States in recent years. Relative to the economic value of their ag-
pied by U.S. agricultural science in the past 50 years can no longer
be taken for granted.

cultural Experiment Stations at the land grant universities, public
vestment in agricultural R&D has been shared by the federal
port of longer-range, or basic, knowledge-creating research, and
clined by nearly 20 percent in real terms in the 1980s. Although a
public investment, and in particular federal investment, for sup-
to private research more for the "D part of the R&D nexus. Re-
stant USDA competitive grants program (currently about $42
million annually) has helped to sustain more basic research in the
states, it too has been stagnant. The growth in funding of special
site and purpose, has done little to arrest declining federal sup-
port of knowledge-building, basic agriculturally related re-
the NSF have increased their support for research in the Agricul-
tural Experiment Stations, preventing a precipitous decline in
the United States. The State's Division of Agriculture and Natural Resources.

The United States has the greatest investment in agricultural
R&D of any single country. However, world agriculture and ag-
ricultural sciences are changing rapidly. Investment growth
rates in agricultural R&D in several other countries, particularly
the industrialized countries, have exceeded those in the United
States in recent years. Relative to the economic value of their ag-
riculture, investments in those countries now exceed the U.S. in-
vestment by a substantial margin. The preeminent position occu-
pied by U.S. agricultural science in the past 50 years can no longer
be taken for granted.

For much of this century, public and private investments in R&D
have kept U.S. agricultural science and agricultural productivity
on the leading edge internationally. Many of the mechanical, bio-
logical, and chemical innovations that have enhanced agricul-
tural productivity worldwide have their origins in American ag-
ricultural research institutions. These investments have yielded
high rates of social returns — as high as 45 percent a year. Today,
however, American agriculture’s competitiveness is eroding,
partly because of underinvestment in R&D.

Currently, U.S. agricultural R&D expenditures total about
$4.6 billion annually — the equivalent of about 3 percent of the
gross value of our agricultural production. Of this, private R&D
constitutes about 57 percent, primarily in plant protection and
nutrition and in postharvest processing and marketing research.
Public investment, by comparison, concentrates more heavily in
crop breeding and management as well as in livestock-related
research.

Trends in U.S. public sector investments in agricultural R&D
also give rise to concerns about the capacity of the system to sus-
tain agricultural productivity and competitiveness into the 21st
century. Beginning with the enactment of the Hatch Act, which
created and provided the federal financial support for the Agri-
cultural Experiment Stations at the land grant universities, public
vestment in agricultural R&D has been shared by the federal
and state governments. Generally, researchers have looked to
public investment, and in particular federal investment, for sup-
port of longer-range, or basic, knowledge-creating research, and
to private research more for the “D” part of the R&D nexus. Re-
cently, however, adjustment for inflation shows that federal sup-
port of state agricultural research through the USDA has been
stagnant. Federal support through “formula” funds actually de-
clined by nearly 20 percent in real terms in the 1980s. Although a
modest USDA competitive grants program (currently about $42
million annually) has helped to sustain more basic research in the
states, it too has been stagnant. The growth in funding of special
research grants through the USDA, often earmarked with respect
to site and purpose, has done little to arrest declining federal sup-
port of knowledge-building, basic agriculturally related re-
search. Fortunately, other federal agencies such as the NIH and
the NSF have increased their support for research in the Agricul-
tural Experiment Stations, preventing a precipitous decline in
overall federal support of basic research.

State support of agricultural research varies widely. The State
of California is by far the largest single source of support (65 per-
cent) for UC’s Division of Agriculture and Natural Resources.

Although that support totals about $92 million annually, by far
the most of any state, it represents less than 1 percent of Californ-
ia's annual gross farm income. Here, too, the modest increases
in state appropriations in the past five years have been ear-
marked for applied rather than basic, mission-oriented research.

These changes and trends in public investments in agricultural
R&D, if continued into the 1990s, will pose ominous overtones
for U.S. and California agriculture’s productivity growth and
competitiveness in global agricultural markets. The one major
means available to California agriculture for maintaining pro-
ductivity growth, and thereby basic economic competitiveness, is
a continued flow of improved and new technology. In the com-
ing decades, maintaining the growth of California's agricultural
productivity will be made more complex and difficult than in the
past by the necessity of minimizing the environmental effects
of agriculture and food production. New or modified production
systems must be developed at the farm level as well as in the food
processing and input-supply sectors to cope with issues such as
soil salinity, deteriorating water and air quality, pesticide use,
and food safety, as well as the likelihood of higher costs for the
water and land used in agriculture.

Clearly, there is now substantial public underinvestment in ag-
gricultural R&D, particularly in the more basic, knowledge-crea-
ning research needed to generate improved and new technologies
for the late 90s and the early 21st century. Two recent reports sug-
gest the magnitude of that underinvestment. The Board of Ag-
culture of the National Research Council, in its 1989 report "In-
vesting in Research," called for a tenfold increase in USDA-ad-
ministered competitive agricultural research grants to $500 mil-
ion annually. In 1988 the National Science Foundation estimated
that $743 million was needed to repair or renovate U.S. agricul-
tural and biological research facilities; another $1.9 billion was
needed to construct new facilities for the same scientific areas.

The American economy, including agriculture, created a boon
of employment and personal income, and a cornucopia of con-
sumer goods and services in the post–World War II era unrivaled
by any country in history. In major measure, that attainment was
made possible by farsighted public and private investments in
scientific R&D. However, in the past two decades U.S. competi-
tiveness has eroded substantially in several economic sectors
such as steel, automobiles, and electronics, in part because of un-
derinvestment in R&D. In recent years, agriculture’s competi-
tiveness has been under increasing pressure, and that will proba-
bly continue to increase in the years ahead. The most important
means to maintain agriculture as a vibrant sector of the California
and American economies is to reverse recent public investment
trends in agricultural research. Increased investment is needed
now and throughout the 1990s if we are to assure our competi-
tiveness into the 21st century.