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Ord Scheme Economics

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Introduction

The Australian federal government released its 'Our North, Our Future: White Paper on Developing Northern Australia' on June 17, 2015. Although the first White Paper of its kind for the region, past prime ministers have declared northern Australian development to be "of immense strategic importance" (Stanley Bruce, 1926), "essential to future security" (John Curtin, 1944) and "necessary and urgent" (Gough Whitlam, 1969) [Bell et al., 2014].

With regard to the Ord River in northeast Western Australia, the White Paper envisages an expansion in the size of the existing irrigation area (the Ord Scheme). This could create the potential to achieve scale to enhance both the profitability and economic resilience of the region [Australian Government, 2015]. This optimism is in spite of the Ord Scheme having had a repeated history of failures while receiving government subsidies totalling well over $1 billion since the 1950s [Dent et al., 2015].

The latest discussion regarding the future of the Ord Scheme stems from perceived opportunities arising from global increases in demand for foods and energy. In particular, these are:

- Access to markets within the growing economies of Southeast Asia, as well as the world's second and third largest economies, China and Japan respectively;
- Asia-Pacific's rapidly growing middle class and evolving food tastes; and
- The demand for Australia's high quality produce as a consequence of food safety concerns in the region.

However, according to an analysis by the ANZ bank, Australia needs to invest $600 billion into agriculture by 2050 (primarily infrastructure) if it is to realise these opportunities [D'Occhio et al., 2014].

This paper will examine the economic viability of the continued interest in developing irrigated agriculture in the Ord area against the lessons of past performance. It will also consider the impact of increased expectation that externalities be included in assessing project success, as well as the potential effects of climate change.

History of the Ord Scheme

Prior to Irrigation

The traditional owners of the Ord River region are the Miriuwung and Gajerrong peoples whose presence can be traced back over 40,000 years.

Exploration of the Fitzroy and Ord Valleys by Alexander Forrest in the 1870's led to the development of cattle grazing, with stock overlanded from the eastern states to the East Kimberley [Davidson et al., 1982]. As early as 1909, the area was considered suitable for tropical crops, including cotton.

In the late 1930s there was interest in a plan for Jewish refugees from Europe to settle in the Ord River area. However, in July 1944 this possibility was abandoned due to a Commonwealth government policy of not supporting the establishment of single community settlements.

In 1945 the Kimberley Research Station (KRS) was established. Jointly administered by the Commonwealth and Western Australian (WA) governments, it comprised 800 hectares of heavy black soils. At the time it was estimated that 32,000 hectares could be irrigated in the area, and that irrigated agriculture could be slowly developed as a sideline to irrigated pastures. Irrigation projects were to be based primarily on finishing cattle prior to delivery to the Wyndham Meatworks.

By 1949 the WA government asked the Commonwealth to consider an Ord River Scheme with the emphasis on improvements to the cattle industry. It also requested consideration of the possibilities for crops such as cotton, rice, groundnuts, tobacco, and later, sorghum, millet, and soybeans.

Throughout the 1950's research continued with support from the Commonwealth, despite misgivings about the economic viability of the scheme and the problems experienced with controlling crop pests. Pests included: budworms in linseed, safflower and cotton; rough and pink bollworm in cotton; stemborer in rice; and later, Cluster grubs in cotton and linseed, and in the 1970's Heliothis armigera in cotton. By 1959 it was decided that pastures and fodder crops, the prime basis for initially considering the scheme, would not warrant the establishment of irrigation infrastructure [Davidson et al., 1982].

Nevertheless, an earlier justification for development on the grounds of defence and closer settlement was a theme endorsed by both major parties in the 1958 federal election. The bipartisan support precipitated the allocation of £1.5 million to the Ord Scheme. Apparently, without a clear agricultural driver for the scheme, the majority of the allocation was outlaid for the construction of a diversion dam [Davidson et al., 1982].

Ord Scheme Stage 1

Without an obvious commercially or agriculturally viable crop, cotton was recommended to the first group of farmers in 1963. The recommendation was on the basis that the price was underpinned by the existing Commonwealth cotton bounty.

Figure 1 Harvesting cotton at the Pilot Farm, Kununurra, 1962 [Ash,2014]

In addition to the issue of pest control, other problems besetting the first cotton farmers were:

- High freight costs;
- Expensive labour; and
- Unsatisfactory farm layout (grades too flat for furrow irrigation and inadequate drain/irrigation capacity).

Although the WA Government did not have an early success story, in early 1964 it pressed the case to finish the scheme. It was supported by a secondary benefits study from the Economics and Commerce Department, and a benefit-cost analysis undertaken by the Bureau of Agricultural Economics [Davidson et al., 1982]. An extensive public debate ensued.

Contributing to the debate was the release of 'The Northern Myth' by Bruce Davidson in 1965 [Davidson et al., 1982]. This study argued that not only was the land unsuitable for large scale intensive agricultural development but the investment would yield lower net benefits compared to allocating the money to southern Australian agriculture [Adamson, 2013]. Further, Australia had a comparative advantage in producing agricultural commodities that required large areas of land (relatively low cost) and little labour (relatively high cost) such as wool and meat from grazing animals, as well as wheat. Davidson observed the history of Australian governments supplying irrigation water to farmers at prices sufficient

only to maintain the irrigation works. He also questioned the scheme's economic modelling claiming it adopted highly optimistic assumptions to justify future income. It was also suggested that the CSIRO had withheld data not supportive of northern development [Lloyd, 1965].

Davidson's main critic was Dr Rex Patterson, former Director of the Division of Northern Development in the Department of National Development. Paterson, like Davidson, was also an advocate of utilising cost benefit analysis. The disagreement between the two centred on the underlying assumptions used in the cost benefit analysis. Davidson viewed Patterson's assumptions with respect to cotton yields (including experimental vs. likely yields) and input costs (particularly pesticides and fertilisers) as too optimistic. Actual cotton yields, Davidson argued, were unlikely to achieve experimental yields. Furthermore, Davidson criticised Paterson's use of subsidised cotton prices rather than the world price for cotton as a basis for economic assessments.

Some newspapers of the time viewed Davidson as challenging the "having a go" ethos of Australia.

Davidson challenged the assertions underpinning the indirect benefits and more general arguments supporting northern development. These were that:

- Land starved Asia would occupy an unpopulated north;
- A populated north is easier to defend;
- Northern Australia could feed hungry Asia; and
- Development could provide a solid base for the employment, assimilation and settlement of Aboriginal people.

Davidson regarded the then shortage of food in Asia as predominantly a question of lack of capital, education and technology rather than one of land shortage. He argued that crops which might be grown in tropical Australia are all produced, or could be produced, by our Asian neighbours. In short, Asia could be a competitor, not customer. He also argued that the use of "subsidies" via direct assistance from the Treasury and artificially inflated, protected local prices, would adversely impact some Asian countries dependent on an expansion of their own agricultural exports to finance development [Lloyd, 1965].

Davidson noted that in 1965, the "least discussed reason for development" was the suggestion that northern Australia should be developed because a large proportion of its population are aboriginal people whose standard of living needs to be raised to that of other Australians [Gosford, 2008]. By the early 2000's Aboriginal workers remained under-represented in the agricultural sector of the East Kimberley compared to non-Aboriginal workers. It also remains likely that the majority of Aboriginals are employed in the pastoral sub-sector [Ayre, 2008].

Nevertheless, following further studies and reports, as well as politicking, the Commonwealth decision to fund the Main Ord Dam was announced in November 1967. Although a critic of Bruce Davidson, Dr Patterson stated that the eventual Commonwealth decision was simply "grandstanding in the worst sense of the word for the Senate election." Each decision the Government had made in respect of northern development was, he said, announced as a matter of political necessity or as a result of an election promise [Davidson et al., 1982].

The main dam opened in 1972 as the cotton subsidy ended. By 1974, insect control costs were 50 per cent of a grower's total costs as up to 30 applications per year were required to maintain yields. Fertiliser costs were high due to transport distances. By 1975, farmers were unwilling to continue with cotton and many of the cotton farmers, having suffered huge financial losses, abandoned their land and left the region [Ayre, 2008].

Figure 2 Ord River Irrigation Scheme [McLean, 2014]

Following the demise of cotton there was a move towards a wide range of high-value field and horticultural crops [Ash, 2014]. In the early 1990's, the WA Department of Resources Development sponsored a series of investigative studies, including an economic valuation report which concluded that "…massive Ord expansions is warranted and viable, and now the issue is essentially commitment by the private and public sectors" [Ayre, 2008]. The conclusion was based on not recouping the prior investment into the scheme. Davidson would view this taxpayer support as a continuation of the government funded local irrigation trust developments, started in Victoria in 1886, in which governments had repeatedly written off construction debts [Davidson et al., 1982].

By the mid 1990's some higher-value crops proved successful. In addition, broadacre agriculture made a return to the Ord with the introduction of sugarcane and the establishment of a small mill. Sugarcane yields of more than 200 tonnes per hectare (t/ha) were common in the early years, however, declined to around 120 t/ha in the early 2000's due probably to the lower inputs being committed to the crop [DF&A, 2014]. However, the small scale of the mill and amount of land in production led eventually to the industry not being viable, and production ceased in 2007.

The privately funded, owned and operated Ord River Dam Hydro Scheme was constructed to supply the Argyle Mine in 1995 - 96.

Managed investment enterprises began with the establishment of sandalwood, African mahogany and mango plantations in the early 2000's. Today, sandalwood has been established on close to half of the available 14,000 ha of irrigated land. Trees take 10 to 15 years to reach maturity, and the long lead times to receive a return on capital for these crops are suited to investor schemes. Their long-term commercial viability is still unknown, but current prices for sandalwood oil are higher than expected, though yields from initial plantings are lower than anticipated [Ash, 2014].

Throughout this period horticultural crops and field crops such as melons, pumpkins, chia, chickpea, borlotti beans and sorghum were successfully grown. The main limiting factors to expansion remain distance from markets, highly variable market prices and transport costs.

Ord Scheme Stage 2 and Beyond

Since 2007 and despite the lack of a benefit-cost analysis available to the public [Economists at Large, July 2013], the WA Government has invested $311 million as part of Stage 2 of the Ord Scheme. Furthermore, the Australian Government has spent $195 million on social infrastructure including housing, schools, a hospital and expansion of port facilities [Dent et al., 2005]. In May 2013, the Northern Territory (NT) government confirmed its support for the expansion into the Northern Territory (Ord Stage 3), which included $400,000 in funding for an Ord Development Unit and the granting of Major Project Status. In its media release the NT government stated that "In this, the 'Asian Century' we must develop a food bowl for which we can sell to the growing middle class in developing Asian nations. The Northern Territory must capitalise on our geographical position and fertile soils." [Economists at Large, July 2013]. Ord Stage 3 was to be a development of 14,500 ha of irrigated farmland in the Northern Territory that would leverage investments already made by other governments and the private sector in Stage 2 [Australian Government, 2015].

Figure 3 Sowing chia at Ord Stage 2 [Bell, 2015]

In 2012 the Kimberley Agricultural Investment company (KAI), a subsidiary of Chinese-based Shanghai Zhongfu, was granted a fifty-year lease to develop the Ord Scheme Stage 2 (13,000 hectares). KAI initially proposed to invest around $700 million over 6 years, with a planned $425 million investment in a sugar mill to produce 500,000 t/year of crystal sugar and ethanol. However, of the 600 hectares of farmland it had cleared and prepared by May 2015, roughly 250 hectares was earmarked for chia production, with sweet sorghum to be planted next [Bell, 2015]. These were considered as interim crops until KAI has access to more land for sugar production, including land from Stage 1 and the proposed Stage 3 in the Northern Territory.

KAI's intention had always been to build a new sugar mill in the region, capable of processing 3 to 4 million tonnes of cane per year [Brann, 2014]. This would require 15,000 to 20,000 hectares at the higher production rate of 200 t/ha, although KAI currently has access to only 13,000 hectares. Agricultural market and economic analyst David Hanlon said of KAI [Brann, 2014] “They need access to that land and the [Wyndham] port needs to be upgraded to take 50,000 tonne ships ($50M investment).”

Speaking at the Food Futures Conference in Darwin in 2014, the director of the Ord Expansion Project, Peter Stubbs, said KAI had made an impressive start to developing Ord Stage 2 and there were three main things governments could do to assist the expansion [Brann, 2014]:

- Release the first stage of the NT lands and allow the developer to sort native title and approvals;
- Fund engineering designs to increase the storage of Lake Argyle Dam by 50 per cent, estimated to cost $80 million, and considered “essential to investor confidence to take on development of the NT lands”; and
- Build a new bridge over the Ord River at an estimated cost of $150 million.

Fifty years on there seemed a need to revisit Davidson’s pragmatic assessments undertaken in the 1960’s and soberly consider the further calls for government funding.

Alternative Economic Analysis

In a study published by the Monash Business School in 2015 [Dent et al., 2015], the value of irrigated land was adopted as a good estimate of the benefits of a new irrigation scheme, assuming that expenditure on irrigation infrastructure is fully capitalised into agricultural land values (a Ricardian hedonic approach to valuation). Or to view it a different way, the value of farmland – its market price – is equal to the discounted stream of expected future profits that it can produce and is reflected in the price that farmers currently pay for irrigated land.

Using this approach for northern Australia, the study estimated that the per hectare cost of constructing a new irrigation district in northern Australia (inclusive of the water storage, distribution infrastructure, and on-farm capital) would be between $26,500 and $77,320 per hectare. This can be compared to an average value of irrigated land in northern Australia, projected to be approximately $6,230 per hectare. Furthermore, the most valuable irrigated land is projected to be worth between $12,870 and $24,220 per hectare and approximately $18,800 per hectare on average. This implies that in a ‘best case’, for every $1 of economic benefit created, between $1.10 and $3.20 would need to be spent constructing irrigation infrastructure.

The study also considered government taxes levied on the income produced by the farmland and added it to the benefit estimates. However, the analysis indicated that

given the low effective tax rate on agricultural output, any tax benefits from irrigation projects are likely to be swamped by the distortionary effects of taxation.

The report concludes that Australians on average would receive no net benefit from the construction of new irrigation schemes. Indeed, their construction would result in a significant transfer of wealth from taxpayers to private irrigators and the Ord River irrigation scheme is a clear case in point [Dent et al., 2015]. Based on this analysis, new private investment in the Ord River area should be welcomed and it would facilitate utilisation of existing infrastructure previously financed by government. Further tax payer funding cannot be economically justified.

It is worth noting that the Monash University study did not factor in the loss of amenity value associated with damming rivers, native title issues, nor the effects on downstream industries such as fisheries or tourism that could well increase the costs of an irrigation scheme.

Externalities

In considering the viability of various agricultural enterprises for the Ord, little attention has been paid historically to the external costs. These are primarily the infringing of the rights of the Indigenous people of the area and impacts on the environment.

Indigenous Land Rights

The region contains the homelands of Aboriginal people who have owned, lived in and managed the lands and waters under custodial law for millennia [Ayre, 2008].

First graziers, and then government-sponsored irrigators, did not until recently consider the wishes of the Indigenous people of the area. Instead, they made unilateral decisions about “transforming” the Ord. The Indigenous people did not benefit from, and were not initially compensated for, the losses that came with the flooding of Lake Kununurra and Lake Argyle [McLean, 2014]. Indeed, the Argyle Downs Homestead and two colonial graves were relocated before the valley was flooded [Hill et al., 2006]. However, access to country and sacred sites became impossible for Aboriginals following the filling of the dam, which resulted in the flooding of ceremonial sites, hunting and fishing grounds, and seasonal routes. The significant increase in access by non-Aboriginal people to remaining traditional sites as part of the irrigation development also resulted in reducing or destroying the ceremonial significance of other places.

Figure 4 Lake Argyle [Madden, 2008]

The Lakes and the resultant irrigated agriculture development of the Ord Stage 1 had the effect of extinguishing Native Title [Hill et al., 2006]. As a consequence, the Miriuwung-Gajerrong peoples asserted that they did not want to enter into any negotiations with the WA Government regarding Stage 2 development unless and until the impacts of Stage 1 were addressed.

Consequently, these impacts were somewhat addressed with the signing in 2005 of the Ord Final Indigenous Land Use Agreement with the Government of Western Australia, Miriuwung-Gajerrong traditional owners and various private sector interests. The Agreement provided approximately $57 million in community-development oriented initiatives, including shared management of new conservation areas, a stake in future development in the Ord, and the return of parcels of Indigenous community land.

In addition, farming enterprises like KAI, are entering into Indigenous development packages that require KAI to employ a certain number of local Aboriginal people and also guides the way the land can be used [Jones, 2004].

As another example of the changing attitude toward Indigenous people and the incorporation of these attitudes into project planning, the Director of the NT's Ord Development Unit, Lorraine Corowa, recently said "We want to demonstrate that the Northern Land Council, the Native Title holders and the Northern Territory Government can do a good deal together over Ord 3A, and then certainly our goal is to do the broader Ord Stage 3" [Brann, 2015]. She said a gradual approach to developing Ord Stage 3 was now the focus of those involved in the planning and negotiations, and one of the main reasons the Ord 3A land is to be developed first is that there are no sacred sites within the 1,800 hectare farming zone.

Environment

Ecological values were also not considered prior to the building of the dams and no surveys specific to dam construction were commissioned [Hill et al., 2006]. The lack of baseline data regarding the pre-dam state of the Ord River system has made it difficult to estimate the rate and scale of change.

Serendipitously, the modifications to the river system have resulted in some areas gaining outstanding biodiversity value. Lakes Argyle and Kununurra were listed under the Ramsar Convention in 1990 due to their importance to waterbirds as a dry season refuge, although this was not an intentional outcome of dam construction. The lakes have also become an important site for saltwater and freshwater crocodiles. These enhanced environmental attributes support recreational uses and tourist boat charters.

The dams have, nevertheless, greatly reduced the frequency and intensity of flood flows and have increased dry season river levels, leading to a loss of seasonality in flows. The loss of seasonality and presence of year-round water has resulted in dense communities of trees and bushes growing permanently along the banks of the river and have increased the potential for weed invasion.

Downstream of the dams the suppression of large floods has resulted in the accumulation of silt within the estuary, and consequently the width of the river has decreased by 50 percent. The changed hydrological regime has also seen a 50 percent reduction in saltwater intrusion in the Lower Ord, and this is expected to have impacts on species and habitat diversity within the aquatic and mangrove communities [Hill et al., 2006]. The altered Ord water quality and flow is considered to have contributed to the disappearance of the Common Banana Prawn in the river.

The damming of the Ord River has restricted certain species from following their usual migration path (e.g. Barramundi and Freshwater Crayfish), potentially resulting in genetic isolation, and in extreme droughts, the localised loss of species.

These changes not only impact commercial interests, but also non-commercial values such as Indigenous subsistence and cultural and recreational fishing.

In addition to surface hydrologic changes, other impacts are evident. Rising groundwater and salinity have occurred as a consequence of dam construction. Pesticides have been strongly implicated as the cause of fish kills, and irrigation has increased the phosphorus and total oxidised nitrogen loads entering the river, raising the nutrient concentrations. When cotton was extensively grown, native fauna and the export market for beef cattle fattened on the Ord was impacted by the heavy spraying of DDT and parathion. For example, grazing cattle were found to contain up to 200 parts per million of DDT exceeding the permissible level of seven parts per million for US exports [Drewe, 1981] and an export ban resulted.

Encouragingly, at the launch of the White Paper on developing northern Australia, Minister Robb highlighted the special environmental values of the north, and stated

that further developments would be managed to avoid or minimise negative environmental impacts [Campbell, 2015].

Climate Change

The White Paper does not incorporate the CSIRO projections for The Monsoonal North West subcluster [CSIRO, 2015], namely:

- Average temperatures will continue to increase in all seasons, with very high confidence;
- More hot days and warm spells, with very high confidence;
- Changes to rainfall are possible, but unclear;
- Increased intensity of extreme rainfall events, with high confidence; and
- Fewer but more intense tropical cyclones, with medium confidence.

This raises critical issues for economic and environmental sustainability in the Ord. Given the failures of the past to fulfil expectations, consideration of the possible and probable effects of climate change warrant incorporation into the feasibility and viability assessments of current development plans.

Discussion

Progressive government investments in the Ord Scheme has been typified as making economic decisions for political reasons, even beyond levels that rational analysis suggested a withdrawal of support [Davidson et al., 1982]. Bruce Davidson's analysis of the Ord was considered controversial in the 1960s as it indicated that irrigation development was uneconomic. At the very least Davidson considered it prudent for the Ord Scheme in 1965 to adopt a 'wait and see' approach after the completion of comprehensive research programmes and provision of support to only existing commercial farming [Lloyd, 1965]. To date Davidson's analysis has been largely vindicated.

Indeed, Davidson (1969) also arrived at a similar conclusion in relation to the Murray-Darling Basin, arguing that assessments supporting irrigation in the Basin had over-estimated the benefits and under-estimated the costs [Adamson, 2013].

The current White Paper 'Our North, Our Future: White Paper on Developing Northern Australia' (2015) sets out principles for appropriate cost-benefit analysis, although Campbell (2015) expresses cynicism as to whether the principles will be followed in practice. The 'Agricultural Competitiveness' Green Paper (Commonwealth of Australia, 2014) has also expounded the principle that capital investment by government and the private sector in future irrigation development should be subject to a consistent, robust analysis of costs and benefits [Grafton et al., 2015], but again, Economists at Large (2013) observe that it is apparent that it is rarely done.

Grafton et al. (2015) point out that the Green Paper identifies that the following should be assessed when building infrastructure for future water supply:

- Ensure sustainable and productive use of natural resources for economic growth and development;
- Improve knowledge of sustainable resources use; and
- Manage weeds and pests.

Development assessment frameworks are thus evolving more towards a natural resource management framework. Indeed, the Ord River Water Management Plan (ORWMP) released in December 2006 had the objective of facilitating the development of Ord Stage 2 inclusive of balancing the water needs of the environment, irrigated agriculture and hydro-power [Ayre, 2008]. Consequently, the water planning process was protracted (10 years) as:

- There was a need to incorporate previous water resources developments and the proposals for expansion of the Ord Stage 2 irrigation area;

- Legal commitments by Government to current water users, and significantly to those relating to native title. This implied the need for associated consent determination and a package of benefits for Aboriginal traditional owners;
- The demand for hydro-power to power a nearby diamond mine was changing (i.e. 2005 decision to re-invest in deep underground mining until 2018); and
- The policy environment was changing and required more baseline research on the Ord River ecology.

Nevertheless, the process was consistent with a holistic approach to natural resource management and could complement consideration of direct and indirect costs and benefits of future Ord Scheme stages, even if the process was not smooth. As is to be expected, the final 2013 water allocation plan (WAP) for the Ord River left some participants and commentators asking for more transparent risk assessment, social input and economic evaluation, and consideration of the benefits that people obtain from ecosystems and the calculation of an economic value on this natural capital [Turville et al., 2014]. Given that Australians store more water per person than any other country [Grafton, 2015], this would seem a reasonable set of expectations.

With an increasing frequency of droughts in southern Australia, and climate change predictions for their frequency to further increase, there is unprecedented interest in the management of water resources in northern Australia [Ayre, 2008]. Nevertheless, this interest needs to be tempered with the experience of the Ord Scheme and the Northern Australian Land and Water Task Force's advice in 2009 regarding the environmental limitations for broad acre agriculture and cropping across the whole of the north. The Task Force report cited poor and easily damaged soils, highly seasonal and erratic rainfall and complex surface and groundwater hydrology as major environmental constraints [Turton, 2015].

Perhaps climate change will cause the Ord Scheme to evolve a comparative water supply advantage. However, as the situation evolves, the principles set out in the 'Agricultural Competitiveness' Green Paper for comprehensive economic assessment should be rigorously applied.

References

Adamson, D. (2013). "Romancing the north: the food bowl furphy", The Conversation, June 28, 2013. Available at: https://theconversation.com/romancing-the-north-the-food-bowl-furphy-15469

ANZ (nd). Available at: http://media.corporate-ir.net/media_files/IROL/24/248677/ANZ_insight_3_Greener_Pastures.pdf

Ash, A.J. (2014). Factors driving the viability of major cropping investments in northern Australia – a historical analysis. CSIRO, Australia.

Australian Government (2015). Our North, Our Future: White Paper on Developing Northern Australia. Commonwealth of Australia (978-1-925237-67-2), Canberra.

Ayre, M. (2008). Collaborative Water Planning: Retrospective Case Studies Volume 4.2. Water planning in the Ord River of Western Australia. Uni Print, Griffith University, Brisbane.

Bell, L. (2015). "Chinese company Kimberley Agricultural Investment sows first crops in Ord Stage 2", ABC Rural, 18 May 2015. Available at: http://www.abc.net.au/news/2015-05-18/kai-sowing-crops-ord-stage-two/6478082

Bell, S., Campbell, A. and Larkin, S. (2014). "Northern Australia, the sequel: remaking an old policy classic", The Conversation, March 5, 2014. Available at: https://theconversation.com/search?q=Northern+Australia%2C+the+sequel%3A+remaking+an+old+policy+classic

Brann, M. (2014). "Lack of scale crushing the Ord Irrigation Scheme's sugar dream", ABC Rural, 13 November 2014. Available at: http://www.abc.net.au/news/2014-11-13/lack-of-scale-crushing-ord-sugar-dream/5885158

Brann, M. (2015). “Small parcel of land in the Northern Territory on verge of being added to the Ord Irrigation Scheme”, ABC Rural, 22 May 2015. Available at: http://www.abc.net.au/news/2015-05-22/plans-to-develop-ord-stage-3a-northern-territory/6486050

Campbell, A. (2015). “Is the white paper a game-changer for northern Australia?”, The Conversation, June 19, 2015. Available at: https://theconversation.com/is-the-white-paper-a-game-changer-for-northern-australia-43458

CSIRO (2015). Climate Change in Australia, Projections for Australia’s NRM Regions. Available at: http://www.climatechangeinaustralia.gov.au/en/climate-projections/futureclimate/regional-climate-change-explorer/subclusters/?current=MNWC&tooltip=true&popup=true

Dale, A., Campbell, A., Douglas, M., Robertson, A., Wallace, R. and Davies, P. (2014). “From Myth to Reality: New Pathways for Northern Development. Northern Development Summit - Creating the Future Australia”. ADC Forum, 26-28 June 2014, Townsville.

Davidson, B. R. (1969). Australia, wet or dry?: the physical and economic limits to the expansion of irrigation. Melbourne University Press.

Davidson, B. R. and Graham-Taylor, S. (1982). Lessons from the Ord, The Centre for Independent Studies, Sydney.

Dent, J. and Ward, M.B. (2015). Food Bowl or Folly? The economics of irrigating Northern Australia. Monash Business School, Department of Economics ISSN 1441-5429 Discussion Paper 02/15.

Department of Food and Agriculture, Western Australia (2014), Sugarcane in the Ord River Irrigation Area. Available at: https://www.agric.wa.gov.au/sugarcane/sugarcane-ord-river-irrigation-area

D’Occhio, M., Paech, N.R., Henry, B., Taylor, C., Gonzalez, L. and Alders, R. (2014). “To grow agriculture in Australia, farmers need to think like miners”, The Conversation, August 6, 2014. Available at: https://theconversation.com/search?q=To+grow+agriculture+in+Australia%2C+farmers+need+to+think+like+miners

Drewe, R. (1981). “The Ord River Dam”, The Bulletin, November 3, 1981, pp. 38-39. Available at: http://economics.org.au/2014/03/the-ord-river-dam/

Economists at Large Pty Ltd (2013). Rivers, rivers, everywhere. The Ord River Irrigation Area and the economics of developing riparian water resources. Available at: http://www.ecolarge.com/work/the-ord-river-irrigation-area-and-the-economics-of-developing-rivers-in-northern-australia/

Gosford, B. (2008). “The Northern Myth – Chapter 1”, Crikey, 22 November 2008. Available at: http://blogs.crikey.com.au/northern/2008/11/22/the-northern-myth-chapter-1/

Grafton, R.Q., Mullen, J. and Williams, J. (2015). “Australia’s Agricultural Future: Returns, Resources and Risks”, The Australian Council of Learned Academies. Available at: http://www.acola.org.au/PDF/SAF07/returns%20resources%20and%20risks.pdf

Hill, R., Golson, K., Lowe, P.A., Mann, M. K., Hayes, S. and Blackwood, J.E. (Editors) (2006). Kimberley Appropriate Economies Roundtable Forum Proceedings. Convened 11-13 October 2005, Fitzroy Crossing, WA, by the Kimberley Land Council, Environs Kimberley and Australian Conservation Foundation.

Jones, N. (2014). “More land to be released in Ord as Chinese company gears up for farming”, ABC News, 9 November 2014. Available at: http://www.abc.net.au/news/2014-11-09/kai-gears-up-for-farming-ord-land/5872722

Lloyd, A.G. (1965). “The Controversy on Northern Development”, Review of Marketing and Agricultural Economics, 1965, vol. 33, issue 03. Available at: http://ageconsearch.umn.edu/bitstream/9018/1/33030119.pdf

Madden, C. (2008). “Pipe Dreams”, ABC Science. Available at: http://www.abc.net.au/science/articles/2008/08/21/2341521.htm

McLean, J. (2014). “Lessons from the Kimberley on developing Northern Australia”, The Conversation, 31 July, 2014. Available at: https://theconversation.com/lessons-from-the-kimberley-on-developing-northern-australia-27993

Turville, A.C., Cullen, S. and Tan, P.L. (2014). “Planning for the Future: Integrated Water Management in the Ord River Catchment”, Water, Vol. 41(4), pp. 80-87. Australian Water Association. Available at: http://www98.griffith.edu.au/dspace/handle/10072/65984

Turton, S. (2015). “Climate: the elephant in the room for developing northern Australia”, The Conversation, 22 June 2015. Available at: https://theconversation.com/climate-the-elephant-in-the-room-for-developing-northern-australia-43528