Patel Memorial Lectures 1980

A POLICY FOR LAND AND WATER

B. B. VOHRA

PUBLICATIONS DIVISION

A POLICY FOR LAND AND WATER

(Two Lectures Broadcast From All India Radio Under The Title "A Charter For The Land")

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PUBLICATIONS DIVISION
MINISTRY OF INFORMATION AND BROADCASTING
GOVERNMENT OF INDIA

December 1981 (Agrahayana 1903)

Price : Rs. 3·50

PUBLISHED BY THE DIRECTOR PUBLICATIONS DIVISION
MINISTRY OF INFORMATION AND BROADCASTING
GOVERNMENT OF INDIA PATIALA HOUSE
NEW DELHI—110001

Sales Emporia ● Publications Division

Super Bazar, Connaught Circus, New Delhi—110001
Commerce House, Currimbhoy Road, Ballard Pier, Bombay—400038
8 Esplanade East, Calcutta—700069
LLA Auditorium 736 Anna Salai, Madras—600006
Bihar State Co-op. Bank Building, Ashoka Rajpath, Patna—800004
Press Road, Trivandrum—695001
10-B, Station Road, Lucknow—226001

Printed by Link Printers, 824 P. L. Sharma Road, Meerut.

Introduction

In 1955, All India Radio introduced a programme of lectures in memory of Sardar Vallabhbhai Patel. Apart from the great role he played in India's freedom movement, Sardar Patel was free India's first Minister of Information and Broadcasting. An annual feature, the Patel Memorial Lectures are designed to contribute to the existing knowledge on a given subject, and to promote awareness of contemporary problems. They have now become almost a national institution and are looked upon as among the highly valued intellectual contributions to Indian life and thought.

Each year, an eminent person, who has specialised in a particular branch of knowledge is invited to present through All India Radio the results of his/her study and experience for the larger benefit of the public.

The two lectures in the present series on the theme "A Policy for Land and Water" were delivered by Shri Bal Bir Vohra, Secretary, (Department of Petroleum) Ministry of Petroleum, Chemicals and Fertilisers. Born at Lyalpur in 1923, Shri Vohra had a brilliant educational career. He joined the Indian Administrative Service in 1948 and was awarded a U. N. Fellowship in Economic Development in 1954. Shri Vohra has written a number of seminal papers on various aspects of the environment and land and water management, which have contributed significantly to thinking on this subject. He has also served as a U. N. Consultant for land and water management. Shri Vohra has since been appointed Chairman of the National Committee on Environmental Planning.

The two lectures focus attention on the need to pay greater attention to the management of the country's vast land resources, which are today not only being underutilised but grossly misused and wasted.

Part I

A Policy for Land & Water

The relevance of good land management to a country like ours hardly need any explanation. We have a large population which is not only growing at an appreciable rate but is also among the poorest in the world. Nearly half of our people still live below the line of poverty. Our economy is also overwhelmingly agricultural in character. Our only hope of achieving a decent standard of living for our people lies in making the best possible use of our land resources, which in the ultimate analysis, are responsible for sustaining all forms of agricultural, animal and forestry production.

There can be little doubt that our record in this field has been far from satisfactory. This is apparent not only from the destitution from which our people suffer, but also from the visual evidence of the neglect of these resources, which is available wherever one might go in this vast country of ours. Denuded hillsides, ravines, waterlogged and saline lands, drought stricken villages, silted tanks and drying wells

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Sardar Patel Memorial Lectures, 1980 by Shri B.B. VOHRA, Secretary to the Government of India, Department of Petroleum on December 22 and 23, 1980.

Note : These lectures were entitled "A Charter for the Land" at the time of the broadcast.

are to be encountered almost everywhere. Floods ravage areas year after year, even as the Rajasthan desert maintains its leeward creep. The expansion of towns and cities continues to take a heavy toll of good agricultural lands. In certain coastal areas, particularly Kerala, erosion by the sea is a major problem. In the North-Eastern parts of the country, shifting cultivation continues to strip once heavily forested slopes of all vegetation.

There is, however, little awareness of the seriousness of the situation which faces us. A surprisingly large number of our planners, politicians, policy makers and economists still believe that there is nothing seriously wrong with the manner in which we have managed our land resources all these years. It is this complacency, born out of a genuine unfamiliarity with the subject or what my friend Dr. Sudhir Sen calls "resource illiteracy", which is responsible for the fact that even 33 years after Independence we are still without a proper policy for the management of these resources, let alone the institutions required to implement it. It would be unbelievable, were it not true, that there is as of today no agency or organisation at the Centre, which is specifically charged with the care and oversight of these resources. In these circumstances, it is not surprising that there is also no proper system for reporting the damage suffered by these resources or the extent to which they are being misused or underutilised. Consequently, the awesome price which the nation is paying for the neglect of these resources is also never computed. If this vicious circle of ignorance, complacency and neglect is to be broken, it is necessary that the exact nature and scope of the problems with which we are faced in this field should be properly assessed and understood. Only then will it be possible to have any meaningful discussion with regard to the manner in which the present state of affairs can be improved.

Let us, however, first take a broad look at the way in which our land resources are being utilized. The total area of the country for which land use statistics are available is 305 million hectares. Of this, 18 million hectares are under urban and other non-agricultural uses and 21 are classified as barren and unculturable, perhaps for certain instrinsic reasons such as these areas being perpetually snow bound or rocky in nature. We are, therefore, concerned only with the remaining 266 million hectares from the point of view of management. Of these, 17 million hectares are classified as culturable wastes and as many as 23 as fallows. This makes a total of 40 million hectares, which though capable of production by definition are today lying unproductive, apparently because of the degradation they have suffered.

Of the remaining areas of 226 million hectares 83 million hectares are classified as forests and permanent pastures and 143 million hectares as agricultural lands. However, it is a well known fact that only about 35 million hectares out of the 83 million hectares described as forests and permanent pastures are actually under good tree or grass cover and that the remaining 48 are more or less completely devoid of vegetation. If these 48 million hectares are added to the 40 which have gone out of production for one reason or the other, we arrive at a total of 88 million hectares which are more or less completely unproductive. This represents a percentage of 33 over our relevant total area of 266 million hectares. However, if we exclude the 143 million hectares of agricultural lands from consideration, this area of 88 million hectares represents as much as 72% of the remaining area of 123 million hectares of non-agricultural lands. In other words, fully one third of our total relevant land area and nearly three quarters of our total non-agricultural area is today lying practically useless.

These figures show how very sick our non-agricultural

lands are. However, our agricultural lands are also not in a completely healthy state. According to information released by the Ministry of Agriculture recently, as many as 175 million hectares equivalent to 66% of our total relevant area of 266 million hectares are affected by degradation caused mainly by serious soil erosion and water logging and salinity which, incidentally, are the only two major ills that the land suffers from. Since the 88 million hectares of non agricultural lands which are more or less completely unproductive must necessarily be part of these 175 million hectares, it follows that the remaining 87 million hectares of sick lands are under agriculture. This represents a percentage of 61 over the 143 million hectares which are classified as agricultural lands. In other words, over three fifths of even our agricultural lands are degraded to a greater or lesser degree.

The actual situation is, however, even more alarming than what the above statistics reveal, because they do not take account of two additional factors. The first of these concerns the vast areas which are revaged by floods. According to the National Commission on Floods, the area affected by annual floods stands today at around 40 million hectares as against 25 million hectares about 30 years ago. The second factor concerns the growing menace of water logging and salinity in newly irrigated canal command areas. No precise estimates of such threatened areas are available, but considering our own experience in this regard as well as the experience of other countries with extensive canal irrigated areas, it would not be unreasonable to assume that at least 10 million hectares out of our total irrigated area of around 40 million hectares are threatened by water logging and salinity and are in urgent need of attention if they are not to go out of production in the near future. Even allowing for a great deal of over-lap between these 50 million hectares and the 175 million hectares already listed as degraded, the total area

which needs to be attended to cannot be less than 200 million hectares out of a total relevant area of 266 million hectares. This represents a percentage of 75.

I am conscious of the fact that although the figures I have quoted are all from official source, they may not be quite accurate, for the simple reason that nobody seems to have ever asked for accurate reporting in this field, so great is our indifference to such matters. However, even allowing for any possible inaccuracies and overlaps, the fact remains that these figures present a truly frightening picture—a picture which should give pause to even the most optimistic among us and silence for ever the professional peddlars of self-induced euphoria who predict a great future for India as an agricultural power and exporter of foodgrains. To repeat, around three quarters of our total relevant area is in need of urgent attention and a third is so sick that it is almost completely unproductive. Category-wise, at least 61% of our agricultural lands and at least 72% of our non-agricultural lands are degraded to a greater or lesser degree. No wonder we are so desperately short of food, fruits, fibres, fuel-wood, timber, animal products and indeed everything that the land produces. No wonder we can barely manage to produce 130 million tonnes of foodgrains from 143 million hectares of agricultural lands while China produces significantly more than 300 million tonnes from a mere 112 million hectares. No wonder destitution and unemployment stalk this unhappy country. It is high time we realised the state we are in, for what we are witnessing is the unchecked erosion—literal as well as figurative—of our resource base even as the demands on it from a steadily increasing population and steadily increasing expectations of a better life are rising rapidly. Our situation can indeed be compared to that of a leaking boat into which more and more people keep climbing even as, unknown to its occupants, the hole in its bottom goes on increasing in size.

That this picture is not over-drawn, will be clear when we consider, in some detail, the exact nature of the problems of land degradation which face us, and the formidable nature of difficulties which we will encounter in trying to tackle them. As mentioned earlier, the two major threats to our land resources are water logging and soil erosion. Each of these merits a discussion in depth before we consider some of the lesser problems of land management.

In soils which are not naturally well drained, the presence of excessive surface water results in a rise in the level of sub-soil water, till it reaches the root zone of crops. As a result, the fertile top soil—which needs adequate aeration for its health—begins to lose its productivity and ultimately becomes totally barren. This process is assisted by the harmful salts which move upwards in the soil along with the water. According to the latest available information the areas which have already gone out of production on account of water-logging and salinity total 13 million hectares. Of these, perhaps half are situated in estuarine and coastal areas and have not been productive in recent times. However, at least 6 million hectares comprise lands which were productive till the other day, so to say, and have been lost to water logging and salinity on account of man-made situations. The first and lesser of these situations arises from the impediments which have been created in the way of natural drainage by engineering works such as flood control embankments and road, rail and canal embankments. If, as is often the case, such embankments do not contain adequate cross-drainage works, water gets held up against them and causes damage to the areas submerged. The answer to such situations though expensive, is fairly easy—it lies in the construction of adequate cross-drainage works wherever these are required.

It is the second kind of situation, peculiar to canal irrigated areas, which is much more alarming. Lands in canal

areas are often flat and poorly drained and the application of irrigation water to them results in water-logging and salinity over a period of time. This process is hastened by two other circumstances. Firstly, the application of canal water to crops is often in excess of their needs, thanks to the absence of field channels and installations necessary to regulate the flow of water to individual fields. Secondly, wherever canals and distributories are not lined, as is often the case, they contribute heavily to water-logging through seepage.

Water-logging and salinity in canal irrigated areas is a global phenomenon and has reached such serious proportions that according to a recent study commissioned by UNDP and UNEP, as much irrigated land is going out of production in the world every year on this account as is being brought under new irrigation. It is also known that about half the world's irrigated land has already been damaged to some degree by water-logging and salinity and that much of the additional land expected to be irrigated in the future is highly vulnerable to similar damage. In Pakistan, out of a total of 15 million hectares of irrigated lands as much as 11 million hectares are already suffering from water-logging and salinity. Egypt, Syria and Iraq also have similar stories to tell. In our own country, we have not only lost at least 6 million hectares to production already but large additional areas are being affected by rising water tables and salinity year after year even in the commands of comparatively new projects.

The answer to the problem of water-logging in canal irrigated areas is not at all easy. It lies in the lining of canals and distributories, the construction of field channels so that just as much water may be applied to the soil as is really necessary and finally the provision of adequate surface and sub-surface drainage. The lining of canals and distributories is called for not only to save valuable lands from water-logging but also to save water losses which often amount to as

much as 40% of the water released from the reservoir. Field channels and drains must be designed and built not on the basis of individual holdings but of natural drainage units, namely the commands of irrigation outlets which are sometimes as big as 200 hectares. Water from the primary drains in each of such units must empty into intermediate drains which in turn must be connected to major drains with a natural outfall into a river. Such works call for not only a very great deal of detailed planning and careful execution but also for huge financial outlays. Experience shows that in most cases the levelling and reshaping of command areas is also necessary before scientific water distribution and drainage systems can be built. However, such works are in turn often possible only if the consolidation of holdings and redrawing of field boundaries are also carried out simultaneously. As can be imagined, such arrangements are extremely difficult, time-consuming and costly to make. This is why anti-water-logging operations make such little progress and why the blessings of canal irrigation are turning into a curse over large areas.

The reclamation of water-logged and saline lands which have already gone out of production is naturally even more difficult than the prevention of water-logging. Not only must drainage be provided to these lands but arrangements must also be made to leach saline soils and to carry out soil amendments and introduce suitable cultural practices. Here as in most other situations, prevention is definitely better than cure.

Even if we give a low priority to the reclamation of water-logged and saline lands which have already gone out of production, we must save the 10 million odd hectares of newly irrigated lands from going out of production. Such a programme will naturally require a huge outlay-perhaps not less than Rs. 10,000 per hectare on an average or Rs. 10,000

crores for the area we have in mind. It will also require technical and administrative inputs of a colossal nature. However, we have no option but to mount such an effort and ensure that it is carried out successfully if we are to save some of our best lands from the most serious damage.

It is necessary to mention in this connection that we must count ourselves lucky that individual farmers whose lands have been ruined by water-logging have not yet started clamouring for adequate compensation. The time, however, does not seem to be far off when greater consciousness on the part of farmers of their rights —and we have some evidence of this already—will result in a demand for damages. One shudders to think of the political and financial implications of such a demand.

Let us now turn to the other major threat to the land—the erosion of the fertile top soil. Erosion can be caused either by water or wind action and is almost invariably the direct result of the over-exploitation of non-agricultural lands by way of excessive felling and grazing. The fact that such lands are nobody's private property but belong either to the State or local communities constitutes one of the major reasons for their misuse. Once the natural original cover of trees and grasses on such lands is destroyed, the soil becomes vulnerable to the erosive action of water, particularly on hillsides and under conditions of heavy rainfall. If the denuded lands are flat and arid, they become vulnerable to the erosive action of strong winds. Once erosion sets in, the land is caught in a vicious circle because the loss of its top soil renders it increasingly less capable of sustaining vegetation just when it needs it most to save it from further damage. It is estimated that the area affected by serious erosion by wind is around 50 million hectares while the area affected by serious erosion by water is around 100 million hectares.

The control of wind erosion lies primarily in the restoration of vegetal cover to denuded lands by curbing indiscriminate grazing by nomadic herds and the creation of wind breaks and shelter belts which reduce the velocity of strong winds and thereby their erosive and desiccating effects. Experiments in Rajasthan have shown that excellent pastures can be developed by merely closing areas to grazing, and that once such pastures have been established, they can under conditions of controlled and rotational grazing, support four times the number of animals as are being carried by the same land today. The planting of wind breaks and shelter belts not only helps to develop such pastures but also to provide timber and fuel in areas which are practically treeless and where even the roots of shrubs and trees are today being dug up for fuel. These are also the methods by which shifting sand-dunes can be stabilised and prevented from smothering vegetation, blocking up roads and railroads and choking irrigation channels in their vicinity.

The reclamation of the desert through such means would make it ideally suitable for vastly expanded programmes of scientific animal husbandry and dairying and make the marginal agriculture that is being practiced in such areas today much less attractive. This would be a most welcome development indeed, because cultivation in areas subject to erosion involves the periodic disturbance of the top soil and thus renders it increasingly susceptible to further damage. A deliberate policy of diverting land from agriculture to animal husbandry, therefore, needs to be followed in desert areas in the interest of the soil as well as of the people.

The control of wind erosion also carries with it the hope of ending the aridity of the desert and of finding a permanent solution to its problems. Studies indicate that one of the possible reasons why moisture-laden clouds pass over western Rajasthan without precipitating their burden on it is the fine

dust suspended in the air over the desert. This dust is, of course, the direct result of wind erosion.

Let us now turn to the erosion of the top soil by water, which undoubtedly constitutes the most serious threat to our land resources. This is so because apart from reducing the fertility of the 100 odd million hectares of land directly affected by it, it has a number of extremely deleterious side-effects. Thus, it leads to the siltation of reservoirs and tanks, the choking of estuaries and harbours, the occurrence of floods and finally to the loss to the sea of a great deal of priceless sweet water. Each of these matters deserves to be considered in some detail.

The genesis of water erosion, as of wind erosion lies in the ever increasing pressure of human and animal populations on so-called forest and pasture lands in their search for fuel and fodder. The diversion of forest lands to agriculture is particularly unfortunate because it involves clear felling and in situations where slopes are steep and the land is brought under the plough without being first properly terraced and bunded, there is great loss of top soil. In tribal areas, growing population pressures result in an increasing shortening of the cycle of shifting cultivation and the laying bare of vulnerable hillsides to the erosive action of rain. The cutting of hillsides for building mountain roads also contributes to erosion and land slides. The over-exploitation of forests by commercial interests is yet another contributory factor. Unscrupulous forest contractors often cut down more trees than they are entitled to. The opening up of hitherto inaccessible forest areas by new all-weather roads and the easy availability of heavy duty trucks in recent years have hastened this process greatly.

It is a sad but undeniable fact that our forest departments have by and large failed to protect our 70 odd million

hectares of so-called forest lands against encroachments, unauthorised fellings, and denudation. This is partly due to the fact that they do not possess adequate legal powers over areas other than reserved forests, which constitute only about half the total forest area. In the remaining half, described as protected and unclassed forests, Forest Departments have very little say indeed. As far as pasture lands—which constitute around 12 million hectares are concerned, these usually vest in village communities and have suffered enormous damage through encroachments and over-grazing.

It may be mentioned that deforestation, denudation and resulting soil erosion are phenomena which are not peculiar to India but also affect many other developing countries where enough attention is not being paid to land management. Satellite photographs show that only 12% of the once lush island of Java is left with tree cover and that in the Philippines, forest cover is today less than 20% of the country's land area and not 33% to 50% as is commonly assumed. In northern Thailand, forests are being decimated at the rate of 5%to 7% a year. In Pakistan although 8·2 million hectares are classified as forest and range lands, only 2·6 million hectares are actually wooded. In Nepal, the destruction of forests is taking place at such a rate that the country is likely to be all but totally denuded by the end of the century. We should be particularly concerned with this development because soil erosion in this neighbouring country has a direct link with floods in the Ganga basin.

It is impossible to quantify the losses resulting from soil erosion. This is so because it is not possible to place a price tag on the fertile top soil, an inch of which it takes Nature anything from 500 to 1,000 years to build, and which is, therefore, for all purposes a non-renewable and irreplaceable resource. Nevertheless, it is possible to get some idea of the price we are having to pay for our neglect of this resource.

According to an estimate made by Dr. J. S. Kanwar in 1972, the quantity of top soil displaced by water erosion alone was 6,000 million tonnes a year. It was calculated that this represented a loss in terms of the major nutrients NPK alone that would require 5·37 million tonnes of inorganic fertilizers to replace at a cost of Rs. 700 crores.

It is easy to work out what this loss represents in terms of current prices of fertilizers. However, the extent and intensity of erosion have undoubtedly increased very considerably during the last 8 years. Current losses must, therefore, be several times this figure. Our actual losses are even greater if computed in terms of the agricultural, animal and forestry production that we are losing year after year as a result of wind and water erosion over 150 odd million hectares of land. Such losses must certainly be of the order of several tens of thousands of crores a year, and it is only because they take place insidiously, and have never been the subject of any proper study by learned economists that they do not form the topic of any serious discussion. However, these losses show up unmistakably in the pitiable condition of our poverty stricken masses for land degradation, like murder, will out.

The indirect losses caused by water erosion are no less serious in nature. The premature siltation of our 500,000 odd tanks and of the 487 reservoirs of our major and medium irrigation and multi-purpose projects on which the community has invested over Rs. 10,000 crores during the last three decades is a particularly serious matter. Observations show that the average rate of sedimentation in most reservoirs is 4 to 6 times as high as the rate which was assumed at the time they were designed and built. The life expectancy of these projects is, therefore, being reduced significantly by soil erosion in their catchments. However, what is particularly alarming is the fact that in most cases, there will be no alternative sites for dams once the existing ones are rendered useless. This

means that even if we have the money to build fresh projects —and this is by no means certain—we shall not have the physical opportunities to do so. What is at stake, therefore, is the loss of the irreplaceable potential—for irrigation, for electricity and for flood control—that these storages represent.

The threat to our hydel potential is a particularly serious matter in the context of the deepening energy crisis and the growing application of electricity to ground water development. It is necessary to stress in this connection that ground water is today responsible for nearly half our total irrigation in terms of area and much more than half in terms of irrigation efficiency and productivity.

Another way in which the country pays dearly for soil erosion is through the losses it suffers as a result of floods, which occur because a great deal of the soil which is washed down from water-sheds gets lodged in the beds of rivers and reduces their carrying capacity. According to the National Commission on Floods, losses caused by floods during the 3 year period from 1976-78 amounted to Rs. 3,180 crores which works out to an average of over Rs. 1,000 crores per annum. However, these figures convey no idea of the suffering and misery caused by the loss of lives or of the toll taken of human and cattle health by the epidemics which invariably follow in the wake of floods.

The only way to tackle the growing menace of floods is to control deforestation, denudation and soil erosion in the water sheds of rivers. Such a task must be undertaken on the most urgent basis particularly in the case of the Himalayan rivers, if certain disaster is to be avoided. If this problem is not tackled in time, it is not difficult to imagine a situation in which, thanks to increasingly frequent and intense floods, and the consequent rise in the level of river beds, large portions

of the rich flat lands of the Ganga basin may be turned into undrainable swamps. Perhaps it is already too late to save the situation because while the denudation and erosion of the Himalayas is already far advanced and is growing rapidly, it will be years—even with the best will in the world—before we will be able to control it effectively. Responsibility for flood control must, in any case, be removed immediately from the Irrigation Departments where it rests today and handed over to organizations which can control denudation and soil erosion in the catchments. It is time we realised that the building of spurs and embankments—which incidentally have to be rebuilt or raised almost every year—is no answer at all to the problem of floods.

Yet another extremely serious consequence of soil erosion is the havoc it plays with our water resources. This is so because the run-off of rain water from denuded surfaces is far greater than from slopes which are well-wooded and well-grassed. This means that a great deal of the water which would otherwise have been retained as sub-soil or ground water is lost to the sea, often after causing a great deal of damage in the process. Incidentally, this is the reason why springs and artesian wells dry up wherever extensive denudation takes place. It is impossible to over-estimate the seriousness of this loss considering that ground water is one of our most valuable resources. It is also worth mentioning in this context that fully recharged ground water aquifers play a most significant part in contributing to river flows during lean months. Both floods and droughts are thus in reality two sides of the same coin of poor land management.

Let us now consider how water erosion can be controlled—in situations, of course, where there has been no total loss of the top soil and the point of no-return has not yet been reached. Fortunately even partially eroded soils are capable of saving themselves from further damage and of generating a natural vegetal cover in a comparatively short period of time,

provided they are left severely alone and protected against further depredations by man and beast. This, it may be pointed out, is a very big proviso because a proper rest cure for eroded lands is difficult to arrange for the very reasons that led to their denudation in the first place. Wherever possible, such protection must be supplemented by the planting of suitable varieties of trees and grasses and, if necessary, by engineering works such as gully plugs, bunds and terraces to prevent the formation of ravines. Such secondary treatment is, however, quite infructuous in the absence of adequate protective measures. It is mainly because we have failed to provide effective protection to denuded lands that the money spent so far on afforestation and soil conservation schemes on non-agricultural lands has shown little results and has been very largely wasted.

The key to the problem of soil erosion obviously lies in the effective use of adequate legal and executive powers to provide the necessary protection to the land till it can be restored to health. Such powers must also be used thereafter to ensure that the land is exploited strictly within the limits of its productive capacity and is not allowed to degenerate again. However, the use of legal and executive powers can be effective only if local communities realise that the restraints placed upon them are in their own best interests in the long run. There is, therefore, a great need to educate the affected populations and win their cooperation in this matter. It is equally important that workable solutions are found to the problem of meeting the genuine needs of local communities in respect of fuel and fodder during the period that the land needs for its recuperation.

How much would a total programme for the control of soil erosion over the 150 odd million hectares affected by it require by way of financial outlays ? Even if we assume, at a very conservative estimate, an average cost of no more than

Rs. 1,000 per hectare, the total bill for treating all the lands presently affected would be around Rs. 15,000 crores. Such an investment though colossal in size would certainly be justified if it can be carried out in a manner which is technically sound, and is supported by the local communities concerned, as well as by a stern political and administrative will. It may be mentioned in this connection that this is exactly the approach followed by China and South Korea which are the only two countries in the developing world that have been eminently successful in tackling their problems of deforestation, denudation and soil erosion on a wide scale. In both these countries, very stern executive action has been taken to ensure effective protection to degraded lands. In South Korea, the entire operation has been made the responsibility of Ministry of the Interior which has not hesitated to use the police for this purpose. In both countries the results achieved have been quite remarkable. China has placed 55 million hectares under new forests during the last 30 years while in South Korea there is now hardly an acre of denuded land to be seen anywhere.

Apart from the two major ills to which the soil is susceptible and which we have examined in detail, there are some other threats to the soil, of which mention needs to be made though only in passing. The first of these concerns the diversion of good agricultural lands to urban uses. Since such diversions are irreversible and since good agricultural lands are a precious commodity, steps should be taken to ensure that wherever possible urban growth takes place only on comparatively inferior soils. Urban expansion should in any case be regulated in such a manner that it is economical and not wasteful in the use of land.

The second threat concerns the possibility of deterioration of some of our best soils which are cultivated intensively in

situations of perennial irrigation and multi-cropping. Such deterioration can take place on account of the continued application of large quantities of inorganic fertilizers and pesticides and the depletion of elements and other micro-nutrients. The health and fertility of such over-worked soils needs to be carefully monitored and maintained through scientific soil testing at regular intervals and suitable corrective measures.

A third threat concerns erosion by the sea which affects many parts of our long coast line but has so far drawn attention to itself only in the densely populated areas of Kerala where the loss of land to the sea is of the order of 2 to 5 metres per annum.

The fourth problem relates to the disfigurement of the land by activities such as brick-making, quarrying and open-cast mining. Such activities should be subjected to appropriate regulation aimed at minimising the loss of good top soil and at making the best possible use of depressions, by converting them, wherever adequate sources of water are available, into fresh water fisheries.

Part II

A Policy for Land & Water

In my previous lecture I have tried to explain the nature and extent of the enormous damage which has been already suffered by our land and soil resources. It has also been brought out that the situation is not static and that the threats to the health and the productivity of our land resources are of a continuing nature. What is more, these threats will become increasingly serious and intractable with the passage of time. The ways in which the further degradation of the soil can be stopped and the tremendous inputs—financial, technical and administrative—which will have to go into such an effort have also been discussed.

We must, however, remember that arresting the further degradation of the soil is only a part of the problem before us and that the positive aspects of land management must also receive due attention. Situated as we are, we have no option but to make the maximum use of our good lands even as we try to stop further deterioration of lands which are

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Sardar Patel memorial lectures, 1980 by Shri B. B. VOHRA, Secretary to the Government of India, Department of Petroleum on December 23, 1980.

already degraded or are threatened with imminent degradation. We must, therefore, take a look at the present land management situation in its entirety and determine the areas and programmes which should be taken up as a matter of priority in the interests of increased production as well as the amelioration of sick lands.

It would indeed be necessary to draw up a well considered perspective plan for implementation over an adequate period of time so that the efforts which we make are not disjointed, isolated or fragmentary, but fit into a rational pattern which takes due account of the pressing demands of a most difficult and complicated situation. This period of time should, naturally, be the minimum possible, considering that we have a lot of leeway to make up and that further damage to our land resources will continue to take place even as we are trying to improve the condition of the lands which have been degraded already and the productivity of those which are still in good condition. Perhaps 20 years is the utmost that we allow ourselves for such a purpose, for what we are engaged in is basically a race against time. We must also remember that according to the latest projections our population will have reached the figure of 1000 million by the year 2000 AD.

It would be useful, in following such an approach, to consider the management needs of our agricultural lands as a matter of the highest priority. It has been noticed already that these lands are 143 million hectares in extent. However, at least 87 million hectares are already affected by degradation and only the remaining 56 million hectares would seem to be free from problems. It would be obviously necessary to ensure that the productivity of these good lands is maximised in the shortest possible period of time. Let us see how we should go about this task.

According to the latest available information, the net area under irrigation stands at around 40 million hectares of which approximately 20 million hectares are irrigated by canals and tanks and about 20 by tube-wells. Very high priority must be given to the care of the 20 million hectares which are irrigated from surface water sources not only because huge public investments have been made in them but also because these lands are particularly susceptible to the threat of water logging and salinity. All such lands need to be looked at closely from the point of view of their drainage needs although only those which are in imminent danger of water logging—estimated to be 10 million hectares in area—should be taken up for treatment first. However, the proper utilisation of irrigation water on all such lands must be achieved as quickly as possible in order to make the fullest possible use of the potential they represent. It may be mentioned in this connection that while yields from our irrigated areas are on an average only of the order of around 1.7 tonnes of foodgrains per hectare, in other countries, yields of as much as 4 to 5 tonnes per hectare from irrigated areas are not uncommon. Part of the explanation for this lies in the fact that the bulk of our canal irrigated areas have yet to be provided with field channels and that until this is done, only a very primitive kind of irrigation, which involves the passage of water from one field to another, is possible. No wonder that in such circumstances, crops receive more water than they need, fertilizer use is inhibited, yields are poor and water logging sets in rapidly. Such irrigation is in fact suitable only for certain kharif crops like rice and sugarcane which can tolerate large applications of water and is completely unfit for most rabi crops. This is why there is so little double-cropping in our canal irrigated areas.

The conservation of the very valuable irrigation potential represented by these 20 million hectares also demands that the

tanks and reservoirs which feed them should not be allowed to get silted prematurely. This means that high priority must also be given in any perspective plan for soil conservation programmes in the catchments of these tanks and reservoirs. We must also remember that apart from the 487 major and medium irrigation schemes which have been completed already, there are another 415 major and medium irrigation projects which have been taken up but have yet to be completed. For obvious reasons, the catchments as well as the command areas of all these schemes also will have to receive the same kind of priority in attention as those of the projects which have already been completed in the engineering sense. Such unfinished projects must of course be also completed in the shortest possible time in the interests of increased agricultural production.

Programmes, aimed at making the quickest and fullest possible use of existing irrigation projects as well as of the projects which are in hand, and of saving their reservoirs from premature siltation will call for enormous outlays and take several plan periods to implement. It is very necessary that this fact should be recognized by Irrigation Departments so that they do not take up any fresh projects however attractive they might appear to be till this work is finished. There would, in any case, seem to be no scope whatsoever for taking up grandiose schemes like the Garland Canal or the linking-up of rivers in the foreseeable future, if cost-benefit considerations are to play any part in our planning processes.

High priority in any perspective plan will also have to be given to the treatment of the water-sheds of rivers which are particularly susceptible to floods so that we may be saved, in as short a time as possible, from the terrible damage which floods cause to the national economy generally and to agricultural production in particular. The offending catchments must be carefully identified and studied so that those

which contribute the most silt are attended to first. Needless to say, all the catchments which are selected for priority treatment, whether to save tanks and reservoirs from premature siltation or to prevent floods, must be treated in the most scientific manner possible. The treatment must start from the top-most reaches of each catchment and proceed downwards in a systematic manner so that it covers all lands whether agricultural or non-agricultural. In order to make the best use of the lands protected for soil conservation, they must be planted with the most attractive commercially or socially useful species of trees and grasses after carrying out a careful study of local soils, slopes and climatic conditions as well as the needs of local communities. Thus, where trees can be grown, a conscious choice should be made whether the plantations should be merely for protection or also for fire-wood or timber or fruits or fodder or for a combination of all these. No single piece of land, however degraded its soil may be, should be left bare in such catchments because, placed as we are, we can do with even the coarsest of grasses and shrubs as they represent bio-mass which can be made available to us free of cost by the energy of the sun received by lands which would otherwise be completely unproductive.

Let us now turn to the management needs of the 20 million hectares of irrigated lands which are served by ground water. These lands are undoubtedly the most productive lands that we have because of the ease with which they can be irrigated in accordance with the exact needs of the crop by the farmer himself. Very large private investments have gone into these lands in the shape of the nearly 7 million tube-wells and pumpsets which have been installed in them during the last 30 years. The interests of agricultural production demand that these investments must not be endangered by over pumping of water beyond the recharge capacity of aquifers. State Governments must, therefore, carry out scientific

hydrological studies to investigate the capacity and recharge characteristics of ground water aquifers in all such areas and introduce regulations to ensure that drawals are made only within permissible limits. They must also ensure that the power needs of tube-wells and pump sets are adequately met whether these are in terms of electricity or diesel. In order to meet these objectives, it will be necessary to set up properly structured and staffed ground water organistaions wherever these do not exist already.

Another area deserving of high priority is indicated by the need to achieve the optimum development of the remaining 16 million hectares of good agricultural lands which do not have access to irrigation today. Some of these lands will undoubtedly receive irrigation from the 415 major and medium schemes which are pending completion. However, it would be wise to arrange for the fullest possible development of the ground water potential of all these lands regardless of whether they are due to receive surface irrigation or not.

A deliberate and conscious policy decision needs to be taken that ground water resources should be tapped to the fullest possible extent wherever these are available because of the inherent advantages which these resources enjoy as compared to surface water. It may be mentioned in this connection that whereas surface water projects take years to plan and sometimes decade to complete, ground water can be tapped in a matter of weeks, if not actually days. In view of the low cost of individual tube-wells, such installations are financed through loans which can be easily repaid within very short periods of time because they result in an almost immediate increase in agricultural production. By contrast, the high cost & the extraordinarily long gestation period of big surface water projects involve the State in huge and recurring losses. Ground water irrigation is far more economical than canal irrigation because it does not call for any expenditure on

storage and transport. It also does not involve the loss, through submergence of large areas of valuable land under reservoirs or the disturbance of the ecological balance as is caused by big irrigation projects. The use of ground water also avoids the loss of land needed to build canals and distributaries. Again, ground water does not require any costly and complicated systems of water distribution and drainage as canal systems do. This is so, because private tubewells serve only small areas of land and because the farmer who is to bear the cost of pumping, uses just as much water as is really required for his crop and no more. Again, the owner of tubewel's irrigated lands can carry out the levelling and shaping of his fields with his own unaided efforts whereas such works in canal commands necessarily require large outlays and big bureaucracies as they have to be taken up on the basis of large outlet commands. Ground water is also not susceptible to the serious losses by evaporation or seepage which characterise irrigation projects. Yet again, ground water development does not call for the subsidies which the operation of most irrigation projects demand.

From the farmer's point of view--and this is what explains the phenomenal growth in the acreage under ground water—tubewell irrigation is incomparably superior to surface irrigation, because it is entirely under his own control, on the other hand, in canal irrigated areas the arrival of water and its distribution during cropping seasons is at the mercy of huge and sometimes corrupt bureaucracies. This is why the use of ground water has a profound psychological effect on the farmer and makes him self reliant even in matters other than irrigation. It is necessary to mention in this connection that the untapped potential of ground water as estimated today is enough to irrigate another 20 million hectares. However, this is undoubtedly an under-estimate because there is great scope for the augmentation of ground water resources as a result of the soil conservation measures which have to be

taken up in any case in catchment areas. It will perhaps surprise many people to know that ground water accounts for more than 90% of all the liquid fresh water available on the earth at any given moment of time. It is also necessary to mention that recent investigations have shown that even non-sedimentary areas – and 70% of India is under-laid by non-sedimentary formations – are capable of holding much larger quantities of ground water than was once supposed. Ground water irrigation is particularly useful in canal commands because it helps in lowering water tables and preventing water logging. The exploitation of ground water resources has proved to be particularly useful in desert areas where it can provide much needed water for irrigated pastures and enable fodder banks to be built up for use in times of drought. The discovery of ground water in certain parts of the Rajasthan desert also offers the hope of preventing large scale migration of cattle in times of drought and, therefore, much loss of valuable cattle wealth.

In view of all these considerations, the replenishment, investigation and scientific management of ground water resources must form the corner stone of all future plans for irrigation. Ground water represents Nature's own way of storing and transporting sweet water over long distances at no cost to the community and without causing any damage to the land. Wisdom demands that we must make the best possible use of this wonderful facility.

Let us now consider the problems of management and productivity associated with the 87 million hectares of agricultural lands which are known to be degraded, most probably as a result of erosion by wind or water. These lands need to be looked at closely, in order to see which of them deserve to be kept under permanent agriculture and which are intrinsically fit only for non-agricultural purposes. Those areas which are marginal in character and have such shallow soils or

steep slopes or so little access to water that they should never have been put under the plough in the first instance should be identified and placed under permanent vegetation of a suitable nature. Such a diversion will save these lands from further erosion and at the same time help them to become more productive.

Those lands which, as a result of such a scrutiny are found to be fit for permanent agriculture by virtue of their deep soils access to water and freedom from serious environmental hazards should be saved from further damage and helped in every possible way to develop their potential. If such lands are threatened by wind erosion or shifting sand dunes they should be adequately protected by shelter belts and wind breaks. If, however, they are subject to water erosion, the entire sub-catchment in which they are situated must be treated for soil conservation before they are terraced and bunded along contours. Such lands should be also protected against erosion by appropriate cultural practices such as contour ploughing and the cultivation of crops which give the maximum cover to the soil. If proper soil and water conservation works are undertaken in the sub-catchments concerned and small tanks built as part of such a programme, it may be possible to give many such areas access to surface irrigation. Ground water should also of course be tapped wherever it is available.

Although it is difficult to hazard a guess in the absence of reliable information, it is very likely that lands with good agricultural potential will not constitute more than 50% of the 87 million hectares of degraded agricultural lands. We may, therefore, assume that while around 43 million hectares may be reverted to non-agricultural use, around 44 million hectares may be developed as good agricultural lands. Such an approach, based on the concept of scientific land use, should reduce the total area under cultivation from 143 million hectares to

around 100 million hectares and increase the area under non-agricultural uses from 123 million hectares to around 166 million hectares. Such a major change in the land use pattern should however cause no concern, for it will result in an increase rather than a decrease in the agricultural potential of the country. It needs to be mentioned in this connection that if, as seems likely, almost all these 100 million hectares can ultimately have access to irrigation, they should, under proper management, be able to yield upwards of 300 million tonnes of foodgrains per year—a quantity which will be sufficient to maintain a population of 1000 million at higher nutritional levels than we can boast of today. It should not be forgotten that under proper conditions of irrigation and soil management, good agricultural lands in a climate like ours should be able to yield at least two crops a year so that even with 100 million hectares under cultivation, the gross cropped area would be at least 200 million hectares. By contrast, even though we have 143 million hectares under agriculture today, our gross cropped area is only 172 million hectares.

The next item in our order of priorities according to this approach will be the care of our non-agricultural lands, which will now stand increased to 166 million hectares as noticed. Of these, 35 million hectares are already under good forest management. It is, therefore, only the management of the remaining 131 million hectares that needs consideration. However, a great deal of this area will be automatically covered by the priority programmes which will need to be undertaken in the catchments of our 500,000 odd tanks, our 900 odd existing and projected reservoirs and the denuded watersheds of our floodable rivers. Large areas will also be covered while treating the catchments which contain the presently degraded lands which deserve to be developed into good agricultural lands. The areas which will remain to be dealt with are, therefore, likely to be only a small part of

these 131 million hectares. Even though such remaining areas will merit a lower priority than the others we have discussed, they must, nevertheless be protected and treated within the 20 year period of the perspective plan.

There can be little doubt that the implementation of a plan of this nature for the optimum management of our total land resources would yield very rich dividends and change the face of the country. Such a plan would probably require the investments of upwards of Rs. 50,000 crores at current prices, mostly in the form of wages to labour required for works connected with land shaping, land levelling, terracing, bunding, afforestation, soil conservation, and the construction of irrigation channels and drains. Apart from creating a very substantial employment potential both for the skilled and unskilled, a programme of this kind would result in a very significant increase in the productivity of the land, agricultural as well as non-agricultural, and put millions of our rural poor on their feet on a permanent basis by engaging them in activities based on multi-cropping, animal husbandry, dairying, horticulture, pisciculture and forestry. The revitalisation of the rural economy would also yield other unexpected benefits. The present drift to the towns – a drift which is threatening to turn them into unmanageable slums – would hopefully abate. Nutritional standards would improve and reduce the country's health bill. With greater employment and prosperity, social tensions born out of poverty and glaring disparities in standards of living wou'd lessen and, therefore, also problems of law and order. Greater productivity from the soil would also help solve our energy problems by increasing the availability of firewood and other forms of bio-mass as well as by prolonging the life of hydel projects.

Assuming for a moment that the requisite political will for formulating and executing such an ambitious, and far-reaching programme will be forthcoming, let us see what are

the changes which wou'd need to be made in our present attitudes, policies and organizational arrangements in order to achieve success in such a stupendous venture.

The very first thing to be done is to correctly understand and appreciate the nature of the resource we are dealing with. We must no longer take the soil for granted as something which has been there from the beginning of time and will continue to serve us for all times to come, without requiring any attention on our part. Contrary to popular belief, the soil is not an inert substance, but a fragile and almost living organism of unrivalled complexity. It will surprise many to know that fertile soil teems with life and that a tea spoonful of it may contain billions of living organisms—the micro fauna and the micro-flora which are responsible for the fixation of atmospheric nitrogen and the breaking down of organic as well as inorganic materials into forms suitable for assimilation by plants and, therefore, also by animals and human beings. The soil is our legacy from the past and must be bequeathed to posterity in as intact and healthy a state as possible. We must indeed look upon ourselves merely as trustees, on behalf of generations yet to come, of this most basic of all natural resources and not permit it to be damaged in any way. This means that the interests of the soil must be given paramount importance in all activities relating to the land.

It is particularly important that this consideration should guide our irrigation policies. Since for all productive purposes, the soil is useless in the absence of water and vice versa, the problems of land and water management constitute a single indivisible whole. However, we must look at these problems only from the point of view of the land because while the land is a continuing and non-renewable resource, water is gifted to us afresh every year by a bountiful Nature. It also needs to be remembered that while land resources can and do suffer

heavy damage at the hands of water, the reverse is not possible. Therefore, there is and can be no such thing as water management per se. Indeed, the only purpose which the management of water can have is to subserve the interests of the land.

Looked at from this point of view most surface irrigation projects, as we have seen already, leave a great deal to be desired. A proper evaluation of such projects should be based not only on the costs of the main engineering structures, but also on the additional costs required to be incurred on the protection of their reservoirs and land treatment and land development in their command areas. The benefits conferred by such projects should similarly be computed after taking into account the damage they may have already caused to the land by water logging and salinity. If such an analysis was to be made, it is certain that States would stop falling over each other in trying to secure more irrigation projects and might even be persuaded to give up some of the 415 ongoing projects, on which much progress has not been made. Such a development would be most welcome indeed because it would release much needed funds for land amelioration and ground water development. It would also hopefully put an end to the interminable inter-State disputes over river waters and cure Irrigation Departments of their almost pathological preoccupation with big projects.

One of the reasons why Irrigation Departments have become almost compulsive builders of dams and latterly, (because dam sites are becoming increasingly scarce) the dreamers of Garland canals, water grids and other similar fantasies, is the fear that they would find themselves out of work when existing projects get completed. This is why new projects are conceived years before existing schemes are anywhere near completion and the pipeline of new schemes is always kept full. However, such fears are completely unfounded if we take

into account the formidable size and scope of the engineering works which need to be carried out in existing command areas in order to achieve their full productive potential. Irrigation Departments have also, in their anxiety to "sell" new projects often under-estimated their costs and over-estimated their benefits. Some of their concepts are in fact quite misleading. To illustrate, the "cultural command area" quoted in project reports is often far bigger than the area which can be actually irrigated and is, therefore, of no practical significance. Similarly, Irrigation Departments include in their figures of "potential created" areas which can be theoretically served by an outlet regardless of whether or not there are any channels beyond the outlet to actually irrigate the land. Yet again, areas which may have received water only once are included in the figures of potential realised, regardless of the needs of the crops irrigated. Such attitudes betray a gross indifference to the interests of increased productivity from the land and little appreciation of what the true role of irrigation departments ought to be. There is, accordingly, a great need to reorient the working of these Departments and persuade them that irrigation as understood by them is not an end in itself but only a means to an end.

Mention must also be made in this connection of the extreme reluctance of Irrigation Departments to touch any thing which is not big in size. This is why small irrigation projects are left by them even to be handled by District authorities who are often technically not properly equipped for the job, and why even the work of building field channels for distribution beyond the outlet has not been attended to by Irrigation Departments. It is this lofty attitude towards small works which also explains why it was left to the Agriculture Ministry at the cetnre to take up the development of ground water. For tubewells cost only a few thousand rupees each and are, therefore, fit to be classified only as "minor projects" in the jargon used by Irrigation Departments. And Irrigation

Departments of course must not handle anything smaller than "major and medium projects". Irrigation Departments have thus shown themselves to be indifferent not only to the needs of the soil but also to a most useful source of water merely because its exploitation does not involve the construction of large projects. For them indeed only "Big is Beautiful".

Whatever justification there might have been 30 years ago for our preoccupation with huge dams and canal systems has since disappeared with the knowledge that we possess today regarding the existence of ground water in most parts of the country and the way it can get replenished free of cost to the community as a by-product of the measures which have to be taken in any case to prevent further soil erosion. Such justification has also disappeared as a result of the knowledge that we possess today regarding the enormously high hidden costs attached to such projects. If the health and productivity of our total soil resources is to be optimised we must take conscious decisions today whether available funds should be spent on the amelioration of degraded lands and the development of ground water or on costly new irrigation projects. The various alternatives for investment must be carefully considered before deciding as to which of them offers the highest economic returns in the shortest period of time. In order that such exercises may be carried out, it would be necessary to place all funds for these purposes under one major budget head for Land Management.

The reorientation of Forest Departments is also called for if they are to play the role expected of them in the days ahead. These departments have developed a certain aloofness in their approach to the people and feel at home only in the reserved forests over which they have absolute sway. They have also, by and large, been friendly towards financially and politically powerful contractors responsible for illegal fellings.

At the same time they have not shown sufficient concern over the increasing denudation of forest lands. If the gigantic task of reclothing some 131 million hectares of bare lands is to be accomplished, it must be approached in a spirit of humility and foresters must learn to work side by side with members of other related disciplines in the common service of the soil.

Another area to which attention needs to be given is the collection of reliable information regarding the use to which various kinds of lands are being put at present and the type of soils they possess. Such data is absolutely necessary if our land resources are to be used for the purposes for which they are ideally suited by virtue of their soils. This is a task which calls for the stepping up of soil survey activities and if necessary the use of time-saving remote sensing techniques.

In order that project areas, whether in catchments or commands are developed quickly and effectively it would be necessary to set up suitable multi-disciplinary area development authorities. It would also be necessary to ensure that such authorities are not hampered in their work by the lack of adequate legal and executive powers. These authorities, must, therefore, be vested with suitable summary powers in the interests of the land so that its improvement and where necessary its physical reshaping may take place as quickly as possible. It would also be worth considering whether long delayed land reforms should not be similarly carried out in a summary fashion in order to release the energies of the people in the interests of increased agricultural production.

In most of the priority areas which we have discussed, land management programmes will necessarily have to be undertaken by the Government. However, it would be useful to allow private initiative and the profit motive to play a role in the other degraded areas. To illustrate large lands particularly in the Rajasthan desert could be identified for

development on commercial lines by joint stock companies on suitable terms. It is necessary to mention in this connection that there is a great scope for the cultivation on such inferior soils of certain newly discovered "hydrocarbon plants" which can yield substitutes for crude oil.

The programmes we have outlined are so challenging in nature that Governments should welcome any assistance that voluntary groups and agencies can provide for their implementation. The mobilisation of students in particular would be most useful for large scale soil conservation and afforestation programmes. There is also a great scope for voluntary agencies to keep the entire land management scene under constant watch and see that governmental efforts do not flag. Such agencies could also play a most useful role in educating the public in matters relating to the soil and fighting "resource illiteracy". The work of such agencies could perhaps be greatly facilitated by an adequately endowed private foundation dedicated exclusively to the service of the soil.

If we mean business, the prevalent vacuum at the Centre where there is no agency or organisation specifically charged with responsibility for the care and management of our land resources must be filled at the earliest possible moment. It would be most appropriate to set up such an agency in the form of a suitably empowered Central Land Commission as has been recommended recently by the Committee on the Environment. Such a Commission must be vested with authority over all activities relevent to land management. The creation of a National Land Development Bank would also seem to be necessary to finance various land improvement projects on a long-term basis, and to introduce some much needed discipline into expenditure in this field.

Consistent with our new approach to the soil, it would be desirable to redesignate the present Ministry of Irrigation as

the Ministry of Land Management and to transfer to it all agencies relevant to this subject. The proposed Central Land Commission would naturally form a part of this Ministry. Once the Centre has given lead in these matters, the States may also be expected to make somewhat similar arrangements.

I would like to stress, before I conclude, that although the tasks I have outlined are most formidable in nature, they are not impossible of accomplishment. One must derive strength at this juncture from the thought that equally difficult tasks in the sphere of politics and administration faced us at the time of Independence. The fact that these tasks were accomplished successfully and in record time and order was created out of chaos was largely due to the unequalled qualities of leadership, organisation, courage and determination displayed by the great son of India, after whom these lectures have been named. It is perhaps not too much to hope that similar qualities will be forth coming today to create order out of the physical and economic chaos which threatens to overwhelm us as a result of the unchecked degradation of our land resources. We have indeed no choice but to meet the challenge that this situation represents, if we have any intentions of surviving as a self-respecting nation.

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