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SUSTAINABLE AGRICULTURE POLICY ANALYSES:
SOUTH DAKOTA ON-FARM CASE STUDIES*

by

Thomas L. Dobbs, David L. Becker,
and Donald C. Taylor**

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Introduction

The efficacies of farming systems in the United States (U.S.) are increasingly being judged by both environmental and economic sustainability criteria. Taxpayers are becoming more insistent that agricultural production systems be compatible with environmental goals; the 1985 Food Security Act and the pending 1990 Federal farm bill place environmental constraints on farming practices as conditions for receiving farm program benefits. Farmers themselves are increasingly concerned about the environmental consequences of particular farming practices which have become "conventional" over the past 30 to 40 years. They are concerned about soil erosion, groundwater contamination by pesticides and fertilizers, and possible human health implications of continued use of some chemical pesticides.

At the same time, farmers generally do not want to sacrifice profits in order to meet stricter environmental standards. Thus, the challenge to farmers, researchers, and policy makers is two-fold: (1) to develop farming systems that are sustainable over time both economically for individual farm families and environmentally for society, and (2) to shape public policies which provide economic incentives (or reduce economic disincentives) to farmers to adopt more environmentally sustainable systems.

The purpose of this paper is to present recently completed research results on the effects of various public policies on the relative profitability to farmers of "conventional" and "sustainable" systems. Analyses were conducted with case farms representing different agroclimatic conditions in South Dakota. Conventional case farms use commercial chemical fertilizers and pesticides in amounts typical for their respective areas. Sustainable case farms either eliminate or greatly reduce the use of commercial chemical fertilizers and pesticides; they emphasize crop rotations, legumes, tillage, and cover crops as means of maintaining soil fertility, controlling weeds, and preventing soil erosion.

In this paper, the sustainable agriculture research program at South Dakota State University (SDSU) is first briefly described. The profitabilities of the sustainable and conventional case farms under baseline conditions are then compared. Following that, the policy options considered in our analyses are described. The results of applying those policy options to five pairs of sustainable and conventional farms are presented next. The paper concludes with a general statement regarding public policies relative to sustainable agriculture.

South Dakota Sustainable Agriculture Research

As in the rest of the U.S., sustainability issues are receiving major attention in the northern Great Plains region, including South Dakota. In response to grassroots initiatives of farmers, SDSU began research on sustainable agriculture in 1984. Initial work of plant scientists involved monitoring "conventional" and "sustainable" farmers' fields in an east-central area of the State. Production practices, soil fertility, yields, and other agronomic parameters were measured. Intensive monitoring has continued on one of the conventional farms and on one of the sustainable farms. Agricultural economists have joined plant scientists in data collection and analysis. Results of a 5-year (1985-1989) economic comparison of the two paired farms recently were presented (Dobbs, et al., 1990).

SDSU's sustainable agriculture research was incorporated into experiment station trials at the University's Northeast Research Station, near Watertown, S.D., starting in 1985. Long-term trials comparing various combinations of crop rotations and cultural practices (conventional, reduced tillage, and sustainable) are being carried on at the Northeast Station. Agronomic and economic results of those trials have been published in journal articles and research reports (e.g., Dobbs, et al., 1988; Mends, et al., 1989; Dobbs and Mends, 1990; Rickerl and Smolik, 1990).

The University's sustainable agriculture research program expanded in 1988 to include a broader perspective on sustainable farming practices across the State. A mail survey of known "sustainable" farmers in South Dakota was conducted that year, and the results of that survey were reported in early 1989 (Taylor, et al., 1989b). A grant received in late 1988 from the Northwest Area Foundation (NWAf) in St. Paul, Minnesota allowed SDSU to greatly expand its work with farmers--through follow-up, on-farm interviews with twenty-two of the sustainable farmers who responded to the mail survey. Detailed results of those interviews and subsequent analyses--covering crop and livestock enterprises, relative riskiness of conventional and sustainable farming systems, management strategies, participation in Federal farm programs, attitudes toward farm policy, and profitability of the farmers' systems--are contained in a series of reports (Becker, et al., 1990; Dobbs, et al., 1989; Taylor, et al., 1989a).

A major purpose of the NWAf grant to SDSU is to assess the potential relative profitability of "sustainable" and "conventional" farming systems in different agroclimatic areas of South Dakota and to determine the impacts of various possible public policies on relative profitability of the systems. The implications of public policies--especially Federal farm program policies--for sustainable agriculture have received a great deal of attention in discussion and debate leading up to the 1990 Federal farm bill (e.g., see Benbrook, 1989; Creason and Runge, 1990; National Research Council, 1989; Reichelderfer and Phipps, 1988; Young, 1989). Nevertheless, there remains a dearth of empirical information on how specific policy options would likely affect the relative profitability of sustainable systems in various agroclimatic areas of the U.S. The NWAf supported research at SDSU is intended to help fill this information void for an area of the U.S. northern

Great Plains. (The NWAFF is supporting a similar research effort, under the direction of Doug Young, at Washington State University.)

For purposes of the policy analyses, we have selected five of the twenty-two "sustainable" farms for which on-farm interviews were conducted. These five farms represent sustainable systems in different agroclimatic areas within South Dakota: south-central, east-central, northeast, northwest, and southwest (Figure 1). These five sustainable farms are compared with five "conventional" farms, one of which (in the east-central area) is an actual operating farm and four of which are "synthetic". The east-central conventional and sustainable (actual operating) farms used in the policy analyses are the ones mentioned above (Dobbs, et al., 1990). For other areas of the State, in which we did not have actual operating conventional farms under study as "controls", a variety of information sources was used to construct hypothetical ("synthetic") conventional farms to compare with the actual sustainable farms. Agricultural Census data, Cooperative Extension and Soil Conservation Service reports, and interviews with key informants were among the information sources used (Cole and Dobbs, 1990).

The baseline profitability analyses are conducted by examining the crop systems of the conventional and sustainable farms in whole-farm contexts. Policy analyses are conducted by simulating the effects of changes in policy on profitabilities of conventional and sustainable farms, respectively, relative to the baseline. Except for the conventional farms in the Normal Crop Acreage policy analyses, any acreage adjustments (e.g., in response to more restrictive supply controls) are made within the overall context of each farm's normal crop rotation. Hence, the analyses with each case farm are not meant to constitute "optimizing" adjustments. Rather, comparisons are made between the sustainable and the conventional farms in each area under various policy scenarios.

Baseline Analyses

The conventional and sustainable farms in each region are first compared under a set of "baseline" agronomic and economic conditions. In the baseline analyses, crop rotations, cultural practices, and Federal farm program set-aside requirements represent 1988, the year for which survey data were collected in the on-farm interviews with sustainable farmers. Crop yields are intended to reflect "normal" yields for each type of farm. Crop budgets were estimated for each farm using 1988-89 marketing year crop prices and Federal deficiency payments for program crops which were "expected" going into the 1988 crop year. Since 1988 turned out to be a drought year in much of South Dakota, use of actual yields and prices for that year would have been misleading for baseline analyses.¹

¹The effects of drought and weather variability on the relative profitability of sustainable and conventional farming systems are analyzed in other recent SDSU studies (Dobbs and Mends, 1990; Tiong, 1990).

The baseline analyses were focused on crops--including legumes that were part of rotations--and did not include permanent pasture and value added through livestock enterprises. Findings covering crop and livestock enterprises combined are being reported separately. For the crop enterprises, a whole-farm approach was used in the analyses (Madden and Dobbs, 1990); since the farms compared within each region are not all exactly the same size, however, economic results are presented here on a per acre basis.

Results of the baseline analyses are shown in Table 1. Sustainable farm economic results are shown both without (w/o) and with (w) organic premiums. Except for the south-central region sustainable farm, each of the case sustainable farms included in these comparisons sells some of its crop production in "organic" markets at premium prices. The analyses with organic premiums include approximations of actual premiums received for those portions of crops sold in organic markets by individual farmers. For example, in the case of one farmer, 50 percent of his millet and 30 percent of his buckwheat were valued on the basis of organic sales. Detailed organic marketing assumptions are contained in Becker, et al. (1990).

Direct costs (sometimes referred to as "operating" or as "cash" costs) are lower for the sustainable farms in all cases (Table 1). In most cases, this is due to the types of crop rotations used and to minimal use of chemical fertilizers and pesticides on the sustainable farms. Differences in direct costs are quite small in the western, wheat growing region of South Dakota, however. The semi-arid climate in that part of the State induces even the more conventional farmers to go light on purchased chemical inputs. Moreover, the northwest South Dakota sustainable farmer uses an "organic" fertilizer which adds about \$9/acre to the costs of several of his crops; hence, direct costs are almost as high on the northwest sustainable farm as on the comparison conventional farm.

Gross income on the conventional farms is higher than that for the sustainable farms, especially in the south-central and east-central parts of the State where corn-soybean combinations have generally enjoyed a comparative advantage over other crops. Average precipitation is higher in these corn-soybean areas than in other areas of the State. In the northeast, where spring wheat, other small grains, and row crops are grown, the difference in gross income between the conventional and the sustainable farm is not as great. In the northwest (spring wheat) and southwest (winter wheat) regions of the State, gross income is only slightly higher on the conventional farms. Inclusion of organic premiums on the sustainable farms closes the gross income gap completely in the northwest region and nearly eliminates the gap in the southwest region.

Several measures of net farm income are presented in the last three columns of Table 1. The first measure includes a deduction for all costs (including items like machinery depreciation and interest) except for land, labor, and management. The next measure includes all costs included in the first measure plus a charge for labor that includes operator and family labor used for crop production. A land charge (based on 1988 land market conditions) is included in arriving at the final measure--net income over all

costs except management. The land charge is the same for the conventional and the sustainable farm within each region. Net income over all costs except management constitutes what is often referred to as pure profit or as return to management for planning and risk taking.

For the sake of brevity, we will focus primarily on the net income measure in the last column of Table 1. We can see that the conventional systems are more profitable than the sustainable systems in the south-central and east-central regions, where corn and soybeans comprise major portions of the conventional farming systems. In more extensive analysis of the paired east-central South Dakota farms, the average net income difference over a 5-year period was not nearly as great as that indicated here, and in at least one year the sustainable farm was more profitable than the conventional farm when organic premiums were fully accounted for (Dobbs, et al., 1990).

There appears to be little difference in the profitability of sustainable and conventional farms within the northeast, northwest, and southwest regions of South Dakota. Both the conventional and the sustainable farm do not appear to be fully covering land costs in the northeast region, and both types of farms are failing to fully cover land and labor costs in the northwest region; inclusion of organic premiums does allow the northwest sustainable farm to cover all costs except land. Both of the southwest region farms cover all costs except management and they are of nearly equal profitability; the sustainable farm is slightly more profitable when the organic premiums are included.

Anyone who has dealt extensively with farm management data and has been involved in farm cost and return calculations should be wise enough to be humble about his or her empirical estimates. The "fallacy of misplaced concreteness", which Daly and Cobb (1989) so eloquently discuss in their recent treatise on the shortcomings of conventional economics, immediately comes to mind. We have been extremely careful and thorough in the analyses leading up to the estimates in Table 1 and elsewhere to follow in this paper.² Nevertheless, we fully realize that any set of estimates, including ours, necessarily results in part from numerous simplifying assumptions which are made along the way. Hence, the estimates should be considered "approximations" of relative profitability. They are our best estimates at this point in time; the estimates are likely to change as further analyses are conducted. We should not become overly reliant on the absolute values resulting from this analysis. Rather, it is the emerging patterns of relationships that are important in this stage of the research on sustainable agriculture.

²For details of the procedures and assumptions underlying estimates in Table 1, see Becker, et al. (1990) and Cole and Dobbs (1990).

Policy Options

The implications of four policy options for the relative profitability of conventional and sustainable farming systems are examined in this study. Brief descriptions of these options follow.

One policy option is to further reduce target prices. Under the 1985 Food Security Act, target prices were held constant the first 2 years (1986 and 1987), and then reduced in stages over the next 3 years (1988, 1989, and 1990). Primarily because of strong pressure on the Federal budget, further reductions in target prices during the 1990s have been considered. In the analyses reported in this paper, we have considered a further decrease in target prices--to levels 25 percent below those of 1990.

A second policy option examined is to tax commercial fertilizers and pesticides. This is an environmental policy option, often discussed at State levels, as a possible means to reduce the application of chemical inputs which may threaten groundwater quality. Thus far, taxes of this nature which have been applied, such as that in Iowa (Reichelderfer, 1990), have been set at rates which help raise revenues for monitoring, research, and education on groundwater quality but which are not high enough to significantly discourage use of the chemical inputs. We examined a considerably higher rate, 25 percent of the retail price of commercial fertilizers and pesticides.

Mandatory supply controls constitute a third option which we examined. Mandatory supply controls were strongly advocated by some individuals and groups in the early and mid-1980s, but have not been seriously considered in the final year of debate on the 1990 Federal farm bill. However, every few years, it seems, there is renewed interest in mandatory controls as a means of increasing market prices.

Hertel (1990) provides an excellent review and conceptualization of the forms supply controls might take. The form we have analyzed is a mandatory acreage control program patterned generally after that in Senator Tom Harkin's proposed "Save the Family Farm Act" in 1986. Macroeconomic analyses by Knutson, et al. (1987) provided acreage reduction and related price adjustment parameters which we adapted for our analyses. Minimum price supports, in the form of loan rates, were set at 72 percent of parity in 1990. There are no target prices or deficiency payments under this supply control policy option. Relatively high (33 percent) mandatory acreage set-aside requirements were assumed for program crops, including soybeans, in attempts to raise market prices to support levels.

The final policy option considered in this paper is a Normal Crop Acreage (NCA) proposal incorporating more planting flexibility than has been available in recent Federal farm programs, including the 1985 Food Security Act. The NCA option we analyzed is patterned after that in the Bush Administration's proposal for the 1990 farm bill (U.S.D.A., 1990). (Flexibility provisions in the U.S. House and Senate bills being discussed in September 1990 differ a good deal from those proposed in early 1990 by the Bush Administration.) A normal crop acreage (NCA) for a farm is established

by summing the individual crop acreage bases and historical oilseed (i.e., soybeans, sunflowers, rapeseed, and canola) plantings for the farm. Any combination of program crops and oilseeds may be planted on the NCA. The planting and harvesting of non-program or non-oilseed crops on the NCA results in a reduction in deficiency payments. In our case study NCA calculations, only soybeans was treated as an oilseed crop. (None of our case farms grew sunflowers, rapeseed, or canola.) Set-aside rates and target prices were assumed to be the same as under the 1990 baseline situations.

Results of Policy Analyses

The policy analyses reported in this paper are based on a 1990 baseline, rather than the 1988 baseline comparison contained in Table 1. Enterprise costs, crop rotations, and yields for the conventional and sustainable farms in the 1990 baseline are assumed to be the same as in the 1988 baseline, but acreage set-asides, market prices, target prices, deficiency payments, and loan rates are based on 1990 farm program provisions and projected market conditions. Market prices and deficiency payments in the 1990 baseline are based on Iowa State University-University of Missouri Food and Agricultural Policy Research Institute (FAPRI) data (Center for Agricultural and Rural Development, 1989), with necessary adaptations to South Dakota price levels. Organic premiums received by sustainable farmers are ignored here. Results of the first three policy options, in comparison to this 1990 baseline, are shown in Figures 2 through 6.

Target Price Reduction

A 25 percent reduction in target prices lowers the profitability of all the farming systems (Figures 2-6). Except in the northwest region, the reduction in "net income over all costs except management" is greater in each case for the conventional farm (it is the same for the conventional and the sustainable farm in the northwest region). In absolute terms, the decrease in net income across all five regions averages \$14/acre on the conventional farms and \$8/acre on the sustainable farms. Conventional farms tend to have a higher proportion of their acreage devoted to program crops covered by target prices and resulting deficiency payments; hence, reductions in target prices normally have greater absolute effects on net incomes of the conventional farms than on net incomes of the sustainable farms.

In one of the regions (the northeast), the reduction in target prices shifted the sustainable farm from "less" to "more" profitable (ignoring organic premiums) than the conventional farm. The reduced target prices caused the sustainable farm in another region (the southwest) to shift from "equally" to "more" profitable than the conventional farm. In both of these regions, the conventional and sustainable farms all had negative net income over all costs except management when target prices were reduced (as well as before they were reduced in the northeast region), but the "losses" were greater for the conventional farms.

Tax on Commercial Fertilizers and Pesticides

The sustainable farmers in these case analyses use either no or only limited amounts of commercial fertilizers and herbicides. As indicated previously, the northwest region sustainable farmer does use an organic fertilizer. The south-central region sustainable farmer uses a very small amount of herbicide, as does the east-central sustainable farmer. The conventional farmers, on the other hand, do use a variety of commercial chemical fertilizers and herbicides. Insecticides were assumed not to be used by either the conventional or the sustainable case farmers--in "normal" years represented by the crop budgets. Thus, in effect, the assumed tax is on commercial fertilizers and herbicides.

Imposition of a tax on commercial fertilizers and herbicides--at 25 percent of the retail price--has much more impact on the profitability of the conventional farms than it does on the sustainable farms (Figures 2-6). On average, across all five regions, the tax reduces net income by \$4/acre on the conventional farms, compared to less than 50¢/acre on the sustainable farms. The effects of the tax are greatest on conventional farms in the eastern part of the State, where there are more row crops and growing conditions are conducive to more intensive use of chemicals. Chemical input use is somewhat limited even on conventional farms in South Dakota's western, wheat-growing regions.

In general, a 25 percent tax does not appear to be sufficiently steep to cause farmers to switch from conventional to sustainable systems, except possibly where the systems are almost equally profitable without the tax. This does not rule out the possibility that such a tax might induce conventional farmers to reduce their fertilizer and herbicide application rates, without switching completely over to "sustainable" systems such as those represented by our case farms. However, Reichelderfer (1990) cites evidence to indicate that a tax on chemical inputs would have to be very high to lead to "significant" reductions in fertilizer or pesticide use.

Mandatory Supply Control

The mandatory supply control option involves parity-related crop prices established through loan rates and 33 percent acreage set-asides on traditional "program" crops and on soybeans. These prices are quite high in relation to baseline levels. The 1990 South Dakota supply control market/loan prices, derived from Knutson, et al. (1987), are as follows (the 1990 FAPRI baseline per bushel returns for South Dakota--which include the higher of market prices and loan levels, plus applicable deficiency payments--are shown in parentheses, for comparison): (1) corn, \$4.09/bu. (\$2.65/bu.); (2) soybeans, \$10.09/bu. (\$4.99/bu.); (3) wheat, \$5.77/bu. (\$4.03/bu.); (4) oats, \$2.34/bu. (\$1.68/bu.); (5) barley, \$3.49/bu. (\$2.15/bu.), and (6) grain sorghum, \$3.71/bu. (\$2.33/bu.). The supply control policy option prices exceed "effective" 1990 baseline prices (market or loan prices plus deficiency payments) by magnitudes ranging from 39 percent for oats to 102 percent for soybeans.

Net farm incomes attributable to crops increase greatly on both conventional and sustainable farms as a result of the high crop prices associated with this supply control option (Figures 2-6). Impacts are greatest on the conventional farms, however. Profits increase by an average of \$47/acre on the five conventional farms, compared to \$25/acre on the sustainable farms. In the eastern regions of South Dakota, the profitability advantage held by conventional farms in the baseline scenario is increased by the supply control option. In the western regions of the State, the supply control option causes the conventional systems to move from less profitable (in the northwest) and equally profitable (in the southwest) to more profitable than the sustainable systems. This general pattern of increased relative profitability for the conventional systems is due primarily to the larger proportion of acreage in the conventional systems made up of crops (e.g., corn, soybeans, wheat) for which acreages are greatly restricted and which benefit from the very high support prices. The sustainable systems have larger proportions of other crops, including forage legumes, millet, and buckwheat. It was assumed that prices of the uncontrolled crops do not change under the supply control option. In reality, the prices of at least some of those uncontrolled crops would likely rise, though not by as much as prices of the controlled crops; this could offset some of the profit advantage experienced by conventional systems under the mandatory supply control option.

These case comparison analyses indicate that a mandatory supply control option implemented through acreage controls is likely to favor conventional farming systems in comparison to sustainable farming systems. Others have drawn similar conclusions. Hertel (1990), for example, notes the incentive farmers have to raise yields, by increasing the use of purchased chemical inputs, when planted acreage is restricted. "Output" (as opposed to "acreage") controls, on the other hand, encourage greater use of land, relative to purchased inputs, thereby being more compatible with "lower variable input" agriculture (Hertel, 1990). Thus, there is a probable "yield and input application rate" effect of acreage controls in addition to the "crop mix" effect brought out in our case analyses.

Dobbs, et al. (1988) have pointed out elsewhere that there are circumstances in which acreage set-aside requirements appear to be compatible with, and may encourage, sustainable practices. When non-harvested legumes (such as sweet and red clover), which are part of some sustainable cropping systems, satisfy farm program set-aside requirements, that can sometimes be the case. However, when set-asides are set at levels which induce very high prices for restricted crops, as in the supply control option treated in this paper, the relatively favorable effects for conventional systems are likely to prevail.

Other effects of strong supply control options may preclude their adoption, anyway. Such effects have been analyzed and discussed elsewhere (e.g., Hertel, 1990; Young, et al., 1989). They include adverse effects on export trade and on consumer prices. Also, livestock producers are adversely affected in the short run by the resulting higher feedgrain prices. The net income calculations in our case analyses did not account for that effect on conventional and sustainable farms which have livestock, as well as crops.

Normal Crop Acreage (NCA) Option

The final option analyzed is that of a Normal Crop Acreage (NCA). In actuality, two versions of this option were analyzed. One version was close to that proposed in early 1990 by the Bush Administration (U.S.D.A., 1990). Deficiency payments in that option are based on historical plantings and base yields--i.e., they are essentially "decoupled"--except for deductions based on any planting of harvested non-program or non-oilseed crops on the NCA. In the other NCA version analyzed, we did not make a deduction from deficiency payments for harvested legumes and other non-program crops (such as millet and buckwheat) planted on the NCA base. In both versions, set-aside requirements had to be met, meaning legumes or other crops could not be harvested on the set-aside acres.

In analyzing the effects of an NCA option, we first assumed that the sustainable farms would, in some cases, slightly modify their crop acreage allocations toward their "ideal" rotation. Some sustainable farmers have been compromising their rotations to comply with set-aside requirements and to avoid losing program "base" acres. We wanted to determine the implications of an NCA for their moving completely to the particular rotations they were "trying" to practice (e.g., a soybeans-corn-small grain-alfalfa 4-year rotation, in one case). Next, we assumed that each conventional farm adopted the same "ideal" rotation as the sustainable farm in its region, together with the fertility, weed control, and other cultural practices of the sustainable farm; also, harvested crop yields now were assumed to be the same as for the sustainable farm. Each conventional and sustainable farm kept its own historical acreage base and base yields, however. Thus, the resulting net income, including government payments, for each conventional farm differed somewhat from its matched sustainable farm. For purposes of this paper, we are most interested in the implications of NCA policies for conventional farms which convert to sustainable practices.

Crop prices used in the NCA calculations were developed on the basis of data contained in Westhoff and Stevens (1990). It was assumed that crop prices would differ from those in the 1990 baseline after a period of adjustment. Corn, barley, oats, and grain sorghum prices are higher under the NCA option and wheat and soybean prices are lower. Prices for non-program crops other than soybeans were assumed to be same as in the baseline.

Results of analyses of the two NCA policy options are shown in Figures 7 through 11. To the left in each figure are bars showing 1990 baseline net incomes for each farm. Net incomes for each farm under the "standard" NCA option, when each farm uses "ideal" sustainable rotations (and sustainable cultural practices) but retains its own program payment base, are shown in the center of each figure. On the right in each figure are bars showing each farm's net income with sustainable rotations and practices, again with their own program bases, but with the NCA modified such that there is no payment penalty for harvesting legumes and other non-program crops which are part of the sustainable rotation but which also occupy part of the NCA base. The farm labeled "conventional" in the center and on the right in each figure is actually a "conventional-converted-to-sustainable" farm.

Results of the NCA analyses differ for the south- and east-central regions, compared to the northeast and western regions. In the south- and east-central regions, both sets of farms--the sustainable farms and the conventional-converted-to-sustainable farms--appear worse off under the standard NCA option. For one thing, the farms in these two regions are adversely affected by lower soybean prices, which are assumed to be \$4.29/bu. under the NCA options, compared to \$4.99/bu. in the 1990 baseline. In the NCA options we analyzed, there were no deficiency payments to help offset the lower soybean price. In contrast, though the wheat price also falls under the NCA option, the resulting higher deficiency payments help offset that decline.

Other reasons that net incomes fall for the conventional-converted-to-sustainable farms in the south- and east-central regions are: (1) the conventional farms grow less corn when they switch to the sustainable rotation; (2) corn deficiency payments per bushel of historic base are reduced, because of higher market prices for corn under the NCA; and (3) the east-central conventional-converted-to-sustainable farm grows substantially fewer acres of soybeans and its soybeans now yield less than with conventional practices.

Removing the penalty for harvesting legumes and other non-program crops on NCA base (the second NCA option, on the right side of each of Figures 7-11) does not make any difference in the south-central region, because no such crops are part of the sustainable rotation there. It does make a difference in the east-central region, however, because alfalfa is part of the sustainable rotation there. In the case of the sustainable farm, this latter version of the NCA option allows the sustainable farm to convert to its "ideal" rotation without any loss of net income. Removing the penalty for harvesting legumes on NCA base adds \$8/acre to net income of the conventional-converted-to-sustainable farm, compared to the standard NCA option; however, it still leaves net income of that farm far below its 1990 conventional farm baseline.

The NCA policy options have a somewhat more positive effect on net farm incomes in the northeast, northwest, and southwest regions. In most cases, both the sustainable and the conventional-converted-to-sustainable farms make as much or more income under either of the NCA options as they do under the 1990 baseline scenario. One exception is the northeast conventional-converted-to-sustainable farm, which earns \$5/acre less than the baseline under the standard NCA option. However, when the penalty for harvesting legumes and other non-program crops on NCA base is removed, this farm recoups most of its historically-based deficiency payments and ends up with the same net income (-\$12/acre) as in its 1990 baseline.

Removal of the penalty for harvesting legumes and other non-program crops on NCA base has no effect on the northwest region farms, because green manure sweet clover--rather than a harvested legume like alfalfa--is the key legume in the sustainable system in that region. There is some effect on the southwest conventional-converted-to-sustainable farm by removing this penalty. Since harvested alfalfa, millet, and buckwheat constitute a portion of the sustainable rotation in this region, some historically-based deficiency

payments on that farm are recovered when the modified NCA option, rather than the standard option, is employed.

It was noted earlier in this paper that there seems to be little difference in the profitability of sustainable and conventional farms in the wheat-growing regions of northern and western South Dakota under baseline conditions. Thus, it is not surprising that NCA policy options, particularly ones which avoid government program payment penalties for harvesting legumes and such non-program crops as millet and buckwheat, would appear to provide at least modest encouragement (or at least no discouragement) for farmers to convert from conventional to sustainable systems. A key assumption underlying that conclusion, however, is that the macro effects of NCA policies do not result in significantly adverse effects on the prices of such sustainable system crops as alfalfa hay, millet, and buckwheat. It is concern about just such potential adverse effects that has caused some sustainable agriculture proponents to advocate gradual, phased-in crop planting flexibility. It is hoped that phased-in and perhaps limited flexibility would remove some of the constraints to sustainable rotations without causing rapid expansions in acreages of hay and specialty crops (e.g., millet and buckwheat), which might result in sharp price declines in the markets for those crops.

Research by Young and Painter (1990) also indicates that NCA policies tend to encourage sustainable systems in wheat growing regions, in their case in the Washington-Idaho Palouse region. Their analysis explicitly accounts for the important fact that NCA options protect against erosion of program base when conventional farmers convert to sustainable rotations which incorporate green manure crops.

Conclusions

Sustainable agriculture policy analyses presented in this paper were based upon a set of on-farm case study comparisons of "conventional" and "sustainable" cropping systems. In baseline comparisons with 1988 Federal farm policies in place, case conventional farms in the corn and soybean growing areas of south-central and east-central South Dakota were found to be more profitable than the case sustainable farms. There is little difference in profitability of the case conventional and sustainable cropping systems in the northern and western regions of South Dakota, where wheat takes on greater importance in the crop mix. In fact, when organic premiums are accounted for, the sustainable farms appear to be more profitable (or less unprofitable) than the conventional farms in those wheat areas.

Several policy options were analyzed to determine probable implications for changes in the relative profitability of conventional and sustainable farming systems. Reductions in Federal farm program target prices by 25 percent were found generally to have greater absolute adverse effects on profits of conventional farms than on profits of sustainable farms. However, in the corn-soybean regions of south-central and east-central South Dakota, those profit reductions do not appear sufficient to induce changes from conventional to sustainable farming systems. They do appear sufficient to induce some such changes in the northern and western wheat growing areas.

Similarly, imposing a 25 percent tax on commercial fertilizers and pesticides exhibited greater absolute effects on conventional farms in the corn-soybean regions, but not sufficiently adverse effects to induce conversions from conventional to sustainable systems. Of course, at some level of taxation, such conversions could be expected to take place even in the corn-soybean regions.

Mandatory supply controls implemented through severe restrictions to reduce the planted acreage of "program" crops (including soybeans) were found to favor the conventional farming systems. This is primarily because of the very high prices induced by those restrictions on crops (e.g., corn, soybeans, wheat) which tend to predominate in conventional systems. In principle, one could design a mandatory acreage control program which requires compliance with certain sustainable practices, such as the use of crop rotations which include legumes. We have not explicitly analyzed such a program in this paper, however. Alternatively, taxes on commercial chemical inputs might be used to partially counter the effect mandatory acreage controls tend to have on application rates of those inputs. In any event, for a variety of other policy reasons--including international trade and consumer price considerations--it seems unlikely that we will see a "strong" mandatory supply control option adopted for grains in the U.S. in the near future.³

Normal Crop Acreage (NCA) proposals do offer some promise for encouraging more use of sustainable farming systems. Where conventional corn and soybean production is quite profitable, as it is in parts of eastern South Dakota, NCA options by themselves appear insufficient to induce changeovers from conventional to sustainable cropping systems. In wheat growing areas of northern and western South Dakota, however, where conventional and sustainable systems often may be of near equal profitability, NCA policies could significantly influence conversions from conventional to sustainable systems, particularly if deficiency payments are not reduced for harvesting legumes and other non-program crops on NCA base. For this positive effect on sustainable systems to exist, it may be necessary for NCA policies to be structured and introduced gradually in ways that limit adverse effects on the markets for legumes and other non-program crops which are important in the rotations of existing sustainable farmers.

³See Schnittker (1990) for a good discussion of political prospects for different farm policy options in the U.S.

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Table 1. Baseline (1988) Economic Comparison of Conventional and Sustainable Farms in South Dakota

Farms, by Regional Type	Direct Costs Other Than Labor	Gross Income *	-----Net Income Over-----		
			All Costs Except Land, Labor, and Management	All Costs Except Land and Management	All Costs Except Management
-----\$/Acre-----					
<u>South-central</u>					
Conventional	63	174	77	65	27
Sustainable w/o Organic Premiums	36	129	62	50	12
Sustainable w Organic Premiums	NA	NA	NA	NA	NA
<u>East-central</u>					
Conventional	79	214	106	99	63
Sustainable w/o Organic Premiums	39	129	61	50	14
Sustainable w Organic Premiums	39	134	66	55	19
<u>Northeast</u>					
Conventional	46	96	23	15	-11
Sustainable w/o Organic Premiums	24	64	18	11	-14
Sustainable w Organic Premiums	24	72	27	19	- 6
<u>Northwest</u>					
Conventional	29	50	1	- 6	-21
Sustainable w/o Organic Premiums	27	47	2	- 2	-18
Sustainable w Organic Premiums	27	50	6	1	-14
<u>Southwest</u>					
Conventional	27	78	32	25	8
Sustainable w/o Organic Premiums	23	70	29	23	6
Sustainable w Organic Premiums	23	76	35	29	12

NA = Not Applicable

* For organic premium details, see information for the following farming systems on pp. 77-79 of Becker, et al. (1990): East-central, Rotation H; Northeast, Rotation S; Northwest, Rotation V; and Southwest, Rotation I.

Sources: Becker, et al. (1990) and Cole and Dobbs (1990)

The map displays the following counties and regions:

- Counties:** HARDING, PERKINS, CORSON, CAMPBELL, MC PHERSON, BROWN, MARSHALL, ROBERTS, BUTTE, MEADE, ZIEBACH, DEWEY, WALWORTH, EDMUNDS, DAY, GRANT, LAWRENCE, PENNINGTON, CUSTER, FALL RIVER, SHANNON, BENNETT, TODD, JONES, LYMAN, HUGHES, SULLY, HYDE, HAND, SPINK, CLARK, CODINGTON, DEUEL, BEADLE, KINGSBURY, BROOKINGS, HAakon, STANLEY, BUFFALO, JERAULD, SANBORN, MINER, LAKE, MOODY, BRULE, AURORA, DAVISON, HANSON, MC COOK, MINNEHAHA, GREGORY, DOUGLAS, HUTCHINSON, TURNER, LINCOLN, BON HOMME, YANKTON, CLAY, UNION.
- Regions:** Northwest, Northeast, Southwest, East-central, South-central.
- Shaded Counties:** CORSON, DEUEL, LAKE, HUTCHINSON.

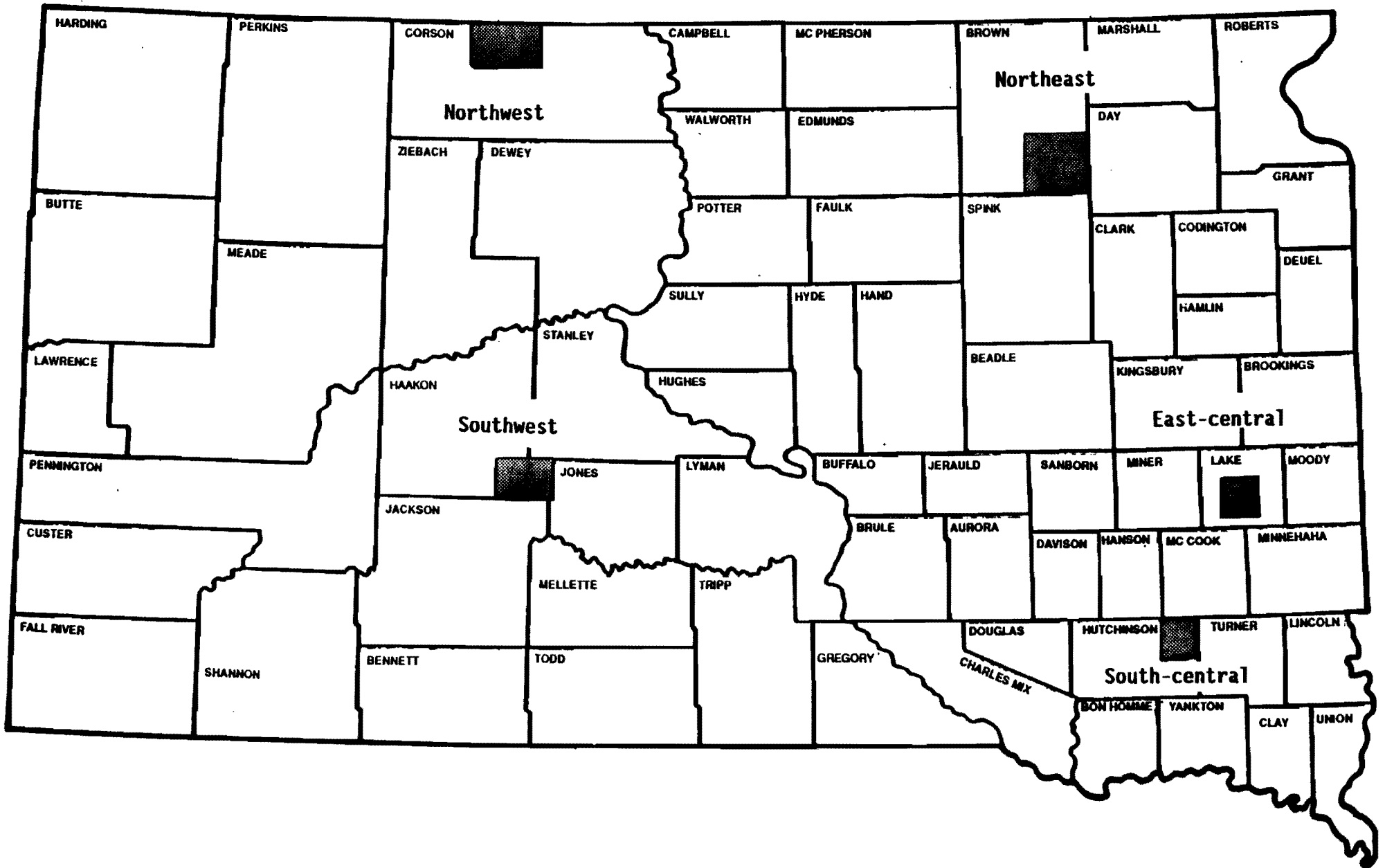


Figure 2. South-central Sustain. & Convent. Farms
Baseline & Policy Analyses, 1990

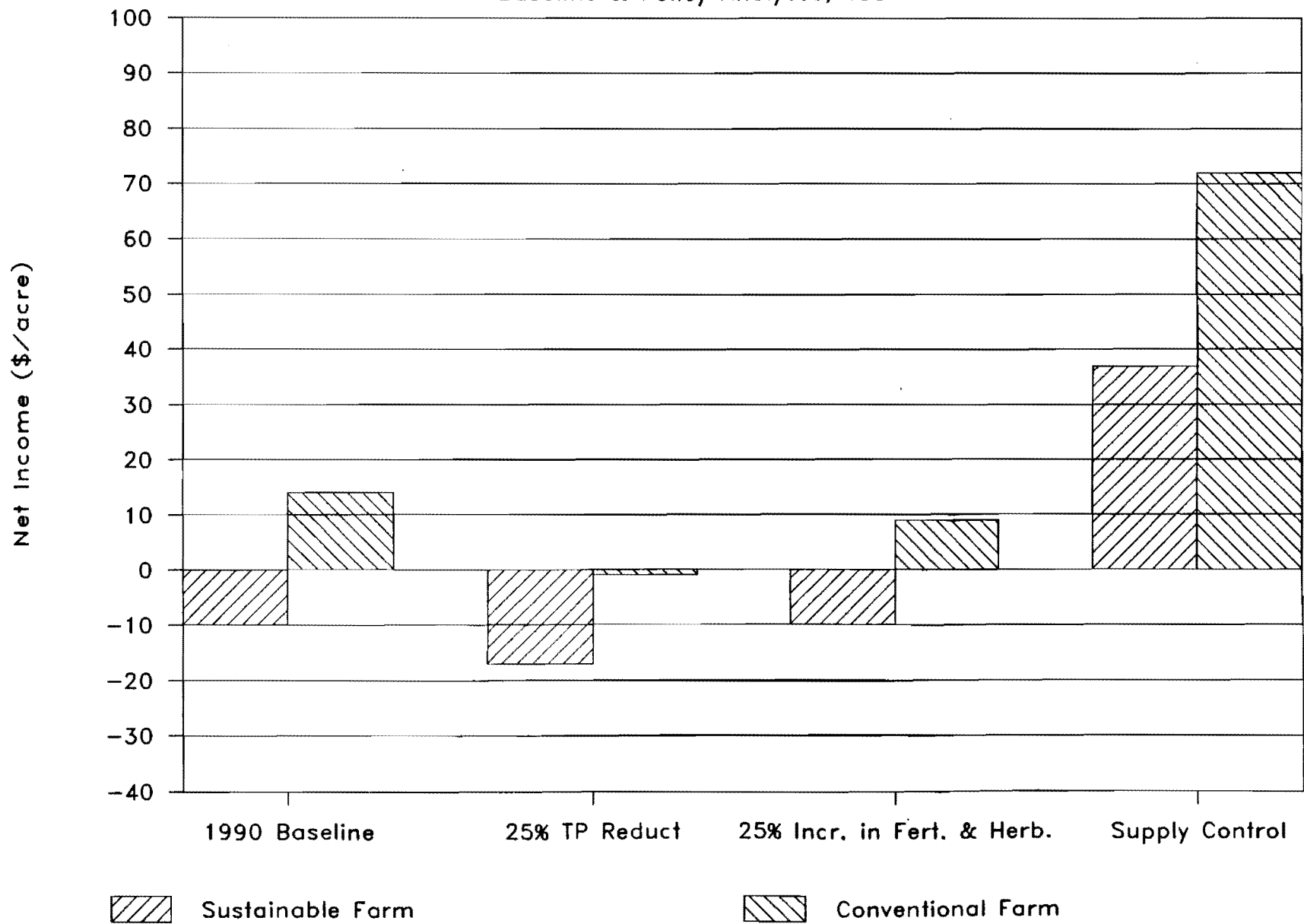


Figure 3. East-central Sustain. & Convent. Farms

Baseline & Policy Analyses, 1990

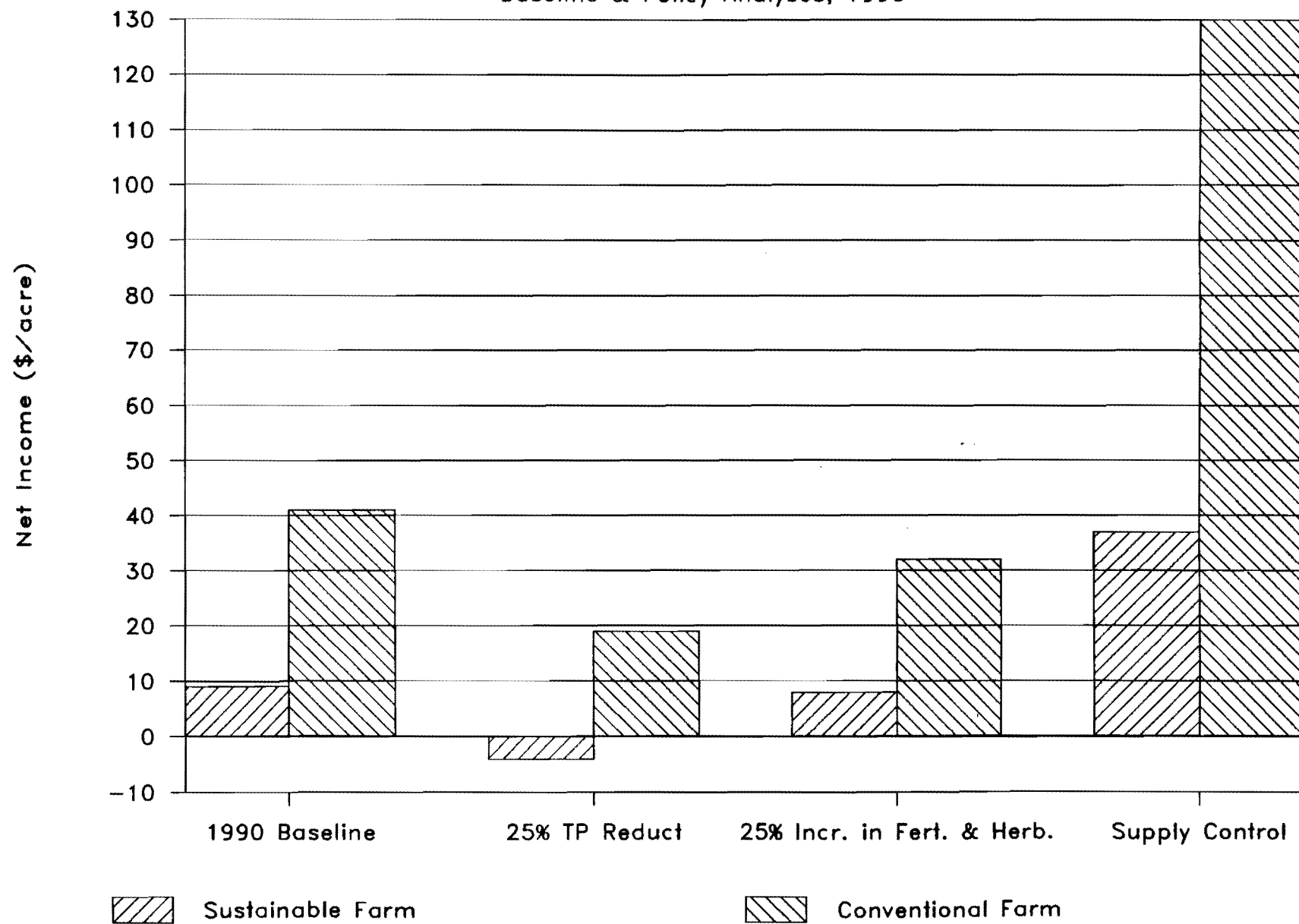


Figure 4. Northeast Sustain. & Convent. Farms

Baseline & Policy Analyses, 1990

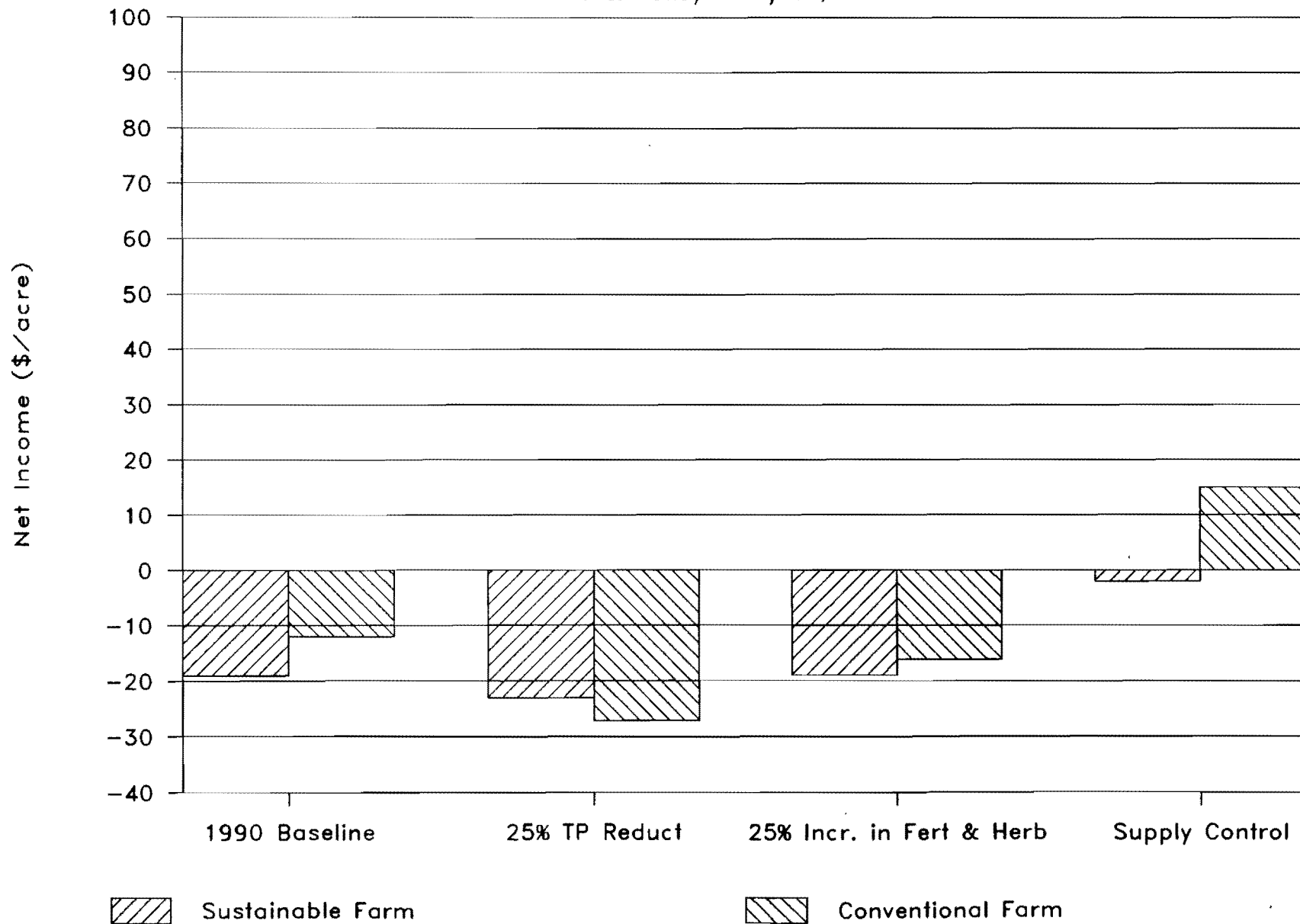


Figure 5. Northwest Sustain. & Convent. Farms

Baseline & Policy Analyses, 1990

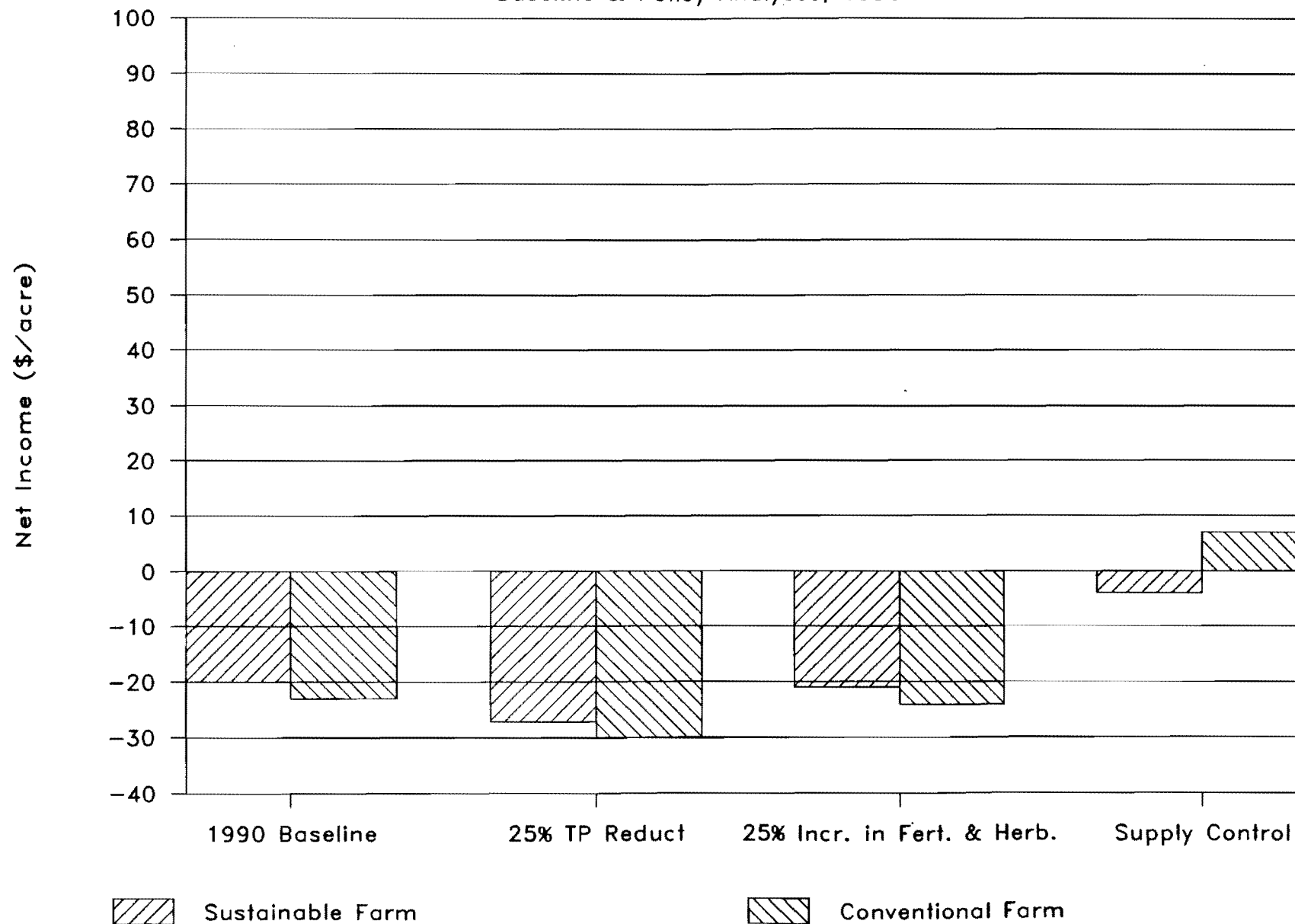


Figure 6. Southwest Sustain. & Convent. Farms

Baseline & Policy Analyses, 1990

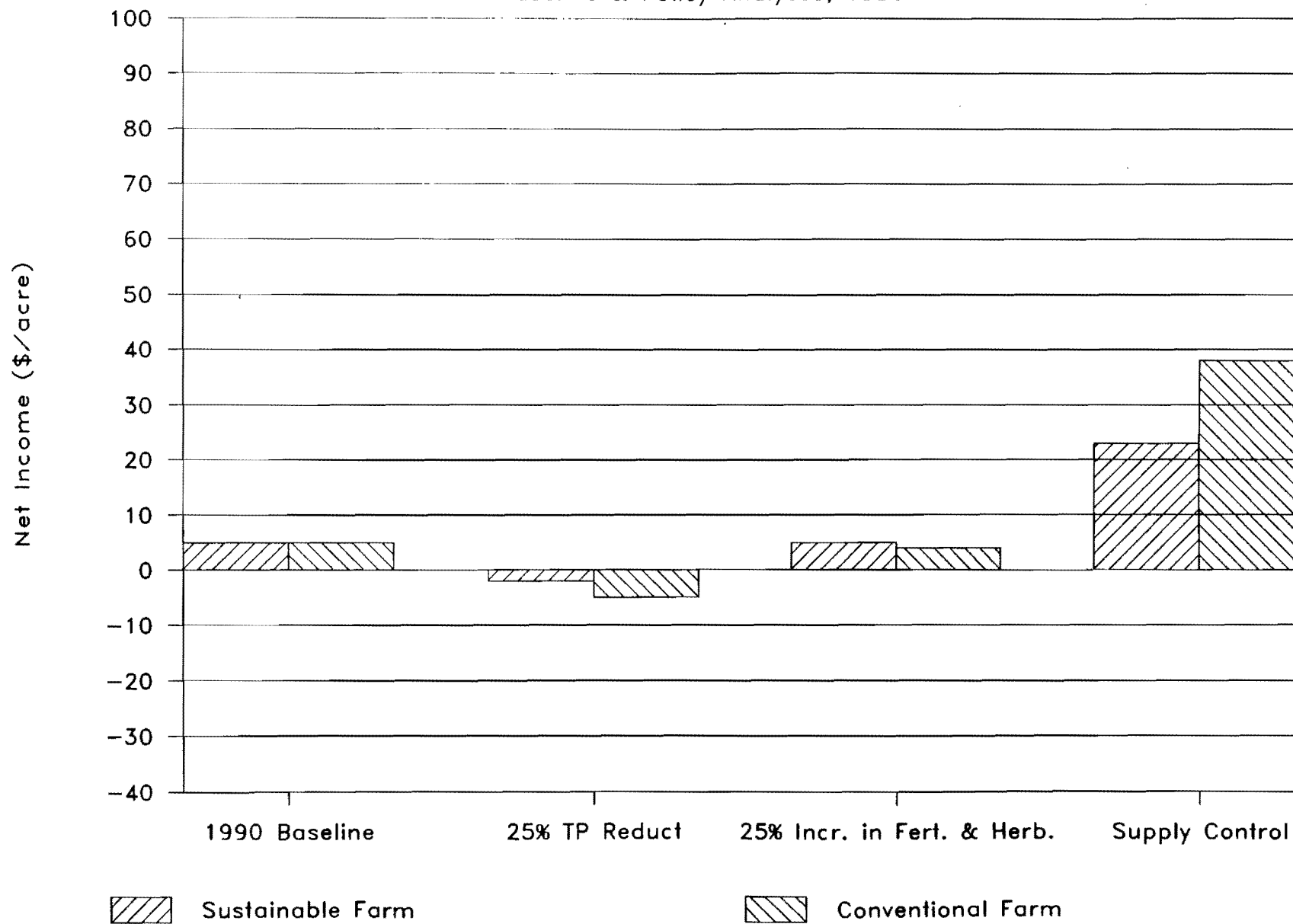


Figure 7. South-central Sustain. & Convent. Farms

Baseline & NCA Analyses, 1990

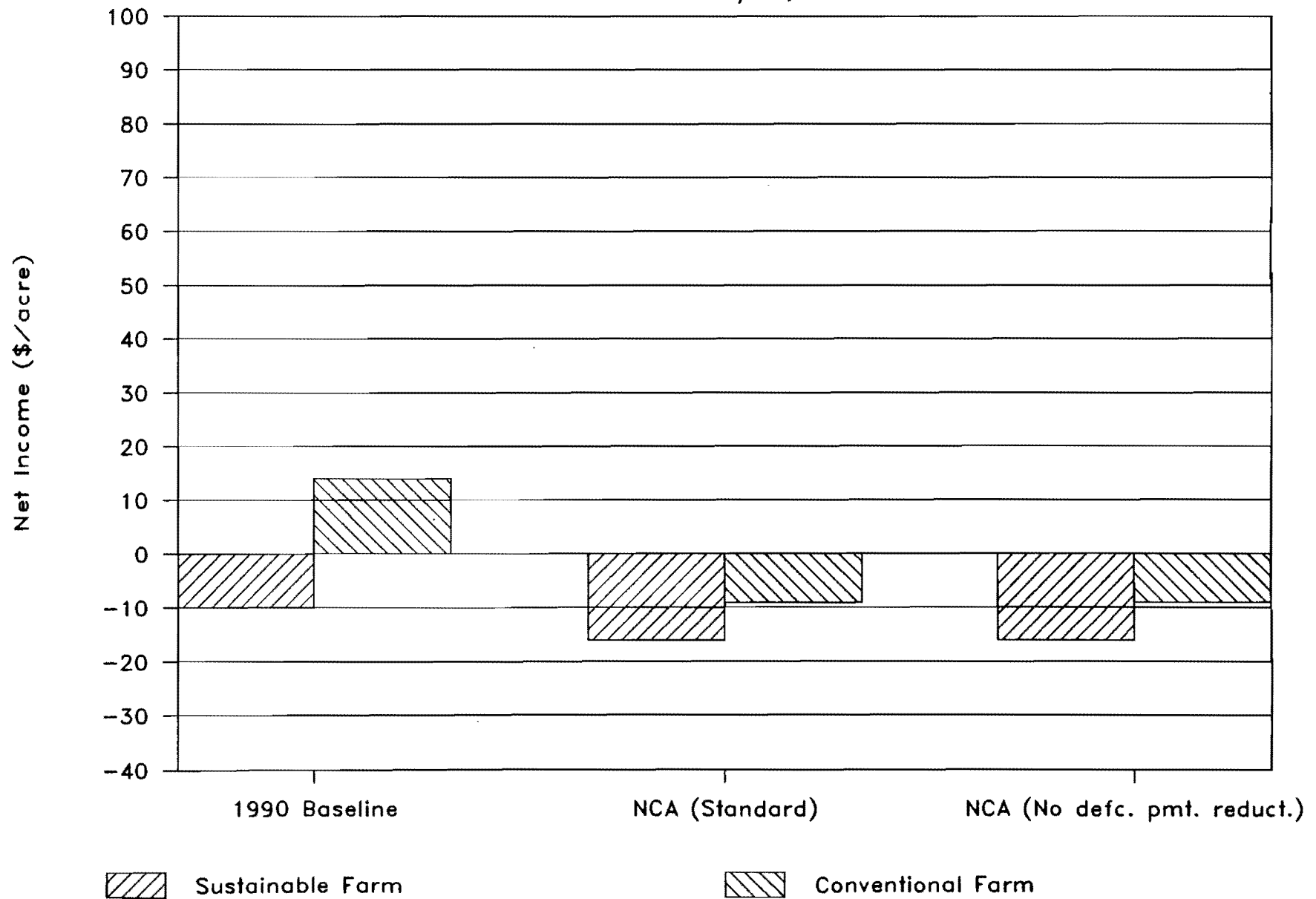


Figure 8. East-central Sustain. & Convent. Farms

Baseline & NCA Analyses, 1990

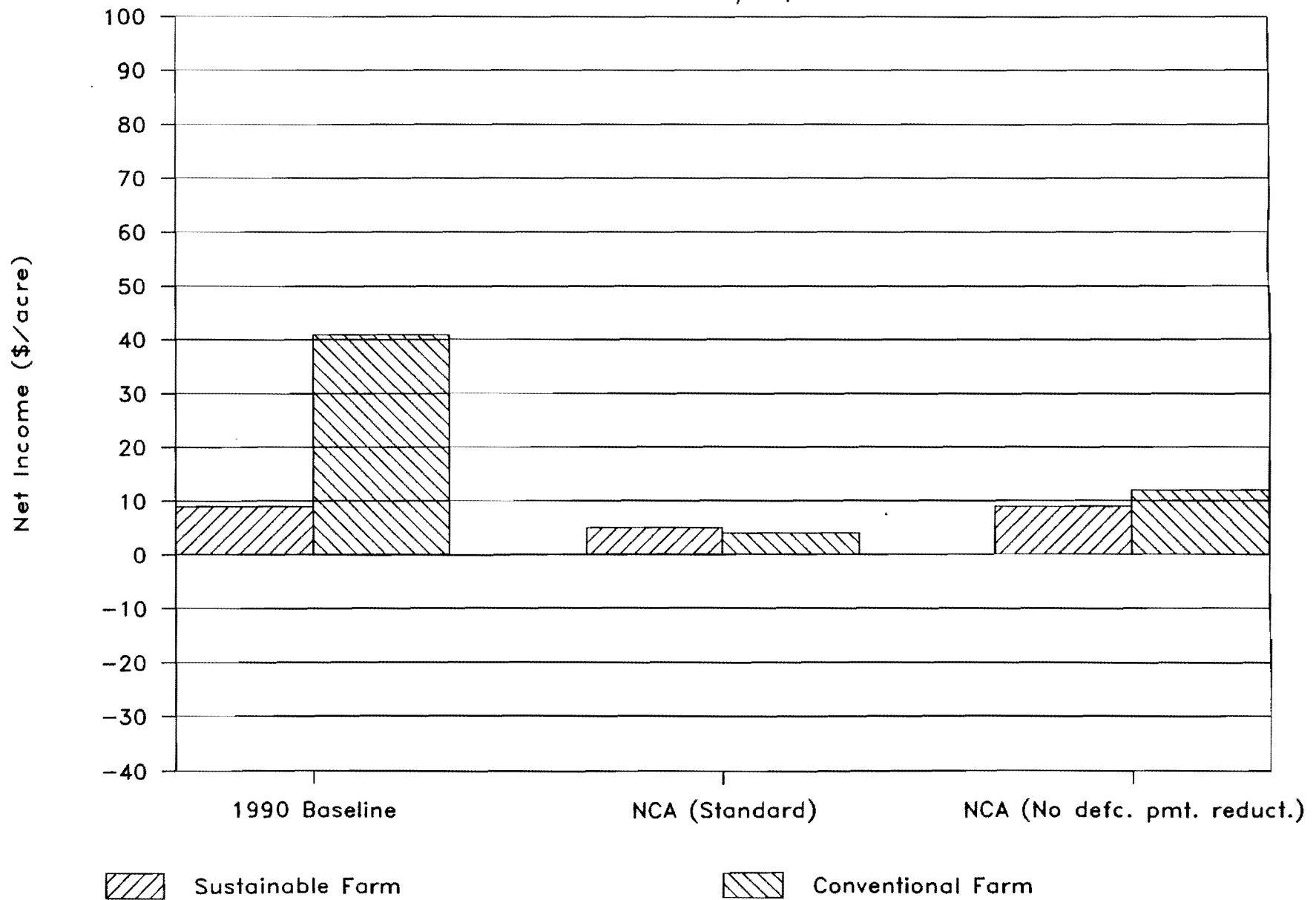


Figure 9. Northeast Sustain. & Convent. Farms

Baseline & NCA Analyses, 1990

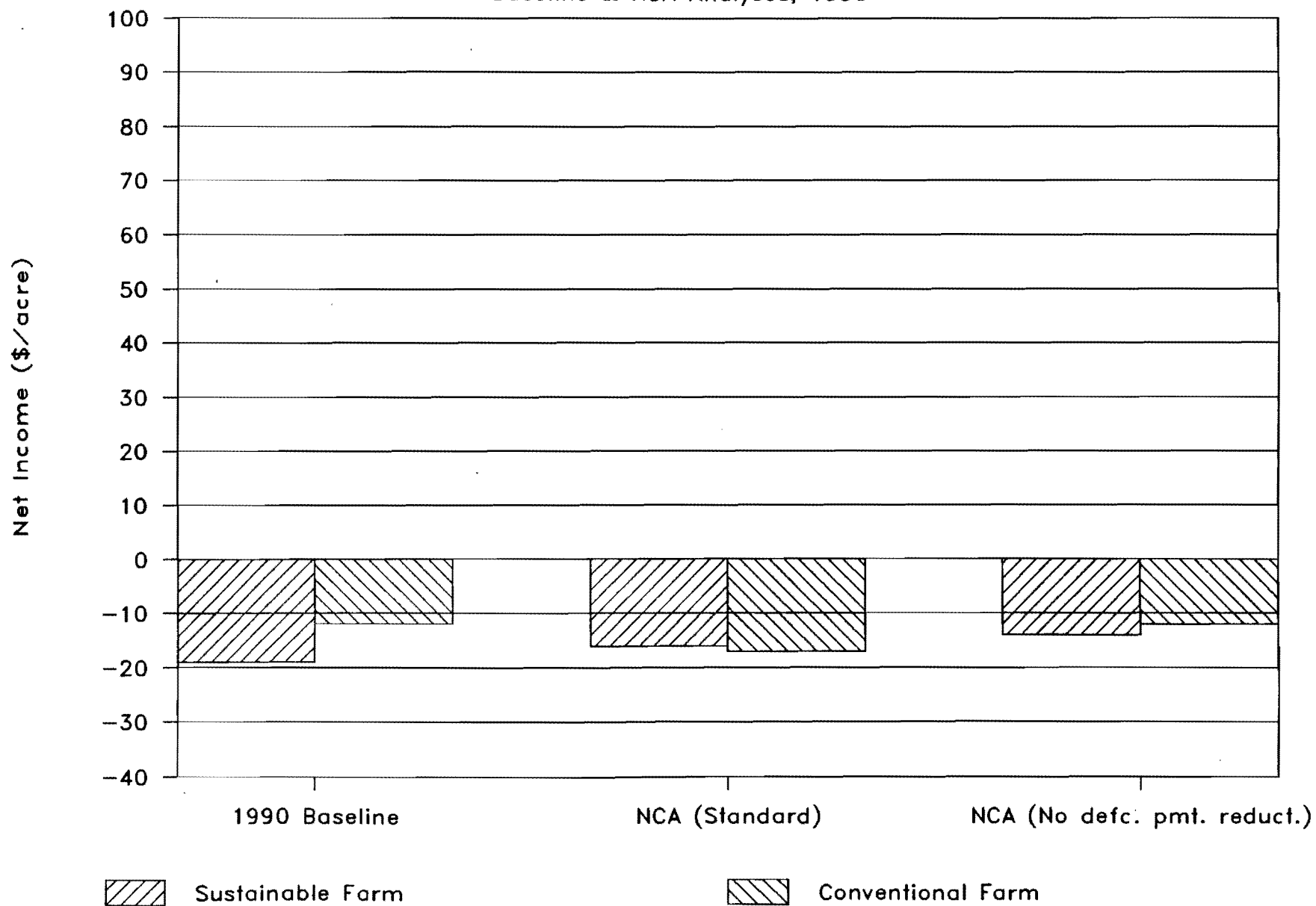


Figure 10.

Northwest Sustain. & Convent. Farms

Baseline & NCA Analyses, 1990

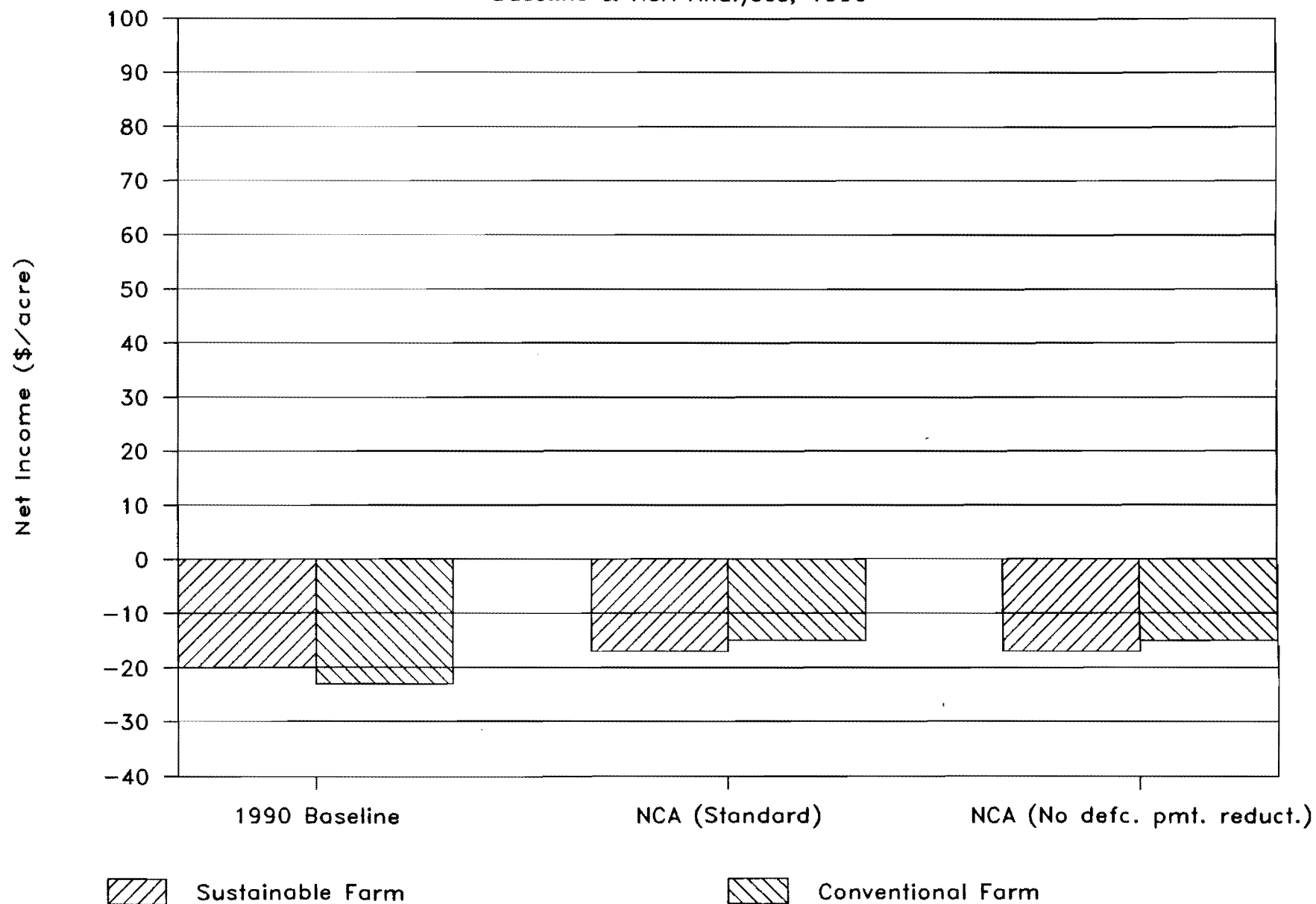


Figure 11. Southwest Sustain. & Convent. Farms

Baseline & NCA Analyses, 1990

