

# Spatiotemporal dynamics of crime in Mexican agroecosystems and socioeconomic performance (2006-2022)

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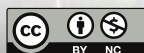
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## ABSTRACT

**Objective:** To identify the spatiotemporal dynamics of the types of crime committed in Mexican agroecosystems and their relationship with the economic performance of Mexican states from 2006 to 2022.

**Design/Methodology/Approach:** The study consisted of the following stages: 1) documentary research; 2) collection of data from official indicators and a hemerographic review of 292 newspaper articles; and 3) a statistical analysis for the evaluation of the information collected.

**Results:** The most frequent crimes in agroecosystems from 2006 to 2022 were homicide, kidnapping, and extortion. The most impacted productive components were livestock, avocado, and seed trade. The states with the highest criminal rates were Guerrero, Michoacán, and Sinaloa. Likewise, according to the statistical analysis, a decrease in socioeconomic indicators causes an increase in crime in the agroecosystems and vice versa.

**Study Limitations/Implications:** The information analyzed was obtained from newspaper reports, given the lack of statements or documents with official figures on the incidence of crime in Mexican agroecosystems.

**Findings/Conclusions:** According to theoretical approaches that consider crime as a fundamentally rational act (based on benefits and costs), crimes in agroecosystems increase as the indicators of economic development decline, and diminish as the economy grows. This phenomenon can be analyzed from a social and economic approach.

**Keywords:** Mexican agroecosystem, crime, rural crimes, economy.

## INTRODUCTION

Agriculture is the most important economic activity both for the biological maintenance of humanity and its social reproduction, as well as for the employment and income it generates for rural areas (FAO, 2009). Likewise, agriculture makes a major contribution to the Mexican economy, because it creates jobs, preserves natural environments, and promotes progress in rural areas. However, given that agriculture produces wealth, agricultural producers are continuously exposed to crime.



Although the reasons that motivate a person to commit crimes are diverse, they can be divided into two main categories: irrational criminal conduct and the rational behavior of a subject who seeks a benefit (Becker, 1974). This research focuses on the latter, since rational individuals who decide to commit a crime expect to obtain greater benefits than they would obtain by legal means; on the contrary, if individuals consider that they will have better opportunities in legal activities, they will be less likely to commit a crime. Therefore, before engaging in illicit activities, people evaluate their profitability; however, faced with the opportunity to obtain a higher income through legal means, their motive to commit a crime disappears. In conclusion, the level of crime increases when economic recessions cause high unemployment rates (Lozano *et al.*, 2018).

Quiroz *et al.* (2015) explain that the global indicators of economic activity and crime have a non-monotonic relationship, because crime diminishes when economic performance is high and increases when the economy declines.

In this sense, crime is a consequence of social disintegration —which is characterized by deep economic polarization, lack of opportunities, and loss of values (Calvillo, 2014). It is a maladjustment that challenges society through non-compliance with the rules of coexistence. It can be found throughout the world, without distinction of social strata and it results in violence, robberies, terrorism, drug trafficking, rape, murder, etc. (Jimenez, 2005).

Criminal violence is one of the problems with the greatest repercussions in Mexico, because it generates human losses, impacts economic activities, causes school absenteeism, and leads to forced migration (Quiroz *et al.*, 2015). Romero *et al.* (2013) point out that the violent criminal conduct that impacts the Mexican economy consist of operations with resources of illicit origin, such as extortion, robbery, kidnapping, human trafficking, drug trafficking, threats, attacks, home invasion, collusion of authorities with criminals, smuggling, forgery, identity theft, burglary, obstruction of the transport system, and homicide. These authors indicate that agriculture is among the most affected economic sectors, since some crimes occur specifically in rural areas, such as the theft of tractors or livestock. Meanwhile, Ceccato (2016) also includes crimes against nature and wildlife among criminal activities committed in rural areas.

In addition to the loss of human lives, crime deeply affects the economic activities of the agricultural and rural sector (Cornejo and Rojas, 2017; Aguirre and Gómez, 2020), since productivity and the ability to provide jobs are reduced by bribery, theft of machinery, livestock, and merchandise, and kidnappings. Some people even stop their economic activities, afraid of becoming victims of violent acts (Díaz and Díaz, 2016).

Smith (2020) highlights that agricultural producers distrust the authorities, because the authorities do not intervene in a third of the crimes that occur in agroecosystems, either due to the lack of complaints or because many of the reported cases are not solved, generating a feeling of rejection. According to Díaz and Díaz (2016), the lack of complaints is related to the potential collusion of rural authorities with criminal groups, generating fear of repercussions if a victim files a report. Therefore, rural population distrusts the authorities, as well as each other. For example, just like the police, some members of the

community associate with criminal organizations to guarantee their well-being, attacking their communities and causing social disintegration.

Although the way in which crime threatens the integrity of rural producers, causes displacement, encourages the abandonment of land, harms production, and violates the quality of life has been documented, the dynamics between crime in Mexican agroecosystems and economic activity has not been analyzed. Consequently, the objective of this research was to identify the spatiotemporal dynamics of the types of crime committed in Mexican agroecosystems and their relationship with the economic performance of the Mexican states from 2006 to 2022.

## MATERIALS AND METHODS

The research mainly consisted of the collection of documentary information and the processing and analysis of the data.

Data was obtained through a hemerographic review and through official indicators. For this purpose, a compilation of newspaper articles about the impact of criminal activities in the agriculture and the rural areas of Mexico was carried out. The said articles had been published in two national circulation newspapers, *La Jornada* and *Reforma*, between December 1, 2006 and November 30, 2022. To address the relationship between crime and the economic performance of Mexico, variables that provided valuable information were established to better understand this dynamic. The variables are described in Table 1.

The information on these variables was captured per year and per state. These data were retrieved from the INEGI consultation portal and the reports published by each state government.

**Table 1.** Variable description.

Variable	Variable Name	Description	Unit of measurement
GDP	Gross Domestic Product	Indicator of a country's economic performance. It can be used to assess economic prosperity and growth over time.	Millions of pesos
GDP PA	Gross Domestic Product by Primary Activities	This indicator specifically focuses on the contribution of agricultural and rural activities to GDP.	Millions of pesos
UR	Unemployment Rate	Indicates the proportion of unemployed people in the active population. Unemployment is related to crime as unemployed individuals facing economic hardships may be more inclined to engage in criminal activities out of necessity.	Percentage
PC	Perception of Corruption	Measures the public perception of corruption. High corruption indices may indicate that it contributes to crime by reducing the effectiveness of institutions that provide security and justice.	Percentage
CIR	Crime Incidence Rate	Indicates the frequency of crimes in specific geographic areas. It helps to understand the magnitude of the crime problem and how it changes over time.	Absolute numbers
CI	Crime Incidents (according to news reports)	Indicates the number of crimes occurring in rural areas. Since there is no source that registers crimes affecting the countryside, news reports can provide useful information to understand this problem, its implications, and the most recurrent regions.	Absolute numbers

The analysis was carried out in two stages: 1) review of newspaper articles; and 2) statistical analysis of the variables.

The hemerographic review was made up of 292 newspaper articles. The variables used for the text analysis were: productive component of the impacted agroecosystem (activity), location (state), date, and crime classification. Table 2 describes the crimes identified in the articles.

Given the extensive amount of data, a six-year average was developed. Consequently, two six-year and one four-year sets with six variables per state were calculated.

Descriptive analysis was carried out with STATISTICA (v. 8.0) to obtain the mean and standard deviation of the variables. Subsequently, diagrams were developed to graph the behavior of the variables throughout the study period. The same exercise was repeated, taking into account only the last year of each period, to obtain a perspective related to the exchange rate between them. However, due to the lack of information before the first period, 2007 was used as a reference year.

## RESULTS AND DISCUSSION

The crimes with the highest rates are homicide, kidnapping, and extortion, which are not necessarily typical of agricultural contexts and, on the contrary, are more frequent in

**Table 2.** Description of crime types.

Crime classification	Description
Cattle Rustling	Involves the theft of animals, mainly horses or cattle, and is characterized by its rural nature (Norza <i>et al.</i> , 2012). It is considered an act against property and is stipulated in most penal codes of livestock-rearing countries, as it affects the growth of the sector (Cornejo and Rojas, 2017).
Extortion	Article 390 of the Federal Penal Code defines extortion as the act of forcing another to give, do, refrain from doing, or tolerate something, with the purpose of obtaining a benefit for oneself or for someone else and/or causing harm to another's property. This includes the collection of fees for protection or "floor rights".
Homicide	A violent act that disrupts the victim's body and causes death, either immediately or due to complications that cannot be treated because they are incurable or because of lack of access to necessary resources (Padrón and García, 2018).
Theft	Taking someone else's property without the owner's consent. It is a crime against economic property that is situational and opportunistic, as its execution depends on three elements: object, person, and place, where accessibility, vulnerability, potential gain, and chances of success are evaluated (Norza <i>et al.</i> , 2012).
Kidnapping	Physical and movable deprivation of a person's freedom, meaning that victims cannot move from one place to another. Its motivations attack the victims' property, as they are forced to deliver money, information, or some goods in exchange for their freedom (Muñoz, 2019).
Piracy	A crime related to copyright, such as the production, reproduction, importation, storage, transportation, distribution, sale, or rental of copies of works, phonograms, videograms, or books protected by the Federal Copyright Law for profit and without the authorization of the copyright holder.
Illegal Logging	Activities that involve dismantling or destroying natural vegetation, cutting down, uprooting, toppling, or felling trees.

urban areas. The most characteristic crimes of the countryside, such as cattle rustling and illegal logging, have a lower incidence (Figure 1).

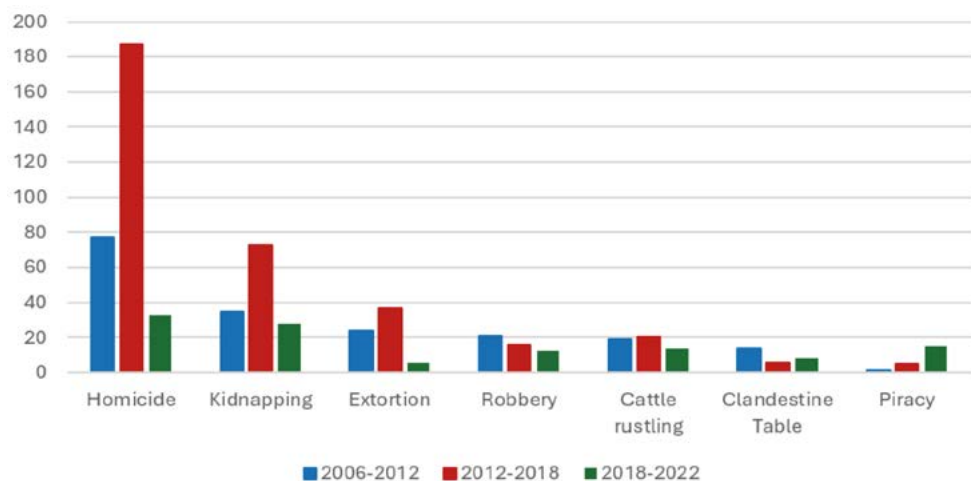
In this study, homicide was the most common crime. The victims belong to any productive component without distinction. Nevertheless, most homicide victims are ranchers, agricultural business owners, and producers who had been previously kidnapped or who refused to pay protection rackets. Other regular victims are the leaders of rural organizations and environmental activists, who pose a threat to the development of the illicit activities of organized crime groups.

Kidnapping was the second most frequent crime and mainly affects livestock producers, avocado growers, and owners of agricultural trading companies or their relatives, who have a greater chance of paying a ransom due to their high level of income. However, income is not a limiting factor, because although the percentage is lower, small producers were also kidnapped. Agrarian organization leaders and environmental activists were likewise targets of kidnappings, for the same reasons mentioned in the paragraph about homicides.

In rural areas, extortion can be observed mainly in the so-called *derechos de piso*, a protection racket system where producers are forced to pay bribe to criminal groups in exchange for permission to work their own land, as well as payments per ton received, and for the use of transportation. Producers are also forced to plant narcotic plants on their plots; refusals to cooperate with criminals results in reprisals. Some agricultural companies are also victims of extortion. They are forced to fine and reduce the payments to the producers, arguing that humidity has damaged the crops. The resulting difference goes to the criminals, who sometimes demand one-time payments to refrain from kidnapping company members.

Information about robberies is scarce and, in most cases, the stolen goods are vehicles, machinery, and agricultural equipment.

Cattle rustling is a major rural crime, with two major modus operandi: 1) the violent robbery of producers, who are subdued while the criminals take away the livestock; and 2) the theft of livestock transport vehicles on the road. In addition to economic losses, cattle



**Figure 1.** Six-year crime incidence, according to newspaper articles.

rustling has repercussions on final consumers, due to the loss of health control, which can trigger an epidemiological problem (Lago *et al.*, 2019).

The articles consulted mention that illegal logging allows organized crime to generate profits from the commercialization of wood and resin, which is a problem for some producers since criminal groups invade their land to cut down trees.

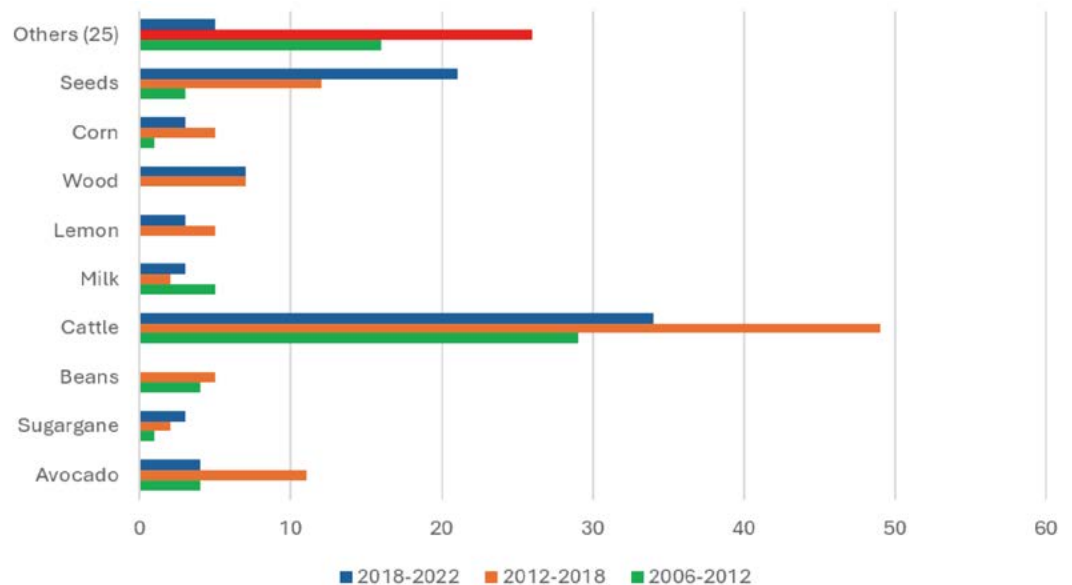
Finally, an unprecedented crime was identified in the agricultural context: the impact of piracy in the seed trade. Criminal groups often steal, reproduce, and market patent seeds. Others collect empty packages of original seeds and fill them with fake product to pass it off as authentic. This situation impacts, on the one hand, the seed companies (which do not obtain profits), and on the other hand, the farmer (who does not obtain the expected productive results).

The state with the highest criminal rates in Mexico was Guerrero, followed by Michoacán and Sinaloa. Figure 3 shows the matches for each state in the newspaper articles consulted.

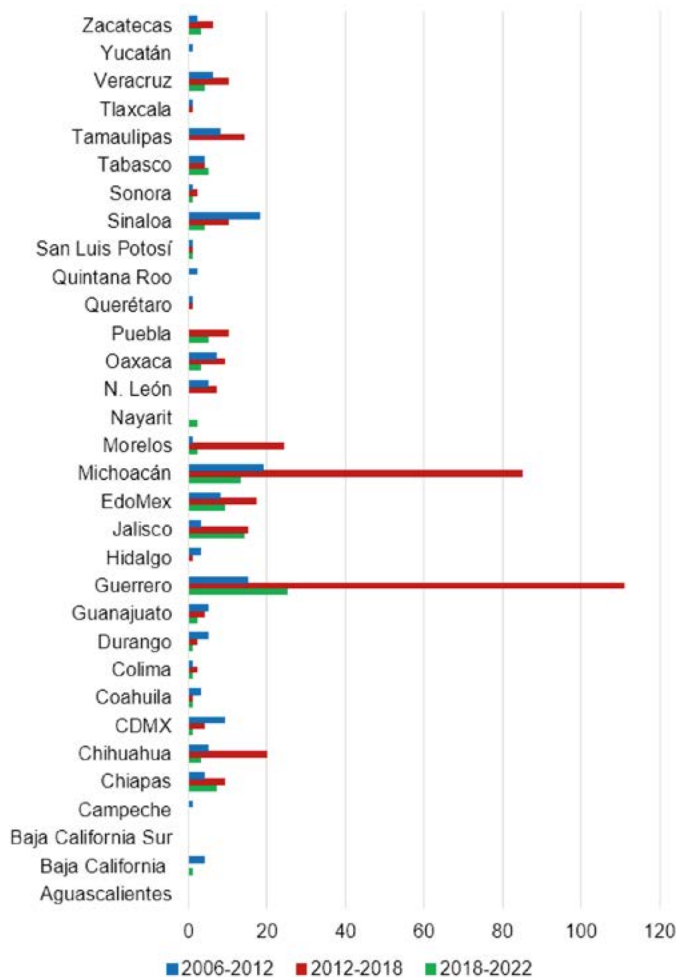
A decrease in the reporting rate of the crimes was recorded, indicating that the authorities are not always aware of the magnitude of the problem. Only 292 articles about the said crimes were found —a small figure, considering that sixteen-year period under study.

One of the major features of criminal violence in agroecosystems is the failure to meet the demand, caused by the reduction and delay in production. This phenomenon is attributed to the loss of producers, either due to homicides or land abandonment, driven by threats or the need to escape the violence that impacts the region. This situation led to a decrease in cultivated areas and the closure of numerous farms.

An additional consequence of the insecurity and violence is the withdrawal of foreign investors, who used to rent land for vegetable production. This withdrawal has a negative



**Figure 2.** Impact of crime on the productive components of agroecosystems, between 2006 and 2022 (six-year periods).



**Figure 3.** Criminal rate in agroecosystems per state (six-year periods).

impact on the local economy and increases the probability that unemployed laborers turn to criminal activities as a source of livelihood.

Furthermore, this low supply increases the cost of agricultural products above their usual prices for final consumers.

Homicide, kidnapping, and extortion were the most frequent crimes found in the study. Based on the Programa Nacional de Seguridad, Samano and Leal (2020) classify them as high-impact crimes and suggest that their high rates have a deep and negative relationship with the displacement of agricultural producers from the state of Tamaulipas. Interestingly, migration and forced displacements are some of the most marked consequences of crime in agroecosystems.

The analysis found that cattle rustling is carried out with violence within the producers' property or through the theft of livestock transport vehicles. However, other research record different modus operandi. For example, Donnermeyer and Barclay (2005) mention that it is common for lost livestock to end up in neighboring herds and not be returned to their owner. They also suggest that some criminals hire local herders who have the necessary equipment and local knowledge.

Articles mentioned that most crimes in agroecosystems are not reported. Donnermeyer and Barclay (2005) indicated that very few cases end in a conviction, because a long time passes between the crime and the moment in which the producers realize that something happened. In other cases, they consider that the authorities are not prepared or aware of the rural context and are therefore unable to address their problems. For their part, Díaz and Díaz (2016) and Aguirre and Gómez (2020) highlighted the inefficiency of the rule of law in Mexico, explaining that agricultural producers do not report crimes due to the corruption of the authorities and their connection with organized crime.

The various economic consequences of rural crimes leave producers vulnerable, because it is easier to engage in criminal behavior as a means of subsistence. This situation further contributes to the deterioration of the social fabric. Arisukwu *et al.* (2020) mention that most of the crimes in the rural areas of Nigeria are committed by unemployed youths. Likewise, Díaz and Díaz (2016) indicate that some rural inhabitants in Mexico first participate in drug trafficking through drug production or working as informers for criminal groups, reporting on every movement that occurs in their communities.

The statistical analysis shows the dynamics of the variables in the three established periods (Table 3 and Figure 4).

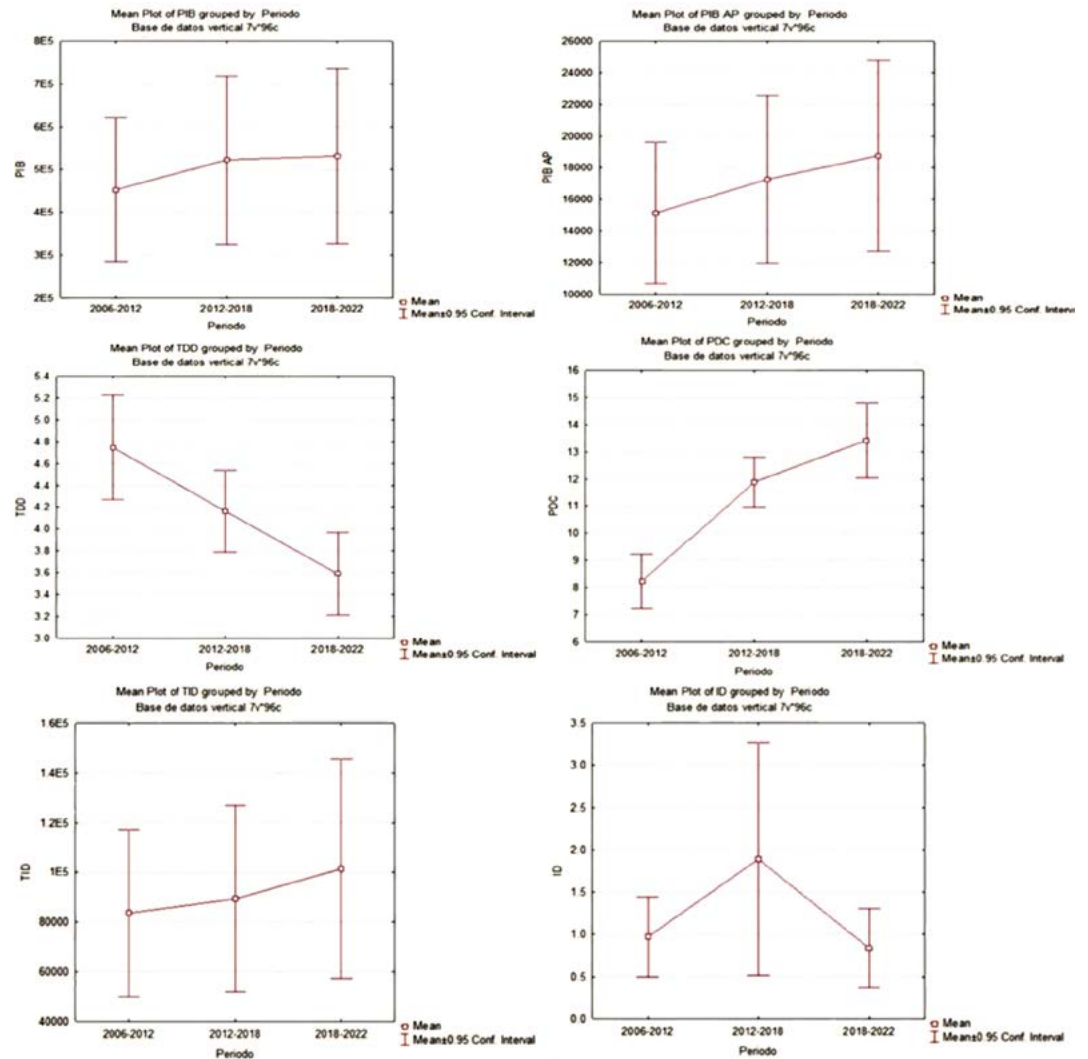
The analysis of the socioeconomic variables in the three periods identified a constant increase in GDP, which indicates a sustained economic growth. Similarly, primary sector GDP (PS-GDP) shows an increase throughout the periods, which suggests growth in the primary sector of the economy.

The unemployment rates (UR) variable shows a constant decrease throughout the periods, indicating an improvement in economic activities and a reduction in unemployment. Meanwhile, an increase in corruption perception was observed throughout the periods, which could indicate a worsening in the perception of institutional integrity. For its part, there was an increase in the crime incidence rate throughout the periods, which suggests an increase in criminal activity. In the case of criminal incidents recorded in newspaper articles, the values fluctuate significantly throughout the periods, increasing from the first to the second and then dropping drastically in the third.

Table 4 shows the values resulting from the repetition of the same exercise, carried out to determine the exchange rate between periods.

**Table 3.** Six-year behavior of socioeconomic variables in Mexico (2006-2022).

Variable	Period			Standard deviation
	2006-2012	2012-2018	2018-2022	
Gross Domestic Product (GDP)	452942.5	522410.5	531284.2	522921.6
Gross Domestic Product by Primary Activities (GDP PA)	15138.0	17266.0	18761.4	14683.4
Unemployment Rate (UR)	4.7%	4.2%	3.6%	1.2%
Perception of Corruption (PC)	8.2%	11.88875%	13.43125%	3.8%
Crime Incidence Rate (CIR)	83590.0	89298.7	101528.2	106433.0
Crime Incidents (CI)	0.968750	1.890625	0.835938	2.5



**Figure 4.** Behavior of the variables in the analyzed periods.

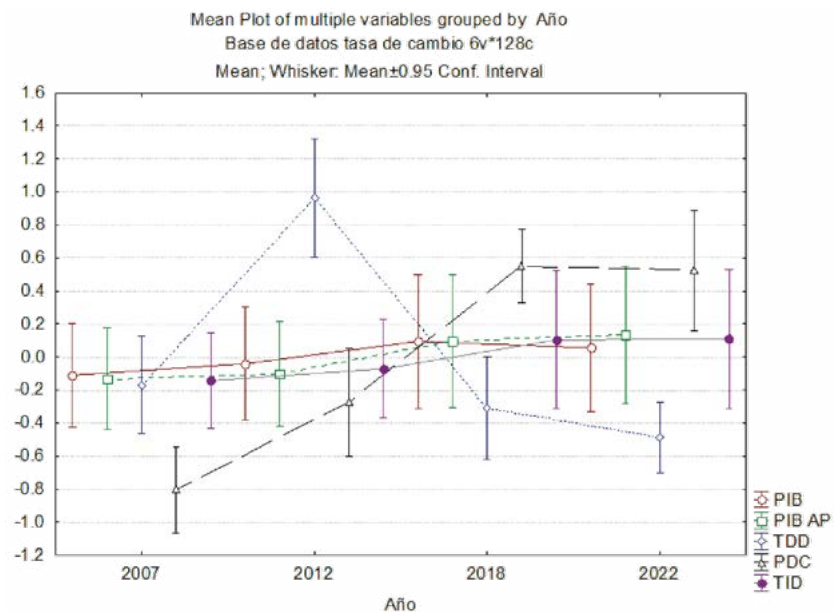
The table shows an increase in GDP except in the last period, but this reduction is barely perceptible. Likewise, the PS-GDP maintained a constant growing trend over the years. The unemployment rate (UR) showed an exponential increase in the first two years, but in

**Table 4.** Exchange rate of the variables between periods.

Variable	Year				Standard deviation
	2007	2012	2018	2022	
Gross Domestic Product (GDP)	445452.0	482218.5	553164.6	532521.7	525077.2
Gross Domestic Product by Primary Activities (GDP PA)	15208.78	15609.84	18563.78	19120.78	14803.1
Unemployment Rate (UR)	3.365313	4.943594	3.170313	2.919375	1.4
Perception of Corruption (PC)	7.975	10.08	13.38	13.27	4.0
Crime Incidence Rate (CIR)	77231.4	85022.5	104135.0	104682.6	109077.9

2018 it fell below the initial point and continued decreasing in 2022. The initial perception of corruption (POC) had high values and increased until 2018, when it began to slowly decrease. The crime rate (CR) grew slowly but steadily until 2018, when it apparently stagnated.

According to the variables of the comprehensive socioeconomic analysis, an inverse trend is observed between the indicators of the economic sector and the factors that favor crime. Therefore, as economic indicators grow, critical variables (such as unemployment and the perception of corruption) decrease, causing a slowdown in crime. This phenomenon established an inverse connection between economic development and the factors that lead to crime (Figure 5).



**Figure 5.** Exchange rate of the GDP (PIB), PS-GDP (PIB PA), UR (TDD), POC (PDC), and CR (TID) variables during 2007, 2012, 2018, and 2022.

## CONCLUSIONS

Crime was present in Mexican agroecosystems and rural life during the 2006-2022 period. The most common crimes were homicide, kidnapping, and extortion. In addition, a new form of crime was found in rural areas: seed piracy. Crime was more frequent in agroecosystems which mainly produce livestock and avocado, but also include seed trade. Agricultural organizations leaders and environmental activists are frequently the victims of crime. The states with the highest criminal rates in rural areas were Guerrero, Michoacán, and Sinaloa.

Crime reached its highest peak during the second period (2012-2018), and decreased considerably in the third period (2018-2022), following the dynamics of socioeconomic development indicators.

This research highlights the inverse relationship between socioeconomic development and crime: when the economy declined, rural crimes tended to increase and, on the

contrary, rural crimes decreased when socioeconomic indicators increased. This research is based on a theoretical current that suggests that crime is fundamentally a rational act and, overall, it should be analyzed from a social and economic point of view.

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