# Ecological Impacts of Agribusiness Transformation in a Spanish Mediterranean Enclave: Impacts on the Mar Menor Coastal Lagoon

Impacts écologiques de la transformation de l'agro-industrie dans une enclave méditerranéenne espagnole : impacts sur la lagune côtière de la Mar Menor

Ökologische Auswirkungen der Transformation der Agrarwirtschaft in einer spanischen Mittelmeer-Enklave: Auswirkungen auf die Küstenlagune Mar Menor

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## Background

Spanish Mediterranean coastal regions have experienced a major transformation of agricultural production over recent decades. Benign weather and public support from local to European institutions has facilitated lengthy crop seasons and optimal conditions for intensive production and global commercialisation. Several of these regions (e.g. Almeria and Valencia) entered global agricultural production networks through an intense process of transformations, such as technical adaptation and commercial convergence with international markets. However, these transformations have affected land health, water systems, and the normal functioning of ecological sites, as in the Mar Menor coastal lagoon case, in which a process of rapid ecological degradation has led to an ecological crisis. The reconstruction of the agribusiness transformation in Mediterranean global enclaves may lead to a better comprehension of the effects of agribusiness on ecological conservation.

One of these enclaves is Torre-Pacheco, a municipality of Murcia autonomous community located within a smaller region called Campo de Cartagena, in southeast Spain. To this day, Torre-Pacheco is the most populated and hosts the largest number of agribusinesses in the region. The municipality has undergone major transformations in recent decades, especially since the completion of the water transfer project, the 'Tajo-Segura *trasvase*', in 1979. These transformations affected the whole region. In 1970, Torre-Pacheco was just a small town with no more than 13,000 inhabitants; it now accommodates triple this figure. The water transfer changed the landscape economically, socially and demographically. Until it arrived, most of the land provided dry farming, with small agribusiness operations run mostly by families and aimed at local or regional markets. Subsequent to the water transfer, agribusiness operations began to orient themselves towards irrigated and intensive fruit and vegetable polycultures. They adapted to international exports to become one of the largest enclaves of global agricultural production in Europe, often referred to as 'Europe's orchard'.

However, these agribusiness transformations could endanger the ecological balance in the region, as has occurred with the Mar Menor coastal lagoon. Various activities are indicated as having contributed towards ecological degradation in the Mar Menor area: agriculture, livestock farming, urbanism and tourism, waste disposal, and other activities carried out in the lagoon, such as

**Greenhouse production in Campo de Cartagena © La Voz de Almería.**



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recreational navigation and fishing. However, scientists have continuously shown agriculture to be one of the principal causes of degradation, while the inputs from wastewater treatment plants and contaminated wastewater from urbanised areas were discontinuous and of lesser volume (García-Ayllon and Miralles, 2014; MITECO, 2019; Velasco *et al.*, 2006).

> “La dégradation de la nature suite aux transformations de l’agro-industrie est parfaitement illustrée dans le cas de la lagune d’eau salée de la Mar Menor.”

Greenhouse production and intensive polyculture farming imply at least four direct consequences: a greater dependence on agricultural inputs; more waste residues (liquid, solid and gaseous); land erosion due to the non-permeability of greenhouse plastics, resulting in a higher flood risk; and loss of biodiversity. Therefore, the Torre-Pacheco case, and the Mar Menor case could suitably illustrate the ecological impact of agricultural transformations that have occurred globally over recent decades.

## Agribusiness transformations in Campo de Cartagena

The hydraulic engineering project of the Tajo-Segura water transfer required the construction of engineering infrastructures to divert Tajo River water to the Mundo River (Albacete province), which constitutes the main tributary of the Segura River. Thanks to the Tajo-Segura water transfer project and to the post-transfer project known as the Campo de Cartagena channel, the transferred water reached the first farmers in Campo de Cartagena in 1979. Consequently, agricultural operations were progressively transformed through the substitution of traditional dry farming, such as cereals, animal fodder, olive and almond cultures, all of which can survive on scarce and irregular irrigation, with intensive polycultures, which involve very high water demands and are dependent on external incomes, such as seeds, fertilisers or pesticides. Agricultural transformations in the region were triggered by the effect of massive water availability and the triumph over traditional farming in the form of a ‘desert conquest’ (De Castro *et al.*, 2017).

In the remaining parts of the Murcia region, most traditional irrigated land was in the plain of the Segura River, but experienced major difficulties regarding its expansion and transformation into cost-effective productive units. The excessive cost and fragmentation of irrigated land hindered its transformation into intensive irrigated agricultural land. Hence the development of the Vega Alta and Vega Media regions continued to be centred on citrus and stone fruit production, whilst traditional orchards in the Vega Baja region, Murcia/Alicante, continued to produce fresh vegetables and citrus fruits. In contrast, the Campo de Cartagena region, that is explored herein, presented the best conditions for the initiation of intensive polycultures when water from the Tajo-Segura transfer became available.

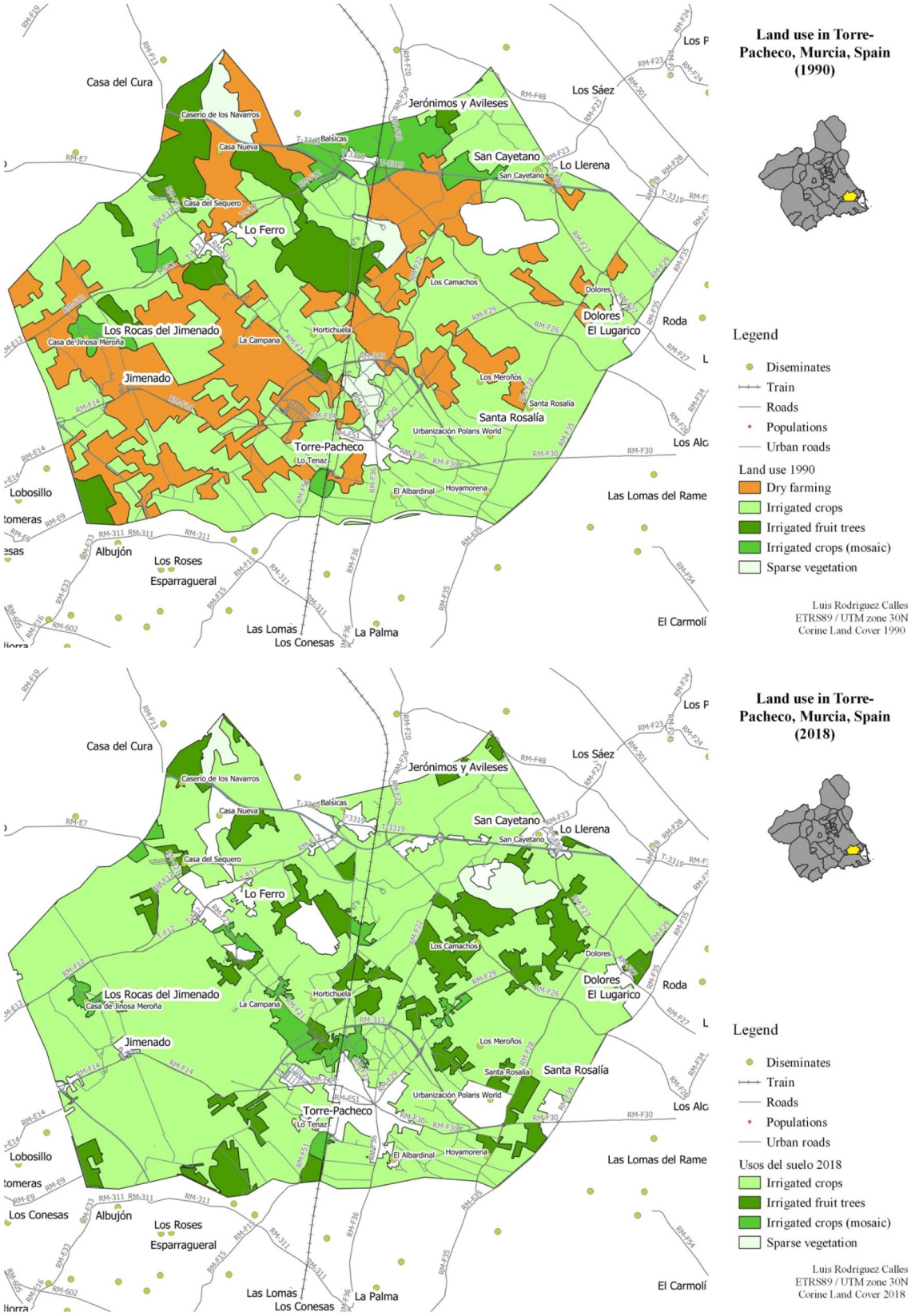
Therefore, in the early 1980s, a new development period started with the sustained growth of agribusiness in the Campo de Cartagena region, which includes Torre-Pacheco. During this first period, the family workforce still prevailed in the agricultural sector with certain external help in specific circumstances; however, this new period revealed a strong need for a workforce capable of meeting demands for work operations such as seeding, pruning and picking campaigns. The increasing demands for a greater workforce could not be met by traditional family workers, and since the indigenous population remained unwilling to meet these demands, the migrant workforce soon revealed became essential. Subsequently, in around 1982, the autonomous community of Murcia started a regional development plan in which the agricultural sector was framed into a regional strategy to connect local agribusinesses with lead companies in global agri-food production (De Castro *et al.*, 2017).

> “Die Salzwasserlagune Mar Menor ist ein perfektes Beispiel für die Zerstörung der Natur durch den Wandel in der Agrarindustrie.”

From this point, the Campo de Cartagena region underwent a complete transformation as did most agribusiness operations in the Murcia region. During these years, communication infrastructures were improved globally to connect international markets, and Torre-Pacheco farmers, entrepreneurs, families, and even the traditional agricultural workforce, actively strove to internationalise their markets and to export agricultural products (Torres, 2007). Those processes finally peaked in the last two decades, with the incorporation of the Torre-Pacheco agribusiness into the global production network as a major agriculture hub. This has resulted in a significant boost to the local economy of the region. Farms in the region of Murcia, in the Campo de Cartagena region, and therefore in the Torre-Pacheco municipality, all experienced the following changes:

- Between 1975 and 1981, 52,600 hectares were transformed from dry farming into irrigated lands in the region of Murcia. These years coincided with the initiation of the water transfer project known as ‘Tajo-Segura trasvase’. The transformation of land use

**Figure 1: Land use changes in Torre-Pacheco (Comparison between 1990 & 2018)**




*Source*: Corine Land Cover 1990 & 2018. Created with QGis3.10 software.

continued along this path in the following decades. In Torre-Pacheco: between 1990 and 2018, the irrigated area grew by 1,224 per cent. Today, unofficial data suggest that up to 60,000 hectares are irrigated in Campo de Cartagena. In short, dry farming has declined in both the region of Murcia and in Campo de Cartagena from 1971 to its disappearance today (see Figure 1).

- The mean size of farms grew significantly. The intensive usage of available land involved the integration into fewer farms cultivated by fewer farmers. No data are available for the Torre-

**Table 1: Main agricultural production in the Campo de Cartagena region (hectares). Historical series 1971–2018.**

| | Grain | Fodder | Industrial | Flowers | Vegetables | Legumes | Tubers | Citrus | Other fruits | Olive | Grapes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 10,552 | 2,632 | 3,370 | 0 | 3,655 | 2,277 | 278 | 482 | 6,331 | 1,050 | 1,028 |
| 1981 | 16,140 | 1,939 | 3,145 | 20 | 6,441 | 36 | 247 | 1,779 | 7,717 | 425 | 433 |
| 1991 | 22,105 | 1,479 | 2,432 | 45 | 13,743 | 66 | 1,070 | 5,239 | 9,223 | 259 | 199 |
| 2001 | 3,127 | 261 | 2,138 | 44 | 16,964 | 72 | 922 | 7,579 | 7,807 | 409 | 151 |
| 2011 | 2,143 | 91 | 30 | 73 | 18,920 | 24 | 926 | 8,133 | 5,544 | 755 | 142 |
| 2018 | 860 | 74 | 101 | 47 | 18,377 | 3 | 3,379 | 8,068 | 5,426 | 620 | 56 |

*Source*: Murcian agrarian statistics. Agriculture, livestock farming and fishery council of the Murcia region.

Pacheco case, but data for the Murcia region confirm earlier tendencies: the largest farms (over 100 hectares) occupy almost 40 per cent of available land, but they constitute only 2 per cent of the total number of farms in the region. In contrast, small farms (up to 2 hectares) occupy only 3 per cent of the land available but represent 40 per cent of the total number of farms today. In 1972, small farms represented more than 50 per cent of the total number of farms. Today, small farms are not profitable in the light of the transformations pointed out before.

- Traditional farming has been transformed over recent decades into profitable polycultures that appeal to global markets, such as fresh vegetables, citrus fruits and flowers. Data for the Campo de Cartagena region are given in Table 1. Torre-Pacheco, as a part of the region, registered similar data, but these data have only been available since 2011 at this level of disaggregation. The main tendencies for the region include the following:
  - Fresh vegetable production has quadrupled since 1971. Today, it constitutes more than 50 per cent of the agricultural production in the Campo de Cartagena region.
  - Citrus production has multiplied by a factor of 16 since 1971, while production of other fruits has remained stable, although slightly declining.
  - The production of tubers for human consumption has grown 12-fold since 1971, most rapidly in the last 5 years.
  - Flower production has also increased since 1971.
  - Grain cereals, fodder cereals, legumes and industrial cultures have declined in most farms.
  - Olives, grapes, and other dry farming yields have decreased since 1971 in favour of a 3,000 per cent increase in the production of crops with high water consumption.
- Greenhouse production grew exponentially to maximise production and cover off-season demands. In Torre-Pacheco, greenhouse production reached 619 hectares in 2020, 526 hectares of which were dedicated to fresh peppers, according to official statistics.
- The number of seasonal workers has increased in the last two decades. Changes in the Murcia region workforce over the last two decades can be observed in Table 2.
- Other transformations occurred simultaneously on a global scale but remain undocumented for the Torre-Pacheco case and the Campo de Cartagena case (e.g. loss of biodiversity and crop variety reduction). Regarding the latter, today market-oriented agriculture mostly operates with 12 crop varieties. Rural economies, in contrast, have worked with more than a million varieties in the past (Shiva, 2016). As observed in Torre-Pacheco, dry farming was substituted with irrigated crops, and with only a few varieties: those that offer monetary rentability in markets.

**Table 2: Agricultural workers and their relationship with farms (number of farms). Murcia region (1997–2016).**

| Year | Owners | Family workers | | Salary workers | | |
|---|---|---|---|---|---|---|
| | | Spouses | Other family members | Permanent salary = Full time | Permanent salary = Partial time | Eventual workers (numbers of days) |
| 1995 | 55,586 | 40,556 | | 4,872 | | 2,939,300 |
| 1997 | 46,431 | 12,935 | 29,573 | 4,449 | 3,114 | 3.668.685 |
| 2003 | 36,506 | 26,245 | 24,596 | 6,855 | 3,467 | 3,945,969 |
| 2005 | 32,896 | 11,544 | 21,430 | 8,058 | 5,503 | 3,528,041 |
| 2007 | 32,069 | 12,826 | 22,852 | 7,741 | 7,060 | 3,311,615 |
| 2013 | 28,703 | 14,770 | 11,551 | 5,922 | 13,131 | 3,485,864 |
| 2016 | 27,324 | 5,959 | 17,337 | 6,636 | 12,646 | 3,127,025 |

*Source:* 'Agriculture farms census and agricultural workers survey'. Murcian Agrarian Statistics

**Figure 2: Runoffs in the Mar Menor lagoon after torrential rains**

*Source*: Sentinel-2 satellite on 13th September 2019.

## Agribusiness transformations deeply affected various ecological systems, such as in the 'Mar Menor' case

Between 1981 and 2003, 23 per cent of the total global world land area suffered degradation, in terms of nutrient loss and soil desertification (Sassen, 2014). In the last two decades, this degradation has grown steadily, largely owing to the unprecedented growth of intensive monocultures worldwide, such as for production of sugar, soybean and palm oil (Shiva, 2016). In the Campo de Cartagena region, soil degradation has been due to several factors related to the intensive exploitation of the cultivated area, including the use of agricultural inputs, reduction of biodiversity precipitated by the expansion of monocultures, cultivation in greenhouses, and toxic waste filtering caused by poor farm management.

In this context, the Mar Menor lagoon has suffered a process known as eutrophication since the early 1990s, and from 2015 began to be considered an 'environmental collapse' (MITECO, 2019). Eutrophication is a process by which an entire body of water, such as the Mar Menor lagoon, is enriched with minerals and nutrients that induce an increase in phytoplankton productivity. Therefore, bodies of water undergo a loss of biodiversity and the invasion of new plant species and become subject to toxicity for both animals and plants. Nitrates and phosphates are the most worrying nutrients in the Mar Menor situation. These nutrients enter the subterranean soils and aquifers, raise groundwater levels, and are then discharged in variable quantities into the lagoon both via the Albujón wadi (dry riverbed) and via the Quaternary aquifer. Furthermore, when torrential rains occur, known as 'cold drops' in the Spanish Mediterranean, the nutrients rapidly run off into the lagoon causing extreme episodes of eutrophication, known as 'green soup' due to the green colour the lagoon adopts, such as that in September 2019 (see Figure 2). To sum up, studies vary, but recent estimates stand at approximately 300,000 tons of nitrates currently accumulated in the Quaternary aquifer, and a discharge of 530–4,800 kg of nitrates a day into the Mar Menor lagoon (MITECO, 2019).

**Dead fish in Mar Menor after a eutrophication episode © Marcial Guillén.**

## Recent regulations failed to reverse ecological degradation

As early as 1991, the European Union had adapted European Directives 91/271/EEC and 91/676/EEC in which the Mar Menor lagoon was mentioned as a 'vulnerable zone'. No public attention was paid, however, until 2017 when the Murcian public authorities rushed to adopt policies, but in an uneven and insufficient manner, according to most scientists and experts involved (García-Ayllon & Miralles, 2014; MITECO, 2019; Velasco *et al.,* 2006). In 2017, 2018 and 2019, the autonomous government of Murcia approved legislation to adopt urgent measures to guarantee the environmental sustainability of the Mar Menor. Nevertheless, various episodes of mortality among marine organisms have occurred since 2016, with the summer of 2021 as the latest incident, when eutrophication and anoxia (lack of oxygen) caused mortality of thousands of marine organisms again.

To this day, there has been no agreement between landowners, authorities and experts. However, a popular legislative initiative (promoted by civil society) that aimed to give legal personality to the lagoon passed the first legislative steps and is about to be discussed and submitted for a vote in the Spanish national parliament. The initiative would transform the Mar Menor into a legal entity, enabling all citizens to sue those responsible for the damage caused to the lagoon (further information could be found in the legislative initiative official website: https://ilpmarmenor.org/).

**Seahorses (*Hippocampus Guttulatus*), almost extinct in Mar Menor**
**© Murcia Autonomous Community.**

In the meantime, until the initiative is under legislative proceedings, ecological degradation of the Mar Menor lagoon continues and public authorities are failing to reverse the situation by limiting such harmful activities. If agricultural production in Torre-Pacheco and the Campo de Cartagena region continues in its current form, in a model highly dependent on external inputs and in an intensive and monoculture production model, the situation will persist.

> "The degradation of nature due to agri-business transformations is exemplified perfectly in the Mar Menor saltwater lagoon case."

## Further Reading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# Summary

## Ecological Impacts of AgribusinessTransformation in a Spanish Mediterranean Enclave: Impacts on the Mar Menor Coastal Lagoon

In recent decades, most Spanish Mediterranean agricultural regions have been transformed to meet global food demands and have joined global agricultural production networks: a convergence process that has granted them steady economic growth. In certain cases, however, this transformation has led to a process of ecological degradation. This article focuses on the Torre-Pacheco case, in the Campo de Cartagena region (southeast Spain, Murcia), to reconstruct the events that have led the region to become a global production enclave in agribusiness and to determine the connections between agribusiness transformation and ecological degradation. To this end, a water transfer project is first addressed as the turning point for the local agricultural sector from which the transformation of agribusiness is described regarding land use, technical adaptations, employment/recruitment changes, etc. A documented result of these agribusiness transformations is subsequently presented: a significant contribution to the ecological degradation of the Mar Menor coastal lagoon, whose natural site will remain endangered if 'business as usual' continues.

## Impacts écologiques de la transformation de l'agro-industrie dans une enclave méditerranéenne espagnole : impacts sur la lagune côtière de la Mar Menor

Au cours des dernières décennies, la plupart des régions agricoles méditerranéennes espagnoles se sont transformées pour répondre à la demande alimentaire mondiale et ont rejoint les réseaux mondiaux de production agricole: un processus de convergence qui leur a conféré une croissance économique soutenue. Dans certains cas cependant, cette transformation a conduit à un processus de dégradation écologique. Cet article se concentre sur le cas de Torre-Pacheco, dans la région de Campo de Cartagena (sud-est de l'Espagne, Murcie), pour reconstruire les événements qui ont conduit la région à devenir une enclave de production mondiale de l'agro-industrie et pour déterminer les liens entre la transformation de l'agro-industrie et la dégradation écologique. A cette fin, un projet de transfert d'eau est d'abord abordé comme le tournant pour le secteur agricole local, à partir duquel la transformation de l'agro-industrie est décrite en termes d'utilisation des terres, d'adaptations techniques et de changements dans l'emploi et le recrutement, entre autres. Est ensuite présenté un résultat documenté de ces transformations de l'agro-industrie: une contribution nette à la dégradation écologique de la lagune côtière de la Mar Menor, dont le site naturel restera menacé si le statu quo se poursuit.

## Ökologische Auswirkungen der Transformation der Agrarwirtschaft in einer spanischen Mittelmeer-Enklave: Auswirkungenauf die Küstenlagune Mar Menor

In den letzten Jahrzehnten haben sich die meisten landwirtschaftlichen Regionen im spanischen Mittelmeerraum gewandelt, um die weltweite Nachfrage nach Nahrungsmitteln zu befriedigen und sich globalen, landwirtschaftlichen Produktionsnetzwerken anzuschließen: Konsolidierung zur Sicherung von konstantem Wachstum. In einigen Fällen hat diese Umwandlung jedoch zu einer ökologischen Verschlechterung geführt. Dieser Artikel konzentriert sich auf den Fall Torre-Pacheco in der Region Campo de Cartagena (Südostspanien, Murcia), um die Ereignisse zu rekonstruieren die dazu geführt haben, dass die Region zu einer globalen landwirtschaftlichen Produktionsenklave geworden ist. Und um die Zusammenhänge zwischen der Transformation der Agrarwirtschaft und der ökologischen Degradation zu ermitteln. Zu diesem Zweck wird zunächst ein Wassertransferprojekt als Wendepunkt für den lokalen Agrarsektor betrachtet, von welchem aus der Wandel der Agrarindustrie unter anderem in Bezug auf Landnutzung, technische Anpassungen und Veränderungen der Beschäftigten beschrieben wird. Das Ergebnis dieser landwirtschaftlichen Veränderungen wird anschließend dokumentiert: Ein bedeutender Beitrag zur ökologischen Verschlechterung der Küstenlagune des Mar Menor, deren natürlicher Lebensraum weiterhin gefährdet ist, sollte 'business as usual' fortgesetzt werden.