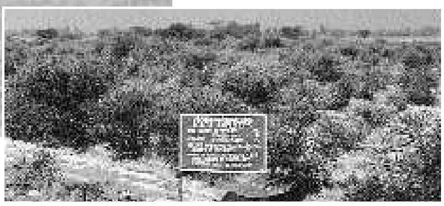
# Productive use of saline lands

Water is essential for life, and not least for agricultural activity. It interacts with solar energy to determine the climate of the globe, and its interaction with carbon dioxide inside a plant results in photosynthesis on which depends survival of all life. Much of the water available to man is used for agriculture and yet its usage has not been well managed. One result has been the build up of soil salinity. The Department of Technical Co-operation is sponsoring a programme, with technical support from the Department of Research and Isotopes, to make more productive use of salt-affected land and to limit future build up of salinity.

## Water water everywhere

Although the total amount of water on the planet is high, 97% is in the oceans, and 2% is locked up in ice caps, which leaves only 1% or approximately 40,000 km$^3$ on the land. Two-thirds of this water flows back into the sea, leaving about 14,000 km$^3$ available for use of which agriculture consumes more than a further two-thirds. As populations rise, so too does demand for water and shortage of water is a serious constraint to development.



***Salt-affected land near Faisalabad, Pakistan in 1992 and*** *(inset)* ***Acacia ampliceps plantation on the same land in 1996.***

***Poor farmers struggle to survive on salt-affected land.***

## Soil salinity

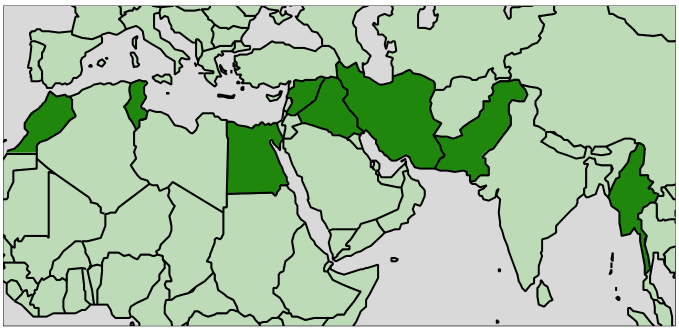
Soil salinity is a worldwide phenomenon but is generally most serious in arid and semi-arid regions where surface water is often scarce or unreliable and where groundwater also tends to be saline. Its many, sometimes overlapping, causes include geological and geographic factors, destruction of ground cover and mismanagement of irrigation. Manmade factors are responsible for saline conditions on about 77 million hectares globally of which about 45 million hectares are in irrigated areas. Much of this land lies barren and unused.

## The options

Where salinity is due to mismanagement of irrigation, reclamation usually takes the form of laying a groundwater drainage system and trying to flush down the surface salts into it with fresh irrigation water. This is a hugely expensive operation and despite massive efforts does not cover even a fraction of the affected lands. More than 70% of irrigated land in Iraq and Pakistan, 50% in Syria, 33% in Egypt and 15% in Iran are still affected by varying degrees of salinity. Furthermore, the water which has been used to leach down the salts is rarely re-used.

There are 32 million hectares of salt-affected land where the salinity is due to geological and geographic reasons, aridity and high evaporation. In many cases the salinity is exacerbated by the removal of plant cover for energy or other needs. Often saline groundwater is present at shallow depths.

In both irrigated and non-irrigated saline lands, fresh water, upon which normal agriculture depends, is scarce but saline or brackish water is usually available. This could be used for cultivation with salt-tolerant plants. Plants have vast genetic variability and more than one hundred species exhibit some native salt tolerance. Salt-resistant plants could be used for food or animal fodder, for timber, fuel, green manure or for processing into food or industrial products.



***Map showing countries taking part in the Model Project. Morocco, Tunisia, Egypt, Syria, Iraq, Iran, Pakistan, Myanmar.***

## The Model Project

Eight countries are taking part in an interregional Model Project. There are a number of aspects to the project in which nuclear techniques play a part (see overleaf) and the overall objective is to demonstrate that economic use can be made of salt-affected barren land using saline groundwater and salt tolerant plants chosen to meet local needs.

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## Irrigation

Seepage from irrigation systems and irrigated fields results in a loss of almost 40% of the water. This seepage of water underground has the effect of raising the groundwater table and bringing salts to the soil by capillary action. Evaporation of the water leaves the salt on the surface. Irrigation must therefore be managed so that there is little seepage from the delivery system and only calculated seepage from the fields - the water should be applied according to the crop requirement plus an extra amount for leaching. There should be proper drainage of the groundwater so that it does not accumulate and raise the water table and, most importantly, the drained water should not be considered a waste and should not be thrown away but used for further agricultural and/or industrial activity.

## *The scope of the Model Project*

The six-year plan, (from 1997) involves two main phases although each country and location taking part will follow specific workplans. Activities in the first phase include:

- choosing at least one experimental 10 hectare site of barren, salt-affected land in each of the participating countries;
- collecting basic physical, chemical and environmental data about each site;
- selecting and initial cultivation of salt-tolerant species that will be of local economic benefit;
- using neutron moisture probes for water management;
- determining water requirements for various species and their comparative survival and growth rates;
- monitoring the soil and water by means of chemical and isotopic analysis (see box).

In the second phase of the project, in addition to the above, the effect of different plants on the soil's salinity will be studied as well as an assessment made of the possible uses for the plants grown - as forage, timber, fuel or for agro-industrial processing. Grazing livestock will also be introduced and a study made of the longer term sustainability of the approach.

***Planting along the banks of irrigation channels helps to protect them from windblown sand.***

***Barley is one of the most promising salt-tolerant cereal crops.***

It should be possible, in the first three-year phase of the Model Project, to demonstrate that saline water can be used for growing plants on saline land. A good, productive use of an otherwise wasted resource will be of major benefit both locally and nationally.

A biological approach to reclaiming salt affected land has many longer term advantages. Land which is brought into cultivation will gradually improve in texture and fertility through the effect of the plant biomass and this improves the environment both below and above the surface. Soil cover by plants reduces erosion, provides shade, builds up organic matter and biological activity in the soil, transforming 'dead', barren soil into a live, dynamic system.

## Why use nuclear techniques?

Using neutron moisture gauges, irrigation can be better managed; only needed amounts of irrigation are applied and salt accumulation controlled. Stable and radioisotopic analysis of groundwater can provide information about the quality and quantity of its recharge and thus the sustainability of its use. Other isotopes can be used for "labelling" plants for tracing the pathways of elements such as carbon and nitrogen which circulate from the atmosphere to plants to soil and again into the atmosphere. Their study can provide information on the effect of plants on soil structure and fertility and much more. Isotopes, particularly isotopes of chlorine, can be used to monitor the movement of saline water and assess whether the techniques introduced will be sustainable. Nuclear techniques are relatively inexpensive and provide results much faster than other means of analysis.

**Recent studies of global water resources paint an alarming picture for the next century. Mankind cannot afford to waste water nor abandon ever-increasing areas of salt-affected land. By using nuclear techniques, the Model Project is intended to demonstrate how bio-saline agriculture can make productive and economic use of two wasted resources, saline land and saline groundwater.**

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