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Natural Resources Conservation Service

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NRCS

Plant Materials Program Costs and Benefits 1935 - 2005

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Summary
The Plant Materials Program of the Natural Resources Conservation Service develops plants and technologies for the successful conservation of our nation's natural resources.

An independent economic analysis was made of the program to compare costs and benefits since the program began in 1935.

Current program leaders asked Curtis Sharp, former national program leader for plant materials, to compare costs with measurable ecosystem and economic benefits derived from the program. All comparisons of financial data are stated in 2005 dollars.

Total annual funds appropriated by Congress for operating the program from its beginning in 1935 through 2005 are $468 million. Measured benefits include the net profit realized by commercial growers from production of developed cultivars since 1977, when estimates of profits were available, and ecological service benefits to society since 1977.

The net benefit to commercial producers from 1977 through 2005 was $518 million. Net benefits of plant cultivars for their ecological service value from 1977 through 2005 were $1.19 billion for a total benefit of $1.7 billion.

The ratio of cost to benefit was 1 to 3.65.

The bottom line: benefits outweigh costs by more than 3 to 1.

In the Beginning

The Soil Erosion Service (later the Soil Conservation Service and now the NRCS) was created in the early 1930's to address rampant erosion and unchecked degradation of our soil resources.

Identified tools needed to address this problem included knowledge of soils, engineering designs for conservation practices, and the role, management and availability of vegetation.

Initially, the role, management and availability of vegetation were addressed by establishing and operating large scale seed and plant production nurseries.

As the nurseries became operative, it was soon recognized that plants needed for conservation purposes were drastically different than those used in production agriculture. The challenge was to determine what plants were best suited not only to the varying climates, but for the harsh environment of eroding cotton land, wind ravaged plains, mountains sculptured for mineral removal, or overgrazed and eroding pasture and rangeland.

That knowledge was lacking, adapted plants were lacking, and there was no supply. The concept of actually selecting and reproducing plants just for conservation was a novel one, but had to be accomplished if the massive soil and water loss from abused land was to be reversed.

If vegetation was to play its role in the new conservation ethic, special plants, and large supplies of them, were required.

Experiences soon showed the

demand and need for conservation plant cultivars that grow in unique and difficult environmental conditions were not going to be met by commercial firms or other government programs.

Development costs were high, and demand for conservation plants, compared to agriculture commodities, was limited. This did not diminish the need, but did diminish the likelihood that their profitability would warrant their commercial development.

If they were to be available it fell to the conservation agency to develop them. As a result, observational nurseries became a part of many production nurseries. Plants of unknown potential were observed on and off the nurseries, against commonly available plants. The best became candidates for production by the Federal nurseries and commercial firms.

The four major focus areas of the observational nurseries were:

• identification of plants with great potential for conservation use;

• learn how to re-establish these selected plants on the harshest of sites;

• develop technology for producing large quantities of a selected plant with conservation potential, and

• development of a commercial conservation seed and plant industry, to take these plants and make them available for public use. This was the final– and critical– link in making conservation plants available for general use.

Birth of Plant Materials Centers

The joint production nurseries and observational nurseries partnership continued until 1953, when all production nurseries and many observational nurseries were closed. The need for finding plants for emerging conservation problems had not abated – 12 observational nurseries became plant materials centers. Since then 15 additional PMCs (two are not included in this report) have been authorized, each serving a unique climatic region.

Source of PMC Funding

Federal funds were the primary funding source for observational nurseries and Plant Materials Centers. For purposes of this study, costs are the sum of the annual funds appropriation by Congress for operating what is now the PMC Program from 1935 through 2005. All costs and benefits of the study are based on the 25 NRCS-funded PMCs that had developed products which reached the commercial market during the study period.

'Bromar' mountain brome, selected for superior growth and establishment, and yellow sweetclover were harvested in green manure trials in 1937 at the Pullman Nursery Unit. The nursery later became the Pullman Plant Materials Center near Pullman, Washington.

Costs of the Plant Materials Center Program

The first appropriated funds included in this analysis, for the operation of what later became PMCs, is from 1935, when the Soil Erosion Service moved from the Department of Interior to the Department of Agriculture.

Production nurseries were being established, many evolving an 'observational nursery' component. The amount of funds spent for this purpose at the multiple locations was not separated in those early budgets, and, although some of the observational nurseries became PMCs in 1954, operations budgets were not available until 1965.

Consequently, estimates of funds used by the agency to carry out observational nursery and PMC functions from 1935 through 1965 were made using historical NRCS budget data for the 1935-1965 periods, and the actual amounts appropriated for PMC use for the 1966 through 2005 period.

The total cost for the operation of the PMCs from 1935 through 2005, in 2005 dollars, was $468 million.

To give an indication of relativity, all final comparisons of financial data are presented in 2005 dollars. The Consumer Price Index-All Consumers (1982-84 = 100), was used for dollar comparisons between different years.

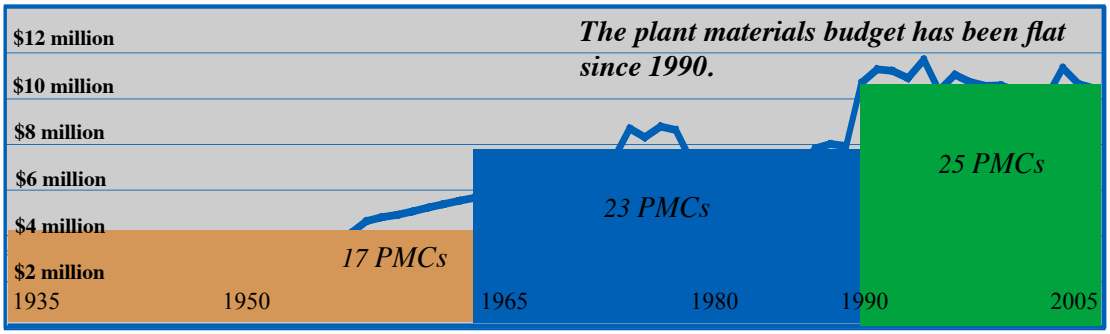
Although some PMCs received funds from non-Federal sources, the vast majority came from Federal appropriations.

However, in the absence of a PMC Program, no funds would have been appropriated, nor would any funds from other sources been available. For these reasons, all costs in this analysis are from Federal funds appropriated for the purpose of operating PMCs.

Year in which Plant Materials Center became operational

State	Year
Arizona	1935
California	1935
Georgia	1935
Idaho	1935
Maryland	1935
Missouri	1935
Kansas	1935
New Mexico	1935
New York	1935
North Dakota	1935
Texas Knox City	1935
Washington	1935
Hawaii	1957
Oregon	1957
Michigan	1958
Montana	1958
Mississippi	1960
Florida	1966
Kentucky	1966
New Jersey	1966
Colorado	1983
Arkansas	1987
Louisiana	1987
Texas East	1990
Texas South	1990

Annual Plant Materials Budget 1935 - 2005 in 2005 dollars



The total cost for operating PMCs from 1935 through 2005, in 2005 dollars, was $468 million. Annual program costs rose through the years as new plant centers were established to test more plants locally. The budget supported 17 PMCs from 1935 to 1965, then 23 PMCs from 1966-1989, and 25 PMCs through 2005. The appropriations peaked at $11.7 million in 1994 but have generally leveled off since 1990.

Net Benefit to Commercial Producers of Plants Developed by the Plant Materials Center Program

Estimates of commercial production of PMC releases by growers are available from 1977 to 2005. This database has the quantity of commercial production for each year, by cultivar and producing state, from 1977 through 2005, as well as the price the producer received for the seed or plants that year.

From this number, the gross value to the grower was determined. The price received each year was indexed to 2005 dollars using the Producer Price Index for Farm products-Hay, Hayseed and Oils. This index more closely represented PMC products than any other indexes.

To determine the net value to producers, production costs were deleted from the gross value. To determine this, each PMC was asked to provide production costs by commercial growers by unit of production, such as price per pound or plant. These production costs were updated to 2005 costs, and deducted from each year's gross production value. From this, the net benefit or loss to the producer was calculated for each cultivar for each year in which there were production data available.

'Selection 75' Kleingrass, released in 1969, was valued at more than $135 million, highest among all releases. It's been established on more than 4 million acres.

Ecosystem Services Benefit of Plants Developed by the Plant Materials Center Program

The services of ecological systems are critical to the functioning of the Earth's life-support system. They contribute to human welfare, both directly and indirectly, by providing goods (such as food) and services (such as erosion control or waste assimilation) to human populations.

Each PMC-developed cultivar should produce some ecological service benefit when established for one or more land uses. The ecological service benefit, as developed by Costanza et al. (1997), is a measure of the value of goods and services produced by ecosystems for human populations, such as regulation of global climate, retention of soil within an ecosystem or that portion of resources extracted from an ecosystem as human food.

For example, if a PMC-developed cultivar for grass/rangeland restoration is successfully established on one acre of land, Costanza et al. (1997) estimated that that acre will result in an ecological benefit to human populations of $117 per acre per year. This is the ecological service benefit for grass/rangeland land use.

Benefits not included

Because of a lack of data, values generated from commercial production of cultivars released and produced from the 1930s through 1976 are not included as a benefit in this study.

Additionally, production data in the analysis include only releases for which NRCS was the principal releasing agency and which are included in the official NRCS listing of released cultivars. This had the effect of deleting the value of the production of approximately 70 cultivars from this analysis, even though one or more PMCs contributed some of the efforts to develop and/or maintain the release.

The benefit comes from the regulation of hydrologic flows, retention of soil within an ecosystem, soil formation processes, recovery and breakdown of nutrients, providing pollinators for the reproduction of plant populations, food production and recreational activities.

Other land uses, such as an acre of tidal wetland, produce $5,033 of ecological service benefit per acre annually, some from the same ecological functions and services as grass/rangeland, plus others such as the recovery of mobile nutrients and the removal and breakdown of excessive nutrients and compounds.

To measure the value of each cultivar, the total number of acre-years of productive life from the 1977-2005 commercial production was determined for each PMC-developed cultivar.

This was done by dividing the typical seeding or planting rate into the total production, which provided the maximum number of acres that could be established from the production.

This figure was then reduced by the anticipated planting failure rate for each release, leaving the number of acres that could be successfully established with the produced plant materials.

The number of acres established was multiplied by the anticipated productive life of a successful planting. This gave a total number of acre-years of productive life for the cultivar. Then, each cultivar was assigned to the land use for which it was most typically used.

The ecological service benefit factor for that land use was multiplied by the acre-years of productive life for each cultivar. This provided the gross ecological service benefit value of that cultivar.

The seeding or planting rates, anticipated planting failure rate, and anticipated productive life data was supplied by the releasing PMC. Although they may not be adapted, plants other than PMC cultivars could be used for the intended conservation purpose.

This was addressed by reducing the ecological service benefit value of each PMC cultivar by 95%, leaving a 5% superiority factor over the anticipated performance of a plant of unknown origin, adaptation or performance.

This is hereafter referred to as the 'PMC Advantage'. This 5% is based on documentation developed for each cultivar at the time of the cultivar's release to commercial growers, as well as numerous other documents and publications about the cultivar.

'Tioga' deertongue, a PMC release, is the only effective native grass for stabilizing soils in the Eastern U.S. with a pH below 4.5.

The superiority of PMC-developed plants over other commercially available plants of unknown origin, adaptation or performance, may be in productivity, forage quality, stabilizing value, speed of spread, increased seed production, heat or cold hardiness, longevity, tolerance to overgrazing, seedling vigor, and adaptation to severe physical conditions, such as salinity, high or low pH or droughty soils.

Alternatively, cultivar superiority may be the result of it being the only one available to meet a specific conservation need.

For example, the characteristics of 'Cape' American beachgrass are such that it dominates the commercial production in its region of adaptation, and 'Tioga' deertongue is the only effective native grass for stabilizing soils in the Eastern U.S. with a pH below 4.5. Other plants are not available to the public to meet conservation needs that these plants fulfill.

The Annual Net Ecological Benefit for a Plant Cultivar

The gross ecological service benefit of a cultivar was derived by:

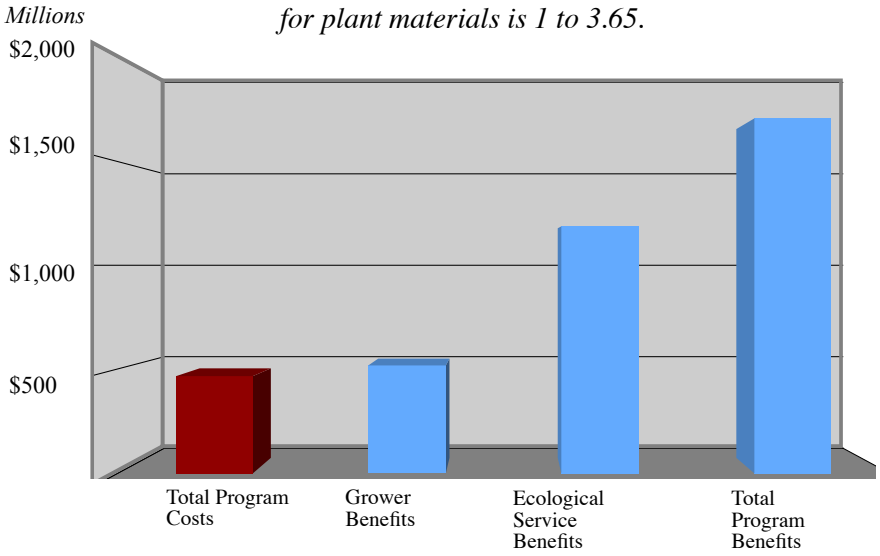
Total commercial production of a PMC cultivar, in pounds
/
Typical seeding rate
x
Anticipated success rate
x
5% (PMC Advantage)
x
Per acre ecological service benefit factor
x
Number of years useful life of planting

This gross ecological service benefit was then reduced by gross per acre establishment costs and annual per acre maintenance costs for the life of planting for PMC Advantage. The result was the net ecological service benefit of a cultivar to human populations.

The ecosystem services benefit was further reduced by subtracting the cost of establishing and maintaining each PMC Advantage acre-year. These costs were determined from a variety of sources, including USDA cost share for conservation practices, state DNR agency figures, private companies and NRCS practice standards.

The sum of this provided the net ecological service benefit of that cultivar. The sum of these provided the net ecological service benefit for the PMC Program.

The ratio of cost to benefit for plant materials is 1 to 3.65.



Costs vs. Benefits of PMCs

The total cost for the operation of the PMCs from 1935 through 2005, in 2005 dollars, was $468 million. Startup costs for the 1935 - 1966 periods, which were minimal, are not included.

Essentially, most PMCs evolved as production nurseries, resulting from the recognition of need, and used existing nursery facilities. When the production nurseries closed in 1953, their facilities simply became PMC facilities.

The net benefit to commercial producers from 1977 through 2005 was $518 million, for a cost to benefit ratio of 1 to 1.11 ($518 million/$468 million), independent of any other value the seed or plants could have produced.

The net ecological service benefit value from 1977 through 2005 commercial production was $1.19 billion. Comparing this to costs from 1935-2005 produced a cost to benefit ratio of 1 to 2.54. The total benefits to producers and to ecosystems are $1.7 billion ($518 million + $1.19 billion), producing a cost to benefit ratio of 1 to 3.65.

Evaluating Methodology for Measuring Benefits

Other approaches considered for measuring consumer benefits of using the PMC-developed plants included placing dollar values on increases in forage production, tons of soil saved or benefits derived from aesthetically stabilized highway slopes or enhanced wildlife habitat.

The absence of a logical methodology or supporting data for these approaches led instead to measuring the value of successfully established PMC products to ecological systems. Costanza et al. gathered information and presented ways of measuring them.

Although limitations to the Costanza et al. methodology may exist, it is both rational and defensible, and represents the best identified approach to assigning dollar values to ecolgical benefit, which is a major outcome from the use of PMC products.

Costs and Benefits of Plant Materials Centers

Measured Benefit	Value	Benefit to cost ratio
Cost of establishing and operating all Plant Materials Centers -1935-2005	$468 million	
Net benefits to producers of all released cultivars for 1977-2005 period	$518 million	1.11
Benefits to ecological systems of successfully established plantings from all released cultivars for the 1977-2005 period	$1.19 billion	2.54
Total benefits to producers and ecological systems from the use of successfully established plantings from all released cultivars for the 1977-2005 period	$1.7 billion	3.65

A Conservative Analysis

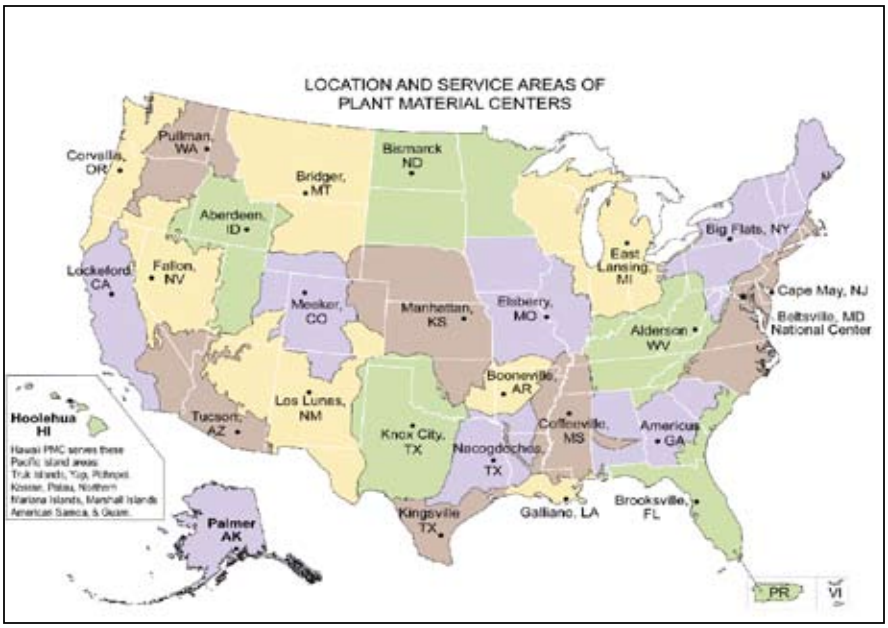
Costanza et al. acknowledged limitations in making ecological benefit estimates, but summarized "most of the problems and uncertainties we encountered indicate that our estimates represent a minimum value."

A good example of this is the underestimating benefits of some plants that were developed for specific conservation jobs but play a much larger role in protecting human developments.

For example, this analysis measures the ecological benefit of vegetating sand dunes along the Atlantic Coast. However, the demand for dune stabilizing plants came not from the need to protect ecological values but to protect the multi-billion dollar housing and tourism industry along the coast.

This analysis showed plants developed exclusively for dune stabilization from one PMC protected 3,127 acres for 15 years, resulting in an ecological service benefit of $255,403. These benefits pale in comparison with the millions of dollars of protection value to beach front home owners, which this analysis did not capture.

Ecologic benefits of 'Cape' American beachgrass pale in comparison to the millions of dollars of protection value to beach front homes.



Background and analysis in appendices

Appendix A- Change in consumer surplus from adoption of conservation-rich cultivars

Appendix B - Benefits of each PMC cultivar, including net producer value, acres established, and ecological value

Appendix C - Ecological benefit function explanations

Appendix D - specific ecological service benefit factors (annual $ per acre) used in this analysis. Updated factors from Costanza et al.1996 values to 2005 dollars.

Appendix E - examples of plant Release Notices archived at the National Plant Materials Center.

For appendices, contact the National PMC at 301-504-8175.

Released in 1944,'Blackwell' switchgrass has produced $44 million in benefits. Of the 28 pre-1954 releases, 17 are still in commercial production – a resounding endorsement of the usefulness of these cultivars.

For more information, visit:
http://Plant-Materials.nrcs.usda.gov

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