

# Chapter 3

# Investment in Postharvest Technology and Marketing Economics Research

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# Investment in Postharvest Technology and Marketing Economics Research\*

Public food and agricultural research in the United States is conducted chiefly by the U.S. Department of Agriculture (USDA) and State agricultural experiment stations (SAES) in conjunction with land-grant universities (including the 1890 Institutions and Tuskegee Institute).\*\* USDA research is funded from Federal sources. SAES research is supported by Federal funds, State appropriations and sales, and grants from private sources.

Historical data are available for public expenditures on food and agricultural research, including postharvest technology and marketing economics (PHTME) research, and are presented in the analysis below. Patterns and trends in USDA and SAES expenditures are analyzed for the 16-year period from 1966 to 1981.

For the analysis of public expenditures, agricultural research is separated into three components:

\*The material found in this chapter was originally prepared by Joseph Havlicek, Jr. and Daniel Otto, and can be found in more detail in their paper, "Historical Analysis of Investment in Food and Agricultural Research," OTA, *An Assessment of the United States Food and Agricultural Research System, Vol. II—Commissioned Papers*, Part C, April 1982.

\*\*A description of the U.S. food and agricultural research system can be found in *An Assessment of the United States Food and Agricultural Research System* (2).

1) production, 2) PHTME, and 3) other. Production research includes research on all aspects of producing crops and livestock. PHTME research encompasses research on all functions after harvest of crops and beginning with the first phase of marketing for livestock. Thus, it includes all functions from storage to distribution of agricultural products through the institutional food trade and wholesale and retail outlets. "Other" food and agricultural research includes all remaining publicly funded research (rural development, human nutrition, conservation of resources, environment, etc.). The "other" category is a residual category that includes all research that is neither production oriented nor PHTME. The particular research problem areas included in PHTME are identified in appendix A.

The scope and amount of food and agricultural research performed by private industry cannot be reported accurately, because reliable data are lacking. Private firms engaged in agricultural research are not required to identify themselves, nor are they required to disclose their investments in agricultural research publicly. Thus, any analysis of agricultural research by private industry is based on incomplete data. The data that are available will be discussed later in this chapter.

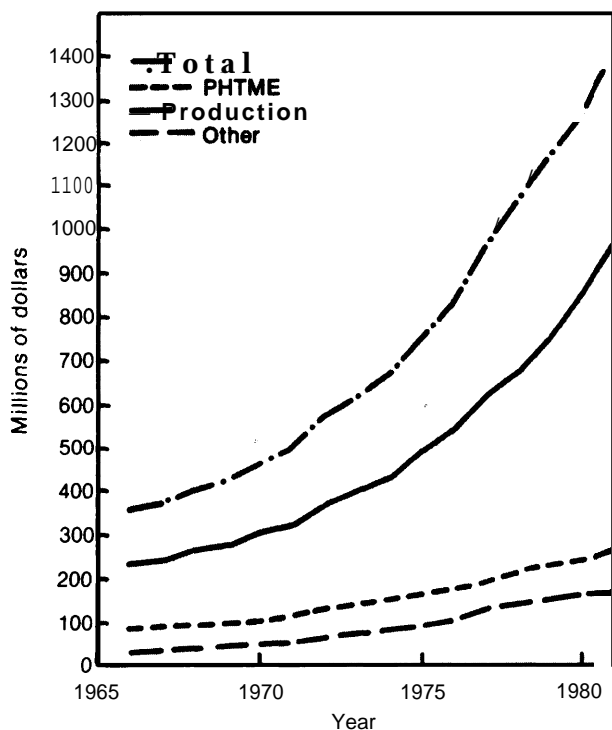
## USDA AND SAES EXPENDITURES ON PRODUCTION, PHTME, OTHER, AND TOTAL AGRICULTURAL RESEARCH, 1966-81

USDA and SAES expenditures on production, PHTME, other, and total agricultural research for the 16-year period from 1966 through 1981 are presented in figure 1, and constant dollar expenditures are shown in figure 2.\* Production research is a much larger component of total public agricultural research than PHTME research is. Pro-

duction research accounted for 69 percent of total USDA/SAES research in 1981. Furthermore, combined USDA and SAES expenditures on production research, in current and constant dollars, exhibit patterns almost identical to those of combined expenditures on total agricultural research. From 1966 to 1981, current dollar USDA and SAES expenditures on production research increased steadily. The current dollar increase during this period was 306 percent, equivalent to a 38-percent increase in constant dollars.

\*Data used to construct these and all remaining figures in this chapter can be found in app. C.

Figure 1.—Combined USDA/SAES Expenditures on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)

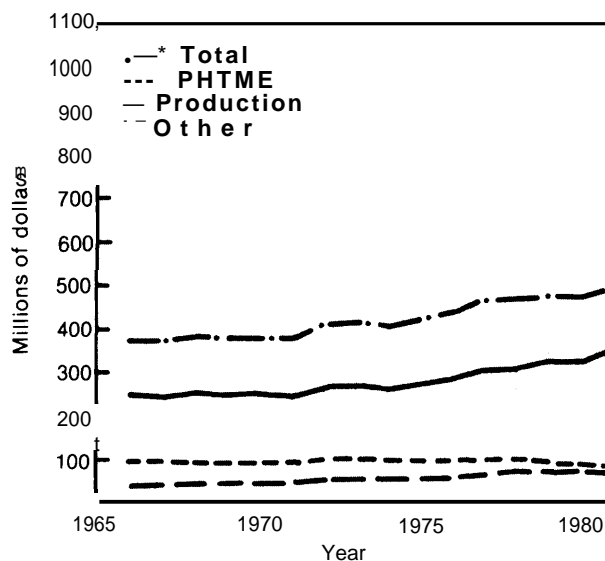


SOURCE: Office of Technology Assessment.

Public expenditures on PHTME research accounted for about 24 percent of total public agricultural research funds in 1966 and for approximately 18 percent in 1981. In current dollars, combined USDA and SAES expenditures on PHTME research steadily increased from 1966 to 1981, but the 198-percent increase in current dollars represented a 1.6-percent overall increase in constant dollars. Between 1966 and 1978, there was an increase of approximately 9.6 percent in constant dollars for PHTME research. However, from 1978 to 1981, constant dollar expenditures for PHTME research declined approximately 8 percent.

“Other” food and agricultural research, the smallest of the three components of public research, in current dollars rapidly increased from 1966 to 1978 but declined from 1978 to 1981. In current dollars, the overall increase during the 1966-81 period was 425 percent, representing a 79-percent increase in constant dollars.

Figure 2.—Combined USDA/SAES Expenditures on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)



SOURCE: Office of Technology Assessment.

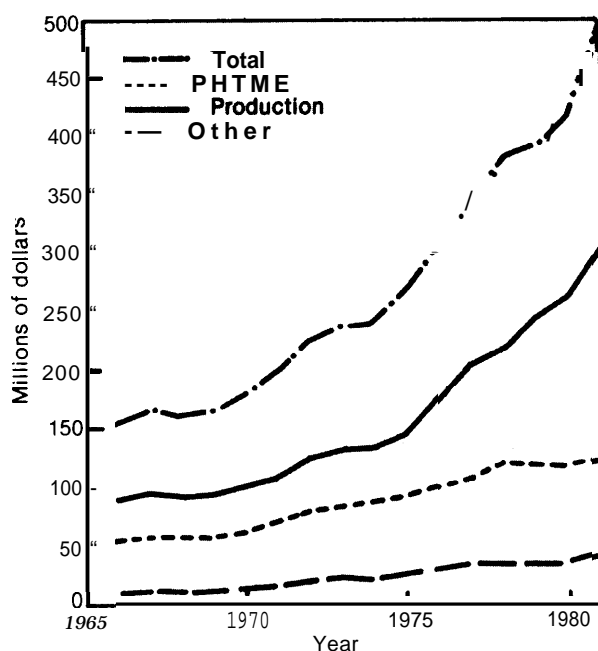
## USDA Expenditures

USDA expenditure patterns for production, PHTME, other, and total agricultural research for the period from 1966 to 1981 are almost identical to combined USDA/SAES expenditure patterns, as shown in figures 3 and 4.

USDA expenditures for production research, the largest component of USDA research, accounted for 64 percent of total USDA research expenditures in 1981. USDA expenditures on production research increased 251 percent in current dollars from 1966 to 1981, but increased about 20 percent in constant dollars.

USDA expenditures on PHTME research increased 144 percent in current dollars from 1966 to 1981, but decreased by 17 percent in constant dollars. Much of this decrease in constant dollar expenditures occurred from 1979 to 1981, partly because of level current dollar funding but also because of the rate of inflation. As a proportion of total USDA research expenditures, PHTME expenditures decreased from 35 percent in 1966 to 27 percent in 1981.

Figure 3.—USDA Expenditures on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)



SOURCE: Office of Technology Assessment

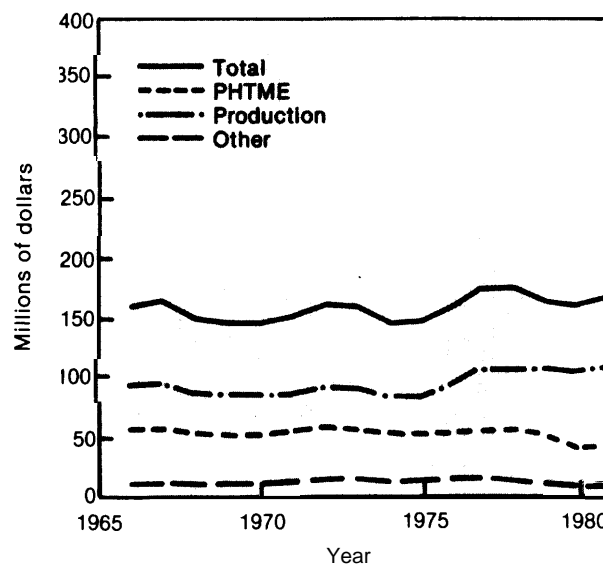
From 1966 to 1981, USDA expenditures on "other" research increased 293 percent in current dollars and 34 percent in constant dollars. Despite these increases, however, other research is still a small component of total agricultural research in USDA and in 1981 accounted for only 9 percent of the total.

### SAES Expenditures

SAES expenditures on production, PHTME, other, and total agricultural research for the 16-year period from 1966 to 1981 are shown in current and constant dollars in figures 5 and 6, respectively. These figures show that SAES expenditure patterns are similar to those for USDA.

Production research is the largest component of total SAES research, and during the 1966-81 period, current dollar expenditures increased 338 percent, although constant dollar expenditures increased by 50 percent. SAES expenditures on PHTME research were of approximately the same magnitude as SAES expenditures on "other" research—but for "other" research, current and con-

Figure 4.—USDA Expenditures on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)



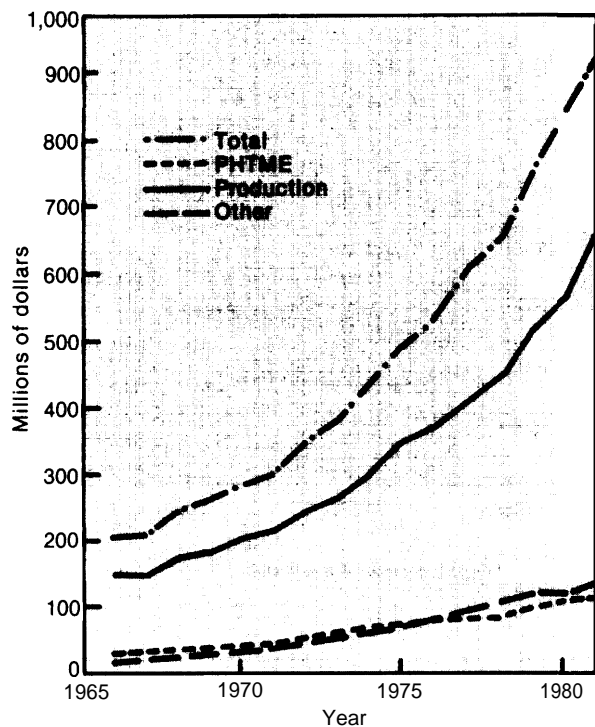
SOURCE: Office of Technology Assessment

stant dollar expenditures increased 488 and 100 percent, respectively, while for PHTME research, current dollar expenditures increased 287 percent and constant dollar expenditures by 32 percent. SAES expenditures on PHTME research decreased from 16 percent of total SAES research funds in 1966 to 14 percent in 1981. The proportion of SAES expenditures devoted to "other" research increased from 11 percent of total SAES research expenditures in 1966 to 15 percent in 1981, but was as high as 17 percent in 1978.

### SAES/USDA Relative Shares of PHTME and Total Agricultural Research

Expenditures by SAES on PHTME and total agricultural research as a percent of combined USDA/SAES expenditures on such research for the period from 1966 to 1981 are presented in figure 7. With some minor variations, the SAES proportion of combined USDA/SAES expenditures on all agricultural research increased from a low of 56 percent in 1967 to a high of 65 percent in 1981. At no time during the 1966-81 period did SAES account for less than half the combined USDA/SAES expenditures for all agricultural research.

**Figure 5.—SAES Expenditures on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)**



SOURCE: Office of Technology Assessment.

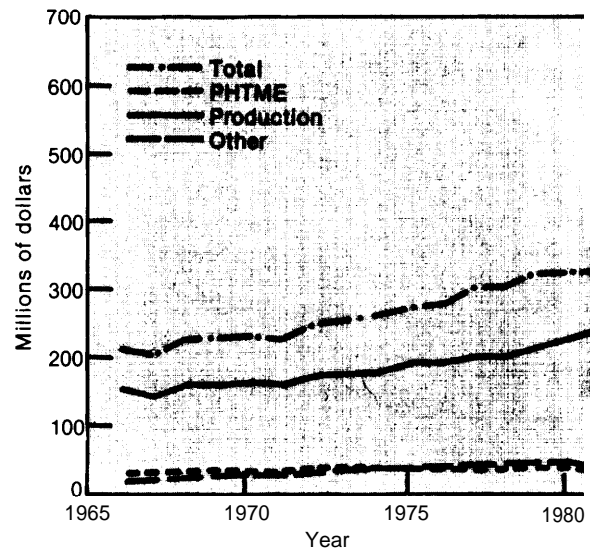
SAES expenditures on PHTME research as a percent of total public expenditures on PHTME research increased about 14 percent during the 1966-81 period. Although there was a slight variation, the proportion increased from about 37 percent in 1967 to 51 percent in 1980.

### USDA and SAES Expenditures on PHTME and Total Research for Selected Commodities

Patterns in expenditures by USDA and SAES on PHTME and total research were analyzed for the 16-year period from 1966 to 1981 for nine selected agricultural commodities: potatoes, other vegetables, corn, wheat, soybeans, rice, cotton, dairy products, and beef. The analysis is presented in detail in appendix B.

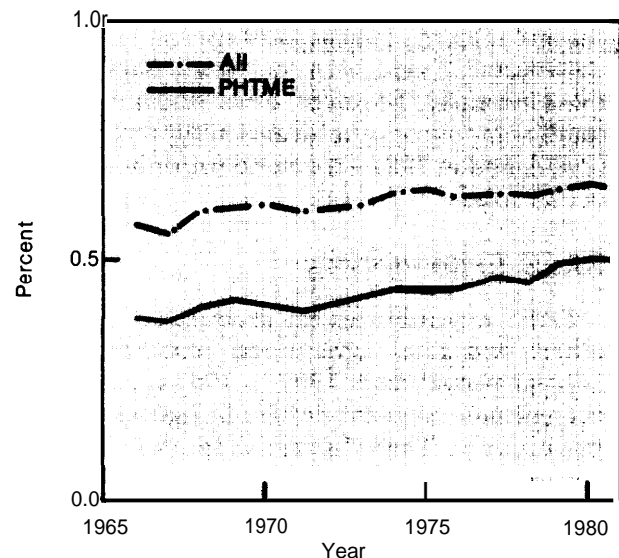
The expenditures of SAES and USDA on total and PHTME research for the nine commodities exhibited several unique patterns in terms of levels and variations in funding. However, some general

**Figure 6.—SAES Expenditures on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)**



SOURCE: Office of Technology Assessment.

**Figure 7.—SAES Expenditures on PHTME and on Total Agricultural Research as a Percent of Combined USDA/SAES Expenditures on PHTME and Total Agricultural Research, 1966-81**



SOURCE: Office of Technology Assessment.

tendencies did exist which allowed the following general conclusions to be drawn:

1. In general, the total expenditures on all research for specific commodities were greater in SAES than in USDA except for cotton.

2. While current dollar total research expenditures by both SAES and USDA for all commodities increased from 1966 to 1981, the constant dollar expenditures exhibited slight or no increases and for some commodities declined substantially.
3. The loss of purchasing power due to inflation from 1966 to 1981 was substantial, and the real dollars available for total agricultural research on the nine commodities in both SAES and USDA remained at about the same level over the 16-year period.
4. In general, the level and proportion of expenditures allocated to PHTME research on these commodities were greater in USDA than in SAES.
5. From 1966 to 1981, both SAES and USDA current dollar expenditures for PHTME research on all nine commodities exhibited an overall increase, but current dollar expenditures for PHTME research for several commodities decreased from 1977 to 1979.
6. From 1966 to 1981, both SAES and USDA constant dollar expenditures for PHTME research on the nine commodities only increased slightly or declined.
7. PHTME commodity research generally declined more in USDA than in SAES during this 16-year time period.
8. SAES did not increase commodity PHTME research enough to make up for the USDA decline.

## **PRIVATE INDUSTRY EXPENDITURES ON APPLIED RESEARCH AND DEVELOPMENT OF AGRICULTURAL CHEMICALS, FARM MACHINERY, FOOD, AND KINDRED PRODUCTS, 1963-75**

Data are not available on agricultural research expenditures by private industry to permit separating out production, PHTME, and other food and agricultural research. Data available for private industry pertain to applied research and development in agricultural-related products: agricultural chemicals, farm machinery, and food and kindred products.

Much of private industry's applied research and development in agricultural chemicals and farm machinery tends to be production-oriented. In the following discussion, it is assumed that private industry's applied research and development on food and kindred products in private industry is similar in nature to the PHTME research in the public sector. This assumption allows some comparisons of trends in public and private expenditures on PHTME research,

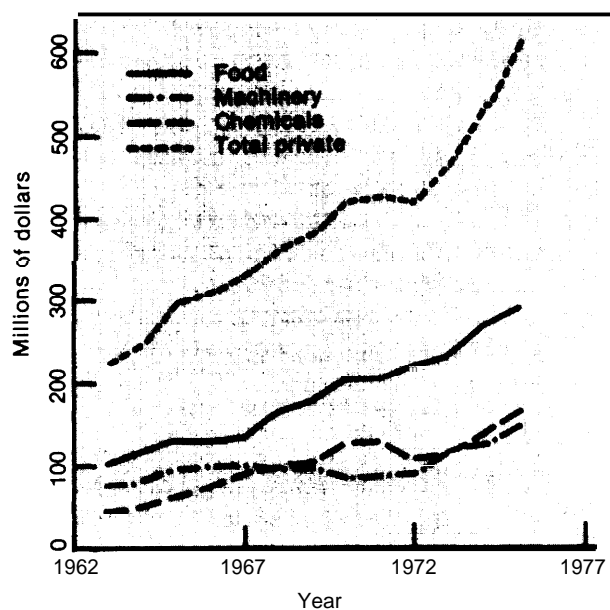
Expenditures by private industry on applied research and development of agricultural chemicals, farm machinery, and food and kindred products for the period 1963 to 1975 are presented in current dollars in figure 8 and in constant dollars in figure 9. The largest of these three components of private industry's applied research and development—and the only one for which there was a steady increase in both current and constant dollar

expenditures in the period 1963 to 1975—was applied research and development of food and kindred products. From 1963 to 1975, private industry expenditures on applied research and development of food and kindred products increased by 186 percent in current dollars and by 47 percent in constant dollars. These expenditures accounted for nearly half the total private industry expenditures on applied research and development of agricultural-related products.

Current dollar expenditures by private industry for applied research and development of farm machinery, while exhibiting an erratic pattern during the 1963-75 period, overall increased about 91 percent. Most of the erratic fluctuations occurred between 1967 and 1972. Constant dollar expenditures in this area exhibited considerable fluctuation, decreasing by 2 percent from 1963 to 1975 and by 15 percent from the high in 1965 to 1975.

Current dollar expenditures by private industry for applied research and development of agricultural chemicals steadily increased from 1963 to 1975, except in 1972 and 1973. The overall increase was about 267 percent. The constant dollar expenditures varied over the 1963-75 period, but overall increased about 88 percent.

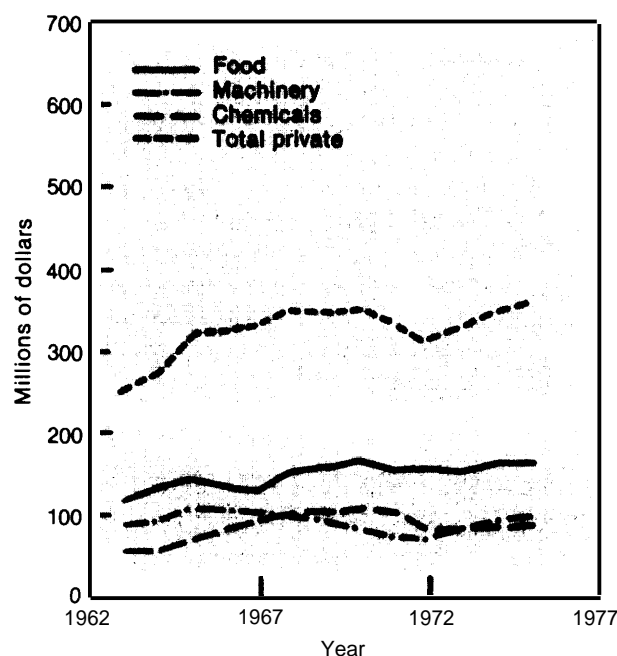
**Figure 8.—Private industry Expenditures on Applied Research and Development of Agricultural Chemicals, Farm Machinery, and Food and Kindred Products, 1963-75 (in current dollars)**



SOURCE: Office of Technology Assessment.

Finally, private industry expenditures on applied research and development of food and kindred products ranged from 150 percent of combined USDA/SAES expenditures on PHTME research in 1966 to 176 percent of these expenditures in 1975. During that 10-year period, the expendi-

**Figure 9.—Private industry Expenditures on Applied Research and Development of Agricultural Chemicals, Farm Machinery, and Food and Kindred Products, 1963-75 (in constant dollars)**



SOURCE: Office of Technology Assessment.

tures by private industry on applied research and development of food and kindred products increased more rapidly than did the expenditures by USDA and SAES on PHTME research.

## USDA EXPENDITURES ON PRODUCTION, PHTME, OTHER, AND TOTAL AGRICULTURAL RESEARCH BY RESEARCH AGENCY, 1966-81

Patterns in expenditures on production, PHTME, other, and total agricultural research for the major research agencies within USDA are analyzed in this section for the 16-year period from 1966 to 1981. The agencies considered are the Agricultural Research Service (ARS) and the Economic Research Service (ERS). For the Agricultural Marketing Service (AMS), comparable data are not available during this time period. \*

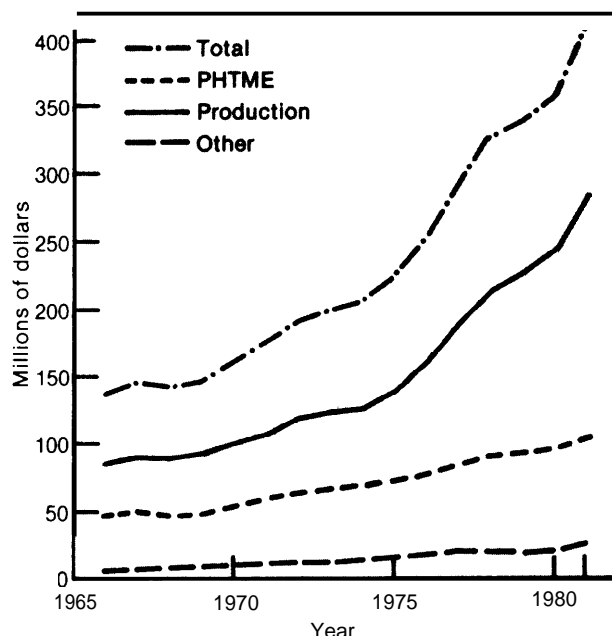
\*Research expenditures by Agricultural Marketing Service for other years are in table C-8 in app. C.

### Agricultural Research Service Expenditures

Current dollar and constant dollar expenditures on production, PHTME, \*\* other, and total agricultural research by ARS for the 1966-81 period are presented in figures 10 and 11, respectively. In terms of total agricultural research funding, ARS was by far the largest service in USDA during this time.

\*\* PHTME research supported by ARS is considered postharvest technology research as defined in ch. 2.

Figure 10.—ARS Expenditures on Production, PHTME<sup>a</sup>, Other, and Total Agricultural Research, 1966-81 (in current dollars)



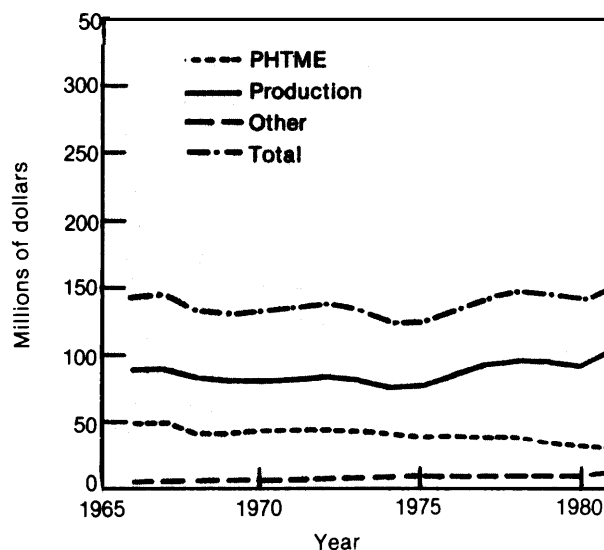
<sup>a</sup>PHTME research supported by ARS is considered postharvest technology research as defined in ch. 2.

SOURCE: Office of Technology Assessment

From 1966 to 1981, ARS current dollar expenditures on all agricultural research increased 207 percent. In 1966, ARS current dollar expenditures on all agricultural research were about \$137 million, and these expenditures increased to approximately \$419 million in 1981. Constant dollar ARS expenditures on all agricultural research from 1966 to 1981 exhibited considerable year-to-year fluctuation. They decreased from \$144 million in 1966 to \$135 million in 1976, then increased to \$150 million in 1978, again decreased in 1979 and 1980, and finally increased to the \$150 million level in 1981.

From 1966 to 1981, production research constituted the largest part of total agricultural research funding in ARS. The pattern of ARS expenditures on production research during that period is similar to that of ARS total agricultural research expenditures. ARS current dollar expenditures on production research increased fairly steadily throughout the 1966-81 period. These expenditures were about \$85 million in 1966 and increased by 235 percent to \$286 million in 1981. Constant

Figure 11.—ARS Expenditures on Production, PHTME<sup>a</sup>, Other, and Total Agricultural Research, 1966-81 (in constant dollars)



<sup>a</sup>PHTME research supported by ARS is considered postharvest technology research as defined in ch. 2.

SOURCE: Office of Technology Assessment.

dollar expenditures on production research by ARS fluctuated from 1966 to 1981, but increased by 14 percent overall, from about \$89 million in 1966 to \$102 million in 1981.

ARS current dollar expenditures on PHTME research, after a slight decrease from 1967 to 1968, steadily increased from about \$46 million in both 1966 and 1968 to \$107 million in 1981. In constant dollars, ARS expenditures on PHTME research exhibited some variation, but decreased by 20 percent overall from 1966 to 1981.

The remaining component of ARS agricultural research, the category labeled "other," has been a small component of ARS research expenditures. The current and constant dollar expenditures steadily increased from 1966 to 1978, but in constant dollars, decreased by nearly \$10 million from 1978 to 1979. In current dollars, ARS expenditures on "other" research were a little over \$5 million in 1966 and increased to nearly \$20 million in 1978. In constant dollars, ARS expenditures on other research increased from nearly \$6 million in 1966 to over \$9 million in 1978, and returned to that level of spending in 1981.

## Economic Research Service Expenditures

Current dollar expenditures on production, PHTME,\* other, and total agricultural research in ERS for the 1966-81 period are presented in figure 12, and constant dollar expenditures are presented in figure 13. ERS current dollar total research expenditures increased by 185 percent during this 16-year period, but constant dollar expenditures decreased by 3.5 percent. However, there was a severe decline of 15 percent in ERS constant dollar total research expenditures from 1966 to 1977.

Expenditures on PHTME research were the largest component of total research expenditures in ERS. Expenditures on PHTME research in ERS, in both current and constant dollars, exhibit patterns similar to those for total agricultural research expenditures in ERS. From 1966 to 1981, ERS PHTME research expenditures increased 164 per-

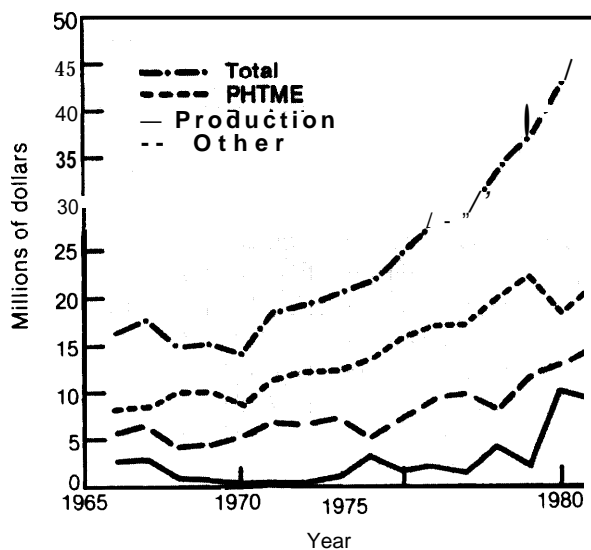
cent in current dollars but decreased by 10 percent in constant dollars.

Expenditures in ERS on "other" research varied substantially and from 1966 to 1981 show erratic patterns in both current and constant dollars. The overall increase from 1966 to 1981 in ERS current dollar expenditures on other research was 183 percent, while constant dollar expenditures decreased 3.5 percent. Throughout the 16-year period, expenditures on "other" research accounted for about one-third of the total research expenditures of ERS.

Expenditures on production research were the smallest component of total agricultural research expenditures in ERS. Expenditures on production research accounted for about 16 percent of total research expenditures in ERS during the early part of the 1966-81 period, but declined to a low of 2 percent in 1971. Thereafter, the proportion of ERS expenditures on production research varied, reaching 25 percent in 1980 but declining to 20 percent in 1979. Current dollar expenditures on production research in ERS increased 255 percent from 1966 to 1981, and constant dollar expenditures increased 21 percent.

\*PHTME research supported by ERS is considered marketing economics research as defined in ch. 2.

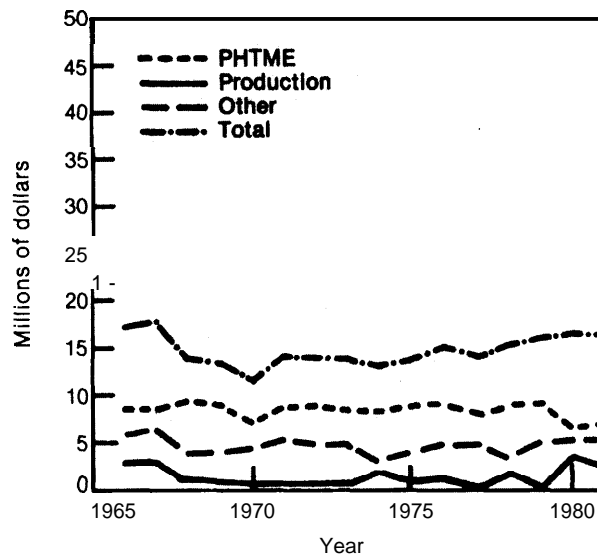
Figure 12.—ERS Expenditures on Production, PHTME\*, Other, and Total Agricultural Research, 1966-81 (in current dollars)



\*PHTME research supported by ERS is considered marketing economics research as defined in ch. 2.

SOURCE: Office of Technology Assessment.

Figure 13.—ERS Expenditures on Production, PHTME\*, Other, and Total Agricultural Research, 1966-81 (in constant dollars)



\*PHTME research supported by ERS is considered marketing economics research as defined in ch. 2.

SOURCE: Office of Technology Assessment.

## SAES EXPENDITURES ON PRODUCTION, PHTME, OTHER, AND TOTAL AGRICULTURAL RESEARCH BY SOURCE OF FUNDS, 1966-81

Trends in SAES expenditures on production, PHTME, other, and total agricultural research for the period from 1966 to 1981 are analyzed below by the types or sources of funding: 1) Federal funds (including Hatch Act funds, USDA cooperative grants and agreements, other Federal sources); 2) State appropriations; and 3) private research funds to SAES.

A major trend in SAES funding is the decline of Federal support and the significant increases in State appropriations. The majority of funds for PHTME research in SAES now come from State appropriations. The analysis in this section shows that from 1966 to 1981, State appropriations increased from 43 to 56 percent of SAES funds for PHTME research, while Federal funds to SAES for PHTME research decreased from 53 to 38 percent.

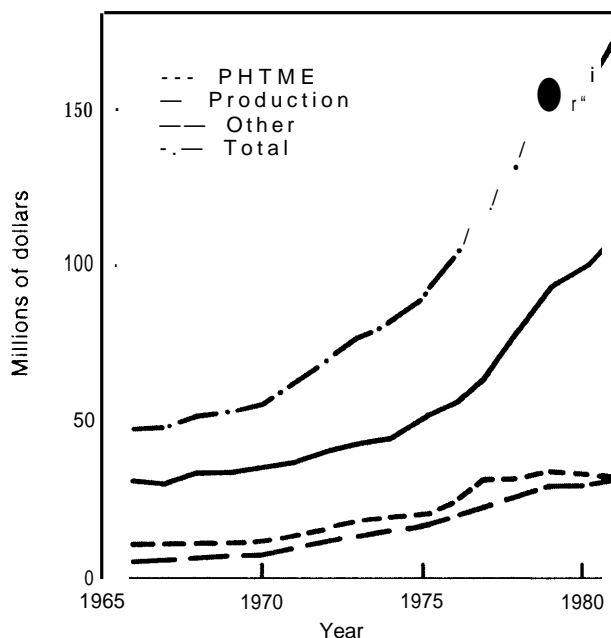
### SAES Expenditures From Federal Funds

#### Hatch Act Funds

Current dollar expenditures on production, PHTME, other, and total agricultural research at SAES and the 1890 land-grant colleges and Tuskegee Institute from Hatch Act or Federal formula funds for the 1966-81 period are presented in figure 14, and constant dollar expenditures are given in figure 15. The total SAES expenditures on agricultural research from Federal formula funds steadily increased in current dollars from about \$48 million in 1966 to nearly \$172 million in 1981, an increase of 258 percent. Constant dollar expenditures varied during the 16-year period, but increased about 22 percent overall.

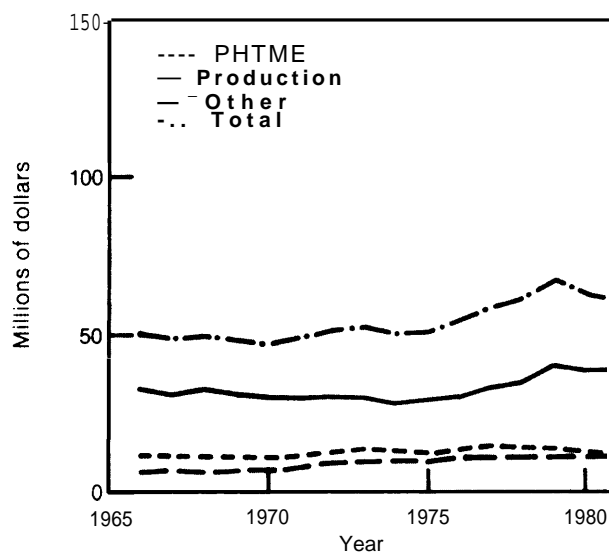
A large part of Federal formula funds (65 percent in 1966 and 1981) were allocated by SAES to production research. Current dollar expenditures on production research from formula funds increased 255 percent from 1966 to 1981, exhibiting a pattern similar to that of expenditures on total agricultural research from these funds. Con-

**Figure 14.—SAES Expenditures From Hatch Act Funds on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)**



SOURCE Office of Technology Assessment

**Figure 15.—SAES Expenditures From Hatch Act Funds on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)**



SOURCE Office of Technology Assessment

stant dollar expenditures on production research from Federal formula funds varied between \$28 million and \$42 million during the 16-year period, and increased 21 percent overall from 1966 to 1981.

SAES expenditures on PHTME research from Federal formula funds increased steadily in current dollars from about \$11 million in 1966 to over \$30 million in 1981, but declined slightly from 1979 to 1981. Overall, the increase in current dollar expenditures on PHTME research from 1966 to 1981 was 181 percent. However, SAES constant dollar expenditures on PHTME research decreased by 4 percent from 1966 to 1981. SAES expenditures on PHTME research accounted for 23 percent of SAES expenditures from Federal formula funds in 1966 and only 18 percent in 1981.

Current dollar expenditures from Federal formula funds on "other" agricultural research steadily increased from 1966 to 1981, declining slightly from 1979 to 1980. The overall increase from 1966 to 1981 was 413 percent. The corresponding in-

crease in constant dollar expenditures was 75 percent. "Other" agricultural research was a relatively small part of SAES expenditures on agricultural research from Federal formula funds, ranging from 12 percent in 1966 to 19 percent in 1977, and then declining to 17 percent in 1981.

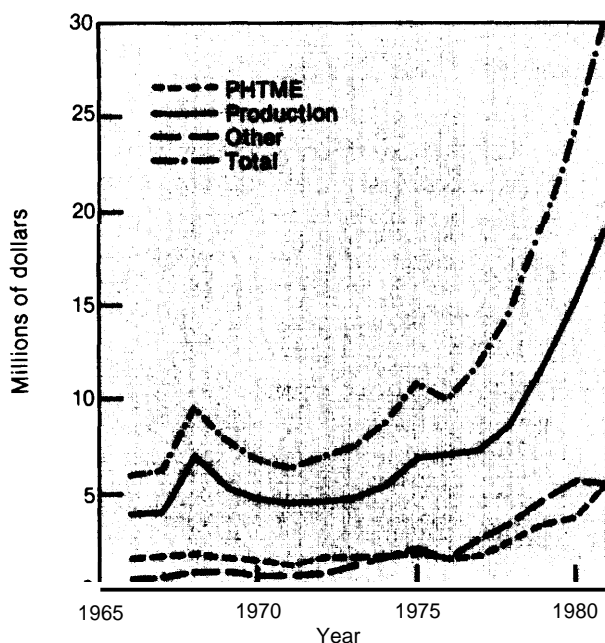
### USDA Cooperative Grants and Agreements

Another Federal source of funding to the States is cooperative grants and agreements with USDA. SAES current dollar expenditures on production, PHTME, other, and total agricultural research from cooperative grants and agreements for the 1966-81 period are presented in figure 16, and constant dollar expenditures are given in figure 17.

From 1966 to 1981, SAES current dollar expenditures on total agricultural research from cooperative grants and agreements increased overall by 396 percent. The corresponding constant dollar expenditures increased 69 percent.

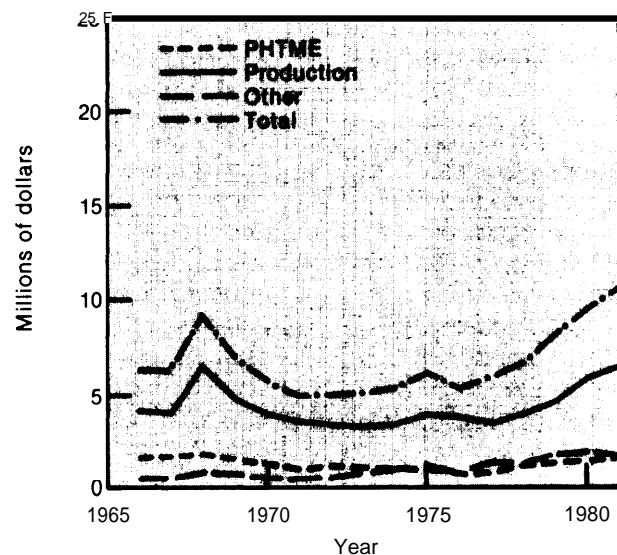
Expenditures on production research were the largest component of SAES expenditures from cooperative grants and agreements. In 1966, expenditures on production research comprised 65 percent of total research funds from cooperative

Figure 16.-SAES Expenditures From Cooperative Grants and Cooperative Agreements on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)



SOURCE: Office of Technology Assessment.

Figure 17.-SAES Expenditures From Cooperative Grants and Cooperative Agreements on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)



SOURCE: Office of Technology Assessment.

grants and agreements, and in 1981, they represented 63 percent. The patterns in SAES expenditures on production research, in current and constant dollars, are similar to those for SAES expenditures on total agricultural research from cooperative grants and agreements. In current dollars, the expenditures on production research increased 381 percent from 1966 to 1981. The corresponding increase in constant dollars was 64 percent.

SAES expenditures on PHTME research from cooperative grants and agreements varied in current dollars during the 1966-81 period, but increased by 251 percent overall. In constant dollars, the expenditures from cooperative grants and agreements on PHTME research increased 14 percent from 1966 to 1981. However, these expenditures decreased by 22 percent between 1966 and 1979. SAES expenditures on PHTME research as a percent of total SAES expenditures on agricultural research from cooperative grants and agreements decreased from 26 percent in 1966 to 18 percent in 1981.

SAES current dollar expenditures from cooperative grants and agreements on "other" agricultural research increased from about \$0.5 million

in 1966 to \$5.5 million in 1981. In constant dollars, this increase was 257 percent. However, other research expenditures have been a small component of total SAES agricultural research expenditures from cooperative grants and agreements and increased from about 9 percent in 1966 to 18 percent in 1981.

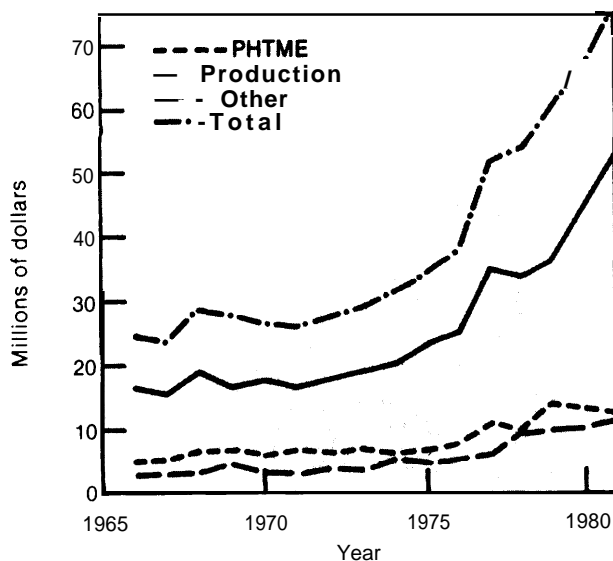
### Other Federal Sources

The other Federal category includes obligations of funds reserved by SAES from contracts, grants, and cooperative agreements with Federal agencies other than USDA. SAES expenditures on production, PHTME, other, and total agricultural research from other Federal sources are presented in current and constant dollars for the 1966-81 period in figures 18 and 19, respectively.

SAES total agricultural research expenditures from other Federal sources exhibited some variation from 1966 to 1981, but current dollar expenditures increased by 217 percent overall. In constant dollars, the total expenditures increased by 8 percent from 1966 to 1981.

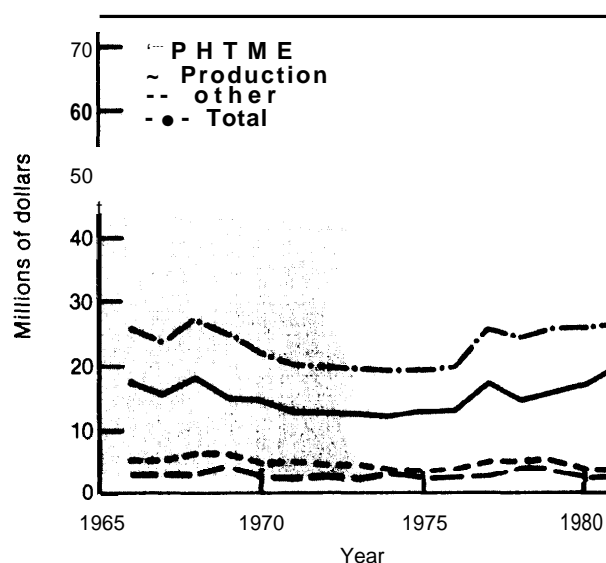
SAES expenditures on production research were the largest component of expenditures from other

**Figure 18.—SAES Expenditures From Other Federal Sources on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)**



SOURCE: Office of Technology Assessment

**Figure 19.—SAES Expenditures From Other Federal Sources on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)**



SOURCE: Office of Technology Assessment

Federal funds during the 1966-81 period. With some minor deviations, these expenditures exhibit patterns in both current and constant dollars that are similar to those exhibited by total agricultural research expenditures. During the 16-year period, expenditures on production research were about two-thirds of the total agricultural research expenditures from other Federal funds. In current dollars, SAES expenditures on production research from other Federal funds increased by 224 percent from 1966 to 1981. In constant dollars, the expenditures on production research increased 11 percent.

SAES expenditures from other Federal sources on PHTME research show some minor variation during the 1966-81 period, but overall the current dollar expenditures increased by 153 percent from 1966 to 1981. In constant dollars, there was a decrease of 14 percent.

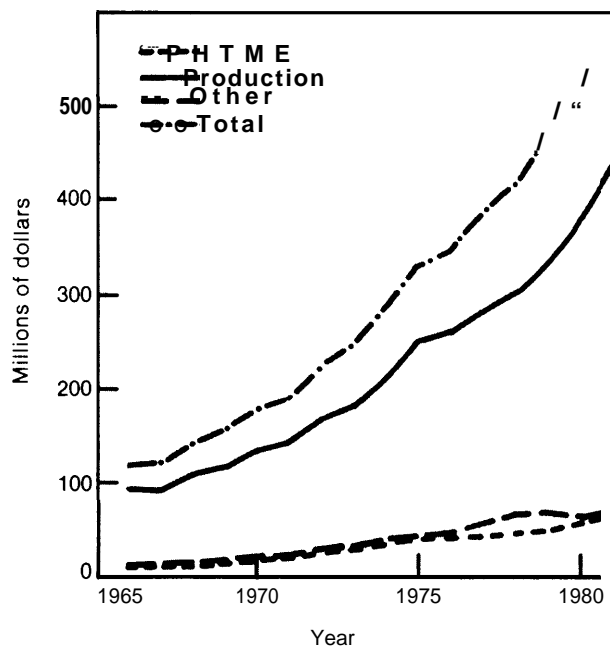
In both current and constant dollars, SAES expenditures from other Federal sources on "other" research increased during the 1966-81 period and

peaked in 1980. In current dollars, the overall increase from 1966 to 1981 was 290 percent, and in constant dollars, the increase was 33 percent. Expenditures on "other" agricultural research as a percent of total SAES expenditures on agricultural research from other Federal sources was about 12 percent during the late 1960's and early to mid-1970's, but increased to a high of 18 percent in 1978, and then declined to slightly under 15 percent in 1981.

## SAES Expenditures From State Appropriations

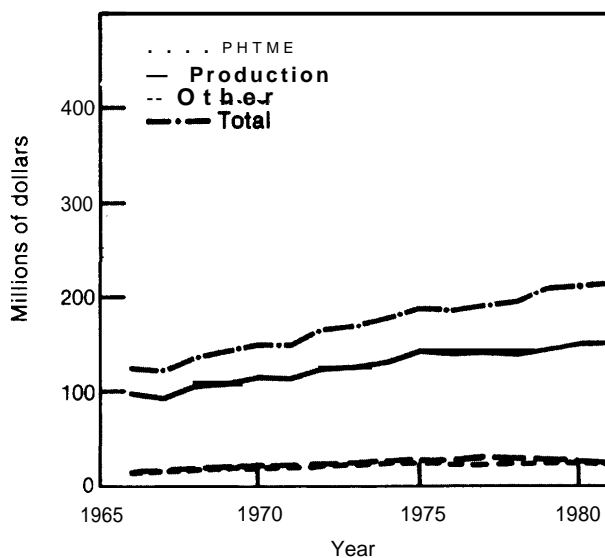
SAES current dollar expenditures on production, PHTME, other, and total agricultural research from State appropriations and sales for the 1966-81 period are presented in figure 20, and constant dollar expenditures are presented in figure 21. SAES current dollar expenditures from State appropriations and sales on total agricultural research increased steadily from \$118 million in 1966 to \$586 million in 1981, which is an increase of 397 percent. The constant dollar expenditures increased fairly steadily from 1966 to 1981, and the overall increase was 70 percent.

**Figure 20.—SAES Expenditures From State Appropriations on Production, PHTME, Other, and Total Agricultural Research, 1966-81**  
(in current dollars)



SOURCE Office of Technology Assessment

**Figure 21.—SAES Expenditures From State Appropriations on Production, PHTME, Other, and Total Agricultural Research, 1966-81**  
(in constant dollars)



SOURCE Office of Technology Assessment.

Expenditures on production research were the largest component of total SAES agricultural research expenditures from State appropriations and sales, and in both current and constant dollars, these expenditures exhibit patterns similar to those for SAES expenditures on all agricultural research. In 1966, expenditures on production research accounted for 78 percent of total SAES agricultural research expenditures from State appropriations and sales, and in 1981, for 75 percent. In current dollars, the expenditures on production research increased by 377 percent from 1966 to 1981. The corresponding increase in constant dollars was 63 percent.

SAES expenditures on PHTME research funded from State appropriations and sales steadily increased in current dollars from \$14 million in 1966 to \$71 million in 1981. The overall increase from 1966 to 1981 was 404 percent. Constant dollar expenditures on PHTME research increased steadily over the 16-year period, and the overall increase from 1966 to 1981 was 72 percent. Throughout the 16-year period, expenditures on PHTME research were about 12 percent of the total SAES agricultural research expenditures from State appropriations and sales.

State appropriations recently have accounted for the bulk of the total SAES expenditures on PHTME research. In 1966, State appropriations accounted for 43 percent of these funds and those of the Federal Government, 53 percent. These proportions gradually changed over the 16-year period, and by 1981, State appropriations accounted for 56 percent of PHTME research funds and those of the Federal Government, 38 percent. This has significant implications on the issue of equity in funding PHTME research, discussed in the next chapter,

The patterns of SAES expenditures on "other" research funded from State appropriations and sales are similar to the patterns for PHTME expenditures, except from 1977 to 1978 when expenditures on "other" research increased nearly \$14 million more than did expenditures on PHTME research. In current dollars, SAES expenditures on other research funded from State appropriations and sales increased 540 percent from 1966 to 1981. The corresponding increase in constant

dollars was about 118 percent. Expenditures on other research were 10 percent of total SAES expenditures on agricultural research funded from State appropriations and sales in 1966 and were 13 percent of these expenditures in 1981.

### **SAES Expenditures From Private Industry Funds**

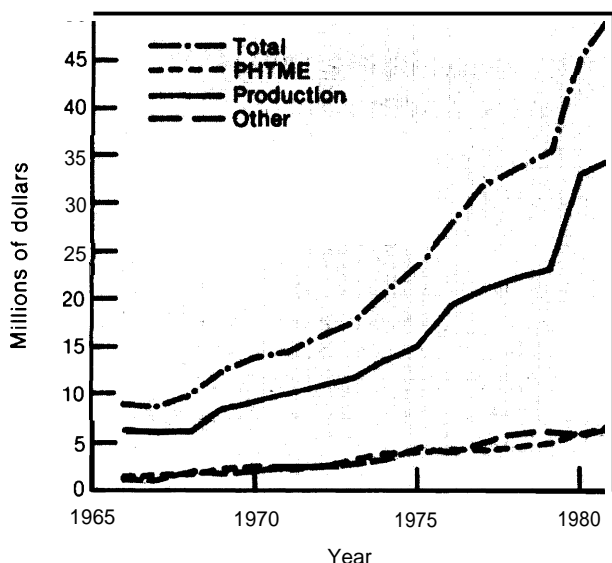
SAES expenditures on production, PHTME, other, and total agricultural research from funds provided by private industry during the 1966-81 period are presented in current dollars in figure 22, and constant dollar expenditures are presented in figure 23. Current dollar expenditures from private industry sources on total agricultural research increased steadily from 1966 to 1981, for an overall percentage increase of 484 percent. The corresponding increase in constant dollars was 99 percent.

Expenditures on production research were the largest component of total SAES agricultural research funds from private industry. Expenditures on production research were 72 percent of total research funds from private industry in 1966 and 69 percent in 1981. From 1966 to 1981, SAES expenditures on production research funded by private industry increased by 464 percent. Constant dollar expenditures increased by 54 percent.

SAES expenditures on PHTME research funded by private industry varied during the 1966-81 period, but current dollar expenditures increased 462 percent overall. In constant dollars, the expenditures on PHTME research increased by 92 percent from 1966 to 1981. Although these percentages are fairly high, the dollar amounts spent were quite small—the largest expenditure during the 16-year period was \$7.7 million for 1981.

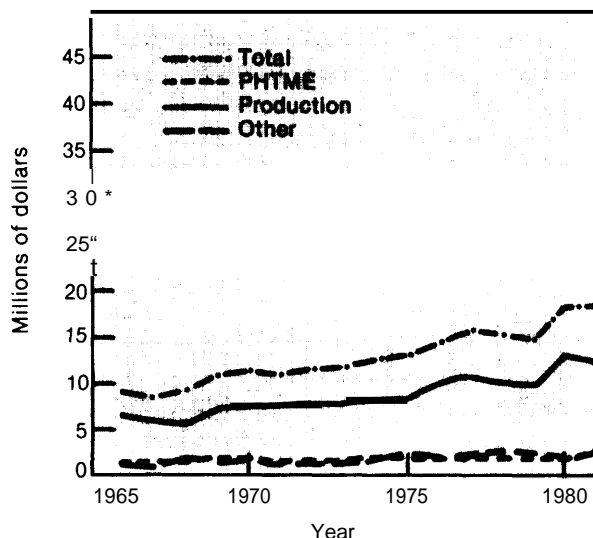
SAES expenditures on "other" research from private industry sources were about the same magnitude as those for PHTME research. From 1966 to 1981, the current dollar expenditures on other research increased 629 percent, while constant dollar expenditures increased by 149 percent. The expenditures on "other" agricultural research were 12 percent of the total SAES agricultural research funds from private industry sources in 1966 and 15 percent in 1981,

Figure 22.—SAES Expenditures From Private Industry Funds on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in current dollars)



SOURCE: Office of Technology Assessment.

Figure 23.—SAES Expenditures From Private Industry Funds on Production, PHTME, Other, and Total Agricultural Research, 1966-81 (in constant dollars)



SOURCE: Office of Technology Assessment.

## PRINCIPAL FINDINGS

- The largest component of USDA research is production research. In 1981, current dollar expenditures on production research totaled \$308.2 million or 64 percent of total USDA research, while current dollar expenditures on PHTME research totaled \$132.2 million or 18 percent of USDA research expenditures.
- In constant dollars, USDA expenditures for PHTME research declined 17 percent from 1966 to 1981.
- Within USDA, PHTME research is conducted chiefly by two agencies: 1) ARS, and 2) ERS. In constant dollars, ARS expenditures on post-harvest technology research declined by 20 percent from 1966 to 1981. The largest component of ERS research expenditures is marketing economics research. However, ERS expenditures on marketing economics research decreased by 10 percent in constant dollars from 1966 to 1981.
- The largest component of SAES research, like USDA research, is production research. In 1981, current dollar expenditures on production research were \$656.4 million or 72 percent of SAES research expenditures, while current dollar expenditures on PHTME research were \$127.3 million or 14 percent of SAES research expenditures.
- In constant dollars, SAES expenditures for PHTME research increased by 32 percent from 1966 to 1981.
- The majority of funds for PHTME research in SAES now come from State appropriations. From 1966 to 1981, State appropriations increased from 43 to 56 percent of SAES funds for PHTME research, while the Federal funds to SAES for PHTME research decreased from 53 to 38 percent.

## CHAPTER 3 REFERENCES

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2. Office of Technology Assessment, *An Assessment of the U.S. Food and Agricultural Research System* (Washington, D. C.: U.S. Congress, December 1981),