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The Moore River Catchment Forum 2000
Thinking Beyond Today

A Series of Essays by the Participants

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Abstract

Lectures given at a Symposium entitled "Thinking Beyond Today" and held at Moora, WA, in July 2000 were tape-recorded and are published here after minimal editing. The Symposium was designed for the benefit of the farming community of the Moore River Catchment area. Speakers from various institutions in WA and from overseas discussed the solving of a broad spectrum of problems of the area, including experiences from overseas countries, particularly Israel.

Preface

The Symposium "Thinking Beyond Today" was designed to bring before the farming community of the Moore River Catchment the latest Australian and international information about the problems farmers in this part of the world are facing in the twenty-first century. These are not just the widely discussed problems of increasing salinity and the loss of biodiversity. They also include many aspects of marketing our produce, of the development of alternative crops and of issues that stem from our farming heritage, both here and overseas.

The meeting was held in Moora on July 28, 2000. It attracted over 400 people from the area. Many of them hoped that the substance of the talks would be published and this Bulletin is the result. None of the speakers was asked to provide a manuscript, but the sessions were recorded on tape recorder and the Bulletin is derived from these tapes. Once the tapes were transcribed they were sent to the known addresses of the speakers with a request to edit them as required. About half the speakers responded. The editorial corrections of those who did were accepted without question. The texts of those who did not were lightly edited and appear very much as they were spoken.

The style is less scientific than that of most Bulletins because the publication is aimed at the residents in the Moore River Catchment rather than the scientific community. I hope that it provides a useful record of a very interesting day.

Stephen Davies **April 2003**

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Foreword: The Moore River Catchment Forum 2000 – Thinking beyond Today

Roger Forte and Helen Nankiville

In July 2002 the Moore River Catchment Group presented a forum at Moora, Western Australia, that was designed to challenge our mindset and lay a pathway to a higher degree of community proactivity within the Moore Catchment. Our speakers were chosen from local and international sources and combined elements of the past, present and future.

The Key Speakers were Professor Uriel Safriel, Director of the Blaustein Institute of Desert Research, Ben-Gurion University of the Negev, and Professor Yosef Mizrahi, Bernard Nichunsky Professor of Desert Agriculture, Ben-Gurion University of the Negev. The idea of inviting the Israelis came from Fiona Falconer who undertook an overseas tour that included Israel in 1999. In Israel she was given some insight into their innovative approach to agriculture and marketing. She thought that the Israeli attitude could do much to boost our progress today and into the future. Uriel and Yosef presented thought-provoking information as you will see in this bulletin. Observations they made from their experiences, directly related to our own development and potential opportunities in the market places of the world – if we wish to listen and learn. At times we need to see ourselves as others see us to move ahead.

The Moore River Catchment Council had hoped for an on-going association with our two key note speakers and the University of the Negev in Israel. Sadly world conditions have as yet prevented this occurring. Uriel and Yosef reminded us that to convince many of our potential overseas markets of our ability to produce products to world NRM standards, we would need to broaden our vision. Since the forum, there have been many changes locally at a government and community level and it is fortunate that our own tertiary institutions and staff along with a number of government and non-government groups have continued to support our development and encourage our on-ground activities.

We are grateful to all our chairman, Grant Woodhams, the speakers and

contributors, and to our many sponsors, including the Water and Rivers Commission of Western Australia, the Miling Zone Council of the Western Australian Farmers Federation, the Grain Pool of Western Australia, the Western Australia Department of Agriculture, the Progress Rural of Western Australia, the Pastoralists and Graziers Association of Western Australia, the Natural Heritage Trust of Australia, the Australian Broadcasting Commission, the Shire of Moora, the Shire of Perenjori and Elders Ltd. The committee and supporters within the Catchment Community worked hard to make the forum the great success it was, attracting about 400 people. We also thank those who hosted and transported our Israeli visitors as they travelled and spoke in the Moora sub-region. The Department of Environmental Biology in Curtin University of Technology kindly arranged the publication of this Bulletin.

Chapter 1 – The influence of New Norcia on the region's development

Abbot Placid Spearritt

Benedictine monks have been around in Europe for 1500 years, and were partly responsible for the spread of Christianity and civilisation in that continent. They had some setbacks, including the dissolution of some monasteries at times such as the Reformation and the French Revolution. When my monks are behaving badly I threaten them that that is just round the corner again. But when monasteries were suppressed in one place, they had a tendency to pop up again somewhere else. The monastery of Saint Martin at Compostela in northern Spain was closed down by an anticlerical government in 1836. A couple of its monks, Salvado and Serra went to the monastery at Cava, near Naples in Italy, but after a few years they caught missionary fever and went off to Rome , volunteering to go anywhere in the world. The Bishop of Perth, Brady, who was something of a rogue, was in town at the time, so these two were sent off with him and arrived in Fremantle in 1846. He, in turn, sent them north from Perth to convert everybody between there and Darwin. They would have died of thirst if they had not been saved by friendly Aborigines. They stopped at New Norcia because it was the first place, north of the last European's house, that had a supply of water and a supply of Aboriginal people. They had a rough time trying to survive in the bush for the first few years, and learned the hard way that they would have to earn their own living. Joseph Serra was made Acting Bishop of Perth in 1852 after Brady, the first bishop, had been ex-communicated.

When they started importing boatloads of new recruits and lay migrant workers from Spain, Bishop Serra set up another monastery on farmland outside Perth which he called Subiaco. St Benedict, who in about the year 500 set up the kind of monastic life these monks were following, was born in Norcia, in Italy, set up his first monastery at Subiaco and ended his years at Montecassino. Hence these names in Western Australia.

The monk who stayed on at the Moore River was Rosendo Salvado. He was made a bishop and became our first Abbot in1867. He set up the monastery along with an extensive sheep run, not many priests, but a lot of lay brothers and lay volunteers. He

was not the first European to take up pastoral leases in the Moore River basin, but he was not here long before he found he had to do that. And he discovered very early on, on the night of his arrival in fact, that water supplies were going to be a problem. So he sent his monks far and wide around the country to dig and line wells that would water their sheep as they went farther afield to find pasture, anywhere between Wyening near Bolgart and the Irwin River to the north. The brothers taught their skills and crafts to Aborigines, who then either worked for wages at the mission, or moved on to jobs with other local settlers. Salvado carefully bought up all the land around the monastery to stop white people bringing diseases and bad habits into the town. That is how the monastery comes to be in the middle of an 8,000 hectare farm on which we depend for a sizable portion of our income today. The farm is now run by three employees and in most years it makes a reasonable profit, from wool, wheat and canola. That is also how we come to have on our hands a town, full of heritage buildings, books, archives, art works, music and museum exhibits. And to be in the unparalleled position in Australia of being able to ensure that developers do not destroy it. At least that is what we want to do: conserve it, develop it sensitively and share it as much as we can with students and visitors of all faiths and of none. Our financial resources are not sufficient to do all the necessary conservation work. We have received some very generous grants over the years, but without tax deductible status for donations, we can not raise the 12 million dollars that our architect estimates will be needed over the next fifteen years. Tourism has brought in some income in recent years. We see that as a way of sharing and developing what we have inherited.

Schools for Aboriginal children operated from the 1850s until 1974. The general boarding schools we ran from 1908 to 1991 contained some Aboriginal students throughout that time. In 1996 we opened a new Education Centre, which is delivering curriculum-related courses in Aboriginal studies and other subjects to primary and secondary school parties and to some adult groups. We see that as an important element of New Norcia's future. Our olive industry has recently become prominent again and looks set for much future development. But the distinctive flavour of the town comes, always has come, and I intend, always will come, from the presence of a community of monks whose primary work and pleasure, is to be at peace with God and the bush, and so far as we can, to be at peace with one another and with everybody else. We think that is

the most important contribution we can make, as monks, to the well-being of the whole Moore River Catchment area.

Chapter 2 - Early farming and development in the region

Dr Rica Erickson

The Moore River Catchment area extends from Carnamah and Perenjori in the north to Gingin and Bolgart in the south. It includes large areas of good agricultural and pastoral land, formerly covered with trees and interspersed with belts of sandplain and extensive salt lakes. Before settlement the Aborigines gathered at permanent springs every summer, where they burnt the bulrushes before harvesting their roots. At the same time they fired parts of the bush to promote fresh growth to attract game after regrowth. Their's was essentially a pastoral life. The colonists used the land in the same way at first. Farming was limited to self-sufficiency and their stock grazed through the bush as freely as the kangaroos.

Pioneers

The first settler in this region was Captain Scully, who in 1839 established the northernmost farm in the colony at Bolgart. His establishment was to be typical of those throughout the Moore River Catchment until the end of the century. Bolgart is at the head of the Toodyay valley. Scully bought a 40 acre block of freehold land adjacent to the Bolgart water reserve, thus securing access to a permanent supply of water, which is the most important thing for the farming of any field. His stock was grazed on surrounding bushland, including a large area of land in the Toodyay valley, which he rented. The whole of the Toodyay valley in 1839 was either rented or owned by only three men, and Scully, Squire Phillips of Culhom and James Drummond of Hawthornden, who were instrumental in spreading settlement farther north. Scully built a cottage at Bolgart, where he grew enough wheat to keep him and his employees in flour for a year. Apart from his housekeeper and a labourer to help tend a large vegetable garden among other duties, he employed two Scottish shepherds. John and Donald Macpherson. When the bush was fired by the aborigines in summer, they had to take their flocks farther afield to unoccupied country, known as wasteland, until the rains stimulated the growth of herbage on their leased land. Apparently this was the situation when in February 1841, Scully, Phillips and Drummond explored north of Bolgart, as far as the Moore River, to find good pastoral country which they named the Victoria Plains. In due course, Scully's

shepherds were tending his flocks there at Badji Badji, while young Johnston Drummond was shepherding the family flocks at Maurin Pool. Shepherds were often paid annually by a share of the increase of their master's flocks, and within a few years they could save as many sheep as the original flock that they tended for their master. However, they could not claim legal rights to land, and were soon competing for access to permanent water on what was called wasteland. Drummond sought to buy a small freehold block of land at Maurin Pool, to secure the water, while the Macpherson's, who by then had small flocks of their own, applied for a freehold block at Badji. The Governor refused both applications, and imposed instead a system of pastoral leases. These were the first in the colony.

In 1845 the Macphersons, with two other Scottish shepherds, named Ewen Mackintosh and John Davidson from the Toodyay valley, pooled their resources and applied for the first pastoral leases. They then had legal right to claim access to water and to deny other people the same privilege. They were soon to become independent flock masters who could rival their employers. After Johnston Drummond was speared by an Aborigine near Maurin Pool in 1845, his flock was brought back to Hawthorndene. That land was soon occupied by a most unlikely group of men, some Benedictine missionaries who came to evangelise the Aborigines. Captain Scully aided them to go to the Moore River, and they were granted some land at the Maurin Pool. No one foresaw the role that they would assume in the pastoral activities in the future of the whole area from the Irwin south to Bolgart. Early in 1847 Scully left for Ireland, having rented his farm to the Lefroy brothers. One of them promptly explored north of the Moore River and in December 1846 leased 4,000 acres of Bebano. It is possible that James Clinch was already in this area, because, within a few days he also took out a lease next to the Lefroys. The Scotch shepherds, the Benedictines, the Lefroys and Clinch were to dominate the Moore River catchment area for decades to come. Other flockmasters to this region were obliged to lease land in isolated areas. James Drummond leased land at Dandaragan, while Mackintosh and Davidson went to the Koojan, leaving Donald Macpherson at Badji. The Whitfields went to lower Moore River, while a shepherd named Conlin, leased Yatheroo, north of Gingin, where the Brockmans held pastoral leases. Clinch blocked the way north at Bebano when he purchased a small freehold block at Watheroo, taking up a very large area of pastoral lease. Within a short time more

leases were added to these original first leases, so you can see how the land was dominated by a handful of men. The spreading leases were prompted partly because of a sudden development of a valuable trade in sandalwood after 1847. Sandalwooders encroached upon the pastoral leases until the Governor decreed that these leases also included the timber rights, which meant that the sandalwooders were denied the privilege of working over that area.

The sandalwood trade was to fluctuate in the future, but it was a valuable source of income when the prices of wool and horses fell. During 1849 and 1855, the Resident Magistrate of the district visited each of the pastoralists in the area and his records give a clear picture of their pastoral and agricultural activity, revealing the dominance of the pastoral enterprise compared with agriculture. There was little clearing of land for farming, although some was conducted also on a three year rotation of cropping, grazing on stubble and fallow. The only manure required was from the dung heaps near the stables and the sheep folds which mounted during the year. Clinch was not married in 1849 and he employed five men. He owned 3,600 sheep, 200 cattle, 20 pigs and 6 horses. He cropped 8 acres of wheat, 4 acres of oats and barley, 4 acres of hay, and also cultivated a kitchen garden. The kitchen garden was more important than the wheatfield. They could bring flour in, but they could not provide themselves with fruit and vegetables through the year, so the clearing of the land was very small. In 1855 he and his wife were living in a comfortable cottage and the outbuildings included quarters for ten employees. Also he had a neat dairy, stables and stockyards. He put down a number of wells and equipped and cropped 50 acres of wheat. These improvements were made over five or six years and although small by today's standards were judged to be adequate. His property was highly commended by the Resident Magistrate, and was to be later named, "Berkshire Valley".

Similar progress was made by Donald Macpherson. He extended his lease to 100,000 acres and he grew 100 acres of wheat on freehold land which he later named "Glentromie". Lefroy at Walebing grew a similar large crop, of 100 acres or more, and he increased his leasehold to 20,000 acres. Much of this lease included excellent agricultural land which some of the labourers wished to buy as small farms. But these moves were opposed by Lefroy, who exercised his pre-emptive right of purchase, so there was no

development for farming there. The Resident Magistrate wrote, 'It is much to be regretted that these monopolies of immense blocks of land give so little encouragement to their labourers and small growers of grain'. Some 20 years later, another generation of Lefroys, was happy to allow the sale of freehold land100 acres or so in extent in the Walebing lease to small farmers which generated a permanent supply of casual labour close at hand.

During 1849-55 the Benedictine community also began to grow. In 1849 there were only seven men in residence, including some laymen. Their stock numbered 1886 sheep, 29 cattle, 54 pigs and goats, and four horses. They grew 20 acres of wheat, but in 1855, due to the arrival of a large band of recruits from Europe, there were 40 men, employed chiefly in building a chapel as well as some farm buildings and a horse driven flour mill. They ground their own wheat, reaped from 150 acres. Some graziers were increasing the acreage under wheat in the 1850s and 1860s in anticipation of winning contracts with the Convict Establishment for the provision of flour. The economy of the colony had been stimulated by the introduction of nearly 20,000 convicts and free immigrants, at the expense of the British Government. This population explosion had generated a need for more food.

Settlement

Farmers near the port of Fremantle sometimes bought guano, obtained from the islands off the Geraldton area, but those people in the Victoria Plains found the cost of hauling too great and they still depended upon their dungheaps, until the railway came through. They gave up farming on such a large scale, as South Australian flour could be imported at a much lower cost than Western Australian flour. The issues of protection and free trade were warmly debated, as much then as now. The graziers of the Victoria Plains turned instead to breeding horses for the India trade and increasing their stock numbers to compete for contracts to supply the meat to the markets down near Perth and other places.

Settlement beyond Watheroo began in the 1860s. A disastrous flood in 1862 along the Avon Valley washed away a number of cottages, and one of these was William Long's house. William Long was a labourer, so he squatted on vacant land at Coorow,

until he was obliged to take out a leasehold. He then made a living as a sandalwooder and a mail contractor, until the 1890s when he was classed as a grazier. The Broad family, whose home suffered the same fate, was allowed to take up land at Round Hill near Walebing. Then in 1867 (after a series of bad farming years in the Toodyay valley, followed by a fire) Duncan Macpherson went farther north to Carnamah to begin as a grazier and a small farmer again. His wagon and equipment were supplied by his brother Donald of Glentromie.

The isolation of the households in the Moore River Catchment area was relieved a little by the introduction of a postal delivery once a month, later increased to once-weekly. Then in 1873 a telegraph line connected Perth with Geraldton and the women in the households along the way were trained to use the Morse Code, and were appointed as telegraphists. News of the world, as well as their neighbours was then readily available. However, distance and the consequent high cost of transport in time and money, discouraged settlement, even when special occupation leases (SOL) were introduced in 1871. These encouraged the labouring class to buy land which they could then secure on a system of time payment. After occupying his lease and improving it, and making payment for ten years on SOL a man could receive the freehold title. At first only a few men in the Moore River area bought a farm block by this means. By 1871, there were only thirty households, and of these, 17 were pastoralists, five were listed as farmers and the remaining eight were tradesmen etc.

Soon after the SOL system was introduced the prices of wool, horses and sandalwood all fell at the same time. Many pastoralists became indebted to the merchants, and forfeited some of their leases to them, which explains how Padbury and Loton become owners of many properties. Those merchants who survived the bad times really carried the burden until the economy recovered, while some pastoralists who weathered the disaster, became more firmly entrenched, despite their mortgages.

During these years the Benedictine community grew even larger. By 1885 Bishop Salvado was leasing nearly a million acres, paying a rental of £967. These stretched in a chain from the Irwin District to Wyening, near Bolgart. Fifteen shepherds were scattered on outstations at that one place. A model farm was developed by the Benedictines at the

mission land near Watheroo, where the acreage under wheat was increased from 200 to 700 acres. That was necessary to support the very large community at New Norcia. Small farmers who were taking up land 500 acres of SOL land near New Norcia were astonished at the size of modern machinery introduced at the Mission.

The Benedictines were the first also to attempt to stop land degradation. In the 1880's they grew concerned about erosion around their wells and the stockyards, so they planted couch grass around these places. Isolation was slowly overcome by construction of the Midland Railway Company that was finally completed in 1894. The railway company received land concessions from the government of over three and a quarter million acres. Many leases had to be given up, and notice was given to the holders of other pastoral leases that many of these would not be renewed. Some pastoralists then continued leasing from the Midland Railway Company. This brought about a worse monopoly of land. Among the first of the Midland Railway Company lands to be sold was a huge area in the vicinity of Bolgart in 1903, which was bought back from the Midland Railway Company by the government for subdivision. The government sold this land in lots of 500 acres. The Moora district land that was subdivided in 1906-8, attracted 80 new farmers to the district, and they were buying blocks of about 1500 acres, because the opportunity to go farming on a bigger scale was given by the creation of an agricultural bank. The Lefroys of Walebing altered their management of the land to suit the needs and the times. Their leasehold of 200,000 acres was reduced to 15,000 acres of freehold which would be divided among members of the family. Instead of open range grazing, they fenced their land (none of the pastoral leases had been fenced before) and they dispensed with shepherds, reducing sheep numbers from 10,000 to 3,000. They cleared trees and scrub and grew pastures, wishing to maintain Walebing as a stud sheep breeding property. They put down dams and when some became salty, this warning of coming environmental damage over the whole of the Moore River catchment area was scarcely heeded. Farms were enlarged, and tractors replaced horses, so there were no more dung heaps. In 1912 areas around Perenjori were opened up for wheat farming, after the railway was extended north from Goomalling. The old methods of land management gave way to the new. Present day farmers are daunted by the task of halting the loss of land through salt and wind erosion. Their hopes are pinned on united action such as that promoted by the Moore River Catchment Group.

Chapter 3 - Israel's agricultural development and the Blaustein Institute for Desert Research

Professor Uriel Safriel

Geography

Since we have just heard the history of this area, the Moore River Catchment, I think it is appropriate, when talking about Israel's agricultural development, to give provide some historical background on Israel. Israel is positioned between Arabia, Africa and Europe, with the Mediterranean Sea to the west. It has a Mediterranean climate and many of its ecosystems are Mediterranean ecosystems. But Israel is only partly a Mediterranean country; it is also an African country in that it includes within its borders part of the Sahara Desert; and finally there are the Asian steppes and deserts that penetrate into Israel from the east, so Israel is also an Asian country.

Israel is not much bigger than the catchment here; it is about 500 kilometres from the southern end to the top end, and not much more than 100 kilometres east to west, altogether 42,000 square kilometres. The rainfalls, which all come in winter, reflect the division of the three regions, the Mediterranean region, the Asian region and the African region. There is a gradient from the south of less than 50 mm a year to the north at sea level about 700 mm a year A very sharp gradient in rainfall exists between the desert part of Israel, which is the Negev Desert and the non-desert part of Israel, the Mediterranean region. Accordingly there are different types of dryland in Israel. From south to north there is the hyper arid part which is like the Sahara, in the southern part of Israel; the arid part, where our university and my Institute is; and the semiarid area and the dry subhumid area. These are the four dryland types of the world, all of them occurring within this small tract of land, Israel.

History

The history of Israel is quite recent. In 1917, by agreement between the British and the French, the land east of the Jordan River became Trans-Jordan and, at the same time, the other, west, side of the River Jordan was Palestine, named after the Philistines, the

biblical Philistines, who had lived in this region. Israel was established in this area called Palestine in 1948 Jewish emigration to Palestine started around 1880. At that time there were about 300,000 Arabs there, mostly nomads, some settled in villages. The nomads were pastoralists and the settled were farmers. Both of them caused much deforestation of the land. About half of the land - 45% of it - was forested, and they used the area for firewood, forage and for rainfed agriculture. So this was the kind of land that the first Jewish immigrants found. Nowadays a little more than 100 years since the immigration started, there are on the land 5 million Jewish Israelis, 1 million Arab Israelis, and 2 million Palestinians in what is now the Palestinian territories, managed by the Palestinian Authority. So this is the land and its relevant history.

The Social Context

Israel is regarded as an agriculturally developed country, especially compared with what it had been in the late 1890's when the first settlers arrived there. And the question is how did they do it. I think there are three elements, or three ingredients, to the Israeli development of agriculture over the last 100 years although in recent times the significance of agriculture has declined in Israel.

The Jewish people that came to Israel felt that they had a mission. It stemmed from religious motivation in part. For example, they remembered Old Testament directives that upon arrival at the land of Israel one should plant trees. And "when you will be there everyone of you will sit under a fig tree and in a vineyard, under a grape vine". So tree planting is the first thing to begin with. There was also a secular mission. Most of the immigrants were secular people, not religious people, and there was the secular mission of turning landless and wandering merchants who came there into landowners and into people who make their livelihood with physical work. It was very important to make this transformation, and what better way to do so than to make this transformation in working the land. The second aspect was the image. The people found that the country into which they came was desert, all of it, non-populated, heavily over-utilised, over-exploited and denuded of vegetation. The reality was very bleak because they came with the Old Testament image of a country that is a land of milk and honey. So where is the milk and the honey? Probably it had once been a land of milk and honey and therefore this image inspired the people to try and do something with this land in spite of

the way it looked. And the third ingredient was, I think, the most important. The people who came there to be farmers had no farming tradition whatsoever. They did not copy from the people that they found living there, because they thought there was nothing to copy there or to imitate when they saw how the country looked compared with the image they had from biblical tradition. They did not have any farming traditions from the countries of their origin that they brought with them because they were merchants or business men and they never owned land in their countries of origin. So these are the three pieces of baggage the settlers brought with them: a mission, an image of something different and no farming tradition. Therefore with no tradition, and not knowing what to do, it was very easy for them to turn immediately to science, and try to find out using scientific methods and scientific institutions how to make the land productive.

Israel's Solutions

The first element that distinguished Israeli agriculture from the indigenous agriculture that they found was the conviction that irrigation is a must, because this is a country with a non-rainy season lasting seven months. Thus the basis of Israeli agriculture is not very different from that of Western Australia's. The three points that I just mentioned are most significant and led to an emphasis on water resource development. A lot of research was done in groundwater development, but also on surface run off control, lake management, the operation of reservoirs that water most of the country, and the transportation of water along great distances. Many advances were made in water conservation, drip irrigation, greenhouse technology, and in conserving water by preventing evaporation, and in waste water reuse for agricultural purposes. Furthermore the settlers have invested a lot in reclamation of swamps, because much of the country was a man-made marsh. They also undertook the reclamation of moving sand and used the sand as prime agricultural land in dry land. In addition they applied soil conservation techniques, terracing and planting orchards, not only for producing food, but also as a means of arresting soil erosion.

The history of the agriculture of Israel is gradually shifting from subsistence agriculture to cash crop agriculture. It means agriculture that is not supplying the needs of the country only, but producing wealth, and this requires marketing and business. This requires a lot of infrastructure, credit systems, transportation, marketing. These require an

asset that most developing countries do not have - a strong, central government that can manage national enterprises supported by science. There are academic institutions in Israel that deal with agricultural research, not only Ben Gurion University to which Professor Mizrahi and I belong, but there are research and development stations in the field in peripheral areas and there are very good extension services that disseminate to the farmers the results of academic research generated by the local research stations.

Chapter 4 - Community attitudes to land degradation – Part 1

Sally Marsh

Last year (1999) a team from Agriculture and Resource Economics at The University of Western Australia was commissioned by the Waters and Rivers Commission to look at community attitudes to land degradation and acceptance of water management options in the Moore River catchment. The work was done by one of our fourth year students. We tried to get attitudes in two ways. First we asked people to give responses to a series of statements and secondly we worked through what is known as a choice modelling framework.

Methods

We surveyed 100 people in the city and 100 people from three rural towns in the catchment, Dalwallinu, Moora and Guilderton. We chose these towns because they are high, medium and low in the catchment. We also interviewed 66 farmers at shows in Dowerin, Moora and Dalwallinu, and of those 43 (65%) came from the Moore River Catchment. The surveys were all done by the fourth year students. Two hundred and sixty six people is not a very large sample for a survey, but the choice modelling technique that we used is very complex, and the surveys take a lot of time and have to be done in a one-on-one situation. That is the main reason why there are only 66 farmers, because many people refused when asked to participate and told it would take half to three quarters of an hour to do.

In the first part of the survey, where we asked people to give a response to a series of statements, we aimed to identify their attitudes towards agriculture and the environment, to identify their awareness of agricultural and environmental problems and to identify their attitudes towards the trade-off between individual and community responsibility for the management of natural resources. We asked people to say whether they strongly agreed, agreed, were undecided, or disagreed with each statement.

Results

From the responses to the questions, we can say that the people in the city were significantly less inclined to agree than the town and farm populations that WA needed to maximise agricultural production, and that government legislation to protect the environment is hampering primary industries. But responses to the statement that the government should give higher priority to policies to conserve and protect the environment were not significantly different between the city, towns and farms. The town populations agreed more strongly than the farm populations that society has a right to expect farmers to farm in a way that maintains land and water in good environmental health.

We went on to score these questions in a different way to obtain an overall score of each individual's attitudes. We added scores for responses to different questions to give an indication of whether their attitudes were pro-agriculture or pro-conservation; whether they were unaware of problems or aware; and whether they thought that the public should be responsible for environmental issues or whether individuals should be. High scores indicated that respondents favoured conservation, were more aware, and favoured individual responsibilities. This gives us a distribution of scores that showed the scores from the three populations were slightly different, but in many ways similar. City people to some extent are less pro-agriculture, as you might expect, than farm people.

All the populations tended to value conservation of the environment to some extent, but the city more than the towns or farms. All populations supported agricultural use of the land, so you could say that these questions enabled them to opt both ways. Awareness of the problems caused by agriculture was only moderate in all the populations sampled and the people in the city were least aware. The people in the city were significantly less aware that salinity is affecting biological diversity, buildings and roads. Farmers were significantly less aware that agricultural activities are damaging river systems and wetlands. All populations tended to think that the general public should accept more responsibility for addressing environmental problems. There was a very low acceptance of the idea that rural landholders should be solely responsible for funding landcare activities in their district, or conversely there was a general acceptance of a larger responsibility. In many ways the conclusions from the first part of the survey are

very general. The choice modelling technique enables us to look at responses in much more detail.

Chapter 5 - Community attitudes to land degradation – Part 2

Professor Michael Burton

Methods

In the choice-modelling framework we offered people different futures for the catchment and then asked them to make choices. It is all very well to make these general statements, "Yes, I want to protect the environment; yes, I want to have a healthy agriculture", but you quite often can not get everything you want at the same time. You have to make choices and trade-offs. What we did was describe what we thought were the key elements of the catchment, that came out from previous focus work with people in the area. The key elements were:

- the amount of land that was being affected by salt.
- the area of the catchment that was planted with trees.
- whether what happened on farms had an impact on wetlands, for example through excessive salt flowing into them.
- whether or not there was the risk of a major flood event in the catchment.

We were a bit unfortunate, because when we were actually surveying we were right in the middle of last year's flood event, so this really came to the fore as to what people were concerned about, but we thought that important because the way the catchment is managed will change the probability of such risks.

We asked what has happened to farmer's incomes, and we thought this was not just important for farmers, but also important for the local community because their businesses are going to depend on the economic health of the farming industries. We also asked them to consider giving a hypothetical contribution to something we called the Moore Catchment Conservation Fund, where they would actually have to put their money in order to achieve outcomes. So people were not just asked to have a free ride, to suggest

changes to the catchment and then not have to pay, we asked whether they would be prepared to make contributions to achieve these outcomes.

In this version we present three different possible futures for the catchment the attributes of which vary. In some you have high risk; in some you have farmers' incomes going up, in some farmers' incomes go down. It is a difficult problem for people to consider which one they would prefer. Remembering that in the end a person could well be opting to actually pay a contribution to achieve the outcomes. Surprisingly people were prepared to do this. We were very grateful for the time they gave to complete the survey. Each had to choose the futures they preferred. We had a lot of responses that we took back into the office to try to work out what it was that people value, by looking at the futures they chose. What is it they are putting value on? What is it they are trying to achieve by making those choices? What element of the catchment is important to them? Essentially what elements of the catchment would they be prepared to pay for? What do they put value on?

Results

Here is a summary of some of the key elements that emerged from the analysis of the responses from the three different groups that we looked at separately, the rural towns, the Perth population and the farmers. The result that emerged was that everybody seemed to prefer more tree cover in the catchment, up to 20%. The way to interpret this is that people would be willing to pay $131 a year into a management fund, if they could get a tree cover up to 20%. And that is a fairly consistent effect across all three groups. On the question would you support 50% tree cover, which would be a major change in the catchment, rural townspeople did not like it, or were indifferent to it; people in Perth thought it would be a great idea if the catchment got up to 50%, or were still quite happy with that. Farmers rejected the idea of 50% tree cover. So there is a diversity of views emerging about the degree of tree cover that might occur in the catchment.

The second proposition was about salt, that is in terms of what is a percentage point increase in the area of salt that would be tolerated. Rural towns were prepared to pay $70 to avoid a 10% increase in the area of salt affected land. Obviously the message about salinity is being taken up, and, I suppose what surprised us, is it is being taken up in

Perth as well. The surprising feature was that farmers did not treat that as being an issue that they were particularly concerned about. Now it is interesting that when you do these surveys, you do not always get the results that you thought you would get, and more questions get raised. We thought there might be a landcare ethic that would be concerned about the salt area but this was not so. This was something we did not know and we want to look at it further.

The third proposition concerned impact on wetlands. Again all communities were aware and concerned about the possible impact on wetlands, and would like to avoid it. It was considered bad to have negative impacts on the wetlands within the catchment that were not on farms.

The fourth proposition was about flooding and, not surprisingly, rural towns, given the time we were doing the survey, were very concerned about flooding. They did not like futures of the catchment that had increased risks of flooding in the catchment. We were doing this survey when there were still the flood marks on people's rooms, and not surprisingly the townspeople were concerned, particularly those in Moora as compared with the other two rural towns. Perhaps what was a surprise, the people in Perth were also aware of the impact that flooding would have on people and wanted a catchment future which did not include flooding. The farmers did not seem to be concerned even though they were closely involved in it, but it was not one of the features that was making them select potential futures for the catchment.

The last proposition we looked at was changes in farmers' incomes. We had the notion that certainly the people in rural towns should be concerned about the economic welfare of farmers; they know them, they are their friends, but they also rely on them for business. What we found across all the groups was that everybody disliked the notion that in the future farmers' incomes would be falling. So they did not choose or they were averse to futures where farmers' incomes were coming down. This was not surprising for people in rural towns, not surprising for farmers, because we were actually asking them would they take an income cut, but the people in Perth also seemed to have some sort of concern and care about the economic welfare of farmers in the catchment. What we managed to do was to identify whether people felt differently about farmers losing

income as opposed to farmers getting increases in income. And what we found was that people did not choose options where farmer's incomes were rising. This suggests that they were prepared to compensate farmers if the management plan in the catchment caused incomes to fall, but they did not want to overcompensate farmers; they did not see any reason why there should be a catchment management plan that caused farmer's incomes to rise. And that was quite consistent; it showed up in the rural towns, it showed up in the Perth population, and perhaps most surprisingly, it showed up with the farmers too. Farmers were not just being self-interested and choosing the future that gave them the highest income. They avoided the futures that gave them losses in income, but they did not just tick the box which gave them over twenty grand a year. Now that, I think, is an interesting response, and it is a hopeful one. It means that people are prepared to view the catchment as a whole, rather than just consider self-interest.

One element that we had was diversity. There was a great diversity in how farmers valued increasing the tree cover in the catchment up to 50%. If tree cover rose to 50% it would mean that a lot of farmers were no longer farmers; they would either be managing bushland or they would be managing plantation, or whatever woodland was planted to make 50% of the catchment into trees. The majority of people did not like that idea and some people would have been prepared to give up $7,500 a year to avoid that option. But there was a very wide distribution. Not everybody in all three groups had the same view as to what was the appropriate management of the catchment.

We found a high degree of diversity within the groups, across the three populations. What was driving that diversity was their differing notions of responsibility and values. If the people thought that the community should be willing to pay to support the environment, they were actually prepared to put money into the system. So they were being consistent across the results that Sally Marsh was showing and the way they were responding here. As I said, where you lived changed your outlook on things like flooding.

Conclusion

In conclusion there was a high degree of agreement across the communities about what they wanted to support within the catchment. In general, they recognised the environmental impacts of farming, they wanted to increase tree cover and so on. There

was also a high degree of variability of response within those populations. For example not everybody in Perth thought the same way about the catchment.

Two elements stand out from the survey. The first element is one of hope, that gives a basis for coming together and agreeing on what should be protected within the catchment. But this leads to the challenge and the second element is a challenge. The challenge is that there is a diversity of opinion within the community. You have got somehow to reconcile this diversity before you can come together with a plan that the whole community can then take forward and implement. So I think the survey showed hope and a challenge for planning the future management of the system.

Chapter 6 - Israel's farming survival on the edge of the European Common Market

Professor Yosef Mizrahi

Israel has achieved recognition around the world that it has a very efficient agricultural systems and its journalists and economists are very keen to make comparison between Israel and other countries in the world. In 1996 one of our most popular Israeli newspapers published a survey to compare the performance of Israel with 46 other different countries. In terms of government expenditure, we are number one in the world to waste money. That is our government is wasting so much money and it is not efficient. On other hand, when it came to agricultural production we were best in comparison with the other 45 countries. Everybody in Israel should be happy with that. On the other hand, if this is the case, why do we have 170,000 doonans (we measure land by doonans, which is one tenth of a hectare) that are idle? The farmers do not cultivate them any more. And why are the number of farmers declining in Israel, how is it that we are number 1 on one hand and we have a major problem within the farming community in Israel on the other? But both figures are true and we do have a major agricultural problem in Israel. The limiting factor is water. Farmers are allocated water because land, even though Israel is a tiny country, is not a problem; the problem is water. How much water we can allocate to farmers to irrigate? And unfortunately we have no more fresh water for agriculture and all the water in Israel for agricultural production is either recycled sewage, or saline water that we found in our Negev Desert. Part of the explanation is given by the price index from 1987 to 1996. We have an overall price index in the country, and we have prices for fruits and vegetables. Both are going up year by year due to inflation, but rate of rise of the general price index is more than that for the fruits and the vegetables. This means that a farmer who used to live happily in 1987, after nine years lost over 40% of his buying capacity. He earns more money in terms of Israeli shekels, but he can do less with them. So this is the problem, that we have inflation that is going up all the time and the prices of agricultural products do not match the rate of rise. The gap is growing all the time and this is the main source of problems to the farming community. We are very efficient, we have very high yields, we have good quality products, but farmers cannot make a living out of them. So everybody says, let's go to the world market and whenever we say market, we mean Europe. Europe is our next door neighbour. There are 360 million people in Europe to whom we can sell our produce. But there are snags.

First problem

We pay very high prices for energy and if we buy machinery abroad, and we do, we pay twice as much as the Europeans, three times as much as the Americans and we cannot compete in the world market under these conditions. So if we are in Israel and if we insist on growing common crops such as the citrus that saved us for almost 100 years we are in trouble. We are in trouble because we have mostly aimed for export and for many years such exports were the main source of foreign currency income to the country. No more. It cost us more to produce citrus than they pay for citrus from Morocco, and both of us compete in the European market. Partly this is an effect of time. The nearer to the market the cheaper you can deliver.

Second problem

So with this in mind, we reviewed the strategy within our university. First we recognized that we like research. Secondly we recognized that someone should take the know how and make a living out of it. That it would be wasteful to undertake research on common crops that do not enable people to make a living. So we decided to examine exotic crops, where returns were high.

Now our philosophy is very simple. Around the world there are thousands of wild plants that people have been using throughout history, but the scientific community ignores them. They are lying there in nature, and nobody does anything with them. A very good example is in Australia. You took the tea tree oil which the aborigines were using to disinfect wounds, and you developed it into a significant world crop. The last figure I heard was in 1995, when I visited the Thursday Plantation at Ballina in New South Wales where they produced tea tree oil and other tea tree products. They told me that they are exporting about 250 million dollars worth a year. I understand there are more companies today that cultivate the tea tree oil and I think it is very important example how we had wild plants that we were simply ignoring.

We, with the help of ethnobotanists, made a list of sixty different wild plants, all of them bearing edible fruits, that indigenous people had been using for thousands of

years. We decided to test them to see whether or not we can grow them as new crops under the Israeli conditions. We brought them to Israel to the southern part of the country, the Negev Desert, Hiem in Betheshaeba, and we established test plots in the Besor Valley, close to the Mediterranean where the water is good quality, around 1 dS/m. Then we established another station in Ramat Negev, where we have both fresh water and saline water at the same station so we can compare the performance of the trees with saline and with good quality water. We have another region, where we have only saline water in the Hakikar Valley on the shores of the Dead Sea., but the water there has more calcium than sodium and more sulphate than chloride, and this make a big difference. The climate there is like hell in summer. It can go to 47°C. We have another station on the north of the Dead Sea. Again each one is different in climatic conditions and in salinity conditions. So we tested these new trees to see if they could survive and if they could produce fruit. We identified the most promising candidates. We aimed for seed collection; we always start from seeds to give us a wide genetic background. We germinate the seeds, of course under quarantine, transfer them to the nursery, we establish them and then we measure plant establishment, growth measurements, phenological observations and everything that we can measure. Later on we come to measure yields and fruit and nut quality, because we are aiming at the export market. To invest in R and D for six million consumers is a waste, but to measure and to work for thirteen hundred and sixty million consumers in Europe deserves R and D effort. And once we reach this stage and are happy with the performance of one of the plants, then we go for vegetative propagation and semi-commercial production and after 16 years of research I am proud to say that we introduced to Europe four totally new crops and all are Cacti.

Third problem

I would like to show you the variation in climatic conditions. Let us, for example take the Neot Hakikar where there is 3,900 mm of evaporation and only 43 mm of rainfall. The difference between this and the best area in the Negev Desert at the Besor, where there is close to 2,000 mm of evaporation and around 200 mm of rainfall is great; Besor has a ratio of 1 to 10 between evaporation to rainfall. Again, if we take Hakikar, it is very hot in summer with the average in June, July and August around 40°C, and the

extreme can go to 45°C, even to 47°C. In some areas in our Negev Desert, in Ramat Negev, we have sub-freezing temperatures almost every year. The average is close to zero, or 3, 4, 5°C, so we have all the extremes from sub-freezing to extreme high temperatures where we test our plants. We have various ways of compensating for these variations. For example in the Arava valley (this is the Syrian-African Rift Valley) when we start planting, each tree is covered with black net to protect it from extra radiation. We then let the tree grow above the net.

Salinity, too, is a very important problem because we have plenty of saline water, but what kind of crops can tolerate irrigation with salinity? We still have some, very little, dry land farming in Israel, but it is not significant; it is not significant in Israel for other reasons, and all the agriculture we are talking about will be irrigated either with saline water or sewage water.

Chapter 7 - Financial implications for future farming

Jerome Gumley

Agribusiness today finds itself swamped in a fast pace dynamic environment. It is important to keep your enterprise in harmony with this environment to keep it profitable. As caretakers of the land it is equally important that we also have a useable resource for the future. What I would like to discuss is profit and sustainability, but also do so in the context of the broad environment in which we find ourselves. So first I shall go through that broad environment before we get into the profit and sustainability elements.

Globalisation

Markets are opening up on the world scale. Many forces affect globalisation of markets, for example that there is a strong similarity between countries and their marketing distribution approaches. There is a technological revolution - e-commerce, leading to close and rapid communication. There are new global-based companies, rather than country-based companies. For agribusiness, we see globalisation characterised through opening markets, reduced subsidisation with each General Agreement on Tariffs and Trade round, increased competition, fluctuating commodity prices and the exchange rate movements. We have also got changes to the supply chain. Revolution in the Australian grains industry is a good example here. We have got the restructure in the form of privatisation with the Australian Wheat Board, Grain Pool and Cooperative Bulk Handling. Similarly in the dairy industry we have undergone some major restructure. On the supply side, we have also seen mergers on the horizon in the merchandise sector; for example the Wesfarmers Landmark merger.

Technology

Already over 50% of Western Australian farmers have computers and a growing proportion are going on line. Computers not only allow us to conduct our cashbook and budgets, we can do on-line banking, do share trade transactions, and access a whole heap if information, whether it is meteorological or other information.

Genetic Modification

The value of the global market for Genetically Modified crops is expected to be six billion by 2005. In 1998 some 30 million hectares of Genetically Modified crops were grown worldwide, over three quarters were in the US. In Australia we have BT cotton, we have basta resistant and roundup ready crops that are awaiting release. These are looking to reduce chemical and culture use in paddocks, which should improve sustainability. On the other hand we have to keep in mind that the European Union, particularly Britain, has been slow to embrace this new technology, due to the consumer concerns. Major food retailers such as Sainsbury, Tesco, Marks and Spencers have all adopted Genetically Modified free or limited Genetically Modified products. There is concern about possible side effects, reduction in biodiversity, and other ethical concerns. So there is quite a bit of debate there to go through. We have got the labelling issue in Western Australia. There is the proposed moratorium for two years to go through the debate a little bit further. So all those things are impacting.

Global warming

The impact is a large fluctuation in weather conditions. Global issues such as carbon credits are seen to be a good way to reduce the carbon emissions. If this principle is fully adopted by Australia, then there is a lot more opportunity for tree planting, not only to have that direct sustainable improvement on land but also to have some extra value as a carbon credit.

Commodity Prices

We have heard the story about the declining terms of trade. I would just like to highlight an interesting set of figures that I found through the Australian Bureau of Agricultural and Resource Economics. We have seen quite a dramatic decline in both wheat and wool prices between two seven-year periods, ending with the year 2000. Over a 40% drop in wheat price and around a 30% drop in wool price shows up. At the same time, the figures are both indicating the increases in production, and you can see that for wheat production, for example, we have increased production by 48%, and there's been a 12% increase in wool production. And that increase in cropping or grain production is largely through

new cultivars and new management techniques.

In the rural environment we're seeing the number of farms decreasing. It is anticipated that the number of farms will reduce by 50% in WA from to 2,400 by 2020. Corporate farming is on the rise. Productive land is being lost to salinity and this trend is predicted to continue. At the farmer level, the average age of farmers is around 55. This same farmer carried an average debt of $169,000 in 1995, moving up to $198,000 in 1998. For those that are into the higher percentage cropping enterprise, that debt change went from $269,000 to $308,000 over that period. Labour on the farm is generally down to about the two principals. Today's farmer needs to be multi-skilled. He and or she, needs to be an entrepreneur, family person, accountant, financier, negotiator, meteorologist, soil scientist, agronomist, researcher, stock specialist, shearer, mechanic, welder, fitter and turner, dangerous-goods handler, pest controller, heavy machinery operator, truck driver, commodity trader, quality assurance officer, marketer, lawn mower, plumber, electrician, child minder, football club committee member. And I am sure there are a couple I have left out.

So in that quick snapshot I have raised a few issues of the environment in which we find ourselves. Now I want to look at profit and sustainability within that context.

Profit

Profit is a decision. It is a culmination of strategies aimed at receiving the best price for products, high production levels and cost efficient inputs. It is the true bottom line for a business. Quality of life begins when you make a profit. Blackburn and Ashby put forward a well used definition for profit. It needs to service borrowings, provide families with an adequate standard of living, allow on-farm investment to maintain productive assets, provide funds for investment, increase long-term productivity and demonstrate ecological sustainability.

What I would like to discuss is some of the indicators we like to look at when looking at profit. I have taken this from a publication that Rural Industries Research and Development Corporation has put out recently on sustainability indicators. Just a couple of the indicators we look at, and by no means are these the hard and fast rules; it just

gives you a bit of a starting point. For example, equity greater than 90% is a strong position, and for less than 75% you need to have somewhat of a more careful look. I mean you would have to qualify the equity situation; for example if you have gone into a farm purchase recently, then obviously equity is going to drop down but because you hav increased the area that you are producing from there is very good ability to retire that debt quite quickly and get back to a strong equity position. You have to take these indicators with some qualification. For operating costs as a percentage of farm income, we are looking at the average of about 50-75%.

Before I go too much further into bench marks, I need to mention a conference I was at recently that had a good analysis of averages, that being if you stand with one foot in a bucket of hot water and the other in cold, on average you should feel comfortable. BankWest has been recording farm performance since the sixties. In 1998-99 we surveyed over 550 farmers and for 199-2000 again we have had a similar number of farmers surveyed, and we are hoping to have the results out by the Dowerin Field Day. Using a couple of the indicators that we looked at before, we can see that equity is an average of 84%, and that is fairly constant. And the other one I wanted to highlight is the operating cost as a percentage of farm income, which. on average, is running at about 76%, with the top 25% down at 59%.

A couple of other good indicators for farm profitability are the gross margins. The greatest amount of farm income tends to come from 60-90% of the farm. And I think that gross margin analysis would have been particularly useful this year (2000) with a late break of season occurring, you can start to look at your paddocks or portions of your property and start to look at the marginal costs and the marginal returns and start to look at your strategies for that particular crop or that particular paddock, and whether canola or wheat or barley is the best option. Also when you are looking at your spraying or fertiliser strategies you can start to look at the amount of money spent already on that particular crop, the condition of the crop at the time and the potential from then on, and start to work out how viable it is to use that extra spray or that extra hundred kilos of urea. Water is used efficiently and is an important indicator for profit; maximising water use has a pull.

Management and planning

These aspects are very important to keep the operation in perspective. You need to have your short term plan, your cash flow budgets, and you also need to have your five-yearly plan or your longer term plan, and your succession plans. All these are very important things to have in perspective. Your land management plans need to be worked in with your farm business plans. Otherwise those large rolls of soil maps with the new fence lines, proposed tree plantings, will remain on top of the fridge You need to revisit your plans regularly and update accordingly. Yield mapping is another management tool that has gained popularity. Having better records of yield and quality through various paddocks not only identifies the management required for those paddocks the following season, but also identifies those areas that it might be better to leave out of crop due to low marginal returns.

Education and information

The farming industry is becoming very technical and specialised. You need to keep up your training in areas of marketing, quality assurance, budgeting, agronomy, and so on. You need the specialist's advice, but it is important to understand fully the advice given, because it is ultimately the farmer who makes the final decision. There is a vast array of information through a number of media outlets. The best or the worst is the Internet. Take advantage of these sources. Select the credible ones and make the most of that information.

Specialist services such as a farm consultant may cost x amount of thousands of dollars a year, but if that consultant is consistently able to lift your yield or make your costs more efficient, then that can lead to tens to hundreds of thousands of improved return.

Value adding and differentiation depend on up-to-date information. In the future one could argue that there will no longer be premiums for high quality; rather the bar will simply be raised and there will be discounts for poor quality. I think that we need to look at developing quality systems for businesses to maintain the overseas confidence that Australia is clean and green. Market deregulation is an opportunity to form cooperatives,

differentiate product and capture new markets.

Sustainability

Of all human activities it is perhaps agriculture that alters the global environment to the greatest extent. I saw a very good quote in America from a company called Casadian Farmer, an organic retailer, the largest organic retailer in the US. They say, "Live like you will die tomorrow, farm like you will live forever". Sustainability, though well used, is still not well defined. Some may even argue that it is minimal impact farming. Sustainability indicators are important to financiers. The indicators cover social, economic and environmental areas. I mean the major security is the land, so it is very important that that asset, that that security, is well maintained for the future. Annual cost of unsustainable farming totals 1.6 billion dollars in Australia, so there is a lot at stake here. The indicators need to be measurable at the farm level. I mentioned the Rural Industries Research and Development Corporation report on sustainability indicators. It is very good on the profit analysis, but not so good on the environmental and other indicators provided. So I think some more work needs to be done in that area. We need to account for the clean green image, and financiers are taking a close look at sustainability. One example is from Canada. You may be aware that the financiers over there are having a close look at resource management and agricultural production because in instances over there the laws have a greater ability to go beyond the corporate veil, as they call it; and in areas where land has become significantly degraded or contaminated they can look beyond the actual farmer or the company which is managing that land and go and take a bite at the financiers. So they are now very interested in land management.

Chapter 8 - The importance of biological diversity

Professor Stephen Davies

I am going to begin by telling you a little bit about what biological diversity or biodiversity is. It refers to the variety of life forms, the different plants and animals and micro-organisms, the genes that they contain and the ecosystems that they form. Now it may be a familiar word, but the concept it names may be a bit unfamiliar to you, so I shall describe examples of areas of high, medium and low biodiversity. This example comes from Dumbleyung Shire, where I was asked to do a survey of their unmade road reserves. One of the things that the early surveyors did was to divide up the land around Dumbleyung, and I gather around other parts of the state, into fairly small blocks that were thought to be individual, viable farm units. Around Dumbleyung these were 600 acres, 240 hectares. We now know that in that district you need 3-4,000 hectares to make a living. So a number of these little blocks were serviced by roads that were planned but never made. There were 400 kilometres of unmade road in the Dumbleyung Shire and I was asked to assess them for their value for conservation. I broke them down into three classes. The road reserves are only about 20 to 40 metres wide. Narrow ones are 20, wide ones are 40. A 40 metre Class 1 road reserve, has been undisturbed, has high biodiversity, probably has over 100 plant species per kilometre, and has a very diverse fauna as well. A Class 2 reserve has been disturbed a bit, often disturbed by having a track put through it and disturbed by having weeds invading it. A Class 3 reserve has often been incorporated into a farmer's paddock with very low biodiversity; there might be half a dozen species of plants apart from the introduced ones. That may give you some idea of what biodiversity is. Where you have high biodiversity, it means you have a lot of different species and quite an abundance of some of them.

Some definitions

There are some difficulties of definition when we talk about biodiversity. One of these is when we talk about a species. A species is a kind of organism, a kind of plant, a kind of microorganism or a kind of animal. Theoretically a species is an interbreeding population but it is often very difficult to test that. Practically, you need to be able to tell the difference between species, and so the taxonomists give us some good guidelines. For

example, if you want to tell the difference between two kinds of snakes, a Gwarda and a Dugite, then you only need to count the scales across their backs. One has 16 and the other has 18, and if you survive the test, you will learn how to tell the difference between the two species. When the definition of a species is as hard as that then the word taxa tends to be used. For conservation it helps to designate rare subspecies as legitimate taxonomic units.

There is another problem, and that is in Australia many species are undescribed; that is, there is no formal definition of how to identify them. I came across a paper that was published in 1993, which is probably superseded now, that talked about there being an estimated 140,000 species of insects in Australia. My suspicion is that there are at least twice as many, and half of them are undescribed. Twenty percent of named insects are beetles, and beetles are really quite important in a lot of agricultural activities. The *Zoological Catalogue of Australia*, for example, sets out to name all the animals in Australia. It is in 62 volumes, and 10 of these volumes are about beetles. So it is that although the beetles are a very important part of our biodiversity, half are probably unnamed. To give you an even more impressive example of how far behind Western Australia, and Australia in general is, I had a student in 1997, who studied small black flies called Phorids, or Scuttle flies (These re the flies you may see only when they squash on your windscreen). In this project, these flies were collected along five rivers, the Moore River being one of them. In her 180 hours of study, which is all she had for this project, she collected 14 species, 13 of those species were undescribed, were unknown to science. So that is our second problem.

Some aspects of biodiversity

So firstly of all define your species, secondly recognise that we do not know half of them.

Next I want to tell you what happens at any one site because that is relevant to how you look at biodiversity. If you record the kinds of species of a group of organisms at a site, say, the ants, and also the frequency with which you encounter each species, you find that for a few species there are many individuals, and for many species only a few individuals. So you may get 100 species, but only about five or six of the species may be very common. Obviously if you have got high biodiversity there will be many species,

even though most will be represented by only a few individuals. If there is low biodiversity many of the uncommon species will not be there. Now a very common shrub could be jam *Acacia acuminata* in this environment. A very rare one could be *Persoonia chapmaniana*, a *Persoonia*, a Proteaceous plant, of which you might find only one in a site. What this means is that environmental conditions are very favourable for the very common, dominant ones. They are in their core range; conditions are less favourable for the rare ones, and they are in their marginal or peripheral range. Now environmental conditions that determine whether organisms are common or rare can vary both spatially and temporally. That is to say there can be times when one plant is dominant and times when it is quite rare at the same site. And there can be variations from one site to another, so that a plant is common in one site and rare in another. In the northern Wheatbelt, the Midlands, where the Moore River Catchment is, we have an extremely diverse flora. There is a great mosaic, of different kinds of vegetation. Much of this is now cleared, but I want to highlight the salt creek system particularly because it is very large and is the most undisturbed part of the whole area. It has certainly been grazed, but a lot of the natural vegetation remains. If you are thinking about creating corridors, which many of you are, then here is a corridor that is almost complete already; and if you can link your other corridors into this, you will probably gain quite an advantage, because you will have a corridor which is continuous here and in fact through most parts of the Midlands and Wheatbelt.

The fact that there is such an important mosaic of vegetation in the area is extremely useful. Clearing has fragmented this mosaic. Reserves preserve some elements of the mosaic; reserves on private land often preserve other elements. Parts of the original mosaic are lost, and private remnants are at the moment little surveyed. They may contain plants and animals that are missing from the main reserves. I am talking about plants because the animals follow the plants pretty closely. Stephen Hopper considers that the mosaic has arisen because the land surface is very, very old and has been little disturbed for about 300 million years. In that time historical factors like fires, floods and wind blown sands, have provided opportunities for various ecosystems to establish. So you get this mosaic in which different ecosystems are in close proximity with each other, all mixed up. Surveys of the reserves show some of this biodiversity. For example the Marchagee Reserve, which is on the Midlands Road, is about 577 hectares, and the

survey of it showed 143 plant species, 64 birds, 26 reptiles and 7 frogs. The Wilroy Reserve, which is halfway between Mowara and Mullewa is 331 hectares and it has 110 plant species, 68 birds, 23 reptiles and 4 frogs. And the Buntine-Nundagong Reserves which are about 5,000 hectares, had 241 plant species, 80 birds, 31 reptiles and 5 frogs. These are government reserves I have just been talking about. To some extent the larger the reserves the greater the diversity on them. But I think that you should also consider the results from some of the reserves on private remnants. For example the private remnants in the North Dalwalinu area, which was 2.8 million hectares, had 240 plant species. The private remnants on the Marchagee Catchment, which is about 100,000 hectares, had 278 plant species. The private remnants on the Waddi Forest Catchment, 41,000 hectares just north east of the Marchagee Catchment e, is, had 329 plant species. Koobabbie Farm, 7,000 hectares, had 390 plant species. Now you will notice that these figures are nearly double those recorded in the government reserves. That is significant, but it is significant in two ways. One is to show that the uncleared land on private land contains a great deal of biodiversity, and in a moment I shall give reasons why I think it is worth preserving. The other thing is to say that a lot of those surveys were made in 1999 and seasonal conditions were wonderful for plants that year, so the fact that I found a lot more species, than did the people who made the formal surveys of the government reserves, is partly the result of being able to work on the private reserves for a long time and in a good season. Koobabbie, with only 7,000 hectares, and which had the highest number of plant species, 390, has of course been surveyed by Alison Doley for many years and she has been able to see the plants under many different conditions. So that emphasises the temporal patterning.

The great diversity is also because, since the time of the formal surveys of the government reserves, more organisms have been described, and because the private land has additional elements of the mosaic, even though most of the private land is cleared. So private land helps greatly to preserve biodiversity of plants, and the animals, of course, follow the plants. For example at Inering, near Carnamah, and at Dumbleyung, I was able to look at the relationship between plants and birds. Birds are often easier to survey than plants. You will remember that I talked about the three classes of road reserves, Class 1, 2 and 3. I was able to show that the structural density of vegetation between 0 and 1 metre, and 1 and 2 metres, varied between those three classes. So it was 7.5 in Class 1, nearly 6

in Class 2 and 3.5 in Class 3. I looked at the particular group of birds that I was concerned with, which I call pioneering or weed species of birds, and which occur almost anywhere in the Wheatbelt. These species of birds will even turn up on the Class 3 road reserves, and looking at the vegetation density and comparing it with the occurrence of bird species, I found that if I had more than 80% of those weed species of birds then the vegetation density at Inering was about eight. But if I had less than 45% of those weed species of birds, that correlated with a vegetation density of about 13. So the animals were mirroring trends in the plants, and to some extent it is easier to monitor the birds, than the plants. What was really interesting was that where the plant diversity was high, I also found bird species that were confined to undisturbed native vegetation. This was true even of the narrow unmade road reserves in the Dumbleyung Shire. That suggests to me that even quite narrow corridors will actually be very helpful at least to the bird species.

Why preserve biodiversity?

That has given you a broad picture, I hope, about biodiversity. Now I want to turn to the question-why preserve biodiversity? One way to do this is to tell you about Middle Island in the Recherche Archipelago. The Recherche Archipelago is a group of islands off Esperance on the south-coast of Western Australia. It is a very windy place. Middle Island is one of the islands. It was visited by Mathew Flinders when he circumnavigated Australia in 1804, and his botanists collected an abundantly flowering Composite (Asteraceae) *Villarsia parnassifolia*, a daisy. Botanists looked for that daisy over the next 170 years without any success; they never found one. The whole island was burnt by a fire in 1975, presumably started by lightening. In 1976 the whole island was completely covered with that daisy, and four other plants not seen there since the 1804 collection. Millions of plants of the daisy that no one had been able to find for 170 years. The next year, 1977, the botanists went back to collect a few more specimens, but found only three. What that means is that the daisy had seeds that were preserved in the soil until there was a fire that created the right conditions for it to grow and from the plant's angle it was exploiting a resource. It was exploiting the available resource. But from the point of view of the function of the ecosystem what the plant did was to preserve the soil after a fire so that the ecosystem could survive; so that the soil would stay there and not be blown away by the very strong winds. Presumably on islands that did not have this daisy and the other ephemeral plants, the soil was blown away. You have to be very careful

about cause and effect here, but the effect on the ecosystem of that plant, exceedingly rare at most times, was to preserve it at a particular time. Rare organisms may have a role in an ecosystem at a particular time.

Plants are also worth preserving because they produce useful chemicals, and there is also an argument that diversity leads to stability. Stability is what you want in Landcare, a continuous extraction of water from the water table and a continuous impediment to erosion. So plantings should be diverse, and that diversity will help to ensure stability. But when you do plant, there are two things that you have to spend much time on. One of them you know about and the other you probably do not. One is that you must control the rabbits, and the other is that you must control the kangaroos because, each summer, they will eat and eliminate the seedlings in your remnants if the density of kangaroos is above *1 per square kilometre of remnant.* The natural density of grey kangaroos in undisturbed woodland is 1 per square kilometre. Above that density they will, in summer, deplete and probably eliminate shrub seedlings.

Chapter 9 - Preserving our fragile soils and learning the lessons of history

Professor Bob Gilkes

The organising committee want me to review everything that has happened in the Moore Catchment in the last three billion years. Then moving on from that, discuss all the soil problems. I have got to review and integrate salinity, sodicity, structural decline, wind erosion, water erosion. In addition I must not depress people, and I have got to end on a positive note. Now that is going to be tricky.

So I have chosen to call this talk "Preserving our fragile soils and learning the lessons of history" because I think much of what we are doing here has been done before. Almost every mistake we have made has been made before; let us try and learn a bit from history before it is too late.

Old history

About ten thousand years ago, and also many times before then, glaciers scoured much of northern Europe, and much of North America, and most of the alpine regions of the world at every latitude were covered by glaciers, which scraped away all the weathered, tired, old soils. When did you last have a glacier through this district to rejuvenate your soils? The last glacier was here of the order of 200 million years ago. We have not had soil cleaning, soil renewing glacial operations here for a very, very long time. Similarly we do not have new mountain chains eroding and giving us fertile silt, and we do not have volcanoes spewing ash over the landscape, re-mineralising and re-vitalising our soils. Really, very little has happened in the Moore River Catchment for probably the last, 2-300 million years. It is quite a boring place geologically-speaking, and every one of the problems we are experiencing with our soil, landscape and water, every one of those problems, is due to the fact we have this tired old landscape that has not been rejuvenated. Eventually when we have crashed into Indonesia for long enough and forced up the Moora mountains and volcanoes, this will change but We are only moving north at the speed of, say, ten centimetres a year at the moment so that is going to be in a long, long time. We have got to do something before then. So what I plan to do now is to discuss the problems that are here, what we can do about them.

What has been going on here and in the rest of the world in the last tens of thousands of years? Until 15,000 years ago most of the world was inhabited by hunter-gatherers. Quite quickly, by about 1500 AD, much of the fertile world was occupied by farmers. Australia was not; we were still occupied by hunter-gatherers up to 200 years ago. And now almost nowhere in the world has hunter-gatherers. So the message here is that farming is a very, very recent newcomer to Australia. Elsewhere around the world there has been farming for a long, long time; with us, farming is really quite a new innovation, and we are still in a pioneering, developing phase. I know this district has been cleared, or at least partly cleared, for 100 years, but we are really just beginning, and that is something we have got to take on board. Agriculture and the land's response to agriculture, has only been occurring here for the last hundred years or less.

My last bit of history. Much of the Old World, and I particularly want you to look at the area our Israeli friends were talking about, which has a rather similar climate to Western Australia, was experiencing agriculture, cereal growing, grazing of sheep and goats, thousands of years ago. So many of the things that are happening in the Moore River Catchment, much of the land degradation that we now see here in response to agriculture, happened there, and happened there thousands of years ago, so there is no real memory of what happened when that land was cleared. We have done the same things in the same climatic zone all in the last hundred years. We have forgotten that lesson of history, of what happened in areas of similar climate as plough-agriculture and grazing were introduced thousands of years ago. And, of course, those areas did experience soil erosion and other forms of land degradation, in much the way that we do now.

It was in these cradles of civilization where there was productive agriculture and there was spare food, that you could afford to build pyramids and develop culture. So if you look at a list of the cradles of civilization you will notice that every one of those areas eventually suffered from soil problems such as flooding, erosion, salinity, infertility, and acidity, the very things that are happening around us here in the Moore River Catchment. And indeed some of these ancient civilizations have entirely disappeared because they could not beat salinity; they could not beat erosion or some

other soil problem. All this happened hundreds or thousands of years ago. It is in the history books but I do not think we in Australia have learnt the lesson well enough.

Some problems with solutions

This catchment, which extends out to about Wubin has, I imagine, within it just about all the major agricultural soil types of Western Australia. It has all of the soil problems, and all of the challenges experienced by the whole of the agricultural region of Western Australia. It is a big, diverse catchment. It has soils with pH ranging from 4 to 11. It has soils that vary in texture from gutless sand through to heavy clays. So when we try to manage the land we need to be very site-specific in the Moore River Catchment, because we have a high diversity of geology, a high diversity of soils and a high diversity of hydrologies. Successful management must be site specific. Identify you soils, your landscape, your problem, the best practice, then start to manage the land.

I will now move on to some of our problems and their management. We have known about salinity, even the cause of salinity, for nearly a hundred years but did nothing. Scientists on the whole, were too timid to stand up and shout about it in the community. There was a lack of determination by politicians to take on board the severity and inevitable consequences of salinity. We knew the process, we could predict what would happen, yet we did very little about it for nearly a hundred years. So scientists really do have to stand up and be counted if we are to avoid similar catastrophes from other degeneration processes now at work.

What are our problems? Here are some of the more manageable ones. Erosion by wind and water; I think we know what to do about those. Erosion is a big problem in this part of the world, but now we know that conservative agriculture, reducing the pressure on the soil, keeping vegetation on the soil, trying to maintain soil structure at all costs, is a good way of minimising, and sometimes completely preventing, wind and water erosion.

Here is another big one, - structure decline. This is associated with poor root penetration in sub-soils, poor water penetration into surface soils. We can manage those problems on the whole for topsoil, by keeping up organic matter and if the soils are sodic,

we can use gypsum, but do not use gypsum unless they are sodic. We seem to be able to manage the problem of structure decline in surface soil but have little understanding of structure decline in subsoils.

Water-logging. A bit more of a problem, but a lot of it is also due to poor structure. If you can keep up the structure of clay soils you get good infiltration, less surface flow and better water use on the whole. So I think the procedures I mention here, gypsum where appropriate, retaining crop residues, use of appropriate contour banks and water management will minimise water logging of valley floors when it is due to near surface flows.

If you can improve soil structure, say for a sodic soil, when you apply gypsum even at a moderate rate, you get an immediate economic return. Apply gypsum to a sodic, poorly structured soil, water-logged at the surface, that the roots could not penetrate, the seedlings could not emerge through the surface and you will get an increase in yield. That increased yield uses more water and water-logging and recharge of the catchment is reduced. So gypsum is something that should be used if you think you have got a problem with sodic soils as there are a number of environmental benefits on top of the yield increase.

Another victory, something we have coped with very well in Australia, is overcoming water repellence. Many of the soils in this catchment are water repellent; the sandy soils shed water and the water runs across the surface. If there is a sudden break of season, the soil erodes. The water does not infiltrate into the soil. You get uneven germination. You get poor weed control, and reduced yields because there is less water in the soil. The water repellence can be overcome very, very simply indeed simply by claying. There is no doubt at all that claying is a very appropriate technique on sandy soils, and it is only on sandy soils that water repellence is severe. It is not an expensive treatment, and it is there for life. It greatly improves the value of your land if you have got water repellent sand. And it pays for itself very quickly indeed. For example some work on the south coast with Dan Carter and colleagues showed that applying clay at just 100 tonnes per hectare gave an enormous yield response in the first year. You do not always get that much benefit, but you generally do get a yield response to claying. And

remember that clay is there forever, provided that you do not let it blow away or wash away. You have converted your sandy soil into something rather better by adding 1 or 2% clay to the top ten centimetres. This is a very useful technique, not only do you get more yield, you get less erosion, clay helps stop wind erosion, you use much more water. In my example the crop after claying was four times the size of the crop before claying. Therefore it used four times as much water, it is that simple, and so the recharge of that catchment under that sandy soil was reduced considerably. Even where clay is not available, furrow sowing, press wheels, etc., can also help combat water repellence.

The big unsolved problems

I do not know if you have been following the debate on salinity in the press recently. I attended a highly publicised conference in the Eastern States from which there have been a lot of press releases and there is a lot of debate in the Eastern States where radical land use changes must occur if farms and towns are to survive. Salinity, we now accept, is a much worse problem than was ever imagined. In the Eastern States the concern is mainly with the salinisation of the Murray-Darling system. In Western Australia our concern is mainly with salinity of land. The two together, if we are to tackle them, will cost somewhere between 30 and 80 billion dollars. So is this telling us that ten years of Landcare and millions of dollars hasn't really improved the situation with respect to salinity? In fact, on the whole it has got worse. And you now hear politicians say, well, with 30 billion dollars to invest, should we spend it on agriculture, would it not be better to spend it on developing the clever economy? Let the farms go, let the rivers go, spend the money on computers and education. You are now hearing politicians saying this sort of thing. Agriculture is only 4 or 5% of the national product, why bother to try to save it from salinity when the money can be spent elsewhere. That is the sort of language that is being used now in Canberra and elsewhere. We are going have to battle really hard to get money to combat salinity. Why have we got salinity? It is very, very simple. It is due to the great age of the landscape. The landscape is porous, it accepts water and salt from rain, the plants use the water and leave behind the salt. And we now have this legacy of thousands of tonnes of salt per hectare in our landscape that is leaking out. Why is it leaking out? It is simply because our crops and pastures only use a proportion of the rainfall. The rest infiltrates, and it is just like filling up a bath. Eventually the water gets to the top of the bath and spills over. Particularly in the eastern parts of the Moore

Catchment, very large areas of the valley floors are eventually going to be submerged in salty water. We thought that planting trees was the answer, a proportion of the landscape returned to trees, would fix it. The latest view is that trees really only affect the land underneath them, for most catchments they do not have a big effect outside the area where the trees are planted. The situation varies a bit with the type of catchment, but planting isolated blocks of trees will not save catchments. You need to cover a lot of the catchment with trees to have any impact on the big picture.

No discussion of land degradation in the Moore River Catchment would be complete without considering soil acidity. Soils become acid simply through agriculture and plant growth. It is just part of the natural equation. Plants growing are part of a chemical equation, and that chemical equation, particularly if there is leaching of nitrate going on at the same time, leads to excess acidity being left in the soil. All of our soils are going acid. If they are neutral to alkaline, it will not be a problem for a very long time; but if they are fairly gutless, sandy, and already acid, they will quickly get more acid. Now we do know how to overcome this. Lime, sometimes even gypsum, can combat acidity. Unfortunately if you sit down and work out the rate of acidification of Western Australian soils in the agricultural region, and look at our lime reserves, a fairly pessimistic estimate is that we will run out of lime in 100 to 200 years time. The large reserves at Lancelin and elsewhere on the coast will not last forever. So that is why I group acidity along with the major problems we have got to battle, not only in this catchment, but in all of our agricultural region.

In conclusion

I have said that I think it is time for soil scientists to stand up and be counted and make a bit more noise. I certainly intend to become a bit more noisy and I will give you some urgent take- home messages. Soils, I think, and I am sure all of you think, are vital to the whole community, not just the farmers but to all of us in Western Australia. All of us want to pass the land on to our children and grandchildren in at least as good a condition as we took it over. We are not doing very well at that at the moment. Why is it particularly difficult for us? I think it is because we are really still pioneering and exploiting and have barely considered what is needed to preserve our soil reserve. We are developing soils and landscapes that are comparable to soils and landscapes in north

Africa that were developed a long time ago and people have forgotten the difficulties that were experienced and disasters that occurred. We did not learn that lesson and because of our awful legacy of salt, and our tired, degraded old soils, We have got a harder job than almost anyone to keep our soils operating. Soils are a non-renewable resource. Once they've blown away, or washed away, or become chemically weakened, that is it, finished! They are not making them any more. The rate at which a granite rock turns into soil is about a micrometre a year, so to get a soil a metre deep you would have to wait a million years. So if you have a bad rainfall event that washes the shallow soil off a granitic hill, you are going to have to stick around for a million years to get back to where you were. That is the sort of timescale we are talking about for soil formation; there is often no second chance.

This takes us back to my central theme that we are a frontier, almost the last frontier, of agricultural development, and we do need to learn from the mistakes of others. We are doing some very good research to improve our techniques and when I say we, I do not just mean scientists. I mean that farmers and other land managers together with scientists are doing very good research, and developing techniques to manage our almost unique and rather difficult land. But do not be overoptimistic and do not rely on technological "fixes" around the corner. Simply planting trees, clever cultivation, drainage of the valley floors and other improved practices are not going to work everywhere. We really need to be able to assess the situation throughout the Moore River Catchment and identify where we should best invest effort and money. The problems of salinity and the developing problem of acidity, will threaten almost the entire catchment. Some land, many streams and much vegetation can not be saved and there are other soil problems lurking in the background. However there can be no more important challenge for us to accept than to preserve much of the environment for posterity.

Chapter 10 - Agro commerce

Ray Wilson

A quote from Australian Bureau of Agricultural and Resource Economics says "Productivity growth is a key factor determining the profitability of Australian agriculture. In the face of declining terms of trade over the past twenty years broadacre farmers have needed to improve productivity to maintain profitability." That was written in June 2000. It could have been written in June 1960, 1970, 1980, 1990. The same message has applied, and that is a very important message. Terms of trade is an economist's index. It is rather complicated, but I put it in simple language by quoting the amount of super that a tonne of wheat can buy over the last twenty odd years. In the late 1970s a tonne of wheat would buy two and a half tonnes of super, in the early eighties it dropped to one and a half tonnes, and today you will get less than a tonne of super for your tonne of wheat. That is what is happening to farming all over the world, and farmers survive because they are able to produce more through better technology. They are producing more profitably. The price of commodities, wheat, wool, livestock, copper, gold, iron ore, are all declining in real terms over time. So let us look at a measure of the productivity, and productivity is not just tonnes per hectare; it is a measure by economists of all the inputs to grow wheat against the output, so it is machinery, it is labour, it is fertiliser, it is lots of things, but obviously primarily kilograms is the main one. And the productivity for Australian grain growers has been rising steadily, on average 3.6% per year. This is an index of productivity and also an index of real wheat prices. And they have, obviously, been falling. We could do the same calculation for wool growers. Unfortunately that productivity growth has only been 0.6% per year. And the reason for higher productivity for wheat or grain growers, certainly in Western Australia, is minimum tillage. So it is quite pleasing that conservation farming has had an impact and obviously so have lupins and canola in the rotation, because in Western Australia that figure is higher than in most other parts of Australia. That productivity growth is on-farm, but is also important and must happen downstream, so beyond the farmer we need more productivity in terms of our marketing people, processors, storage, distribution and all the rest.

Future trends

The task is to look, given the need to become more productive as the backdrop, at what is happening in the future. Four issues are important: strategic alliances, value marketing chain, the 80/20 rule, and management focus.

Strategic alliances. There has been a lot happening in recent years. For example you read in the paper that some of the merchandise suppliers are having great difficulty; they are suffering big losses One industry analyst says we have to pick up or lose 48 million dollars in the cost of getting rural merchandise out to farms, or in other terms some 300 billion dollars in assets has to be taken away from the system for the rural merchandise and fertiliser suppliers and distributors to remain, to get a reasonable return on their capital. And that is why a number of well known companies are struggling at the moment. So that is the reason why alliances are happening, from end to end in the flow of goods. Elders, for example, has invested downstream, with the world's second biggest top maker, BKW. That is happened, lowering cost per unit sold by integrating total process. An example there is the mooted Australian Wheat Board and CBH getting together. They will still be individually owned and operated, but partnering and forming alliances. There is also a big move to fewer suppliers. The retailers who, years ago, might have 300 or 400 suppliers, are now getting that down to 3 or 4; these are the big retailers in Europe and also in Australia. They do not want to deal with a whole lot of smaller suppliers, they would rather deal with one to six major ones. And all this is happening through adoption of new technology and obviously e-commerce is having a major part to play. I guess some farms are sick of hearing about the word e-commerce. One farmer, in terms of computing, was asked, "How can you make you computer go really fast?" His answer was "Throw it out the window". But it is important. Despite the fact that you might not like computers, they are e-commerce. Internet, e-mail is really driving a lot of efficiencies in the distribution system. And e-commerce or Internet; we are going to have portals, so I can see down the track, the Moore River Catchment Group can have its own Internet portal where all your local research data, group activities, some of the papers from this forum, could be all accessed locally, so I think there will be a lot of more regionalised data access through the Internet. At the moment it is more broad scale, but I am quite confident that down the track there'll be a lot more regionalised, localised access to information via the Internet. So it is easily accessible and it is speedy to access.

Marketing. We, in Australia, are moving away from average pricing. We are seeing that with wheat, where farmers are now being paid premiums, or if you like, there'll be discounts for protein, screenings and, of course, the variety of wheat. I think that those, the difference between the average and the premiums, or the average and some of the discounts will only get bigger. And in that regard, quality measure on farm will certainly become more prevalent. Laser scan technology is here and it is happening with wool where you can measure micron on a sheep's back, so for farmers that are looking at improving their flock, that has a huge benefit. Middle men in terms of marketing. There has always been criticism of the role, the questionable role, of middle men, and, I guess that Elders, in many respects of our business, we are a middle man. But people forget, what does a middle man do? I argue that middle men, either add value to the chain, or they will not have a role. So for many of our activities, we source it, we store it, we transport it, we organise finance, we organise processing, accumulation, there are all sorts of activities, and most of all we take the risks. So I think middle men do have a role to play, and rather refer to it as being part of the marketing value chain. Input suppliers,Elders, is an input supplier in terms of finance, insurance, fertiliser, etc. We as a company are moving forward, downstream and getting involved in processing of wool, and of livestock, meat. But at the same time we are seeing companies like AWB move backwards, so they are moving back into finance and insurance, so a lot is happening in the market place in terms of marketing.

The 80/20 Rule. You have probably all heard that, the Parado Principle, for many companies when they look at their client base, 80% of their profit from 20% of their clients. And in banking, in the bank I used to work for, it was actually 90% to 10%. So 90% of their profit came from 10% of their customers. And as a result they are rationalising so the service that the bottom 90% get from the bank is a lot less, or a lot less costly than the service they are providing for the biggest 10% of accounts. The Wheat Board's doing the same; I think growers who are producing, more than probably 5,000 tonnes, are getting some exclusive service in terms of risk management advice, that the smaller growers are not getting, and its simply a logical approach to servicing clients based on how much profit they return the company. You will soon be seeing this in one of the major banks in Australia, pulling out a lot of its managers from country towns.

Those clients, those business and farming clients who do not have $250,000, or more than $250,000 in loans or deposits, will lose the manager, so that is going to impact on quite a few people. And your business with them, with that institution will be done over the phone and fax. They cannot afford, or they say they cannot justify, face-to-face service with those smaller end clients. And that second point there, spreading your business can be costly. In banking, if you take two people, one with a $50,000 loan, someone else with a million dollar loan, and they are the same risk profile, the same security, there is usually about a 1.75 or 2% difference in the cost of their funding or their margin. When you work that out it is about a 20% discount, so if someone said to you I can give you a 20% discount on your loan if you borrow more with us, I am sure a number of you would start, rather than dealing with two financiers, to think about the benefits of dealing with one. And that applies to merchandise, and lots of other factors, so I think you are going to see more and more companies talking about key account management as a broad concept.

Management. There are four issues I have identified. One I said is beyond benchmarking, I guess that is beyond financial benchmarking. Most of you have some sort of benchmarking tools. You might do your own, calculating net income per hectare and dollars invested in your machinery per hectare and dollars per hectare for fertiliser and all those sort of things. Well I think, farming is a biological system so to me we should look behind the financial benchmarks and into the biological ones. Benchmarking our soils, I think groups like Top Crop and Wool Pro have a huge role to play there and I think we are seeing more benchmarking behind the financials. I was involved recently with the International Farm Comparison Network, and we did some, we used benchmarks, but we did some hypothetical farming. We got six farmers in a room. We came up with some dimensions in terms of farm size, soil types and we said how are we going to farm this operation, so it was a really fun day and they all said they learnt a lot from working together to come up with this farm and the data from that will be used to compare that Western Australian hypothetical farm, or a virtual farm, I guess, with farms in other countries, so it will be interesting when that data comes through, and they hope, to create more of these networks, or these farmer groups. The Liebbe Group, hopefully, will be one of those as well.

Price Risk Management

Only some 5% of farmers are managing their price risk, which is a real concern, given that the various Departments of Agriculture, State Governments, are really putting a lot of resources to get more and more farmers to do that. The biggest risk that farmers have, if you look at, if you adjust your farm programme, if you make a 10% change to any of your variables, yield, some of the costs, prices, the one factor that causes the biggest volatility in your farm returns is, in fact, movements in exchange rate. And not too many farmers are managing that. The technology is there and there are consultants around who can help you do that, so obviously, down the track, I think, more and more farmers will be getting involved in price risk management. It is quite complex, but I think there will be consultants there to help you work it through.

Professional advisor groups

We find many farmers now have two or even three consultants. They have a general farm consultant. They have an agronomist. They might have a marketing consultant, in terms of price risk management. I can see that farm groups will be formed, farm advisory groups, where there will be a group of specialists to help you, their client. They will bring in the respective specialists. It is very hard these days for one person to be good at all those aspects of farming. In that regard I must say, if there is any accountants in the audience, close you ears, because I can see that the old tax accountant is on the way out. A number of times I have been to see a tax accountant about a mutual client, and that tax accountant does not know that his client is technically insolvent or going backwards. I mean they really are just tax accountants. They do not really understand your business, so I can see that management accountants will have a bigger role to play with farm, and farm businesses in general.

The human side of management

Often forgotten, but if you look at farm management only on the technical side, the financial and the economic, the one missing ingredient in many business plans you see, and in many farm operations, is that human side. Think how many farm businesses fail or are really in dire straits because dad is not talking to son, problems with daughter-in-law,

or son-in-law. We have got wills, problems with wills, all sorts human issues and, I guess, its just general communication with the farm family. And there are not too many people out there who can help, who are trained in that regard. Accountants can put your succession plan in place from a legal perspective, but to get to that stage, you have really got to get the family round the table. It might take two years; but, that said, there are not that many people skilled at facilitating that side of the business. The same fifty-year old farmer who made the comment about the computer said to his son, "Some day son this will be all yours, assuming I can get my father to give it to me." We still see quite a bit of that, and you might have your agronomy right and finances right, but I think if that part of the business is not right, you could be in trouble. So are we concluding? I think that whether we are talking at the farm level, or beyond, downstream, it is all about relationships; relationships with your farm family, relationships with your consultants, your accountants, your farm advisors. And for business, it is our relationships with other players downstream, so partnering and alliances have become a big thing, so, in conclusion, I think we need to learn more about how to manage relationships.

Chapter 11 - Global warming – common indicators and the near future

Professor Uriel Safriel

Global warming is caused by what is called greenhouse gases, and the major greenhouse gas is carbon dioxide that everyone in this room now emits to the atmosphere of this room. But this is not the carbon dioxide that causes what we call global warming. We are interested in anthropogenic global warming, that means global warming caused by people, but not by people breathing air. It is from fossil fuel combustion and also a great deal of it is from cement production. In Israel, for example, we build from stone and cement, and this is a big factor in contributing carbon dioxide to the atmosphere. The pre-industrial concentration of carbon dioxide in our atmosphere was 280 parts per million. And in 1990 it was already 350 parts per million, so that by burning fuel during the time from 1950 to 1998, the concentration of carbon dioxide in the atmosphere rose steeply. As a result the carbon dioxide in the atmosphere acts, as it was expected to act, as a greenhouse gas. It is called a greenhouse gas because its effect is like the glass of the greenhouse. After the earth is heated by the sun's radiation, the carbon dioxide does not let the heat to escape beyond the atmosphere: it is trapped in the atmosphere.

The greenhouse gases

Carbon dioxide is the major problem. There is another gas that is also very important. This is methane that is also produced naturally, but the current increase in greenhouse gases is due to this gas as well. When we burn organic material with oxygen, carbon dioxide is the result; when we burn organic material without oxygen, methane is the result. And the origin of methane nowadays is landfills, or garbage, and rice paddies, and also the rumens of ruminants. Cattle for example emit methane. In all these places organic matter is burned without oxygen and the result is methane. Methane is much rarer in the atmosphere than carbon dioxide, but it is twenty times as effective as carbon dioxide as a greenhouse gas. To repeat, in 1990 the atmospheric concentration was 350ppm. We expect, given the trends that exist today, that by 2100, which is already not very far away, it will be doubled. And, as a result of this, or given these two figures, scientists are trying to predict what will be the global mean temperature when the carbon dioxide concentration of 1990 is doubled. This is expected around 2100, and the

prediction is a rise of between 1.5 and 4°C. This is with a 10% chance of being wrong; either it can be higher than that or it can be lower than that.

Effects of global warming

What are the global effects of warming? The increasing temperature will cause climate change, just being warmer is not enough - there will be a climate change. This means changes in the rainfall. Globally more rainfall, because of higher evaporation from the ocean, but, and this is not intuitively obvious, a higher frequency of extreme climatic events. There is another effect, and this is that evapotranspiration will, of course, increase. And there will also be something which has nothing to do with the climate, a sea level rise between 2000 and 2100, of 12 to 88 centimetres. This will cause salination of groundwater in coastal areas.

All these predictions are generated by mathematical simulation models of the global climate circulation. But there are also fingerprints that show that something is happening, besides just measuring the temperature. For example, there are heat records in cities during the last years; there are sea level rises; in Fiji, for example, there is a retreat of the coast; in Bermuda, mangroves are dying because of sea level rise. There are thawing glaciers, which are measured very accurately. And there is Polar warming, detected in Alaska and in Antarctica. There are also indicators of the impact. For example the Adelie Penguin in Antarctica - 33% of the population declined during the last 25 years and this is due to the ice melt of the shelf that they depend on. There is a certain butterfly that changed its range and is not found any more in elevations and latitudes that it used to be found, and this is due to the warming. Some people may say they do not care about the penguins and Chequer Spotted Butterfly in California. However, there is also a higher incidence of malaria in high mountains because of the ability of the malaria vectors to live in places with higher temperatures where they did not live before. There is widespread occurrence of forest fires, many more in the last ten years than there have been before, and these are also expected and predicted by climate change experts. And there is evidence from the reaction of wildlife, birds and insects to earlier springs. Also there are extreme events, for example the event in Sydney in 15 to 17 August 1998 when the rainstorm precipitated three times more rain than the average for this month.

All these events and all these predictions made governments assemble an intergovernmental panel of experts from all UN members, on climate change, and they produced in 1995 the second assessment report of global change, temperatures, climates and its effect on all life systems. This assessment appeared in 1996; every five years such a report is going to be composed. This year, the panel is working on the third assessment report, which will be published next year. I happen to be a member of this panel and I have for you non-citable and non-publishable information on the impact on Australia and New Zealand. There will be considerable damage to coral in the Great Barrier Reef; there will be raised snow lines and alpine ecosystems will be reduced in size. One can say that one, especially in Western Australia, need not care very much for the coral reef, and for where the snow line is. However there is a likely increase of aridity, over much of Australia, with increased competition for limited water supply, and this is a prediction for the whole area of Australia. Furthermore, forests in southern and inland Australia would be particularly vulnerable to a combination of warming, reduced rainfall and increased fire. Finally there is a potential for an increase in insect borne diseases.

Development and sustainability

So what do we do about it? Let us remind ourselves that in 1992 there was the Rio Summit - the UN Conference on Environment and Development. This was the first time that the world tried to put development and environment together and see if there are conflicts or if development requires environment. What this conference came up with was a new term, not very new, it was already used a few years before, which is "sustainable development". This is a kind of buzzword, and everybody dealing with development wants to say that "his" development is sustainable development. But what is really sustainable development? To explain this visualize Australia before settlement of Europeans. All Australia was then "environment", with man having very little effect on this environment. Then came "development" that took up only a very small proportion of Australia, or even of the whole globe. No one at that time used the word "environment" when development started. However, when development further progressed came the realisation that development comes at the expense of environment. Subsequently there was a second realisation - that development is served by the environment. Surely agricultural development, especially irrigated agriculture, cannot be sustained if there is no environment to generate the renewable water resources for irrigation. So as the

development increases, it requires more services, but there is then a smaller environment to produce or to generate, these services. Eventually, development increased in dimensions and spread all over the world. As a matter of fact we do not know what is the spatial extent of development beyond which it becomes non-sustainable, namely that there is not enough environment to produce services for that development.

Sustainability, or sustainable development, is therefore defined as follows: First, the rate of resource use does not exceed the rate of its renewing, and second we are striving for an intergenerational equity, so if, indeed, the resources we use today are not used at a faster rate than the resource's renewability, all is well; but if we use resources faster than their rate of renewal we are beyond the red line, and our development is not sustainable. However, we all know that all our development now depends on fossil oil, fossil fuel, which is not renewable. And therefore, by this definition, every development now on earth is not sustainable. However, the use of a non-renewable resource should be linked to the development of a renewable resource. It means use the resources - the wealth generated now - by exploiting non-renewable resource but this in order to develop an alternative renewable resource to be used when the non-renewable resource cannot be used any more – only this will guarantee in the future sustainable development.

Ecosystem services

The Rio Conference came out with a UN Framework Convention on Climate Change that was signed in 1992 by 170 states. The text of this Convention stipulates the following statement: "Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures." We are often told that we do not know enough, and this is true, we do not know enough about everything, and therefore we cannot wait until we know enough, because always there will be some who will say it is not enough and they will be right. But this should not deter us from starting to work on the issue right now. There are some ways to act, and the first is to know what to expect, and accordingly to act. The predictions of the Third Assessment Report of the Intergovernmental Panel on Climate Change on the global impact are that the losses of biodiversity will occur, meaning loss of species, species that are instrumental in the provision of "ecosystem services" – the services that are the services of the environment, the ones that are important to sustain development. The loss

of biodiversity will cause reduced ecosystem services, and this will start at 1°C increase above what we had in 1990. Thus we are very close to that already. By 1999, for example, it was already 0.7°C degrees increase as compared with that of 1990. There will also be market losses. These will be felt when there will be 2°C increase, and the effect will depend on the geographical latitude: developing countries will suffer a lot of market losses, and the high latitude developed countries will gain from climate change. Above 2°C increase everybody will lose, developed and developing countries, low and high latitude. With further warming above the 4°C increase, there will be major changes in climate regulatory mechanisms globally, there will be disintegration of what is called the west Antarctic and Greenland ice sheets, they will disintegrate and this will have a great effect on global climate. Also there will be a shut down of the Atlantic thermohyaline circulation . This is a current in the ocean that has an important regulatory effect on the climate around Europe. What we can do about this? Surely to reduce emissions. But this is very easy to say; we do not do that at the moment. Reducing emissions can be done, and it can be what is called the win-win situation. We can reduce emissions simply by being more efficient with our energy, without compromising any of our comforts, or our economic development or economic activities. So it is good to be efficient on energy, it is money saving, it is saving our oil reserves, and it is also reducing the risks of climate change.

But another issue is that of the sink and the reservoir. The sink is actually the photosynthetic mechanism of plants. They take the carbon dioxide from the atmosphere, and deposit it in their bodies as organic matter, as wood, as plant material. This is the sink function, and plant material that is stored on earth in living trees, in litter on the ground, in the soil, is the reservoir. We can manage it so that there will be less carbon dioxide in the atmosphere, and more carbon in organic material on the earth. At the moment, we cut forests, and forests in Australia were cut long ago, and it continues in many parts of the world. We lose soil due to desertification processes and we lose top soil that has a lot of organic material in it and once the top soil is swept into the air, or more than anything, into the lakes and into the oceans, it oxidises, it means it burns, and the carbon that is stored in the soil, is turned into carbon dioxide in the atmosphere, i.e. into an addition of greenhouse gas. Thus management is, first of all, to take care of the soil, so that the carbon of the soil is not oxidised. Furthermore, it is necessary to stop deforestation, and

finally to be engaged in afforestation. If we arrest deforestation, combat desertification, which is soil degradation, and do afforestation, then we are fine. It is also important to realize that as long as the global mean temperature will not increase beyond 2°C the whole biosphere absorbs carbon dioxide through photosynthesis and emits carbon dioxide through respiration, but there is a positive balance, and more carbon dioxide is absorbed and becomes live biomass as well as dead biomass in the form of litter and soil organic matter. This function of the global ecosystems in storing climatically-inert carbon is called "sink". However, when the temperature will rise to more than 2°C above the present, then the biosphere will start to lose its carbon sink function; the soil carbon storage will start to be oxidised, and converted to carbon dioxide in the atmosphere. Thus, one of the services of the ecosystem, carbon storage, will be curtailed by global warming, alongside many other ecosystem services. Most of these shortcomings result from loss of wild plant and animal species, that are instrumental in the provision of ecosystem services.

What can we do to maintain ecosystem services?

Can something be done to reduce the loss of species due to climate change? Some new research in Israel suggests a way.

Take for example Israel, where climate naturally changes rapidly within a narrow spatial extent. It is well known that every population of plants or animals, amongst them the plants or animals that are instrumental in the provision of ecosystem services, has a core area of distribution and a peripheral area. In climatic transition zones like in Israel, and also like in Western Australia, there are species that lives on one side of the climatic transition zone, and other ones that live on the other side of the transition zone. But within the transition zone itself, both types of species live, but they are represented there by their peripheral populations. Our research showed that peripheral populations are different from the populations of the same species that live in the core areas of their distribution, far from the distribution periphery. The difference is in the within-species variability. In each species there are several genetic types – genetic variability. The more genetic types are in the population, the greater is the variability. We found, in several species we studied, that genetic variability is low in the core but high in the periphery. Why is this? Whereas in the core areas of distribution the environmental conditions to

which the species are adapted are usually stable, in the peripheries conditions fluctuate between years; in some years the climate in the climatic transition zone resembles the climate on one side of the zone, and in other years it resembles the climate on the other side of the transition zone. Now, whereas in the core areas of distribution there is a relative climatic stability, populations there will be of a few genetic types, all of them adapted to the stable, uniform climatic state prevailing in the core. Once the climate in the core changes, due to the global climatic change, all the populations in the core may become extinct, because they lack the genetic types adapted to the new climate. In the periphery, on the other hand, several climate types alternate, and populations have some genetic types adapted to one type of climate, and others adapted to the other type of climate. A climate change in the periphery will mean that one of the natural climatic states will become prevalent, and hence the genetic types adapted to it will become predominant in the population. Thus, climate change will eliminate whole species populations in core distribution areas, but will not eliminate them from peripheral areas; some genetic types will be eliminated from the periphery, but others will not, and become common. This gives us some hope. When climate change takes its course, species populations in the core may become extinct. If it is a species instrumental in the provision of ecosystem services, it will be lost in most of its area. However, few genetic types of the species will persist in the peripheral areas of distribution, in the climatic transition zone. These populations could then be used for rehabilitation, and reconstruction of this species in the centre part of its distribution. This rehabilitation of lost species will bring about the reconstruction of some of the ecosystem services that will be otherwise lost due to climate change. Therefore, what can be done by us now is to identify these climatic transition zones in every country and conserve the habitats of the species there. This will enable us to use these conserved populations in the future when damage from climate change to natural ecosystems becomes evident.

Chapter 12 - New and diverse products

Professor Yosef Mizrahi

I would like to go with you around the world and try to find many neglected commercial plants. If you open the scientific literature of plant sciences, you can find mainly two kinds of plants. Either model plants, which are very easy to work with, and the most famous these days is *Aradopsis tariana*. With this plant you put the seed in the ground and you wait a month and you get a seed which completes the life cycle in one month, so you can have twelve generations a year. And many scientists love to work with this species.

Another of the kinds of plant that scientists deal with are common crops and this is a catch 22 rule. If you have big production with wheat, rice, cotton, apples, potatoes, tomatoes, you have a certain portion of the sales coming back to the research, and if you have more know-how, more production, then money for more research. It is like turning more light on in a room which is completely illuminated.

Yes, I have already mentioned to you that in the wild there are thousands and thousands of plants that human beings were using for food and other purposes throughout history, and the scientific community simply ignores them. You have just heard that we are expecting an increase in temperature. And for sure, today's crops may not be the crops of the future because of those climatic changes. To the best of my knowledge, not very many people are doing something to combat this phenomenon. One approach is to try to modify, by genetic engineering means, the common crops, and introduce some genes that will help them to tolerate the drought and the heat. But we have a different approach; we go back to the wild to find plants that can tolerate, by their very nature, the various stresses. By growing them in our Negev Desert in the extreme heat that we have in the Arava Valley, we can find, maybe, some crops for the future. This is why we are doing what we are doing.

The Yehib

I am going to start by talking about a plant, a shrub, called *Yehib Cordeauxia* edulis from the pea family that grows wild in Somalia and Ethiopia in the Ogaden Desert. The *Yehib* is a shrub, and we observed that after six consecutive years of drought in the Ogaden Desert, this bush was still yielding grains and giving the local people the nuts that they are using as a staple food. All the rest of the plants simply vanished there, the only one surviving was the *Yehib*. Because of overutilisation it is about to be extinct from this world. And to the best of my knowledge no one around the globe is doing anything to save this plant. This was the reason that we took it on.

The fruit is a pod, inside the pod there is a seed, with a very thin shell, and when you break it open you have the nut, which is edible and more nutritious than wheat, and serves as the staple food of the nomads in Somali and Ethiopia. We introduced *Yehib Cordeauxia edulis* to Israel and with a lot of difficulties were able to establish a few stands of plants. This is down in the Arava Valley on saline water and we were very, very optimistic to see the plant growing, starting to yield the nut because it is very hard to get seeds of it. And after a spell of cold, all the plants died, and we cannot continue this research any more in Israel, but I am sure that many other countries can do it and I wish that someone will take a chance and continue to work with this important shrub, whose nuts serve as the staple food to the people in Ogaden Desert.

White Sapote

White Sapote *Casimiroa edulis* grows here in Western Australia. In 1995 I visited an orchard here. You have a very active organization here called Tree Crop Centre, headed by David Moiler. He took me in 1995 to that orchard and the manager there told me that the fruits are already on sale in Australia. I bought them in 1995, in Woolworth's in Sydney, and when I came to pay at cashier, they did not know what they were, and they charged me price for apples, while they were white sapote, very delicious and tasty fruit.

If you go to Mexico, the country of origin, you can see that the people sell it along the roadside. Inside the flesh is buttery, sweet, very tasty. And I know one farmer who

makes his living from it, he is in southern California and in the Cartenterrea also, they sell the white sapote. In conjunction with Freida Copplenson in the USA, and we selected some clones, a white one, a yellow one with yellowish flesh, and one which is green with white flesh and only few seeds, so the ratio between seed and pulp is good. My main problem is that nobody is ready to grow them on a commercial scale in Israel, nobody is ready to give it a chance, to sell it on the world market.

When I come to the chief scientist in Israel Agriculture to get some grants to work on it, he always asks me how much can you sell in the world market for what price, and of course, there is no answer to this question. Always I answer him that it looks like avocado and tastes much better. And if avocado is sold from Israel in Europe, 100,000 tonnes a year for $2 a kilo, this about 200 million dinars. It is not bad, and it looks like avocado and tastes much better than avocado, but I have been told, that is not an answer. I do believe that it has a chance because it grows very well under Israeli conditions, provided the water is not saline, then it can grow in 45°C, even 47°C and gives you very high yields of good quality fruits.

Monkey Orange

In the Loganiaceae there is another fruit. Now we are moving from Mexico to the Kalahari Desert, where we can see a strange plant by the name Monkey Orange or, the local name Bufoforani. We are talking about three different species, all belong to *Strychnos cocculoides* (S. spinosa) and if you go to the desert there you can see that the Bushmen eat the fruit, and it is called monkey because it has very thick shell, you have to break it open to enjoy the flesh, then you can scoop it, very tasty fruit; if you taste the flesh it tastes a mix between banana, orange and apricot. And it has a very strong smell of clove.

When I presented this seminar in the Agriculture Research Centre in Israel, the people came and asked a question what does it taste like, and I told them. They told me, we have bananas in Israel, we have apricots, we have orange, we can even buy some cloves, and we can mix them together. So give us a break; you and your stupid plants. This is the attitude to the establishment to new crops. To the best of my knowledge

nobody ever did anything to domesticate it. It is a very good, tasty fruit. It contains a lot of good nutrition, and this year, for the first time we have a MSc student trying to analyse the genetic variability among the seedlings and another student is going to give me two and a half hectares to grow it in his backyard, in his farm. He is ready to invest in it and something may come out of it in the future.

Argan

Argania spinosa : There is hysteria in the world, including Western Australia, to plant olive trees, because olive is a very good oil for your health, and everybody is planting millions of hectares all around the world to extract the oil from the olive. However, if you go to Morocco you can see *Argan Argania spinosa*, from the Sapotaceae, growing wild there. Goats reach into the trees, eat the fruits and secrete the stone in the faeces. You can see the whole fruit, you can see the whole stone; you break it open. Inside you have kernels, and the shepherds go behind the goats, collect the seeds, collect the stones, bring them home, break them open, and then they squeeze the oil out and put it in jars.

We are fortunate to have 600,000 Israelis with Moroccan origin. If you show them Argan you can see their eyes are shining and ready to pay any price to get this oil. It is a culinary oil; also you can use it for the cosmetic industry. And they used to tell you a lot of stories about how good this oil is. Again we put a student to do analysis on this oil and now we have scientific evidence to support the claim of the Moroccans, that this is really the best culinary oil in the world; much, much, much better than the olive oil.

We brought this plant to Israel. It does quite well under highly saline water, in all climates from -7°C to 47°C, no problem. And the fruits fall to the ground so you can mechanise it, and then, of course, you can take it and do everything you want with it, without any difficulty. This tree grows in the Neot Hakikar, on the shores of the Dead Sea, where the salinity is quite high. The plant can produce quite an abundance of fruit. We have now in Israel two and a half hectares of seedlings from which to select clones. We already marked ten specimens with high yield and hopefully we will be able to continue with these in the future. And again there is no support from the Israeli establishment to go ahead with this project. When I deal with marketing, we do not have

any marketing problem because we have in Israel 600,000 people of Moroccan origin ready to pay any price to get this oil. There is very small import from Morocco, and it is sold in Israel ten times more, six times more, depends on where you sell it, more than olive oil. This is one of the good shrubs, or trees, that we have with my colleague Dr Shaprit in our Negev Desert Research Station.

Marula - the King's nut

Next we come to Marula from South Africa. *Sclerocarya birrea* subspecies *caffra* from the Anacardiaceae, the same family as the mango, the cashew, and the pitascheo. In that area there is summer rain of about 400 mm a year and you see during the season, which is summertime, a carpet of fruit lying below the trees. The local people stand there and eat the fruits. The fruit falls on the ground when it is totally green. It takes a week in summertime to change colour and be fully ripe, and then the families and the children pick up and enjoy the fruits, and the children particularly know in the bush where the good and tasty marulas are. Again the only country to make commercial use of it is South Africa, where they sell marula cream, marula liqueur, and even the nut is edible, and very tasty. In the local language of the Chawana people its called, "the king's nut" because only kings deserve to eat this delicacy.

Under our conditions it does extremely well. We get yields up to 400 kilograms of fruits, per tree, per year, on highly saline water, on water that will kill other trees. It does better than in its native area because in Israel they are free of insects and diseases that jump on it in its natural habitat. I do not know where the salinity tolerance came to this plant, but in fact it can grow very well on saline water. We expect this year to get 15 tonnes from this fruit, and now we are preparing 5,000 trees to be planted on a semi-commercial basis. The big question is whether or not the farmers will be able to sell the fruit for profit. If their answer is yes, then the road will be open for another crop that we wish to introduce.

Chapter 13 - Review of the Blaustein Institute for Desert Research – it is diverse roles and future

Professor Uriel Safriel

The Blaustein Institute for Desert Research in Israel operates in an area of 100 mm annual rainfall. The institute was established in 1972, and its mission, given to it by the Government of Israel upon its establishment, is to study the desert, specifically the Negev Desert. Why? To find means to settle the desert. The planning for the establishment of this institute started 30 years ago, taking account of the fact that 60% of Israel is desert and the need to "rectify" this situation. The philosophy was that in order to do so one only needs to think a little, something that scientists are expected to do. Thus, the government's rationale was "let's recruit some scientists, put them in the middle of the desert and they will find out how to make the desert bloom". The Institute has been there 27 years . What can we say now, after 27 years of the operation of a scientific institution that was established by a government to fight the desert and make desert into non-desert – did it live up to the expectations?

Working with the desert

If one looks at Israel these days, there is still desert there, lot of desert. Our current attitude, as it is in many other countries, is that it is both futile and unnecessary to fight the elements, to fight nature, and to "conquer" the desert. What the Blaustein Institute is trying to do is to find ways, not ways for fighting the desert, but ways to work with the desert - for the benefit of humankind. What are these ways? First of all, many things that we see in the desert and traditionally view as curses of the desert, can be turned into blessings. The major curse of the desert is, of course, the heat. It is hot in a desert. But heat is also warmth. And for many crops warmth is an asset. It is all, of course, relative; it depends on the environment in which one lives, and to what one relates the conditions, so if we take Israel as an entity, then in the non-desert part of Israel, it is cold in the winter and that affects crops. In the desert it is warm in the winter. In the summer it may be hell, but in the winter it is warm - and this is an asset. So let's not try to make the desert cooler in the summer, but take advantage of the fact that the desert is warm in the winter. The source of desert warmth and heat is the sun; the sun generates all our energy,

and solar energy is renewable energy. There is no reason why the deserts of the world would not turn into the energy suppliers of humanity in one or two generations. In this way the sun, the desert curse, can be turned to be of benefit for desert people, just as the oil is now very beneficial to some desert people in the Middle East.

Brackish water, which is actually fossil water since it is non-renewable, abundant not only in the Israeli desert, but also in many other deserts in the Middle East and Africa. Brackish water may not always be beneficial for many crops because of its salinity, but saline waters are perfect for aquaculture. There is no reason why not to raise fish in the desert, or to grow algae in the desert for production of industrially-important chemical compounds. Algae reproduce more quickly than other plants, and can therefore use brackish water efficiently.

Finally, deserts are regarded as places that nobody wants - they are desolate, and there is "nothing" there. But nowadays, especially in the developed world, human population has become dense, affluent, with a lot of spare time, with a high degree of motorisation and transport ability, and people see the deserts as their open spaces. Thus, these areas which used to be worth nothing, because there was "nothing" there, have now become very beneficial and of a very high market value, exactly because indeed, there is nothing there. Indeed, in a very dense country like Israel, the non-desert part will become a continuous tract of land with only skyscrapers, roads and airfields. Therefore it is the desert part of Israel that becomes now a very valuable real estate, just because it is a desert and "nothing" has been done with it yet. "Nothing" is indeed an exaggeration. There is agricultural development in the Israeli desert, but most of the Israeli desert is actually a training ground for the Israeli army, unfortunately a very important use; if Israel did not have its desert, may be it would have needed to rent one from Australia... However, if and when one day the army will not need the desert any more, then Israel will have a desert for recreation use and for developing its tourism industry.

Desert agriculture

All agricultural research institutes in Israel, including the Blaustein Institute for Desert Research, have reached the conclusion that it will always be economically less beneficial

to grow subsistence food in desert than in non-desert. The farmer, who lives in the non-desert, fertile area in the centre of the country, will make more money than the farmer who lives in the desert area. No question about that. So it is important to improve desert agriculture. But if it is subsistence agriculture; if the farmer depends upon the agriculture that the farmer generates for himself, this farmer will be always poorer than the farmer in the non-desert area. And therefore it is very important to move from subsistence agriculture to cash crop agriculture and make agriculture in the desert a business for growing what can be generated in the desert better than in the non-desert.

Furthermore, people of the desert do not necessarily have to make their livelihood from agriculture, from the productivity of the land, but they can use the land, if it is a scenic area, if it is a wilderness area, for other uses such as for example mining industries and the tourism industry. In this case research institutions in the desert will not necessarily study how to improve agriculture, but instead will study how to improve living conditions of people. One important issue to receive attention by scientists is how to make living conditions in the desert comfortable, noting that it is currently less comfortable to live in the desert than in the non-deserts: just the heat and also the very low temperatures in the winter make desert living conditions uncomfortable. Therefore, the Blaustein Institute for Desert Research puts much emphasis not only on how to improve agriculture, dryland agriculture, but also on how to improve dryland living conditions.

After a generation of desert research in Israel, we know that sustainable desert development needs not necessarily be agricultural development. However, we also come now to the realization that the real problem is not how to develop deserts, but rather, how to combat desertification. Many deserts have appeared on the surface of the earth due to desertification processes, caused by naturally occurring climate changes. Sometime in the history of the globe they have not been deserts, but have become so by a process of desertification following climate warming. It is the desertification that we are causing today by human activity, which is a serious problem. We are turning semi-deserts into deserts, without climate change. Usually the difference between desert and semi-desert is determined by climate, but the climate also determines land productivity. We, by our mismanagement of drylands reduce the productivity of semi-arid areas and bring it down

to the low level of productivity of arid areas. This process is the current desertification, desertification brought about by human activity, not by climate change: to desertify land, we do not need to change the climate, we change the productivity directly, and this we do by, first of all, overpopulation, that brings about overstocking of livestock, and then overgrazing, and not only overgrazing, but also overexploitation for firewood. This overexploitation causes removal of the vegetation, and the removal of the protective cover of the vegetation causes soil erosion.

When the productivity of the rangeland decreases, especially in Africa and many part of Asia, the rangeland is transformed to cropland, and the result is, due to improper methods of irrigation, salinisation. Cropping also causes increased soil erosion, by improper tillage practices. This combination of topsoil erosion and salinisation is desertification. The recent spread of global desertification has led the Blaustein Institute for Desert Research to a new research agenda: rather than continue to put efforts in research that leads to desert development, the Institute focuses now on research leading to combating desertification. To put it in a nutshell, the Blaustein Institute for Desert Research is investing less research into how to make deserts more productive, and more research into how not to make semi-deserts less productive than they are naturally. But not that the Institute still sticks to its original mission – desert development, but there is an added mission – desert development in a sustainable manner, or – sustainable development of deserts, one that does not lead to their further desertification.

Because Israel does not suffer very much from desertification as yet, the Blaustein Institute for Desert Research can have the luxury of directing most of its activities for exporting knowledge, know-how, and technology, especially for assisting developing countries already affected very seriously by desertification. This work is in compliance with another United Nations agreement resulting from the Rio Conference - the UN Convention to Combat Desertification. Australia was much involved in the negotiations and deliberations of this treaty, although it has not yet ratified the convention (In 2001 Australia ratified the Convention to Combat Desertification).

Focal studies at Blaustein

An outstanding expression of the change in the attitude of the Blaustein Institute is the establishment of an international school for desert studies, the Albert Katz International Institute for Desert Studies. The School has already launched a massive science programme in desert studies. It confers a new academic degree that is accredited by the Israeli Authority for Higher Education. The word "international" in the name of the School means that the teaching language is English, so the school can take students from all over the globe. Currently the School has only 50 students from twelve countries, not an Australian yet, but Australians are welcome.

What is then, in summary, the profile of a desert research institute that serves a country like Israel with 6 million people, with 60% of its area desert, and only 7% of the population of the population living in the desert. The Institute has 60 faculty members, 50 technical and administrative staff, and another 50 staff members on "soft money", and 150 research students. "Soft money" means short term, contracted money raised in a competitive manner. The annual budget is US$10 million, from the Government of Israel, 5 million that is raised competitively by the 60 member faculty. The Institute has six research departments, and a Centre for Scientific Co-operation. This Centre controls an endowment fund that enables the Institute to bring post-docs, visiting professors, and advanced students from other countries on an exchange basis.

The first two of the six research and teaching departments, each having about ten scientists, are made up of scientists that study the desert environment - what is there, how it works. There is a department of environmental physics and solar energy. Besides studying the climatic conditions of the desert, the soil condition of the desert, the physics of the desert, this department is engaged in applied research into the development of solar energy. This department is now developing a solar settlement, an isolated desert settlement, which is powered by a solar power station. About 100 to 200 families will use one big parabolic dish that concentrates about several thousand suns on a photovoltaic panel. Instead of having a battery of several thousand photovoltaic panels, it

is cheaper to have one big mirror of simple glass, and one photovoltaic panel for power generation. It may take five years of research from now until such a facility can be operational and it is based on previous ten years of cooperative research between an Australian research institution and the Blaustein Institute in Israel. Also Remote Sensing ability is developed in this Department.

The second department is that of ecology. Here are biologists that are dealing with biodiversity in the desert, and the relations between biodiversity and the provision of ecosystem services.

The third department is the water department, made up of two groups: a group of hydrologists, obviously. Less obvious - there is also a group of microbiologists in this department. There are environmental, aquatic microbiologists because most of the water for agriculture is already treated waste water, and will be much more so in the future; in order to treat waste water you need to have a lot of microbiological expertise. Not only this, but the desert water and desert soil are fouled and polluted by industry. This is a tendency of many developed countries, Israel included, throwing out the polluting industries into the desert. Thus, Israel has a lot of polluted water, not only domestic waste water but also industrial waste water – and as a result - polluted soils, due to the polluted water. All these can be remediated by micro-organisms. That is why there are microbiologists in the water department.

There are two departments dealing with the desert biological productivity. One is the Department of Biotechnology, dealing with aquaculture and with genetical engineering. The second department is the Department of Dryland Agriculture, dealing with several aspects of agriculture in the drylands. One is rangeland management. Not much of Israeli drylands are used as rangeland, but rangelands are very important to Israel's Arab neighbours, and researching rangeland management will be highly beneficial when peace comes to the Middle East. Another area of research of this department is that of run-off harvesting. Much knowledge has been generated in this area by Israeli scientists who attempted to find out how 3000 to 2000 year-old settlements that do not exist today, managed to generate for themselves enough biological productivity supported by rainfall that does not differ from current quantities. It is now known that

these ancient farms subsisted on harvesting surface run-off. The Blaustein Institute further investigates run-off harvesting practices; though this research does not target the Israeli farmer who uses high tech agriculture; for dryland farmers of developing countries in Africa and Asia, knowledge of how to employ ancient techniques, but with a some modern improvement, may make the difference between life and death.

All that is done by the five research departments just mentioned above is very relevant and significant. However, it has very little meaning for most people in developing countries! This is because what these people there need is not necessarily the technology and the advanced know-how. What they really need is the enabling environment. The reason why they are suffering from desertification is not so much due to the ignorance of their farmers. It is due to the lack of economic economic infrastructure, socio-political problems, and especially the lack of political will. Therefore, to guarantee that the knowledge and know-how generated by the five departments can become instrumental in the life of these people, the Institute has established the sixth department - Man in the Desert. This department targets to cover in its research the human dimension of desert development and of combating desertification. The faculty members of this department come from the social sciences - social anthropologists, economists, regional planners, as well as architects that specialise in the design of desert settlements and in human habitats in desert environments. More specifically – this department has made a name in passive cooling and heating of human habitats in ways that require the least expenditure of energy for cooling and heating.

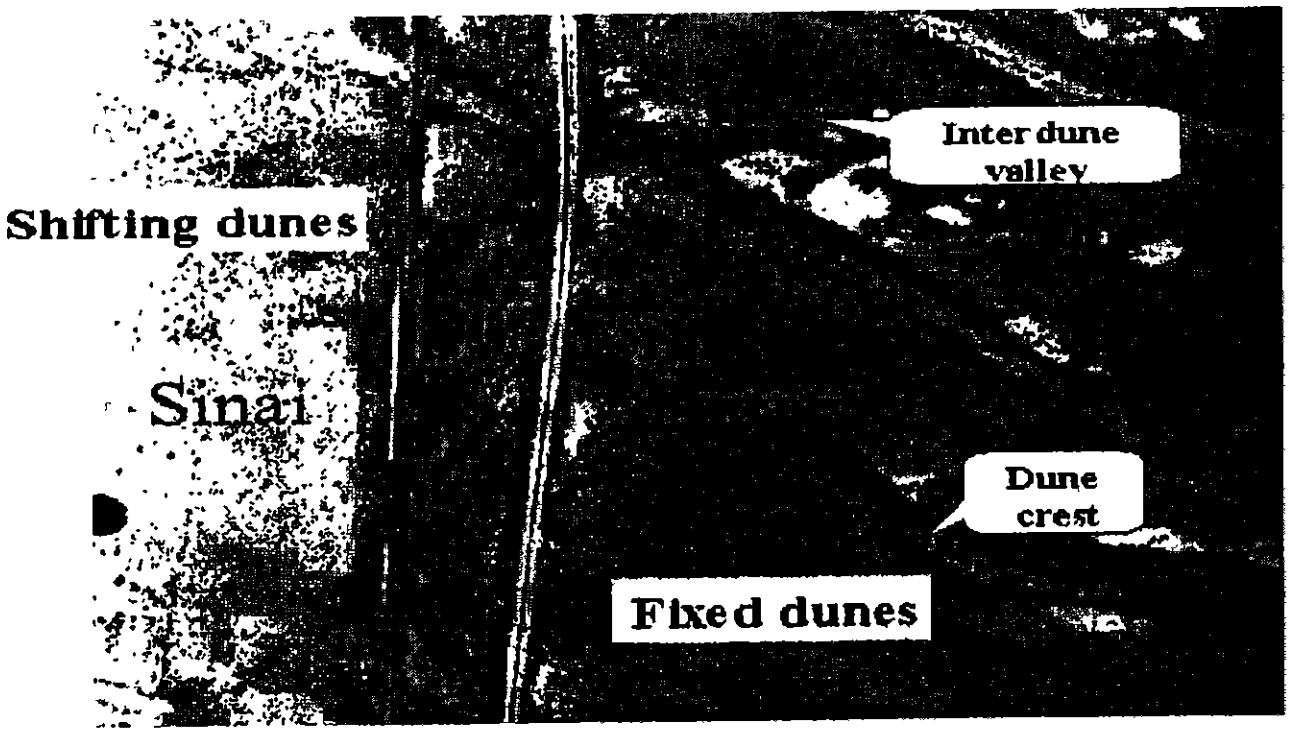
Examples of research

These six departments combined, attend now the mission of improving the combat of humanity against the encroaching desertification. One measure of combating desertification in Israel is dryland afforestation, a practice that is further studied and elaborated on by the Blaustein Institute. Decades ago, most slopes in Israel were exposed from soil, due to soil erosion, due to deforestation. The slopes lost their protective cover of a diverse indigenous vegetation dominated by scrub oaks and Pistacia. The local, indigenous agriculture was that of non-irrigated agriculture in the valleys, with some terracing, and the remnants of the slopes' protective, indigenous vegetation were a few individuals saved for religious reasons. The landscape of Israel today is that of year-

round land cover of agricultural crops, and of afforestation by an indigenous pine tree. Though the pine is native, it is naturally rare. However, it was found to be the most effective tree for arresting further soil erosion, and for creating conditions for the natural, indigenous vegetation, to regenerate. The Blaustein Institute now studies the contribution of this huge afforestation project not only to prevent further soil erosion, but also to re-charge aquifers, and for rehabilitation of the water cycle.

Another example of research achievement relates to the elucidation of desertification mechanism using remote sensing technologies. In Sinai, on the border between Israel and Egypt which runs from the Mediterranean Sea to the Red Sea, a satellite Imagery showed a difference in the colour between the two sides of the border. Research by the Blaustein Institute revealed that the bright colour of the Sinai side of the border is evidence for desertification caused by overgrazing, whereas the dark Israeli side evidences protection from desertification, by a protective cover of vegetation that includes a biological soil crust. The cause for the Sinai desertification is the overstocking of livestock. More damage than the one caused by overgrazing, is that caused to the biological crust that is broken by the trampling of the overstocked herds. The combined effect of the loss of crust and vegetation brings about the destabilization of sand dunes, and the eventual shifting of the sands, which prevents colonization by plants. The result is a degraded range, i.e., desertification. The herds are prevented from crossing the border; hence in the Israeli side of the border the dunes are fixed and stable, and provide forage in a sustainable manner, for controlled grazing.

This can be observed in the picture on page 77. The grey colour is dotted - the dots are bushes. Note that in the Egyptian side there are very few bushes, and the colour is yellowish not greyish. The grey colour of the surface of the Israeli part is the colour of the biological crust made of bacteria, photosynthetic bacteria, mosses and algae, green algae, nearly all of them microscopic organisms. These combined hold the dune from moving.


Shifting dunes
Sinai
Inter dune valley
Dune crest
Fixed dunes

and carbon dioxide is absorbed during the night time. When day comes the stomata close, remain closed during most of the day, reopen late in the afternoon and remain open during night time. The carbon dioxide that is absorbed by these plants during night is not less than that which is absorbed by C3 and C4 plants during the day.

The general myth that cacti grow very slowly is not true. There are cacti that are fast growing, there are cacti that are slow growing, like in any other family of plants. The most important thing is that during the night the external temperature is lower than during the day and the relative humidity is higher at night than during the day. As a consequence the water loss is minimal in these plants during the night, when the day comes the stomata are closed, so they are saving the water, and in the late afternoon and at night time they reopen and have the highest water use efficiency that you can obtain among plants. This is why the cacti are so important for us in Israel when we have no more fresh water. The main sources of water are recycled or brackish water that we have in our Negev Desert. So we need to have a plant that can pay the price of desalination, it costs US$1 per cubic metre. The only crop plants that will be able to pay the price of desalination will be the Cactaceae family. Just for comparison we irrigate orchards in our Negev Desert, citrus, mangoes or avocado around one thousand millimetres per year, and when we come to cacti we apply around 100 millimetres a year. We are not sure if this is the proper quantity. Maybe we need to add a little bit more, maybe we have to add a little bit less, but they are productive with this amount of water, and that is terribly, terribly important for us.

Pitaya

If you go again back to Mexico not only do you see beautiful natural forests of the cactus, but you can also see ladies felling fruits obtained from wild stands of cacti called Pitaya. Pitaya is a common name for about 25 different species of columnar cacti. And to distinguish between them the Mexicans add another name. Pitaya agria, which means sour pitaya, pitaya doulce, the sweet pitaya, pitaya di maia which ripens in May, pitaya maria the yellow pitaya, pitaya di Augusti, etc. So they have many pitayas and each one of them is different from the other, like cherry from plum, and plum from apple and apple from apricot. They are different, even though they all belong to the same family and share

the same common name.

This is why I go to the marketing people and beg them, do me a fovour and do not use the name pitaya, because it is difficult for the consumer to distinguish between them. One day you call it pitaya and give him something like a cherry and then another day you call it pitaya and give him apricot; it is not going to work doing that. And they say, you do not understand marketing, leave it to us, you are a plant scientist. They are good fruits, their seeds are soft and edible, unlike the prickly pear, and there is not a single reason why we cannot grow them in orchards, irrigating them with one order of magnitude less water than any other crop, and send them to Europe as an export item.

Cacti as vegetables

Claddoes of cacti are the national vegetable in Mexico. They eat it fresh like we eat cucumber and apples. They also use it for cooking, just as we use all the cooking vegetables that we know. A very good taste, very good vegetable, and there is not a single reason why we cannot grow it as a vegetable crop in Israel. So I did find a farmer that was ready to grow it for me. He grew two-tenths of a hectare and obtained 40 tonnes of young claddoes ready to go to the market. When he tried to offer them to Israelis, they refused to taste it; when he gave it to them, they said "Who do you think I am, to eat a cactus. Forget about it." He was able to sell only two tonnes out of the forty tonnes that he had, and he eradicated his plantation. I am stubborn enough to give it another chance. And I am going this year with another farmer to start to grow it as animal feed, because there is no other plant that with 100 mm of irrigation, that can give you 40 tonnes per 0.2 ha. And the animals eat it as well. Again the left overs that the animals will not eat, we'll try to sell as a vegetable. It may sound bad, but this is my strategy.

Opuntias

There is one country around the Mediterranean that has grown the prickly pear for many years as a fruit crop. Europeans and Americans who come to visit us do not like it because it has seeds, hard seeds, and always they tell me, "Josef, very tasty fruit but why the hell you fill my mouth with gravel, can you remove it?"

In addition Sicily grew 40,000 hectares of a cactus *Opuntia ficus-indica*, and we went to them to see what they do, because when we started our research in 1984, and my colleagues saw that elderly people in villages in Sicily take the corollas of the cacti, they put them in boiling water, prepare tea and drink it. When my colleagues ask them why do they do that, they told them that when you will turn fifty, your prostate will swell and you start urinating every half an hour. If you would like to get relief, prepare tea made of these flowers and you will be cured. He came back home with this story and wrote it up. He sent the information to seventy patients in our hospital, who were about to go through prostate surgery for benign, not cancerous, tumours. And he treated sixty of them with capsules made of this flower, just ground up, put in capsules and given to them. In 60% of them the prostate shrank to the point that it was unnecessary to go through surgery. The mechanism of the effect has already been unravelled by a publication in Journal of Forology in 1998. Today there are three companies in Israel buying the dry corollas from the farmers, grinding them and putting them in capsules and selling them, and there is a huge demand in Europe, mainly from Germany. We cannot provide enough.

So far I demonstrated to you its use as a fruit tree, its use as a vegetable, its use as a medicinal plant, and now I will demonstrate an industrial crop. There is an insect called Cochineara and it contains carmine, and it grows only on claddoes of *Opuntia ficus-indica*. There is now a whole business growing the Cochineara, this insect, to extract the carmine around the world.

So you can see that one single species of cactus can serve you as an industrial crop, medicinal plant, vegetable plant and a fruit plant. It is sold as a fruit with different varieties but the main obstacle is the seed inside the fruit. The Israelis love it and they are ready to pay high prices for the fruit as you will see in a minute. The problem in Israel, when we converted it into a fruit crop, is that it ripens between 15 July to 15 August, in one month. If 10,000 tonnes comes to the local market, the price goes down. So what we did, we developed a technique, to enable us to force the plants to flower whenever we want it to do and get fruits year round. The price is very low during July and August, if you move away of it, it goes almost as much as almost five times more than in the normal season, because Isrealis are crazy about this fruit and ready to pay almost any price to get it.

farmers who were ready to do that. We went around Israel, begging farmers, do me a favour, would you like to plant this tree. They tell me yes, can you tell me how much fruit I can get. I told them, yes, this is a crop that you can expect. Where I am going to sell it? I tell him, you know it is a beautiful fruit, give it a chance, first in the local market and then go to Europe. They ask how much is sold in Europe. Nothing. So what do you expect me to do, to plant a tree that no one ever saw and nobody knows about. I told them, yes, but there is a potential. Look at the beauty of the fruit, do something. No one was ready to do anything about it.

Luckily enough I came across one person who saw the point. He was 64 when I met him first and he used to work with our biggest export company, called AGREXCO. You know we used to be a socialistic country and we had one arm to export our commodities, our fresh products abroad, called AGREXCO, or Carmel, a brand name. When I came to them to help me to make connection between the farmers and the sellers in Europe, they refused to listen to me. With the same question, how much is sold in Europe. I told them, nothing. So why do you expect us to help you? Because, there is a potential in the new crop. And they told me, prove to me first and then I will join you. I am a plant scientist, I cannot do the marketing. This is your job to do the marketing. And they said to me, give me a break, you and your stupid fruits.

Then this guy, Josef Safrea, told me, Yosef, I see the fruit, I see the potential, give me the chance and I will do that. He started to grow them, also he has his small company because he is one of a few firms that got permission to export Israeli products to Europe about ten years ago. He has a small company called Tropi Graden, and he started to sell it in Europe in 1996. The fruit is so beautiful you do not have to advertise it. Everybody will be attracted and asks what is this fruit? He sold ten tonnes in Europe. A year later, AGREXCO, the biggest company, woke up. Hey, Josef Safrea is selling fruits for prime prices in Europe. We would like to do the same. They came to the farmers and asked them. How much does Josef give you for a box? They told him the number; we give you one shekel more. A shekel now is about 25 American cents. Then they went to the buyers in Germany and asks them, for how much Josef sell you the box? They told him for x deutchamarks. They told him we give you a deutchamark less, and that started the competition between these two companies. The year was 1997. They sold 30 tonnes, 25

tonnes were sold in Europe, 50% by Josef Safrea, 50% by AGREXCO, the giant. So 95% of our export goes through these companies. And in 1998 they sold 65 tonnes. 1999, 135 tonnes, and in 2000 I expect more than 300 tonnes to be sold in the European market. And there is competition between these two, the giant AGREXCO and the small firm Tropi Garden that is also a grower.

But Israel has made a big mistake in marketing pitaya. It put in the same leaflet three different fruits. The yellow pitaya belongs to one genus, *Stenocerus, Stenocerus megalanthus*, the taste is super, the best of the best, ripens in wintertime, does have big spines which excise upon ripening. Another pitaya from a totally different genus ripens in summertime. It has no spines. The taste is totally, totally different, like the difference between apricot and apples. They are different. So why put them in the same leaflet and give them the same name? And they tell me, you know nothing; we know about marketing more than you do. But this is a big mistake, in my opinion. Each fruit deserved its own leaflet, with a description of what it is all about and so forth. But they are already selling them in Europe and both are competing with each other.

Queen of the night

The last plant I should like to tell you about is a crop that grows in Gingin, Western Australia, *Cereus peruvianus*, Queen of the Night, because it has huge big flowers that flower only once during the night time. And you do not know that this is a fruit tree. We now know the reproductive biology of this fruit, as a result of a PhD student of mine, and we are now able to get fruits. The fruits are smooth, without spines and they can be of different colours, all the way from yellow to deep, shining red. We already have two commercial varieties in Israel. It has a unique aroma, very pleasant like a good candy, and sour and sweet, seeds are soft and edible, and it is also Pitaya. When AGREXCO heard, that the pitaya is going well in Europe, they came to the farmers and asked them, who has pitaya. And some farmers came and said, I have pitaya, and they have this pitaya, which is in the genus *Cereus*, a totally different fruit. And they started to sell it. And then I came, do me a favour, you see the difference between the different pitayas, give each its own name. This time they were ready to listen to me and gave it a brand name called Kaudo, and today if you know how to manipulate the plant, it can be fruitful,

I can guarantee 20 tonnes per hectare, with 100 mm of rain, versus 1000 mm of irrigation with avocado with half that yield. Today it is exported, and we are now trying to store it under different temperatures, different clones and you can see they differ from each other, and the best temperature to preserve them in. This crop grows in pure sand, 99% sand, coarse sand, and again it goes out to Europe under the brand name Kaudo Carmel, because they thought it is pitaya, and it is pitaya, but now they realise it is a totally different crop.

New wine in old bottles

I would like to end with a very important take-home lesson. All the time, I am trying to get support from my government, from my chief scientist, Ministry of Agriculture, and all the time they turn me down. I came to the export company and asked them for help, and they turned me down. I am known as a good teacher in the university, the students give me high marks for my teaching ability, so I thought it does not lie in my lack of expertise to explain what I am talking about, so why do they not understand what I am saying? This has potential, this is a water saving plant, beautiful fruits, tasty fruits, why nobody is ready to help me? Then a student of mine showed me something he found from the R & D strategy for Israeli agriculture and associated industries, by Shi Shiream reported to the Agriculture Research Organization in 1989. And what he said is dealing with marketing and developing new product development.

"It is not for nothing, that in all the firms surveyed, and they surveyed 11 firms, development of new product is spoken of as a special topic distinct from the rest of the problems encountered in R and D management. Anyone who has ever tried to develop or promote a new product is familiar with the trials and tribulations involved. The opposition of the production and marketing people, associated with the standard products, for whom the new product represents a pain in the neck, the wise guys and experts, keen to nip the new concept in the bud, neglect on the part of the directors of the firm, who due to more pressing problems cannot find the time to safeguard the new concept, which in the nature of things, lacks the lobby and has plenty of opponents and potential victims. From the survey of American industry we learn that this is not an exceptional situation, but rather the rule, every production system in every mature organization, is equipped

with antibodies against deviation from the routine. These antibodies work all the time to kill all interest in the new product and are very likely to succeed. It is an innate property of every established industrial organization which is why most of the new products are created and brought to the market by young organizations that have no standard product to occupy them. Established organizations, Israeli Agriculture among them, that want to get into this business of introducing new products, have to build themselves managerial mechanisms designated to act as a countervening weight against the forces of routine described above."

This is the take home lesson because the establishment do not like to pick up new headaches, new things. Give them a break, they have their own problems, and do not bother them with new things. If you would like to be involved in new things, you have to put it in your agenda, this is what I want to do, and devote the manpower and the budget to do that. Otherwise you are going to have problems.

Chapter 15 - Concluding Comments by after visiting the Moore River Catchment

Professor Uriel Safriel

Long-term

Salinization and soil erosion are extreme expressions of land degradation causing reduction of productivity in drylands (Mediterranean systems are usually defined as dry-subhumid drylands). Land degradation in drylands induced by human activity is desertification. Since soil salinization and erosion in Western Australia result from human-induced deforestation of a dryland, Western Australia is defined as a region affected by desertification. As stated in the UN Convention to Combat Desertification (an international legally-binding agreement that has been negotiated with the active participation of the Government of Australia), countries affected by desertification should give priority in their national efforts to combat desertification occurring within their territory. The soil salinization in Western Australia (together with soil erosion) is therefore not just the problem of the individual farmer whose farmland is being degraded. Rather, it is an environmental problem of national dimension, which causes degradation and loss of a national, non-renewable natural resource (soil) and as a result – a loss of current and potential productivity generated by this national natural resource. It is therefore the responsibility of the government to assist farmers to combat desertification on their land.

If it is well established that the salinization problem can be resolved by reforestation, farmers should be encouraged by the government to engage in reforestation, because by reforestation farmers (a) reduce soil erosion, and in this way combat desertification; and (b) increase carbon sink and reservoir, and in this way assist the government of Australia to comply with commitments of developed countries with respect to the UN Framework Convention on Climate Change and its Kyoto Protocol.

Finally, farmers who restore the productivity of the land by afforestation also contribute to the promotion and conservation of biodiversity, and in this way comply with the third international environmental treaty, the UN Convention on Biodiversity. By promoting biodiversity the health of natural and managed ecosystems is secured, and their

functioning in generating environmental services (such as regulation and maintenance of air, soil, and water quality) – is restored.