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Impact of Improved Varieties in Bean Production  
in Latin America A Preliminary Review

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By 1986 national programs in Latin America had liberated over 100 new bean varieties derived from germplasm distributed by CIAT (Table 1) Some of these lines have already achieved widespread adoption by farmers others clearly have not been nor ever will be broadly adopted and many lines are still in the stages of seed production and initial diffusion To monitor the progress of these new bean varieties, CIAT has collaborated with national programs in the conduct of surveys of bean farmers These surveys can provide useful feedback on the constraints to the adoption of new varieties When shortcomings in the varieties are identified this serves to guide future selection to overcome these problems When institutional constraints to adoption are found often it is possible to seek means to remedy these problems When widespread adoption is observed it is useful to document it and analyze the factors leading to success This paper briefly reviews the findings to date of some studies of adoption of new bean varieties in Latin America

Costa Rica

In 1980 Costa Rica released the improved variety Talamanca originally developed by ICA in Colombia This was followed in 1981 by the release of Brunca a line developed at CIAT The adoption of these improved bean varieties in Costa Rica was first observed in a 1982 IICA survey of 98 small farmers (Chapman et al 1983) This was followed by a survey of 195 farmers by the University of Costa Rica in 1983 (Ballestero 1985) and surveys of 279 farmers by CIAT in 1985 (Pachico and Borbón) In 1986 the Ministry of Agriculture and the National Production Council surveyed over 300 farmers but these data are yet to be analyzed

The farm surveys indicate that in 1985 in the southern region (accounting for 32% of national production in 1984/85) 68% of the area in beans was planted to improved varieties while in the northern region (21% of national production) 65% of area was in improved varieties

Production functions estimated with the survey data from the northern region found a statistically significant effect on yield from use of new varieties leading to an increase of 265 kg/ha compared to an average yield of 502 kg/ha with local varieties (Pachico Borbón Viana and Valderrama 1987) Adoption functions estimated for the northern region showed that the high yield of the new varieties was a significant factor in farmers decision to adopt while access to official seed also had a significant effect Use of the shifting cultivation system was negatively related to adoption of new varieties while farm size had no significant effect (Pachico et al 1987)

Small farmers (< 10 ha) were found to be the most likely to couple the improved varieties with more intensive management (eg weed control, use of



agrochemicals) in the south This combination of new varieties and intensified management favors small farmer resource endowment of ample labor and scarce land because compared to the shifting cultivation system it absorbs significantly more labor per hectare as well as resulting in more than doubling net returns per hectare (Pachico and Borbón)

The spread of the new bean varieties has been associated with profound changes in production and imports Production was stagnant until the new varieties were widespread oscillating between 11 000 and 16 000 tons/yr from 1975 to 1983 From 1984 onwards Costa Rica has enjoyed three successive record years in bean output as output doubled (Agrotécnico 1986) Moreover while Costa Rica had imported 48% of total bean consumption from 1970-1983 since 1985 Costa Rica has ceased to import beans (Stewart 1986 Consejo Nacional de Produccion)

Based on the farm survey data it is estimated that 21 700 ha were planted to improved bean varieties in 1985 and this as calculated to have resulted in 5 300 tons of production above that which would have been produced with traditional varieties The value of this increased production due to the improved varieties is estimated at \$2 670 000 in 1985

#### Guatemala

In 1979 the improved varieties ICTA Quetzal Tamazulapa and Jutiapa were released for southeastern Guatemala The adoption of these improved bean varieties in Guatemala was first assessed in a 1984 survey of 102 farmers who had obtained seed of the new varieties through extension trials This was followed in 1985 by a survey of a random sample of 235 farmers These studies were conducted in the departments of Jutiapa Jalapa and Santa Rosa which together produce 32% of national bean production (Dirección General de Estadística) In 1986 54 farmers were interviewed in Jutiapa

According to the 1985 survey 23.8% of farmers had adopted improved bean varieties that were cultivated on 24.1% of area sown to beans (Pachico et al 1987) while the 1986 survey (which may not be fully representative) found 30% of farmers using improved varieties (Ruiz Orozco Viana and Aldana 1987) These estimates are conservative compared to previous estimates of adoption ranging up to 50% (Stewart 1986)

Production functions estimated with the 1985 survey data found a statistically significant effect on yield from the use of new varieties leading to an increase of 334 kg/ha compared to an average yield of 770 kg/ha with the local varieties Adoption functions were also estimated and showed that access to official seed was an important determinant of adoption but that the longer maturity of the new varieties compared to farmers traditional varieties had a negative and statistically significant effect on adoption (Pachico et al 1987) Thus the preferred strategy of farmers adopting the improved varieties is to grow them for their high yield potential on part of their bean area while keeping some land in traditional early varieties which give farmers some protection against the

risk of late season drought stress (Viana 1986) In 1986 ICTA released an earlier maturing new variety Ostua which may respond to farmers' needs for earliness

Based on these studies it is estimated that 12 300 ha were planted to improved bean varieties in Guatemala in 1986 This could be an underestimate because they may to some extent be grown in departments not included in the study Moreover the adoption of the varieties released for the Guatemalan highlands has yet to be assessed The estimated production increase due to the new varieties over what could have been produced with traditional varieties is 4 100 tons worth \$2 061 000 in 1986

### Argentina

From 1980 four improved varieties of black beans obtained from CIAT international trials began to diffuse in Argentina DOR 41 (same as ICTA Quetzal in Guatemala) BAT 304 (same as Brunca in Costa Rica) BAT 448 and BAT 76 (Gargiulo 1986 p 56) The diffusion of improved bean varieties has been measured by a survey of 183 bean farmers in northwestern Argentina comprising a 15% sample of producers (Gargiulo 1986 p 58) Based on the survey data an estimated 85 5% of black bean area was sown to improved varieties in 1985 (Gargiulo 1986 p 98) The improved varieties obtained an average yield 292 kg/ha more than that of the traditional variety which yielded 1091 kg/ha This difference was statistically significant at the 01 level (Gargiulo 1986 pp 67-8) The improved varieties are produced with the same technology as the traditional varieties

With a substantial increase in black bean sowing in 1986 (Michigan Bean Digest 1986) it is estimated that some 90 000 ha were planted with improved bean varieties in 1986 This resulted in an increase of production of 26 300 tons over what could have been produced with traditional varieties worth \$13 150 000 Counting benefits accrued only through 1985 the internal rate of return on bean investment in Argentina has been estimated at 40% (Gargiulo 1986 p 104)

### Cuba

In 1979 the improved variety Pijao was released It was originally developed by ICA in Colombia and obtained through CIAT international trials Official sources rather than survey data have been the main measure of the impact of new bean varieties in Cuba It has been reported that 10 000 ha are sown to new varieties in the state farm sector with an average yield increase over traditional varieties of 700 kg/ha (Sanchez and Scobie 1986 p 110) Data obtained directly from the Ministry of Agriculture put the area in improved varieties in the state farm sector at 11 200 in the period 1982-84 Moreover an additional 5700 ha were reported in improved varieties in the private sector in the period 1982-84 (Galvez)

The new bean varieties in Cuba have been accompanied with improved management practices including fertilization irrigation and pest control and yield an average 1 573 kg/ha (Galvez) This is more than double the national average bean yield of 729 kg/ha before the release of the new varieties (FAO 1979) This yield increase can be due to a pure varietal effect the effect of improved management and the greater responsiveness of the new varieties to intensified management Attributing half of the observed yield increase to varietal related attributes leads to a yield improvement due to the new varieties of 420 kg/ha roughly comparable to that observed elsewhere with new bean varieties At world market prices this leads to an increase of \$3 550 000 in value of increased production

Previously the annual value of increased bean production in Cuba has been put at \$2 900 000 and the internal rate of return to bean research at 23% (Sanchez and Scobie 1986) That estimate attributed a much greater yield gain to the new varieties (700 kg/ha vs 420 kg/ha) and utilized higher world prices than those used in this paper s estimate (\$570/ton vs \$500/ton) but covered only the state farm sector The price used here is the 1985 international price for black beans which reflects normal' market conditions for the 1980 s (Bean Market News 1986 Bean Market Summary 1986)

#### Nicaragua

Several improved lines developed at CIAT have been released as varieties in Nicaragua Revolución 79 (BAT 41) Revolución 81 (A 40) and Revolución 83 (BAT 1215) being the most widespread Improved bean varieties in Nicaragua are estimated by national program sources to be grown on 14 000 ha or 17% of bean area (Broenniman et al 1986 p 22) A survey of over 300 bean farmers throughout Nicaragua carried out in 1986 by the Ministry of Agricultural Development and Land Reform indicates that about 30% of farmers are cultivating the new varieties (MIDINRA) Assuming a yield increase of 250 kg/ha with the new varieties (lower than the yield increase observed elsewhere) the new varieties are estimated to have increased bean production by 3500 tons annually for a value of \$1 925 000

#### Summary

Improved bean varieties released by national programs have already had a significant impact on bean production in Latin America Nearly 155 000 ha were planted in 1986 to varieties obtained through the CIAT germplasm network with a total production of almost 190 000 tons (Table 2) The yield impact of these varieties led to a production increase of 46 000 tons worth \$23 560 000 This sum is more than three times the total direct and indirect costs of the CIAT bean program in 1986 These estimates do not include production from new varieties in countries like Brazil or Peru where studies to document adoption are being planned

This impact of course is due to the collaborative efforts of CIAT and national programs For illustrative purposes if half the benefits of

the new bean varieties were attributable to CIAT the net benefits (CIAT s share of gross benefits minus total direct and non-direct CIAT bean program costs) would be as shown in Figure 1 Since 1984 the CIAT bean program has been earning a positive and increasing return above costs