

TABLE 11.2. The calculation of the derived gross benefits attributable to the Puebla Project, associated costs, derived net benefits, and present value of net benefits for seven years of operation of the project.

Year	Average yield* of all farmers in the area kg/ha	Average yield of farmers in credit lists kg/ha	Average yield of farmers not on credit lists** kg/ha	Change in yield of farmers not on credit lists (%compared to 1968)	Change in yield attributable to climate (%compared to 1968)	Change in yield attributable to the Puebla Project (%compared to 1968)	Increase in yield attributable to the Puebla Proj. kg/ha	Area of maize farmers not on credit lists ha	Increase in production attributable indirectly to the Puebla Project kg	Derived gross benefits + \$	Associated costs ** \$	Derived net benefits \$	Present value of net benefits° 1967 ** \$
1967	1300		1300					80,000	0	0	0	0	0
1968	2091	3894	2089	base	base			79,924	0	0	0	0	0
1969	1790	2765	1713	-18.0	-18.0	0	0	74,162	0	0	0	0	0
1970	1917	2670	1776	-15.0	-15.0	0	0	67,399	0	0	0	0	0
1971	1883	2618	1721	-17.6	-21.0	+ 3.4	71	65,562	4,654,902	350,049	321,516	28,533	14,716
1972	2499	2920	2381	+11.3	- 6.0	+17.3	370	62,467	23,112,790	1,738,082	522,724	1,215,358	534,510
1973**	2499	2920	2353	+ 9.2	- 6.0	+15.2	325	59,396	19,303,700	1,853,155	497,026	1,356,129	484,210
													Total 1,033,436

* All yields in the table are with 12% moisture for 1967-1971 and 14% moisture for 1972-1973. (See footnote, Table 11.1).

** The average yield of farmers not on credit lists was calculated using the following relationship:

$$\text{Average yield of all farmers} = \left(\frac{\text{hectares of farmers on credit lists}}{80,000} \right) (\text{average yield of farmers on credit lists}) + \left(\frac{80,000 - \text{hectares of farmers on credit lists}}{80,000} \right) (\text{average yield of farmers not on credit lists}).$$

+ A price of \$75.20 per ton was used for the years 1968-1972 and \$ 96.00 per ton for 1973.

+ + Assuming zero labor costs.

° See footnote, Table 11.1.

°° Yields for 1973 were estimated in September, just prior to harvest.

$$\text{Benefit: cost ratio including derived benefits: } \frac{B}{C} = \frac{1,765,586 + 1,033,436}{695,014} = 4.03.$$

Table 11.2, shows that the first step in estimating the derived gross benefits was to calculate the average yields of farmers not on credit lists. The following relationship was used for this calculation:

Average yield of all farmers =

$$\left(\frac{\text{Hectares of farmers on credit lists}}{80,000} \right) \left(\text{Average yield of farmers on credit lists} \right) + \left(\frac{80,000 - \text{hectares of farmers on credit lists}}{80,000} \right) \left(\text{Average yield of farmers not on credit lists} \right)$$

It was assumed that the total harvested area of maize in the Project area was 80,000 ha.

The average yields of farmers not on credit lists, calculated according to the above relationship, are shown in Table 11.2. The differences between the average yields of farmers not on credit lists in 1968 and such yields in the following years are shown as percentages in Table 11.2. These values estimate the changes in yield due to climate and the use of the new technology. These values, less the changes in yield due to climate (Table 9.9, column b), represent the changes in yield attributable to the Project, expressed as percentages.¹ These percentages were multiplied by the average yield of farmers not on credit lists in 1968 to obtain the increases in kg/ha attributable to the Project. Increases in yield were multiplied by the number of hectares of maize corresponding to farmers not on credit lists to obtain the annual increases in production. Increases

1. The decrease in nitrogen prices by about 14 percent at the national level in 1971 may have contributed to an increase in fertilizer use, and, in turn, in maize yields. The effective decrease in nitrogen prices at the local level was less than 14 percent, due to shortages of fertilizer at periods of peak demand and, consequently, increases in prices by local distributors.

in production, expressed as tons, were multiplied by the price of maize to obtain the derived gross benefits.

Associated Costs

The associated costs are the costs of fertilizers, transportation, interest, crop insurance, and labor in excess of those incurred by farmers using the traditional technology. It was recognized that the use of the recommended technology requires a more intensive use of farm implements and work animals than the traditional technology, but these increases were considered negligible. Labor requirements calculated in Table 10.3 show that the recommended technology requires some 12.1 man-days per hectare more than the traditional technology. Several alternative assumptions can be made to calculate the associated cost of this increased labor requirement.

Alternative 1 assumes that there is excess rural labor in the area. In this case, there is no associated cost to increased labor requirements.

Alternative 2 assumes that there is seasonal unemployment in the area, but that labor is fully employed at harvest time in cutting and shocking the stalks and shucking the ears. This assumption is consistent with the remark (footnote 5, Chapter 10) that labor scarcities occur at specific times of the year. In this case, hired labor must be found for these activities that imply 5.3 man-days per hectare more than with the traditional technology. Following Cano and Winkelmann², the daily wage of hired labor can be set at \$1.28.

In Alternative 3, an opportunity cost is charged for family labor so that all 12.1 additional man-days per hectare are accounted for in the associated costs. Again following Cano and Winkelmann, a reservation price can be assumed for family labor at half the wage of hired labor.

2. J. Cano and D. Winkelmann, "Plan Puebla: Análisis de Beneficios y Costos," *El Trimestre Económico*, Vol. XXXIX (4). No. 156, pp. 783-796, 1972.