
Formulation of research needs in irrigation and drainage that promote integration of irrigation and drainage management and contribute to a sustainable water, salt, and financial balance

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Research needs for arid areas

1. Research on the physical and economic **effects of waterlogging and soil salinity** in order to sustain appropriate drainage development
 2. The need is great for research on **minimization of irrigation losses**. The following topics should be investigated carefully:
 - possible water savings from **integrated management of irrigation and drainage**
 - the economic effects of **canal lining** to reduce water losses
 - the extent of water saving, and the agronomic and economic effects of **re-use of drainage water** of varying salt concentrations
 - the effects of various **drainage designs** on irrigation efficiency
 - the effects of various **water pricing** systems on irrigation (and drainage) efficiencies
 - the effects of various degrees of **autonomy and accountability of the organizations** involved in operating and maintaining water management systems on the quality and the cost-effectiveness of scheme **operation and maintenance** and, consequently, on irrigation efficiency and the reduction of drainage effluent.
 3. Research on the sustainability of **large-scale irrigation systems** under various conditions, with the use of predictive models.
 4. Research on the role of integrated irrigation and drainage management in maintaining **water and salt balances**.
 5. Research on the role that **drainage management** can play in improving the unequal distribution of irrigation water.
 6. Research on the conditions necessary for the successful implementation of **service-oriented** (integrated) irrigation and drainage management.
 7. Research on **farmers' perceptions** of irrigation and drainage, to improve **communication** between suppliers and users of irrigation water, and to facilitate the introduction of **farmers' participation** into project management.
 8. Research on **appropriate project designs** (and unit sizes), to facilitate farmers' participation in project operation and maintenance.
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9. Research on possible improvements in the **conjunctive use** of surface water and groundwater, to provide irrigation water efficiently while controlling groundwater levels.
10. Research on **groundwater use** is urgently required. This research should include the following topics: the interaction between streams and aquifers; water quality; the possibility of artificially recharging the aquifer; sustainable rates of withdrawal. To improve **protection of available groundwater resources**, and to facilitate the introduction of adequate legislation on water resources, predictive models should be developed of the long-term impact of the unbridled exploitation of groundwater, and of the on-going pollution of the aquifers.
11. Research on the reduction and eventual **disposal of drainage effluent**, with special emphasis on:
 - simultaneous improvement of irrigation and drainage management
 - the possible contribution of the re-use of drainage water
 - the technical and economic feasibility of evaporators and evaporation ponds
 - the technical and economic feasibility of cultivating salt-tolerant crops and trees.
12. Research on the **incorporation of environmental costs and benefits** into the evaluation of water management projects.

Research needs for humid areas

1. Research on the technical and economic **feasibility of dual-purpose canal** systems for evacuating excess drainage water in the wet season, and for (supplementary) irrigation in the dry season.
2. Research on technical solutions to the problem of **storing excess water** in the wet season for use in the dry season. (Examples: cascade irrigation in Sri Lanka; horizontal drainage of sandy soils in India.)
3. Research on the benefits of introducing **service-oriented management** into (dual-purpose) irrigation and drainage systems.
4. Research on **broadening the criteria** for **designing irrigation and drainage systems** in problem soils (peat; acid sulphate soils; sodic soils), with a view to the specific characteristics of such soils.

Finally, the approximately one hundred participating experts from all over the world were urged to **continue rethinking their concepts** of irrigation and drainage development and management, taking into account the **interests and 'perceptions' of the various groups of farmers**.

To ensure that ILRI's future research activities will target generally accepted research needs and will not overlap the activities of other organizations, due attention will be given to the research needs that have been formulated already in recent international fora for related issues.
