



IRRIGATION RESEARCH & EXTENSION COMMITTEE

2009



FOR IRRIGATION CROPPERS

Optimising bankless channel surface irrigation systems

Paper prepared by

MICHAEL GRABHAM

CRC for Irrigation Futures

IREC

C/- CSIRO Land and Water, Griffith

Private mail bag 3 Griffith NSW 2680

Tel: 02 69601550 **Fax:** 02 69601562 **Email:** irec@irec.org.au

OPTIMISING BANKLESS CHANNEL SURFACE IRRIGATION SYSTEMS

Michael Grabham, CRC for Irrigation Futures PhD Candidate.

Surface irrigation systems are the most widely used form of irrigation in most parts of the world. In Australia, 60 % of irrigated land is irrigated using surface irrigation systems such as furrow, border or basin irrigation systems. On appropriate soil types surface irrigation systems can be operated to achieve high water use efficiency and uniformity. Unfortunately, this level of performance is often compromised through inappropriate field design and/or irrigation management.

The development of measurement tools and techniques, computer models and evaluation procedures has provided the potential for great improvements in conventional furrow irrigation system performance. However, these techniques cannot be readily applied to all forms of surface irrigation.

BANKLESS CHANNEL IRRIGATION

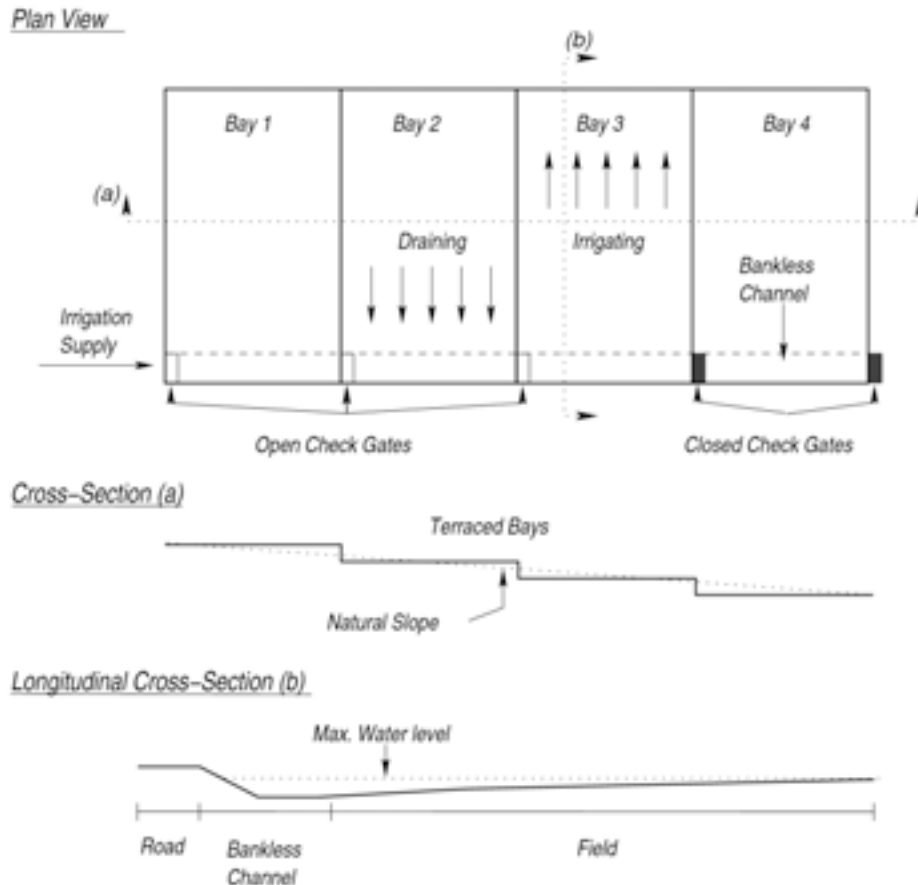
One form of surface irrigation currently under investigation through the CRC for Irrigation Futures is Bankless Channel Irrigation Systems (BCIS). While similar to “Drain Back Level Basins” developed in the United States in the late 1980s, BCIS in Australia feature reverse grades, higher flow rates and typically larger bays and are being installed on heavier soil types than their US counterparts.

Developed in the 1990s, Australian systems were designed to improve water management and production performance in rice-based farming systems. These adjustments not only provided cropping alternatives but also increased operational and labour efficiencies while decreasing occupational health and safety risks and, anecdotally, water use. Beds were subsequently added to the system enabling row crop production in rotation with rice-based production crops.

The system has now been adopted outside traditional rice-based farming areas and is being used exclusively for the production of row-crops in Queensland and Northern Australia.

BCISs consist of a series of terraced bays which, while irrigated separately, are connected by a bankless channel. Each bay is irrigated by backing up water behind a closed gate in the bankless channel, causing water to spill into the adjacent bay.

Once irrigation is complete for that bay, the gate is opened allowing both supply water and drainage water from the bay to flow into the next bay in the series. This process is repeated until all bays in the series have been irrigated.



The key advantages of BCIS over conventionally irrigated furrow systems which have led to their adoption outside traditional rice growing areas include:

- Increased labour saving through the elimination of siphons,
- Improved machinery operation efficiency as a result of the elimination of rotor-bucks and the introduction of a drive-through head ditch;
- Improved irrigation performance of hard setting soils; and
- Reduction in tailwater flows.

The system is not without limitations. Some recognized limitations include installation costs, unproductive land area and weed management issues on banks. In addition, current methods of evaluation are not suitable for assessing the irrigation performance of each bay. Consequently, published irrigation performance data for this system has relied on system scale evaluation. While these figures are comparable to conventional siphon irrigated fields, the distribution uniformity within each bay is arguably more important as with this information and a method with which to measure performance, the system can be optimised.

Optimising the water application efficiency of most surface irrigation systems involves well defined procedures. However, for BCIS these procedures are not applicable. Current irrigation optimisation procedures are compromised by some of the operational aspects of BCISs, such as the presence of reverse grade slopes and inter-bay hydraulic influences. Furthermore, without an appropriate evaluation method, design and management guidelines for optimising the irrigation performance of the system cannot be developed.

Through field evaluation studies, it is anticipated that design and management practices may be developed to improve the irrigation performance of BCIS. Identification of these elements will lead to improved operation with benefits for both the irrigator, community and the environment.

This research seeks to develop an evaluation method for BCIS and to subsequently identify and validate hydraulic simulation models capable of modelling these systems. With these capabilities design and management guidelines can then be established to assist designers and irrigators to optimise the performance of current systems and improve the design of new systems.

WHAT'S BEEN DONE TO DATE, FIELD TRIALS ETC

The first challenge has been to identify how field slopes, inflow rates and time interact during an irrigation event and how these can be measured reliably and accurately. Methods currently being employed include the installation of flow meters at each regulator in the system, depth probes at appropriate points in the field, comprehensive field surveys to identify field slopes and regular measurements of furrow discharge.

FINDINGS

It was anticipated that irrigation advance in each bay would be relatively even, as has been observed in bays with no beds. However, the results show that irrigation advance can be quite variable in these systems. While wheel track rows do contribute to some of this variability, it is hypothesised that differences in elevation and the evenness of slope within each furrow is having a greater impact. Analysis of information from this season will reveal the reasons behind this variable advance.

Another important observation from the data collected so far is the variability in water applied to each bay. Release of water from each bay is largely dictated by both observations of furrows to ensure all furrows a 'through', and time. Consequently, the amount of water applied to each bay is variable and, without measuring discharge at each bay outlet, it is difficult to assess when to release to achieve an equal application of water to each bay.

These observations highlight the complexity of managing the system to achieve efficient water application. Perhaps more importantly it identifies the value of a simulation tool which will enable operations to be simulated and consequently optimised for various operational aspects of the system.

During field trials over the last two seasons it has been identified that a combination of depth, flow and advance measurements within each bay will probably yield the best inputs for an irrigation event to be optimised.

FUTURE RESEARCH

Over the coming twelve months a simulation model being prepared by the University of Southern Queensland will be validated. Once validated, irrigation simulations will be conducted to optimise irrigation performance. Once optimised, design and management guidelines will be developed.