

New Bean Varieties and their Economic Impact: Evidence from Latin America



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Introduction

Since 1980, the national research centers in Honduras, El Salvador, Nicaragua, Costa Rica and Ecuador, in collaboration with Zamorano, CIAT and the DGP/CRSP (formerly the Bean/Cowpea CRSP), have been able to provide farmers with many improved bean varieties (IVs) over time. Although a few studies have been done about the impact of bean IVs in the region, it is important to know current country- and regional-levels of adoption of IVs and to determine the economic impact of these efforts. This study is a step in that direction.

Objectives

This study was conducted to:

- (1) Estimate the yield gains associated with using new bean IVs vs. old IVs for small red (Central America) and red mottled (Ecuador) varieties.
- (2) Empirically estimate overall adoption rates of bean IVs in Honduras, El Salvador, Nicaragua, Costa Rica and Northern Ecuador.
- (3) Evaluate the economic impact of the use of new bean IVs in these countries.
- (4) Generate recommendations to stakeholders to augment the economic impact of their efforts.

Methodology

The data for this study came from three sources and was analyzed using Excel and STATA. First, experimental yield data from the bean breeding programs at Zamorano (Honduras) and INIAP (Ecuador) were used.



Second, in the Summer 2010, key informants (e.g. breeders, government officials, seed producers) were interviewed to collect information related to adoption of bean IVs in each country of interest.

Third, secondary data from national statistical offices and FAO were used.

To estimate yield gains from using new bean IVs, experimental yield data were used. The advantage of using these data is that most variables that influence yields are deliberately held constant; hence, the differences in yields reflect the effect of the variety. Ordinary Least Squares (OLS) regressions were used to estimate the following models:

Equation (1)
$$Y_{it} = \alpha + \sum_{t=1}^{T-1} \beta_t D_t + \sum_{i=1}^{I-1} \gamma_i D_i + \sum_{c=1}^{C-1} \pi_c D_c + \mu_t$$

Equation (2)
$$\ln(\hat{Y}_{it}) = \alpha + \sum_{t=1}^{T-1} \beta_t D_t + \sum_{c=1}^{C-1} \pi_c D_c + \lambda V_i + \mu_t$$

Where Y_{it} is the yield of variety i at time t (averaged across locations, but not countries), D_t are dummy variables for each year, D_i are dummy variables for each variety included in the dataset, D_c are dummy variables for country where the varieties were tested (only for Central America), u_t are error terms, and α , β_t , γ_i and π_c are the estimated coefficients. The predicted yields from Equation (1) were used to estimate Equation (2), where V_i is a vintage variable (i.e. year of release) and λ is the coefficient of interest; i.e. yield gains. Due to data limitations, yield gains (i.e. λ) were estimated for Central America as a region, Honduras and Ecuador.

Adoption rates were estimated using key informants' information and cumulative (logistic) diffusion curves were generated. Finally, a surplus analysis was conducted to estimate the economic benefits of bean research.

Selected Results

The OLS regression results on experimental yield data suggest that, on average, new IVs yield more than old IVs and for:

- Central American countries, yield gains were 0.49% per year, which roughly translates to a potential yield gain of 10 kg/ha/yr.
- Honduras, yield gains were 0.56% per year, which roughly translates to a potential yield gain of 12 kg/ha/yr.
- Ecuador, yield gains were 1.68% per year, which roughly translates to a potential yield gain of 21 kg/ha/yr.

Bean experts estimated that in 2010, on average, 65% of the bean area was planted to IVs in the countries included in this study. Furthermore, adoption rates were highest in Nicaragua (82%) and lowest in Honduras (46%). As Figure 1 shows, the cumulative diffusion curves had positive slopes for all countries except Costa Rica, suggesting that adoption of IVs has increased over time in all countries except Costa Rica. Within the five countries included in the study, IVs have been adopted more rapidly (i.e. steeper slope) in Nicaragua, Ecuador and El Salvador. Moreover, while the IV adopted most widely in Central America in 2010 was *Amadeus 77*, the IV adopted most widely in Northern Ecuador was *Portilla*.

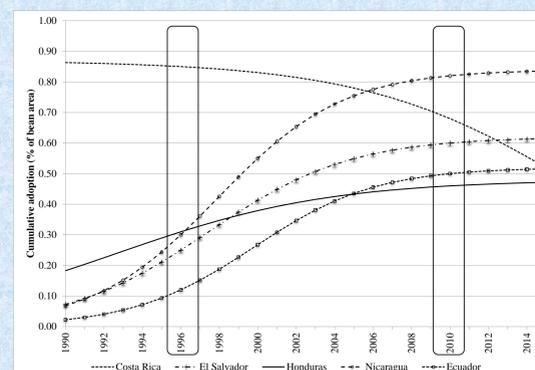


Figure 1. Cumulative diffusion curves of bean IVs. 1990-2015.

Table 1. Summary of net present value (NPV, \$) and internal rates of return (IRR, %) estimations of investments on bean research in Central America and Ecuador. 1991-2015.

Country	NPV (\$)	IRR
Costa Rica	-1,645,431	<0
El Salvador	42,495,919	29%
Honduras	36,683,914	26%
Nicaragua	92,323,006	30%
Ecuador	7,209,263	35%
Central American countries only	169,857,407	22%

Source: Generated by the Authors.

NOTE: Net present values are in real 2009 US\$.

The economic analysis shows that investments in bean research have been profitable in all countries except Costa Rica (Table 1). For the period of evaluation (i.e. 1991-2015), net present value (NPV) of these investments ranged from US\$-1.6 million in Costa Rica to US\$92.3 million in Nicaragua. While NPV was above US\$36 million in Honduras and US\$42 million in El Salvador, this value was just above US\$7 million in Ecuador. While the estimated internal rate of return (IRR) was negative for Costa Rica, IRR ranged from 26% in Honduras to 35% in Ecuador, suggesting that investments in bean research have provided returns well above the assumed opportunity cost of capital in countries where NPV and IRR were positive. For Central America as a region, NPV was close to US\$170 million and IRR was 22%.

Implications

The implications of these results are as follow:

First, in Costa Rica, more efforts should be devoted at promoting the use of red IVs and at developing new black IVs. Although black beans account for the largest market share, the last black IV that received good acceptability (*Guaymi*) was released in 1996. Furthermore, the most widely adopted black IV (*Brunca*) was released in 1982.

Second, the governments of each country need to maintain/increase the financial support to bean research since, to date, investments in this area have been profitable.

Finally, although some governments are heavily investing in seed production as to provide producers with seed of bean IVs, there is still a need to increase investment in seed production, especially in Ecuador.

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