governing groundwater. Such congres-
sional action has been the history of this
country. If states fail to address problems
that can have a long-term impact on the
production and transportation of food
and fiber, federal laws are inevitable. As
of December, 1983, a congressional bill
(H.R. 2867) proposes a “National
Groundwater Commission” to investi-
gate groundwater problems nationwide.

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Economics
of salinity
management

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With future water supplies for
agriculture likely to be in-
creasingly limited, it is impor-
tant to consider direct use of water of
impaired quality — increasing use and
reuse over time of water with varying
levels of total dissolved solids. Plant
breeding will provide some salt-tolerant
varieties that can produce yields nearly
equivalent to those of crops traditional-
ly produced in areas without salinity
problems. Harmful physical and eco-
nomic effects may thus be lessened,
but farms in areas unaffected by salt
buildup may still be able to produce
better quality products at lower cost
than those in salt-affected areas.

Irrigation scheduling and use of
improved low-volume application tech-
ology can slow salt buildup and decrease
its harmful effects in many irrigated
areas. However, the capital cost of in-
roducing this new technology may be
beyond the repayment capacity of the
more extensive agricultural crops. Im-
provements in plant breeding and irri-
gation management may ease short-
run transition problems, but the extent
of their efficacy over the long run is
not certain.

Climate, soil permeability, drainage
(natural or artificial), and the salt toler-
ance of crops adaptable to specific
locations determine whether or not irri-
gation water of a given quality is us-
able. Crop, soil permeability, and drain-
age limitations are not absolute; some
substitutions are possible among the
physical conditions. Artificial tile drain-
age, for example, can be substituted
for water quality through the use of a
higher leaching fraction. Or, if econo-
mic factors permit their production, crops
with higher salt tolerance can replace
sensitive crops as water quality deter-
rates. Using the concept of a long-
term steady state, one can describe or
define the limitations to a long-term
irrigated agriculture, based on these
physical factors. These factors thus
determine the necessary conditions for
a successful long-term irrigation agricul-
ture, but they do not describe or define
the sufficient conditions: these are
found in economic factors influencing
the choice of crop to be produced and the
income it can generate.

Physical production response func-
tions can be used to develop
complex production response relations
for numerous combinations of irrigation
treatment, water quality level, and leach-
ing fraction for various soil types and
crops. From these, “efficiency frontier”
functions are developed to show the
tradeoff, or substitutability, among wa-
ter quality, water quantity, and capital
investment. The conclusion is that, to
obtain the same yield of a particular crop
as water quality declines (soil salinity
increases), larger and larger volumes
of water must be applied. A companion
problem is salt accumulation: salinity of
the drainage water or percolating water
may increase, leading to degradation of
groundwater or rising water tables that
may hasten the increase in local soil
salinity.

Extended economic analyses by the
Department of Agricultural Economics
at the University of California, Davis, of
the effect of water quality on Imperial
Valley farms served by Colorado River
water predict 12 to 15 percent increases in
income level over time as salinity of the
water increases by a projected 33 percent
by the year 2000. Alternatively, if by
desalination or dilution it were possible
to reduce Colorado River salinity by 50
percent, net returns to agriculture would
increase by 12 to 14 percent. These
changes are explained by changes in total
crop acreage, in the proportion of high-
valued salt-sensitive crops, in the teach-
ing fraction, and in the irrigation regime.

With increasing salinity levels, pro-
jected cropping changes include both re-
duced total acreage in crops and reduced
double-crop acreages. Changes in crop
mix, which have an important influence
on net returns, include reduction of sen-
tive crops such as lettuce and alfalfa
and an increase in fallowed land.

In all solutions to increasing salinity
in irrigated agriculture, one overwhelm-
ing problem remains — the removal and
disposal of accumulated salts away from
the root zone. For an irrigation economy
to be sustained, adequate drainage must
either be available naturally or be sup-
plied by installation of buried drains.
The drainage outflow must be disposed
of without creating problems in other
areas of the environment.

According to one estimate, as much as
15 to 20 percent of the land now in
irrigation would have to be removed
from production to provide space for
evaporation ponds in regions where re-
move disposal is impossible. With cur-
tent values of even subsurface land in
the range of $500 to $1,000 per acre, the
potential regional investment in sali-
disposal is formidable. To this must be
added costs of a collection-drain system
and possible on-farm tilling. The invest-
ment will probably have to come from
agricultural interests, but the long-term
alternative may be even greater financial
loss with land being abandoned as re-
regional salinity builds up.

Even if geneticists are able to shift
salinity tolerance of plants to permit
using water with ever-increasing saline
content, drainage requirements cannot
be reduced to zero. The soil is a reservoir
for holding moisture and nutrients and a
repository of precipitated salts. If placed
under stress by excess deposition of salts
or inadequate drainage in relation to the
quantity of water applied, the set of
resources that make up the root zone can
pass a critical level and become irretriev-
ably salinized.

Given the level of irrigation technol-
yogy, the optimum rate at which the
absorptive capacity of the root zone is used
(salt buildup) depends on the long-term
interest rate and a positive net income in
each planning period. Economic survival
of irrigated agriculture requires that pe-
riods of low commodity prices in the
future be more than offset by periods of
positive net incomes sufficiently large to
cover costs of drainage, collection, re-
moval, and disposal of salts.

For land in which the salt level in the
root zone is currently not in equilibrium
(progressive salinization), increasing the
salt tolerance of plants and improving
irrigation management technologies
merely postpone the time when capital
investment for drainage and disposal
must be made. The physical, economic,
social, and institutional costs and feasi-
bility requirements for salt disposal will
have to be met as part of the necessary
and sufficient conditions for a prosper-
ous long-term agriculture.

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