Trade effects on the environment
2nd Symposium of the CCA

NAFTA and conservation of maize diversity in Mexico

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CEE and PRECESAM
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25-26 March, 2003

Impacts of NAFTA and internal agricultural reform in maize production in Mexico

- NAFTA and domestic reforms
- Expected impacts
- The facts after 9 years of NAFTA
- Hypotheses to explain the trends

NAFTA and conservation of maize diversity in Mexico

- Previous threats to maize *in situ* conservation
- Increasing maize imports
- The spread of maize transgenes

Prospects and recommendations

The reforms and NAFTA

NAFTA, part of the package to reform the agricultural sector of Mexico

- 1988-99. Process to abolish CONASUPO
- 1991…. Ejidal Reform (property rights on land)
- 1991… ASERCA (commercialization supports through *indifference prices*)
- 1994-2008. NAFTA, transitional period
- 1993/4-2008. PROCAMPO (direct income transfers to the producers of basic crops)
- 1995. Alliance for the Countryside (agricultural supports and Kilo por Kilo)
- 2002 …
  - Contigo (Alliance-Progresa for the poor)
  - Blindage (reaction to the 2002 US Farm Bill)

Reforms and Maize

- 1994-2008. NAFTA
  - Liberalization of maize seeds imports
  - TRQs (2.5 millions of Tons. 1994) and over quota tariffs (215%)
- 1995-99. CONASUPO
  - Elimination of maize producer price supports
  - Abolishment of the *tortilla* subisdy
  - Transfer of DICONSA to the Ministry for Social Development
- 1993/4-2008. PROCAMPO
- 1995 … ACERCA
- 1995…. Alliance for the Countryside (Kilo por Kilo)
- 2002 …
  - Blindage

Expected impacts on Mexican maize

- Increase in competition (specially from USA)
- Reduction of maize prices
- Increase in maize imports from the USA
- Raise in efficiency, productivity and elimination of non-competitive producers
- Crop substitution: from maize to competitive crops
- Sharp reduction of domestic maize supply
- Raise in rural out-migration

Reduction of genetic diversity of maize?

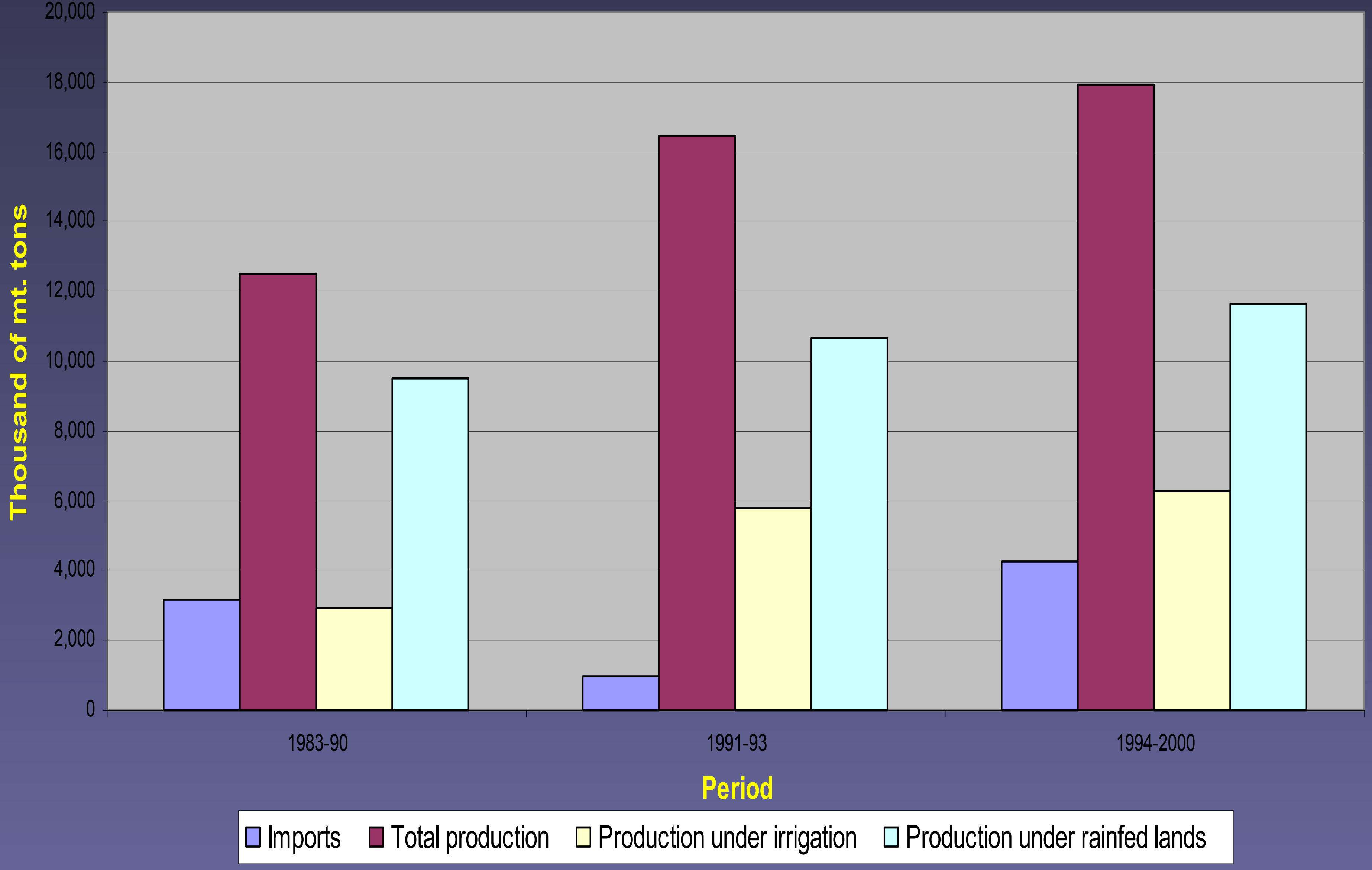
The facts after 10 years of NAFTA

- Increase in maize imports
- Raise in productivity (but only in irrigated lands)

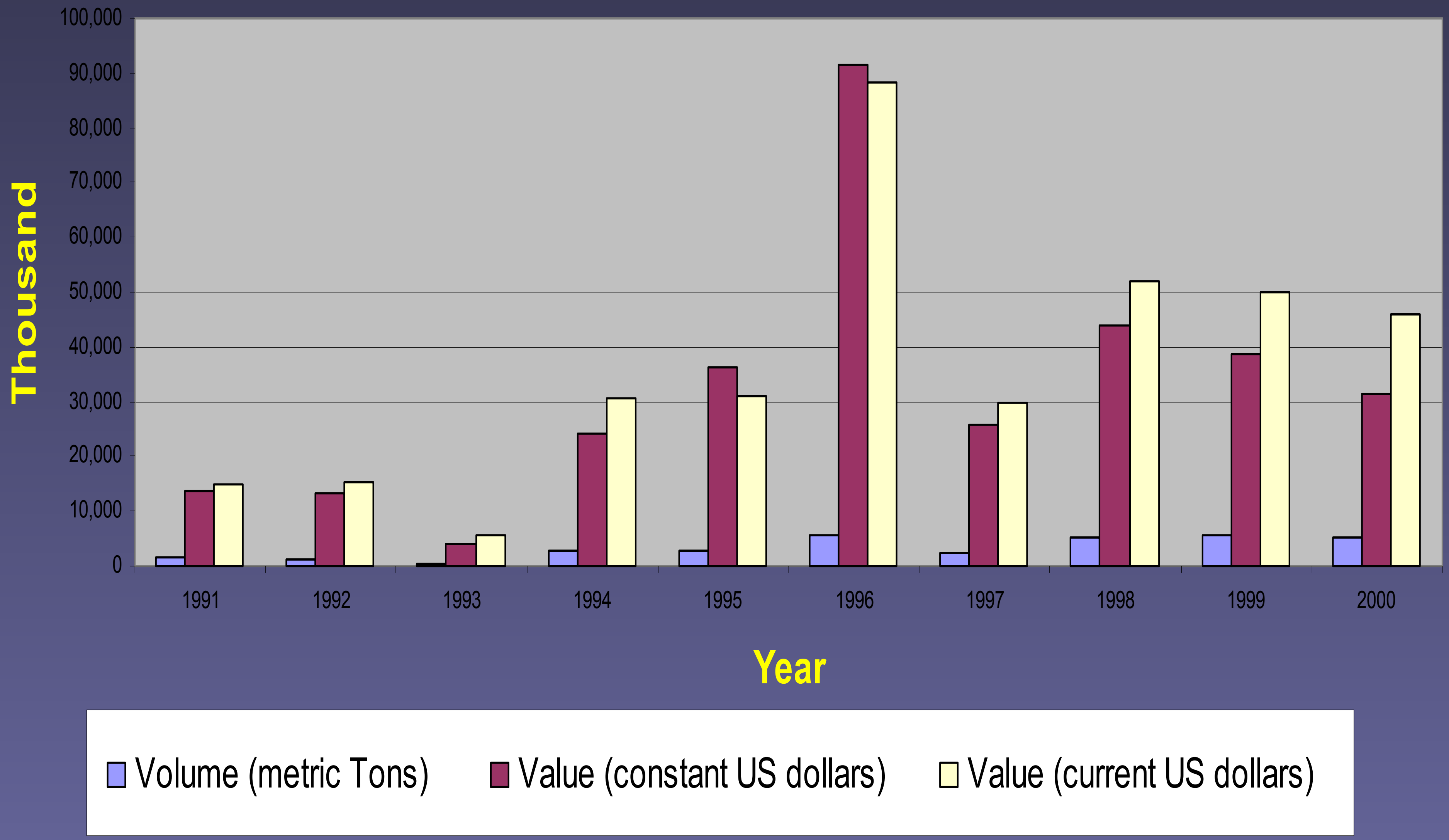
However

- Change in maize imports has not suffered structural change
- Domestic maize supply has not collapsed, and
- Rural out-migration has not sharply increased

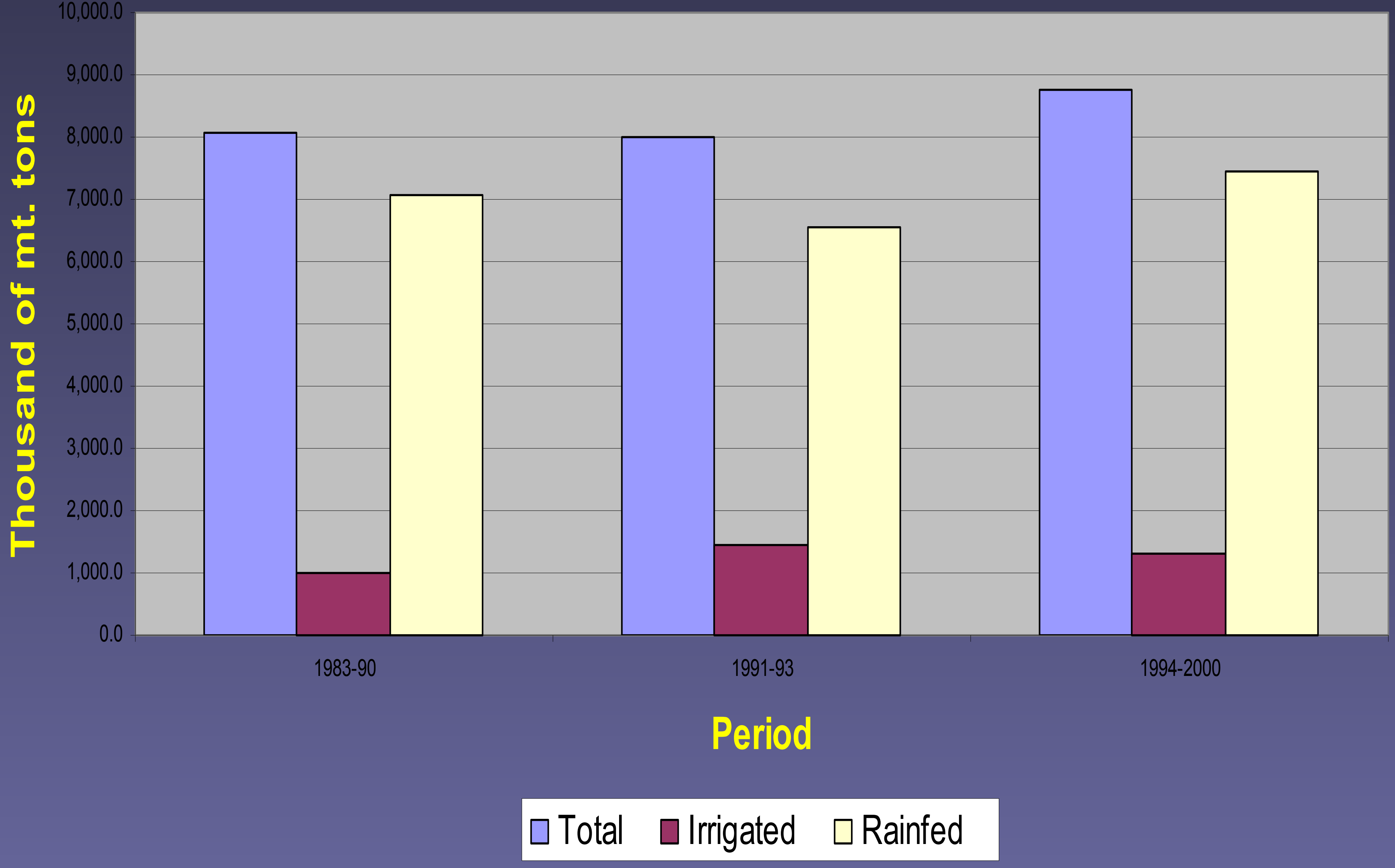
Maize. Imports and domestic production (annual averages)



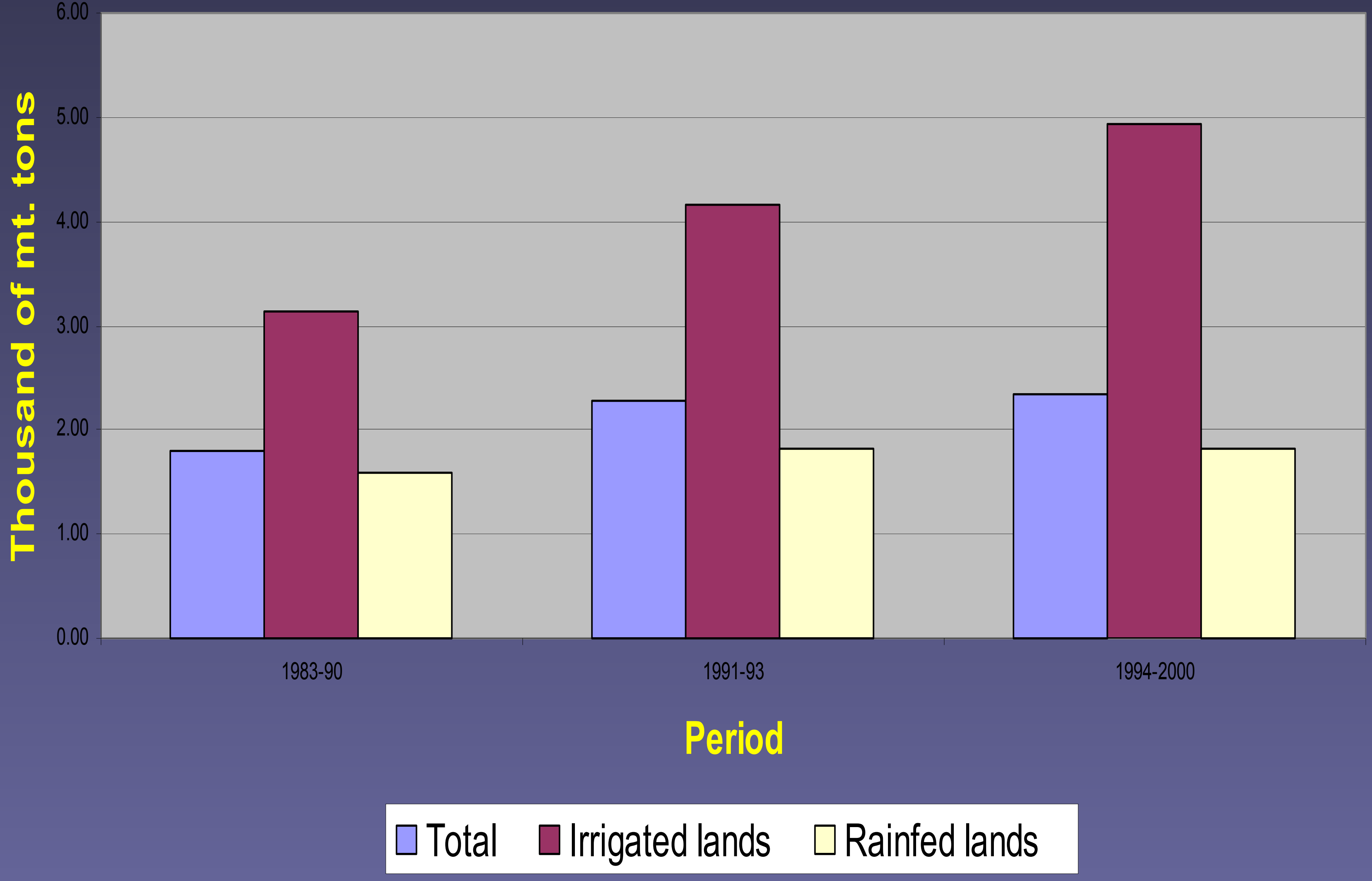
Maize Imports: 1991-2000



Maize. Cropped areas (annual averages)



Maize. Yields (annual averages)



Explanations (hypotheses)

- Macroeconomic instability (sharp exchange rate movements)
- Domestic policies
- Heterogeneity of maize producers
  - Commercial
    - Irrigated
    - Receiving the supports from ASERCA and ALLIANCE
    - Reacting to price changes
  - Subsistence (where maize diversity prevails)
    - Rain-fed …
    - Inelastic supply response to maize price changes?

Table 2.3 Adoption of Improved Maize Germplasm (OPVs and Hybrids), Early 1990s

	1992 Total Maize Area (million ha)	Area Under Improved OPVs (%)	Area Under Hybrids (%)	Area Under Improved Materials (%)
Latin America[a]	25.1	13	36	49
Sub-Saharan Africa	15.7	17	20	37
West Asia and North Africa	2.3	6	20	26
South, East, and Southeast Asia[b]	17.6	29	13	42
Mainly nontemperate developing countries[a,b]	60.7	19	24	43
China	21.1	7	90	97
Argentina and Chile	2.4	8	85	93
All developing countries	84.3	15	43	58
Industrialized countries	37.7	1	99	100
World	132.6	10	63	73

Sources: FAO Agrostat database, Primary Crops Production. CIMMYT maize releases database.

Notes: a. Excluding Argentina (1.7 million ha) and Chile (0.1 million ha).

b. Excluding China (22.1 million ha).

Morris 1998

nda

DIRECTORA GENERAL: CARMEN LIRA SAADE

MEXICO, D.F. AÑO DIECISIETE NUMERO 6044

HOY MIERCOLES 27 DE JUNIO DE 2001

6 pesos

Arruinó la *guerra* del maíz en el TLC a 15 millones de mexicanos

Campesinos abandonaron sus tierras tras el *disparo* en la importación del grano estadunidense a precios más baratos, dice el grupo defensor Public Citizen

25

CNIC: "franco

Transgenic DNA introgressed into traditional maize landraces in Oaxaca, Mexico

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Concerns have been raised about the potential effects of transgenic introductions on the genetic diversity of crop landraces and wild relatives in areas of crop origin and diversification, as this diversity is considered essential for global food security. Direct effects on non-target species[1,2], and the possibility of unintentionally transferring traits of ecological relevance onto landraces and wild relatives have also been sources of concern[3,4]. The degree of genetic connectivity between industrial crops and their progenitors in landraces and wild relatives is a principal determinant of the evolutionary history of crops and agroecosystems throughout the world[5,6]. Recent introductions of transgenic DNA constructs into agricultural fields provide unique markers to measure such connectivity. For these reasons, the detection of transgenic DNA in crop landraces is of critical importance. Here we report the presence of introgressed transgenic DNA constructs in native maize landraces grown in remote mountains in Oaxaca, Mexico, part of the Mesoamerican centre of origin and diversification of this crop[7–9].

In October and November 2000 we sampled whole cobs of native, or 'criollo', landraces of maize from four standing fields in two locations of the Sierra Norte de Oaxaca in Southern Mexico (samples A1–A3 and B1–B3), more than 20 km from the main mountain-crossing road that connects the cities of Oaxaca and Tuxtepec in the Municipality of Ixtlán. As each kernel results from ovule fertilization by individual pollen grains, each pooled criollo sample represents a composite of ~150–400 pollination events. One additional bulk grain sample (K1) was obtained from the local stores of the Mexican governmental agency Diconsa (formerly the National Commission for Popular Subsistence), which distributes subsidized food throughout the country. Negative controls were cob samples of blue maize from the Cuzco Valley in Peru (P1) and a 20-seed sample from an historical collection obtained in the Sierra Norte de Oaxaca in 1971 (H1). Positive controls were bulk grain manuscript, the Mexican Government (National Institute of Ecology, INE, and National Commission of Biodiversity, Conabio) established an independent research effort. Their results, published through official government press releases, confirm the presence of transgenic DNA in landrace genomes in two Mexican states, including Oaxaca. Samples obtained by the Mexican research initiative from sites located near our collection areas in the Sierra Norte de Oaxaca also confirm the relatively low abundance of transgenic DNA in these remote areas. The governmental research effort analysed individual kernels, making it possible for them to quantify abundances in the range of 3–10%. Because we pooled all kernels in each cob, we cannot make such a quantitative statement, although low PCR amplification signal from criollo samples is compatible with abundances in this percentage range.

Using a nested primer system, we were able to amplify the weak bands from all CMV-positive criollo samples (Fig. 1) sufficiently for nucleotide sequencing (GenBank accession numbers AF434747–AF434750), which always showed at least 98% homology with CMV p-35S constructs in commercially used vectors such as pMON273 (GenBank accession number X04879.1) and the K1 sample (accession number AF434746).

Further PCR testing of the same samples showed the presence of the nopaline synthase terminator sequence from *Agrobacterium tumefasciens* (T-NOS) in two of the six criollo samples (A3 and B2; GenBank accession numbers AF434752 and AF434751, respec-

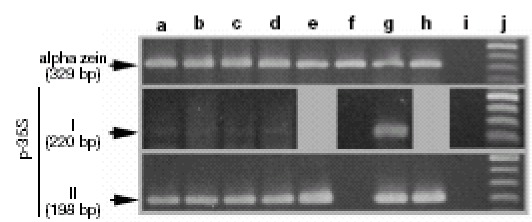

Figure 1 PCR amplification of DNA from the maize-specific alpha zein protein gene (top panel) and the CMV p-35S promoter (centre and bottom panels). The centre panel represents amplification protocol I (single amplification); the bottom panel indicates amplification protocol II (nested priming amplification). **a–d**, Criollo maize samples. Samples A2 (**a**), A3 (**b**), B2 (**c**) and B3 (**d**) are shown. **e**, Sample K1 from Diconsa store. **f**, Negative control P1, from Peru. **g**, Roundup-Ready maize RR1. **h**, Bt-maize Bt1. **i**, Internal negative control for PCR reaction. **j**, DNA ladder (100 base pairs (bp)), 500-bp marker at the top in each panel. Expected size for each fragment is marked on the left.

Genetic Conservation of Plants Useful to Man*

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ABSTRACT

The conservation of primitive cultivars and of the wild relatives of our domesticated plants has become an urgent world problem of very great importance for the continuing productivity of cultivated plants. The main centres of genetic diversity are situated in the developing countries of Asia, Africa, and Latin America, where rapid agricultural and other development is threatening the continued existence of these ancient plant populations. Measures which should be taken without delay include a rapid inventory of genetic resources in the field and in existing collections, protection in situ *of threatened and important wild communities, and conservation of primitive cultivars in collections and, wherever possible, in long-term seed storage. International stimulation*

even weeds—both of which, though to different degrees, are subject to Man's control.

Yet wild species cannot be ignored altogether. Some which are directly useful to Man are endangered to varying degrees. Prominent among these are forestry species which, with few exceptions, are wild. There are now numerous examples of important gene-pools, especially of tropical species, which are being decimated or destroyed to make way for replanting with exotic trees or for agricultural development. The wild orchards in Anatolia, wild fruit species in the Malayan rain forests, and indeed the ancient mixed orchards throughout Malaysia and Indonesia, are similarly

Rapid agricultural and other development is threatening the continued existence of these ancient plant populations.

Frankel 1970

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Notes: a. Excluding Argentina (1.7 million ha) and Chile (0.1 million ha).
b. Excluding China (22.1 million ha).

Morris 1998

The production technology for the traditional crop is simply a fixed net (financial) return of R dollars per acre allocated to that crop. Two additional prices need to be defined in the system, namely, P, which denotes the price per unit of the modern crop, and c, denoting the cost per unit of fertilizer.

Assuming that the farmer's objective is to maximize the expected utility of income, it is reasonable to characterize the utility function as strictly concave, reflecting risk aversion, i.e.,

$$U = U(\pi); \quad U' > 0; \quad U'' < 0$$

$$\max_{x,L} EU\{P \cdot L \cdot [y(x) + \varepsilon \cdot h(x)] + R \cdot (\bar{L} - L) - c \cdot x \cdot L\}$$

$$L \leq \bar{L}$$

where E is the expectations operator and L is farm size.

Three observations may be made at this point: The first relates to the specification of the production function. One standard specification which is common in the literature assumes a multiplicative random effect [Batra

Feder 1980

Table 17.2 Farmers' selection concerns

Source	*Agroecological*	*Use*	*Technological*
Lando and Mak, 1994c	Field adaptation Maturity Drought tolerance Flood tolerance Lodging resistance	Yield Eating quality Price Volume expansion	Not reported
Lambert, 1985	Performance under different levels of water depth Drought tolerance Dependability: production on adverse conditions	Texture (glutinous, vitreous, viscous), related to use for subsistence or market Yield Price Colour of husk	Resistance to weeds, insects and disease
Rerkasem and Rerkasem, 1984	Drought tolerance Flood tolerance Maturity (earliness) Lodging resistance	Texture (glutinous subsistence, non-glutinous market) Quality Price Production of straw for mulch	Fit with multiple cropping patterns Fit with patterns of off-labour

Bellon et al. 1996

amount of total maize outputs to retain on the farm ($\mathbf{X}^c$), maximizing V subject to a budget constraint:

$$\max_{\alpha, \mathbf{X}^c} E[V(\alpha, L)] \mid \boldsymbol{\Omega}, Z, \tag{1}$$

subject to

$$C(\alpha, K, L) \leq I + \mathbf{p}'[\mathbf{X} - \mathbf{X}^c]$$

and a technology constraint

$$F(X, z|\alpha, K, L) = 0. \tag{2}$$

Outputs $\mathbf{X}$ are a function of their production attributes and nonseed inputs K.

Smale et al. 2001

Table 2 Number of maize varieties in communities across Mexico.

		total number of varieties		(c) number of local landraces	(d) number of varieties per household[1]	(e) (a)/(d)[1]
Sierra Santa Marta (Rice *et al.*, 1998)	30	30	24	-	5.8	5.2
Cuzalapa (Louette & Smale, 1996)	26	26	21	6	2.4 + 2.6	5.2
Guanajuato (Aguirre *et al.*, 2000)	23-16	23		-	-	-
Ocozocoautla (Brush *et al.*, 1988)	14	14		-	2.7 (1-5)	5.2
V. Guerrero (Bellon & Taylor, 1993)	15	15		-	-	-
V. Guerrero (Bellon & Risop., 2001)	20+	20	11+	-	-	-
Chalco-Amecameca (Perales, 1998)	8 (3-7)	8	7 (3-6)	-	1.6 (1-4)	5
Valley of Cuautla (Perales, 1998)	17 (4-13)	17	13 (0-10)	-	1.4-1.8 (1-4)	9.4-12.1
Naupan, SNP (Evangelista, 1998)	6	6	6	-	-	-
Nauzontla, SNP (Inzunza, 1988)	6	6	6	6	1.3	4.6
Sierra Zacapoaxtla, SNP (VanDusen, 2000)	-		-	-	1.1	-
Zoatecpan, SNP (this study)	-		-	-	1.75	-
Oaxaca (Bellon, 2001)	11?	11	-	-	1.6 (?-2.1)	6.9?

1. Range in parenthesis.
Source: Dyer (2002).

Dyer 2002

Example: Explanatory factors and variables for farmer variety choice

Explanatory factor or concept	Variable measured: Nepal	Morocco	Turkey	Mexico
Agroecology	latitude; longitude; elevation; land use; soil type; fragmentation	temperature variability; length of growing period; rainfall distributions; soil type	land quality	length of growing period; soil type
Market infrastructure	distance to nearest market; distance to nearest road		price differentials; percent of district output marketed	road surface; electricity and water supply; number of health clinics, schools, and business establishments
Household characteristics				
economic status and objectives	caste; farm size; sharecropped area; number of months food self-sufficient		has refrigerator, tap water, electricity, own livestock; total land	own tractor; own oxen; have irrigation; percent of harvest sold
income sources	seasonal migration	crop share of farm income; farm share of total income	off-farm income	remittances from migrants
human resources	family size; years of education	household composition; years in school	number of household members over 13; years in school; age of head	household composition; years in school
land resources	fragmentation		land quality	soil types; fragmentation

Sources: Meng 1997 (Turkey); Aguirre *et al.* 2000 (Mexico); Rana *et al.* 2000 (Nepal); Nassif 2000 (Morocco); Jarvis *et al.* 2000.

Jarvis et al. 2001

A Training Guide for *In Situ* Conservation On-farm

Version 1

D.I. Jarvis, L. Myer, H. Klemick, L. Guarino, M. Smale, A.H.D. Brown, M. Sadiki, B. Sthapit and T. Hodgkin

IPGRI

SWISS AGENCY FOR DEVELOPMENT AND COOPERATION SDC

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Bundesministerium für Wirtschaftliche Zusammenarbeit, Germany

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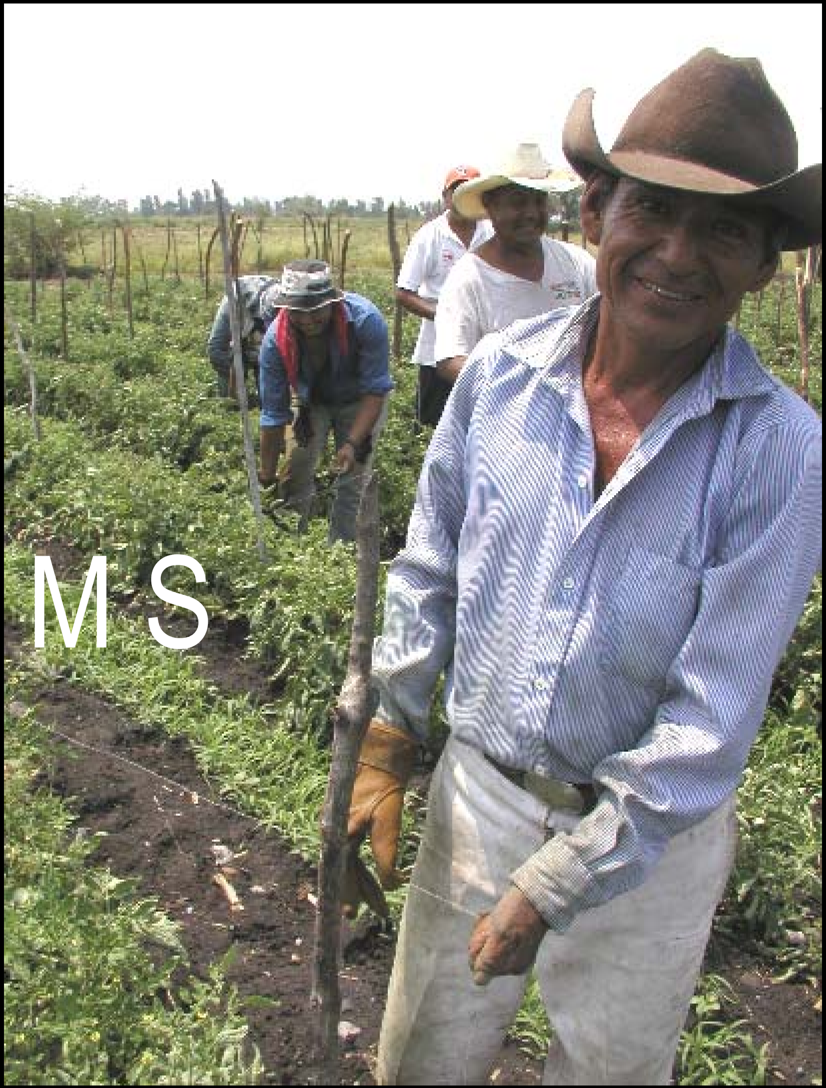
IPGRI is a FUTURE HARVEST Centre

"…economic development reduces the interest farmers have in growing diverse crop populations. As agriculture intensifies and becomes commercialized, farmers tend to specialize in crops and varieties they can sell in the market…"

REFORMS



NAFTA

Table 8: Sectoral Results, Scenarios 1 to 3a (Percentage Change from Base Model Solution)

	1. Industry trade liberalization		2. All trade liberalization		3. Trade and all agriculture		3. Trade and corn	
	Output	Exports	Output	Exports	Output	Exports	Output	Exports
United States								
Food corn	0.2		6.7	134.7	7.8	149.8	7.7	153.1
Program Crops	0.1		0.7	43.7	1.0	69.4	0.7	43.3
Fruits/vegetables	0.1	−2.9	0.4	9.6	0.6	7.7	0.5	9.4
Other agriculture	0.1	−2.4	0.2	6.9	0.3	4.5	0.2	6.8
Food processing	0.1	7.4	0.1	6.4	0.3	6.7	0.2	6.4
Other light manufacturing	0.1	5.8	0.1	5.2	0.2	5.0	0.2	5.2
Oil and refining		13.5		13.4		13.2		13.4
Intermediates	0.2	6.7	0.2	6.0	0.3	5.5	0.2	5.9
Consumer durables	0.1	7.5	0.2	6.8	0.2	6.5	0.2	6.8
Capital goods	0.1	7.2	0.1	6.5	0.2	6.0	0.2	6.5
Services		−0.6	0.1	−0.8	0.2	−0.8	0.2	−0.8
Food corn	-1.3		-13.1		-19.3		-18.9	
Fruits/vegetables	0.4	1.3	5.2	18.1	2.6	16.0	5.3	18.4
Other agriculture	−0.5	1.3		3.0	−1.9	1.4		3.2
Food processing	−0.6	6.0	−0.5	7.3	−3.1	4.5	−0.5	7.3
Other light manufacturing	0.5	7.2	0.6	8.1	0.7	8.6	0.6	8.2
Oil and refining		3.8		3.9		4.0		3.9
Intermediates	1.4	4.1	1.4	4.8	1.4	5.3	1.4	4.9
Consumer durables	3.3	5.4	4.7	7.0	5.9	8.4	4.8	7.2
Capital goods	2.4	6.7	2.8	7.7	3.2	8.4	2.9	7.8
Services	−0.3	0.3	−0.3	0.5	−0.2	0.8	−0.3	0.6

Real output and exports. Exports are to the partner country (United States or Mexico).

Robinson et al. 1993

Maiz en Mexico
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1970
1975
1980
1985
1990
1995
2000
produccion (miles de toneladas)
temporal
riego

Nauzontla, Mexico

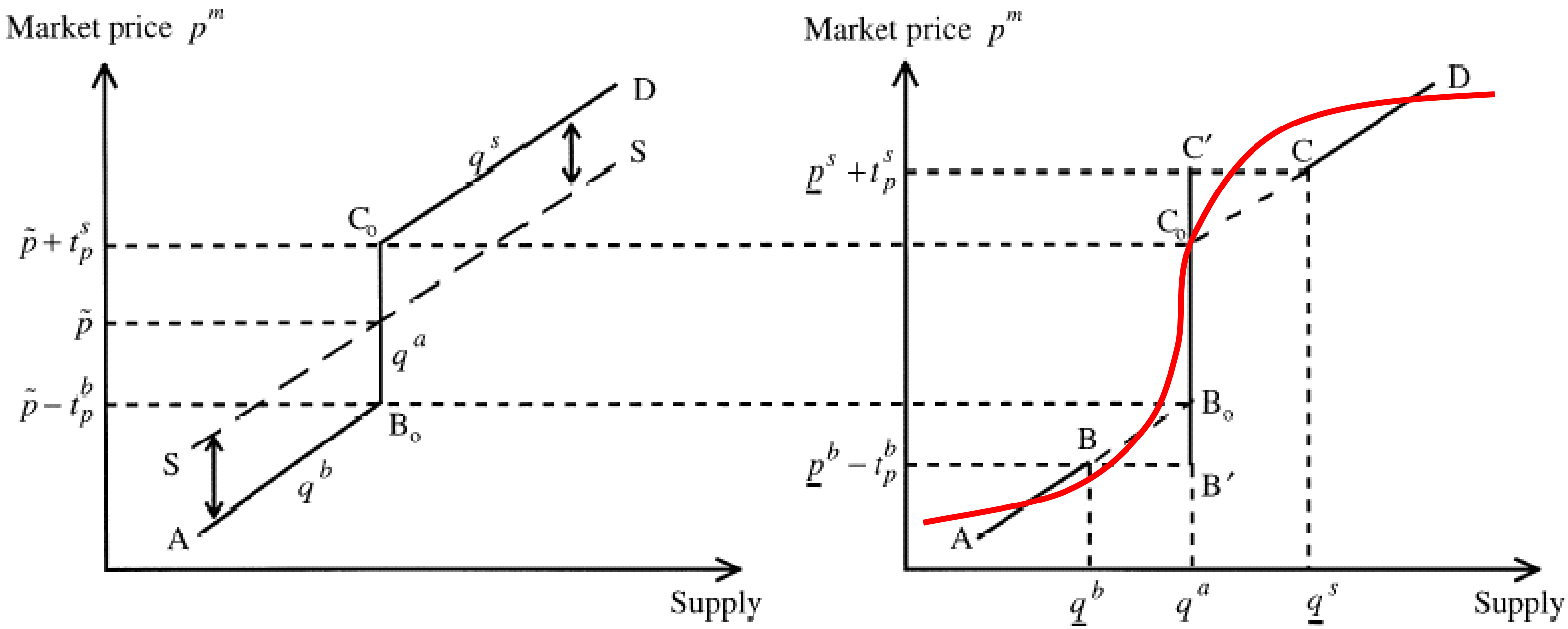


Figure 2. Household supply under (a) proportional and (b) proportional and fixed transactions costs

Key et al. 2000

(1) $u(c; z_u)$

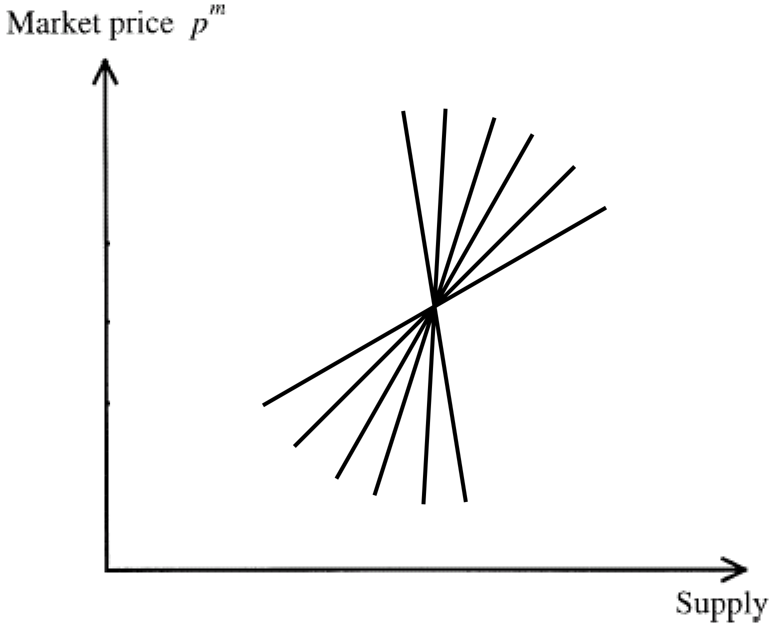
(2) $\sum_{i=1}^{N} p_i^m m_i + T = 0$

(3) $q_i - x_i + A_i - m_i - c_i = 0, \quad i = 1, \ldots, N$

(4) $G(q, x; z_q) = 0$

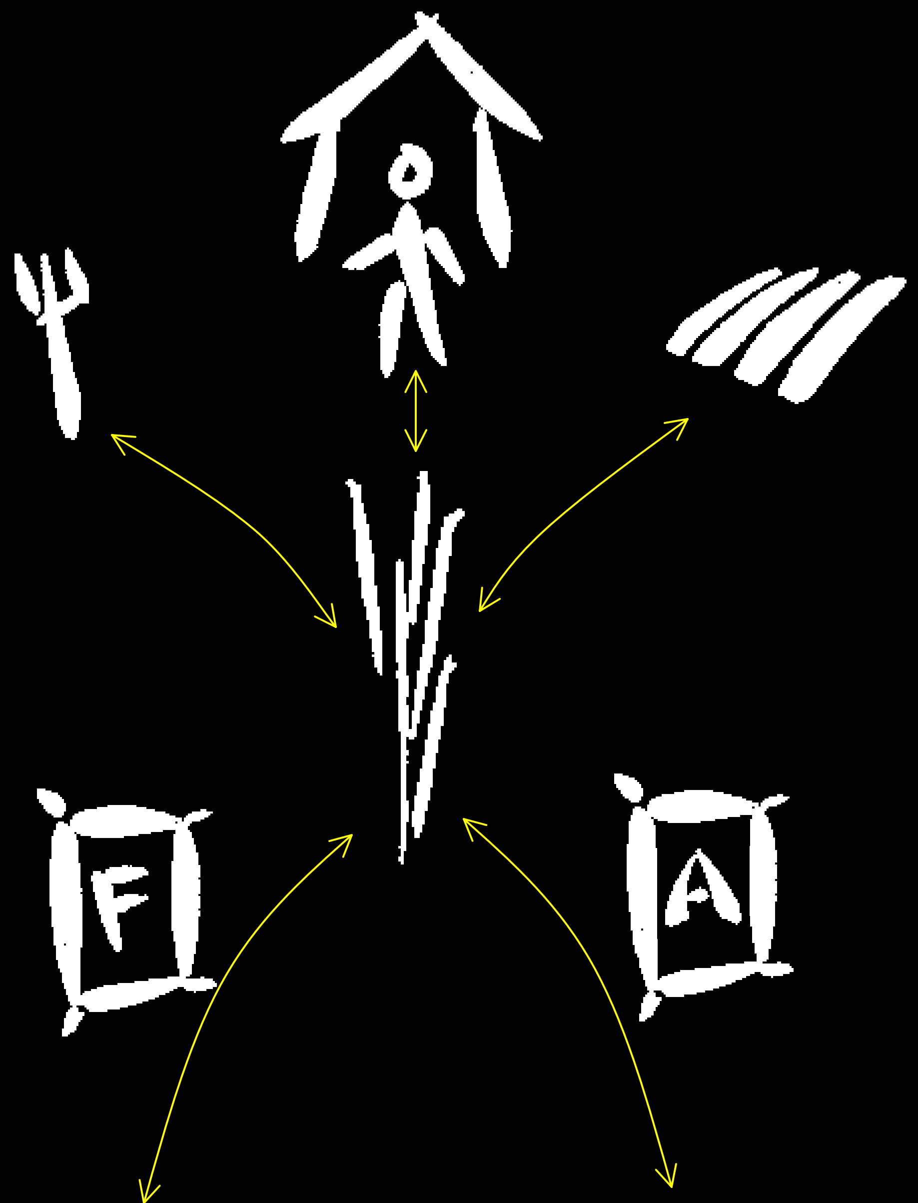
(5) $c_i, q_i, x_i \geq 0$

Key et al. 2000



"Con lo que me ahorro, siembro otro poquito"

Dyer & Taylor 2002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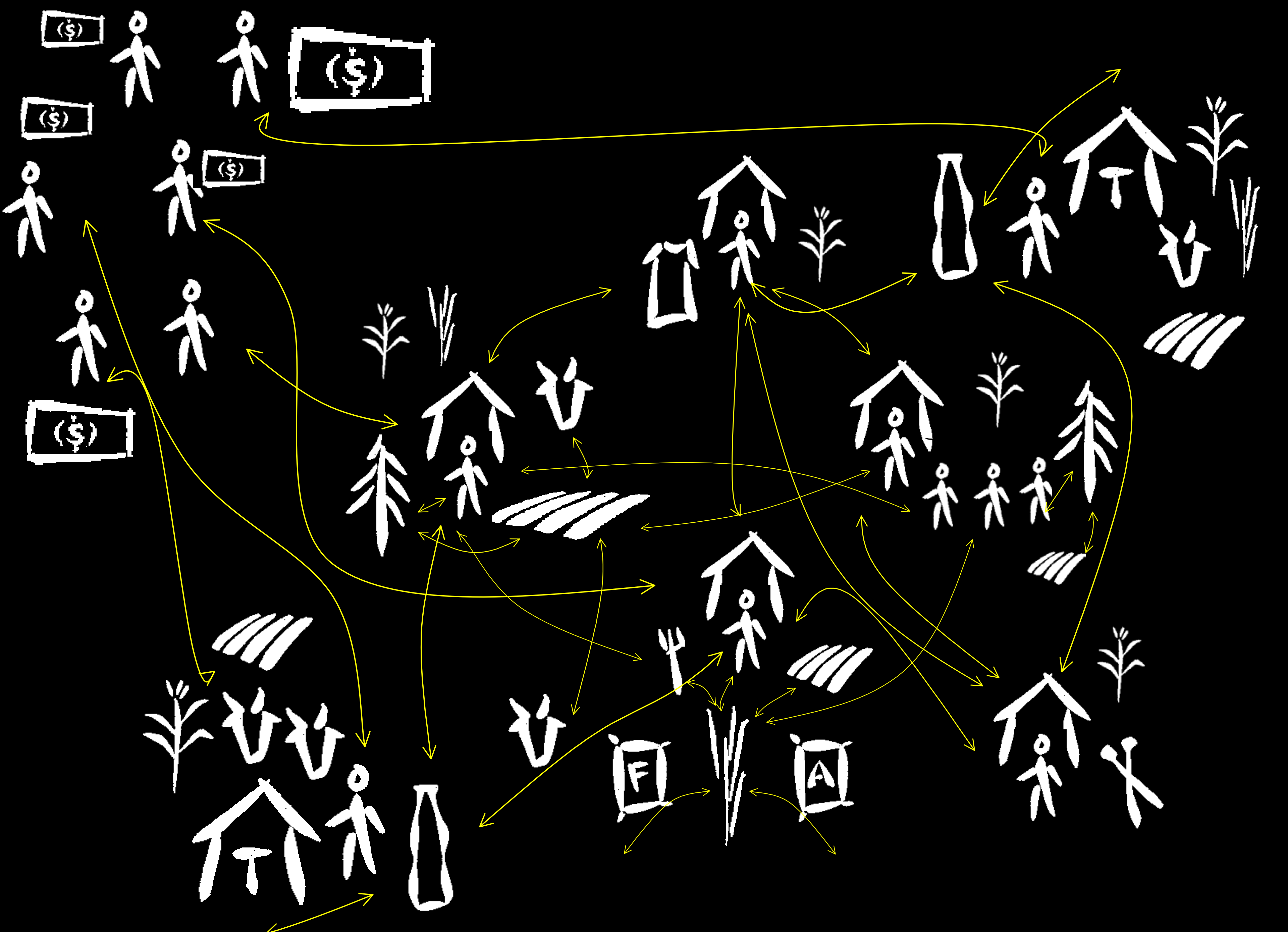
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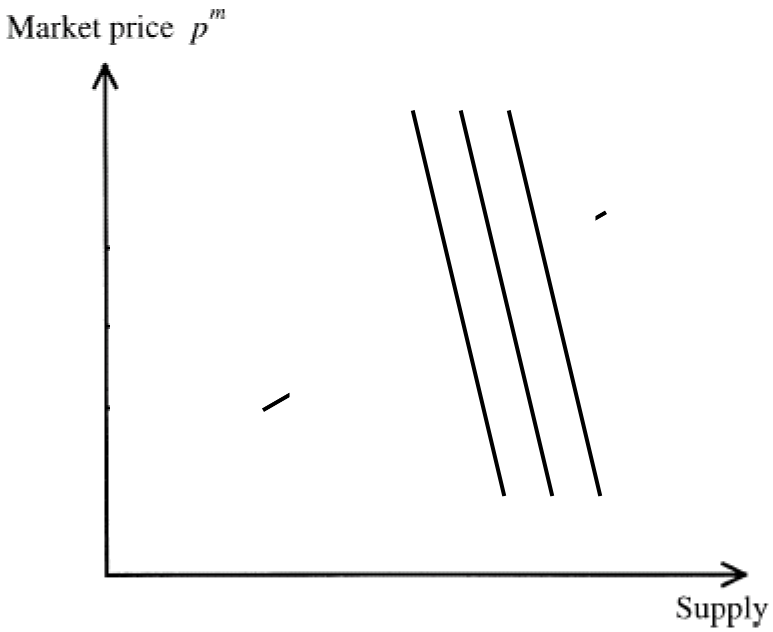
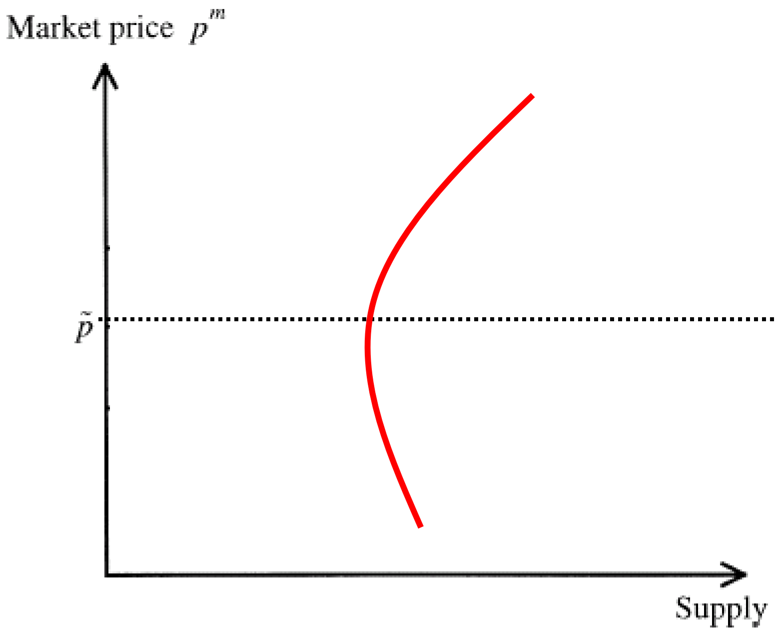


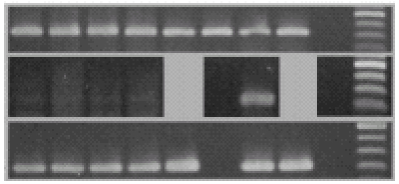
Dyer & Taylor, 2002

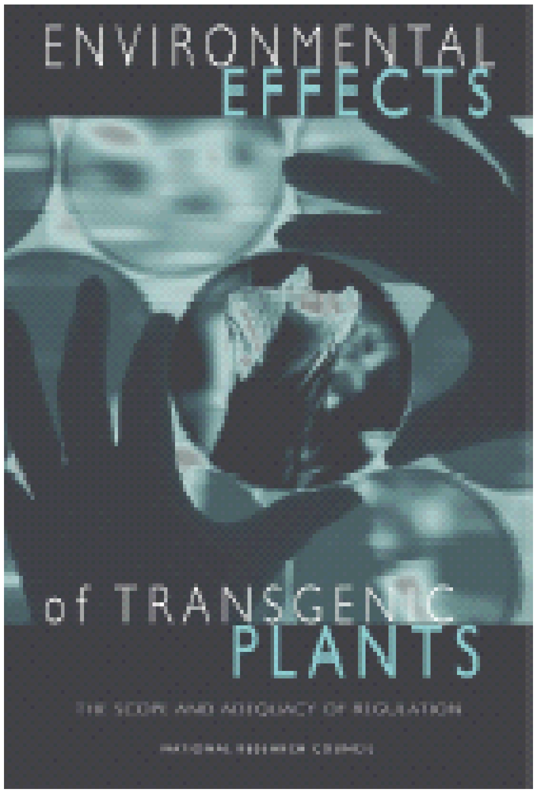


Dyer & Taylor 2002

Key et al. 2000


Sinaloa
Puebla





…the committee finds that the transgenic process presents no new categories of risk compared to conventional methods of crop improvement…

NRC 2003

PROCEEDINGS OF A FORUM

Gene Flow Among Maize Landraces, Improved Maize Varieties, and Teosinte: Implications for Transgenic Maize

Technical Editors:

J. Antonio Serratos, Martha C. Willcox

and Fernando Castillo

INIFAP

The Mexican National Institute of Forestry, Agriculture, and Livestock Research

CIMMYT

The International Maize and Wheat Improvement Center

CNBA

The Mexican National Agricultural Biosafety Committee

Held at El Batán, Mexico, 21-25 September, 1995

M. Goodman:

I don't doubt in any way that all sorts of remote Mexican farmers are going to grow transgenic crops and I think they are going to do it whether it is legal in Mexico or not. The same thing is probably true all over the world. You have everything from Mexican migrant labor to Mexican PhD students to missionaries in the Congo. All of these people think they are doing good by carrying this material around. And this has nothing to do with phytosanitary rules or any of the sorts of things that we like to think protect us against exactly this sort of thing. Somehow, regardless of the outcome, the problem has to be faced and it has to be faced worldwide. These things are never going to be restricted to a single country, as much as the companies would like to restrict them.

Transgenic DNA introgressed into traditional maize landraces in Oaxaca, Mexico

David Quist & Ignacio H. Chapela

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in crop landraces is of critical importance. Here we report the presence of introgressed transgenic DNA constructs in native maize landraces grown in remote mountains in Oaxaca, Mexico, part of the Mesoamerican centre of origin and diversification of this crop[7-9].

In October and November 2000 we sampled whole cobs of native, or 'criollo', landraces of maize from four standing fields in two locations of the Sierra Norte de Oaxaca in Southern Mexico (samples A1–A3 and B1–B3), more than 20 km from the main mountain-crossing road that connects the cities of Oaxaca and Tuxtepec in the Municipality of Ixtlán. As each kernel results from ovule fertilization by individual pollen grains, each pooled criollo sample represents a composite of ~150–400 pollination events. One additional bulk grain sample (K1) was obtained from the local stores of the Mexican governmental agency Diconsa (formerly the National Commission for Popular Subsistence), which distributes subsidized food throughout the country. Negative controls were cob samples of blue maize from the Cuzco Valley in Peru (P1) and a 20-seed sample from an historical collection obtained in the Sierra Norte de Oaxaca in 1971 (H1). Positive controls were bulk grain

manuscript, the Mexican Government (National Institute of Ecology, INE, and National Commission of Biodiversity, Conabio) established an independent research effort. Their results, published through official government press releases, confirm the presence of transgenic DNA in landrace genomes in two Mexican states, including Oaxaca. Samples obtained by the Mexican research initiative from sites located near our collection areas in the Sierra Norte de Oaxaca also confirm the relatively low abundance of transgenic DNA in these remote areas. The governmental research effort analysed individual kernels, making it possible for them to quantify abundances in the range of 3–10%. Because we pooled all kernels in each cob, we cannot make such a quantitative statement, although low PCR amplification signal from criollo samples is compatible with abundances in this percentage range.

Using a nested primer system, we were able to amplify the weak bands from all CMV-positive criollo samples (Fig. 1) sufficiently for nucleotide sequencing (GenBank accession numbers AF434747–

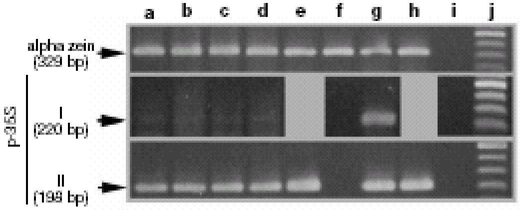

Figure 1 PCR amplification of DNA from the maize-specific alpha zein protein gene (top panel) and the CMV p-35S promoter (centre and bottom panels). The centre panel represents amplification protocol I (single amplification); the bottom panel indicates amplification protocol II (nested priming amplification). **a–d**, Criollo maize samples. Samples A2 (**a**), A3 (**b**), B2 (**c**) and B3 (**d**) are shown. **e**, Sample K1 from Diconsa store. **f**, Negative control P1, from Peru. **g**, Roundup-Ready maize RR1. **h**, Bt-maize Bt1. **i**, Internal negative control for PCR reaction. **j**, DNA ladder (100 base pairs (bp)), 500-bp marker at the top in each panel. Expected size for each fragment is marked on the left.

In Situ Conservation of Maize Diversity, Gene Flow, and Transgenes in Mexico

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Abstract

Mexico is within the primary center of domestication and diversity of maize (*Zea mays* L.). The knowledge, preferences, and farm management practices of small-scale Mexican farmers have played a key role in the evolution of maize and its diversity in the country—a role that is still present and widespread. This paper argues that these same conditions—farmers' knowledge, preferences, and farm management practices—that promoted and maintained maize diversity in Mexico would be conducive to the diffusion of transgenes into maize landraces if they were introduced in Mexico. To assess the potential diffusion and impact of transgenes into maize landraces in Mexico, it is therefore fundamental to take farmers' conditions and management into consideration. The paper describes the way Mexican small-scale farmers manage their maize populations, particularly

widespread. This paper argues that these same conditions—farmers' knowledge, preferences, and farm management practices—that promoted and maintained maize diversity in Mexico would be conducive to the diffusion of transgenes into maize landraces if they were introduced in Mexico. To assess the potential diffusion and

Mexico is within the primary center of domestication and diversity of maize (*Zea mays* L.). This diversity is confirmed by the presence in Mexico of maize races reported for Mesoamerica (Bretting and Goodman 1989). A maize race is the basic taxonomic unit used to describe the diversity of maize landraces[1]. A maize "race" has been defined as "a group of related maize plants with enough to be recognized as a group" (Anderson and Cutler 1942:71). In Mexico 49 maize "races" have been identified (Sanchez and Goodman 1992). Both isozyme analysis (Doebley et al. 1985) and analysis of morphological characteristics (Sanchez and Goodman 1992) indicate that the variability between races is significant. A long history of coevolution connects maize and human populations

Table 2. Relative importance of different maize varieties grown in Cuzalapa (survey of 39 farmers over 6 crop cycles).

		% area sown to variety	% farmers	Grain color
	Local varieties			
	White grain varieties			
1	**BLANCO**	**51%**	**59%**	**White**
2	**CHIANQUIAHUITL**	**12%**	**23%**	**White**
3	**Tabloncillo**	5%	6%	White
4	**Perla**	**0.4%**	**0.02%**	**White**
	Colored grain varieties			
5	**Amarillo Ancho**	**8%**	**23%**	**Yellow**
6	**Negro**	**3%**	**34%**	**Blue**
	Non-local varieties			
1	Argentino (2)	5%	10%	White
2	Enano (2)	3%	12%	White
3	Amarillo (1)	3%	11%	Yellow
	17 minor varieties			
4 5 6 8 9	1) Canelo - Ahumado - Blanco (de Tequesquitlán) -	<3%	<4%	Mostly
7	Amarillo (de Tequesquitlán) - Negro Gordo - Guino Gordo -	per	per	white
10 11 12	Guino rosquero - Tuxpeño - Negro (externo) -	variety	variety	
13 14 15 16	Guino (USA) - Cosmeño - Tampiqueño - Tosqueño			
17 18 19	2) Híbrido - Híbrido (mejorado) - Enano Gigante			
20	3) HT47			

Non-local varieties: 1) local varieties from other regions; 2) advanced generations of improved varieties; 3) first and second generation of hybrid HT47.

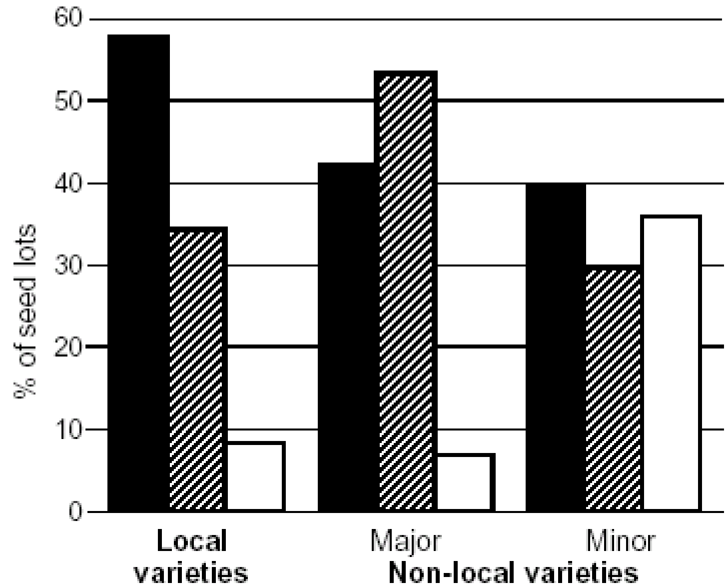
Louette 1995

Table 2 Number of maize varieties in communities across Mexico.

	total number of varieties	number of local landraces			(e) (a)/(d)[1]
Sierra Santa Marta	30	24	-	5.8	5.2
Cuzalapa	26	21	6	2.4 + 2.6	5.2
Guanajuato (Aguirre *et al.*, 2000)	23-16		-	-	-
Ocozocoautla (Brush *et al.*, 1988)	14		-	2.7 (1-5)	5.2
V. Guerrero (Bellon & Taylor, 1993)	15		-	-	-
V. Guerrero (Bellon & Risop., 2001)	20+	11+	-	-	-
Chalco-Amecameca (Perales, 1998)	8 (3-7)	7 (3-6)	-	1.6 (1-4)	5
Valley of Cuautla (Perales, 1998)	17 (4-13)	13 (0-10)	-	1.4-1.8 (1-4)	9.4-12.1
Naupan, SNP	6	6	-	-	-
Nauzontla, SNP	6	6	6	1.3	4.6
Sierra Zacapoaxtla, SNP (VanDusen, 2000)	-	-	-	1.1	-
Zoatecpan, SNP (this study)	-	-	-	1.75	-
Oaxaca (Bellon, 2001)	11?	-	-	1.6 (?-2.1)	6.9?

1. Range in parenthesis.
Source: Dyer (2002).

Dyer 2002



	Lots	Area
Own seed	52.9%	44.9%
Seed obtained in Cuzalapa	35.7%	39.9%
Introduced seed	11.4%	15.1%

Figure 3. Seed exchange: provenance of seed lots according to type of variety.

Louette 1995

Xochitlan, Mexico


S.N.Puebla
Cuzalapa
Chalco

“Conservation *in situ* is fraught with difficulties when man-made ecosystems are involved. Farms cannot simply be conserved in forest reserves or national parks.”

O.H. Frankel (1970)

ex situ conservation

“the interventions … required for the survival of landraces in agricultural landscapes would be too extensive to be considered”

IBPGR (1985)

“Contributions to the FAOs fund for genetic resource preservation have remained insignificant”

Frisvold y Condon (1998)

"If we can't save all species, we need a ranking based on one or more criteria, from which we select the highest ranked for conservation"

G. Brown (1990)

“To many [...] biologists, it seems self-evident that genetic diversity has economic value […;] economists have been more skeptical than biologists concerning the need to protect all forms of genetic diversity”

D. Gollin y M. Smale (1999)

in situ conservation

Table 3. Proportion of farmers (%F) and of area (%) with locally recognized maize types, Amecameca and Cuautla Valleys, 1995.

Maize type	Ayapango 2400 masl		Tlaltetelco 1700 masl		Tecajec 1400 masl		López 1200 masl	
	%F	%A	%F	%A	%F	%A	%F	%A
[illegible]	[illegible]	[illegible]	31	41.3	28	38.9	13	12.8
Traditional varieties								
White varieties								
White	96	87						
Cacahuacintle	8	1						
Ancho			10	10	7	<1		
Ancho-pozolero			68	55	7	<1		
Delgado					21	14		
Tehuacan					7	5	38	28
Tehuacanero					4	<1		
Ancho morado					4	<1		
Arroceño							8	1
Colored 'criollos'								
Blue chalqueño	38	9						
Blue delgado			--		4	<1	8	1
Blue ancho			16	4	11	1		
Blue (x e.occ.)					4	<1		
Xitocle	4	<1						
Red	4	<1	3	<1	4	<1	15	2
Rosa pozolero			3	<1				
Yellow	8	3						
Modern varieties								
[illegible]					18	35	38	34
MV's adv. gen.	4	<1	6	1	42	31	15	16
Costeño adv. gen.							15	19
Special cases								
'Acclimatize hybrid'			48	29				
Commercial hybrid + landrace					7	9		

Colored 'criollos' in different communities are not the same type. MV's adv. gen. are advanced generations of modern varieties, several types. Costeño adv. gen. are advance generations of costeño mejorado, an open pollinated cultivar.

Perales et al. 2003

Variedades

tipos de maíz

m.2

¿Cuáles tipos de maíz sembró en *ciclo 1*? ¿Y en *ciclo 2*? ¿Cuál es su nombre local?		¿Tiene otro nombre *variedad?* - en lengua indígena, por ejemplo, o nombre comercial.
variedad	***ciclo***	
1. Tipos de maíz	*1. Ciclo 1* *2. Ciclo 2*	*1. Tipos de maíz*

origen de la semilla

m.3

La semilla de *variedad* que usaron uds. en *ciclo,* en el 2002, ¿salió de su propia cosecha o la consiguieron con alguien más? ▶	*Si propia:* ¿Desde qué año ha guardado esta semilla sin pedirla a alguien más o comprarla? ▶	La última vez que consiguió la semilla con alguien más o que la compró, ¿fue con un familiar, un vecino, en DICONSA, en otra tienda o con quién o cómo? ▶	¿En *comunidad* o dónde? ▶	¿Algun vez ha revuelt esta semilla con otra ▶
				□ *si* □ *n*
				□ *si* □ *n*
				□ *si* □ *n*
				□ *si* □ *n*
				□ *si* □ *n*
1. Propia cosecha *2. Alguien mas* *3. Ambos*		*1. Hogares/ vecinos* *2. Tiendas* *3. Intermediario* *4. DICONSA* *99. Otro (esp.)*	*1. Comunidad* *2. Otras* *99. Otro (esp.)*	

Variedades

tipos de maíz

m.2

¿Cuáles tipos de maíz sembró en *ciclo 1*? ¿Y en *ciclo 2*? ¿Cuál es su nombre local? *variedad*	*ciclo*	¿Tiene otro nombre *variedad?* - en lengua indígena, por ejemplo, o nombre comercial.
1. Tipos de maíz	*1. Ciclo 1* *2. Ciclo 2*	*1. Tipos de maíz*

destino de la semilla

Colecta

m.4 En los últimos 5 años, ¿ha vendido, regalado o intercambiado Ud. esta semilla con otra persona para sembrar? ▸	**m.5** *Si ha dado, vendido o intercamb. semilla:* En los últimos 5 años, ¿A cuántas personas les ha dado Ud. esta semilla? ▸	¿Cuántas de estas personas son de fuera de *comunidad*? ▸	¿Dio o vendió Ud. de esta semilla a otra persona **para sembrar** en el 2002? ▸	**m.6** ¿Tiene Ud. 5 mazorcas de *variedad,* buenas para siembra, que me venda? ■	***Númer***
☐ *si* ☐ *no*				☐ *si* ☐ *no*	***Num. Comu***
☐ *si* ☐ *no*				☐ *si* ☐ *no*	***Num. Comu***
☐ *si* ☐ *no*				☐ *si* ☐ *no*	***Num. Comu***
☐ *si* ☐ *no*				☐ *si* ☐ *no*	***Num. Comu***
☐ *si* ☐ *no*				☐ *si* ☐ *no*	***Num. Comu***
1. Vendió *2. Regaló* *3. Intercambió* *0. Ninguno* *99. Otro (esp.)*			*1. Vendió* *2. Regaló* *3. Intercambió* *0. Ninguno* *99. Otro (esp.)*		

Variedades

tipos de maíz

m.2

¿Cuáles tipos de maíz sembró en *ciclo 1*? ¿Y en *ciclo 2*? ¿Cuál es su nombre local?		¿Tiene otro nombre *variedad?* - en lengua indígena, por ejemplo, o nombre comercial.
variedad	***ciclo***	
1. Tipos de maíz	*1. Ciclo 1* *2. Ciclo 2*	*1. Tipos de maíz*

Colecta

m.6

¿Tiene Ud. 5 mazorcas de *variedad,* buenas para siembra, que me venda? ■	***Número de colecta***
si *no*	***Num. Comunidad - - 1***
si *no*	***Num. Comunidad - - 2***
si *no*	***Num. Comunidad - - 3***
si *no*	***Num. Comunidad - - 4***
si *no*	***Num. Comunidad - - 5***