Conversion of Noncropland to Cropland: The Prospects, Alternatives, and Implications

by

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A major conclusion of researchers in universities, government, and private research institutes is that the U.S. has adequate agricultural resources to meet and exceed any projected increases in the domestic demand for food and fiber and to provide these goods at reasonable prices. Most researchers would also agree that domestic demand could be accommodated without the conversion of noncropland to cropland and without significant environmental damage. However, the responsibilities of the U.S. agricultural machine have been broadened to include not only U.S. consumers but also the willing and able buyers of the rest of the world. Most of the world export market is currently supplied by the U.S. (Frey and Otte, Heady and Timmons).

Ericksen and Johnson present projections prepared by ESCS analysts which predict an expanding market for U.S. agricultural products. Their supply and demand forecasts indicate that the 1980's will generally be a period of intermittent tight supply which will test the ability of the U.S. to respond to an increase in demand for food and feed grains. The full production potential of U.S. agriculture will be needed to meet the anticipated level of demand.

The potential for increased production depends on the ability to increase yields or to increase the cropland base. Though technological innovations, such as improved varieties, planting rates, fertilizers, and pesticides, have combined to substitute for land to increase yields during much of the twentieth century, continued yield growth is questionable. Yield increases at rates comparable to those of the 1950's and 1960's are not realistic, especially in the face of increased fertilizer, chemical, and irrigation costs, decreasing budgets to support basic research in plant breeding, and more stringent regulations to control the externalities of agricultural production.

Production records through 1978 generally support the hypothesis that growth in yields has plateaued or actually decreased (Crosson). However, Heady recently argued that "when the record yields of 1979 are included, quantitative proof does not yet exist to indicate that U.S. crop yields generally are now plateauing" (Heady, p. 23). If they are not, the question is whether growth in yields will be adequate to compensate for growth in demand.

Should yields continue to increase at the 1972-1978 rate, Crosson estimates an additional 70 million acres above 1977's 331.6 million acres will be required to meet the USDA projected demand for the year 2000 (Crosson, p. 102). This substantial increase in the cropland base must come from lands that have a potential for conversion to cropland rather than cropland held out of production under government programs (Ericksen and Johnson). Though set aside and diverted cropland amounted to 62 million acres in 1972, no land was set aside or diverted from 1974 through 1977. The upgrading of present cropland by drainage, landforming, and irrigation may also provide for increases in production.

Potential for Expansion

Nationwide Potential

The potential of the U.S. to expand its cropland base has been the subject of numerous studies (Amos and Timmons, Cotner et al., Davis, Dideriksen et al., Frey and Otte, Lee, Shulstad et al.). Most researchers have relied on the 1967 National Inventory of Soil and Water Conservation Needs (CNI), the 1975 Potential Cropland Study, or the more recent National Resource Inventory (NRI) to provide base data for their estimates (Cotner et al., Davis, Dideriksen et al., Frey and Otte, Lee. The techniques used in these studies are similar--SCS district conservationists conferred with the local county agent, the Agricultural Stabilization and Conservation Service county manager, and the local Farmers Home administration officer in order to rate each survey point on its potential for conversion.

The Soil Conservation Service 1975 Potential Cropland Study identified 78 million acres of noncropland as having high potential for cropland development and an additional 33 million as having medium potential under 1974 agricultural product-price relationships. Thirty-five million acres of the high potential land was believed to have no limitations to development (Dideriksen et al.). The preliminary results of the NRI indicate that nearly 36 million acres of pasture, range, forest, and other lands has high potential and 91 million acres has medium potential for conversion to cropland under the less favorable 1976 prices and production costs (Brewer and Boxley). It is further estimated that only 2.2 million acres could be converted quickly to crop production without major outlay for soil preparation or water facilities (Ericksen and Johnson).

Lee, in A Perspective on Cropland Availability, expands on the Dideriksen et al. 1975 Potential Cropland Study to provide detailed accounting of convertible cropland by region and the associated limitations to conversion. Major difficulties include erosion hazards, clearing and/or drainage, limited water or fertility, and ownership problems. Lee and others who have published reports on the subject call for additional research into the cost, both public and private, of converting noncropland to cropland and more evaluation of the potential for conversion at various stages in the product-price relationship (Brewer and Boxley, Frey and Otte).

The General Accounting Office in a report to Congress criticized the USDA potential cropland study for failing to consider the current agricultural use of potential cropland and owner preferences. The General Accounting Office recommended that potential cropland estimates be developed in which consideration is given to current land use, production tradeoffs, development problems and costs, and other economic values such as changes in the relationship of production and development costs to commodity prices.

Regional Potential

Regional efforts to quantify the economic feasibility of converting noncropland to cropland are exemplified by studies conducted at Iowa State University and the University of Arkansas. The studies by Amos and Timmons in Iowa and Shulstad, May, and Herrington in Arkansas are part of a larger effort by Resources for the Future to project the potential for acreage expansion, its implication for soybean production, and the possible environmental consequences.

The Iowa and Arkansas studies evaluated the present land use and the opportunity costs associated with conversion, and enumerated the costs of the conversion process including clearing, drainage, land preparation, and maintenance. The gross returns to converted land were compared with the full private costs associated with that land--i.e., the conversion costs, the operation and maintenance costs, and the opportunity costs--to evaluate the feasibility of conversion.

In both studies a land type matrix was constructed where by land is classified by soil productivity class and land use. Productivity classes are aggregations of soil mapping units into groups that are homogeneous in terms of yield, production costs, and management techniques.

The Iowa team used two sets of land use data, the 1967 Conservation Needs Inventory and the 1977 National Erosion Inventory. Those sources could not easily provide data for the Mississippi Delta which is made up of subregions of several states. Therefore a sample of seven counties was selected within Arkansas which is proportionally representative of the Delta soils. Land use data for these counties were obtained from the Resource Information Data System (RIDS) data bank. RIDS is a joint effort of the Soil Conservation Service and the Economic Statistics and Cooperatives Service to identify land use for the center of each square kilometer by field survey. Information is retrieved by soil mapping units and can be aggregated into productivity classes based on the characteristics believed most significant by the researcher.

Conversion costs were obtained from field surveys of commercial land clearers and drainage experts as well as farmers who had recent conversion experience; annual production and maintenance costs were those representative of the study areas. The Iowa study used the USDA production budgets and the Arkansas study used the 1978 Arkansas crop budgets.

Each study considered alternative scenarios to determine the potential for expansion on the extensive margin of production. Product prices were those used in the USDA Grain-Oilseeds and Livestock Model (GOL) and reflected 1985 baseline conditions and 1985 high demand conditions. Under baseline conditions world grain trade prices in real terms are assumed to average closer to the low levels of the 1969/70-1971/72 base period than the high levels of the 1972/73-1974/75 period. Under high demand conditions, real grain prices would be substantially higher than those of the base 1969-72 period but still below the levels of 1972-75.

The scenarios examined in both studies involved 1985 baseline and high demand prices; normal regional yields and yields representing those obtained by the top 10 percent of managers; normal production costs and variable production costs increased by 33 percent; three alternative rates of discount; a 20 year planning horizon; and alternative crop rotations.

Comparison of the Iowa and Arkansas findings shows the economic feasibility of the conversion process to be much more sensitive to changes in price and cost levels in Iowa than in the Mississippi Delta region.

Within the ranges of crop prices, input prices, conversion costs, and yields assumed, the elasticity of supply with respect to crop prices ranged from 6 to 13 in the Iowa study and from 0 to 3.4 in the Mississippi Delta Study.

The elasticity of supply with respect to variable production costs ranged from -4 to -6 in Iowa and from 0 to -2.14 in the Delta.

Under the most optimistic assumptions examined, and under all scenarios assuming high management, all the remaining privately owned woodland and pastureland within the Mississippi Delta region that is not frequently flooded or too steep is economically feasible for conversion. This land amounts to 2.6 million of the 25.36 million acres within the region. Under the most unfavorable assumption the potential for conversion is reduced to 1.38 million acres.

The potential for conversion in Iowa ranges from a high of 3.86 million acres to 50 thousand acres (Amos and Timmons).

Both Iowa and the Mississippi Delta region have potential for significant increases in the cropland base--11 and 10 percent, respectively. Neither region, however, is representative of the potential 37 percent reported at the national level (Brewer and Boxley). Moreover, the results of regional studies must be examined in the context of the nationwide potential for increased production. Major increases in one region could easily be offset by decreases in other regions.

Environmental Effects of Land Conversion

The conversion of noncropland to cropland is analyzed through the comparison of private costs and returns. External costs and benefits are undoubtedly generated in the conversion process, and environmental regulations are now attempting to force the consideration of these costs and benefits by the farmer. An estimate of the external cost of the conversion process was developed in the form of increased soil erosion in tons/acre/year.

Several serious environment consequences result from additional land conversion. One is an increase in soil erosion. Woodland and pastureland are land uses which minimize soil loss. The conversion of woodland and pastureland to cropland will increase soil loss dramatically on those acres. The extent of the increase in soil loss depends on the particular soil group and the crop rotation selected.

Variation in the cost, price, and yield assumptions leads to variation in the crop rotations determined to be optimal for each soil productivity group and has major implications for the resulting erosion. Figure 1 is a plot of the per-acre increases in soil loss caused by conversion of woodland and pastureland in the Mississippi Delta region under conditions of 1985 baseline prices, high yield management, normal production costs, and a discount rate of 10 percent (Shulstad et al.). Per-acre soil loss is plotted against the acreage of soil in each soil group. In all scenarios the first soil group to be converted consists of soils that have moderate permeability, loamy surface texture, and 1 to 3 percent or gently undulating slope. These soils provide the greatest private rate of return to conversion but also have the highest soil loss per acre after conversion. Under most alternative scenarios the soils having slow permeability, loamy surface texture, and 1 to 3 percent or gently undulating slope have the lowest potential for economical conversion. These soils are also very erosive. The remaining soil groups have lower per-acre soil losses after conversion.

If land is converted in descending order of its rate of return, average soil loss will not be related directly to the quantity of land conververted within the Mississippi Delta region.

Both the Mississippi Delta and Iowa studies indicate conversion of noncropland to cropland can be extremely detrimental to environmental quality if effective soil erosion control measures are not used.

Within the Mississippi Delta region, the weighted average increase in per-acre soil loss ranges from 8.47 tons/acre/year with 2.4 million acres converted to 14.06 tons/acre/year with 2.6 million acres converted. Average soil loss for converted acreage in Iowa ranges from 15.4 to 98 tons/acre/year.

Amos and Timmons limited soil loss to no more than 5 tons/acre/year and introduced additional agricultural practices for soil loss control. In a controlled situation the average percentage decrease in potential crop land in Iowa is 44 percent, ranging from 2.1 to 68.3 percent. Gross soil loss is reduced 97.5 percent, ranging from 95.6 percent to 98.6 percent, and net income decreased about 46 percent, ranging from 6.4 to 89.1 percent (p. #143). The average soil loss is generally less than 2 tons/acre/year.

Seitz and his associates at the University of Illinois found it unreasonable for farmers to restrict their production methods in order to decrease soil erosion if their planning horizon is of a normal 20-to 30-year length. This being the case, federal or state programs will be required to change the incentive structure faced by farmers. However, the relationship between erosion and soil productivity remains ill defined. Research is underway to quantify the relationship. An extensive review of this research is provided in a recent SEA white paper.

Another adverse environmental effect of land conversion is an increase in chemical and fertilizer runoff. Table 1 shows the total increase in fertilizer and pesticides applied per year to converted land in the Mississippi Delta. Concern for excessive pesticide concentration in Delta rivers is increasing and state pollution control agencies are attempting to monitor concentration levels. Enforcement of section 208 of PL 92-500 remains tied to voluntary participation with the hope that federal funds will be available to subsidize control mechanisms.

The economic value of the environmental impacts of conversion of non-cropland to cropland has not been quantified. However, institutional changes which force a restriction of soil loss or pesticide runoff will slow the conversion process.

Alternatives to Conversion

Land Forming

Though significant yield increases are not expected to occur at the national level, the potential remains for increased production on the intensive margin within some regions.

The Mississippi Delta study examined the potential for the upgrading of present cropland through land forming as an alternative to land conversion.

Land forming is a process of cutting down high spots and filling in low spots to create a field of uniform shape and slope. The field is first surveyed to determine the areas to be cut, filled, or left alone. Tandem dirt buckets are pulled behind huge tractors to make the cuts and haul the soil to lower areas where it is dumped as smoothly as possible to create roughly the desired slope. When the dirt bucket work is finished a land plane is pulled over the field to smooth the soil to the final grade. Because of the exacting nature of the land forming process, many farmers prefer to hire custom land formers rather than do the work themselves. Only 0-1 percent slopes and gently undulating slopes are considered for land forming.

Land forming is also performed to eliminate old, meandering sloughs and ditches that run through fields. Local soil experts estimate this filling often increases the farmable land area of a field by 10 percent.

The effects of slope creation and field consolidation are immense. Drainage is improved by the elimination of low spots and the creation of better slopes. Yields are improved as a result of better drainage. The acreage of farmable land is increased with the filling of old sloughs and ditches. The efficiency of time, labor, machinery, and chemicals is increased. However, land forming can be radical surgery on some soil groups, especially those having thin top soil. Some cuts may go below the top soil into the subsoil and create spots which yield poorly for a time. The lower areas and filled sloughs and ditches are spongy until the soil settles. For these reasons a period of adjustment is required before most soils reach their pre-land-forming yields. This period varies widely among soils as do the yield reductions in the years immediately following land forming. After this period yields increase over those of nonformed cropland of the same soil group.

Rice rotations are increasingly being used as a follow-up to land forming in the Mississippi/Delta because rice returns higher levels of organic matter to the soil than most other crops and does not undergo the yield reductions associated with other crops.

Land forming does add an extra cost to crop production. The field must be land planed to maintain the desired slope. Most farmers prefer to make two trips over the field yearly with the land plane but time factors sometimes prevent them from doing so.

The acreage of present cropland that could be economically land formed in the Mississippi Delta region is estimated to be 12.6 million acres. The increase in soybean production which could result from land forming in the Delta region ranges from 50 million bushels or 18.5 percent of 1978 production to 58 million bushels or 21.5 percent of 1978 production depending on the scenario examined.

The increase in regional soybean production attainable through land conversion ranges from 26 million bushels or 9.8 percent to 71 million bushels or 26.4 percent.

The conversion of noncropland to cropland and the upgrading of present cropland can be conducted simultaneously. The total increase in soybean production attainable from conversion of new acres and land forming of present cropland in the Mississippi Delta region ranges from 76 million bushels or 28.3 percent of 1978 production to 121 million bushels or 45.0 percent of 1978 production. The low estimate is based on the assumption that all land forming and land conversion is done by average managers. The high estimate is based on the assumption that the conversion is done by the upper 10 percent of managers.

The change is soil loss after land forming was not computed. However, the forming process creates a uniform slope of smaller magnitude than the slope on nonformed land. Thus, land forming decreases soil loss per acre.

Irrigation

Irrigation is another alternative for increasing production on the intensive margin at the regional level. A study of the potential for additional irrigation in the Mississippi Delta region currently underway at the University of Arkansas indicates that soybean yields can be increased from 26 to 71 percent through the economically efficient application of irrigation.

The environmental consequences of irrigation in the region are not well understood, but are believed to be less severe than those associated with gaining an equal increase in production through land conversion.

The potential for productivity gains through irrigation at the national level is much less promising (Heady).

Summary and Implication

The National Agricultural Land Study estimates the U.S. has the potential to increase cropland acreage by 37 percent (Brewer and Boxley). Regional studies in Iowa and the Mississippi Delta project the potential to convert only an additional 10 percent based on 1985 price levels.

The conversion of noncropland to cropland is proceeding rapidly throughout the Mississippi Delta region, time and capital restrictions being the primary limiting factors.

Increases in soybean production as great as 45 percent are economically attainable within the Mississippi Delta region through the simultaneous conversion of noncropland to cropland and the upgrading of present cropland through the process of land forming. Increases in the region's soybean production of up to 21.5 percent can be accomplished through the upgrading of present cropland alone without any environmental damage due to increased soil erosion.

The decision to convert noncropland to cropland has been shown to be sensitive to changes in the levels of conversion costs, yields, and production costs. Thus, regional studies such as those examined here may be needed to predict accurately the rate of conversion and the implications for society.

Agricultural and environmental agency decision makers must examine closely the incentive system now influencing the individual farmer and determine its implications for regional, national, and world communities.

Figure 1. Per-Acre Increases in Soil Loss Resulting from Conversion of Woodland and Pastureland in the Mississippi Delta Region Under Conditions of 1985 Baseline Prices, High Yield Management, Normal Production Costs, and a Discount Rate of 10 Percent

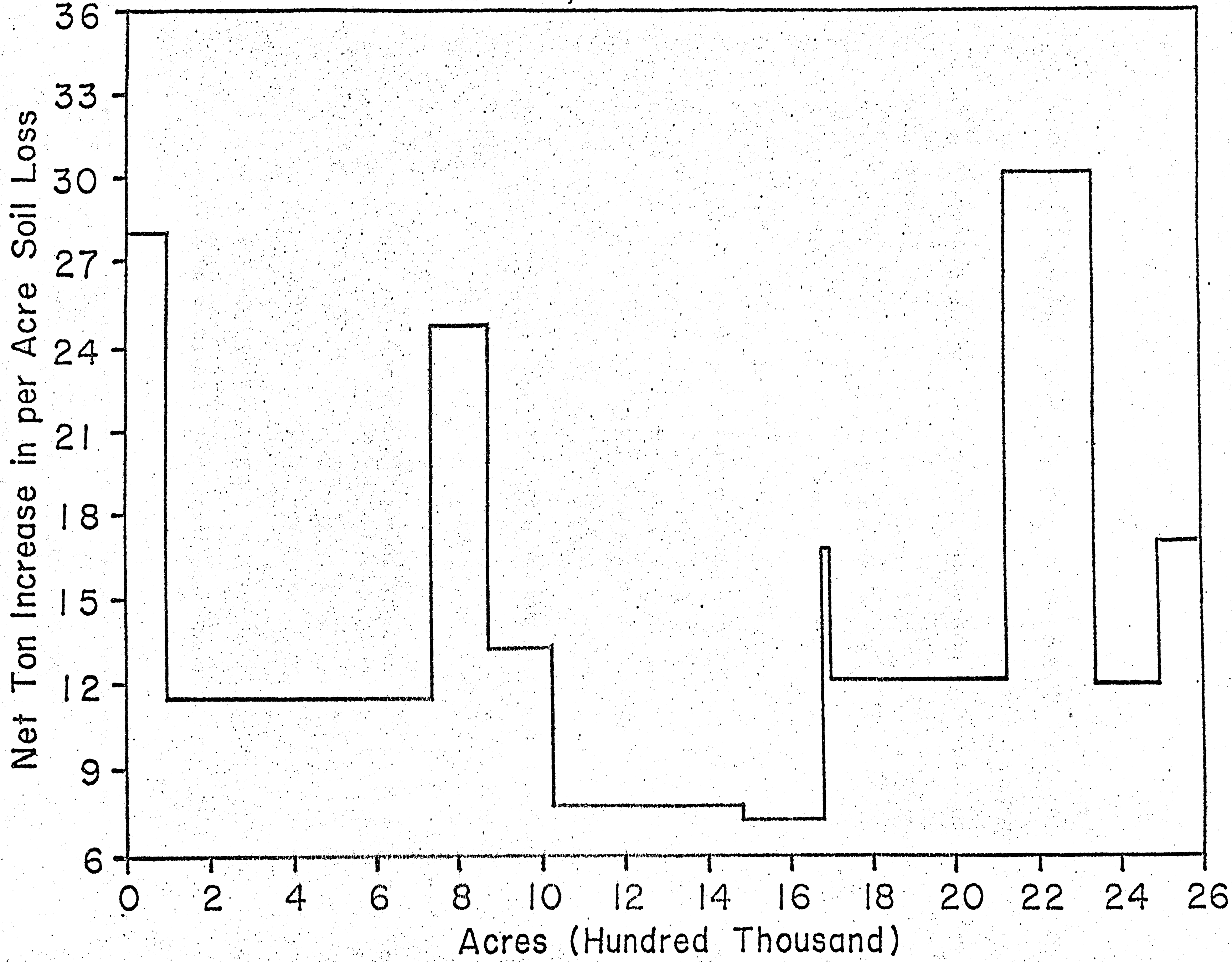

Table 1. Total Increase in Applied Materials on Converted Land per Year: <u>All Crops</u>[a]

2,592,299 Converted Acres in Mississippi Delta Region

Nitrogen	93,772,454 lbs.	(46,886 tons)
Phosphate	44,165,920 lbs.	(22,083 tons)
Potash	87,623,533 lbs.	(43,812 tons)
Treflan	1,613,167 quarts	(403,292 gal.)
Cotoran	758,473 lbs.	379 tons)
Cotoran + MSMA	1,198,091 quarts	(299,523 gal.)
Dinoseb	1,226,290 lbs.	(613 tons)
	365,008 quarts	(91,252 gal.)
Basagran	174,276 quarts	(43,569 gal.)
2,4-DB	463,754 lbs.	(232 tons)
Karmexdl + MSMA x2	214,179 quarts	(53,545 gal.)
Tox + MP	1,960,077 gal.	(1,960,077 gal.)
EPN + MP	84,575 gal.	(84,575 gal.)
Defoliant	1,523,381 pints	(190,443 gal.)

[a]All estimates are based on an average rotation year.

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