

# *Institute of Natural Resources*

## *Natal takes a lead with computer aids to optimum land use planning*

Two of the greatest problems facing Natal are closely linked to one another. They are unemployment and rural poverty, concerns that are becoming increasingly common throughout the world. They stem from a complex of causes, including an unacceptably high rate of human population growth, the unequal pattern of land holdings, the extension of subsistence agriculture into marginal habitats, degradation of the environment, the concentration of available investment in the modern urban sector, and the glaringly obvious gross inequalities in the distribution of wealth. Few could deny that the major actor in this tragedy is population growth, which is surging ahead of progress in investment and technology.<sup>1</sup>

It is only comparatively recently that man has come to appreciate that the majority of our contemporary social, economic and environmental problems are directly or indirectly connected with a rapidly increasing human population. In the early eighteenth century, the heyday of mercantilism, the prevailing opinion was that population growth was desirable; more people enabled countries to expand their labour force and to have bigger armies.<sup>2</sup> In the middle of the eighteenth century, however, the first indications of resource shortages stimulated a question of some considerable consequence: are there physical limits to the possible size and growth rates of human populations?

This was an important departure from the blind acceptance of a world of limitless space and facilities, but the proponents of this question, although they were ahead of their time, had no idea that the world's population would increase fourfold from one thousand million in 1830 to four thousand million in 1975, and that this alarming increase would be accompanied by unprecedented pressures on social and family life as a consequence of resource shortages and environmental degradation leading in turn to economic instability and unemployment. As we enter the 1980s, it has become only too obvious that it is impossible for us to maintain the high rates of economic growth that are required to alleviate unemployment because the *per capita* availability of almost all resources has declined. These resources include the products of forests, fisheries, grasslands, croplands and cheap oil.<sup>3</sup>

South Africa, in particular the Province of Natal, has not been exempt from these problems, and although the scale of the social and environmental perturbations are generally less pronounced than elsewhere in the world, the country has no grounds for complacency. The population of South Africa is expected to increase from an estimated 24 570 000 in 1974 to 50 288 000 in the year 2000,<sup>4</sup> and there is already every indication that this rate of growth will stretch existing resources and facilities to breaking

point. In common with other developing countries, shortage of jobs and rural poverty are the two biggest challenges facing South Africa, and there can be little doubt of the urgent necessity of programmes and plans to tackle these problems throughout the whole of the Republic. In 1980, the University of Natal in Pietermaritzburg will begin to make a unique and vital contribution to the required planning process in Natal itself, following the creation of a new *Institute of Natural Resources*. In fact, Natal has been given an exciting opportunity to set an example in resource management and land use planning for the rest of the continent to follow, and the concomitant social, ecological and economic advantages of this new approach to planning that will flow from the creation of the *Institute* should make a very significant contribution to the alleviation of unemployment and rural poverty throughout the Province.

The concerns outlined above are recent. Why have they come into being? What has changed in the world whereby man finds his future on this planet threatened as never before? To answer this question, we must go back in time and look at the world before the advent of agriculture, a time when early man interacted with his environment in much the same way as other animals did.<sup>5</sup> In Africa, we need go back no more than 400 years and look at the continent before the European settlers arrived here. In places, it must have been a magnificent sight; the greatest variety of large mammals to be found anywhere in the world could be seen feeding together. We know that each species had its own rôle to play in the dynamics of the forest or savanna communities, and very often two or more species worked together to feed on the vegetation. Over a period of thousands of years, a fascinating complex of inter-relationships had evolved whereby there was an incredible variation in the structure and habits of the animals that culminated in nearly all parts of the plant communities being used for food. The warthog dug below the ground for tubers and bulbs. The zebra, with its strong upper and lower teeth ate the coarse grass that was too tough for other species, and the wildebeest and hartebeest moved in when the zebra had finished. Other selective grazing species were present, mixing with those that both grazed and browsed, such as the elephant and the impala. The giraffe reached high into the taller trees, nibbling on leaves far above the heads of other browsers. The tiny duiker browsed at the bottom, and a range of species filled the intermediate regions. Overall, there was a surprisingly high degree of population homoeostasis, and man was as much influenced by the process and characteristics of natural environments as were other species.

Unfortunately, man's capacity to influence the physical environment on a large scale developed rapidly with the advent of agriculture, and although such moves were initiated elsewhere in the world up to 10 000 years ago, it was not until the European settled in Africa that similar changes occurred here. All too often, development of early industry and the introduction of modern farming methods resulted in an unprecedented slaughter of the indigenous fauna, and the destruction and elimination of the indigenous flora. Large mammals in particular were killed in their thousands. South Africa had an incredibly bad record. Heavy slaughter, to provide meat and hides, for sport, and to remove competition for domestic livestock, virtually eliminated larger wild animals from all accessible areas by the

late 1800s.<sup>5</sup> As if this was not enough, a new and additional threat emerged in the form of a human population explosion throughout much of the continent, a consequence of the European settlers introducing death control without birth control. Today, some of the highest population growth rates in the world are to be found in parts of Africa, with doubling times of less than 25 years.

The rapidly increasing pressures of human populations have been accompanied by an equally dramatic increase in livestock. Man is inexorably bringing about the total replacement of Africa's natural and stable ecosystems with towns, industry, roads and a vast agricultural "civilization". We have failed to appreciate that the survival of man, like any other animal, depends on our having a sustainable relationship with the environment, an environment that contains all the necessary life support systems.<sup>6</sup> Environmental problems arise when the available resources of the habitat are unable to provide the requirements for the species living there. It follows that there must be a limit to the population that can be supported by finite resources, and in human terms, if this limit is exceeded, not only will environmental degradation follow, but there will also be a reduction in the standard of living. In short, the instabilities and disruptions that are evident all around us result from our failure to recognize the necessity of maintaining balance and planning effectively towards that end.

Rural poverty and associated unemployment are prime examples of inadequate planning, and are not necessarily an inevitable accompaniment of the increase in human numbers. If this is accepted, then it follows that the potential exists to develop strategies to reduce both rural poverty and unemployment, but these will not be developed unless we come to understand where our present beliefs and behaviour are leading us. This can best be understood by looking in more detail at our present predicament, with particular reference to the relationship between food production and human survival, economic stresses, and unemployment.

It has been emphasized already that the survival of any species of animal, including man, *depends on that species having a sustainable relationship with its environment*. There is quite obviously a limit to the number of animals that can be supported by any one habitat. This concept of "carrying capacity" is all too familiar to farmers, but unfortunately not to political decision makers. To a farmer, the carrying capacity of an area is the number of animals of a given size which can be supported for a given period of time by the vegetation growing in that area without adversely affecting vegetation production. In any natural biological system, the carrying capacity is determined by its maximum sustainable yield, and this is a product of its size and regenerative potential. The carrying capacity *cannot* be exceeded indefinitely *without reducing the system's carrying capacity*. Two simple examples will illustrate this point. If the offtake from a fishery exceeds its regenerative capacity, stocks will dwindle and it will eventually collapse. Secondly, if the numbers of cattle, sheep and goats increase too rapidly, the herds will decimate grazing lands, turning pastures into barren and unproductive wastelands. The world is full of other examples of man exceeding the carrying capacity, and inevitably environmental degradation has been the consequence.<sup>7</sup> The conclusion should be obvious. If we are to survive on this earth, we must recognize

that *all* ecological systems have a limit to the extent of the exploitation that can occur without causing irrevocable damage.

The problem of overfishing is worth looking at in a little more detail, because it provides a classic example of the consequences of making excessive demands on natural biological systems. It is a subject that is certainly not new to the residents of Natal after the recent shad fishing restriction controversy, yet at the time few took it seriously. From 1950 to 1970, the world's fish catch more than trebled from 21 to 70 million tons, the increased catch yielding 18 kg/person/year. Of this total nearly 90 % came from the oceans, and the remainder came from lakes and rivers. However, in 1970, the upward trend was abruptly and unexpectedly halted, and in spite of increased effort, it has subsequently fluctuated between 65 and 70 million tons. Meanwhile, the human population has continued to grow, and with the world fish catch stabilizing the *per capita* catch has declined by 11 %, resulting in rising prices for virtually every edible species.<sup>7</sup> Serious overfishing now occurs in many parts of the world, and the coast of South Africa is no exception. Yet, for many years, the oceans of the world have long been considered as a major potential source of food, with the hope that man could turn to the oceans for food as pressures on land-based food resources increased. This hope is being shattered, resulting in an even greater intensification of pressures on the land. Can the land cope?

In the last ten years, the decline in the fishing industries has been accompanied by a very pronounced reduction in the huge world surplus stocks of food. From 1950 to 1971, *per capita* grain production had increased 31 % from 251 kg to 328 kg. In spite of more land being brought into production, the world *per capita* consumption in 1977 was only 324 kg. In 1961, the combination of reserve grain stocks in exporting countries equalled 112 days of world grain consumption, falling to an alarming 39 days in 1973.<sup>7</sup> Although there has been a modest rebuilding of stocks since then, there are no grounds for optimism. The overall global balance between supply and demand remains delicate, a situation that is aggravated by the fact that all food exporting countries are experiencing increased demand, further reducing the quantity available to rebuild reserves. Even the U.S.A. will be unable to help, because the anticipated 24 % increase in the domestic population between now and the end of the century means that all of the food produced in the U.S.A. would be consumed there.<sup>8</sup>

Nearly all countries that have a declining *per capita* food production have populations growing at over 2 % per year, and it is quite obvious that unless this high rate of population growth is accompanied by sound agricultural technology, chronic food insecurity is an inevitable consequence. The world's fishermen, farmers and other food producers are already finding it impossible to feed over 4 000 million people, and yet each year another 64 million are added to the earth's surface. Since the Second World War, literally scores of countries have become food importers. *Not one new country has emerged as a significant cereal exporter during this period,*<sup>7</sup> a warning South Africa, and Natal in particular, cannot afford to ignore. Although we are still one of only eleven significant food exporting nations and the fifth largest food producer in the world, we will suffer an annual grain shortage of over seven million tons by the end of

this century. Of the 83 % of South Africa that is used for agriculture, only a mere 11% of this area is suitable for cultivation, severely limiting an increase in crop production.<sup>9</sup>

An additional limiting factor in the expansion of food production is energy. Almost half of the world's agriculture is highly energy-intensive, being heavily reliant on mechanical power and also on chemical fertilizers and irrigation. Chemical fertilizers use energy in their production, and massive quantities of these fertilizers are used in modern agriculture, particularly those containing nitrogen. Nature annually fixes an estimated 120 million tons of atmospheric nitrogen through such means as legumes and soil microflora, and we now add 40 million tons of additional nitrogen to the soil in the form of nitrogen fertilizer.<sup>7</sup> With the recent dramatic increase in the costs of all forms of energy, further cut-backs in food production seem inevitable.

"Desertification" is a new term that has come into prominence in this decade, and it refers to the reduction or destruction of the biological potential of the land leading ultimately to desert-like conditions.<sup>10</sup> This process has been inextricably linked with overcrowded rural areas and rural poverty. Grazing lands cease to produce pasture, dryland agriculture fails and irrigated fields are abandoned owing to salinization, water-logging, or some other form of deterioration. Overgrazing is becoming very widespread, and is cause for grave concern. On every continent, the area in grass exceeds that planted to crops. Approximately 2,5 billion hectares are grassland, and these areas play an important rôle in food, energy and industrial sectors of the global economy. Protein is provided for human consumption, fuel is provided for cultivating one-third of the world's cropland that is tilled by draft animals, and wool and leather are produced for industrial use. Recent estimates indicate that these grasslands support 2,7 million domesticated ruminants, and their numbers are increasing,<sup>7</sup> overtaxing these grasslands as never before at a time when overgrazing is already commonplace. The end result is inevitable — desertification. Deserts that have been created by man are already afflicting at least 680 million people living in 63 countries, and they are spreading at the rate of five to seven million hectares each year, an area equivalent to two Belgiums!<sup>11</sup> In the vast Sahelian Zone, which extends across the continent from the Atlantic Ocean in the west to Ethiopia and Somalia in the east, desertification is very pronounced, and in recent droughts nearly 200 000 lives were lost. The nomads who live in the area lost nearly two-thirds of their cows, sheep and goats, their traditional form of livelihood.<sup>12</sup>

Such examples and statistics might seem far removed from Natal, but once again the Province should take note of what is happening elsewhere. If the loss of topsoil becomes too great, the initial depletion of fertility can end in lands being rendered totally useless for crop production. In a recent survey of soil erosion in Natal,<sup>13</sup> it was concluded that soil loss from most arable fields is well in excess of acceptable limits and in some cases it has reached alarming proportions. Desertification is only a short step away if present trends continue.

The environmental degradation described so far is directly related to food production. Deforestation threatens just as many ecological systems,



A typical river scene with well-tended farm lands in the background.

Photograph by courtesy of R. A. HOLLIDAY Esq., F.R.P.S., Pietermaritzburg



The result of winter veld burning.

Photograph by courtesy of R. A. HOLLIDAY Esq., F.R.P.S., Pietermaritzburg



An African kraal showing poor veld management and consequent erosion.

Photograph by courtesy of R. A. HOLLIDAY Esq., F.R.P.S., Pietermaritzburg



A particularly severe case of veld erosion.

Photograph by courtesy of R. A. HOLLIDAY Esq., F.R.P.S., Pietermaritzburg

and also undermines the stability of soils. In our urban environments, surrounded as we are by the synthetic materials of the modern age, it is easy to forget that millions of people rely on wood for cooking, heating and building, and that the average person in a rural subsistence economy consumes over one ton of wood each year.<sup>14</sup> A recent review has shown that most of the Middle East and North Africa, and much of continental Asia and Central America are virtually treeless, and similar trends are becoming apparent in southern Africa. Once the trees have gone, a dangerous substitute is used — dried animal dung. It is dangerous because organic material and nutrients which should be returned to the soil and recycled are going up in smoke. This is already apparent in several parts of KwaZulu, an ominous warning of the dangers ahead. Our forests provide more than just wood products; they exercise considerable control over the circulation of nutrients, erosion, climate, hydrology and the cleansing function of air and water. When the forests are removed faster than they can regenerate, soil erosion and flash floods are inevitable, and the forests' vital contribution to the essential complex biogeochemical cycles is lost forever.

Environmental mismanagement associated with a rapidly growing human population must lead to rural poverty. It has happened, and is still happening all over the world, and it is being exacerbated by world economic stresses and the energy crises. It is a sad reflection on our present predicament that the evolution and structure of present-day society has been determined by the amount and form of energy that we use. Over the past generation, cheap energy has shaped the global economic systems and helped triple the output of goods and services.<sup>7</sup> Today we consume the energy equivalent of eight billion tons of coal per year, or two tons per person, not including wood and cow dung. The importance of oil as a source of energy is well known, and much of the world has become heavily dependent on the pre-industrial societies of the Middle East for their fuel supplies. Thirteen of the major oil exporters have joined forces within the Organization of Petroleum Exporting Countries (OPEC) to form a commodity cartel, but this has done little to help world economic stresses. On the contrary, the latest price hikes by OPEC, coupled with the fact that several members of OPEC have introduced a surcharge over and above agreed wholesale prices, has caused unprecedented inflationary pressures and widespread capital scarcity.

As if this was not enough to contend with, many parts of the world, including Natal, are being faced with a new competition for resources between the food and energy sector. For example, Brazil has launched a programme to produce ethanol from sugar cane and cassava to drive automobiles.<sup>7</sup> If the goal to produce most fuel for automobiles from agricultural sources by 1995 is realized, vast areas of cropland will be tied up in fuel production, in effect driving food prices even higher. This dilemma could be facing Natal in the very near future.

South Africa is not alone in experiencing dramatic increases in the price of many commodities in the seventies. The increases in the price of energy have played their part here, but of equal importance has been the extra demands from a rapidly growing population. Severe inflation is a real danger for every government. It can distort economic and social

values and undermine public confidence in the government of the day. Of major significance is the realization that economic depression and rising unemployment are linked to homicide, crime, mental breakdowns, family disintegration and other psychological problems. In short, the slow-down in economic growth is intimately connected with the carrying capacity of the world; we have reached our limit of growth.

Low expectations and low income from a rapidly deteriorating rural subsistence economy in many of the developing countries leave men with no real alternative but to drift to town in search of work. It is happening every day in Natal, as it is in much of the rest of Africa. Yet the towns have no hope of accommodating this influx. On a global basis, the World Bank estimates that by the year 2000, 600 million urban dwellers will be living in conditions of "absolute poverty", a standard of living described by the President of the World Bank as "a condition of life so degraded by disease, illiteracy, malnutrition and squalor as to deny its victims basic human necessities".<sup>15</sup> Once again, the high rate of human population growth has exacerbated the situation. In the developed countries, where the fertility rates are low, young people fill the vacancies created by the retirement of older workers. In contrast, most of the developing countries have high fertility rates, and here new jobs must be created each year. Every year in South Africa *alone*, 210 000 new work-seekers enter the labour market, and the government is faced with the impossible task of creating 1 500 new jobs each working day, a total of 4 200 000 new jobs between 1979 and the year 2000. It is too simplistic to look to industrialization as the answer to unemployment. A recent survey by the Urban Foundation showed that there are 30 industrial undertakings in KwaZulu, involving a total investment, including infrastructure, building and capital equipment of R63 000 000. As a result, 2 500 people are employed, but the cost of creating one job was more than R25 000.<sup>16</sup>

It is indeed a bleak scenario. The major actor in the tragedy, rapid population growth, has precipitated a chain-reaction that will culminate in an ecocatastrophe of frightening dimensions. Lester Brown believes that the essential choice open to us is whether to limit births and individual consumption consciously and voluntarily so as to avoid excessive pressures on the earth's natural systems, or to continue pressing against the earth's biological limits until regulation becomes mandatory. Historian Arnold Toynbee sees increasingly authoritarian government emerging as economic growth slows or stops. He writes: "In all developed countries a new way of life — a severely regimented way — will have to be imposed by ruthless authoritarian government."<sup>17</sup> The recent severe fuel restrictions in South Africa may be an indication of what is to come. But is authoritarian government the only solution? Have we reached the stage where strict regimentation is our only hope? Rapid population growth, and the consequences of it, will be with us for some time to come, but the problems of rural poverty and associated unemployment *can* be tackled effectively without going to extreme measures. Put quite simply, in rural areas a rural land use strategy is required which recognizes the prime importance of food production, but at the same time safeguards soil and representative samples of natural ecosystems. Before this can be done, a land capability analysis is required that considers all the possible

competing forms of land use, such as crop production, grazing, forestry, and game reserves. Quite obviously, the production of food must rate as a high priority choice for land use, and areas that have a high potential for food production will have to be used accordingly. Also, those areas particularly suited for timber production will be similarly used, and so on. However, the choice of *how* the land will be used will be made only after an objective land capability analysis has been completed, which will be based on information on the density and distribution of the human population in relation to relevant natural resources. This is where the *Institute of Natural Resources* will show its real value and potential, particularly with the development and use of a computer-based natural resources data bank.

Why do we need such sophisticated tools to help us overcome the problems of rural development in the 1980s when at the turn of the century our unaided intellect was quite adequate? After all, the success and uniqueness of man lies in the fact that we alone have indulged in the inheritance of acquired characteristics by means of the written and spoken word,<sup>17</sup> and the accompanying simple powers of reasoning which lifted us out of the Stone Age into the present have served us amazingly well up until now. But with the complexities of modern planning, the demands on our unaided intellect have become too great. In holistic planning, it is quite impossible to visualize all the relevant resources at any one time, and with the information explosion that is taking place, coupled with rapid modification of existing data as populations move and increase and resources become depleted, there is a very real danger that planners will become completely overwhelmed in their attempts to plan efficiently.

A computer-based natural resources data bank is the logical solution to this dilemma. Very briefly, this system would enable us to store on a standard geographical basis all the relevant information we would require for efficient planning, and, of great consequence, the information could be rapidly retrieved and up-dated. It is perhaps unfortunate that this computer aid to planning is called a "data bank", because the prime function of such a system is not the storage of facts *per se*, but rather the rapid manipulation of the available data in a variety of ways to aid the planning processes, and to stimulate the outcome of different management strategies.

Although the initiation and formation of a data bank will be a key feature of the *Institute of Natural Resources*, there will be four principal objectives.

Firstly, the *Institute* will conduct *research* in integrated resource planning related to the computer-based data bank.<sup>18</sup> Methods will be studied to optimize the storage and retrieval of information on such aspects as human population distribution and density, climate, soils, geology, mineral potential, land use, land ownership, forest cover, agricultural potential, water and transport facilities. In the first phase of the research and development programme, great emphasis will be placed on the identification of users of the data bank and an assessment of their needs. In the second phase, research will concentrate on the development and testing of the data bank, involving pilot applications in key areas, again related to user requirements. As was stressed earlier, a data bank is not just a store, and the ultimate justification for the system will be the demand for the

facilities the data bank can offer.

Secondly, the *Institute* will become involved in *land use planning* in Natal. The operational phase of the data bank is the end product of the research programme, and the *Institute* will have qualified staff available to ensure optimum use of the data bank, placing emphasis on the dynamic integrative nature of the system.

Thirdly, the *Institute* will have a vital rôle to play in *education*, by providing a post-graduate course at Master of Science level in integrated resources planning, and by helping to identify and to focus attention on environmental problems in Natal by lecturing and producing papers for a wider audience of decision makers and the general public.

Finally, the *Institute* will become intimately involved in the *co-ordination of integrated resource planning in Natal*. There is already a duplication of effort taking place in several fields, simply because various Departments have not known what work was completed or under way in other Departments, and this is a waste of time, effort and money. A very important objective of the Institute will be to promote the maximum use of the data bank by all potential users by encouraging contact and regular meetings between the relevant sectors of commerce and industry and the relevant Government Departments.

In conclusion, an integrated approach to rural development is long overdue in South Africa as the most effective and desirable means of raising the standard of living for the majority of the population, thus reducing the migration from rural to urban areas. The holistic multi-disciplinary nature of integrated resources planning does not fit into any one of the traditional academic disciplines, and the *Institute of Natural Resources* will provide the combined expertise that no one discipline can do at present. It is an exciting opportunity for Natal to make a significant contribution to alleviating the problems of rural poverty and unemployment.

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