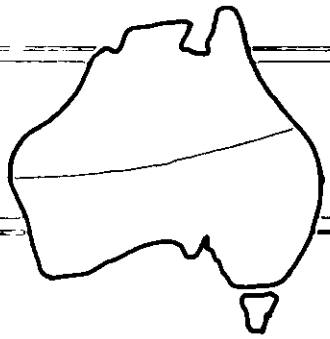
HUMPTY DOO
Rice in the Northern Territory

Wayne S Mollah



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ABBREVIATIONS

CPRS	Coastal Plains Research Station
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organization
MIA	Murrumbidgee Irrigation Area
NADC	North Australia Development Committee
NTA	Northern Territory Administration
UARES	Upper Adelaide River Experiment Station

PREFACE

One of the major projects of the North Australia Research Unit is a study of attempts at cropping in the north. It has involved sifting facts from myth and weighing the various contributions of biology, economics, sociology and politics. This monograph, the 5th in the new unit monograph series, is the result of one phase of that study.

While agriculture is now firmly established in southern Australia it has not become an integral part of the rural landscape throughout the tropics. The eastern coastline, its immediate hinterland and the Central Highlands in Queensland provide exceptions. Across the remaining expanses of the north the grazing, mining and tourist industries hold sway. Absence of a significant cropping sector has been a source of frustration, annoyance and at times embarrassment. Over more than a century numerous attempts at large-scale and small-scale farming have failed to establish a permanent place in the economy of the north. One of the most famous of the large-scale efforts was the Humpty Doo rice development scheme which captured national interest in both its promotion and its abandonment. Twenty years later the details of this major development are blurred but the belief that hordes of magpie geese were responsible for its failure is firmly implanted in Australian agricultural mythology. Yet at most the birds symbolize the largely unknown and difficult environment selected for the venture. All farming involves an element of chance and the risks are multiplied many times where the environment is not fully appreciated.

While the geese played a small part in the Humpty Doo story the whole venture is one episode in the history of endeavours in the development of the north. Prominent throughout that history is the role of man - as promoter, decision-maker and analyst. And also as interpreter of his own history. Proposals for development create expectations for success against which actual achievement is measured and the events are interpreted accordingly, often with ambivalence or ambiguity. When a project is successful it is said to have followed from inspired leadership or diligent hard work. On the other hand failures and disappointing results may be attributed to environmental factors, absolving human principals from much of the responsibility. Humpty Doo is an interesting case study in this general context.

An inherent difficulty in setting down an historical account of any project is that participants move on, memories fade and records, often sketchy at the best of times, become lost. Nevertheless, several people helped piece together what happened at Humpty Doo. It is not possible to name them all, nor would it be fair to attempt to do so. However, several who participated in the scheme deserve special mention. Sir William Gunn allowed ready access to his personal files. Mr P.A. Cullen and Mr A.G. Lowndes also made valuable comments about the concept and management of the scheme. Mr R. Parker, who supplied the photographs, and Mr E. Kilpatrick were invaluable sources of information about events in the field. Mr A.L. Chapman and Mr E.W.R. Thorpe made valuabe comments on the text. Cartographers from the Research School of Pacific Studies, Australian National University, drew the maps.

INTRODUCTION

During the 1950s publicity given to proposals for large-scale rice production in the Northern Territory excited interest across Australia. For several reasons Humpty Doo became a household name at the time and to some extent still is (see, for example, Sydney Morning Herald 9 January 1982, editorial). First, if the scheme had been successful, it would have been one of the largest farming developments in the world and would have been a granary for Asia. Proponents of the scheme held few doubts that this would be so for the prevailing conditions appeared to be ideal for rice. Secondly, the location in a remote, unknown part of the Territory lent itself to images of taming a frontier. The name of the site where the development would start, Humpty Doo, was both unusual and easy to remember. Some interest was also aroused because the crop was more popularly associated with oriental cuisine and was not then a staple of the Australian diet. Finally, the scheme was backed by a group of wealthy American investors, some of whom were associated with the glamour of the Hollywood entertainment industry. While promotion of the project thrived on all these romantic elements a more prosaic reason drew support from the Australian government, namely, that the social and political climate was ripe for the Northern Territory to be developed. Within that context an enormous farming venture was seen as an ideal lead industry to stimulate more settlement and commercial activity.

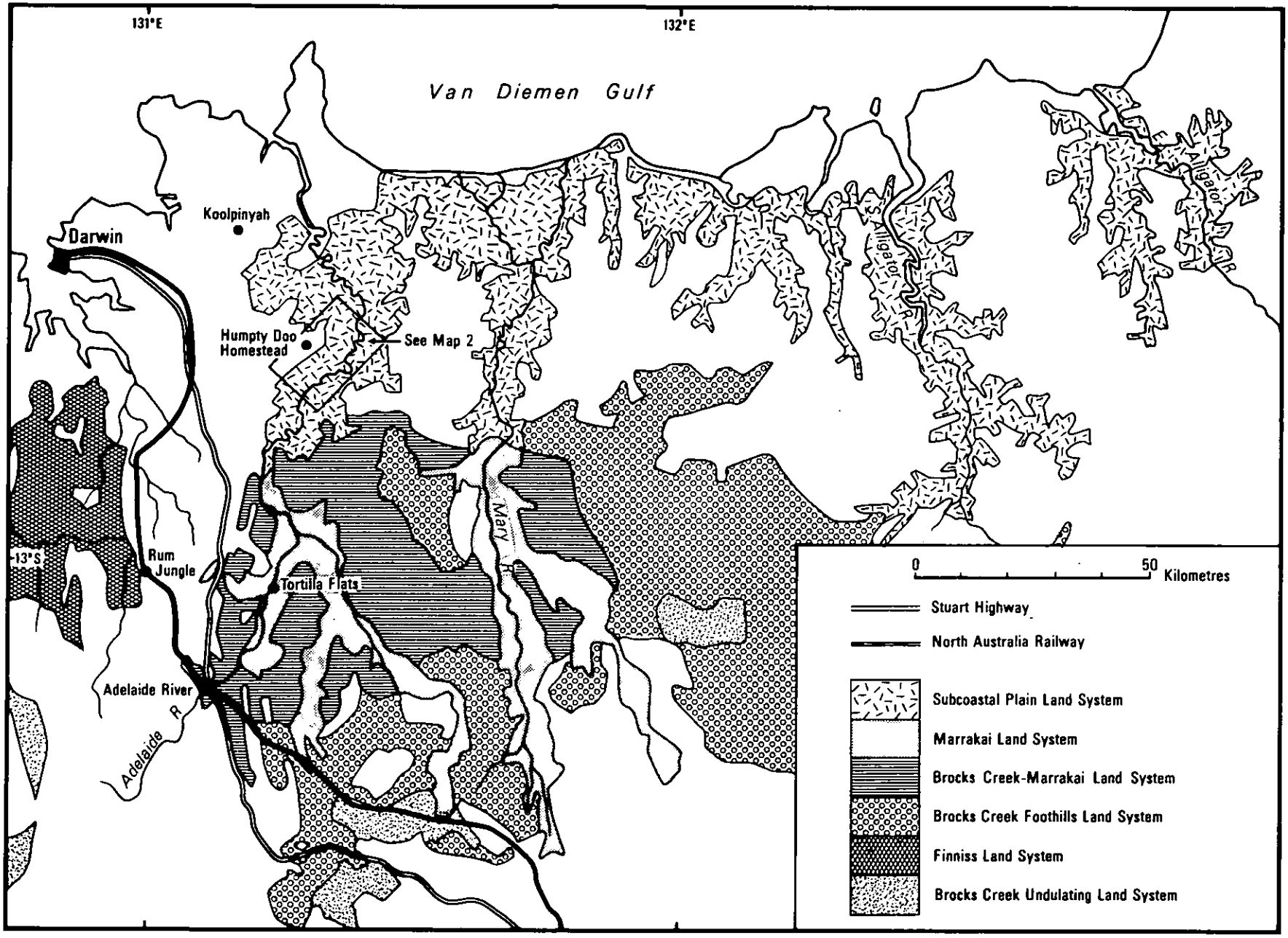
In less than ten years the high hopes for success were proven to be too lofty as production never approached anticipated levels and the promotion was abandoned. However, because of the enormous appeal and fascination that the undertaking had attracted, the popularly acceptable causes of failure could be nothing less than exotic. An integral part of Australian agricultural folklore is that the downfall resulted from the voracious feeding of countless magpie geese (Anseranus semipalmata). Although these birds did play a part they cannot be blamed totally for the demise of the scheme and one purpose of this study is to dispel the mythology that has developed about them.

More deep-seated causes become apparent if some consideration is given to the position of the scheme in relation to the continuing development of agriculture in Australia. From the start of European colonization the incursions of settlers in search of a permanent home in the nineteenth century were based upon the exploitation of natural resources to produce crops and animals. The settlement process followed two precedents set in Europe for achieving greater output. First, larger areas were brought into production until restricted by the amount of available and suitable land. Thereafter, improved farming techniques were the major contributors to increased farm turnoff. On the Australian scene, as settlers became more familiar with local conditions, the expansion of areas under plough and pasture was complemented by the development of new ways of farming which supplemented or replaced imported methods.

The principal external source of technology during the twentieth century was the United States where better farming methods had been adopted over several decades. These methods spread rapidly during the 1930s and 1940s. Higher yields resulted from the scientific development of better breeds, more effective use of fertilizers and the mechanization of as many farm operatons as possible. These improvements were expressed in national production figures: for all grains the total cultivated area in the United States fell from 85,643,000 hectares in 1948 to 65,242,000 hectares in 1961 while production rose from 152,301,000 tonnes to 163,517,000 tonnes in the same period (Brown 1965, 134).

Throughout the 1950s rural production in Australia was increased by both modern scientific farming and the time-honoured process of expansion of cropping areas. Changes of both kinds affected the production of the main crop, wheat, which showed national production trends typical for all grain crops: between 1951-52 and 1961-62 the area under wheat increased from 4,202,405 to 5,958,000 hectares (41.8 per cent increase) and production increased by 54.8 per cent to 6,727,213 tonnes (Bureau of Census and Statistics 1955, 752-3; 1963, 1016-18). When the Humpty Doo project is examined against this background it becomes one more example of a national trend.

But the new technology was applied in a virgin environment; there was no experience of farming in it from which the rice project could draw practical lessons. Yet for the project to succeed full knowledge of both the environment and the capabilities and limitations of mechanisation was essential. This knowledge was lacking and the transformation of the northern plains was attempted with deficient analysis of conditions and a misapplied concept of industrialised farming. This is a study of the factors that contributed to the collapse of the Humpty Doo scheme and it highlights some of the difficulties of cropping in monsoonal Australia.



Source: Christian & Stewart, 1953

CONTEXT

A Desire for Development

By 1946 the Northern Territory had been settled for the better part of a century but economically it lagged behind the rest of Australia. The major land uses were cattle-rearing on an extensive scale and mining but neither industry was in a buoyant state. In 1947-48, 113,181 head of cattle were exported to Queensland, South Australia and Western Australia for fattening and slaughter; mineral production, mainly of gold, mica, wolfram and tin, amounted to $458,874 (Bureau of Census and Statistics 1951, 347-8). Only a small labour force was required by these two forms of activity and they attracted few people to the Territory. The national census of 1947 found the population, excluding Aborigines, to be only 10,868 which represented less than one thousandth of the total population in one sixth of the area of the continent (Bureau of Census and Statistics 1951, 518).

The Australian government which administered the Territory was not content with its state of underdevelopment and set out to rectify the situation. Two reasons lay behind the move. In 1942-43, the bombing of Darwin and the penetration of invading forces to Timor, the closest island to the north-west, exposed the vulnerability of the north of the continent. These recent experiences highlighted the need to do more to ensure the future security of Australia and economic development in the Territory would help whatever defence measures were needed. A second, compatible motive for the commitment to develop northern resources was to be found in the platform of the Australian Labor Party which, in 1946, formed the Commonwealth government and the governments of Queensland and Western Australia. Party policy called for the decentralization of the Australian economy away from the industrial foci of Sydney and Melbourne and development of north Australia would constitute a tangible expression of that platform.

The three governments embarked upon a co-ordinated, measured approach. A North Australia Development Committee (NADC) was formed of three officers of the Commonwealth government and two each from Queensland and Western Australia to prepare a blueprint for the north and to co-ordinate development by giving appropriate priorites to various projects in primary, secondary and service industries. In later years the Commonwealth government was guided by the Committee's three main recommendations for fostering the development of primary industries in the north. Easier land tenure conditions were enacted, transport, communication, marketing and financial infrastructures were improved and research, experimental and extension activities increased. Pastoral leases were limited to a total of 12,950 square kilometres each and special leases, called pastoral development leases, were created to encourage lessees to improve their properties (Crown Lands Ordinance, 1931-48: Section 59). Improvements in roads, more air services and greater use of radio communications helped to ease problems of isolation and to bring Territorians closer to one another and to the rest of the country. Loans to settlers from the government-run Primary Producers Board became more readily available. The most significant move involved the expansion of the role of science in agriculture and this started while the NADC deliberated over specific development options.

Assessment of Land Resources

Before the NADC could arrive at specific recommendations for any particular type of agriculture it needed to know more about the nature of the resources available. As a matter of urgency the Council of Scientific and Industrial Research (CSIR) was commissioned to undertake a reconnaissance of the land resources of the Katherine-Darwin region where the bulk of the war-time capital expenditure in north Australia had been concentrated. This survey, conducted in 1946, was the first of several and it uncovered basic information that was used to sponsor the scheme at Humpty Doo. A formal classification of the resources available for exploitation was needed and to provide it the Land Research and Regional Survey section adopted a novel approach. All the natural

resources that would affect agricultural development were integrated and land was regarded as 'the land surface and all its characteristics of importance to man's existence and success' (Christian 1959, 591). Specialists in a variety of disciplines teamed to delineate land systems which were seen as 'an area, or group of areas, throughout which there is a recurring pattern of topography, soils and vegetation' (Christian and Stewart 1953, 21). Land systems were considered to be of three types - simple, complex or compound - and most of the nineteen described for the 68,197 square kilometres of the original survey were either complex or compound.

Some of these land systems had more potential for development than the others. The Tipperary Land System lay astride the middle sections of the Daly River and extended south beyond Mataranka and the Flora River. Other areas recommended with potential for agriculture were the 'acid' alluvial flats and plains of the Marrakai, Brocks Creek and Finniss Land Systems (Map 1) where conditions could favour rain-grown rice (Christian and Stewart 1953, 13). Scattered pockets of land in the remaining land systems could possibly be used for agriculture as well.

Of importance for the later commercial development of rice was the Sub Coastal Plain Land System which covered several discontinuous areas extending up to 100 kilometres inland along the major streams of the north and west (Map 1) (Christian and Stewart 1953, 114-16). Meandering tidal streams and associated distributaries, channels and billabongs flooded the flat or nearly flat plains to a depth of up to two metres for 6-8 months of the year. Little was known about the chemical composition of the dark grey, generally mottled clays (Stewart 1956, 47; Hooper 1969, 95-113) but the annual flooding-drying cycle endowed them with two contrasting physical characteristics; thorough wetting produced boggy conditions which denied access to all but wallowing buffalo and wild pigs and when the clays dried they cracked deeply and set like concrete. In these conditions wild rice (Oryza spp.) and sedges (Eleocharis spp.) dominated the swampy grassland vegetation.

In addition to a description of the characteristics of the Katherine-Darwin region comments were made on the potential for exploitation of each of the land systems and recommendations made for future lines of investigation. Because of their significance for the rice scheme several sections of the report are quoted at length. The summary of agricultural prospects for the sub-coastal plains stated:-

> There does not appear to be any prospect of preventing the flooding of these plains and, owing to the heavy texture of the plain and the wetness of the swamps, agriculture in the dry season is impracticable. The plains carry a perennial species of Oryza (rice), but even rice cultivation under conditions of white labour and mechanized farming does not appear practicable (Christian and Stewart 1953, 116).

In a discussion on the prospects for various cultigens the following comments were made concerning rice on the Sub Coastal Plains:-

> In view of the fact that some concern is now being expressed regarding the use of water for this crop in that area, the possibilities of the crop in the Northern Territory should be further examined. If the crop can be grown by natural flooding this would represent a far more economic use of water and land.
>
> There are numerous areas in the region subjected to seasonal flooding for varying periods. As rice is not particularly specific in respect to soil requirements provided artificial fertilizer can be applied, it would appear certain that some areas suitable for its production can be found. However, the economics of production would need to be carefully considered.

> At various times observers have commented upon the suitability of the flooded plains of the sub-coastal region for rice production. The soil of these plains are heavy clays which crack badly when dry and would be extremely difficult to cultivate in this condition. Under conditions of white labour, and with existing farm machinery, it is very doubtful if these plains could be successfully cultivated when wet (Christian and Stewart 1953, 125).

The final recommendation for rice investigations appeared as follows:

> A form of agricultural production which warrants investigation is the production of rice under natural rainfall on the freshwater alluvial flats and plains of the Brocks Creek, Marrakai, and Finniss Land Systems. These are flooded for several months each year, and by the construction of suitable levees, this period might be extended. However, the survey was conducted during the dry season and this proposal requires further examination, particularly, in the first instance, by engineers (Christian and Stewart 1953, 14).

The cautious note in these observations must be emphasised. Before any final answer could be given on rice cultivation in the Territory much more work was needed and this should be concentrated further inland away from the sub-coastal swampy plains.

Climate

In addition to the attractive features of the flatness of the extensive plains and the abundance of suitable soils the climate at Humpty Doo served as an incentive for growing rice for it led to the natural flooding of the plains. Detailed analysis of the climate of the Top End, the region from Katherine or thereabouts north, have been published by Prescott (1938), Christian and Stewart (1953, 27-31), Slatyer (1960), Ashton (1961), the Bureau of Meteorology (1961), Fitzpatrick (1965, 39-52) and Southern (1966). Owen (1967) and McAlpine (1969, 49-55) dealt specifically with the climate of the sub-coastal plains. The key element is rain and for five months enough falls to promote plant growth but for the rest of the year the area where farmers can operate is restricted by the availability of permanent natural or supplementary water. Temperature, humidity, evaporation and day length all have subordinate influences.

Five rain-producing systems have been identified for the Darwin-Katherine region (Southern 1966). The most important system consists of equatorial or monsoon troughs and it is supplemented by the other systems of local convection, regional convection, tropical cyclones and easterly disturbances. These may produce widely distributed general rainfall or scattered falls affecting small areas. The net effect of the five systems is that approximately 90 per cent of the seasonal total falls from November to March although each influence varies in importance during these five months. Rain has been recorded in all months of the year but falls from April to October are usually preliminary to the main wet season or represent an aftermath tailing into the dry season. Accordingly, the conventional description of four seasons has been abandoned locally for two more serviceable terms, 'the wet' and 'the dry'.

Detailed, long-term rainfall data had not been kept for Humpty Doo when the rice development began but records from Koolpinyah (Map 1) were able to show the rainfall regime of the area (Table 1). Rainfall records for the decade of the rice program at Humpty Doo are given in Table 2. These two sets of data can be used to summarize briefly the general rainfall conditions.

TABLE 1

Rainfall Summary for Koolpinyah for the 40 Seasons, 1915-16 to 1954-55

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Season Total*
Rainfall (mm)													
Maximum	12	43	56	164	311	501	700	665	590	483	60	24	2009
Minimum	0	0	0	1	33	102	126	67	66	0	0	0	935
Average	1	2	12	56	166	232	332	322	299	94	6	2	1522
Variability (%)	303	435	130	71	39	45	39	43	43	107	190	225	17
Number of Raindays													
Maximum	4	4	8	13	24	26	29	27	27	18	5	4	130
Minimum	0	0	0	1	6	12	11	9	8	0	0	0	64

* Note: Seasonal values calculated separately and are not the summation of monthly values shown.

Source: From Records of Bureau of Meteorology, Darwin

TABLE 2

Rainfall (mm) at Humpty Doo 1953-54 to 1962-63

Season		July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1953-54	Rainfall	0	0	0	37	75	147	356	233	269	394	0	0	1511
	Raindays	0	0	0	3	5	13	20	19	14	17	0	0	91
1954-55	Rainfall	0	0	0	255	124	265	169	351	275	139	37	7	1622
	Raindays	0	0	0	13	10	19	17	20	17	9	5	1	111
1955-56	Rainfall	23	0	0	58	160	125	219	687	185	204	53	0	1714
	Raindays	2	0	0	7	17	14	18	20	13	9	7	0	107
1956-57	Rainfall	6	0	15	112	72	330	398	464	482	74	3	0	1956
	Raindays	2	0	1	9	8	17	16	21	25	7	1	0	107
1957-58	Rainfall	0	2	0	13	79	254	187	123	203	76	1	8	946
	Raindays	0	1	0	3	7	21	15	17	15	5	2	2	88
1958-59	Rainfall	0	0	0	69	179	187	298	78	160	392	2	0	1365
	Raindays	0	0	0	6	11	17	18	8	17	13	3	0	93
1959-60	Rainfall	0	0	0	16	80	364	336	352	423	42	39	0	1652
	Raindays	0	0	0	1	8	18	18	22	21	7	4	0	99
1960-61	Rainfall	0	0	6	4	45	251	241	197	108	78	2	0	932
	Raindays	0	0	3	2	9	15	18	21	11	6	1	0	86
1961-62	Rainfall	0	0	1	15	264	90	528	431	85	29	0	0	1443
	Raindays	0	0	1	5	10	10	25	26	7	3	0	0	87
1962-63	Rainfall	0	0	19	51	155	225	376	295	304	95	1	0	1521
	Raindays	0	0	1	8	12	13	25	24	23	11	1	0	118

Source: Records of Bureau of Meteorology, Darwin

Both the forty-year seasonal average for Koolpinyah of 1522 millimetres (Table 1) and the average for Humpty Doo of 1617 millimetres (calculated from Table 2) are very high seasonal totals in the national context. However, seasonal rainfall on the sub-coastal plains varies widely and comparison of the totals in the wettest and driest seasons shows a range of over 1000 millimetres. In all seasons summer rainfall is dominant and January and February are the wettest months (averages for Koolpinyah were 332 and 322 millimetres respectively). Rainfall intensities can also be high, as can be seen when the monthly rainfall totals are read in conjunction with the numbers of raindays. For example, at Humpty Doo in February 1956, 687 millimetres fell over 20 raindays to average 34.35 millimetres per rainday. Rainfalls of this amount and intensity produce heavy flooding on the plains, flooding that can severely disrupt all farming operations. A stark contrast can be seen three years later in February 1959 when only 78 millimetres were recorded over 8 raindays.

Widely different readings of this nature require consideration to be given to rainfall reliability. This is measured as the coefficient of variation expressed as a percentage. The seasonal variability of 17 per cent (Table 1) represents a reliable rainfall. Greater variability is shown within seasons but rainfall in the wetter months has a much lower variability (39 per cent for November and January) than for the drier months when the occasional heavy fall increases variability markedly. Nevertheless, rainfall distribution during the wet season can produce dry spells and prolonged absences of rain can have harmful effects on a crop, especially at vital stages such as floral initiation and when grain is set. On these occasions water stored from earlier heavy rains or from other supplementary supplies eases stress on the growing crop.

Discussions on the adequacy or otherwise of rainfall hinge upon factors such as the variety of crop to be grown and the particular type of farming system to be used. For example, pregerminated seed sown into flooded paddies will have an advantage over dry sown seed. To provide a gauge of the rainfall regime Chapman and Kininmonth (1972) formulated a water balance model for rain-grown, lowland rice on the heavy clay soils of the sub-coastal plains. Data from 24 years of records at Humpty Doo showed that estimated dates of soil saturation ranged from 23 October to 4 January. After the initial soil saturation dry spells usually occurred during which ponded water evaporated and the top 2-3 centimetres of the soil dried out. Permanent ponding did not occur until the soil had been saturated several times and took place between 14 November and 25 January. For varieties of rice that took 100 days to mature, planting earlier than 15 January was not recommended because of the risk of heavy rains interfering with the harvest at the end of the season. Experience up to the time of the work of Chapman and Kininmonth showed wet tillage (when paddies were already under water) to be most effective in controlling weeds during the early phases of crop growth. Best results would come if sowing took place within 2-3 days of wet tillage while the soil was in a suitably rough condition to favour crop establishment. Given these conditions, inadequate rainfall could, on average, cause crop failure one year in thirty and a severe reduction in yield every tenth year. However, an examination of rainfall records showed that poor seasons tended to occur together between sequences of more favourable conditions. The climate at Humpty Doo would support rice provided that the appropriate cultural techniques were used and the timing of these was adjusted, whenever feasible, to suit the incidence of rainfall in each season.

In the early 1950s long-term temperature data were not available for Humpty Doo but temperatures at Darwin were similar and recordings from there were used to assess conditions. It can be said that throughout the year conditions remain hot with the average maximum temperature always above 30 degrees C and the average minimum never below 19 degrees C. The hottest months are October-December (average maximum for November 34 degrees C) when cloud cover is too dispersed and intermittent to reduce effectively the increasing solar radiation. Although during the dry season both the days and nights are cooler, temperatures remain sufficiently high to promote year-round growth and to require the use of heat-tolerant varieties. Owen (1967, 248) pointed out that day length varies from 12.7 hours in December to 11.3 hours in June. However, in January and February the mean hours of sunshine per day are at their lowest because rainfall and cloud cover are at their maximum in these months when the rice crop is in its early stages of vegetative growth.

In summary, when the rice was first contemplated the sub-coastal plains to the east of Darwin had much to offer. A seasonal concentration of rain provided abundant water to inundate the plains and, with high temperatures, the conditions seemed to suit rice admirably. The Australian government, although it changed from Labor to a Liberal-Country Party coalition in 1949, remained keen for such an area to be developed.

The Trend to Rice

The Report of the Administrator of the Year 1912 (Commonwealth of Australia 1913, 16) stated that rice had been grown in the Territory for at least half a century and apparently with success in each season. In particular its cultivation had flourished with increases in the Chinese population. These people had first been attracted to the gold diggings in the 1870s (Bauer 1964, 178) and a second major influx had found work on the construction of the Darwin-Pine Creek railway during 1887-89. After Australia had become a Federation enforcement of the White Australia policy severely restricted the labour-intensive cultivation methods of the Chinese, and Europeans were not successful in their attempts to grow rice because methods had not been developed to produce the crop '... with the same degree of efficiency with which wheat is machine handled ...' (Commonwealth of Australia 1924, 13). Rice growing lapsed until a few farmers, desperate for a commercial crop that would succeed in the Territory, petitioned the government to provide seed for small, experimental plantings for the 1937-38 season. These requests were denied because of a 'gentleman's agreement' amongst governments not to make plantings in opposition to the Murrumbidgee Irrigation Area (MIA) in New South Wales (Commonwealth of Australia 1939, 30).

The MIA had become established as Australia's rice growing region after the first commercial crop of 62 hectares in 1924-25 yielded 309 tonnes (Bureau of Census and Statistics 1927, 667). At least 16,000 hectares were estimated to be suitable for rice cultivation and rapid expansion of the areas grown and quantities produced occurred following the success of the first crop, as is shown in Table 3. Exports of Australian rice began in 1927-28 and thereafter ready markets were found in the United Kingdom, Canada, New Zealand and the Pacific Islands. Success came because of the availability of varieties suitable for the area, a water supply that was adequate and could be controlled, nearness to sources of supply and markets and continued research work.

Interest in rice in the Territory was reawakened in the post-war years by the search for crops for northern Australia. Various regions appeared to be suitable for the crop and also markets could be found in Great Britain and Asia where demand exceeded supply. Experiments with rice had their humble beginnings at the Kimberley Research Station on the Ord River in Western Australia where the first plantings were made on 0.6 hectares of heavy Kununurra clays in November 1947 (Poggendorff 1949, 19-21). Caloro, the variety common in the MIA, was tried and after surviving attack by grasshoppers it was destroyed completely by cockatoos just before harvest. Plots yielded the equivalent of only 1320 kilograms per hectare from dry season plantings in June 1948 and trials on 0.1 hectares in the 1948-49 wet season and the 1949 dry season were severely attacked by a variety of birds and insects. Despite this inauspicious beginning confidence in the prospects for rice persisted and a survey was commissioned specifically to try to confirm its potential. At the instigation of Rice Equalisation Association Limited, a company involved in the industry in New South Wales, a specialist in the crop, W. Poggendorff from the New South Wales Department of Agriculture, was invited to inspect areas where rice cultivation might be possible. After examining parts of the Fitzroy and Ord Valleys in Western Australia he inspected the swamps near Darwin, the Adelaide River, Marrakai and Daly River plains and possible plant quarantine areas near Pine Creek and Katherine. He travelled through the region in September-October 1949, at the start of the seasonal changes leading to the wet, and was accompanied by the first Agricultural Officer in the Territory who had been recently appointed.

Because of the timing of his trip Poggendorff could do little more than rely on hearsay regarding the wet season when rice could be cultivated under rainfed conditions. His report fell short of a carte blanche endorsement for massive areas of rice cropping.

TABLE 3

Summary of Australian Rice Production and Exports

(excluding production in the N.T.)

Year	No. of Holdings	Area (hectares)	Production (tonnes)	Exports (tonnes)
Before Operations by Territory Rice				
1924-25		62	309	-
1925-26		631	1,165	-
1927-28		4,007	16,748	5
1938-39	313	9,523	52,866	12,757
1943-44	364	16,467	76,490	35,852
1947-48	349	10,606	50,980	28,439
During Operations by Territory Rice Ltd.				
1955-56	620	16,666	90,016	43,600
1956-57	652	20,428	81,196	29,758
1957-58	743	18,929	107,790	32,633
1958-59	775	19,042	126,099	45,060
1959-60	848	19,810	128,251	67,136
During Operations by Rice Developments Pty. Ltd.				
1960-61	787	18,664	114,325	62,773
1961-62	878	20,310	134,215	52,299
1962-63	956	22,230	135,815	58,189

Source: Commonwealth Bureau of Census and Statistics

Converted to metric

After being told that much of the Adelaide River plains flooded to a depth of one metre, which was too deep for rice, he found that 'it seems probable that extensive marginal areas of these plains, flooded to a more suitable depth for normal varieties, could be found' (Poggendorff 1949, 23). Wild rice already grew on these plains and Poggendorff further justified belief in the prospects for commercial rice production by his knowledge of areas of production overseas.

> A very large proportion of the world's rice is produced under similar conditions of periodic natural flooding, on the plains and delta lands of the rivers of Southern and Eastern Asia, in the total absence of any major irrigation works (Poggendorff 1949, 30-31).

However, he also noted possible pitfalls for any major development on the sub-coastal plains. For economic production under large-scale methods of farming and in the absence of records of depths of flooding care would be needed in locating suitable sites, taking into account the feasibility of flood control where necessary, control of natural vegetation, cultural methods and costs of establishment and operations. Furthermore, varieties suited to the area would be needed.

Poggendorff's findings provided sufficient stimulus for the Minister for Territories to set up a Rice Advisory Committee to formulate proposals for development. This committee consisted of the Agricultural Officer of the Northern Territory Administration (NTA), the head of the North Australia Survey Section of Commonwealth Scientific & Industries Research Organisation (CSIRO, formerly CSIR) and a representative of the Department of Works and recommended that the potential for rice production be explored on the Sub Coastal Plain and Marrakai Land Systems. On each land system different problems would be encountered; rice growing on the first would be dependent upon natural rainfall and flooding whereas on the Marrakai natural rainfall would have to be supplemented by water conservation and irrigation (Department of Territories 1954, 1-2). Field trials were essential before farming could begin. Staff to work in agriculture had been increased to form an Agricultural Section within the Lands Branch and in 1952 this group started two Rice Research Stations. The first, at Humpty Doo, consisted of approximately 80 hectares and at the 'Sixty Mile', south of Darwin on the Stuart Highway, the station was much larger and covered 600 hectares.

At Humpty Doo natural flooding each wet season would guarantee abundant water but for successful cropping this supply had to correspond in amount and timing with the needs of rice. Advice differed on how easily such synchronization could be achieved. The Director of Drainage and Irrigation in Malaya inspected the potential rice areas in early 1953 and forecast that for large-scale development rainfall would have to be supplemented by irrigation and that at least five years of surveys and basic research would be necessary to obtain sufficient hydrological data (Commonwealth of Australia 1955, 21). Early experimental plantings at the Rice Station emphasized this view. Heavy rains and floods ruined the 18 hectares planted for the 1952-53 season and water problems were amongst those that beset the experimental plantings made in December 1953; a dry spell of three weeks in February 1954 retarded plant growth, some varieties were infected by a small population of moth stem borer, (Tryporyza innotata), magpie geese fed on the ripening grain which grasshoppers and rats also shared before a cyclone on 10 April removed any chance of ascertaining yields (Agricultural Section 1954, Appendix B). Notwithstanding this experience the Agricultural Officer was optimistic about the future for rice when in 1954 he wrote:-

> Very considerable progress has been made ... the suitability of the area for rice growing has been placed beyond doubt. Not only that, but the introduction of tropical varieties has indicated clearly the varietal requirements and has produced at least one variety on which it will be safe to base large-scale operations ... while the engineering aspects associated with the development of the rice country must receive further attention, it is felt that these are not nearly as massive as originally described by many who had been denied the benefit of continuous observation on the spot. This applies more particularly to the

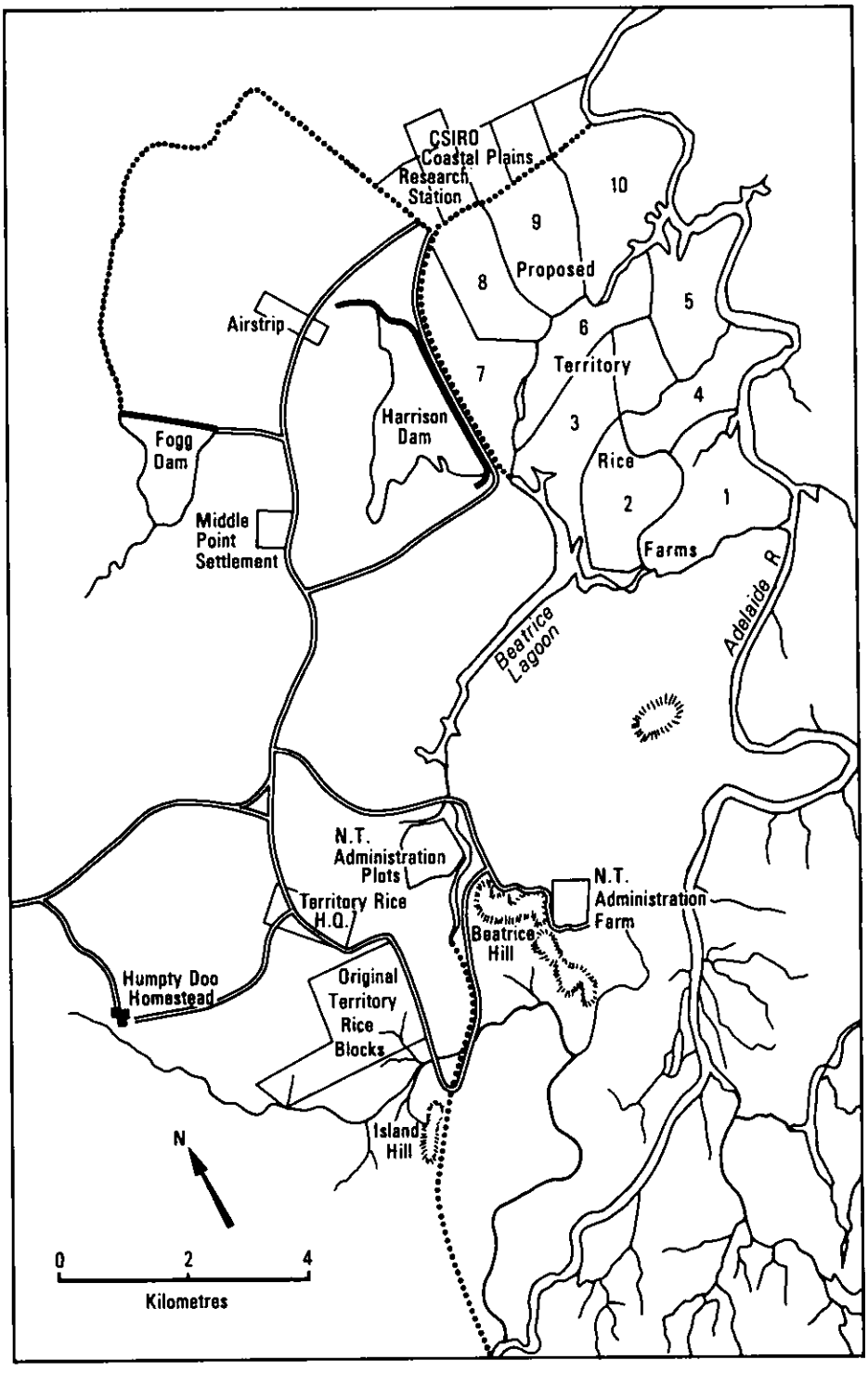
> development of the coastal plain areas. Considerable engineering will be necessary to bring in the more restricted Marrakai areas ... An aspect has crept into discussions on development of the coastal plain area which should be treated with considerable reserve. This is the preoccupation with the principle of storing water as a prerequisite to successful rice cultivation. It should be clearly understood now that normally such reserves would only be of value during the first two or three weeks in January. At this period, there is no water available, as a rule, for storage. This is only one of the dangerous misconceptions that are being put forward in the absence of first hand knowledge of local conditions ... The original conception for the development of these splendid plains must not be lost sight of in a welter of ingenious hypothesis. To recapitulate - the area has unique advantages. It is a treeless, practically flat plain covered by an excellent rice soil. It is flooded annually from January/February to April/May. Conditions exist for large scale mechanized preparation of the seed bed and dry land planting and harvesting. It is a matter of extreme doubt to the writer if a similar expanse of country with similar conditions exists elsewhere (Agricultural Section 1954, 5-6).

Favourable endorsements of this tenor did not prevail throughout the Territory. Upon his return from a study tour of North America and South Africa in 1956 the Administrator, an experienced agricultural scientist himself, recommended a thorough investigation of what was involved in the proposed rice program.

> It is very vital that the first investment in rice production be an investment in research in every phase of the industry, but more particularly into the local circumstances obtaining near Darwin ... There was a great tendency by members of the Chase group to consider that success was certain, but I have tried, without killing their enthusiasm, to induce more realistic thinking (Wise 156, 9).

The optimism of the local agricultural officer coincided with interest from overseas and greatly encouraged investment in the area although the events of later years showed how difficult it was to manage and work.

Map 2



Experimental and Proposed Rice Cropping Areas at Humpty Doo

Source: Department of Territories 1961:76

Roads

Dam walls

Channels

Elevated rocky outcrops

THE PLAN AND THE PERFORMANCE

While he was in the United States in 1953 Harold Holt, Australian Minister for Labour and National Service, renewed contacts with Allen Chase, an experienced entrepreneur whom he had previously met in Singapore. At a social gathering hosted by Chase, discussion about the potential of the Northern Territory stirred Chase's interest enough for him to visit the sub-coastal plains later that year and then to form a syndicate to pioneer rice growing in the area. Territory Rice Limited was incorporated in Sydney on 9 November 1955 with an authorised capital of 500,000 shares of $2 par value. Allen Chase became Chairman and four other shareholders came from the United States. One third of the company was owned by Mainguard (Australia) Ltd, a merchant bank headed by Mr Cullen, that had been attracted to the conept of a development scheme in the north for some time.

Two Crown Lands Ordinance were enacted in 1956 by the Northern Territory Legislative Council to allow development to proceed at Humpty Doo. Agricultural Development Leases were created to encourage investment in the Territory and applied for thirty years over areas for which specific developmental and agricultural requirements would be laid down (Agricultural Development Leases Ordinance, 1956). Within twenty years of taking up land the lessee could submit a plan for partial or total subdivision into units of a maximum area of 20,235 hectares. If the Administrator of the Territory approved the plan an agricultural lease would be granted for each of the subdivided areas on the condition that these be transferred to a new lessee within two years.

The second piece of legislation, the Rice Development Agreement Ordinance 1956, ratified an agreement signed on 21 December 1955 between Territory Rice Limited and the Commonwealth government. This had followed nearly two years of negotiations and was to be effective from 1 January 1956. Under this agreement the company was given exclusive rights to develop the sub-coastal plains to the east of Darwin. Within five years the company was to select 303,525 hectares of the plains for the progressive investigation of their rice growing potential. Agricultural Development Leases would be granted for units of about 2,000 hectares up to a maximum of 202,000 hectares, if such an area was favourably assessed. Annual rental for land held under these leases was set at $0.50 per hectare. The staged development of these units over fifteen years was stipulated and is summarized in Table 4. For five years the rate of establishment of units was slow to allow the initial teething problems to be dealt with but from then on the rate of development could be stepped up to a maximum of ten units in each of the last five years. Agricultural leases would be granted for each established cropping unit. The minimum area of an Agricultural lease was approximately 520 hectares which would have allowed nearly 400 farms of this size to be sold if all of the 202,000 hectares were developed.

Clause 26 of the agreement covered the company's financial structure and stated that

> The company will have sufficient subscribed capital and other resources available each year, other than by charging, encumbering or mortgaging any lease granted by the Commonwealth for the purpose of agricultural development, to carry out its obligations under this agreement.

At least one quarter of the share capital had to be held by Australians or Australian companies. For its part the government agreed to provide a rice seed nursery of 100 hectares and to undertake experiments on rice varieties, rice growing techniques and hydrological investigations and to make the results available to the company. If Territory Rice Limited defaulted in its program of development the government would not be bound by the agreement. However, the company would not be considered in default if it had developed the minimum areas shown in Table 4.

TABLE 4

Rice Development Agreement Ordinance 1956

Summary of Development Requirements*

Year	Annual		Progressive Total		Minimum Area Necessary to Avoid Default ('000 ha)
	No. of Units**	Area ('000 ha)	No. of Units	Area ('000 ha)	
1	1 or 2	2 or 4	1- 2	2 - 4	
2	1 or 2	2 or 4	2- 4	4 - 8	
3	1 or 2	2 or 4	3- 6	6 - 12	
4	3	6	6- 9	12 - 18	
5	3	6	9 - 12	18 - 24	12
6	5	10	14 - 17	28 - 34	
7	7	14	21 - 24	42 - 48	
8	9	18	30 - 33	60 - 66	
9	9	18	39 - 42	78 - 84	
10	9	18	48 - 51	96 - 102	52
11	10	20	58 - 61	116 - 122	
12	10	20	68 - 71	136 - 142	
13	10	20	78 - 81	156 - 162	
14	10	20	88 - 91	176 - 182	
15	10	20	98 - 101	196 - 202	113

* Measurements of area in the original agreement were written in acres. Here they are written to the nearest '000 hectares.

** Unit = an area of 2000 hectares

Source: Rice Development Agreement Ordinance 1956

Under the supervision of Mr A.G. Lowndes, who Mainguard had hired as rice consultant, exploratory activity began in 1954 when the syndicate planted 8 hectares to rice trials on a block of 100 hectares they had rented on the edge of the Adelaide River plains. Floods in February 1955 covered much of the area and prevented evaluation of varietal trials which were important for finding a rice best suited to the development. However, all was not lost as some agronomic experience was gained with rates of sowing fertilizer applications and cultivation techniques and also seed supplies were multiplied for future plantings. Little was known in Australia about the types of rice that would grow best in the monsoonal conditions and anything that could be learnt about them first-hand was vital for the project. Fourteen varieties were planted on 100 hectares in the 1955-56 season but heavy rains produced record floods in February 1956 (Table 2) and caused serious losses. From the harvesting that was possible in May-June, introductions from Malaya, Burma and Kenya gave plot yields up to 4,500 kilograms per hectare which, under the circumstances, compared well with the MIA commercial average of 5,400 kilograms per hectare. While the yields were encouraging care was also taken to ensure that the crop was of a top quality. To avoid grain damage caused by drying by the sun in the field, known as sun-checking, the rice was harvested at a high moisture content and dried artificially. Consideration was also given to the use of other crops in a rotation program: cotton, grain and fodder sorghums, oil crops and legumes and various fodder crops were all thought to be likely participants.

As a concession to the experience with floods the area to be cultivated for the third (1956-57) season was chosen on higher ground closer to the Adelaide River and north of Beatrice Lagoon (Map 2). Eight hundred hectares were to be planted but, as Table 2 shows, the period from December 1956 to March 1957 was the wettest the Humpty Doo project had encountered. Rainfall was so great that Christmas 1956 was celebrated with all tractors bogged and all seasonal and long-term operations well behind schedule. Only about half the area had been planted and to complete the job seed was applied by plane. From this operation stems the story that magpie geese destroyed Humpty Doo; as seed was released from the aircraft 'it was a race between gravity and the geese. They caught half of the seed going down and the rest they dug out of the rice paddies' (Chase 1966, 121). Only half the seed germinated and further damage was caused by floods, insects, cockatoos or brolgas with the end result for the season that 243 hectares produced 200 tonnes. Included in the delays caused by the wet conditions were the construction of earthworks designed to give greater water control. Run-off from one wet season was to be stored in Fogg Dam for use in dry season experiments or until the next season when it would give the new crop a sound, early start. The Australian government was also involved in this phase of development for the construction of this first dam was undertaken by an R.A.A.F. Airfield Construction Squadron based in Darwin using hired equipment from Utah Construction Ltd. Paradoxically, the floods which ruined much of the crop would not have been so serious if earthen banks around the rice areas had been completed.

The first three seasons had stretched the company's finances to the limit and for the 1957-58 season only a token area of 80 hectares was planted for various agronomic trials and to ensure continuity and adequacy of seed supply for future crops. Ironically, the season was the most favourable for rice production experienced since the inception of the scheme (Agricultural Branch 1958, 2). A small dry season trial of 24 hectares which followed in May 1958 was irrigated from the Adelaide River but it was not harvested because of a lack of funds.

Faltering operations in the field brought about a major overhaul of company ownership and management. In 1957 one of the American shareholders, Robert McCulloch, dispatched an emissary to investigate whether continuing the scheme was feasible and worthwhile. As a result of a favourable assessment McCulloch installed his own management and over the next three years injected nearly $2,000,000 into Territory Rice by taking up a majority shareholding, guaranteeing a loan to the company and paying off outstanding debts. This infusion of funds and energy allowed commercial cropping to be restarted in the 1958-59 season when 2,024 hectares were planted but it did not remove or solve all problems. Poor seed produced low germination rates and incomplete fencing allowed cattle to cause considerable damage to the crops and to the levee banks, but the main problems continued to revolve around water management. To help supply water in dry times a second dam, Harrison Dam, was commissioned but the site chosen for it was an unfortunate one; the dam wall was built next to a main channel to the river and about ten per cent of it subsided

into that channel. The dam did not command a natural catchment and after repairs to the wall had been made water was pumped from the river in an attempt to fill it. Repeated breakdowns prevented the pumps operating to capacity and they stopped completely when lightning set fire to the power substation with the result that the dam never filled and contributed little to the cropping.

Water supply problems of a different kind arose in April 1959 when a cyclonic depression deluged the plains with 380 millimetres in twenty-four hours. In addition to damage to the crop this rain made conditions very boggy and self-propelled harvesters were denied access to the paddies until July. By that time the stems had weakened and were unable to support the mature heads of grain which fell to the ground. This lodging of the crop prevented satisfactory harvesting. Furthermore, trucks for bulk handling the crop could not drive onto the wet fields and harvesters were forced to scurry back and forth to the headlands to empty their bins - a time-consuming and costly process. The slowness of the harvest increased losses from lodging and sun-checking and only about half the crop was taken off to yield 1,270 tonnes. Further losses occurred in milling and a final product of mediocre quality was not readily accepted on the Australian market.

A dry season planting of 280 hectares in 1959 suffered from water shortages and only fifteen tonnes were taken from 100 hectares. For the 1959-60 season 2,180 hectares were planted and yielded 3,300 tonnes. In November 1960 this was shipped to Hong Kong where better milling facilities and a market were available. At this time integration of other activities was considered to help ease the total reliance on rice; beef cattle could be fattened on rice stubble and natural grasses of the plains and shipped live to Hong Kong on the same vessels as rice. Additional investment would be needed to set up this operation but after the years of disappointing performances the proposal was not sufficiently attractive to induce McCulloch to continue supporting the scheme. The burden had become too much and Territory Rice passed into liquidation in 1960. By this time the program of development was well behind schedule and the area under cultivation did not approach the minimum of 12,000 hectares necessary to avoid defaulting on the agreement with the government (Table 4). Growing rice could perhaps provide partial support for development of the plains if it was integrated with other activities such as fattening cattle.

Arrangements were made whereby the major creditors retained ownership of the assets by paying out the minor creditors and then set about recovering what was owed by continuing to grow rice. Four men who had seen the original project expand and decline were persuaded to farm 200-hectare blocks on a share basis. They organised themselves as Rice Developments Ltd, agreed to hire equipment from the creditors and to pay a percentage of receipts to eliminate outstanding debts from the original company. By maintaining the earthworks in the field and continuing with rice growing it was also hoped that a buyer could be attracted to carry on the development.

But this was not to be. All operations ceased after three seasons although Rice Developments' yields averaged better than those obtained previously (Table 5). Reasons for stopping were not hard to find; the need for proper water control persisted, weeds became a problem, seed quality was variable and the lack of a more suitable type of rice was keenly felt. In the absence of any outside support the sharefarmers were also required to mill and market their grain and bear all associated charges - freight, insurance, packaging - and payments for sales in Australia and Papua New Guinea were not received for over twelve months after harvest. Under these circumstances they were forced to seek livelihoods elsewhere. Thus, within a decade the project that was promoted as a future granary for Asia had become but a relic of that vision.

Before considering why the program was so short-lived it must be pointed out that the venture did not suffer alone; the neighbouring experimental area fun by the Northern Territory Administration confirmed the problems but did little to produce solutions. In 1959 the Beatrice Hill site changed focus to combine cattle fattening and fodder crops and pastures with rice growing. Rice work by the Agricultural Branch was moved upstream to the Upper Adelaide River Experiment Station (UARES) at Tortilla Flats on the Marrakai plains (Agricultural Branch 1960, 7-8) (Map 1). Also in 1959 the CSIRO set up a Coastal Plains Research Station (CPRS) at Middle Point (Map 2) and carried out basic rice investigations there until 1973. During that time work on soils identified the rates and

TABLE 5

Performance of Rice Developments Limited

Season	Area Planted (ha)	Yield (tonnes)	Sales (tonnes)
1960-61	809	900	770
1961-62	374	325	183
1962-63	95	140	n.a.

n.a. = not available

Source: Agricultural Branch Annual Reports 1961, 48-51; 1962, 27-8; 1963, 22-5.

forms of nitrogen and phosphorus fertilizers needed and also showed that soil salinity could be ameliorated with adequate fresh water (Fisher et al. 1977, 47-8). Studies on rice itself enabled harvesting to be spread over a longer period by growing photo-insensitive varieties and these, if pregerminated, could be sown into standing water after the wet season had started. Contemporary breeding work at the International Rice Research Institute (IRRI) in the Philippines produced varieties which seemed likely to do well on the plains of the Territory. The CSIRO efforts at CPRS also made valuable advances in the control of weeds, pests and diseases.

Notwithstanding this progress in research commercial rice production has since been of minor consequence. Government pilot farms set up on the Marrakai Land System in 1964 tried rice for a few seasons before abandoning it. One farmer planted up to 40 hectares on the Marrakai in 1973-74 and 1974-75 and obtained yields of about 3,700 kilograms per hectare despite insects, birds and buffaloes (Anon. 1975, 4-7). The last crop planted was in 1975-76 but floods and better returns from other crops brought this production to an end.

One further footnote can be added to the rice story. In May 1980 the Northern Territory Legislative Assembly enacted the Agricultural Development and Marketing Bill which identified plans for the development of agriculture in two stages over fifteen years. Stage 1 would involve initial establishment of commercial rice production on existing farms in the Upper Adelaide River area and it was expected that 45 farms would be in full production at the end of the second stage. Within a year, in March 1981, plans for this commercial rice development were deferred because an uncertain water supply cast serious doubts over the profitability of the exercise.

HUMPTY DOO ASSESSED

Any development scheme which sets out to pioneer an area must go through an initial phase of familiarization with the new conditions during which teething problems are identified, worked on and solved. How long this lasts before the program becomes established depends upon a host of variables including the complexity of the environment, the type of cultigen(s), the mode of production and the perception, skill and experience of labour and management. After a farming region has become established an element of chance persists through each season but, in a new environment that is not fully understood, the enterprise is even more risky. This was the case at Humpty Doo where the area appeared to have so many advantages. Seasonal rainfall patterns provided abundant, free water in which rice could grow, the flat plains required no clearing and lent themselves to mechanized farming -- an advantage in an area where agricultural labour was scarce. The location just east of Darwin provided access to a port, although a small one, and through it to the expanding market in South-East Asia. Previously the area had been used for the open range foraging of cattle and to grow rice for export was one way of introducing the more intensive exploitation sought for in the north. Furthermore the land was available through long term leases which allowed for later subdivision. What was required was capital and the Americans had access to this.

These factors which meshed together to inspire the development were also the ones that interacted to cause its downfall. Supplies had to be brought long distances by little used routes and no regular services ran to the markets which effectively increased the remoteness of the location. The annual abundance of water did not automatically coincide in time with the needs of the crop and expensive methods of water control and careful husbandry were necessary to try to bring the two into harmony. Finally, insufficient capital was provided to overcome these problems and make the project profitable.

Earlier analyses of the project have identified technical reasons for its demise. In 1960 an inquiry into the prospects of agriculture in the Territory presented its findings in what has become known as the Forster Report (Department of Territories 1960, 92) and identified the problems for achieving satisfactory results with rice to be poor establishment of the crop, the varieties of rice available and the cultural methods used, hydrological problems, the harvesting and storage procedures which allowed cracking of the grain and the absence of a suitable component to fit into a crop rotation. Moir (1961) felt most of the problems sprang from the need for mechanization and expressed them as the lack of suitable varieties, inadequate water control, the methods of crop establishment, soil fertility and the quality of grain sent to market. A more recent examination of technical problems summarized the causes of failure as a poor choice of site, a lack of knowledge of the agronomy of rice in the area, attempting to expand the program too rapidly without sufficient study of the agronomic and managerial problems and a poor standard of land levelling that brought about problems with water control and weeds (Fisher et al. 1977, 49-50).

None of these acted in isolation and the interpretations quoted above only differ in the emphasis placed on various aspects of what happened. How the different factors interacted can best be shown by looking at some of the key difficulties more closely, including the role of finance and management.

Location

The location played a part in the formulation of the concept of development but presented problems for its implementation. In the aftermath of World War II interest in development of the north arose partially because it lay closest to possible sources of threat from Asia and one way to reduce the likelihood of attack was to populate the area by developing it. Distances to southern Australia made this difficult to achieve. For a

scheme such as that undertaken at Humpty Doo transport links capable of handling heavy, bulky loads were essential. Railways could not provide any direct connection with the south because the line from Darwin to Larrimah was separated from the Adelaide to Alice Springs line by a gap of 1,000 kilometres. Road transport was held up each year by floods and air services could only be used for urgent, small requirements. Shipping provided the most satisfactory way of getting supplies in and exports of rice out although it too had disadvantages. Darwin was a minor port away from regular international sealanes and it was difficult to hire freighters for only small, irregular shipments. Long turn-around times also militated against frequent use of the port; to load 3,000 tonnes of bagged rice in 1960 took 12 days whereas unloading in Hong Kong was finished in 24 hours. The Adelaide River was found to be navigable up to the rice areas and, as an alternative to Darwin, a trial shipment was loaded in 1961 from the riverbank using especially designed conveyor belts but the operation was not without incident. The only suitable vessel available was unfamiliar with the coastline and was delayed by damage to its propellor before difficulties with the tides meant only half the cargo could be loaded at the pump site, and the remaining 350 tonnes had to be loaded back in Darwin. This exercise re-emphasized that the mill was poorly situated, it was neither at the production site nor at the point of export but halfway between and this involved much extra handling of grain. All these types of setbacks derived from the location and, although individually they were not catastrophic, they combined to add to the amount of work involved and to total costs.

One of the advantages that the sub-coastal plains were considered to have was the similarity in conditions to those in Asia where 60 per cent of the world's rice was grown, without irrigation (Manshard 1974, 71). Admittedly the plains were flat, treeless and naturally flooded but what was overlooked was that the rice areas in Asia were exposed to droughts and floods which contributed towards the need to import rice. The monsoonal rainfall in north Australia was sufficient to grow rice but it varied greatly throughout the season and over short distances, especially at the start and the end of the wet. A sound working knowledge of the environment could only come over a period longer than the two years Territory Rice allowed before embarking on major commercial cropping.

Types of Rice

From the beginning one problem was to decide which of the thousands of different rice types grown throughout the world would best suit mechanized farming in the conditions at Humpty Doo. Two broad strains of rice were of importance, *indica* and *japonica*, each of which had advantages and disadvantages. *Indica* rices were common throughout southern Aisa where their long, dry-cooking grain formed the staple diet of millions. For mechanized production a particular problem was that they lodged easily because their long, weak straw was unable to support mature heads unless they were harvested promptly. *Japonica* rices had shorter, stronger stems and did not present this problem but acting against them were their mid-latitude origins; they grew well on the MIA but in the north they were better suited to the dry rather than the wet when sterility became a problem. Also their small grain became glutinous when cooked which was an acceptable quality in Japan but not in the parts of Asia with greatest market potential.

Indica rices were decided upon but a further selection was needed to find varieties that would match the length of the growing season. The seasonal variation of the time of the onset of the wet, the intensity and distribution of rains and the time of the end of the wet complicated this selection process. Day length neutral varieties took a standard length of time to mature regardless of the number of hours of daylight. Staggered times of planting would, in effect, spread the harvest time to allow men and machinery to cope better but the length of time that these rices took to mature and the best time for harvesting required that they be planted in what could be expected to be the wettest part of the wet. Aerial sowing was a new concept and the experience of January 1957 cast doubts on this method. Photosensitive or day length sensitive rices flowered and set seed when the number of hours of daylight declined to a critical level. Planting could be undertaken earlier in the wet season but they matured at the same time and therefore concentrated the harvest within a few brief weeks. Throughout the cropping, varieties of this type, A-36-3 and Meli No 2, were favoured because they had shown up best in trials at

Kimberley Research Station and in limited work in the Territory. However, they were not ideal and higher yielding rices would have helped considerably.

Technology

Two strategies were considered to ensure successful crop establishment in the variable conditions at the start of the wet season. In each case land preparation was begun at the end of the previous harvest and completed during the dry. For the system actually used, seed was planted to about 10 centimetres which meant that the heavy rains needed to initiate germination at that depth would also carry seedlings through until follow-up rains fell. The alternative method required suitable water management; water stored in dams from the previous wet season could be used for irrigation until the rains came but this option was never really available because of the inadequacy of the dams and the problems in getting them filled. Pumps that were not satisfactorily chosen or installed could not fill the dams from the river while wet season run-off provided abundant fresh water. So little water was stored at the end of the wet that in 1959 the crop could not be irrigated when it became water stressed as the grain matured. By the end of the dry, water levels in the dams had been lowered even further by high evaporation rates which effectively prevented the use of irrigation in crop establishment.

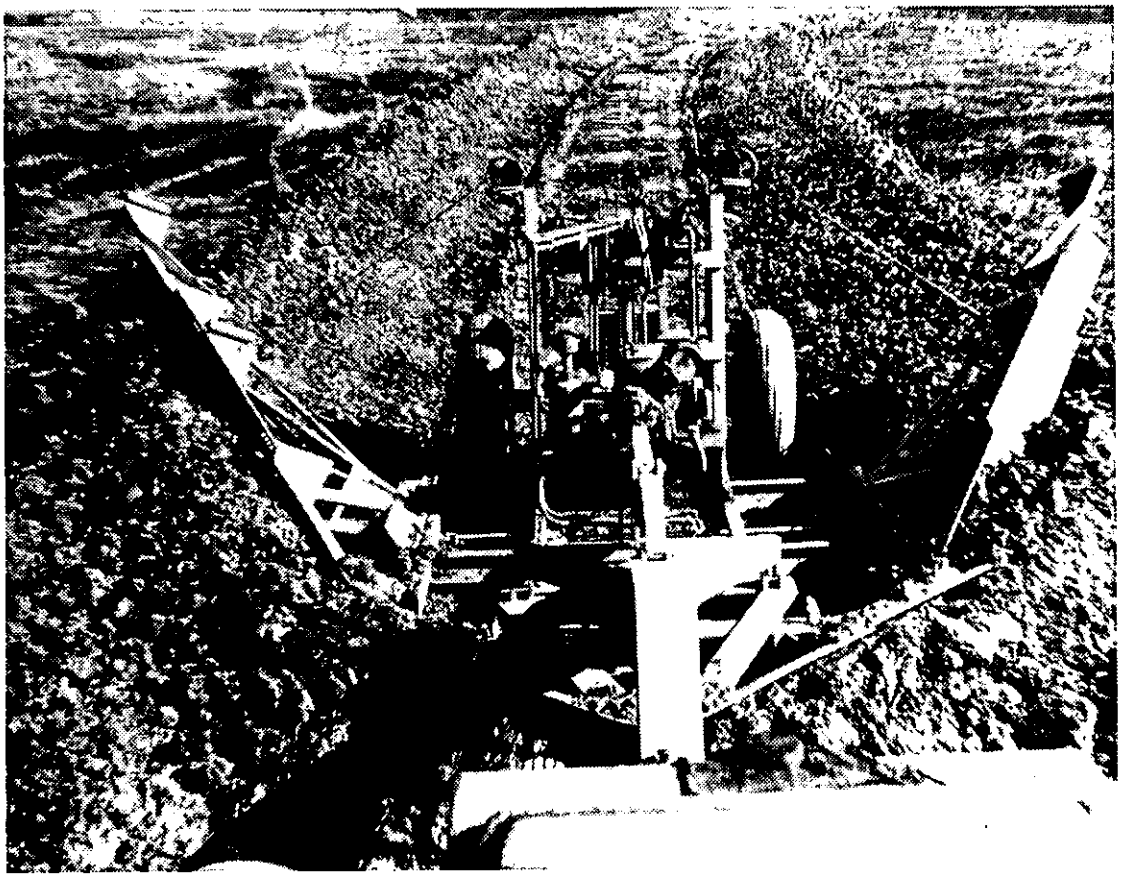
While sufficient water could not be provided when it was needed, controlling unwanted superfluous water was equally difficult, particularly as the plains did not flood to uniform depths. During the flood of February 1956 an inspection by boat and plane showed that:

> it appeared that the extent of the available rice growing land on the sub-coastal plains on each side of the Adelaide River was not as extensive as formerly estimated as several areas were deeply inundated and other parts were too high for the successful growing of rice unless extensive water control measures were adopted. It does appear that Territory Rice Limited may have difficulty in selecting 500,000 acres of land suitable for rice growing in the sub-coastal plains east of the Stuart Highway (Agricultural Branch 1956, 9).

Further study by the Water Resources Branch of the Northern Territory Administration increased an understanding of the flooding, although it came too late to help the Territory Rice project. A longitudinal profile of the Adelaide River showed parts of the plains to lie below the high water tide level at the coast (Purich 1966, 2) which accentuated flooding and drainage problems. The same investigation showed that the Adelaide River plains were the most suitable for development as they did not flood as frequently or as deeply as those of the Wildman, Mary, West Alligator, South Alligator and East Alligator plains (Purich 1966, 5). Therefore, Territory Rice was fortunate in selecting the Adelaide River plains in preference to these as the site for its program. Under the Rice Development Agreement Ordinance the company was entitled to expand its operations to the plains of these other rivers but, had it done so, greater problems with water control would have been encountered.

As it was, enormous difficulties were confronted on the Adeliade River plains. Two metre high walls built to protect the crop were covered by the flood of February 1956 and as the water receded the crop remained covered and drowned. In other seasons the walls were breached in places and the resulting torrent of water gouged out contour levees and parts of the paddies. Although a network of channels had been installed these were unable to handle the volumes of water involved and drainage of the plains remained a problem throughout the project.

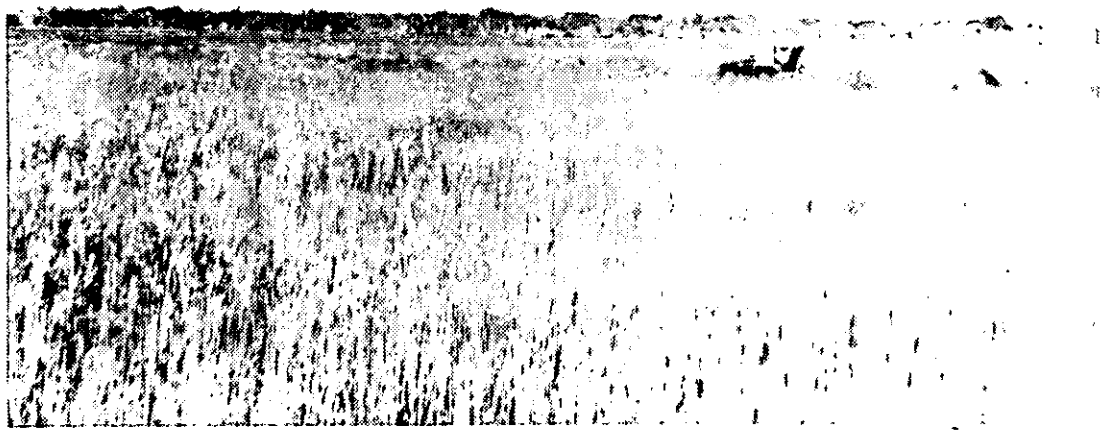
Associated with the water problems was the incidence of magpie geese - the villains widely blamed for the scheme's demise. The geese did eat seedlings and grain and trampled plants on what had been their traditional breeding grounds but their annual feasting did



1. A 'Farley' channeller pulled by a bulldozer to gouge drainage and irrigation channels across the black soil plains.

2. This RAAF bulldozer has become bogged while building earthworks where water was to be pumped from the river. Delays of this sort frustrated attempts to keep to work schedules. The cloud cover poses another threat.

3. Flooded paddies located adjacent to the Adelaide River. The banks follow the contours to produce the irregular shapes which slowed the harvest when self-propelled harvesters were forced to return to headlands to empty their bins.



4. Rice was grown successfully at times but not with sufficient frequency or in sufficiently large amounts for the whole development to succeed.

not bring about the failure. CSIRO research shed light on their habits and showed that solutions to this problem were possible, although expensive (Davies 1961, 1962, 1963; Frith 1955, 1959; Frith and Davies 1958a, 1958b). Basically the rice and the geese must be separated and, with breeding grounds denied the geese in the immediate vicinity of the farming, they would be forced to seek more distant refuges from which they would not trouble the rice. A combination of measures would achieve this. Rice fields should be developed on a continuous front instead of as a patchwork amongst the swampy areas, or, alternatively, breeding grounds should be drained completely or inundated to depths too great for the geese. Extensive earthworks, especially strong walls, would be required in all cases. Greater precision in levelling the paddies would be needed to ensure that pools did not encourage geese to congregate within the crop itself. In first-year paddies on the naturally gilgaied plains this would not be easy as depressions filled in by landplanes subsided once they became saturated and pools formed once more. The work was not done satisfactorily and the geese remained but they did not cause the project to collapse in the manner that Australian folklore would have it.

Inadequate water control also affected the time of harvesting. The grain was left to ripen in the field but if it was left there too long the risk of losses through lodging, sun-checking or cracking later in the mill increased. Therefore, the essence of the harvest operations was to get the grain off quickly but if the soils were too wet as a result of prolonged flooding late in the season, the harvest was delayed. A great deal depended upon the few half-track harvesters which were the first to go to work in any season while the majority of the fleet, wheeled machines, waited for the ground to dry. Appropriate measures were vital to allow complete regulation of the flooding and draining of the paddies to allow the crop to be grown and harvested successfully and the failure to provide these contributed to the downfall of the scheme.

Finance

Mechanized, large-scale farming in any environment requires skilful management and adequate capital. The absence of these lay at the root of all problems at Humpty Doo. In the three phases - when Allen Chase and then McCulloch provided the driving force and later during the sharefarming - the absence of capital, managerial expertise or both had serious consequences for the project. The first phase was characterized by a continuous quest to attract investors, slow remittances of funds to Australia and drastic cuts in proposed expenditure, all at a stage when foundations were being laid for future progress. In December 1955 the inital share issue of 100,000 shares of $2 par value was only paid up to $50,000. Calls on these shares and six subsequent issues followed but money was slow in reaching Australia; for example in March 1957 the funds from the United States were over $70,000 in arrears, about half of what was required to continue operations (Unpublished company correspondence, 31 March 1957). Under these circumstances the company soon exhausted the amount of credit available to it, management was diverted to trying to appease creditors but, even so, many suppliers and agents placed Territory Rice on a 'cash only' basis. As a result equipment could not be ordered and delivered by the time it was needed and performances in the field suffered accordingly. One device used to try to overcome this was to offer shares in the company to manufacturers or their agents as payment for the supply of machinery. Because of a lack of performance the shares were worth little, few suppliers accepted the option and this practice soon ended, but not before it had given the project a wide range of machinery, not all of it suitable, for which obtaining spare parts became an unending headache.

Insufficient funds meant that budgets were always subject to pruning. For the first year to 30 June 1955 an amount of $12,000 was cut from an approved spending of $36,000 but the most drastic revision affected plans for 1956-57. A long range plan agreed to by the directors and management in November 1955 allowed for $268,000 to be spent on preparing and growing an experimental area of 200 hectares. In April 1956 the amount available was reduced to $168,000 but the proposed cropping area was doubled to 400 hectares. Although reaching this target was not easy, work proceeded well until November 1956 when instructions were sent for another 400 hectares to be sown but without any additional funds! Two reasons may be given for the revision; returns from the extra crop would have

helped finances but what appears more likely is that a show of rapid expansion was needed to help raise $75,000 through another share issue in late 1956. Whatever the reason the added work-load proved to be too much, the crop failed to generate higher investment or returns and the company was left with increased indebtedness. Initially Mainguard protested against the hasty expansion and Lowndes, the Australian technical adviser, resigned on the basis that unacceptable agronomic problems were involved. By the time the results of the season became known, however, Mainguard had other worries and it was taken over in 1958. This and mounting dissatisfaction amongst American investors led to the change in control in 1958. At this stage it would have been interesting for the company's finances to be examined in the light of Clause 26 of the Rice Development Agreement which required that the Company have sufficient funds to carry out its obligations. The exact state of the company's funds was not available then and comprehensive accounts are not available now but it appears funds committed were well short of what was needed to have a minimum area of 6,000 hectares under production.

McCulloch's men took on a difficult job as they were left with accumulated losses, estimated to total $1,053,034 in June 1958 (Unpublished company files, 27 November 1958), and were faced with trying to put right the incomplete or inadequate works in the field. Weaknesses in this new management compounded the inherited problems. Insufficient control was kept over expenditure, especially as costs for all items landed at Humpty Doo were high. The cost of labour provides one example of how expensive the project was. At its peak, with 2,180 hectares under cultivation, the project employed ninety-nine men, fourteen of them in the workshop, at a rate of $56 per week plus keep, although no limits applied to the working hours. The average weekly rate for agricultural workers in Australia at this time was $36.20 (Bureau of Census and Statistics 1959, 415). Earthworks for June, July and August 1958 cost an unexpected $160,454 and still did not permit proper water control. In other ways false economies were tried; cheaper, less satisfactory equipment only acted to the detriment of rice production - old pumps from the Rum Jungle uranium mine did not solve the water supply problems and graders, although operating at a cheaper rate, could not perform drainage work as well as bulldozers. Faced with poor results, debts totalling $406,150 and a report which recommended even more investment, McCulloch decided not to continue after 1960.

The financial arrangements made to support the sharefarmers actually presented them with many of the problems that had plagued the early days of the development. The first year's advance from the Commonwealth Development Bank of $100,000 was not available until September 1960 and this delay hindered planning and delivery of supplies. Payment for the first crop did not come for twelve months and advances for the second and third seasons were also slow to arrive. Lease arrangements were on an annual basis which meant that only one crop at a time could be planned. Hesitancy on the part of the authorities to give full support is perhaps understandable in the light of what had gone before but it militated against success for the sharefarmers. Uncertainty about their future prevented them from signing a contract to sell all their rice in Perth over a five year period. In retrospect it appears incongruous that the original scheme was granted such favourable lease conditions while similar confidence was withheld from the growers who actually performed better.

The Philosophy behind the Scheme

One question that now arises concerns the philosophy underlying the original proposals for the venture and interesting parallels can be drawn with a contemporary episode in Western Australia. Along the southern coast lay the Esperance Downs and the State government was keen to extend the development that had begun there in 1950. The most far-reaching phase began in 1955 with the formation of Esperance Plains (Australia) Pty Ltd, financed by an American sydnicate with Allen Chase as principal director. The company was granted options to 607,000 hectares at $0.98 per hectare on the condition that some 700 farms would be developed for sale (Field 1963, 42). Although the officially stated objectives of this scheme were to develop lands lying idle, to attract more people to the area, to earn more dollars for Australia, to increase the interest of the United States in Australia and to realize the strategic value of Australia as a food producer in

the South Pacific, its clear aim was to develop farms and to return a profit from the sale of these. This it did not do; by 1959 the syndicate had developed only 7,200 hectares out of a selected area of 60,000 hectares whereas independent settlers had brought into production 7,700 hectares, one third of the nearby areas that they had selected (West Australian 28 August 1958). Of the $28,000,000 mentioned at the inception of the scheme (West Australian 26 March 1957) little had actually reached Esperance. After an ambitious beginning, presumably to impress potential American investors (West Australian 31 October 1958), the scheme suffered from a lack of capital to make the proposals a reality (Schapper 1960, 45). Under pressure from the Western Australian government this particular phase ended in 1960 and another company took over.

This shows how closely the two Chase schemes were related. In each case large tracts of land were readily and cheaply obtainable, ambitious plans were floated for the exploitation of the agricultural potential of the two areas and vigorous publicity campaigns were undertaken to attract investment. Fulfilment of the stated farming goals would indicate what could be achieved in these two new farming districts but, more importantly, it would provide additional incentive for investment capital for development and attract buyers for the farms that were to be subdivided from the main development areas. The most substantial profits for the investors would not come from the returns from cropping but would be realized in the long term by the sale of the farms and the ease with which these could be sold depended upon the success of the early, corporate farming efforts.

To establish farming required a large commitment of funds to 'prove up' the agricultural potential but this was not forthcoming for a couple of reasons. Firstly, investors did not readily subscribe to the programs and attracting funds was always a difficult job. Secondly, the developers regarded crop production as only the first stage in the project and not the ultimate goal. Also, in the enthusiasm to proceed with the Humpty Doo project at least, it seemed that the environment required only simple measures to produce impressive yields. Therefore, management's philosophy was that maximum profits could be obtained if initial farm development costs were kept to a minimum. As a result sufficient funds were never committed for cropping to succeed and a question mark hung over what could actually be produced, farms were not sold and the original incentive for the projects - profits from the sale of proven farming units - was not achieved.

One of the misjudgments of Territory Rice Development is that it was a heavily capitalized project. In comparison with what had gone before in the Territory this was so but in terms of achieving stated corporate goals it lacked adequate, well-managed backing. This is often overlooked by those who see the venture solely as another indictment of the cropping potential of the Northern Territory.

While the attitudes of Chase and his supporters are under examination it is also worth considering briefly the parts played by government. In dealing with the Esperance Downs project the Western Australian government followed a different course from the Australian government's approach at Humpty Doo. The original proposals in each case were welcomed and their implementation assisted by releasing land on favourable terms. When the Territory Rice scheme collapsed the Australian government, through CSIRO, continued to research rice growing on the sub-coastal plains but failed to do anything further to foster settlement based on growing rice. It may well be argued that more support in areas such as finance and marketing would have allowed the share farmers to carry on and to show the way for a settlement program based on rice production. In contrast, the Western Australian government took more positive steps to develop and settle the Esperance area. After the Chase syndicate had made no more than tardy progress in opening up the area, the government resumed control over the land and fostered development by another company and by individuals keen to pioneer their own farms. As a result a large agricultural community now flourishes at Esperance in contrast to the remnants of a dream that lie on the plains of the Adelaide River. Admittedly, the environments at the two locations are vastly dissimilar but the different priorities given to long-term development by the Australian and Western Australian governments were also important.

CONCLUSION

The causes of failure of the Humpty Doo venture that have been identified above do not necessarily mean that large-scale production of a range of crops will always lie beyond the realms of achievement. They do serve to highlight the pitfalls that must be overcome. For successful commercial cropping to be realized the technical, economic and social components of agriculture as it is known in Australia must be blended together in a manner appropriate for the place and the time. Conversely, this does not mean that each development project will require a completely different approach. General principles are involved and a few concluding remarks can be made about these broader issues. Gregor (1970) gave as characteristics of industrial farming crop specialization, advanced cultivation and harvesting techniques, large operating units, large-scale production, heavy capital investment and management centralization. Examination of the Humpty Doo venture against these criteria allows understanding of the scheme to be broadened beyond the limits of the Territory.

The original raison d'etre for the project rested with the cultivation of rice on well-watered, 'level' land. Concentration on one crop appealed to the promoters because of the economies of scale that it offered in production. Furthermore, it was not believed that such specialization would leave the scheme vulnerable to a market collapse; large and increasing populations in South-East Asia were expected to make a greater demand for rice inevitable. For Territory Rice, future markets could be guaranteed through successful negotiation of long-term contracts for a top quality product. In this market context it should be noted that Steele (1960, 109, 111) later reported that the world trend in rice was for supplies to increase at a slightly faster rate than demand with a corresponding reduction in prices. However, with a quality grain, diversification of the types of rice available for sale and an aggressive selling policy, Steele predicted that Australia should be able to expand its exports but, possibly, at lower returns. The impact of these market conditions on Territory Rice would have depended upon the quality of the rice produced. Low levels of production, however, meant that the state of the world market had little bearing on the final result at Humpty Doo.

When the scheme was first floated the economies of scale to be had through mechanization were essential and modern methods of planting and harvesting were employed. Bulldozers, landplanes, aerial seeding and autoheaders were all examples of the mechanical armoury that was brought into action. Their use was a direct result of the majority American interest in Territory Rice Limited. In the United States mechanization of this sort was rapidly increasing in rice growing areas and transfer of the technology to the Territory was an obvious and logical initiative. (For contemporary summaries of rice production techniques in the United States see Davis 1950; Finfrock & Miller 1958; Finfrock, Viste, Harvey & Miller 1958; Mikkelsen, Finfrock & Miller 1958; Reynolds et al. 1954.) Problems arose when the machinery was not managed or used with the care necessary for the conditions on the sub-coastal plains.

Gregor's criteria for large operating units and large-scale production were integral parts of the original proposal although they were not achieved. The agreement of 1955 called for at least 2,000 hectares to be developed each year at a time when 620 growers had 16,666 hectares under rice in the MIA - an average production area of 26.88 hectares (Table 5). In the Sacramento Valley of California, a major rice producing area, 942 farms averaged 130 hectares under rice in 1954 (Wise 1956, 8), areas that were much smaller than those initially proposed for Humpty Doo. Production on the MIA and in the United States was mechanized but these regions both lay in the temperate latitudes where more was known about the environment.

For the sub-coastal plains data about the climate were limited and cropping experience was absent. Therefore, to try to introduce a novel method of production, devised in temperate latitudes in established farming areas, into a monsoonal area with no cropping history was extremely optimistic. Although farms growing rice were limited in area, the general trend in agriculture had been that as productivity and efficiency improved large farm units were formed by the aggregation of small neighbouring units. In

'Humpty Doo type' programs large units were to be established for subdivision into smaller areas - an approach in keeping with suburban real estate developments.

The internal organization of Territory Rice Limited also presented problems as labour and management were split but management was not centralized. In the corporation responsibility for various functions was spread amongst Humpty Doo, Brisbane, Sydney and Los Angeles and only decisions at the lowest levels were made by those associated with daily activities. The scattered management and offices had to be funded from the rice program which was also to provide a livelihood for the workforce in the field and dividends for shareholders. Perhaps this last item could be deferred until land was sold profitably but the costs of production could not. This was different from the rest of Australian farms where, by and large, the owners were also the operators, decisions were made on site and the overheads of several offices and management staff did not drain funds away from field operations.

One further dimension to the failure needs to be mentioned. An important reason the Commonwealth government saw for encouraging the scheme was that it would help to make the north more secure by bringing about closer settlement. This basic reasoning had previously been questioned by Gilruth (1934, 34) and later by Davidson (1965, 4-5) who both found it incongruous that an undeveloped region should attract envy from overseas whereas developing the region (and hence solving some of its problems) would deter undesirable attention. Regardless of the soundness of this view in strategic terms it was one that prevailed at the time. The argument was that modern, highly productive cropping would attract manpower from outside the region and stimulate demand for industrial goods which, in turn, would attract more manpower and establish closer ties with southern Australia. To achieve modern, highly productive cropping required capital and the failure to provide this defeated both the corporation's stated objectives and those for closer settlement.

What then can be salvaged from a project that failed in its simplest and broadest objectives? Specifically it pointed to problems with breeds of rice available and the methods of their cultivation. More widely it showed that a general understanding of climate and soils was not enough and that the reliable conditions can vary quickly and, for cropping, drastically. Experience gained over many years will deepen understanding of the conditions of plant growth and until that experience is gained ambitious attempts to import foreign experience will founder. If capital intensive schemes are to succeed then they must be capital intensive and management must recognize this. For the Territory Humpty Doo has important lessons, although later schemes of industrialised farming show they have not been quickly learnt.

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