is not available as to its location and extent.

It appears desirable that systematic records should be compiled as soon as possible. The information thus obtained would be valuable as a guide to the localities where there is a necessity for action and would also permit of an estimate being formed at regular intervals as to the amount of erosion then occurring throughout the State.

In dealing with remedial and control methods, it must be taken into consideration that liability to erosion depends on four main factors, viz.

- (1) The amount of the annual rainfall together with its distribution and intensity.
- (2) The steepness and length of the slope.
- (3) The physical and chemical properties of the soil.
- (4) The extent and nature of the vegetative cover.

It is, therefore, obvious that the steps taken for control will vary according to district, and often with each particular instance.

It is most important, therefore, that a commencement be made immediately with experimental and investigational work in relation to all forms of erosion in Victoria, in order that data may be systematically collected and recorded as to the best methods of treatment of the various kinds and degrees of the trouble. Such information would be valuable when advice is being tendered to inquiring landholders.

The problem of erosion control depends in a great measure on being able to determine where and how natural protection may be removed to facilitate land use without causing disastrous losses.

The following methods have been utilized with varying success in other parts of the world and in Victoria. They should not however, be taken to be a complete list as further investigation may produce other methods more suitable for this State.

Water Erosion

Sheet erosion is generally the forerunner of gullying, although either may take place independently of the other, both being due to excessive run-off.

Methods for the prevention or control of water erosion must be applied by such land management as will tend to restrict to a minimum the amount and the speed of run-off water.

Where erosion is likely to occur, retention, where possible, of natural vegetative cover should be a primary aim. Generally speaking the denser the cover the less the likelihood of damage forest, scrub, or pasture, as found in nature are all useful agencies as cover and their removal should never be undertaken, particularly on hilly land without due provision being made to accommodate accelerated run-off.

The overgrazing of pasture paddocks should be carefully avoided otherwise the thin sward resulting would have little effect in controlling run-off or in checking erosion.

The following measures may be used to combat various forms of water erosion:

1. Growing Dense Vegetative Cover, such as Shrubs or Timber with Undergrowth.

A very large quantity of the rainfall is, under such conditions required for growth and transpiration of the plants and, in addition, a forest floor or mat is developed which acts as a mulch on the ground surface, into which the moisture is readily absorbed and run-off is greatly retarded. Timbered country does not have this effect unless a suitable forest floor is present.

2. The Establishment of a Thick Pasture Sward.

A heavy sole of grass, in addition to requiring a large quantity of water for its maintenance is very effective in checking the speed of water flow and in preventing erosion.

From a soil fertility standpoint, mixtures of grasses and clovers are preferable to straight stands of single species. Clovers contribute largely to the vigorous growth of grasses present, the whole mixture becoming woven together in a thick mat greatly retarding water run-off, and resulting in a strong soil-binding root growth. Good results are generally obtained at a comparatively low cost by introducing subterranean clover among native grass, and top dressing with superphosphate. Grasses, such as paspalum, couch, or Kikuyu are useful when soil conditions require a good binding species.

Apart from its use in the prevention of sheet erosion, pasture may be effectively used to prevent gullying in shallow drains constructed for the disposal of run-off water. It is often possible to correct slight gullying by ploughing-in the gully and sowing pasture on the broader depression or drain so formed. Such a drain, when well grassed, should carry a large volume of water down comparatively steep slopes without scouring.

3. Rotational Cropping.

In the past little attention, if any, has been given in Victoria to rotation of crops from the point of view of soil erosion control. Different crops affect the soil both physically and chemically in different ways, and the adoption of longer rotations, including more pasture periods, appears to be desirable. The inclusion in the rotation of crops requiring inter-row cultivation increases the risk of erosion, whilst the growing of dense pastures and crops, such as lucerne, assists in the building up of soil fertility as well as in the prevention of erosion.

4. Contour Cultivation.

The use to which land is put must be governed to a large extent by its slope and soil texture. It is essential that the utmost care and foresight be used in breaking in land for cropping. In the first place cultivation should be restricted, as far as possible, to land where the slope is small and soil conditions are not such as favour erosion. In principle, cultivation should be confined to level country, rising ground should be placed under pasture, and very steep hills reserved for shrub and forest cover - the denser the better.

In practice, however, it is often necessary to cultivate slopes and where this is done, all ploughing, working of soil, and cropping should be carried on across, and not down the slope, every furrow thereby acting as a check to run-off water. The position in such cases is still further improved by the use of contour banks, which are easily made, and should be so constructed as to limit the slope down which the water moves to a safe minimum. Contour banks reduce the speed of run-off and allow more water to soak into the soil, thereby not only providing more moisture for the crop, but also reducing the quantity of surplus water to be disposed of. Surplus water will be directed by the contour banks into shallow drains which should be maintained in a well-grassed condition.

5. Strip Cropping.

On small mixed farms it would be of advantage when cropping on hilly ground, if different types of crops were alternated in strips across the slopes. The value of this form of cropping has been recently tested in parts of America, where further experimental work is still proceeding. It is considered that the general adoption of strip cropping would not be practicable in Victoria in view of the fact that crop-farming is almost invariably associated with the raising of stock and the cost of the temporary fencing required to protect the growing crops would be prohibitive.

6. Check Dams.

When bad gullying has occurred it is usually impossible to restore the surface again therefore efforts should be directed towards preventing further damage. This can be done by plugging the head of the gully and by building check dams of which there are numerous types; these should be placed across the gully at intervals along its course, the idea being to minimize the cutting power of the water by reducing its speed and also to encourage siltation. Most types of structures are simple in design, and can be put in by the landholder himself at a comparatively low cost. The observations of the Committee, however, have shown the necessity of proper advice being obtained by the landholder before he attempts work of this nature.

In view of the permanency of the damage done when gullies become established, the greatest care should be taken to deal immediately with each small scour as it appears. In early stages soil-binding grasses, such as Kikuyu, couch, paspalum, &c., can be used with success. Shrubs and willow trees may also be used to advantage for larger gullies.

7. Methods of Preventing Stream Erosion.

It is important that a strong cover of vegetation should be maintained along all streams liable to erosion, and that the banks should be broken as little as possible. Where banks are eroding they can be effectively protected by restoring a lining of vegetation, but as these banks are usually steep or even vertical, it is necessary to slope them before vegetation can be planted. If floods are frequent, however, the soil may be washed away before the vegetation has a chance to establish itself, more especially as the swiftest current usually hugs the eroding bank. In this case, means of protection must be installed so as to give the vegetation time to grow and bind the bank. This may be done with sheet-piling or cribwork along the foot of the bank; but if there is sufficient width in the river bed to provide ample waterway for floods, a cheaper method is the use of groynes, or short piers built out from the bank into the stream at intervals. These, if suitably placed, not only keep the eroding current away from the bank, but have the effect of gradually building up the area between the groynes with silt, in which trees or shrubs with strong root systems can be planted, to bind the soil and assist in further reclaiming the land. In this way, the area which has been eroded will be slowly built up and made useful again.

As excessive siltation of river beds will divert the flow of streams in flood time, thus causing erosion of the banks and possibly a total breakaway into a new course, it is important that all causes which tend to increase the amount of silt deposit in the beds of streams should be eliminated as far as possible.

As a rule, a stream will naturally lengthen its course by winding about until it has developed a grade suitable to the slope and characteristics of the country through which it flows. Any considerable shortening of its length by the cutting of bends will tend to upset this natural balance, and, in the more active streams, will probably set up erosion.

Generally speaking, the condition of rivers in Victoria has been deteriorating steadily since settlement. Good work has been done from time to time on some streams, e.g., the Ovens, but sufficient provision has never been made for systematic river improvement and maintenance. Rivers, like roads, need regular maintenance if they are to be kept in good order. In England, Catchment Boards have been created with power to levy charges on all properties within their respective catchments for the purpose of carrying out works of improvement and maintenance of rivers, and to supervise generally all drainage works in their prescribed areas. It is desirable that serious consideration be given to the introduction of a similar system for Victoria in view of the number of applications for river improvement works which have already been made by landholders in this State. As the first step in this direction, immediate provision should be made for the formation of River Improvement Trusts to carry out necessary works for the maintenance and general improvement of streams, including the prevention of erosion and the reclamation of eroded land. Protection guards of this nature have been operating successfully on an extensive scale in New Zealand for some years.

Land Slides

Generally speaking, the most economical method of dealing with slopes liable to slip is the use of contour drainage above the area likely to be affected, or alternatively, by reforestation.

Wind Erosion

As previously indicated, wind erosion occurs to a serious extent only in the Mallee areas, and the following remedial measures refer particularly to those localities:

1. The Use of Vegetative Cover.

On tops of sand hills and in other places particularly liable to blow, it is essential to retain the existing vegetation. Where the natural covering has already been removed, attempts should be made to induce the growth of a substituted cover of a permanent nature.

2. Reduction of Area under Bare Fallow.

It is obvious that a great deal of the drift trouble in the Mallee is caused by the utilization of bare fallow, consequently every effort should be made to evolve a system of farming, the general adoption of which would reduce the area under bare fallow to a minimum.

3. Evolution of Suitable Pasture Plants, Permitting the Institution of a Longer Crop Rotation.

It is probable that the type of farming best suited to the Mallee generally is a combination of wheat and sheep.

In the past common rotations have been fallow-wheat-oats, or fallow-wheat-oats (for hay or grain) oats (for grazing), but recent work with certain pasture species at the Mallee Research Station suggests the possibility of success in the development of a Mallee pasture of grass and clover which should form a valuable member of a standard rotation, say, fallow-wheat-oats for two successive rotations, followed by six years of pasture (thus-fallow-wheat-oats fallow-wheat-oats pasture-pasture-pasture pasture-pasture-pasture). Such a rotation would be a big factor, not only in preventing drift, but also in building up soil fertility.

4. Partial Substitution of Bare Fallow by a Crop Cover.

Although actual yields are greatest after bare fallow, it now appears that best results from a general standpoint may be obtained by the growing of a cover crop of oats on the fallow in the winter, and grazing it until about October, after which the paddock, with the stubble and root still in the ground, is left over the summer until cultivated shortly before sowing time.

The Committee considers, therefore, that the next step would be a campaign of education to bring home to landholders generally that soil erosion is a menace; that it is largely preventable; that measures for erosion prevention and control will not only preserve production, but also increase it; and that, while the State is prepared to advise on general lines, the final solution of the problem lies in their own hands. At the end of say five years, the position might be reviewed. It may be found then that there are some landholders who are too conservative or too indifferent to take any measures to stop erosion on their properties, in which case legislation would then be necessary to compel them to check it, not so much in their own interests as in the interests of others.

It is believed, however, that once the landholders of Victoria generally realise that soil erosion is a menace to their future prosperity as well as that of the State, the great majority of them are sufficiently clear-sighted to voluntarily adopt measures to combat it.

Much advantage should accrue by furnishing landholders with all available knowledge on the subject and encouraging them, by means of practical demonstrations on affected areas, to take the necessary steps towards the prevention of erosion on their properties.

The Committee considers that this work would be greatly facilitated by the creation of local "erosion control committees" among the landholders of any particular district. Not only would this save time and money by enabling any officer demonstrating control methods to deal with groups of land holders instead of with individuals, but the local committee could also do valuable work in collecting information as to conditions of the district and of undertaking experiments and investigations.

The experience of New South Wales is of interest. Consequent on the investigational and educational work undertaken in the last few years by the Soil Erosion Committee and the Department of Agriculture in that State, the interest of land holders was awakened and as a result of requests made by farmers' and graziers' associations legislation for the creation of a special Soil Conservation Service has been brought forward. It is reasonable to assume that an educational campaign would develop an equal interest among the landholders of Victoria and result in a demand for similar action in this State.

While the Committee is of opinion that the creation of a Soil Conservation Service on the lines of that in New South Wales is not essential in Victoria at the present juncture, it considers that popular demand will eventually make it so. The recommendations which follow have, therefore, been framed with this in mind.

RECOMMENDATIONS

It is recommended :

- (1) That, in order to safeguard national storages and catchment areas throughout the State, a Soil Conservation Committee 'be constituted to consist of one technical officer from each of the following Departments :

Department of Lands and Survey,
State Rivers and Water Supply Commission
Forests Commission,
Department of Mines,
Department of Agriculture.

The main functions of this Committee would be to

- (a) consider and, if deemed satisfactory, to approve of any utilization or undertaking proposed in respect of State-owned land within catchment areas as defined by the State Rivers and Water Supply Commission ;
and
 - (b) decide on what measures are necessary for the prevention and control of erosion on State-owned lands.
- (2) That, in order to meet immediate requirements an Executive Staff be provided consisting of an engineer of the State Rivers and Water Supply Commission, and two officers, one from the Department of Agriculture and the other from the Forests, Commission, who would, acting in conjunction -
 - (a) institute measures of an educational nature, particularly in districts where the menace of erosion is greatest, and encourage the formation of local erosion control committees ;

- (b) arrange for supplying appropriate advice to land holders through local committees ;

5. Deeper Ploughing and Improved Cultivation Methods.

It is probable that a close study of cultivation methods in the Mallee would show that a decrease of drift could be brought about by certain specific methods of ploughing and cultivation.

For example, the little study in this direction that has, so far, been possible indicates that deep ploughing may be of advantage, and that some prevention of drift trouble is effected by the maintenance of a rough surface, also by cultivating the land, so far as possible, to maintain ridges at right angles to the prevailing winds.

CONTROL ORGANIZATION

In the opinion of the Committee it would be advisable when considering ways and means for countering erosion in Victoria to view the question from two aspects, firstly as regards land which is State owned, and secondly in relation to alienated lands.

State-owned Lands

In the case of land not alienated from the Crown, irrespective of whatever State authority is in control, it is essential to ensure

- (a.) That utilization of each area is appropriate to its particular land characteristics and climatic conditions having regard to the interests of the State as a whole.
- (b) That suitable precautions are taken for the prevention and control of soil erosion where it has already appeared.

Whilst regard has already been paid in a general way to the first question by some State authorities, it would be advantageous to have some means by which the objectives of all the Departments may be readily ascertained and co-ordinated. It is considered that this purpose would best be served by the appointment of a committee on which each Department carrying out extensive operations on Crown lands would be represented by a senior technical officer who has had practical field experience and whose ordinary duties involve personal familiarity with conditions in different parts of the State. The duties of this committee would be to consider and advise from the erosion aspect on all proposals for the utilization of Crown lands or any undertaking therein; also to investigate erosion problems on State-owned lands and make recommendations as to remedial or preventive measures.

Alienated Lands

Soil erosion on Crown lands is, however, only a portion of the problem. Erosion on privately-owned land is a more serious threat to the prosperity of the State, and must also be combated. The difficulty here is that the State has at present very little control over the manner in which alienated land may be used, however much damage the State may suffer directly or indirectly. Therefore the active co-operation of the landholder must be obtained either voluntarily or by compulsion before any movement for the control and prevention of erosion on private land can be successful. It is incumbent on the State to initiate action to bring about the desired co-operation.

As previously mentioned, action to check erosion has been taken by a small percentage of landholders and requests for advice are being received from others throughout the State. Conversation with many more indicates that they have begun to realize the damage being done by erosion, but do not understand how it can be prevented. It would be of advantage to the State and to the individual, therefore, if as a first step some means were provided by which all these land holders could be furnished with information and advice on erosion control.

This, however, would not be sufficient. It is apparent that, generally speaking, the man on the land does not fully appreciate the loss he is liable to incur from the effects of erosion and, consequently, he may not be inclined to seek advice or to go to any trouble and expense in the matter. It might be urged that legislation should be passed in the public interest, compelling all landholders to adopt stated erosion control measures, either by refraining from practices likely to cause erosion or by undertaking works to check it. The Committee, however, does not consider such action desirable at present.

In the first place, unless the need and purpose of such legislation were clearly understood by landholders, most of them would inevitably resent it; and legislation which is apposed by a majority is very difficult to enforce with success. Secondly, while the general principles underlying erosion and its cure are fairly clear, details as to the effects of local conditions have not received sufficient study, so that any such legislation would probably need to be considerably amended as further experience was gained.

- (c) arrange for preparation of articles and pamphlets dealing with erosion control for distribution ;
 - (d) systematically record and file all information as it becomes available in respect to erosion in Victoria;
 - (e) make recommendations as to experiments in erosion control and to assist in conducting them
 - (f) supervise the carrying out of any control measures recommended by the Soil Conservation Committee.
- (3) That the limited work of an experimental and observational nature regarding sand drift in the Mallee at present being carried out by the Department of Agriculture be extended, and that to permit this being done, provision be made for the appointment of an additional officer to be stationed at the Mallee Research Station.
- (4) That, in view of the fact that funds for the remedial work being done on stream erosion are insufficient, the Rivers and Streams Fund be subsidized by a vote of say, £10,000 a year for the next five years.
- (5) That legislative authority be sought to permit of the formation of River Improvement Trusts for the improvement and maintenance of rivers in any particular district. The activities of these Trusts should not be restricted by shire boundaries as is the case under existing legislation in respect of Drainage Areas. The legislation might be framed with a view to the desirability of the ultimate adoption of a system of Catchment Boards similar to that obtaining in England where revenue for works is obtained by differential rating over the whole of the catchment area.

In the appendix to this Report will be found a number of illustrations of typical examples of erosion seen by the Committee during the course of its investigations.

In addition to the matter contained in the Report, which of necessity is in the nature of a summary, a considerable amount of supplementary detail has been recorded by the Committee, which would be of value to any officers appointed to deal with erosion questions and would be suitable for publication in pamphlet form for general distribution.

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