THE ECONOMICS OF BOLIVIAN SELF-SUFFICIENCY IN WHEAT PRODUCTION*

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INTRODUCTION

The primary purpose of this paper is to provide estimates of the government subsidy that would have to be paid to wheat producers if Bolivia is to reach self-sufficiency in wheat. These estimates are then utilized in a producer's surplus analysis to determine whether or not such a policy would enhance the economic welfare of the country.

Bolivia has a chronic deficit in wheat production. Imports composed about 80 percent of consumption in 1971, the last year of our data series (Table 1). Domestic production in 1971 was roughly the same as 14 years earlier, while imports have steadily increased. A linear regression of imports on time revealed an annual increment of imports of 7,748 metric tons (MT), whereas total annual consumption increased by 8,833 MT. (Thus increases in imports have supplied about 88 percent of the estimated increases in consumption.) Requirements of foreign exchange for wheat purchases have been heavy, especially as Public Law 480 concessional sales have been winding down and Bolivia has had to turn to purely commercial transactions to satisfy her consumption requirements.

Efforts have been made, in recent years, to introduce hard wheat varieties and better production techniques in traditional wheat producing areas, but results have not been very encouraging.

It has been noted by several researchers [4, 2, 5, 6] that any significant increase in wheat production would most probably have to come from new areas opened in the lowlands of eastern Bolivia.

Plans exist in various ministries of the government of Bolivia to colonize new areas in the east, but only one section in that region is undergoing significant change: that south of the triangle formed by the Rio Grande and Ichilo rivers, which includes the provinces of Ibanez, Santisteban, Sara, Warnes and Ichilo, in the Santa Cruz department. In a country characterized by traditional subsistence-type agriculture, with slow and limited responses to market incentives, the Santa Cruz area presents a contrasting picture of rapid growth and high response to market incentives [1].

Wheat production in Santa Cruz is of negligible importance now, but technical feasibility has been demonstrated as a winter rotation crop with cotton. "Adequate yielding, disease-tolerant, well-adapted varieties are available and sufficient seed can be produced. There is enough rainfall for an average yield of 1200 kilos per hectare. Additionally, in rotation with cotton, insect problems can be reduced . . . " [5].

Government policy in Bolivia has been directed towards domestic production of previously imported agricultural goods. The principal justification for import substitution has been to save foreign exchange. This policy has been successful with sugar cane and rice, and the country is now self-sufficient in each. The next government target appears to be at least partial elimination of the wheat production deficit. At the same time, increasing wheat and/or flour prices to dramatically stimulate production response is a potentially explosive political issue because of the high fraction of population that uses

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TABLE 1. WHEAT PRODUCTION AND IMPORTS IN BOLIVIA, 1950-71

Year	Production MT	Consumption MT	Imports	
			MT	Percent of Total Consumption
1950	45,652	103,501	57,849	55.9
1951	31,326	109,172	77,846	71.3
1952	24,163	120,499	96,336	79.9
1953	20,581	107,593	87,012	80.9
1954	17,000	102,458	85,458	83.4
1955	17,000	81,573	64,573	79.2
1956	40,000	73,553	33,553	45.6
1957	45,000	186,573	141,573	75.9
1958	64,300	157,072	92,772	59.1
1959	62,260	175,644	113,384	64.6
1960	40,000	146,875	106,875	72.8
1961	35,000	179,340	144,340	80.5
1962	40,000	191,528	151,528	79.1
1963	55,200	216,092	160,892	74.5
1964	57,900	195,043	137,143	70.3
1965	55,000	220,571	165,571	75.1
1966	57,900	204,636	163,636	80.0
1967	27,000	229,665	202,665	88.2
1968	45,000	250,573	205,573	82.0
1969	53,000	244,905	191,905	78.4
1970	43,912	250,211	206,299	82.5
1971	61,029	291,086	230,057	79.0

SOURCE: Gomez, Enrique et. al., "Estudio del Trigo," Ministerio de Agricultura y Ganaderia, 1972.

wheat products as its nutrient staple [4]. Every new government that comes to power continues to keep the prices of bread and flour far below world market levels. In this analysis it is assumed that consumer prices remain at these "low" levels.

After the 67 percent devaluation of Bolivian currency [the monetary unit is the peso boliviano ($b.)] with respect to the U.S. dollar in 1972, the government required an incentive price to be paid by flour mills to wheat producers. In turn, a subsidy was paid to millers, since the flour price was also controlled. There have been minor changes in these payments over the years, but the character of the policy is unchanged since 1972.

THEORY AND EMPIRICAL METHODS

Two wheat producing areas are considered in this analysis: the traditional areas, mainly in the Central Valleys of Bolivia, and the newly colonized areas in Santa Cruz. They are represented by the hypothetical supply curves S_1 and S_2, respectively (see Figure 1). The total supply function for wheat production in Bolivia is S, the horizontal sum of S_1 and S_2 at given prices. D represents the domestic demand for wheat.

To reach self-sufficiency in supply, while maintaining the current pegged demand price at P_A, Q_B must be produced. The supply price of wheat would have to be P_B to induce Q_B. At price P_B, QQ_{B1} would be produced in traditional areas and QQ_{B2} in the Santa Cruz region.

The empirical supply function for traditional areas was derived by assuming unitary price elasticity and taking the 1971 estimate of wheat production in Bolivia as a base.[1]

The potential wheat supply function for the Santa Cruz area was obtained by means of a linear program, using alternative incentive prices paid to wheat producers. Physical and economic data were collected from a sample survey of farmers in the study area. Average product and factor prices and farm size of the area were utilized. The objective function of the linear program to be maximized was expected net returns accruing to agricultural producers. Coefficients of the a_{ij} matrix were derived directly from sample survey data. Operating capital was not constrained since it was obtained primarily from international loans that appeared to be ample and available at favorable terms. A stepwise positively-sloped labor supply function with an elasticity of two was estimated for different wage rates.[2]

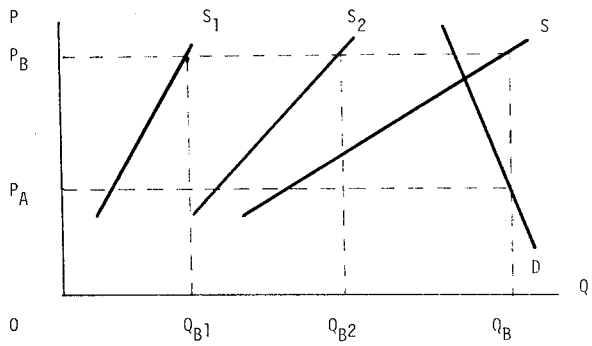

FIGURE 1. WHEAT SUPPLY AND DEMAND CURVES

Land constraints were set for each province in the region that reflected total land available for mechanized production (cleared of tree stumps), total land presently in use, and finally the additional amounts of land that feasibly could be brought into production after being cleared.[3] Maximum production constraints were placed on sugar cane (based on present milling capacity), on rice (based on total domestic demand) and on soybeans (based on planned milling capacity).

WHEAT SUPPLY RESPONSE AND WELFARE ANALYSIS

As the price of wheat increased parametrically in the model, quantities produced increased until a maximum of 4.84 million cwt. (approximately 220,000 MT) was reached at the $b. 100 cwt. price (approximately $3 per bushel).[4] No further response

[1] Worldwide estimates of supply elasticity for wheat production have been compiled by Johnson and Krishna [6, 7]. Johnson reports a short-run price elasticity of supply of .7 to 1.3, estimated by Hutchinson, Naive and Tsu for Argentina, Bolivia's neighbor on the South. Long-run elasticities tend to be higher as do those for more advanced countries. Krishna's estimates tend to be lower: (1) .31 for rice in India during 1914-15 for the short-run and .59 for the long-run, (2) for cotton during 1948-61, .64 in the short-run and 1.33 in the long-run, and (3) for wheat during 1914-43, .08 in the short-run and .14 in the long-run. The problem with Krishna's wheat data is that the time period covered was pre-World War II, and elasticities were acreage responses to price rather than output responses. Economic theory would suggest that output responses to higher prices should be higher than acreage responses, since other inputs would presumably be utilized more intensively.

[2] The quantity of locally available agricultural labor was estimated to be 52,038 persons at the full employment level. It was assumed that it would be available at current wages. Additional amounts could be attracted from other areas at higher wage rates. Our best estimates, based on information from the area, indicated that the quantity of migrant labor available would increase in steps of 25,000 men for wage increments of $b. 1.00 per day. (The current exchange rate is $b. 20 for one American dollar.) From such a labor supply schedule, a marginal factor cost curve (MFC) was constructed. Each increment in hired labor would mean higher wages not only for the imported labor, but for those already working in the area. Each point on the MFC curve was calculated using the equation: MFC=P(1=1/E) where P is the wage rate on the supply schedule, and E is the assumed supply elasticity.

Bolivia is a country where about 80 percent of the population is engaged in subsistence farming, with many densely populated agricultural areas. There must be considerable underemployment of agricultural labor. Of course, to move this labor from areas of current employment to the Santa Cruz region implies an increase in the wage rate.

The total labor supply schedule considered was 250,000 persons, which is about 20 percent of the total agricultural labor supply in the country. It was difficult for us to conceive conditions that would "pull" more workers than this into the new Santa Cruz region, except in the very long run.

[3] The quantity of land available for mechanized production, including total land presently in use, was estimated basically from a production survey made by the Office of Statistics of the Ministry of Agriculture. Figures on land that could be cleared were estimated from soil maps published by the British Mission in Santa Cruz [3].

[4] It must be emphasized that we are dealing here with relative prices; i.e., when wheat price reaches $b. 100 and all other product prices remain unchanged. This note of caution is needed because nearly all prices in Bolivia are currently rising rapidly. The absolute price for wheat has already risen above $b. 100 (September 1974) but relative price has not changed as much.

was noted, even if price were increased to $b. 150 per cwt. (Table 2). The reason is that wheat production had reached the land constraints in all five provinces.

Wheat production in the entire country was estimated at 1,326,715 cwt. in 1971 [6], and guaranteed prices paid farmers at the mills were $b. 46.0 and 52.0 per cwt. for native and hard wheat varieties, respectively. Total consumption was 8,045,400 cwt., however. If the foregoing analysis is valid, it appears that higher incentive prices could sharply reduce wheat imports, but the price would have to reach "fantastic" levels before self-sufficiency could be attained. It must be emphasized, moreover, that it has not been demonstrated that any increased domestic supply would be economically efficient, i.e., benefits of the incentive price program would more than offset the costs.

Proceed with the welfare analysis of such a program. After deductions were made for hectolitric weight and impurities, it was estimated that average price received by wheat producers in Santa Cruz department was $b. 46.75 per cwt. in 1971.

After the 67 percent devaluation of currency in 1972, it was estimated that domestic factor prices increased by about 40 percent by the end of the following year. It is roughly estimated that the general price level of the economy had increased by about 50 percent at the time of the study (June 1973). Presumably, the price of wheat had followed this trend in inflation (50 percent increase), i.e., from $b. 46.75 to $b. 70.12 per cwt. Therefore, the 1971 estimate of domestic wheat production was probably produced at the adjusted relative price of $b. 70.12 cwt. after devaluation.

As explained earlier, a land constraint was put on wheat production in the new provinces as a first cut. For purposes of viewing whether self-sufficiency is a "reasonable" goal, those constraints still seem fairly realistic. If so, it seems hopeless for Bolivia to think in terms of self-sufficiency in wheat production in the near future, especially if consumer prices are pegged far below free-market levels. In order to address the question of whether or not supply response to incentive prices is economically efficient, however, liberalize the constraints on land as it becomes more and more profitable to produce wheat as its relative price rises. This may require that other crops will be displaced by wheat and/or that newly-cleared land will be brought into production in still other provinces in the Santa Cruz area.

TABLE 2. WHEAT SUPPLY RESPONSE TO INCREASED PRICES IN SANTA CRUZ

	Land Presently in Use		Newly Cleared Land[a]		Total	
$b/cwt	Hectares	cwt	Hectares	cwt	Hectares	cwt
70.12	24,483	489,667	---	---	24,483	489,667
78.07	24,483	489,667	128,858	2,577,152	153,341	3,066,819
80.00	24,483	489,667	128,858	2,577,152	153,341	3,066,819
85.00	22,999	459,980	131,072	2,621,439	154,071	3,081,419
90.00	23,360	467,190	137,291	2,745,813	160,651	3,213,003
95.00	23,360	467,190	137,291	2,745,813	160,651	3,213,003
100.00	50,519	1,010,374	191,705	3,834,094	242,224	4,844,468
150.00	50,519	1,010,374	191,705	3,834,094	242,224	4,844,468

[a]It is assumed that 15 percent of this land will be cleared annually until the maximum available level is reached.

The situation is depicted in Figure 2. Assume consumer price is fixed and that total demand at that price is also fixed. Also, assume that the supply curves for traditional wheat areas and the Santa Cruz area are as shown.

The derived demand curve facing Santa Cruz producers can be regarded as total demand minus the supply from traditional areas, yielding the Santa Cruz demand as shown. Santa Cruz supply and demand do not intersect because of constraints put on land in wheat, as previously explained. This gives rise to skepticism about Bolivia's ability to be self-sufficient in wheat.

Suppose, however, that by removing land constraints the supply curve moves along the dotted line in Figure 2 until it intersects demand at a price of $b. 150.[5] If the government desires to maintain a constant relative wheat price of $b. 70.12 per cwt. for consumers (which is also assumed to be the price of imported wheat), while attaining self-sufficiency in production, the subsidy to producers would have to cover the gap between $b. 150.0 and $b. 70.12 per cwt. In consequence, a subsidy of $b. 79.88 per cwt. (113.92 percent of the consumer price) would be needed to raise domestic production to 8,045,400 cwt. This would require a subsidy payment of $b. 642.66 million annually.

Since the wheat supply curve for traditional areas had been assumed unitary elastic, quantity supplied from that area at $b. 150 would increase also by 113.92 percent, or from 1,326,715 to 2,838,109 cwt. The gain in producer's surplus in the traditional

[5]This assumption permits us to force self-sufficiency at an incentive price of $b. 150. We can then proceed to determine the welfare implications. The choice of an intersection price of $b. 150. is no doubt arbitrary, but implies an elasticity of supply of about .025 which does not seem unreasonable given the difficulty of bringing new acreage into production.

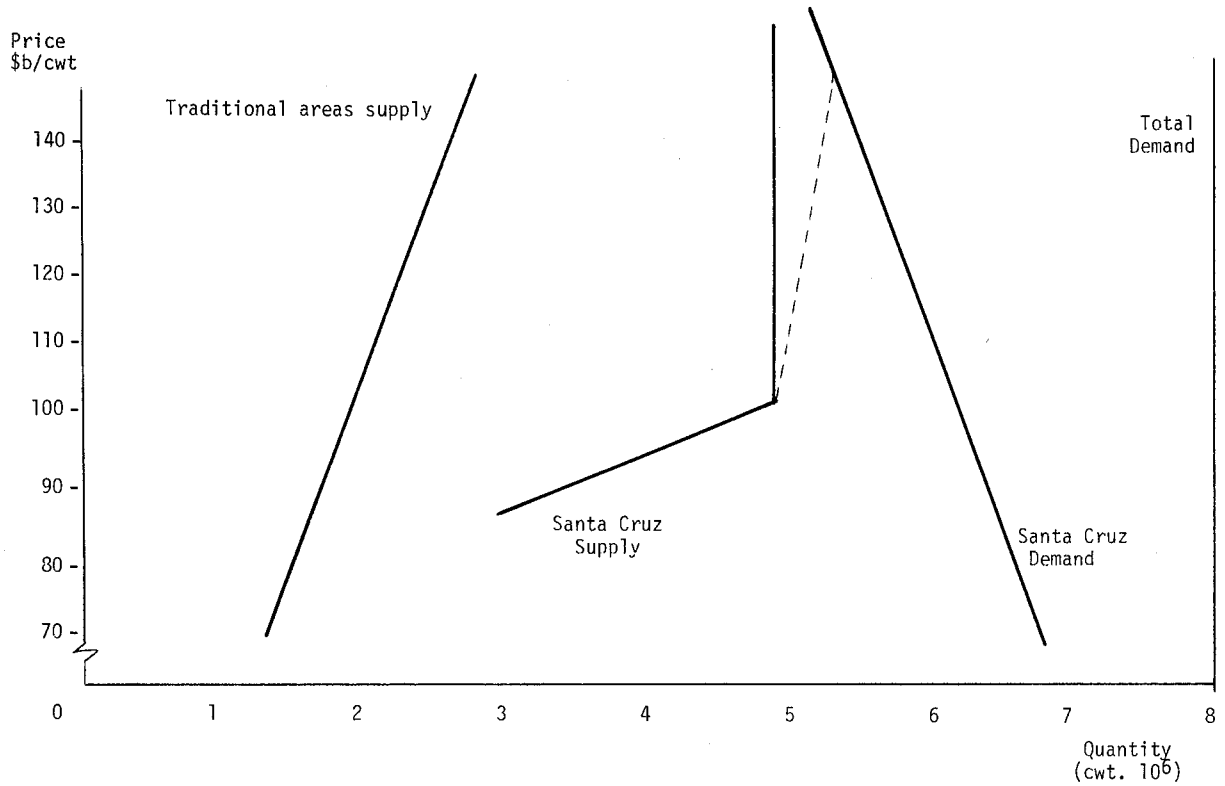

FIGURE 2. WHEAT DEMAND AND SUPPLY ESTIMATES WHEN A PRICE SUBSIDY TO CONSUMERS IS IN EFFECT

areas would be approximately 116.34 million of pesos bolivianos, calculated as follows: ($b.79.88X1.327 million cwt.)+($b.79.88X1.51 million cwt.)/2.

The gain in producer's surplus in the Santa Cruz area is composed of two parts. First, it is represented by increase in total net returns to agricultural producers, as wheat prices are raised from $b. 70.12 to $b. 100 per cwt.;[6] that is, the increase in value of the objective function in the linear program.[7] The value of the objective function increased from 704.61 to 843.72 million pesos bolivianos, representing a net increase of 139.11 million pesos bolivianos. Secondly, the remainder of the producer's surplus captured in the Santa Cruz area is calculated geometrically by moving along the assumed supply curve (dotted line, Figure 2) as the price is increased from $b. 100.0 to $b. 150.0 per cwt. This gain in producer's surplus is estimated to be 252.50 million pesos bolivianos.[8] The total gain in producer's surplus in the Santa Cruz area, resulting from the wheat price rise of $b. 70.12 to 150.0 per cwt., is thus 139.11+252.50=391.61 million pesos bolivianos.

To assess the overall impact of price subsidy on total welfare, government expenditure of 642.66 million pesos bolivianos[9] must be weighed against total gain in producer's surplus, both in traditional areas and in Santa Cruz ($b. 391.61+166.34= 557.95 million).

No change in consumer surplus exists, since real price to consumers and quantity consumed are assumed to be the same with price subsidy to producers as without it. Net social cost of implementing a program of self-sufficiency in wheat production, without an increase in price paid by consumers, is estimated by subtracting total gain in producer

[6] It is assumed that after the price reaches $b. 100, the supply curve takes the shape of the broken line in Figure 2, and proceeds until it intersects the demand at price $b. 150. This assumption is consistent with the conclusion reached earlier that there is no further acreage response after the price reaches $b. 100 (see Table 2).

[7] Net returns to agricultural producers represent the revenues remaining after all input purchases have been covered. Thus, the value of the objective function is similar in concept to rent accruing to the resources owned by the farmer and producer's surplus as traditionally defined.

[8] This calculation was made as follows: [(4.8 million cwt.x$b.50)+(.5 million cwt.x$b.50)] /2.

[9] Calculated as [($b.150—$b.70.12)x8.0454 million cwt.].

surplus from government expenditures for the price subsidy: 642.66—557.95=84.71 million pesos bolivianos.

The conclusion is that if the government is determined to maintain "low" wheat prices to consumers, costs of a subsidy to induce national wheat production self-sufficiency seem to be greater than benefits to wheat growers in the form of producer surplus arising from the subsidy.

This analysis neglects several important factors, however. One set of issues relates to income distribution. If the government collects revenues used to pay the subsidy to "poor" farmers from "rich" merchants, landholders, etc., then income distribution "gains" might well offset efficiency "losses" of the subsidy program. Alternatively, there is no reason to assume that present consumer prices and consumption are optimum. If prices to consumers were allowed to rise, then consumption would decline and losses of consumer surplus would have to be considered along with changes in producer surplus in order to arrive at an efficiency optimum. Thus, elasticity of demand would also be of crucial importance.

Finally, this analysis was completed before the "huge" increases in world price of food grains occurred. At the time of the study, consumer wheat prices in Bolivia were reasonably close to world prices. The current situation has not been carefully studied, but consumer prices utilized in this study are equivalent to prices of about $2 per bushel. World prices are currently much higher. The opportunity cost to the Bolivian economy of supplying domestic wheat is world price. Given high world price, the Bolivian government may well subsidize some increases in domestic production more cheaply than buying wheat in world markets. In fact, the price of $b. 150 per cwt. (or $4.50 per bushel) needed to stimulate large supply increases suggested in this study, is not far above recent world wheat prices.

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