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Understanding the expansion of energy crops beyond the global biofuel boom: evidence from oil palm expansion in Colombia

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Abstract

Background: The global palm oil market experienced a remarkable boom since the year 2000. Since palm oil can be used for biodiesel production, the global expansion of oil palm cultivation has been associated with the global biofuel boom. Biofuel policies—especially those adopted in the European Union (EU)—have been blamed for the socio-environmental impacts of oil palm expansion. We explore how the global biofuel boom interacts with national geographies and social-economic and political processes to produce country-specific trajectories of biofuel crops expansion. We analyse the expansion of oil palm cultivation in Colombia between 2000 and 2010 from a political ecology perspective.

Methods: The analysis is based on a framework that positions expansion of commodity frontiers within the 'space-of-flows' and the 'space-of-place'. Through this approach, we identify the markets and geographies that define the country-specific trajectories of expansion of oil palm in Colombia, and their connections with general patterns of land control. The empirical analysis is based on primary data collected during fieldwork, and on an extensive review of secondary data about the palm oil sector and the socio-environmental effects of oil palm expansion in the country.

Results: The contemporary oil palm expansion in Colombia was not specifically influenced by the international biofuel market. Expansion was characterized by an increasing production of palm oil for biodiesel, to supply a policy-driven national biofuel market controlled by national palm oil producers. The evidence shows that this oil palm expansion proceeded through a variety of land control practices that constitute forms of 'accumulation by dispossession' and 'assimilation'. These are embedded in contextual factors that include the agrarian history of Colombia, the armed conflict, and government policies.

Conclusions: Our study shows that the ways in which expansion of biofuel crops unfold in each producing country depend not only on the global biofuel market. They are also shaped by the country-specific geographies and political economies. Therefore, research and policies on the global expansion of energy crops should account for the complex and interrelated factors that mediate the specific ways in which the global demand for biofuels creates biofuel crop booms at country level.

Keywords: Biofuels, Palm oil, Colombia

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Background

The global palm oil market has experienced a remarkable boom since the year 2000, which has led to an accelerated expansion of oil palm cultivation in palm oil producing countries. Global production increased from 21.8 million tonnes in 2000 to 45.8 million tonnes in 2010 [1, 2].

The global expansion of oil palm cultivation at the beginning of the 21st century has been linked with the global biofuel boom, i.e. the policy-driven increase in biofuel demand and production at global scale that started around the same time [3–8].

The palm oil industry, governments of palm oil producing countries, and multilateral organizations defend expansion of oil palm cultivation on the basis of the potential benefits for climate change mitigation, rural development, and poverty alleviation [9, 10]. However, there is a broad range of literature documenting local negative socio-environmental effects of oil palm expansion [11–13].

Biofuel policies stimulating demand and enabling large scale production—especially those adopted in the European Union (EU)—have been blamed for the socio-environmental negative impacts of oil palm expansion [6, 14–17]. However, the ways in which the biofuel and palm oil booms unfold in each palm oil producing country depend not only on the global biofuel market; they are also shaped by country-specific geographies and political economies.

In this paper, we explore how the global biofuel boom interacts with national geographies and social-economic and political processes to produce country-specific trajectories and the resulting effects of the expansion of biofuel crops. To do so, we analyse the expansion of oil palm cultivation in Colombia between 2000 and 2010 from a political ecology perspective.

Colombia is among the five leading producers of palm oil in the world, and it is the largest in the Americas. The expansion of oil palm cultivation has accelerated across a large area since 2000. Different actors at both national and international levels have expressed serious concerns regarding the socio-environmental impacts of oil palm expansion in Colombia [15, 18–20]. For example, the advance of oil palm cultivation in Colombia was included as a case of special concern in terms of land appropriation and human rights violations in two reports by the Special Rapporteur on the Right to Food [21, 22].

This paper is structured as follows. Firstly, we present the conceptual and analytical framework to operationalize the concept of commodity frontiers used in this paper, and describe briefly the data collection methods. Secondly, we present a brief historical overview of the expansion of the palm oil frontier in Colombia. Thirdly, the "Results and discussion" section contains the findings from empirical data and discussion about the country-specific trajectories of the 2000-2010 expansion of the palm oil frontier in Colombia. The paper finishes with some conclusions about both the case of Colombia and the interaction between global processes and country-specific trajectories of expansion.

Methods

In this paper, we use concepts from political ecology to analyse the expansion of biofuel crops, which we describe using the concept of "commodity frontiers". The expansion of commodity frontiers is the process of "production and distribution of specific commodities, and of primary goods in particular, that ha[s] restructured geographic spaces in such a way as to require further expansion" ([23]: 410).

Moore understands the expansion of 'commodity frontiers' as a socio-ecological process, defining a frontier as a "zone beyond which further expansion is possible" [23]. The 'frontier mode' of expansion takes place through organized production and distribution commodity chains. Thus, the concept of commodity frontier incorporates two spatial dimensions, a *'space-of-place'* and a *'space-of-flows'* ([23]: 412).

The *'space-of-place'* dimension refers to the geographical places where the different processes of commodity chains operate and expand. In the case of an accelerated expansion of crop-based commodity frontiers - such as the expansion of biofuels crops during the 2000s - the 'space-of-place' dimension is well captured by Hall's concept of *'crop booms'* defined as: "taking place when there is a rapid increase in a given area in the amount of land devoted to a given crop as a monocrop or near-monocrop, and when that crop involves investment decisions that span multiple growing seasons" ([24]: 840).

The *'space-of-flows'* dimension refers to the "forward movement of the capitalist system" ([23]: 412). In Castells' words, "the space-of-flows represents the material arrangements that allow for simultaneity of social practices without territorial contiguity" [25]. As markets are the main spaces through which capital operates and expands alongside the 'space-of-place', the markets through which commodities flow from extraction to consumption represent the main 'space-of-flows' of commodity frontiers.

When seen from a long term perspective, the expansion of a global commodity frontier may, as shown by Moore in his study about historical global expansion of the sugar frontier, occur as a gradual and lengthy process [23]. However, the long term expansionary process does not occur evenly across time and space. Commodity frontiers may pass through periods of accelerated expansion, followed by periods of consolidation and quiescence. Furthermore, expansion may be more accelerated, concentrated and /or intense in some regions, countries and localities than in others. It may also take different forms in terms of

resource access control in different countries, and may result in different responses from local people.

In this paper, we call these variations: *country-specific trajectories of commodity frontier expansion*. These particular trajectories are rooted in country/local-specific geographies, with their associated social, economic, and political processes. The characteristics of the commodity also shape the resulting geographies and 'space-of-flows' connected with the frontier expansion [24].

The concept of *'flex crops'* illustrates well the relevance of the features of crops used for biofuel production, such as oil palm, soy, corn or sugarcane. Borras et al. define 'flex crops' as "crops that have multiple uses (food, feed, fuel, fibre, industrial material, etc.) that can be flexibly interchanged while some consequent supply gaps can be filled by other flex crops" ([26]: 94). Due to their versatility, the emergence of 'flex crops' at global scale is a logical outcome of the current dynamics of global capitalism represented by:

i) "the convergence of multiple crises: food, energy, climate change and finance capital" ([27]: 846); and
ii) a paradoxical combination of "relative scarcity of natural resources (a regime characterized by high prices) with a tremendous expansion in the production of natural resources" ([28]: 561).

The expansion of a commodity frontier involves ecological changes and demands access to natural resources along different processes of the commodity chain - from extraction (here we use the term extraction frontier to refer to the space where the crop cultivation takes place) to disposal - that may result in severe socio-environmental impacts in specific sites at the local level. Specific local geographies across the processes of the commodity chain are socially and physically modified as the frontier expands in the 'space-of-place' through different mechanisms of resource access control.

In the case of 'crop booms', land control is inherent to the frontier expansion, in particular, to the expansion of the extraction frontier. Peluso and Lund define *'land control'* as "the practices that fix or consolidate forms of access, claiming, and exclusion for some time" ([29]: 668). Such practices include not only legal mechanisms established in tenure regimes but also illegal mechanisms such as fraud, theft, "force, violence or the threat of them" ([29]: 668), [30].

This definition of land control is based on Ribot and Peluso's theory of access, according to which access to resources is defined as the ability to benefit from resources [30]. Ribot and Peluso distinguish between access *control* (the ability to mediate other people's access) and access *maintenance* which are the practices by which people expend "resources or powers to keep a particular sort of resource access open" for themselves ([30]: 159). Access *maintenance* entails negotiation of benefits between the actors who control access and those who seek to maintain their own access. In addition, Ribot and Peluso introduce the term *gaining* access to refer to "the more general process by which access is established" through different means - legal or illegal ([30]: 159).

Practices of land control used for the expansion of commodity frontiers are practices to *gain* and *control* access. These may correspond with global patterns of *'accumulation by dispossession'*, and *'assimilation'*. The concept of 'accumulation by dispossession' refers to practices of capital accumulation by certain human groups at the expense of the livelihoods of others [31]. Such practices deprive local people from the land and resources that constitute the basis of their livelihoods. An alternative pathway to *gaining* and *controlling* access to resources for the expansion of a commodity frontier is through practices of 'assimilation'. According to Escobar, 'assimilation' is represented by forms of inclusion that deny and erase differences in culture and identity [32, 33]. Practices of 'assimilation' may also result in 'adverse incorporation', i.e. inclusion on disadvantageous terms [34, 35].

Country-specific trajectories of a commodity frontier expansion and their interaction with broader processes at different scales can be identified by unpacking the 'commodity metabolism', that is, the flows along the commodity chain from extraction to destination markets [36]. This approach enables identification of:

i) the configuration of the 'space-of-flows' represented by the markets to which a commodity is directed; and
ii) the country-specific geographies of the expansion, i.e. the 'space-of-place' represented by the extraction frontier and the related dynamics of resource control.

Figure 1 is a graphic representation of this analytical approach, showing how the concepts we use are interrelated. We use this analytical strategy in order to identify the markets and geographies that define the country-specific trajectories of the palm oil frontier expansion in Colombia.

The expansion of commodity frontiers, such as the expansion of the palm oil frontier in Colombia is a continuous dynamic process. Therefore, there was a need to place the study presented in this paper in a timeframe for practical reasons. The timeframe of our study covers the period between the years 2000 and 2010. The focus on this period allows observation and unpacking of the remarkable expansion of the palm oil frontier that occurred during a period where governmental support for the oil palm sector was particularly strong, i.e. the two successive governments of Alvaro Uribe Vélez's between 2002 and 2010 [37]. Still, we

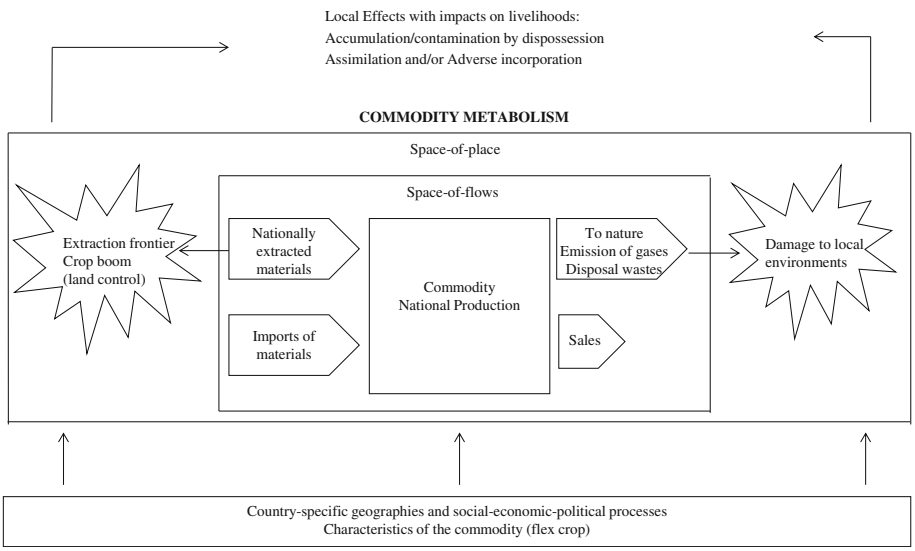

Fig. 1 Analytical and conceptual framework: 'commodity metabolism' for the study of country-specific trajectories of commodity frontiers expansion. Source: own construction

present the historical background of the palm oil agro-industry in Colombia and provide a brief update of the developments after 2010 in "Overview of the expansion of the palm oil frontier in Colombia" section.

The empirical analysis data come from different sources: 1) an extensive review of secondary sources about the palm oil sector; 2) a literature review of cases in different regions of palm oil cultivation in Colombia for which socio-environmental effects have been reported; and 3) open-ended interviews, group meetings and direct observation during fieldwork in Colombia. We selected cases reported in public official documents of state institutions and the academic literature, and cases that have been subject to in-depth analysis by several institutions so that information could be cross-checked. The literature review was complemented with primary data collected during two periods of fieldwork in Colombia (January - February of 2010 and August - December of 2011). The first fieldwork period was exploratory and resulted in 22 in-depth interviews and one group meeting in two different regions of oil palm cultivation (the central and the east regions of the palm oil geography) and one institutional workshop in Bogotá with the participation of members of civil society organizations, academia, practitioners and business actors connected with the palm oil agro-industry. The second fieldwork period involved 24 in-depth interviews and 4 group meetings in the central region of the palm oil geography and the capital-Bogotá.

The data about the development and expansion of the palm oil frontier after 2010 come from secondary sources. Since these data come from the time period after our fieldwork was conducted cross checking with primary data is not possible. For this reason, we present only a descriptive account of the developments of the palm oil sector after 2010 in "Overview of the expansion of the palm oil frontier in Colombia" section.

Overview of the expansion of the palm oil frontier in Colombia

The agri-business of oil palm cultivation and palm oil production started to consolidate in Colombia in the 1960s, although the first plantations started as early as 1945 [38–40]. Since then, oil palm cultivation has expanded continuously, although not evenly across time. It has passed through periods of increase and stagnation depending on government support, market changes, and natural and ecological conditions as shown in Fig. 2.

Mostly national entrepreneurs started to cultivate and produce palm oil to supply the national market with the support of the national government in the 1960s [38–40]. Between the 1960s and the end of the 1980s, government support, in particular the protection of the national production through policies to control imports of vegetable oils and fats, facilitated the establishment and growth of the national palm oil sector. These policies made it possible to keep palm oil national prices substantially higher than international prices, so protecting the revenues of the national palm oil agro-industry [38, 41, 42]. As a result, oil palm cultivation and palm oil production was consolidated as a flourishing agro-industry controlled by national entrepreneurs and oriented to the national market for traditional uses (food, oleo-chemical, soaps and animal feed).

The scenario of prosperity of the 1980s changed during the 1990s when a combination of three interrelated

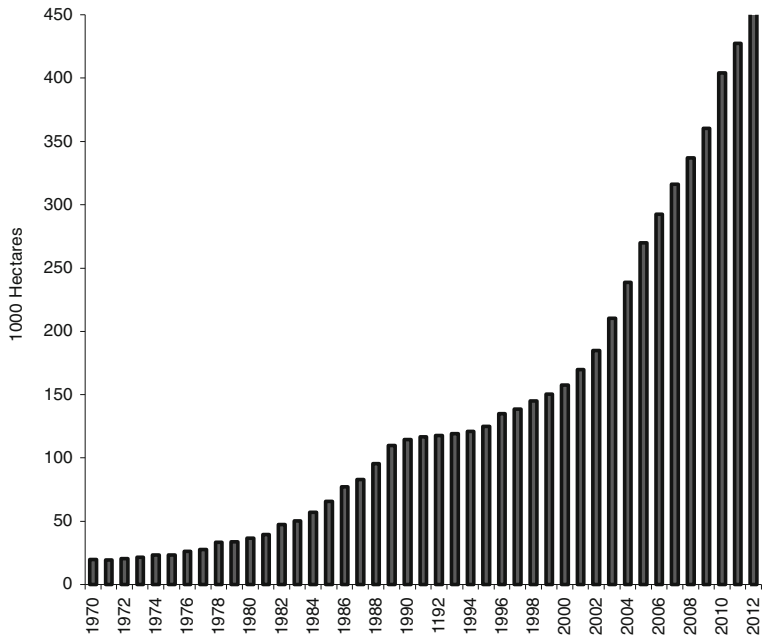

Fig. 2 Oil palm cultivation in Colombia (hectares planted) 1975–2012. Source: [44]

factors resulted in stagnation of oil palm cultivation and palm oil production [38, 41, 43].

i) a commercialisation crisis due to saturation of the palm oil national traditional market (food, oleo-chemical, soaps and animal feed);
ii) the liberalisation of the Colombian market that allowed imports of vegetable oils from cheaper sources,[1] and
iii) the lack of government support appropriate to the needs of the palm oil agro-industry such as credit lines suitable for late-maturing crops.

However, since 2000 Colombia has followed the global trend of an accelerated expansion of the palm oil frontier. The country-specific trajectories of this expansion are expressed in the 'commodity metabolism' (see "Analytical framework and Methods" section) of the Colombian palm oil commodity chain during the 2000–2010 period, which encompasses both the markets where palm oil is directed to (the 'space-of-flows'), and the expansion of oil palm cultivation at the extraction frontier ('space-of-place') (see Fig. 3).

This 'commodity metabolism' was characterised by:

i) A substantial increase in palm oil sales for export since 2003. However, oil export started to decrease in 2008 when sales for the national biodiesel market started to rise.
ii) An accelerated expansion of oil palm cultivation between 2002 and 2010 that entailed land control through practices of 'accumulation by dispossession' and 'assimilation', as explained in detail in "The 'space-of-place': oil palm 'crop boom' and trajectories of land control:" section. The amount of land under oil palm increased from 158,000 in 2000 hectare to 380,000 hectare in 2010 [44].

"Results and discussion" section presents a detailed account of these trajectories of expansion in the 'space-of-flows' and in the 'space-of-place' between 2000 and 2010, together with the country-specific geographical, socio-economic and political factors that shaped them.

After 2010 the palm oil frontier has continued to expand reaching 466,185 hectare in 2015, although at a slower pace (see Fig. 2) [44].

Most of the national palm oil production has been directed to the national market, since palm oil demand for national biodiesel production has continued to increase. By 2014, the national biodiesel industry absorbed 55% of the palm oil sales to the domestic market [45] linked to the gradual implementation of a 10% biodiesel blending mandate introduced in 2008.

However, in 2011, exports started to rise again [44] because: i) the palm oil demand for national biodiesel production is reaching its maximum as the biodiesel blend approaches the limit set in the mandate, and ii) the demand for palm oil from the national traditional (that is the non-biodiesel) market has not absorbed the palm oil surplus. Therefore, the palm oil agro-industry has looked for new markets in which to sell the surplus.

An important trajectory of oil palm cultivation between 2010 and 2015 has been the removal and renewal of

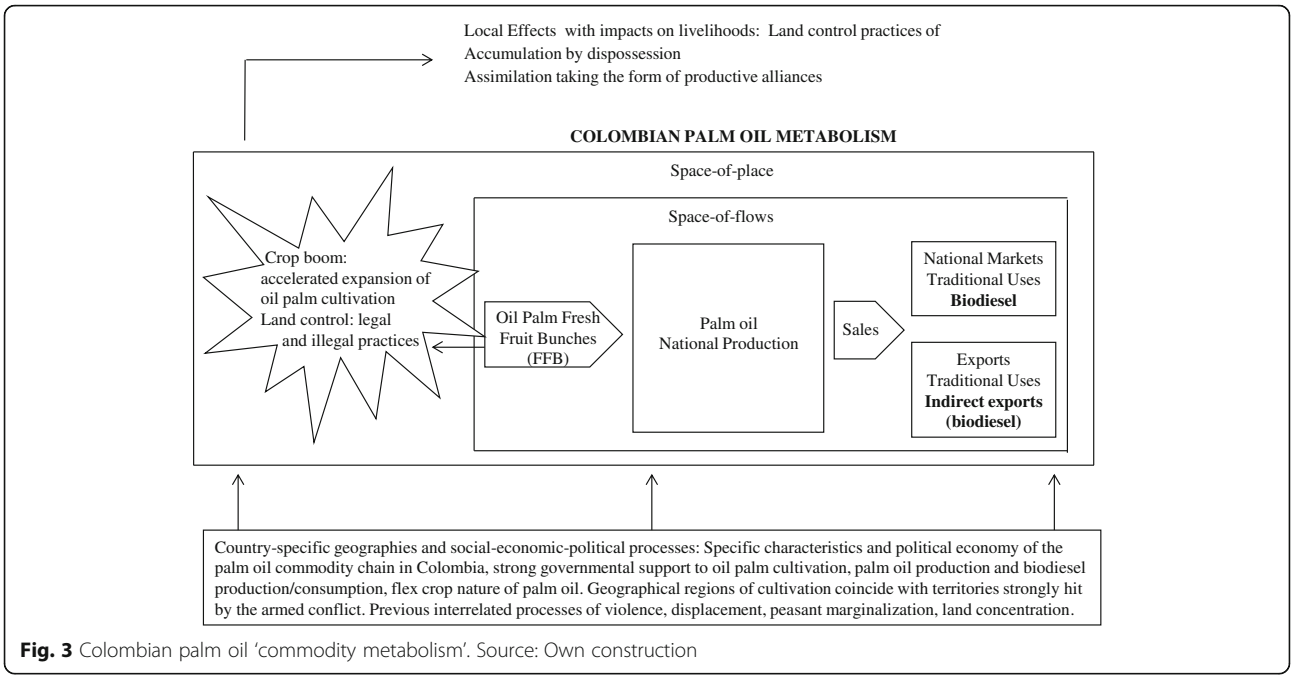

Fig. 3 Colombian palm oil 'commodity metabolism'. Source: Own construction

plantations affected by the 'bud rot' disease.[2] Although the disease started in 2006 in the South-west region of oil palm cultivation, it spread to other regions in 2009, in particular to the Central region. By 2015, the number of hectares affected by the 'bud rot' had reached about 100,000 [46]. Controlling the spread of the disease, as well as removing and renewing the oil palms affected, has become a priority for the palm oil agro-industry. Therefore, the expansion of oil palm cultivation has been relatively limited after 2010 in the zones affected by disease.

Results and discussion

Trajectories of expansion in the 'space-of-flows': markets, 'flex crops' and biofuels

The 'space-of-flows' of the Colombian palm oil 'commodity metabolism' was, until the 1990s, limited to the national traditional market (food, oleo-chemical, soaps and animal feed). However, changes in the national economy led palm oil producers to seek new markets.

By 1989, the national traditional market could no longer absorb the increasing palm oil production. At the same time, due to market liberalisation, some companies from the national traditional industries started to import vegetable oils from cheaper sources [43]. In addition, market liberalisation for palm oil producers meant an end to price protection and competition from cheaper imported vegetable oil.

The alternative chosen by the palm oil agro-industry to cope with the emerging crisis was to direct the palm oil surplus to export markets. Exports began to expand at the beginning of the 1990s. To facilitate exports the government introduced a price stabilisation fund in 1996 which helped protect the revenues of the palm oil producers [43].[3] However, the export market turned out to be less profitable than the national market, in particular, the high production costs in Colombia made competition with the two global largest producers—Indonesia and Malaysia—-difficult [43].

The volume of palm oil exports remained relatively low until 2000 after which, the 'space-of-flows' started to change substantially. The period between 2000 and 2010 was characterized by a substantial increase in exports. However, the share of exports in palm oil sales started to decrease in 2008 when producers started to switch to the national market, in response to the emergence of a new national market for biodiesel; (see Fig. 4).

This trajectory of the contemporary expansion in the 'space-of-flows' was shaped by the flexible nature of palm oil as a feedstock and the political economy of the Colombian palm oil commodity chain.

Oil palm is a typical 'flex crop' [47] which fruit can be processed into a range of products to serve different markets. Palm oil is the principal product, but from the oil extraction also yields byproducts that can be used to produce animal feed (meal and palm kernel meal), and palm kernel oil that is further processed into food products, soap and cosmetics. Moreover, palm oil as a vegetable oil is also itself 'flexible'. It can be further transformed into intermediate and final goods for the food, biodiesel, oleo-chemical, cosmetics and animal feed markets. It is this flexibility of oil palm that enabled growers and producers to respond quickly to the opening up of the new market in biofuels.

In Colombia, the specific characteristics of the palm oil commodity chain and the political economy of biofuels

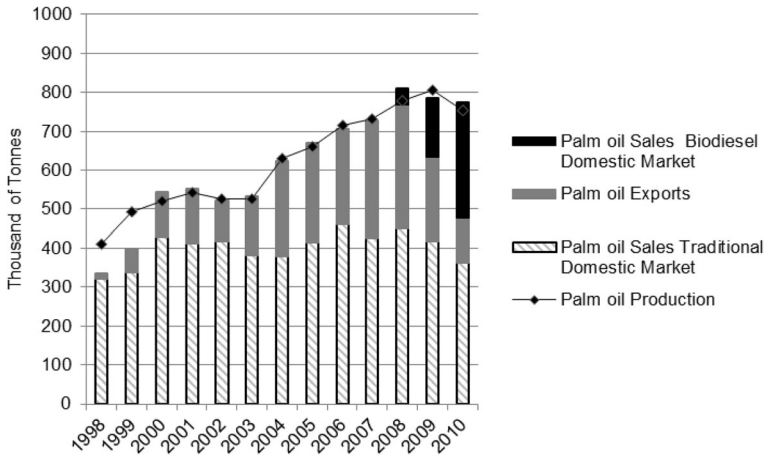

Fig. 4 Colombian palm oil production and sales per market of destination 1998–2010. Source: own construction on the basis of data extracted from [44]

and palm oil shaped the ways in which industry responded to the global biofuel boom resulting in country-specific trajectories of palm oil frontier expansion in the 'space-of-flows'.

Palm oil extraction is the central production process of the commodity chain around which it is possible to integrate the two other main processes: oil palm cultivation at the upstream end of the chain and industrial transformation at the downstream end. Industrial transformation can be further divided in different processes depending on the intermediate and final goods to be produced from processing crude palm oil.

The organization of the Colombian palm oil sector along the commodity chain is rather complex. By 2010, there were 54 palm oil extraction companies with a range of organisational forms for the integration of palm oil production and processing. Integration could be to form commercial alliances with other organizations, and/or to become involved with other processes upstream or downstream in the commodity chain such as oil palm cultivation, palm oil refining or biodiesel production. In spite of this complexity, the specific trajectories of expansion of the palm oil frontier in the 'space-of-flows' are rooted in four distinctive traits which can be considered as characteristic of the Colombian palm oil commodity chain:

i) historical control of the different processes by national entrepreneurs, rather than by foreign transnational corporations [38, 39], most of whom belong to wealthy families that have established prosperous business groups at the national level.
ii) High levels of vertical integration between agro-industrial (oil palm cultivation and palm oil production) and industrial processing activities so that palm oil production is sold directly by palm oil producers to processors that are part of the same business group they are integrated in ([42]: 60), as shown in and Table 1.
iii) Development of the agro-industrial activities (oil palm cultivation and palm oil production) driven by government support.
iv) Low international competitiveness of the Colombian palm oil production and the marginal position in the international market compared to Indonesia and Malaysia.

For such a nationally oriented and highly integrated Colombian palm oil sector, the biofuel boom represented a twofold business opportunity to deal with the commercialisation and competitiveness challenges.

First, palm oil producers took advantage of the government stimulus to biofuels. The Colombian president Álvaro Uribe Vélez (2002–2010) embraced the global enthusiasm for biofuels. Uribe Vélez's government promoted the creation of a national biodiesel market based on palm oil which enabled the enlargement of the national market for palm oil. In doing so, Uribe Vélez kept an election promise in which he had expressed his desire to establish the enabling policy environment to promote national biodiesel demand and production [43]. Measures taken during his time in office to stimulate the demand for biodiesel included a blending mandate, tax exemptions credit facilities, subsidies, fiscal incentives, and price regulation. These measures enabled palm oil producers to expand oil palm cultivation, enlarge the capacity of palm oil extraction plants, establish biodiesel refineries and increase exports [37].

Second, the use of vegetable oils for biodiesel production in other countries—especially in the EU—increased the demand for these commodities in the international market, so creating market opportunities for palm oil exports [7, 48–50].

Table 1 Commodity chain integration of palm oil producers involved in biodiesel production in 2010

Biodiesel producing companies	Percentage of palm oil sales (in terms of volume) absorbed for biodiesel production in 2010	National palm oil producers with participation in biodiesel companies	Percentage of palm oil sales (in terms of volume) absorbed by other processing or exports businesses belonging to the same palm oil producers in 2010
Oleoflores s.a.	*8.1%*	Oleoflores group (Murgas Dávila Family)	Oleoflores s.a *1.9%*
Biocombustibles Sostenibles del Caribe s.a.	*5.5%*	DAABON Group (Dávila Abondano Family)	C.I Tequendama (processing) *2.5%*
			C.I Tequendama (exports) *1.7%*
		Palmeras de la Costa s.a.	Palmeras de la Costa s.a. *1.2%*
Aceites Manuelita s.a.	*10%*	Aceites Manuelita s.a.	
Ecodiesel Colombia	*5.5%*	Extractora Central s.a.	
		Oleaginosas las Brisas s.a. (Business group CasaLuker)	(CasaLucker is part of Alianza Team through the Affiliate Grasas S.A.) Alianza Team absorbed *7.3%* of the palm oil sales.
		Palmas Oleaginosas Bucarelia s.a.	Lloreda s.a *3.2%*
		Palmeras de Puerto Wilches S.A.	
		Agroince Ltda. Y Cia. S.C.A	
		Palmas del Cesar S.A	
		Extractora Monterrey s.a.	C. I Santandereana de Aceites s.a *2.7%*
BioD s.a.	*10.4%*	15 palm oil producers/ growers	Some are vertically integrated with processors.
Odin Energy (established in February 2009. Out of operation since January 2012)	*0% (in liquidation)*	N.A. (Japanese investors non - palm oil producers)	
	Total: 39.5%		*Total: 20.5%*

Sources: own construction on the basis of data from [42, 43, 51, 95–97]

The result in the 'space-of-flows' was a two-pronged trajectory of expansion:

Firstly, the palm oil sector privileged the increase in sales to the national market to supply palm oil for the national biodiesel market and industry. There was a substantial increase in palm oil production linked to the establishment of a national biodiesel industry vertically integrated with palm oil producers.

As shown in Fig. 4, palm oil production has risen rapidly since 2003 until 2010 when the 'bud rot' disease that infected thousands of hectares of oil palm led to a decrease in palm oil production. Six biodiesel refineries were built and put into operation between 2005 and 2010. Since 2008, the national biodiesel industry started to gradually absorb a larger share of the palm oil sales and production. By 2010, about 40% of the national palm oil production and sales was used for biodiesel [51]. Five of these biodiesel refineries are totally or partially owned by national palm oil producers (Table 1).

Secondly, palm oil producers took advantage of the available opportunities in the international market as long as they were profitable.

While the national biodiesel industry was establishing, palm oil producers needed an outlet for the surplus resulting from increased palm oil production. This outlet was provided by a biofuel-driven increasing demand for vegetable oils at the international level—especially in the European Union. Between 2003 and 2008 Colombia palm oil exports more than doubled. However, they started to decrease in 2008 with the implementation of the national biodiesel blending mandate (Fig. 4). From 2004 until 2008, most palm oil exports went to the European Union (Fig. 5).

Several factors converged to shape this particular exports flow:

i) Palm oil exports were favoured by the increase in international prices (see Fig. 6), and government support through a subsidy that partially funded the fees for exchange-rate risk coverage.

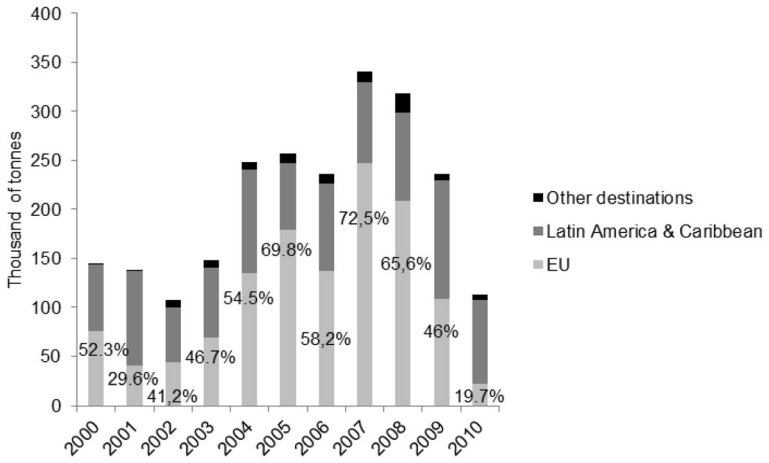

Fig. 5 Colombian palm oil exports per regions of destination 2000–2010. Source: own construction on the basis of data extracted from [44]

ii) Venezuela—which had been the most important destination for exports—restricted access to the market for Colombian palm oil since 2002 by imposing import tariffs and import licenses ([43]: 104). Therefore, palm oil producers were faced with looking for other markets for the increased volume of palm oil output.
iii) The EU became an attractive market due to: *first*, an increasing demand for vegetables oils resulting from the EU increase in biodiesel demand and production driven by the EU Biofuels Directives [52, 53]. *Second*, a privileged access to the EU market for palm oil imports from Colombia through preferential imports duties granted under the EU's 'Generalised Scheme of Preferences'.[4]

The increase in exports from Colombia to the EU coincided with a trend of increasing consumption of vegetable oils in the EU, which has been attributed to EU policies for the promotion of the use of biofuels. Palm oil is not produced in the EU; therefore, all the oil is imported. Some analysts consider that the increase in EU palm oil imports since 2003 is explained by the use of imports to substitute for rapeseed oil diverted from the food market to biodiesel production [54–56]. These imports are defined by Edwards et al. as 'indirect imports', i.e. imports of substitutes for feedstock diverted from other uses to biofuel production [54]. Palm oil's versatility made it possible for Colombian palm oil producers to grasp the opportunities derived from a global biofuel boom in international markets, especially the EU 'indirect imports' of palm oil. Indirect imports demonstrate that the flex-crop nature of palm oil is not only represented by its inter-changeable multiple uses, but also by its perfect exchangeability with other vegetable oils such as rapeseed oil, soy oil and sunflower oil [26, 57]. A consequence of the exchangeability among these different vegetable oils is that their markets are intertwined so that international prices of any of these commodities may affect the demand, supply and prices of the others [26, 47].

Trajectories of expansion in the 'space-of-place': oil palm 'crop boom' and trajectories of land control

The contemporary expansion of the palm oil frontier in the 'space-of-flows' took the form of a 'crop boom' in the 'space-of-place'. Although the land devoted to oil palm cultivation has expanded continuously in Colombia since oil palm cultivation started to be consolidated in the 1960s, the most significant increase in cultivation started in 2002. Between 2000 and 2010, the amount of land under oil palm more than doubled (see Fig. 2).

The geography of this expansion was determined by the physical requirements of oil palm cultivation/palm oil production and the way in which production is organized. However, this geography overlaps with the geography of an agrarian history of peasant marginalization, violence and land concentration in Colombia. This agrarian history has shaped country-specific trajectories of expansion involving land control practices of 'accumulation by dispossession' and 'assimilation'.

Oil palm cultivation and palm oil production in Colombia are organized in what the agro-industry calls 'palm oil nuclei'. A palm oil nucleus consists of an extraction plant and its supply base (that is oil palm plantations that supply oil palm fresh fruit bunches - FFB).

The locations of the palm oil nuclei and the sites of expansion of cultivation—i.e. the 'space-of-place' of the palm oil frontier—as well as the form such expansion takes, are determined by two characteristics of the crop.

First, palm oil has to be extracted from the FFB within 12 h following the harvest to ensure the quality of the oil [58]. Therefore, oil palm plantations and the palm oil extraction plants need to be located close to each other [58]. As a consequence, the expansion of cultivation

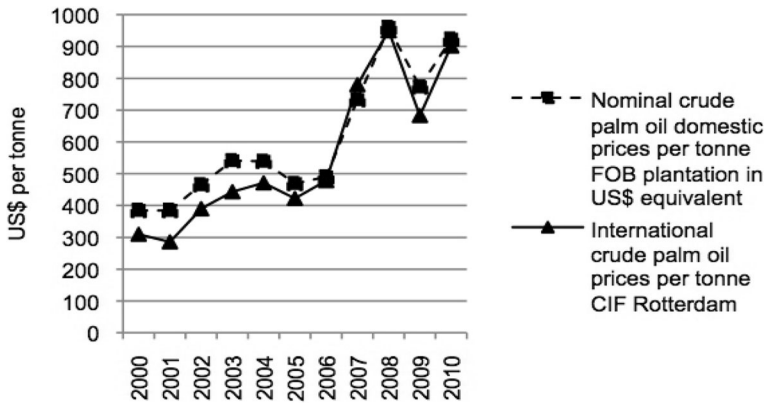

Fig. 6 National and international crude palm oil prices 2000–2010. Source: data extracted from [44]

necessarily takes place around palm oil extraction plants forming enclaves.

Second, the oil palm requires certain edapho-climatic conditions to grow—i.e. specific soil qualities, altitude, topography, temperature, humidity, precipitation, solar radiation and hydrological balance—which determine the physical location and potential expansion of palm oil nuclei.

In the case of Colombia there are four geographical regions where oil palm cultivation takes place (North, East, Central and South-west). Although the expansion of the frontier occurred within these geographical limits, the vastness of the regions allowed significant expansion in the cultivation area between 2000 and 2010. Such expansion took place, not only in the municipalities where oil palm had been traditionally grown until the end of the 1990s, but also across municipalities where oil palm had not previously been grown, so shaping and expanding the new frontier. The number of municipalities with oil palm plantations more than doubled during the 2000–2010 period, from 47 in 1999 to 106 in 2010. New municipalities either form new enclaves or are contiguous to former municipalities of oil palm cultivation, so enlarging old enclaves.

A particular feature of the contemporary expansion of the palm oil frontier in Colombia is that, despite the increase in the cultivated area, the number of extraction plants remained stable across time. Thus, expansion took the form of an enlargement of existing palm oil nuclei in terms of cultivation area due to an increase in the installed capacity of existing palm oil extraction plants and the higher plant utilization ([43]: 85).[5]

Although the enlargement of the palm oil nuclei indicates that the expansion of the frontier was mainly driven by former palm oil producers (hereafter, we refer to these producers as *established palm oil producers*), new actors also entered into the business of oil palm cultivation (hereafter, we refer to these producers as *newcomers*).

From the empirical evidence results that the group of newcomers included large- and medium-scale land holders, politicians, and national and local elites attracted by a new source of capital accumulation. Within the group of newcomers were also illegal armed groups who saw in oil palm cultivation an opportunity to legitimise the territorial control over land that these groups have gained or maintained illegally through displacement and dispossession of local people (see Fig. 7).

Both established palm oil producers/oil palm growers and newcomers used different legal and illegal practices of land control in order to *gain* and *control* access to land for oil palm cultivation. Common practices to gain and control access to land include different forms of 'accumulation by dispossession' and 'assimilation' (see Fig. 7). Details about how these land control practices worked in the case of oil palm expansion in Colombia are given in the following two sections: "Land control, productive alliances and 'assimilation'" and "Land control and 'accumulation by dispossession':". "Oil palm expansion and the Colombian agrarian history" section shows how the agrarian history of peasant marginalization, land concentration and armed conflict has shaped the trajectories of palm oil expansion in the 'space-of-place' in Colombia.

Land control, productive alliances and 'assimilation'

'Productive alliances' are a business model to integrate groups or associations of small- and medium-scale land holders (*supply allies*) into the supply chain of a palm oil extraction company (*anchor company*).[6] The establishment of 'productive alliances' was one of the dominant strategies used by established palm oil producers to enlarge the palm nuclei under their control.

The first 'productive alliance' scheme for oil palm dates from 1999 [59]. By 2010, there were 109 associations involving about 5000 growers throughout the palm oil geography [60]. This form of integration spread so extensively that by 2010 oil palm cultivation under

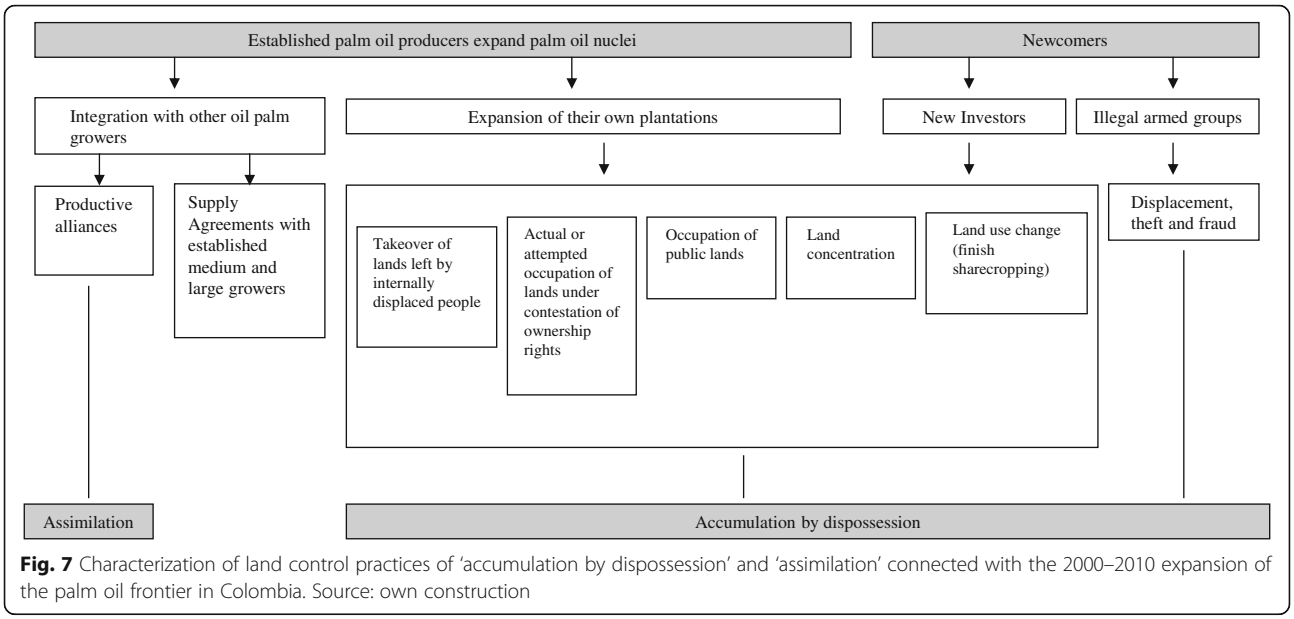

Fig. 7 Characterization of land control practices of 'accumulation by dispossession' and 'assimilation' connected with the 2000–2010 expansion of the palm oil frontier in Colombia. Source: own construction

'productive alliances' had taken place across more than half of the municipalities of the palm oil frontier. Approximately 25% of the 61,000 hectare newly cultivated with oil palm between 2000 and 2010 were under the form of 'productive alliances' [60].

The characteristics of the 'productive alliances' model allow anchor companies to gain access to and control over land without having to embark on land acquisition and other significant financial outlay. Under this model, the supply allies commit to devoting land and labour to grow oil palm and to supply FFB to the anchor company, while the latter commits to buy the FFB from the allies at an agreed price. It is common practice for the supply allies to take out loans to cover costs of establishing the plantation. The cost of buying land can also be financed through loans [61].

The anchor company controls the plantations through the conditions of the alliance agreement. Typically, the agreement involves a long-term exclusive supply commitment on the part of the growers. The term is usually equivalent to the commercial lifetime of a plantation, i.e. 25–30 years. In order to ensure the quality of the raw material and the efficiency of the business, supply allies are required to commit to follow the recommendations of the anchor company in terms of technical management of the plantation and administrative management of the association [61]. Usually, the supply allies have to pay the anchor company for the palms, the technical support and the extension services provided by the company.

The operation of a 'productive alliance' under the conditions detailed above requires participants to adopt the business mindset necessary for managing a commodity plantation. Thus, this form of land control not only leads to 'adverse incorporation', i.e. inclusion on disadvantageous terms [35, 62] but may also entail 'assimilation' when it denies and erases the cultural practices and symbols of identity that differentiate peasant agriculture from capitalist agro-industries. Assimilation takes place when peasants adhere to the 'productive alliances' because growing palm under this model is 'the' option to be able to *gain* or *maintain* access to land and to ensure a livelihood in a context of marginalization and violence. As explained in "Oil palm expansion and the Colombian agrarian history" section, the lack of alternatives resulting from an agrarian history of peasant marginalization and armed conflict has led farmers that come from a peasant tradition to become members of associations for small-scale oil palm growers despite their agricultural practices being at odds with the business mindset required to manage an oil palm plantation ([63, 64], fieldwork interviews). This situation is illustrated by the following quote from a member of an association engaged in an oil palm 'productive alliance': 'The best lands are being cultivated with palm, there are no more offers for the peasant, that is why palm continues to expand' (small-scale oil palm grower quoted in Spanish in ([63]: 22). English translation by Marin-Burgos).

The lack of alternatives to *gain* or *maintain* access to land while practicing peasant agriculture is also illustrated by the case of internally displaced peasants who are members of an association called ASOBENPRO—*Asociación de Beneficiarios del Proyecto de Palma el Progreso*. The members of ASOBENPRO were assigned land by the central government on the condition of establishing oil palm plantations. During a group meeting, ASOBENPRO members explained that, although they came

from the peasant tradition, they accepted to grow oil palm because it was the only way to gain access to land and a means of a livelihood (group meeting with members of ASOBENPRO, municipality of Sabana de Torres, 13 September 2011).

Land control and 'accumulation by dispossession'

Besides 'productive alliances', the contemporary expansion of the palm oil frontier in Colombia has encompassed a variety of practices for land control that represent forms of 'accumulation by dispossession' as they result in dispossession of local people's access to land. These practices can be analytically grouped into six categories.

i) Oil palm cultivation in connection with displacement operated by illegal armed groups,
ii) takeover of land left by internally displaced people,
iii) actual or attempted occupation of lands under contested ownership rights,
iv) occupation of public lands,
v) land use change, and
vi) land concentration.

Table 2 presents a summary of the cases which form the empirical basis for this categorization. This list is by no means an exhaustive compilation of the ways of gaining land control for oil palm cultivation in general terms. It constitutes a categorization of 'accumulation by dispossession' practices for land control made on the basis of the cases studied by the authors regarding the 2000–2010 expansion of the palm oil frontier in Colombia.

The cases in Table 2 do not necessarily belong exclusively to one category. Several of the cases exhibit two or more forms of 'accumulation by dispossession'. This intertwining of different forms of 'accumulation by dispossession' shows that land control for the expansion of commodity frontiers can reach high levels of complexity and sophistication.

The remainder of this section presents in detail how these forms of 'accumulation by dispossession' were operated in practice.

The most extreme form of 'accumulation by dispossession' is the violent displacement followed by oil palm cultivation by illegal paramilitary groups who use the facade of a legal agri-business to give legitimacy to and retain territorial control and to extract economic rents (Cases 1, 2 and 10 in Table 2) . This practice has received most of the attention from the media, academia, civil society organizations, international organizations and state agencies. For example, the case of the displacement of communities of Afro-Colombians in the *Jiguamiandó* and *Curvaradó* river basins (Case 1 in Table 2) is often cited in the literature reporting the negative effects of the palm oil expansion in Colombia [19, 65, 66].

However, most of the cases of 'accumulation of dispossession' in Table 2 have involved other types of land control practices but receive less attention in the academic literature and the media.

Cases 3, 4, 5, 6 and 8 show that tenants, sharecroppers and subsistence users of public lands can be dispossessed from access to land when expansion of oil palm cultivation hinders the traditional land tenure arrangements and practices for access to land. People who do not own land in rural areas in Colombia have mainly relied on two types of land tenure arrangements to gain or maintain access to land which do not necessarily imply ownership.

The first type of land tenure arrangement used by landless people is represented by land-rental and sharecropping agreements with landowners. In cases 6 and 8 tenants and sharecroppers were dispossessed of their access to land when landowners decided to use that land for oil palm cultivation.

In Case 8, dispossession not only occurred due to termination of sharecropping or land rental arrangements, but also because established palm oil producers and newcomers took over lands left by displaced people to expand or establish oil palm plantations [67].

In case 6, dispossession occurred simultaneously with 'assimilation' since some of the landowners were local farmers who were members of 'productive alliances' [68]. Also in case 9 (Table 2), 'assimilation' and dispossession occurred simultaneously in a context of land use change. However, in this case the people affected were not landless peasants, but Afro-Colombian communities with collective land titles recognised under the Colombian law. The change in land use when oil palm was introduced affected the environmental conditions of the neighbouring communities' territories, so putting at risk the traditional land uses that constituted the basis of the livelihoods of those communities not incorporated into 'productive alliances'. This situation resulted in a conflict between Afro-Colombian communities who were members of productive alliances and those who were not members [69].

The second form of tenure involves the use of two types of public lands:

i) land for which the ownership is reserved exclusively for the state or a public entity, for example communal savannahs and marchlands. Under Colombian Agrarian Law (Law 160, 1994), this type of land can be used by local people for cattle grazing, fishing and subsistence food production.
ii) land intended to be assigned by the government to individuals or peasant associations who are able demonstrate that they have occupied and used the land for their productive activities for at least 5 years (Law 160, 1994 - Articles 65 and 69).

Table 2 Cases of 'accumulation by dispossession' connected with the 2000–2010 expansion of the palm oil frontier in Colombia

Case (Region in the palm oil geography)	Form of 'accumulation by dispossession'						Previous displacement of local population	Sources
	Occupation of land left by displaced people	Oil palm cultivation in connection with displacement operated by illegal armed groups	Actual or attempted occupation of lands under contested ownership rights	Occupation of public lands	Land use change	Land concentration		
1. Forced displacement and oil palm cultivation in the *Jiguamiandó* and *Curvaradó* rivers basins. Municipality of *Carmen del Darién-Chocó*. (North Region)		✓					✓ 1998	[65, 98–101] Interview with officer from the Ombudsman Office during fieldwork in 2010.
2. Forced displacement and oil palm cultivation in the areas of *Monterrey and San Blas*. Municipality of *Simití-Bolívar*. (Central Region)		✓					✓ 1998	[68, 102, 103].
3. *Las Pavas* estate. Municipality of *El Peñón-Bolívar*. (Central Region)	✓		✓	✓			✓ 2003	[104–106]. Interview with the PDPMM's coordinator of the land protection project during fieldwork in 2010.
4. 1500 hectare of the *Bellacruz* estate. Municipality of *La Gloria-Cesar*. (Central Region)	✓		✓	✓			✓ 1996-2005	[107–109]
5. Plots in the middle of palm oil plantations used by peasants for small-scale subsistence farming. Municipality of *San Alberto-Cesar*. (Central Region)			✓				No	[110] Interviews and group meetings during fieldwork in 2011.
6. Massive establishment of oil palm by different actors in the Municipality of *Simití-Bolívar*. (Central Region)				✓	✓		✓ 1998-2006	[68]
7. Oil palm oil cultivation in Afro-Colombian collective territories of *Alto Mira* and *Frontera* Municipality of *Tumaco-Nariño*. (South-west Region)			✓				No	[70, 111] Interview with officer from the Ombudsman Office during fieldwork in 2010.
8. Massive establishment of oil palm. Municipality of *Zona Bananera–Magdalena*. (North region)	✓				✓	✓		[67]
9. *Guapi Abajo* palm oil project. Municipalty of *Guapi-Cauca*. (South-west Region)					✓		No	[69, 96, 112]

Table 2 Cases of 'accumulation by dispossession' connected with the 2000–2010 expansion of the palm oil frontier in Colombia *(Continued)*

10. *El Agrado1,2,3* estates. Municipality of *Mapiripán–Meta* (East Region)		✓		✓ 1997-2006	[113]
11. *El Secreto1,2,3* estates.Municipality of *Mapiripán Meta* (East Region)	✓		✓	✓ 1997-2006	[71, 113]
12. *Las Palmeras* estate. Municipality of *San Juan de Arama-Meta* (East Region)			✓	✓ 2000-2006	[71, 114]
13 Poligrow palm oil project. Municipality of *Mapiripán-Meta* (East Region)			✓	✓ 1997-2006	
14. Bioagroindustrial de Colombia Ltda. *Tibu-Norte de Santander*(Central Region)			✓	✓ 1998-2006	
15. Inversiones Palma Oriente. *Tibu-Norte de Santander* (Central Region)			✓	✓ 1998-2006	
16. Ecopalma s.a.s *Tibu-Norte de Santander* (Central Region)			✓	✓ 1998-2006	

Unlawful occupation and appropriation of these two types of public land by oil palm growers led to landless peasants' dispossession of access to land. Case 6 gives an example of this type of appropriation where public communal savannahs and marshlands used by landless people for fishing or growing short cycle crops were unlawfully taken over [68].

Peasants often settle in the second type of public land maintaining access through informal land tenure practices. While peasants can apply for recognition of property rights and titling they tend to do this only when their access is threatened or contested resulting in land tenure conflicts. This is the situation in cases 3, 4 and 5.

In cases 3 and 4, peasants' land access was threatened when wealthy landlords seized public lands to which peasants had the right to obtain the titles. As a response, peasants started the legal procedure for the recognition of their property rights. However, the situation deteriorated further when the peasants had to abandon the land under pressure from illegal paramilitary groups. This forced displacement allowed the landlords' consolidation of the land grab, who then fraudulently sold this land to established palm oil producers and new investors enabling the expansion of the palm oil frontier. Although the palm oil producers and investors were not involved in the actions of displacement, they exacerbated and deepened dispossession by appropriating and establishing oil palm plantations on public land the ownership over which peasants have legitimate claims. Further dispossession materialised when some of the peasants attempted to return to the lands and were physically prevented from doing so.

In case 5, a large-scale palm oil company threatened to evict peasants from small-holdings located on public land that the peasants had used for more than two decades. The company laid claim to these plots in order to incorporate them into their established plantation. In response, the peasants began a legal process, with the support of a local non-governmental organization (NGO), for the recognition of their property rights. The palm oil company also resorted to legal procedures and de facto actions to appropriate the land and restrict peasants' access to it, so operating a form of 'accumulation by dispossession'.

'Accumulation by dispossession' through the occupation of land under contested ownership rights not only occurred in cases involving public lands, but also in territories of Afro-Colombian communities. In case 7, territories of Afro-Colombian communities were partially invaded by oil palm growers while the communities were waiting for the granting of the collective title to recognise their property rights under the Colombian law [70].

Disclosure by NGOs, state agencies protecting human rights, and researchers of all the cases of land control through 'accumulation by dispossession' described above started during Álvaro Uribe Vélez's government (2002–

2010). However, the emphasis that the subsequent government of Juan Manuel Santos (2010–2014) put on land restitution to dispossessed people led to the investigation and discovery of more cases of land control practices of 'accumulation by dispossession' for the expansion of the palm frontier. For example, there has been unlawful concentration of land by established oil palm growers and new investors in municipalities that have been subject to large-scale forced displacement and land grabbing. The establishment of oil palm plantations through unlawful concentration of land reinforces the processes of dispossession suffered by peasants and victims of internal displacement. Cases 11, 12, 13, 14, 15 and 16 are illustrative of this practice [71]. From the information available at the time of writing it appears that in these cases palm oil growers designed strategies to circumvent the Colombian Agrarian Law so that they could accumulate lands that: i) amounted to extensions larger than those permitted by the law, and/or ii) were reserved to be assigned to landless peasants or were left by people subject to forced displacement.

Oil palm expansion and the Colombian agrarian history

The forms of 'accumulation by dispossession' and 'assimilation' through which oil palm expansion has taken place in Colombia are shaped by the country's agrarian history of violence and peasant marginalization.

By marginalization we refer to the historical process by which peasants have lost 'the ability to control their own lives (where they live and derive their income, what crops or stock they produce, how hard and when they work)' ([72]: 125). This process has its roots in many years of government neglect of peasants' claims to support their production systems which tends to be small-scale and not in-line with the methods used by agro-industries.

The rural areas in Colombia have been for more than 60 years the theatre of agrarian conflict. The conflict is rooted in historical land concentration that originated in the colonial period between the years 1492 and 1821 [73]. This concentration has persisted and deepened as successive post-colonial governments have failed to address the unequal distribution of land. The armed conflict has contributed to peasant marginalization by the displacement and the destruction of the socio-economic base of rural territories [74]. In particular, the developments of the internal armed conflict after the 1990s helped shape the land control trajectories of the contemporary expansion of the palm oil frontier in the 'space-of-place'.

The agrarian question was the seed for the formation of guerrilla groups in the 1960s resulting in a violent country-wide armed conflict. The conflict evolved and became more complex as the agrarian issues became interwoven with the incursion of the narco-economy[7] in rural areas and the emergence of illegal paramilitary forces. The complexity deepened with the participation of both guerrilla and paramilitary groups in the narco-economy and the consequent intertwining of the armed conflict with the government's response known as 'the war against drugs' [75–78].

It is in this rural setting where the contemporary expansion of oil palm cultivation—and the expansion of other extraction frontiers—is played out. Two recent processes connected with the armed conflict are relevant to understand the trajectories of the contemporary expansion of the palm oil frontier in the 'space-of-place'.

First, the promotion of agricultural productive activities as alternatives to illegal cultivation of crops through substantial financial support to the 'productive alliances' including those used for the expansion of oil palm cultivation. Peasants have been subject to historical marginalization which made them easy targets for 'assimilation' processes through incorporation in 'productive alliances' since these schemes were presented and perceived as "the" option to *gain* or *maintain* access to land and make a livelihood.

Second, the widespread forced internal displacement of people in rural areas, especially between 1997 and 2005, resulting from the armed conflict [75].[8] Displacement entailed a process of "emptying rural territories"[9] not only from their inhabitants but also from the land uses attached to rural dwellers' livelihoods and identity [74–76]. This process paved the way for 'accumulation by dispossession', and created a setting which supported promotion and establishment of oil palm 'productive alliances'.

Figure 8 combines the geography of displacement between 1998 and 2006 with the geography of the palm oil frontier showing the location of both areas cultivated with oil palm under 'productive alliances' and areas where cases of 'accumulation by dispossession' have taken place.

Figure 8 shows that almost all the municipalities in the palm oil frontier registered high or medium levels of displacement. The cases of 'accumulation by dispossession' have taken place in the municipalities affected by high levels of displacement.[10] Figure 8 also shows that oil palm cultivation under 'productive alliances' takes place in more than half of the municipalities located in the palm oil frontier.

Conclusions

In this paper we draw on the situation of the contemporary expansion of the palm oil frontier in Colombia to explore how expansion of biofuel crops interacts with national geographies and social-economic and political processes to produce country-specific trajectories of expansion and resource access control. We use the concept of 'country-specific trajectories of commodity frontiers expansion' to describe the specific ways in which the expansion of the biofuel crops boom unfolds in a particular country that is not necessarily linked to the global biofuels chain.

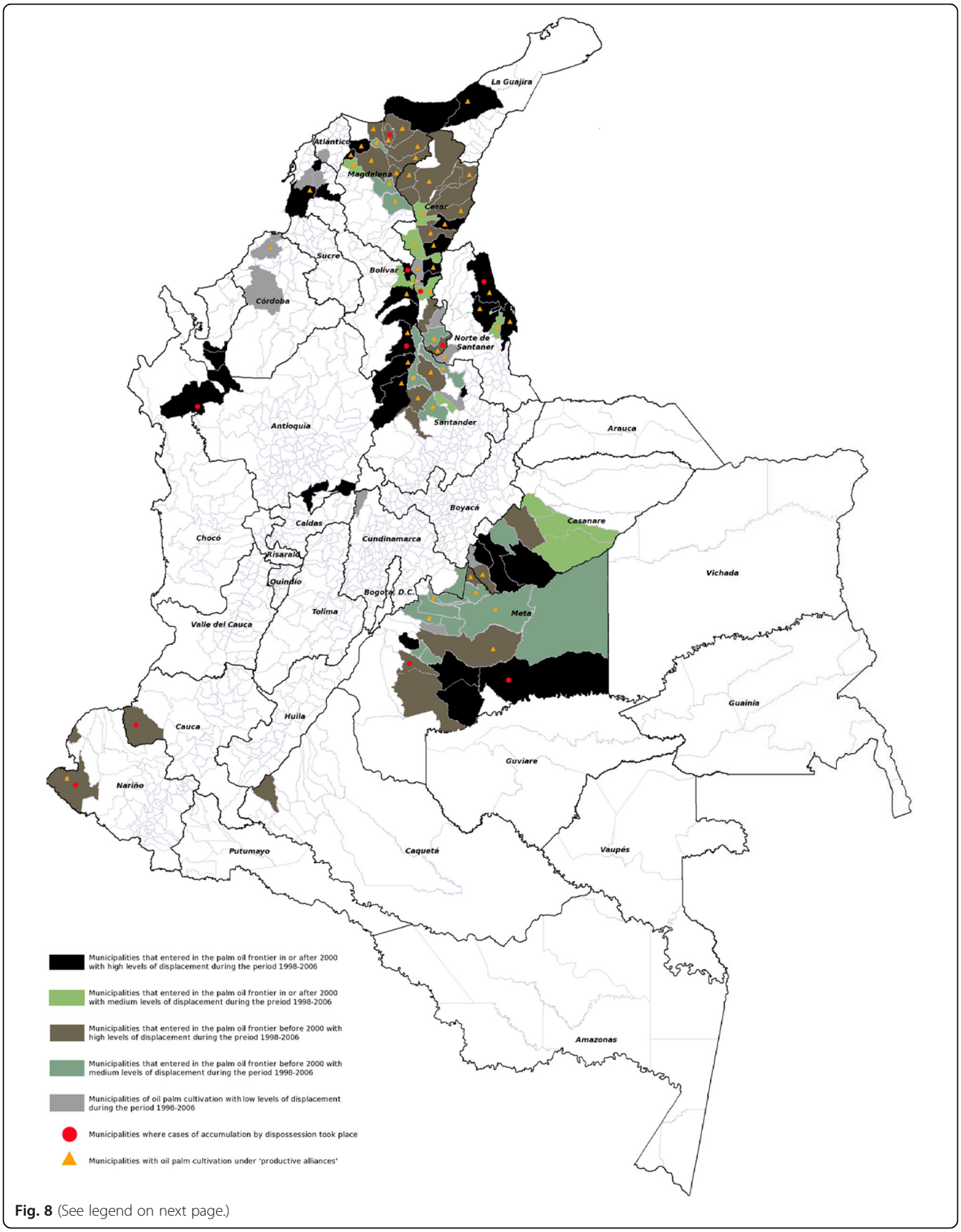

Fig. 8 (See legend on next page.)

(See figure on previous page.)
Fig. 8 Map 1 Geography of internal displacement between 1998 and 2006 in the palm oil frontier in Colombia. Source: own construction. Note: Data about displacement rates per municipality during the 1998–2006 period found in Reyes Posada et al. [92, 93]. Data about the palm oil geography come from Fedepalma [89, 90]. Data about 'productive alliances' found in [61, 94]. See Table 2 for data sources of cases of 'accumulation by dispossession'

The analysis, using concepts from political ecology, is based on a framework that positions expansion of commodity frontiers within the 'space-of-flows' and the 'space-of-place'. This approach allows to identify the markets and geographies that define the country-specific trajectories of expansion of commodity frontiers, and their connections with general patterns of resource control.

The analysis shows that, in contrast with the world largest palm oil producing countries—Indonesia and Malaysia [16, 24]—oil palm expansion in Colombia between 2000 and 2010 was not strongly influenced by the international market. Conversely, expansion was characterised by an increasing production of palm oil to be processed into biodiesel in order to supply a policy-driven national biofuel market controlled by national palm oil producers the emergence of which simultaneously compensated for the saturation of the national traditional market for palm oil. This particular trajectory was shaped by a combination of several interrelated factors that include processes at the global level, the 'flex crop' nature of palm oil, and contextual factors such as the political economy of palm oil production in Colombia.

Our study shows that the physical transformation of the territories and land control practices in Colombia follow patterns of 'accumulation by dispossession' and incorporation of small holder farmers through contract farming.

Contract farming arrangements called 'productive alliances' represent one of the dominant trajectories of expansion in the 'space-of-place'. Our analysis shows that 'productive alliances' may constitute forms of 'assimilation' when palm oil producers incorporate local peasants in the palm oil supply chain in order to gain control over land by taking advantage of peasants' marginalisation by the state, and denying differences in culture and identity.

The expansion of the frontier has also involved land control practices of 'accumulation by dispossession' as in other producing countries, in particular Indonesia [11, 79]. However, our analysis shows that in Colombia, there is a distinct country-specific set of practices. In several of the cases studied, two or more forms of 'accumulation by dispossession' have been used. This combination of forms of 'accumulation by dispossession' shows the complexity of the trajectories of the contemporary expansion of the palm frontier in the 'space-of-place'. This demonstrates that the study of the expansion of biofuel crops requires research approaches, such as political ecology, that provide the conceptual and analytical tools to unpack the complexity involved in country-specific trajectories of expansion.

From the analysis presented in this paper about the case of Colombia, we draw some general conclusions about the interaction between global expansion of biofuel crops and country-specific trajectories of expansion.

Firstly, it may be rather simplistic to state that direct cause-effect relationships exist between expansion of biofuel crops in the Global South and policy-driven biofuel demand in the Global North. It overlooks the complex and interrelated factors that mediate the specific ways in which the global demand for biofuels creates biofuel crop booms which in turn translates into country-specific trajectories of crop expansion and the negative consequences borne by peasants living in the expansion areas. Therefore, generalised explanations about the causes, effects and forms of expansion of biofuel crop booms based on overall observations at the global level or on single country case studies may result in misleading conclusions as regards both global dynamics of expansion and expansion in other producing countries. A better understanding of the dynamics of expansion of biofuel crops requires research at the country/local levels as well as comparative analysis across countries and localities.

In spite of the specificity of the trajectories of the expansion of biofuel crops in each producing country, such trajectories are linked up with broader processes at national and global levels through complex and interrelated strands of economic, political and geographical factors. Therefore, we acknowledge that the factors which shape the expansion of biofuel crops at global scale cannot be disregarded in the analysis of country-specific trajectories of expansion. In the case of oil palm expansion in Colombia analysed in this paper, the findings support conclusions from previous studies that the 'flex crop' character of biofuel crops has been a relevant factor contributing to their contemporary expansion at both national and global levels [26]. The Colombian case shows how the 'flex crop' nature of biofuel crops makes it possible for producers to align the trajectories of expansion in the 'space-of-flows' with switching to new market opportunities that are more profitable. As the multiple and flexible uses of biofuel crops allow a diversified product portfolio [26], producers can allocate sales to different markets according to their profitability. This supports the conclusion by Borras et al. ([27]: 851) that the accelerated expansion of 'flex crops' during the current phase of capitalism is logical since the versatility of these crops allows continuous capital accumulation in a context of multiple converging crises.

Secondly, the case study not only supports conclusions from previous research regarding the factors shaping the

global expansion of biofuel crops. Our findings also complement and resonate with the findings of previous studies regarding contract farming in the context of expansion of biofuel crops and the global land grabbing. The critical agrarian literature on global land grabbing shows that outgrowing and contract farming schemes have been used to control land for cultivation of biofuel crops. As Hall et al. point out, the common defining feature of the diverse outgrowing and contract farming schemes 'is not necessarily production by smallholders but the use of smallholders' land for contracted production' ([80]: 519). This literature has focused on the terms of incorporation and on the reactions of local people to these schemes [35, 62, 81–83]. Our analysis of 'productive alliances' in terms of 'assimilation' contributes to this literature by showing that these schemes not only result in 'adverse incorporation' but may also deny and erase peasant culture and identity. Moreover, our findings about the structural factors underlying local people's acceptance of 'productive alliances' resonate with other studies showing that 'long histories of government neglect and a lack of alternative livelihood possibilities' are at the basis of local people acquiescence to incorporation even on unfavourable terms [83, 84].

Finally, our study shows that biofuel crops expansion may also take place outside of global chains and hence can fall outside of global governance initiatives intended to mediate the negative consequences of such chains. In such a case, global governance instruments fall short to deal with negative socio-environmental effects of biofuel crop expansion. Therefore, national policies and regulations that tackle the actual and potential negative consequences of such expansion are also necessary.

Endnotes

[1]By 'liberalisation of the Colombian market' we mean the measures taken by César Gaviria's government (1990–1994) to withdraw the 'import substitution' model based on the protection of production that took place under previous governments, and a move towards an open market model in which national production enters into competition with imports. In the agricultural sector the liberalisation of the market involved the withdrawal of import barriers and agricultural price support [85].

[2]'Bud rot' is an infection of the tissues of the oil palm leading to decomposition of plant material and the eventual death of the oil palm. The decomposed tissue attracts insects that further spread the infection [86].

[3]The palm oil price stabilisation fund was created in 1996 to optimize the sales revenues and ensure that all palm oil producers could participate under conditions of equal prices in both national and foreign markets [87]. The fund works by collecting revenue from the sale by producers, distributors and exporters to the market with the highest price (either the national or the exports market), in order to make compensation for the sales to the market with a lower price [88].

[4]The EU's 'Generalised Scheme of Preferences' is an unilateral system of trade preferences that allows certain developing country exporters to pay lower duties on their exports to the EU to facilitate their access to EU markets and contributes to their economic growth.

[5]The number of extraction plants increased only slightly between 1999 and 2010 from 51 to 54, while the installed processing capacity increased from 748 to 1249 FFB tonnes per hour [89, 90].

[6]The 'productive alliances' are defined by Fedepalma as 'a set of relationships and formal arrangements between producers of agricultural goods, traders, agro-industries, and public or private support organizations, the purpose of which is to expand the area of agro-industrial cultivation of late-maturing crops and modernise technologically the productive units of small-scale growers' ([61]: 3) (English translation by Marin-Burgos).Orignal in Spanish: "*son un conjunto de relaciones y arreglos formales entre productores de bienes agropecuarios, comercializadores y agroindustriales y organismos de apoyo, públicos o privados, cuyo propósito es expandir empresarialmente las áreas de cultivos de tardío rendimiento y actualizar tecnológicamente a las unidades productivas de pequeños productores.*"

[7]The term narco-economy is used in this paper to refer to the cultivation, processing and commercialisation of crops classified as illegal under the Colombian law (marijuana, coca and opium poppy) and the products derived from processing such crops (for example, cocaine paste, cocaine base, cocaine, opium poppy latex, heroine).

[8]A comprehensive report on the historical armed conflict estimates that the number of internally displaced people is around 5,700,000 [75].

[9]The term "emptying territories" ("vaciando territorios" in Spanish) was borrowed from Vélez [91].

[10]Data about displacement rates per municipality during the 1998–2006 period found in Reyes Posada et al. [92, 93]. Data about the palm oil geography come from Fedepalma [89, 90]. Data about 'productive alliances' come from [61, 94]. See Table 2 for the data sources of the 'accumulation by dispossession' cases. The classification of municipalities into those with high, medium and low *levels* of displacement is based on the classification of municipalities with high, medium and low *rates* of displacement made by Reyes Posada et al. [92, 93]. Municipalities with high *levels* of displacement refers to municipalities that registered a *rate* of displacement of more than 5000 people displaced per 100,000 inhabitants (i.e. a high *rate* of displacement) in 1 or more years during the period 1998–2006. Municipalities with medium *levels* of displacement are those that have not registered a high *rate* of displacement in any year in the 1998–2006 period, but

registered a *rate* of displacement between 1000 and 5000 people displaced per 100,000 inhabitants (i.e. a medium *rate* of displacement) in 1 or more years during the same period. Municipalities with low *levels* of displacement are those that registered neither high nor medium *rates* of displacement in any year in the 1998–2006 period, but registered a *rate* of displacement less than 1000 people displaced per 100,000 inhabitants (i.e. a low *rate* of displacement) in 1 or more years during the same period.

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Authors' contributions
VMB conceived and designed the study, collected the data, carried out data analysis and drafted the manuscript. JC participated in the design of the study, contributed to the interpretation of data and critically reviewed the draft of the manuscript providing substantial contributions to improve the analysis. Both authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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