Agriculture, irrigation and drainage research in the past and the future

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Abstract

Irrigation has so far not been very important in the development of agriculture in Ethiopia. Unfortunately, the country suffers from severe food shortage due to chronic droughts when there is a potential to develop over three million hectares by irrigation. Land under irrigation accounts for only 5% of the potential and nearly half of this is under traditional irrigation scattered all over the country. Most of the modern commercially managed agriculture is found in the Awash Valley and mainly produces cotton, sugarcane and horticultural crops.

Irrigation and drainage research in Ethiopia has been undertaken at the Werer Agricultural Research Center where most of the commercial farms are found and serves mainly these farms or similar other farms in far away places.

The major outputs of research in irrigation and drainage management at Werer have been the determination of water requirement, frequency and depth of application for cotton, wheat, maize and horticultural crops. Significant investigation has also been done on drainage and fertiliser management under irrigation in the region. Continuous monitoring of the quality of Awash River water for irrigation has indicated no major problems concerning salinity except for a few sites.

The constraints and gaps observed in irrigation and drainage research, limitations observed in the scaling up of the technologies to other locations, and future strategies and approaches in research on agricultural water management are presented in the paper.

Background

Presently, irrigated area in the country accounts only for 5% of the total land suitable for irrigation and about one-third of this is located in the Awash basin. But the improperly planned irrigation projects not supported by improved irrigation and drainage management technologies, had invited further degradation causing salinity, sodicity and siltation problems. This is observed in the major state farms of the Middle and Lower Awash.

Research on irrigation management and drainage in Ethiopia was first initiated in 1964 at Werer Agricultural Research Center. The main focus of the research was on the
agronomic aspects of irrigation on cotton production. More work has been done on the
crop water-requirement of different crops, namely fibres (cotton and kenaf), horticultural
and lowland oil crops. Investigations on alternative irrigation systems and an assessment of
indigenous knowledge were conceived only recently. At present, research on irrigation,
drainage and water conservation has been initiated in other centres of the Ethiopian
Agricultural Research Organization (EARO) located in the sub-moist and moist
agro-ecological zones of higher altitudes such as Debre Zeit and Melkassa. The justification
for this is that the research on agricultural water management at Werer may not cover the
interest of the highlands or other potential areas for irrigation development. However, the
centre still lacks skilled manpower and facilities.

Ethiopia needs to raise the national capability in agricultural water management
activities (irrigation, drainage, water harvesting), and water resource development through
research and development.

In Ethiopia, most of the research activities have been mainly concentrated on
agronomic components giving less attention to the engineering aspects. It is also observed
that the research has focused on plot-based studies than looking into integrated water
management for agriculture.

Adoption of research findings in water management and assessing and upgrading the
indigenous knowledge of irrigation by farmers should be the major outputs of the research
activities.

Objectives

The objectives of this paper are briefly to assess:
1. the irrigation and drainage research by the former Institute of Agricultural Research
   (IAR, now the Ethiopian Agricultural Research Organization, EARO)
2. the gaps and constraints encountered in the process and,
3. the strategy to strengthen irrigation and drainage research in the future.

Research achievements

Water requirement studies

Irrigation research at Werer has been going on for over 35 years assisted by the Food and
Agriculture Organization of the United Nations (FAO) in the first 10 years. The main
activities during this time were determining frequency of irrigation and water closure dates,
experiments to determine optimum combination of irrigation frequency and depth of
application, and experiments to evaluate sensitive stages of growth for moisture stress,
moisture depletion patterns and the effect of water logging on yield.

It was reported that the water requirement of cotton planted in mid-May was 1009 mm
while that planted in mid-July was 915 mm. The drop in July is due to the reduced
evapotranspiration and the small rain received at the time. The amount reported was within the range and values given by other researchers (e.g. Kandia 1982). It was also found that cotton in the Middle Awash can be irrigated by one of two irrigation regimes, i.e. once in two weeks with 75 mm of water per application, or once in three weeks with 120.5 mm of water per application. Water budget method was also studied and it was found that with 70% irrigation efficiency, gross irrigation requirement for cotton in mid-Awash region is found to be 120 mm (Kandia 1982).

Studies on cotton–water yield relation confirmed that irrigation of 150 mm water at squaring; flowering and boll formation stages are best for optimum production. Irrigation intervals for cotton grown on salt-affected soils revealed that one to two pre-planting irrigation perform well on cotton yield.

Other practical recommendations were made on optimum irrigation regimes (frequency and amount) of maize, kenaf, groundnut, sesame, bean, wheat, onion, pepper, banana, tomato and citrus.

**Monitoring the water quality of Awash River**

The quality of Awash River water for irrigation has been monitored for many years. In 1973 the quality of the water sampled at Amibara Irrigation Project site was reported to be satisfactory for sustained irrigation with adequate leaching and drainage. The quality reported from 1987 to 1989 for Middle Awash was also considered safe except when water was not available in June and July between Werer and Meteka farms (Endale et al. 1992).

**Drainage**

Studies on sub-surface drainage systems under a pilot drainage scheme revealed that a 40 to 60 metres drainage spacing with red-ash filter material is best to reduce soil salinity and control groundwater table in the Middle Awash Valley. Leaching as a reclamation method for salt affected soils revealed that intermittent leaching practice with 150 mm of irrigation water is effective in removing soluble salts from the root zone of cotton crop in the Middle Awash.

Cumber-beds of different width have been recommended for draining excess moisture and application of N and P fertilisers highly increased the yield of crops grown on vertisols.

**Constraints and gaps**

a **Manpower status**

Manpower is one of the limiting factors in agricultural water management research. The balance of manpower in soil and water research compared with that in the crop science research is discouraging. It also indicates the low weight that had been given to the management of the natural resources in the past. The balance within the programme is not
also encouraging. Of the total manpower engaged in the programme, the ratio for agricultural water management, soil and water conservation and soil fertility and plant nutrient management is 15:18:57. Laboratory technicians (diploma graduates) are also the most limiting resource.

The technical capacity of the available staff is also limited due to lack of in-service training, scholarships and support from more advanced research and academic institutions.

b  Financial allocation

By nature, agricultural water management research activities need relatively higher amount of financial resources. Unlike the other sectors of agricultural research the funding for irrigation, drainage and water harvesting research from EARO has been extremely restricted inhibiting involvement of the research staff into the solutions of agricultural water management problems.

Therefore, it is important that this area of research must get financial assistance from other sources. International institutions need to have a better involvement in this respect.

c  Facilities

Most of the soil and water management divisions in the research centres have a small unit of soil laboratory. However, the constraints faced are lack of hydraulic laboratory, maintenance of instruments, shortage of chemicals and glassware in the existing laboratories.

d  Scope of research area

The scope of the research has been confined to irrigation agronomy trials to recommend irrigation application and to develop the methods of drainage of heavy clay soils. Priority areas for irrigation and drainage research, based on studies of the country’s problems, have yet to be identified.

Research in water resource development could enable the development of low-cost structures and irrigation systems for handling water. Where research information is lacking, there is a danger of over-design, which results in high cost or under-design, which results in failure. Specific research have not yet been conducted to address problems related with flow structures (canals, ditches, flumes etc.); water storage facilities (farm ponds, irrigation reservoirs) and sediment traps.

Agricultural water management research should, therefore, be accompanied with the water resource development and research activities to have a significant impact on the future development of irrigated agriculture.

e  Poverty

Not only the research work, but also the implementation of developed agricultural water management technologies has high initial cost. Most of the grass-root communities who are
supposed to use these technologies are poor. Due to this fact, it is difficult to implement these technologies unless they get financial support.

**Dissemination of research results**

Even though there are some technologies already developed in agricultural water management programmes, little has been done in disseminating these technologies. This is because of loose linkage between the research and extension on the one hand, and lack of awareness by the extension services about the importance of these technologies on the other hand.

Much attention by extension people has been given to the dissemination of high yielding crop varieties and fertiliser, rather than agricultural water management technologies.

**Lessons learned**

**Need for participatory approach**

Under the former Institute of Agricultural Research (IAR) (now EARO), most of the research activities were developed through the initiatives of the researchers themselves without the participation of the stakeholders and the end users. This has not speeded up the transfer of the developed technologies to locations away from the centre.

According to Andargachew (2002), the participation of the stakeholders in the research has the following importance:

- a recognition that farmers’ input in the research leads to more adoption and sustainability
- contacts between researchers and farmers lead to recognition of the value of local knowledge especially in complex, diverse and risk prone conditions
- provides technologies relevant to the needs of resource-poor farmers
- allows the generation and/or dissemination of technologies under local conditions
- provides opportunity for accepting or rejecting technologies at an early stage and at the same time allows the easy adoption of promising technologies and
- gives information on the characteristics of a technology that farmers consider important.

Participatory approach is, therefore, the best solution for the dissemination, adoption and sustainability of any research activities.

**Need for strong research–extension linkage**

Like in crops research, aggressive dissemination work is required in the transfer of available technologies of agricultural water management to the farming communities, to bring real change in the agriculture sector. For example, considerable efforts have been put to build soil and water conservation structures using available technologies, unlike agricultural
water management. Efforts should be made by the researchers in water management to make strong and closer linkage with the research–extension group to disseminate the improved technologies to the end users.

**Need for integrated water management research**

In the past research projects were developed independent of the involvement of other disciplines and this has incurred more time and cost to the research activity. Future approach should consider involving the different stakeholders from planning to implementation of the research projects to shorten the time frame between technology generation and transfer.

The research should also focus on the investigation of national, zonal, regional and other problems in particular to the needs of the people related to water resources development in line with the agricultural water management. This could provide practical and sustainable solutions to the existing problems. Moreover, applied research should be given priority than the theoretical one. Therefore, integrated research approach is the key for bringing effective, efficient and complete research technologies to the end users.

**Need for research networking**

Based on their importance, some research activities will be undertaken at a larger scale involving many users. To ensure complementarity of efforts and avoid duplication, it is suggested that some of these activities be grouped under the umbrella of networks where appropriate centres would play the lead co-ordination role.

**Ongoing and planned activities**

**Ongoing activities**

- establishing soil, crop and water relationships and developing efficient water uses for sustainable production particularly by determining the crop water requirement and irrigation scheduling for different crops under different agro-ecological zones (AEZs)
- evaluating different surface irrigation systems aimed at increasing the water use efficiency and crop yield of different AEZs
- monitoring the water quality of the Rift Valley lakes and Awash River to facilitate the existing and new irrigation works by avoiding risk and uncertainty
- assessing and evaluating farmers’ indigenous knowledge of agricultural water management practices to upgrade and improve the traditional knowledge on irrigation water management
- developing of different drainage technologies to manage poorly drained soils and
- water harvesting and conservation using contour bund in arid areas to mitigate the risk of chronic drought (EARO 2002).
Planned activities

Short term

- Identifying and prioritising agricultural water management research
- Inventoring, characterising and evaluating farmers’ knowledge of agricultural water management practices of watershed areas and water logging soils
- Evaluating the existing research outputs on agricultural water management and making them available to the users
- Studying the tolerance of different crop, grass and tree species on salt affected soils and developing crop production management systems.

Medium term

- establishing soil, crop and water relationships and developing efficient water use for sustainable production. Developing appropriate irrigation and drainage technologies
- developing engineering parameters for irrigation and drainage design
- undertaking water balance studies in different AEZs
- identifying suitable and appropriate irrigation methods under different AEZs (EARO 2000).

Summary

Research on irrigation has been going on at Werer Agricultural Research Center, for more than 30 years. It has served the interests of the large commercial plantations of cotton and horticultural crops in the valley. It will continue serving the purpose of these large-scale commercial farms as many more are expected to come into existence in the next few years. However, from now on, irrigation development is not only focusing on the production of industrial crops but also food crops and high value cash crops in the highlands where most of the population live. The Ministry of Water Resources has nearly completed comprehensive master plan studies of the major river basins and is embarking on the implementation phase. The master plan studies not only focus on the potential lowland irrigation but also on the development of potential areas in the highlands with emphasis on food crop production.

The Ethiopian Agricultural Research Organization (EARO) is mandated to generate technologies on irrigation and drainage in all agro-ecologies of the country and to this end it has developed strategies for short, medium and long-term periods. To implement the strategy EARO has started to recruit junior researchers in agricultural and water engineering. Agricultural water management, watershed management and water conservation are given high priorities in the short- and medium-term plans of the organisation. EARO is working with all stakeholders and partners to achieve its objectives.
References


