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Controlled Drainage A path for uptake and dissemination

(KAR Project R7133)

Report OD 148
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DFID Department For
**International
Development**



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Summary

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This report represents the fourth output of a project, supported by DFID under its Knowledge and Research (KaR) programme, on integrated irrigation and drainage to save water. In particular the study has looked at controlled drainage, its benefits, potential application and the conditions necessary to achieve the uptake of controlled drainage. This present report presents a path for dissemination and uptake of controlled drainage methods with the intention of increasing the adoption of this technique.

The report briefly reviews the findings of the study, which incorporates the field experience from Egypt, the development of the predictive tools and practical guidelines for controlled drainage and the potential for controlled drainage in other countries.

Maximum benefits of controlled drainage accrue from a coordinated effort, which can only come about from a planned programme of training and awareness building. Four principal actions to encourage dissemination and uptake are recommended.

- Awareness creation among policy makers/decision makers
- Study of farmer management of controlled drainage through pilot trials
- Enhancing the skills and knowledge of front line staff
- Simple guidance leaflets for farmers.

The proposed programme could be aimed at Egypt and India in the first place taking advantage of Egyptian experience.

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1. PURPOSE OF THIS REPORT

This report briefly considers controlled drainage, its benefits, potential application and the conditions necessary to achieve the uptake of controlled drainage. By understanding what is involved, who will benefit and what is required of individuals and institutions, a plan for dissemination and uptake of the method is proposed.

This document forms one of the outputs of the DFID KaR (Knowledge and Research) contract R7133 – Integrated irrigation and drainage to save water. HR Wallingford, working in collaboration with the Drainage Research Institute of the National Water Research Centre, Egypt, undertook this project.

1.1 Project – Integrated irrigation and drainage to save water

The overall aim has been to develop integrated irrigation and drainage management strategies incorporating controlled drainage, to save water, and protect soil and water resources in semi-arid regions.

The introduction of controlled drainage has the potential to improve the livelihoods of farmers by reducing water application costs and maintaining agricultural production in water short years. At the basin scale the technique can save the quantity of water being used for irrigation.

At the farm level the introduction of controlled drainage has the potential to improve the livelihoods of farmers by reducing water application costs and maintaining agricultural production in water short years. At the basin scale the technique can reduce the quantity of water being used for irrigation. The project outputs are:

- A predictive tool to assess water saving, crop production, soil salinity and drain water quality under controlled drainage, OD/TN96, OD/TN102, (Abbott *et al* 1999 & 2001).
- Practical guidelines for designing and assessing the benefits of integrated irrigation and drainage incorporating controlled drainage, OD147, (Abbott *et al* 2002b).
- Report on the potential for controlled drainage around the World, OD146 (Abbott *et al* 2002a).
- Guidelines for uptake and dissemination of controlled drainage strategies, present report.

In the first stage of the study a literature review and an investigation of the potential and constraints to the introduction of controlled drainage in the Nile Delta in Egypt, and the initial development of software tools to predict the impacts of controlled drainage were completed. The results of these activities are presented in the phase 1 report, OD/TN96.

A proposal to build awareness among decision takers and the donor community on the contribution that controlled drainage can make to better agricultural water management.

This document deals with the last output listed above; a proposed path for uptake and dissemination that will in its turn increase adoption of controlled drainage techniques. This short report, developed from an internal project discussion note with particular emphasis on Egypt, is addressed to selected donor and government officials in the first place. A combination of methods to build awareness among decision takers and the donor community is proposed. Adoption of the ideas proposed should enable informed decisions to be taken on the introduction of controlled drainage.

2. CONTROLLED DRAINAGE

To be effective agricultural water management requires control of how much water is added to the soil (irrigation) and how much water is removed (drainage). Agricultural water interventions have, understandably, focussed on perfecting the control of irrigation water. The result, in general terms, has been to ignore the importance of drainage. Drainage removes excess water from the soil profile and provides a tool to control soil salinity. Some soils drain naturally but in many irrigated lands drainage systems have to be installed and operated to maintain watertables at an acceptable level.

Controlled drainage makes better use of irrigation water by controlling how much water is removed from the soil by the drainage system.

Controlled drainage makes better use of irrigation water by controlling how much water is removed from the soil and maintaining watertable levels. This approach allows more time for the crop to use the water while preventing waterlogging and the accumulation of salts in the soil profile. Successful use of the technique should reduce the number of times a crop is irrigated and can aid in improving water quality of drainage effluent.

Agricultural land drainage systems are usually designed to cope with worst-case situations in terms of crop rooting depths and drainage requirements, as well as the expected loss of performance as systems age. For many crops and for much of the time this results in more water being removed from the soil profile and passed to drains than is necessary. Farmers often over-irrigate to compensate for rapid removal of water by drainage systems.

Where significant volumes of agricultural drainage water flow out of the basin, or to sinks, then an increase in agricultural water use efficiency (i.e. making the most of the water applied, whether irrigation or rainfall or both) can directly benefit the basin by the quantity of water saved. However, water quality is also important. In areas where poorer quality drainage water is reused the productivity of that water is limited. Drainage water is inherently of poorer quality, and thus of lower productivity (for agriculture and other uses). Therefore, water saved at the field level from reduced drainage flows can result in increased water productivity at the basin level.

2.1 Types of controlled drainage

Controlled drainage can be achieved by blocking and then unblocking drains, or by using weirs to control the maximum watertable depth.

There are two principal ways that drainage outflows can be controlled, (a) by blocking drains or (b) by using weirs.

Lateral or collector pipes are periodically blocked and unblocked. With this approach the watertable rises and falls in response to irrigation releases and operation of the drains, which are either “on” or “off”.

The alternative is a fixed or adjustable weir used to control the drain-flow from the field. The weir is placed in the drainage ditch receiving the drainage flow, or, if the subsurface system has catch-pits, along the collector pipes. When the watertable rises above the level of the weir, water flows over the weir and out of the system. Flow ceases when the watertable drops below the level of the weir, and only commences again when rainfall or irrigation causes the watertable to rise again above the weir level.

2.2 Potential benefits of controlled drainage

Controlled drainage can make an important contribution to integrated agricultural water management, improved water use efficiency being the principal benefit.

Controlled drainage can make an important contribution to integrated agricultural water management. Improved water use efficiency is the principal benefit of this approach in semi-arid and arid areas. Others benefits reported include:

- improvements in crop yield,
- control of soil water through-flow rates that can ensure soil fertility is not degraded in high irrigation or high rainfall areas,
- control of nitrate and phosphate losses to downstream water bodies so reducing the potential for eutrophication and ecological damage,
- conservation of wetlands and water-sensitive regions.

These potential benefits can be translated into benefits viewed from the point of view of society and the individual farmer.

Potential benefits	As viewed by Society	As viewed by individual farmers
Improved water use efficiency	Water savings	Water savings Savings in time to irrigate Savings in pumping costs
Improvements in crop yield	Increased agricultural production	Increase of yields in case of water shortage Shift towards more profitable crops Ability to irrigate larger land areas
Control of soil water flow	Less generation of drainage water	Savings in pumping costs
Control of salts and nutrients	Less environmental pollution due to reduced use of agrochemicals	Savings in agrochemical (particularly fertiliser) use
Conservation of wetlands	Decrease in non-point pollution from drainage effluent	

Analysis of the data in OD 146 indicates a total of 168 million ha of irrigated land in semiarid / arid areas of the world (65 percent of world irrigation). Of this area approximately 50 million ha (30 percent) is equipped with drainage and approximately half of this area could be considered to have potential for controlled drainage.

The countries (regions) of greatest potential are:

Algeria, Bahrain, China (north), Egypt, India (Haryana, Punjab, and Rajasthan), Iraq, Israel, Pakistan, Syria, Uzbekistan, Tajikistan, and Turkmenistan.

2.3 Requirements for controlled drainage

Controlled drainage is more likely to be taken up and sustained if most of the following pre-conditions are present or can be put in place.

- Relatively flat agricultural areas.
- Surface irrigation is the main method of water application but where water supply is sporadic or unreliable, or areas where water is pumped from canals to fields.
- Artificial drainage systems comprising a network of open drains or horizontal sub-surface piped systems with suitable access points (such as manholes) in place or planned.

- Crops with similar irrigation and rooting-depth requirements over significant areas of the drained area (crop consolidation). Implying prior agreement over crop rotations by farmer collaboration or by large individual landholdings.
- Farmer collaboration and organisation to take on the tasks associated with controlled drainage.

Despite potential benefits over a significant portion of the world's irrigated area ... uptake is likely to be more successful and sustainable if certain preconditions are met.

From the above sections it is clear that there are good potential benefits over a significant portion of the world's irrigated area. Despite these benefits it should be recognised that the uptake is likely to be more successful and sustainable if certain preconditions are met. Furthermore adoption of the method will require investments by farmers acting as individuals or together (either formal or informal groupings). The benefits for wider society are not likely to accrue unless farmers can be convinced that the benefits outweigh their costs.

It is likely that farmers will be expected to:

- invest in drain flow control devices including constructing access points
- assume risks associated with the introduction of new technology
- devote time to meeting and collaborating with neighbours
- compromise, co-ordinate, and consolidate cropping patterns.

Encourage and support farmers to adopt the techniques through a strategy of up-take and dissemination.

A cost-benefit analysis of the experience in Egypt produced for this project (Morris 2001) concludes that controlled drainage can improve water use efficiency, but that farmers are exposed to the management burden and additional costs of a system where the greatest potential benefits accrue off-farm. As the principal benefits of this technique are improvements in agricultural water use efficiency and long-term environmental protection then a strategy to support up-take and dissemination is needed. The strategy should be to encourage and support farmers to adopt the techniques, both technically and financially. The approach though should not be focussed entirely upon the farming community.

Awareness building is needed to inform and enlighten decision-makers.

A considerable amount of awareness building is needed to inform and enlighten decision-makers if help and support is to be forthcoming. This is especially important where many small poor farmers will be expected to take action and where land fragmentation and diverse cropping patterns is the norm. Specific assessments of social potentials and constraints should be an essential element of any programme aimed at the introduction of controlled drainage as these may take precedence over (perceived) economic and environmental benefits to the society or individual.

3. PROPOSED UPTAKE PATHWAY

For controlled drainage to be effective the farming community will need to take-up the ideas and put them into practice. As has been reported from Egypt some farmers are now doing just that but not always with the knowledge and agreement of their neighbours or with the agreement of the drainage authorities. In other places in Egypt controlled drainage has been introduced to farmers and provision has been made for compensation during construction.

One solution for greater uptake of the technique, in Egypt and elsewhere, has been to argue that farmers must be trained. While the farming community in any country will certainly benefit from better training and knowledge there are important steps to consider before farmer training in its widest sense can be introduced.

Controlled drainage can be effective if the farming community take-up the ideas and put them into practice.

Benefits need to be clearly demonstrated if farmers are to be convinced of the merits of the system and persuaded to invest in controlled drainage.

If farmers are to be convinced of the merits of the system and persuaded to invest in the method then the benefits to them need to be clearly demonstrated. They also require technical support before, during and after the intervention possibly best supplied through appropriate extension and advisory services. The provision of advisory and extension services, in turn, needs motivated and knowledgeable staff to provide appropriate knowledge transfer.

The importance of co-operative drainage management by farmers is essential for the success of controlled drainage. An internal project note (Skutsch personal comm.) reports on the current thinking in India where the technique is known about but not widely practised or encouraged. The Indian authorities recognise that, as the pressure for land and water increases, incentive schemes and co-operative management by farmers with support from state government agencies will be needed. Existing water user associations (WUAs) offer an opportunity to execute community action and agreement for controlled drainage. A study undertaken by the Egyptian Drainage Research Institute (DRI) found that new institutional arrangements on the establishment and operation of WUAs and collector user groups (CUGs) could enhance cooperation among farmers and provide a practical platform for the presentation of drainage and water management advice, (Shaban et al, 1998). Most successful instances of cooperation depended upon the influence and availability of active group leaders.

Existing WUAs could be a vehicle for community action and agreement on successful and sustainable controlled drainage.

A workshop of professionals in Cairo in March 2001 (IPTRID 2002a) emphasised the importance of building awareness among decision and policy makers. Without that important step the benefits of controlled drainage for society, as a whole will be difficult to sustain. Recognition of the role of farmers and the farming community to actually deliver controlled drainage is paramount. Institutional support to provide a package of incentives and training can only come about if decision/policy makers are made aware and convinced about the method. The uptake and dissemination path therefore gives high priority to awareness building for senior officials based upon the knowledge generated by the research already undertaken and targeted field demonstrations.

Four actions are recommended as important and immediate steps towards the promotion of controlled drainage:

- Awareness creation among policy makers/decision makers
- Study of farmer management of controlled drainage through pilot trials
- Enhancing the skills and knowledge of front line staff
- Simple guidance leaflets for farmers

3.1 Awareness creation among policy makers/decision makers

3.1.1 Seminars and advocacy papers

- Purpose:
To inform the target group of senior officials in the donor community and in government departments about the benefits of controlled drainage and how to achieve these benefits through policy changes.
- Expected outcome:
Series of high level seminars and advocacy papers tailored to the needs of the target group. Controlled drainage, its benefits, costs and pre-conditions presented to identify what the target group should do to create an enabling environment for controlled drainage uptake.
- Comment:
Care will be needed to research the material and to prepare the messages for the target group. Material should be brief but informative and stress the next steps and future action required by the now aware target group. Clear demonstrations of institutional interventions such as the strengthening of existing water users associations (WUAs) will be particularly relevant¹. The impact of different water charging mechanisms on farmer participation should be clearly shown.

3.1.2 Technical exchange – senior officials

- Purpose:
To provide a forum for senior officials in selected countries to exchange views and to learn of the application of controlled drainage especially comparing institutional arrangements.
- Expected outcome:
Experience about the institutional arrangements and requirements to put controlled drainage into practice in Egypt and NW India.
- Comment:
The aim would be to arrange technical exchanges and placement of seconded staff between, say the Government of Egypt and selected State Governments in India. The intervention of one or more donors could be beneficial in facilitating this through the services of IPTRID or the International Commission on Irrigation and Drainage (ICID). This initiative will need funding and co-operation between governments and donors.

3.2 Study farmer management of controlled drainage through pilot trials

- Purpose:
To provide practical examples of successful controlled drainage interventions by farmers/farmers groups, particularly on non-rice crops.
- Expected outcome:

¹ In Egypt, existing WUAs are thought to be a better option than creating new groups (Shaban et al 1998)

Study should be designed to feed information into awareness seminars and technical training for front line staff. Lessons for the design of appropriate institutional interventions, such as models for farmer cooperation, incentive packages and compensations.

- **Comment:**
Experience and information was originally based upon the rice growing areas in Egypt. Additional experience has been gained from controlled drainage under wheat and maize cultivation, (OD/TN102) and simulation runs on non-rice crops (OD147). While these studies have contributed valuable information more is needed on the practicalities of controlled drainage under non-rice cultivation if the technique is to be applicable to a wider area, especially outside of Egypt. These studies should not be confined to technical issues but examine and record how organisational aspects can help farmers harmonise their efforts.

3.3 Enhancing the skills and knowledge of front line staff

3.3.1 Technical training for front line staff

- **Purpose:**
To strengthen the skills and hence the confidence of front line staff (agricultural extension officers, agricultural advisers, drainage advisers) to work with farmers/farmer groups to implement controlled drainage.
- **Expected outcome:**
Technical information transferred to front line staff by means of a technical field manual supplemented when needed with technical seminars. The field manual/guide could be similar but with narrower focus to that prepared by IPTRID (2001a). Manual/field guide would be prepared as a loose-leaf folder but could be supplemented with a CD-Rom that could contain more background information on technical and institutional arrangements and experience.

An alternative method would be to prepare a targeted workshop to present the principle findings of this study (the predictive and cost-benefit tools and the practical guidelines). The intention here would be for the principal collaborators in Egypt to prepare the material with the guidance of the project team. The focus would be to concentrate the formal part of the technology transfer into one time period and then allow time for practical problem solving under appropriate tutelage. The workshop could be held in Egypt with some attendees from outside of Egypt.

- **Comment:**
The report OD147 provides the technical knowledge and background on controlled drainage. However, as it stands this report can not be used directly for training purposes. Experience with the field manual/guide approach has been positive as this initiative can reach a greater number of the target group than training seminars alone. It is not feasible to train individual farmers though the field manual/guide could be made available to informed farmers. Experience has shown that there is a greater chance for sustained take-up if farmers have a corps of trained advisers to turn to and who they can feel confident about.

The alternative, a workshop could be undertaken in a shorter time period and at shorter notice than the field manual/guide. To be effective though proper follow-up and dissemination of the workshop papers and working sessions would be needed.

3.3.2 Technical exchange – front line staff

- **Purpose:**
To provide a forum for front line/technical staff in selected countries to exchange views and to learn of the application of controlled drainage especially comparing institutional arrangements.

- Expected outcome:
Technical exchange of selected technical and front line staff involved in promoting and advising on controlled drainage.
- Comment:
The suggestion would be to see if a suitable exchange arrangement could be established between, say the Government of Egypt and State Governments in India. The intervention of one or more donors could be beneficial in facilitating this through the services of IPTRID or the ICID.

3.4 Simple guidance leaflets for farmers

- Purpose:
To provide a variety of information media aimed at the farming community on the benefits of controlled drainage and where further information can be sought.
- Expected outcome:
A selection of attractive but low-cost leaflets, posters and information sheets produced and disseminated by front line staff and available at agricultural supply outlets (shops, seed merchants, equipment sale points).
- Comment:
Experience of developing information especially for farmers has been positive. An important step is to make sure that front line staff are not sidelined. There has been a tendency in the past for international experts and central government experts to train farmers directly. Missing out the front line staff can endanger the long-term prospects for knowledge transfer by exacerbating a lack of trust and confidence.

3.5 Possible involvement of funding agencies and donors

This study has already attracted funding from DFID to develop and test the ideas. Other international donors that may be interested to support the uptake of controlled drainage are the Netherlands and Canada. Both countries have a close involvement in drainage in Egypt and in India. Assistance with the technical exchanges may be viewed as a useful and practical next step for projects funded by the Netherlands and Canada in both countries. The World Bank has lent a considerable amount of funding to both Egypt and India, particularly on aspects of water resources reform and reuse of water that could benefit from a wider application of controlled drainage.

The Government of Egypt has already invested in the application of controlled drainage and closer cooperation between experienced Egyptian agencies and similar agencies in other countries and regions may be a logical next step.

The International Programme for Research and Technology in Irrigation and Drainage (IPTRID) hosted by FAO while not able to fund uptake initiatives directly are able to facilitate the process and are already working with government agencies in several of the priority countries. Early involvement of IPTRID who have recently produced a related study on biodrainage (IPTRID 2002b) will be of advantage to further uptake and dissemination.

4. CONCLUSIONS AND RECOMMENDED PROGRAMME OF ACTION

Controlled drainage is an important technique to improve water use efficiency and likely to be a practical tool for integrated water resources management (IWRM). The technique offers the potential to save water and reduce non-point pollution of drainage water under certain conditions. It is estimated that the method could be applied on about 25 million ha, most of this area being in semi-arid/arid regions. Uptake of the method requires the co-operation, agreement and active participation of farmers. Many of the benefits accrue off-farm so strategies to retain the co-operation of farmers need to be in place. A package of measures including awareness building, training, farmer support services (extension and drainage advice) and incentives will be necessary. Policy makers and decision takers in government departments and agencies and within donor and funding agencies need to be convinced of the benefits, practicalities and sustainability of the proposed methods.

Uptake of controlled drainage therefore requires a programme of dissemination activities to build awareness among decision takers and the donor community through to practical demonstrations of the technique to farmers and farming advisors (extension staff). The proposed path for dissemination and uptake of the results of the studies undertaken involves the following steps:

- Awareness creation among policy makers/decision makers
- Study of farmer management of controlled drainage through pilot trials
- Enhancing the skills and knowledge of front line staff
- Simple guidance leaflets for farmers.

The proposed programme could be aimed at Egypt and certain states in India in the first place, taking advantage of Egyptian experience to demonstrate how the methods can be applied and sustained. Support from interested donor agencies, IPTRID and ICID would be beneficial in this process.

Failure to disseminate the knowledge researched in the project would limit and slow the uptake of the method both in Egypt and elsewhere. Some farmers are already applying the method when they see fit but without the co-operation of their neighbours and the technical guidance of front line staff. Maximum benefits accrue from a co-ordinated effort, which can only come about from a planned programme of training and awareness building.

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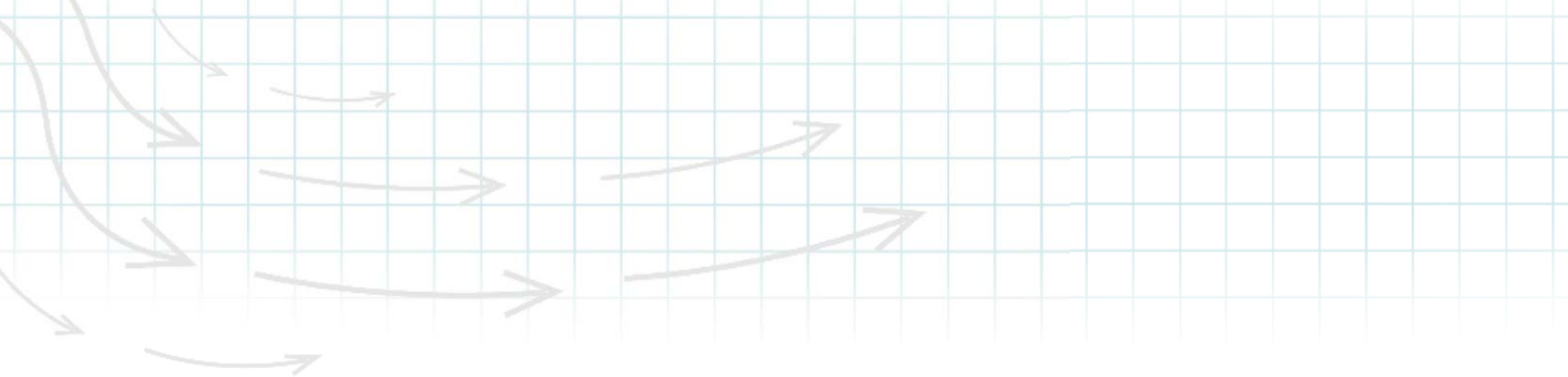
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