
3.4 Structural Adjustment, Market and Policy Failures: The Case of Maize

by George Dyer and Juan Carlos Belausteguigoitia

Overview. *This paper analyses the effects of structural adjustment policies in agriculture on crop diversity. The specific case of maize in Mexico is studied. The Mexican government has introduced high yielding varieties (HYVs) of maize into the agricultural sector in an attempt to increase productivity. In terms of biodiversity impact, the result has been a shift from traditional varieties of maize to HYVs and consequently a loss of maize diversity. The main problem is that the benefits from crop diversity are not internalised in the market system and they are therefore not taken into account by national policy-makers. In future, policy-making must take place more at the local level and be conducted in consultation with local peasants. Structural adjustment policies in agriculture too often fail to consider effects at the micro-economic level. One of these effects can be, as in the case of maize in Mexico, biodiversity loss.*

3.4.1 Introduction

A large fraction of the planet's biodiversity is maintained in developing countries; which is true not only of wild species but also of crops. Some of these countries have an interest in preserving this diversity, but lack the know-how and experience required in policy design and implementation to achieve it. The policies of biodiversity conservation have been designed and implemented largely in more developed countries, and are being exported to other countries as part of a larger set of policies commonly known as *structural adjustment*.

In developed countries, markets are the norm. Conservation policies take this for granted, and rely greatly on the correction of market failures concerning natural resources. However, in less developed countries, incomplete or even non-existent markets are the norm, and other institutions are often lacking. Still not enough attention is given to this fact when adapting policies. The transfer of policies may be positive, but it needs to be carefully examined before implementation. The conditions of resource use and conservation are particular to each country, or even region, and the indiscriminate transfer and adoption of policies may be counter-productive. This paper examines the pertinence of this transfer and its implementation in the context of maize diversity conservation in Mexico.

Maize is a staple of the Mexican diet, and it has been so for many centuries (Warman, 1995). Mexico is maize's centre of origin and diversification: 32 of the 40 ancestral varieties or "landraces" of maize in ancient Mesoamerica were developed and are preserved in Mexico, presumably in indigenous communities (Brush *et al.*, 1988). There has been a deep symbiosis between

crop and man, and indeed, this farmers' knowledge is now considered part of the crop's genetic resource (Brush, 1995). Thus, to design policies consistent with the conservation of maize diversity requires learning about the process of use and preservation of land races at different scales: from the national to the farm-household level (de Janvry *et al.*, 1995).

3.4.2 A biodiversity conservation strategy in an economic liberalisation context

When private lenders withdrew from developing countries a few years ago, the capital supplied by multilateral organisations became critical. With the financial resources from these organisations came a package of economic advice that headed many developing countries towards structural adjustment. The advice consisted of an orthodox set of policies which were often "applied indiscriminately across countries". The standard policy package consisted of (i) nominal exchange rate devaluation; (ii) trade policy reform; (iii) removal of price distortions; and (iv) tax reform. The purpose of the package was twofold: shifting resources towards tradable goods, and improving the efficiency of resource allocation (Devarajan, Lewis and Robinson, 1994).

Many of these multilateral organisations have now extended the range of their policy-export activities into biodiversity conservation and sustainable development strategies. The standard strategy in this field consists of the correction of economic and policy failures in several issues: (i) integration of natural resources into markets, (ii) elimination of price distortions that preclude, (iii) definition of property rights and (iv) integration of policies and incentive measures among sectors, and between each of these and the environment (OECD, 1993, 1995a,b). One of the fundamental instruments to achieve integration is undistorted market prices. Thus, structural adjustment policy is supposed to reach all the way into biodiversity conservation and sustainable development strategies.

One of the problems of structural adjustment is that it will take countries very far from their starting point. The process requires resources, institutions and human capital that are very scarce in developing countries. Thus, governments may adopt some policies and delay others, according to their possibilities, without fully considering that the policies have been designed to work together, and that their partitioning can produce different results from those expected. Predicting and avoiding unwanted results, however, also requires resources.

Establishing market prices and trade liberalisation in sectors that are already within the market have come first in the adjustment process, since it is

relatively straightforward. As a result, market liberalisation in some sectors is now concurrent with the lack of markets or at least the pervasiveness of market failures in other areas. Many natural resources, and certainly maize genetic resources, are usually in the latter circumstance, since markets fail to reflect the value of the maintenance of their diversity (Boyce, 1995). This will not necessarily lead to an efficient resource allocation, but quite the contrary. For example, it has been suggested that maize trade liberalisation in Mexico, particularly the North American Free Trade Agreement, threatens to eliminate much of this crop's genetic diversity, partly due to "ecological dumping" (see for example, Boyce, 1995, and references therein).

Another difficulty in the adjustment process, derived from the first one, is the integration of economic and environmental policies. Biodiversity conservation has raised the issues of irreversibility, non-substitutability and the existence of thresholds at the bargaining table. All of these concerns exist in the context of widespread uncertainty and even ignorance. This also characterises the pervasive links between many economic sectors and the environment. The effects of policies are often transmitted through them, ultimately affecting biodiversity conservation (OECD, 1995b). Thus, if the links are not identified, different and seemingly unrelated policies may counteract each other with unexpected results. The links between the agricultural, livestock and forestry sectors and biodiversity conservation are many. The limited extension of land inevitably produces a trade-off between the possible land-uses, including economic activities, but also, ecosystem conservation. Therefore, the lack of policy integration and incentive measures would be critical in crop diversity conservation

Indeed, work on a sustainable agriculture strategy has achieved relevance in many countries (see for example OECD, 1995a); some work has also been done towards a consensus on a biodiversity conservation strategy (see for example OECD, 1995b); and there have also been some advances in agricultural and environmental policy integration (see for example OECD, 1993). However, reference to crop diversity in either biodiversity conservation or sustainable agriculture strategies is marginal (OECD, 1995a,b, although see WRI, IUCN and UNEP, 1992). Moreover, agricultural and environmental policy integration focuses on either the perverse effects of agriculture on natural resources (e.g. deforestation) or on the effects of agro-chemicals on the environment (e.g. pollution). An approach to this problem could require that selected governmental institutions have biodiversity conservation strategies of their own, which would be coordinated by the Ministry of the Environment (OECD, 1995b). This approach may seem burdensome in many cases, but should be carefully considered in the foregoing case.

Maize, for example, is well established on the international market; and it is thus subject to agricultural and trade policies. However, maize as a genetic resource is not, since maize's price excludes the value associated with the conservation of its diversity. Correcting this market failure requires government intervention. As long as it is not corrected, maize genetic diversity will be inadvertently but directly affected by agricultural policies, and indirectly by other policies. The joint effect of all of these on land races is largely ignored and unexplored, and the omission is aggravated by the uniqueness of this kind of diversity: in contrast with natural ecosystem conservation, setting aside areas from human intervention will not preserve crops' genetic diversity; the evolution and preservation of this diversity is completely dependent on human activities.

3.4.3 Maize use and conservation by peasants in its cradle area

During the last twenty years, there has been concern that the "green" revolution has backlashed and endangered the biological resources that gave it origin: high-yielding varieties (HYVs) may have displaced land races in crop "cradle" areas, even though the germplasm of land races has provided the material basis from which HYVs have been developed (e.g. Hawkes, 1983 in Bellon and Brush, 1994; Barkin, 1987).¹ This constitutes a generalisation that needs to be particularised, but should nevertheless alert decision makers. The production of maize in Mexico and the policies affecting it are an interesting study case.

For several decades, HYVs have been introduced in Mexico. Nevertheless, as early as 1971, Hernández (in Bellon and Brush, 1994) suggested that the introduction of HYVs in Mexico actually increased the number of maize varieties. Indeed, Ortega-Paczka (1973 in Bellon and Brush, 1994) found that in spite of great social and economic changes in the State of Chiapas, Southeastern Mexico, the number of maize varieties had not diminished between 1946 and 1971.

However, David Barkin (1987 in Yúnez *et al.*, 1993) suggested that autochthonous, well adapted maize races are endangered by official efforts to modernise agriculture, in particular by the extended adoption of improved seeds and by the tendency to substitute maize for exotic crops such as sorghum. Besides, according to him, public policy in the sector has historically widened the gap between modern and traditional agriculture, with commercial growers on one side and peasants or subsistence growers on the other. At that time, it was suggested that mainly the latter were

¹ There have also been some analog concerns about the effects of transgenic crops on their wild relatives (e.g. Hoffman and Carroll, 1995).

responsible for the conservation of land races. According to Barkin, since peasants have preserved and transformed land races by using their own seeds in the agricultural cycle, subsidies to seeds of HYVs – which are produced commercially by other agents – will change these patterns, and the consequence will be the substitution or loss of native genetic resources.

The information on the characteristics of maize production in Mexico is very scant. Most of the official statistics are aggregate and pertain to macroeconomics. This kind of information is not sufficient to understand the dynamics of crop diversity conservation, but it does reveal some interesting patterns. Yúnez and his associates (1994) examined some of the available aggregate statistics based on the dichotomy of commercial and peasant agriculture. They observed that large scale, irrigated, high-productivity maize cultivation is associated with the use of HYVs. These producers incur the highest input costs per hectare, sell most of their production and receive the highest benefits. Owners of small, rain-fed plots, in contrast, largely produce their own seed, have low costs and benefits per hectare, and consume a large part of their maize production. In their view, the statistics do point to the fact that peasants – especially in southern Mexico – are responsible for the use and conservation of maize landraces.

De Janvry and his associates (1995) investigated the microeconomics of maize production within the peasant sector, based on an official social-sector survey (SARH-CEPAL, 1990, in de Janvry *et al.*, 1995).² This survey data is more revealing of causal relationships than aggregate statistics since it explores patterns at the household level. Working with data from three Mexican states, they categorised maize producers according to their production/consumption ratio and their diversification into other crops. The analysis of the data revealed that a large farm size is a determinant of achieving seller status. Sellers also own more capital goods, a larger share of land under irrigation; they display a greater incidence of use of some inputs, and practice more intensive methods; they also belong more frequently to marketing and producers' organisations and have more opportunities for lowering transaction costs. Finally, families of sellers are smaller, and their members are dedicated more often to agriculture (de Janvry *et al.* 1995). However, the survey reveals little in terms of landrace management.

Soon after Barkin's suggestion, Steve Brush and his associates (1988) tested the genetic erosion hypothesis in the Mexican State of Chiapas. They surveyed individual households, focusing on the management of genetic diversity. They found that in peasant communities, maize diversity is often apparent at the household level (see also Bellon and Brush, 1994);

² The social sector is basically formed by the ejido --property of the State but held individually by peasants-- and land property of indigenous communities.

households often own several plots that are distributed on different climatic and soil types, which seems to guarantee equity among community members. This fragmentation and consequent environmental diversity often forces households to grow different varieties of maize on their plots. Thus, the substitution process should occur within as well as among households, which emphasises the need to investigate at this level.

They recorded 14 different varieties, and an average of almost three varieties per household after 20 or 30 years of HYVs introduction. Only one of these varieties was a HYV. They found that when the HYV was introduced, households added it to their repertoire without abandoning the land races. This seemed to be a consequence of the heterogeneity of soil types, which is a rather permanent factor in this area. Thus, the introduction of HYV's actually increased the *number* of races. However, its effect on genetic diversity is not clear: while several races were found in the flat valley bottom, the HYV occupied 60% of this land. At the same time, eight land races and the HYV were found on the hillsides. Since the flat land was opened first, while hillsides have only recently been put into agricultural production, the data suggests that land races have been displaced by the HYV (Brush *et al.*, 1988).

Several socio-economic factors could explain this substitution. Within a household, the total area planted with maize, the amount of hired labour employed in maize production, and the amount of family labour in off-farm work were all positively correlated with the percentage of area planted with an HYV, and thus, negatively correlated with the percentage of area planted to land races. Brush and his associates thus suggested that use of the HYV is associated with a higher availability of capital. Their results also suggested an association of HYV use with risk aversion, which seems contrary to findings of other researchers (Brush *et al.*, 1988).

Bellon and Taylor (1993) took this case further by trying to explain the partial adoption of HYVs in Chiapas, with the use of an econometric model. They found that environmental as well as socio-economic factors are involved. According to their results, the use of three different groups of varieties of maize is associated with increases of specific soil types in the household landholding. HYVs and intermediate varieties (advanced generations of an earlier HYV) are associated with increases in the best soil types, while the traditional varieties are associated with increases in the poorest soil types. This explains the substitution of land races for HYVs in the valley field, and the displacement of the former to the hillsides (Bellon and Taylor, 1993). Other factors associated with use of HYVs are (i) overcoming of credit and human capital constraints, and (ii) young age of farmers. Factors associated with use of traditional varieties are (i)

fragmentation of landholding, (ii) availability of male family labour, and (iii) off-farm income (Bellon and Taylor, 1993).

3.4.4 Economic, agricultural and conservation policies

Structural adjustment in the agricultural sector

During the last few years, Mexican agriculture has gone through major policy changes as part of structural adjustment. In 1992, the *Ejido* reform was introduced to give flexibility to the land market and help define property rights (see for example Yúnez-Naude, 1995). The reform legalised the renting and even selling of *ejidal* land among peasants, but also the renting by peasants to private investors. It also legalised the ownership of other land by corporations, either national or foreign. Thus, it promoted the formation of larger, private landholdings.

Other policies consisted of the restructuring and descaling of state participation in research and extension, marketing, insurance, fertiliser, seed, and other inputs; but also, reorganisation of the financial sector and elimination of credit subsidies (Thompson and Wilson, 1994; de Janvry *et al.*, 1995). Besides, officially guaranteed prices were eliminated for all but two crops: beans and maize. Instead of these, a program of direct income transfers (PROCAMPO) was established. This substitution is consistent with the promotion in multilateral organisations like GATT, of de-coupled (not linked to production) forms of support for agriculture, (OECD, 1993). Finally, agricultural trade quotas have been substituted by tariffs (Yúnez-Naude, 1995). Most, if not all of these policy changes have occurred at the federal level.

Agricultural Policy

In addition to these major policies, in October, 1995, the National Agriculture and Livestock Program for the new Federal Administration was presented by the President and the Minister of Agriculture, Livestock and Rural Development (Zedillo, 1995; Labastida, 1995). It is a six-year program with short and long term objectives produced jointly by eight Federal Ministries as well as several national-level producer organisations. It is thus conceived as an integral, decentralised program for agricultural production and rural development, with a clear market orientation but mindful of the natural environment. Its main objectives are (i) increasing rural producers' income, (ii) productivity; (iii) achieving national alimentary sufficiency, and (iv) promoting agricultural foreign trade. The program is planned to achieve greater productivity by transferring decision making to producers. Consistently, applied research and extension will be transferred to local governments, but basic research and policy-making will remain centralised.

Two specific programs are focused on small-scale and subsistence producers. PROCAMPO has been given a semi-permanent character, since it will be applied uninterrupted for the following 15 years, and the transfers involved will be indexed to inflation starting in 1996. The second major transfer program, known as PRODUCE, will be destined to three different goals: (i) capitalising producers, (ii) achieving productive re-conversion, and (iii) preserving natural resources.

In its capitalisation mode, PRODUCE will subsidise the acquisition of equipment – including irrigation and fertilisation equipment – for agricultural production, but it will also subsidise the establishment of pastures for livestock. In its productive-reconversion mode, it will consist of decoupled transfers to producers who decide to change production from annual to perennial crops. Finally, in its conservation mode it will support “ecological” projects that promote a more efficient use of water and soil. The National Forestry Program, under the Ministry of the Environment, Natural Resources and Fisheries, will also depend on PRODUCE’s reconversion mode to promote the establishment of commercial tree plantations on lands that currently hold annual crops (Programa Forestal y de Suelos, 1996). It will also promote ecosystem restoration with financial resources from the Forestry Development Fund (FONDEFOR).

Apart from the former, the basic grains sector will be bolstered by technological transfer and capitalisation. Even though alimentary sufficiency in basic grains is one of the objectives of the National Agricultural and Livestock Program, the promotion of HYVs was not mentioned at its presentation. However, since the relatively low use of HYVs in this sector is perceived by high-ranking government officials as a major lag (Herrera, 1996), it seems likely that use of HYVs in maize production will be encouraged.

Some Comments on Policies

Concerning agricultural policy, it should be noted that it is obviously a policy focused on increasing productivity, and not on conserving crops’ genetic diversity. Genetic resources are still very much out of the market, but also out of government policies. These policies and structural adjustment were intended to define property rights (in the case of land), and to promote increasing returns to scale, efficiency in resource allocation, and higher productivity. However, because of the exclusion of conservation benefits from the market price, they may also have inadvertent consequences in biodiversity conservation. If this were the case, it would constitute a policy failure. Therefore, it is useful to analyse our current understanding of maize diversity management.

According to Bellon and Brush (1994) the *ejido* organisation favouring non-partitioned inheritance of land and prohibitions against selling or renting land were factors favouring the fragmentation of household landholdings into small plots distributed on differing work sites. In turn, these patterns promoted crop diversity conservation since they increased the number of households keeping maize land races. Indeed, Bellon and Taylor (1993) found that landholding fragmentation was associated with the growth of land races, as opposed to HYVs. Yúnez and his associates (1994) also note that the use of land races is associated with small landholdings. All of these characteristics of *ejido* organisation were undermined by the *ejido* reform.

The reform also legalised the renting of *ejido* land by commercial farmers. According to Yúnez-Naude and his associates (1994), commercial maize agriculture is associated with the use of HYVs. Therefore, while the reform was intended to give flexibility to the land market, promote returns to scale and define property rights, it could inadvertently work against the conservation of land races by peasant households.

Regarding trade, several macro-economic studies have analysed the impact of the North American Free Trade Agreement (NAFTA) on Mexican agriculture (these studies are cited in Yúnez-Naude, 1995). All of them concluded that maize production would be substantially reduced. However, these macro studies probably overstate the effects of NAFTA, since they ignore the flexibility of rural production (Taylor & Yúnez, 1995). De Janvry and his associates (1995) were interested in analysing the impact of NAFTA on the social sector based on more detailed information. According to their predictions, because of high transaction costs, maize trade liberalisation, and its consequent price decline in Mexico, will affect mostly commercial producers of maize, but scarcely subsistence producers. However, the current agricultural policy intends to convert the latter into the former.

Taylor and Yúnez (1995) modelled the economy of an *ejidal* community in central Mexico. They predicted the effects on the agricultural sector of a fall in the price of maize due to its liberalisation. Then, they predicted the effect of two different policies designed to mitigate the decrease in family income after liberalisation. The first policy is PROCAMPO; the alternative policy is a local increase in government investment – in the same amount as PROCAMPO – and a subsequent increase in agricultural productivity. According to their results, PROCAMPO had no mitigating effect on agriculture, while the alternative policy cut by one third the decrease in production due to price liberalisation.

The effects on biodiversity of structural adjustment and its mitigating policies cannot be fully assessed without studying production/consumption linkages within and outside rural villages, which occur between the economic sectors and with natural resources. However, if the trend towards elimination of guaranteed prices and trade liberalisation continues, maize production will undoubtedly fall.³ The conservation of local land races could be undermined by the lack of markets for its benefits. Thus, the alternative policy could be considered as a solution to the market failure affecting the conservation of these resources.

Some Comments on Policy Integration

The National Agricultural and Livestock Program was designed as an integrated initiative. However, as we have seen, its environmental consequences have not been sufficiently weighted. The major joint effort between the Agricultural and Environmental Ministries will probably exist through the PRODUCE, in its conservation mode. This program, however, will centre on sustainable use of water and soil. A deficiency of policy integration, however, is evident in this same program but in its capitalisation mode.

As we have seen, PRODUCE will subsidise investment in agricultural equipment, which will probably raise productivity and production of maize, and have as yet indeterminate effects on conservation of its genetic resources. However, PRODUCE will also subsidise the seeding of pastures for livestock even though the decrease in maize, all of its own, could expand livestock production (Boyce, 1995). Since growth of land races has been displaced from the most productive to marginal agricultural lands (Brush *et al.*, 1988), maize's genetic resources could be squeezed between high-productivity agriculture, livestock, forestry, and ecosystem conservation which claims marginal agricultural land. Moreover, PRODUCE's productive-conversion mode will also undermine maize production, since it is intended to promote perennial crops.

The objectives of the previous policies must be understood. PROCAMPO is intended to raise family income without distorting production. The objectives of PRODUCE's conversion mode seem various, and raising income may be one of them. In its capitalisation mode PRODUCE is intended to promote agricultural production, which is consistent with an alimentary self-sufficiency objective. But it will also subsidise the livestock sector. Livestock in Mexico has little value in terms of biodiversity (OECD, 1995b). Nevertheless, livestock production may as well be a national

³ There has recently been a sharp reduction in maize production in Mexico. The culprit is variously identified in the downfall of maize's guaranteed price (Hernández Navarro, 1996), in financial problems (Gómez, 1996), as well as on extended drought (Alemán, 1996).

priority, as the previous objectives clearly are, but the previous group of policies are most probably incentive incompatible, and their results could be unwanted. All of this makes an undeniable case in favour of integrating economic and conservation policies.

A Note on Decentralisation

Notwithstanding policy integration, sustainability may imply trade-offs between different desired outcomes (see for example OCDE, 1995a). Nevertheless, to anticipate these trade-offs the links between sectors must be understood. The nature of the links may vary from region to region. The result of a given policy is quite sensitive to a region's economic circumstance. High transaction costs may imply a closed market for certain sectors, which affects the outcome of policies such as PROCAMPO and PRODUCE (Taylor and Yúnez, 1995). Although this type of circumstance is common in rural Mexico, it is seldom assumed in policy analysis (de Janvry *et al.*, 1995; Taylor and Yúnez, 1995). But then again, policy analysis requires often scarce resources.

3.4.5 Conclusions

The import of policy packages and their implementation at the national level will usually dismiss the differences between regions and undermine conservation efforts. Even though there is still much to learn in terms of peasant maize management in Mexico, we could benefit from policy integration at the present time based on the current state of knowledge. Nevertheless, policy making needs to take into account local conditions as well as non-evident links among economic sectors and with the environment. This will require an infrastructure and human capital that is often non-existent. However, some recent studies have addressed economic linkages of the previous type, at the local level, only to find unexpected results (see for example Taylor and Yúnez, 1995; Yúnez-Naude *et al.* 1995). However, the study of linkages involving effects on biodiversity and other natural resources is only now being developed.⁴

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⁴ This sort of work is being done as part of the project "Conservation of genetic diversity and improvement of crop production in Mexico: A farmer-based approach", funded by The McKnight Foundation, in which one of the authors is presently involved.

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