

Effective adoption of the Pinto Saltillo common bean variety (*Phaseolus vulgaris* L.) in Durango and other states of México

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ABSTRACT

Objective: To analyze the area of effective adoption of the improved common bean variety (*Phaseolus vulgaris* var. Pinto Saltillo) in México.

Design/Methodology/Approach: The area planted with Pinto Saltillo was obtained from the Statistical Yearbook of Agricultural Production (SIAP) and other data sources. Variables such as planted area, seed yield, and total production under both rainfed and irrigated conditions were included. The data were analyzed using principal component analysis (PCA), descriptive statistics, graphs, trend lines, and maps showing the level of technological adoption.

Results: The results show a gradual reduction in the annual area planted with common bean in the state of Durango (39-97%). Extensive Pinto Saltillo plantings were observed in 11 states of México, mainly under rainfed conditions. The highest cumulative values were recorded in Durango. The state of Zacatecas ranked first due to its high Pinto Saltillo planting area under irrigation (47,838 ha year⁻¹), followed by Chihuahua (30,840 ha year⁻¹).

In México, the cumulative area planted with Pinto Saltillo between 2012 and 2024 reached 5.1 million hectares, with a total grain production of 2.8 million tons. Traits associated with the extensive adoption of Pinto Saltillo include disease resistance, high seed yield, slow seed coat darkening, and grain reduced cooking time.

Study Limitations/Implications: The study was conducted using information obtained from two databases; therefore, additional state, national, and international information sources should be considered in future analyses.

Findings/Conclusions: The productive and quality impact of Pinto Saltillo is evident on the common bean market, where the “Pinto Saltillo” commercial class has been recently introduced.

Keywords: *Phaseolus*, breeding, productivity, quality, sustainability.



INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is the second most important staple crop in México (Félix *et al.*, 2019; Matul *et al.*, 2024). This staple product is used by farmers throughout the year for household consumption and for the generation of income through its gradual sale. For many years, common bean commercialization faced challenges associated with traditional pinto-type varieties, whose seed coat is subject to a rapid darkening (Hernández *et al.*, 2023). In response to this problem, common bean breeding programs focused on reducing seed coat darkening, which led to the development of the Pinto Saltillo variety. This common bean variety was developed from the improved line PT93004, selected in Ignacio Allende, Durango, based on its local adaptation, light seed color, and tolerance to seed coat darkening (Sánchez *et al.*, 2004; Junk *et al.*, 2008; Anaya *et al.*, 2021; Jiménez *et al.*, 2024).

The registration of the Pinto Saltillo common bean variety began in 1999 and was successfully completed in 2001 (Sánchez *et al.*, 2009). After its registration and release in Coahuila, seed multiplication and commercialization of the Pinto Saltillo variety began, mainly in the states of Chihuahua and Durango. In Chihuahua, the municipalities of Namiquípa, Cuauhtémoc, and Riva Palacio stood out for their adoption of Pinto Saltillo (Jiménez and Acosta, 2013). This variety was particularly adopted in northern Durango (municipality of Hidalgo) and the region known as “Los Llanos de Durango” (municipalities of Cuencamé and Guadalupe Victoria) (Ávila *et al.*, 2011). The rapid and widespread adoption of the Pinto Saltillo common bean variety by producers was favored by its competitiveness and consumption-related advantages (Hernández *et al.*, 2023).

The improved Pinto Saltillo variety offers several advantages, including tolerance to drought, high yield potential, and reduced cooking time, as well as an extended shelf life due to the slow darkening of the seed coat (Sánchez *et al.*, 2009; Hernández *et al.*, 2023). Consequently, the Pinto Saltillo common bean variety was widely adopted in the Semi-Arid Highlands of México (Ávila *et al.*, 2011). Subsequently, other common bean-producing states and regions of México accepted this variety. Farmers have continued cultivating Pinto Saltillo due to the high-income levels it generates, as a result of its high productivity, ease of commercialization, and the premium market price of the common bean (Hernández *et al.*, 2023).

Currently, the Pinto Saltillo common bean variety is cultivated in several states across the Semi-Arid Highlands, Subhumid Highlands, and even in the Dry Tropics of México. This variety has gained both commercial and dietary relevance, becoming a recognized commercial class in national and export markets. Consequently, several studies have characterized producers, determined the level of adoption, and evaluated the economic impact of the extensive use of the Pinto Saltillo common bean variety. In addition, González and Wood (2006), González *et al.* (2009), Ávila *et al.* (2011), and Hernández *et al.* (2023) recommended the identification of factors associated with the adoption process. The aim was the establishment of a strategic framework for the successful promotion of other improved common bean varieties.

Public and private sector agencies have generated different techniques that facilitate the study of the adoption process of technological developments. These techniques

include the use of large-scale databases and their analysis through different algorithms, which enable the development of highly accurate models. The objective of this study was to analyze the area of effective adoption reached by the improved Pinto Saltillo common bean variety in the Semi-Arid Highlands and other common bean-producing regions of México.

MATERIALS AND METHODS

A descriptive analysis focused on the interpretation of historical data to understand the context of common bean production in Durango from 1980 to 2024. Data on planted area, harvested area, disaster area, total production, and yield were obtained from the Statistical Yearbook of Agricultural Production–Statistical Yearbook of Agricultural and Livestock Production (SIAP, 2025).

Meteorological variables, including average monthly and annual minimum and maximum temperatures, as well as monthly accumulated precipitation, cropping cycle, and year, were obtained from the historical records of the National Meteorological Service (Sistema Meteorológico Nacional) (<https://smn.conagua.gob.mx/tools/DATA/Climatología/Pronóstico%20climático/Temperatura%20y%20Lluvia/PREC/1985-2024.pdf>). Additionally, the FAOSTAT historical database (FAOSTAT, 2025) was consulted to verify domestic yield information. A database was developed by using the collected data, sorting the information according to the water regime of common bean production —*i.e.*, under rainfed and irrigated conditions. Whenever possible, differentiated statistics were obtained for major varieties, such as Pinto Saltillo.

The data obtained were analyzed using descriptive statistics (Excel[®], Ver. 16.100.1) and Principal Component Analysis (PCA) performed with the R software (version 4.4.2). The results were presented using graphs and trend lines generated by Excel[®] v. 16.100.1 computing program. Additionally, maps were developed based on the technological adoption index at both the state level (Durango) and the national level. These maps were developed using the software packages Spyder Python v. 5.4.3 and ArcGIS Pro v. 2.5.0.

RESULTS AND DISCUSSION

The evaluated climatic parameters recorded high variability at the monthly, cropping cycle (July-October), and annual headings for common bean cultivation, as well as between years. These findings highlighted the importance of temperature and accumulated rainfall under rainfed (Figure 1a) and irrigated conditions (Figure 1b). Based on daily values and other evaluation periods, common bean have adapted to different temperature and precipitation patterns. Principal Component Analysis (PCA) required a high number of principal components to achieve a considerable accumulation in the explanation of variance (Table 1). Six principal components accounted for 70.1% of the variance under rainfed conditions and 68.0% under irrigated conditions. The variables had the highest influence on common bean response in Durango, under both irrigated and rainfed conditions, were the average minimum temperature and the average maximum temperature recorded during the year. Temperature, particularly minimum temperature, influences the growth and development rates of common bean

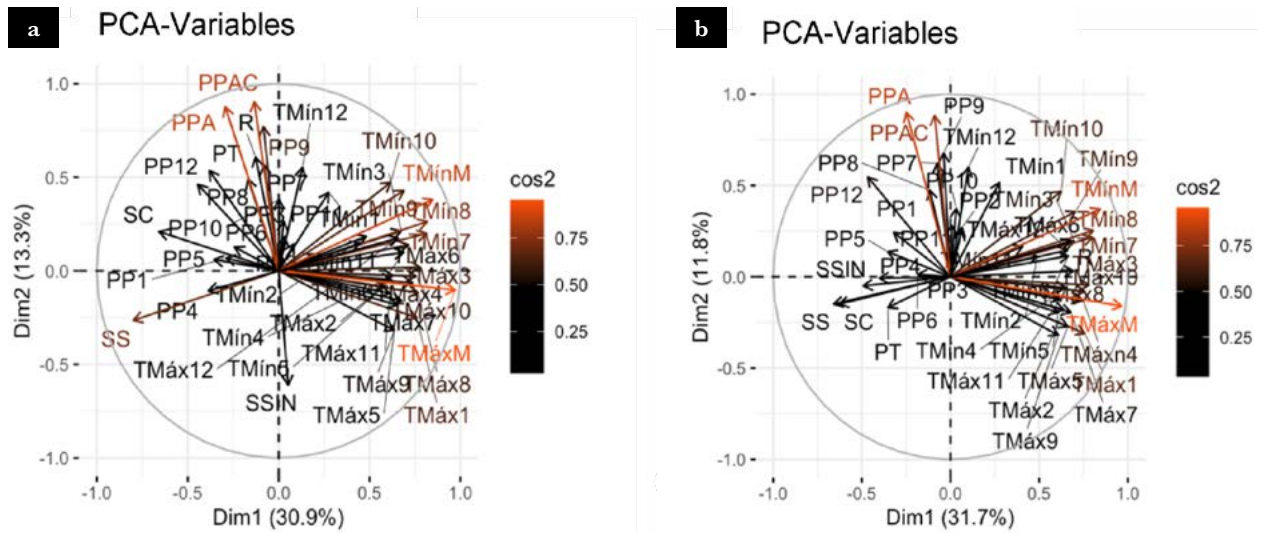


Figure 1. Cosine of the variables used in the Principal Component Analysis (PCA) for rainfed (a) and irrigated (b) common bean cultivation in Durango.

Table 1. Eigen values and levels of explanation of variance according to the Principal Component Analysis (PCA) for common bean cultivation variables in Durango (1985-2024).

Principal Component	Rainfed			Irrigated		
	Eigen Value	Proportion (%)	Accumulated (%)	Eigen Value	Proportion (%)	Accumulated (%)
CP1	13.9	30.9	30.9	14.3	31.7	31.7
CP2	6.0	13.3	44.2	5.3	11.8	43.5
CP3	3.8	8.4	52.6	3.4	7.6	51.1
CP4	3.1	7.0	59.6	3.1	6.9	58.0
CP5	2.5	5.6	65.2	2.4	5.4	63.4
CP6	2.2	4.9	70.1	2.1	4.6	68.0

CP=Principal Component.

plants (Rosales *et al.*, 2001), which is associated with biomass accumulation, translocation of photoassimilates to the seeds, and common bean yield. In addition, temperature affects the survival, arrival time, and levels of damage caused by insect pests, such as the Mexican bean beetle (*Epilachna varivestis*) and the pod weevil (*Trichapion* spp.).

Other variables that influenced common bean cultivation were the accumulated precipitation during the cropping cycle and the total precipitation recorded throughout the year. The total precipitation also impacted common bean grown under irrigated conditions due to the influence of water on different biological factors, such as the presence of beneficial (*Rhizobium*) and pathogenic (*Fusarium*, *Rhizoctonia*, and *Pythium*) microorganisms. Additionally, precipitation hinders the survival and phases of arrival for insect pests, including white grubs (*Phyllophaga* spp.), the Mexican bean beetle (*Epilachna varivestis*), and the pod weevil (*Trichapion* spp.) and increases common bean productivity under both rainfed and irrigated conditions.

The study area should be expanded, and the accuracy of the observations should be improved to establish a direct relationship between agroclimatic variables and common bean productivity in Durango and other states of México. Currently, agrometeorological variables are often evaluated using damaged or obsolete equipment with limited maintenance. In addition, the personnel in charge of recording the meteorological data has little experience, multiple activities, and undergoes constant rotation. Likewise, there is a shortage of personnel and limited resources to conduct field sampling required to determine statistical data related to planted area, harvested area, and seed yield. Consequently, only incomplete and variable databases are available, reducing the accuracy and usefulness of the information for the study of the influence of meteorological factors on agricultural production.

The importance of common bean cultivation in the rural sector of México was confirmed: 613,345 production units were found throughout the country (INEGI, 2022). Nevertheless, a decreasing trend in planted area and fluctuations in yield under rainfed conditions were observed, particularly during the 2000s. This trend was associated with low productivity and the slow adoption of technologies aimed at the improvement of profitability and production sustainability (Sangerman *et al.*, 2010).

Drought (water stress) was another determining factor affecting common bean productivity, which was associated with the scarcity and irregular distribution of rainfall. Drought impacted the main common bean-producing regions in México and reduced competitiveness during several years within the evaluated period.

According to agricultural statistics, the low production recorded between 2011 and 2023 was the consequence of the great proportion (>90%) of the areas planted with common bean were grown under rainfed conditions (SADER, 2022). In addition, the lack of market regulation contributed to imbalances and inequalities among actors within the production chain. The area planted both under rainfed and irrigated conditions in Durango recorded a negative trend. Likewise, yield lacked a clear trend for rainfed common bean production (Figure 2a and 2b).

In Durango, the planted area and common bean production significantly declined starting in the 2000s (Figure 2; Table 2). Under rainfed conditions, the common bean planted area decreased by 57%, dropping from 347,000 ha in 1988 to 150,000 ha in 2023. This reduction was associated with the increasing preference for forage crops such as maize (*Zea mays*) and oats (*Avena sativa*), which are used for livestock feeding, particularly in La Laguna region. Under irrigated conditions, the common bean planted area decreased by 97%, giving priority to the production of forage species such as maize, alfalfa (*Medicago sativa*), sorghum (*Sorghum bicolor*), and oats. Additionally, perennial industrial species—such as pine (*Pinus greggii*) and cenizo agave (*Agave durangensis*) which are considered production alternatives for poor rainfed soils—were established. The compound annual growth rate (CAGR) decreased from 1.02% to -2.29% between 2010 and 2023. Common bean cultivation was gradually displaced toward marginal areas, where growing other plant species is almost impossible, negatively impacting the productivity and quality of grain produced in Durango.

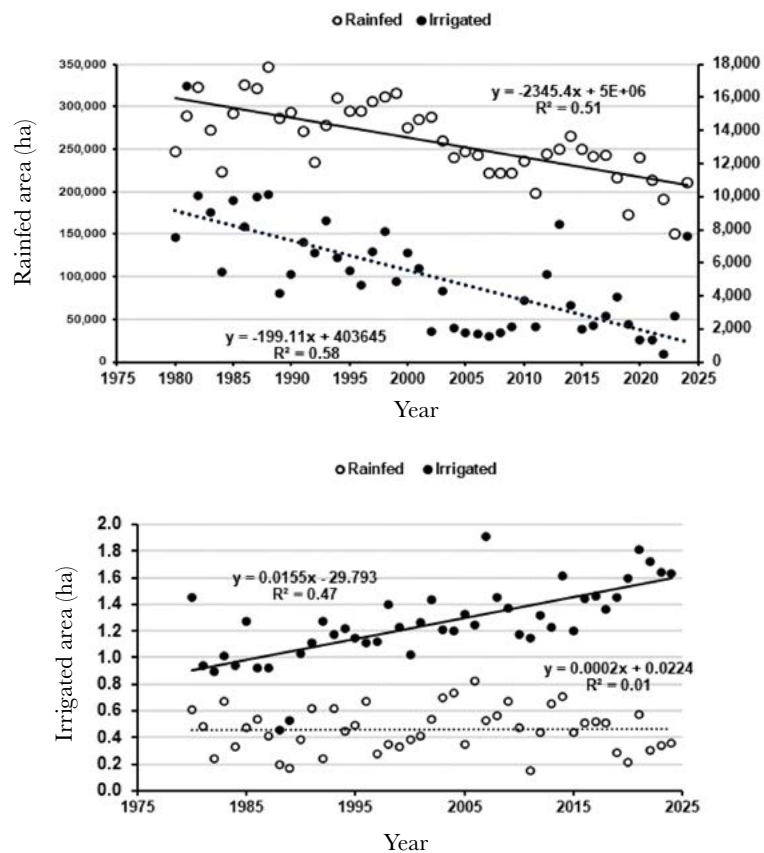


Figure 2. Planted area and common bean yield in Durango (1980-2023).

Table 2. Compound annual growth rate (CAGR) of common bean planted and production areas in Durango, México (1980-2023).

Period	Planted area (ha)	AAGR ¹ (%)	Total Production (t)	AAGR (%)
1980-1989	301,900	1.02	113,465	-4.01
1990-1999	297,644	1.70	121,542	-3.66
2000-2009	253,625	-2.74	135,574	0.29
2010-2023	225,426	-2.29	97,387	-4.42

¹AAGR=Average Annual Growth Rate. Source: Prepared by the author using data from SIAP, (2025).

The reduction in production volumes from 113,465 t to 97,387 t resulted in negative compound annual growth rates (from -4.01% to -4.42%) for total common bean production in Durango (Table 2). Consequently, since the 1980s, México became an importer of common bean and the main buyer of the United States (USA). Low yields, high production costs, and the deterioration of real prices were also recorded. These factors negatively impacted the competitiveness of common bean production, a situation that was further intensified by the cancellation of state marketing arrangements. These arrangements had been developed by the Compañía Nacional de Subsistencias Populares (CONASUPO), through price setting and market regulation (Ayala *et al.*, 2008).

Additionally, farmers faced water scarcity (drought), limited seed availability for improved varieties, lack of irrigation water, decapitalization, insufficient machinery, poor condition of agricultural implements, pests, diseases, and early frosts. Furthermore, farmers had limited access to technology transfer programs, training, technical assistance, and comprehensive support to restore degraded soils and move toward a sustainable common bean production (de los Santos *et al.*, 2017; Borja *et al.*, 2018).

An accelerated process of adoption of the Pinto Saltillo common bean variety was observed, particularly in Durango, Chihuahua (Ávila *et al.*, 2011), and Zacatecas (Table 3). Consequently, this variety was extensively grown, mainly under rainfed conditions. In Chihuahua, cumulative values reached 881,434 ha, while in Durango the cultivated area reached up to 1,832,307 ha from 2014 to 2024 (Table 3). In the case of Zacatecas, a shift in preference toward Pinto Saltillo was observed, aimed to replace the flor de mayo and flor de junio varieties (SIAP, 2025).

The state of San Luis Potosí also had a high level of Pinto Saltillo planted area, reaching 459,409 ha under rainfed conditions. The attributes of Pinto Saltillo favored its expansion across multiple states in México. Additionally, the levels of commercialization and consumption required the designation of a new commercial class: “Pinto Saltillo”. The slow darkening characteristic differentiated it from Pinto Nacional, a variety susceptible to seed coat darkening approximately one month after the harvest and threshing process.

The state of Zacatecas stood out with a large area sown with Pinto Saltillo, grown under irrigated conditions (56,306 ha), followed by Chihuahua (37,010 ha). This situation contributed to an increase in total production and seed yield average, favored by the genetic potential of the Pinto Saltillo improved variety. At domestic level, the cumulative values for the 2012-2024 period reached 5.1 million ha and 2.8 million metric tons of Pinto Saltillo common bean (Figure 3).

The results exceeded previous estimates, which had predicted a reduction in the total area planted with Pinto Saltillo beginning in 2012 (González *et al.*, 2009). This response was associated with the acceptance and significant expansion of the Pinto Saltillo planting area in the Semi-Arid Highlands and part of the Subhumid Highlands of México. High

Table 3. Cumulative values for variables related to the adoption of the Pinto Saltillo common bean variety (2012-2024).

State	Irrigated			Rainfed		
	*PA (ha)	TP (t)	SY (t ha ⁻¹)	PA (ha)	TP (t)	SY (t ha ⁻¹)
Chihuahua	37,010	66,349	1.92	881,434	567,523	0.70
Durango	25,614	40,595	1.62	1,832,307	760,392	0.44
Guanajuato	5,784	13,757	2.39	38,582	18,927	0.52
Nayarit	20,357	31,712	1.49	80,104	109,313	1.32
Querétaro	561	1,110	2.11	6,913	2,128	0.44
SLP	5,557	10,741	1.92	459,409	149,493	0.45
Sonora	10,064	20,416	1.99	--	--	--
Zacatecas	56,306	123,556	2.00	1,603,470	906,760	0.63

* PA=Planted area, TP=Total production, SY=Seed yield.

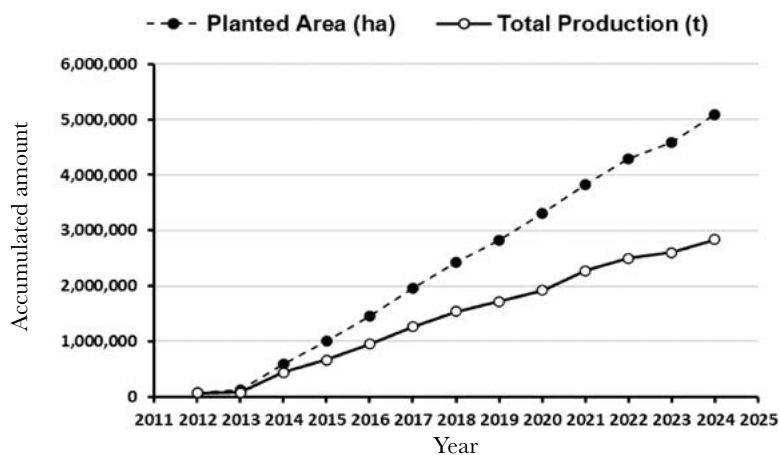


Figure 3. Cumulative values for planted area and production of the Pinto Saltillo common bean variety in México (2012-2024).

values were detected for the area planted with Pinto Saltillo under irrigated conditions in Zacatecas, Chihuahua, and Nayarit (Figure 4a). In the third state, sowing was related to the seed renewal (refreshment) process that takes place during the autumn-winter off-season (November-February); the seed is later used during the spring-summer cropping cycle (July-October) in Durango and other states of the Semi-Arid Highlands of México.

Under irrigated conditions, higher average for common bean yields were recorded for the Pinto Saltillo variety in Guanajuato, Querétaro, and Zacatecas ($>2.0 \text{ t ha}^{-1}$), as well as in Chihuahua, San Luis Potosí, and Sonora ($>1.9 \text{ t ha}^{-1}$). High yields were also reported in Nayarit under rainfed conditions (1.3 t ha^{-1}), associated with deep soils, high accumulated rainfall, and the use of supplementary irrigation. In contrast, the average yield values in the Semi-Arid Highlands ranged from 0.07 t ha^{-1} (2014) to 0.98 t ha^{-1} (2024). The Pinto Saltillo variety is mainly used in the Dry Tropics region for winter seed multiplication and this variety has also been adopted for grain production. In both Nayarit and Sinaloa, extensive areas were sown with Pinto Saltillo, to meet the demand from national and international grain and seed markets. Additionally, some areas in Nuevo León, Coahuila, and Tamaulipas were sown with Pinto Saltillo common bean variety.

In 2023, Pinto Saltillo was grown in 11 states of México, reaching an average yield of 1.8 t ha^{-1} in a sowing area of 18,341 ha established under irrigated conditions (Figure 4a). Under rainfed conditions, Pinto Saltillo was sown in 281,162 ha, accounting for an average yield of 0.64 t ha^{-1} . Compared to other varieties, the characteristics associated with the acceptance and widespread adoption of Pinto Saltillo include disease tolerance, high yield, and slow seed coat darkening. In addition, this variety has short grain cooking time, high consumer preference, and strong demand in the domestic market (Rodríguez *et al.*, 2010; SE, 2012).

Common bean productivity under irrigated conditions was more stable and showed an increasing trend, although its level of use was considerably lower than under rainfed conditions. Consequently, the area established with irrigated common bean production should be expanded in order to increase the certainty of production and seed yield. The

objective was to obtain at least the minimum volume required to meet the annual demand in the state of Durango (18,000 t) (Figure 4b). This objective could be achieved planting approximately 15,000 ha of Pinto Saltillo common bean under irrigated conditions, with an average yield of 1.2 t ha⁻¹.

Adoption of Pinto Saltillo in Durango

The Pinto Saltillo common bean variety has shown high growing potential across the common bean-producing regions of northern México (Figure 4a). This variety had a substantial impact during the 2021-2024 period, when it accounted for 79% of the growing area and 81% of the total common bean production in the state of Durango (Figure 4b). Within the state, the municipalities with the largest areas planted with Pinto Saltillo were Cuencamé and Guadalupe Victoria, followed by Durango, Pánuco de Coronado, Canatlán, and Nuevo Ideal. At the state level, the total sowing area ranged from 142,000 ha year⁻¹ (2014) to 278,000 ha year⁻¹ (2023). The area planted with Pinto Saltillo gradually expanded, reaching a total of 29 municipalities, where this improved variety is currently used for commercial common bean production. As a result, Durango has been the leading producer of Pinto Saltillo common bean since 2005.

The Pinto Saltillo variety has been widely adopted in Durango, largely due to the competitive advantages that this technological development has provided to farmers. The major benefits include the increase in the price paid to farmers for the grain, driven by a strong market demand and its tolerance to seed coat darkening, a trait associated with extended shelf life. This characteristic has allowed producers to extend the negotiation period with traders. In contrast, grains in traditional varieties such as Pinto Nacional and Pinto Villa typically darken approximately one month after harvest. The accelerated darkening of the seed coat caused the need of a rapid commercialization process of traditional pinto common bean varieties, due to the price reduction caused by the “old grain” appearance.

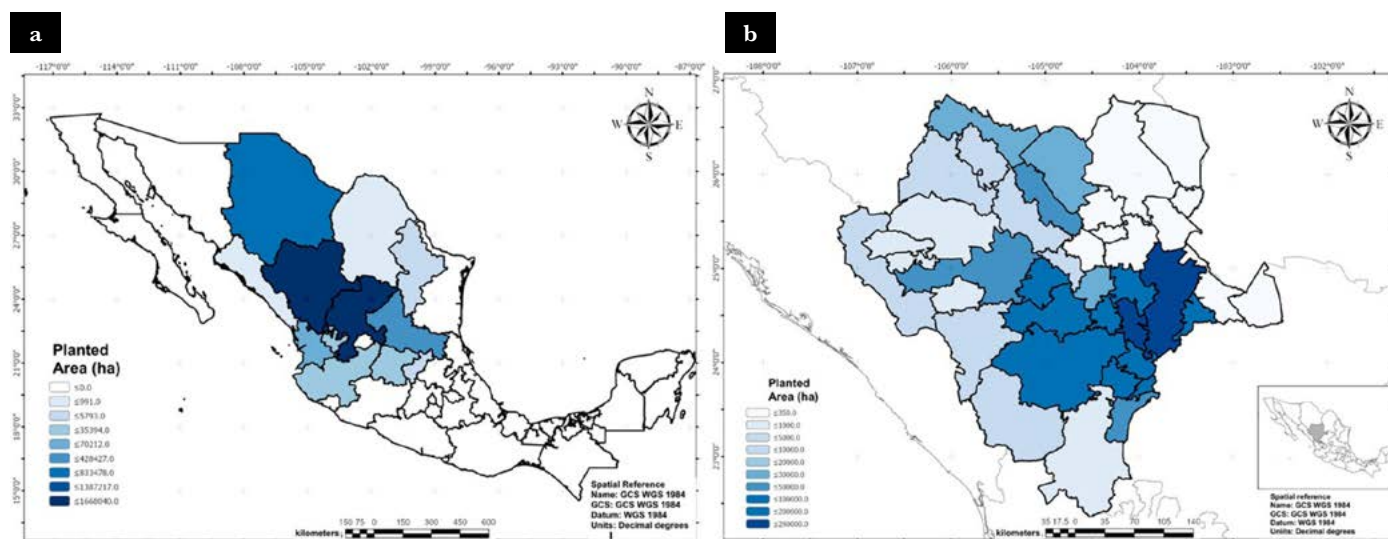


Figure 4. Level of adoption of the Pinto Saltillo common bean variety in México (a) and Durango (b).

Pinto Saltillo maintains its seed coat color and brightness for extended periods (>12 months), preserving its commercial value and consequently favoring greater economic returns for farmers. Short cooking time and easier household food preparation are other two important attributes of this variety. In addition, the reduced cooking time lowers the consumption of gas and other fuels, therefore decreasing the associated pollutant emissions. González *et al.* (2003) and Mutari *et al.* (2021) indicated that the main factors associated with the widespread adoption of improved varieties, such as Pinto Saltillo, include: (a) adaptability to particular field conditions, (b) disease resistance, and (c) high yield potential.

Additional government actions have complemented the productive and commercial attributes of the Pinto Saltillo variety, contributing to its widespread adoption. Various federal and state institutions have implemented initiatives to promote the use of Pinto Saltillo, including the Fundación Produce de Durango A. C. (FPD), the Secretaría de Agricultura, Ganadería y Desarrollo Rural of Durango (SAGDR), and the Secretaría de Agricultura y Desarrollo Rural (SADER) (SADER, 2020). The *Kilo por Kilo* program is one of the federal programs implemented to support common bean production. This program was developed by SADER in coordination with state agricultural agencies. Within this framework, suitable common bean seeds were provided to farmers as a support for sustainable agriculture. The program targeted farmers with growing areas of up to 30 ha (rainfed) and up to 5 ha (irrigation).

The common bean varieties distributed to producers through government programs included Negro San Luis, Pinto Saltillo, and Negro Michigan (SADER, 2020). Meanwhile, the *Frijol para México* government initiative has provided support to smallholder farmers through several strategies. These strategies include: (1) the Programa de Apoyo para Productores de Maíz y Frijol (PIMAF), which provides financial support for the acquisition of inputs (such as seed, fertilizers, and plant protection products) and technical support aimed at the improvement of production; and (2) the Programa Frijol del Bienestar, which offers a guaranteed price per kilogram of common bean, ensuring fair and direct income for farmers.

In 2021, the “Use of Certified Common bean Seed for Chihuahua, Durango, and Zacatecas, with expansion to San Luis Potosí, Nayarit, Quintana Roo, and Yucatán” strategic project was implemented, benefiting 5,945 producers across these states (SADER, 2022). As part of this initiative, the states of Zacatecas, Durango, and Chihuahua received support for the acquisition of Pinto Saltillo certified seed. This initiative contributed to the expansion of both the sowing area and the period in which this improved common bean variety can be used, while simultaneously it increased the economic returns on the investment made during its development and technological transfer.

In Durango, a gradual reduction in the area planted with Pinto Saltillo has been reported (SIAP, 2025). This trend has been associated with several factors, including delayed rainfall onset, reduced cumulative precipitation, and increased irregularity of rainfall distribution (FIRA, 2020). Additionally, a decline in the genetic purity of the variety has been observed, mainly due to mechanical mixtures and the authorization to use commercial common

bean grain as seed for sowing. These practices have limited the productivity and quality of common bean produced in México. Market dynamics have also influenced this trend, particularly the increasing demand for black common bean and the release of other pinto common bean varieties such as Pinto Centauro and PID 2, also considered in the Pinto Saltillo market class. Other important factors include market pressures and constant fluctuations in consumer prices, which have apparently contributed to the reduction in the area planted with Pinto Saltillo (Figure 5a). Despite these fluctuations, the area sown with Pinto Saltillo has varied throughout the years and, since 2009, has accounted for >70% of the total area planted with common bean every year in Durango (Figure 5b).

The results confirmed the widespread and persistent adoption of the Pinto Saltillo variety. In 2021, the adoption rate reached 87%, while farmers were 13% likely to abandon the technology within the following four years (Hernández *et al.*, 2023). These findings contradict earlier projections made during the evaluation of the adoption process. Previous studies predicted that since 2012, the use of this variety would gradually decline (rejection) in growing areas of Durango (González *et al.*, 2009).

Common bean genetic improvement in different regions of México increased yield by approximately 40% between 1961 and 2023. During this period, the national average common bean yield increased from 395.9 kg ha⁻¹ to 950.5 kg ha⁻¹ (Figure 6). This remarkable national achievement took place under highly diverse production

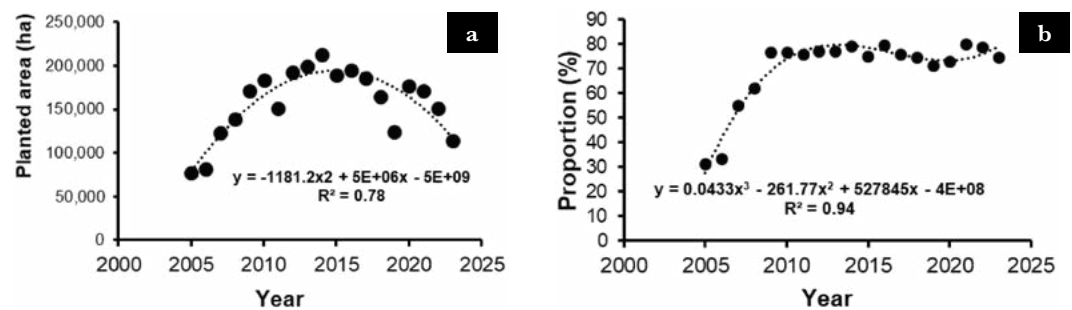


Figure 5. Planted area a) and proportion used by farmers b) for Pinto Saltillo common bean cultivar in Durango, 2005-2023.

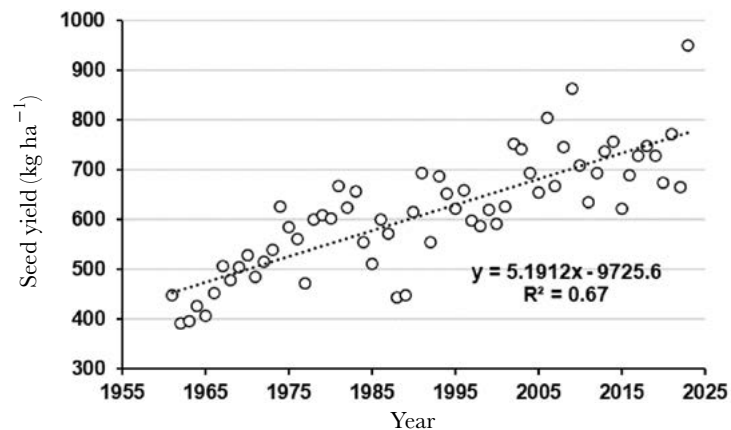


Figure 6. Common bean yield in México (FAOSTAT, 2025).

environments, including both rainfed and irrigated systems. The Pinto Saltillo variety has made a major contribution to domestic common bean production since 2005. The increase in productivity has maintained the national supply for domestic consumption despite the reduction in planted area. In some years, common bean imports were required (<200,000 t); however, this situation was most likely caused by industrial demand, import quotas established under international trade agreements, and credit facilities granted to Mexican traders and agro-industrial firms.

The effective adoption area achieved by the improved Pinto Saltillo variety exceeded every initial production expectations in the Semi-Arid Highlands and even extended to other common bean-producing regions of México. The area sown with Pinto Saltillo has increased steadily since 2005 and by 2023 the variety was grown in 11 states of the country. In 2023, an average of 281,162 ha year⁻¹ were cultivated using Pinto Saltillo under rainfed conditions, with a mean yield of 0.64 t ha⁻¹. Under irrigated conditions, 18,341 ha year⁻¹ were established, with an average yield of 1.8 t ha⁻¹. The highest cumulative values for the area sown with Pinto Saltillo were recorded in the states of Durango, Chihuahua, and Zacatecas, ranging from 833,000 to 1.7 million hectares. The cumulative area sown with Pinto Saltillo in México reached 5.1 million hectares, resulting in a total production of 2.8 million tons.

CONCLUSIONS

The high adoption levels of the Pinto Saltillo common bean variety were associated with several key attributes, including: disease tolerance, high yield potential, extended shelf life, and short cooking time. Adoption was also supported by the involvement of federal and state institutions that provided technical and financial assistance, as well as the implementation of certified seed distribution programs. Higher levels of common bean consumption in specific areas and favorable market prices also contributed to the widespread adoption of Pinto Saltillo, a variety developed by the common bean breeding program of the INIFAP in Durango.

The productive and commercial impact of Pinto Saltillo and other improved common bean varieties developed since 1960 has positively influenced domestic agricultural production in México. This impact is reflected in the increases of common bean yield and total production, which have been documented and validated by various national and international institutions. The use of the Pinto Saltillo variety contributed to the steady yield increase, particularly under irrigated conditions and favorable rainfed environments (>450 mm of rainfall). In addition, its adoption strengthened the food market through the introduction of a new commercial class known as “Pinto Saltillo.” Traders, agro-industrial processors, and consumers have also benefited from the adoption of this variety, which protects the value of the investment, reduces cooking time, and ultimately supports common bean consumption in México.

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