doi: 10.15174/au.2018.1553 | ISSN online: 2007-9621

ACTA UNIVERSITARIA
Multidisciplinary Scientific Journal

# The effect of oil palm on income strategies and food security of households in rural communities in Campeche, Mexico

## El efecto de la palma de aceite en las estrategias de ingreso y la seguridad alimentaria de grupos domésticos en comunidades rurales en Campeche, México

**Recibido:** 11 de agosto del 2016
**Aceptado:** 6 de noviembre del 2017
**Publicado:** 1 junio del 2018

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**Cómo citar:**

Rosas Urióstegui, F. I., Pat Fernández, J. M., Pat Fernández, L. A., van der Wal, J. C. (2018). The effect of oil palm on income strategies and food security of households in rural communities in Campeche, Mexico. *Acta Universitaria, 28*(2), 25-32. doi: 10.15174/au.2018.1553

**Keywords:**
Sustainable livelihoods; rural development; social capital.

**Palabras Clave:**
Modos de vida sustentables; desarrollo rural; capital social.

## ABSTRACT

Oil palm cropping expands rapidly in the Mexican state of Campeche. The crop has the potential to contribute to agricultural diversification and economic development of rural communities. At the same time, the effect of its rapid, unplanned expansion on income strategies and food security of domestic groups in rural communities is largely unknown. The goal of this study is to analyze the effects of the oil palm crop on income strategies and food security in rural communities of the south of Campeche State, México. The Sustainable Livelihoods (SL) approach was used and information on cropping and SL was gathered through a survey and participatory community workshops. Results show that, until now, oil palm cropping is a complementary activity to the income strategies of the farmers' families as these incorporate palm cultivation, while maintaining their other productive activities. Oil palm plantation establishment contributes to productive diversification, job creation and provision of stable incomes of domestic groups (DGs). Furthermore, domestic groups that include oil palm production in their income strategies have a greater degree of food security.

## RESUMEN

El cultivo de la palma de aceite se expande rápidamente en el estado de Campeche, México, y tiene el potencial de contribuir a la diversificación agrícola y al desarrollo económico de comunidades rurales. Al mismo tiempo, el efecto de su expansión rápida, sin planeación, en la estrategia de ingresos y seguridad alimentaria de las familias campesinas es mayormente desconocido. El objetivo del presente estudio fue analizar el efecto de la palma de aceite en las estrategias de ingresos y en la seguridad alimentaria en comunidades rurales del sur de Campeche. Se utilizó el enfoque de Modos de Vida Sustentables (MVS) y se generó información sobre el cultivo y MVS mediante una encuesta a las familias y a través de talleres comunitarios participativos. Los resultados muestran que la palma de aceite es hasta la fecha una actividad complementaria a la estrategia de ingresos de las familias campesinas, ya que incorporan el cultivo de la palma al mismo tiempo que mantienen sus demás actividades productivas. El establecimiento de las plantaciones de palma de aceite contribuye a la diversificación productiva, la creación de empleo e ingresos constantes de los grupos domésticos, como también a un mayor grado de seguridad alimentaria.

## INTRODUCTION

Production of vegetable oil is one of the most rapidly growing agricultural sectors worldwide (Wakker, 2005). Currently the world's greatest source of vegetable oil is the oil palm (*Elaeis guineensis* Jacq.) (Foreing Agricultural Service. U. S. Dep. Agric.-Foreign Agric. Serv [USDA-FAS], 2012). Oil palm cultivation has great potential for economic development in rural areas as it generates long-term income and employment (Mekhilef, Siga & Saidur, 2011; Rist, Feintrenie & Levang, 2010; Sheil *et al.*, 2009). The crop is attractive to tropical farmers, as its establishment and management requires little investment compared to vegetable oil crops such as soy bean. Furthermore, it produces the greatest yield among the oleaginous crops (Feintrenie, Chong & Levang, 2010; Sheil *et al.*, 2009). However, it has been stated that oil palm threatens traditional livelihoods and increases rural communities' social and economic vulnerability. Castiblanco, Etter & Ramireza (2015) mention how violence and land tenure concentration increase in oil palm municipalities in Colombia, enhancing inequity and poverty. Though oil palm may reduce the use of fossil fuels by offering a renewable fuel source, it also increases global carbon emissions due to deforestation previous to its establishment and threatens biological diversity (Fitzherbert *et al.*, 2008), particularly in hitherto diverse land use mosaics.

Accelerated and relatively unplanned expansion of oil palm may cause a range of social problems, including reduced food security. Oil palm plantation establishment and cropping may compete for land and labor resources with food cultivation, and thus displace the production of basic grains, other crops and livestock products, reducing their availability for home consumption and eventually provoking reduced consumption due to price increases (Food and Agriculture Organization [FAO], 2010). However, competition for available land may not always reduce food availability. As Feintrenie *et al.* (2010) explain, the principal cause of food insecurity is poverty in terms of low income and lack of access to education, agricultural inputs, technology and agricultural credit. In countries suffering from food insecurity, a majority of the vulnerable population mainly depends for income and food on local agriculture. Therefore, if production of oil palm contributes to rural income, it may also be a path towards reducing food insecurity. Among the different concepts for food security, it is considered that, for the purpose of this research, food security exists when people have physical, social, and economic access – at all times – to sufficient quantities of nutritious food to cover their dietary needs, allowing for an active, healthy life (FAO, 2010).

Food security is linked to local and particular circumstances of rural communities, with livelihoods and their socioeconomic context as determining factors (Pat, López, Van der Wal & Villanueva, 2011). In the case of Asia, oil palm expansion has triggered an economic boom that has attracted investment from outside the rural areas towards buying or leasing of land. The high demand for land has increased the land prices, as well as the pressure on the small farmers to sell their lands and change their livelihoods. As small farmers sell their lands, they have to find alternative ways to survive, either by working on oil palm plantations or by leaving for the city to find jobs. This has increased social vulnerability (Colchester *et al.*, 2006; Wakker, 2005).

In the late 1990s, public policies in Mexico started stimulating oil palm cultivation in Campeche with the aim of covering the national vegetable oil deficit. By 2002, a total of 6000 ha had been planted with oil palm. The large majority of planters were small-scale "*ejido*" farmers. Ejidos were originally established as communally managed lands granted by the Mexican government to poor, small-scale landholders and tenant farmers, intending to ensure that "*ejidatarios*" would perpetually have access to land that could not be sold (Turner *et al.*, 2001). A law reform in the 1990s allowed the private ownership of ejido lands, and their selling. The area planted with oil palm decreased to just over 3000 ha by 2007 due to hurricanes and inadequate management (Palacios, Tucuch, Ku & Estrada, 2003), and remained stable until 2010 (*Servicio de información Agroalimentaria y Pesquera-Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca* [SIAP-Sagarpa], 2012). Between 2010 and 2012 the area covered with oil palm plantations quadrupled from 3000 ha to 12 000 ha (*Gobierno del Estado de Campeche* [GEC], 2013). Expansion has continued ever since.

With oil palm cultivation rapidly expanding in the region, there is a need for studies that analyze the impacts on livelihood strategies and food security. Livelihood strategies of domestic groups (DGs) make use of the various capitals or resources for social reproduction and income strategies on a family level. A DG is considered to be a group made up by one or more related or unrelated nuclear families sharing a single residence (Estrada, 2005). In this article, the effect of the expansion of the oil palm area on the livelihoods and food security of DGs was analyzed. The income strategies and food security of DGs were first identified and then evaluate if both are affected by the introduction of oil palm, comparing DGs from communities with and without oil palm.

### Study area

This study was carried out in the southeast of the state of Campeche, Mexico, in the rural communities Conquista Campesina (18°10"50'N, 91°17"13'W) and San Isidro (18°38"01'N, 91°02"58'W) in the Carmen municipality, sharing similar biophysical and socio-economic characteristics. Climate is warm sub-humid, with a dry period

from November to April and a rainy period from May to October. Average annual rainfall ranges from 1200 mm to 2000 mm, and average temperature ranges from 26 ºC to 27° C. In the regional topography lowland plains alternate with small hill areas (*Instituto Nacional de Estadística y Geografía* [INEGI], 2010). Prevailing soils are black vertisols, with high clay content, and with sandy soils in some small areas (Palacios *et al.*, 2003).

The Ejido Conquista Campesina has currently 750 inhabitants. It was founded in 1964 and has a territory of 5223 ha. The most important economic activity is cattle ranching, practiced on over 50% of the area. People also practice other activities like small-scale agriculture, and recently oil palm cropping has expanded. Besides pasture lands, land cover includes oil palm plantations, secondary forests and lands used for minor crops.

The Ejido of San Isidro has 535 inhabitants. It was founded in 1945 and has a territory of 3978 ha. Currently, the main economic activity is cattle ranching, but there are also small farmers cultivating local products like corn or bean, and some practice beekeeping. The Ejido's vegetation mainly contains cattle ranching lands, as well as crop lands and secondary forests.

## METHODOLOGY

The Sustainable Livelihoods (SL) method was used, which involves quantifying the assets (material as well as social resources) and activities necessary for earning a living. A livelihood is sustainable when it is capable of resisting and recovering from tensions and shocks while maintaining and improving domestic groups' present and future opportunities and assets, without damaging the existing natural resource base (Chambers & Conway, 1992). The SL method identifies capitals, and collective and family strategies which sustain families' livelihoods (Departament for International Development [DFID], 1999). Capitals can be natural, physical, human, financial or social. Social capital refers to social relationships, institutions and organizations which influence the capabilities of families and their livelihoods. In this context the SL approach contributes to understanding how families and communities depend on the interaction among DGs' resources, as well as institutional processes and policies, which determine their economic strategy to confront poverty (Soussan, Blaikie, Springate-Baginski & Chadwick, 2000).

The region was first characterized socio-environmentally, based on documentary research and field visits. Thereafter we gathered data on livelihoods through field visits, participatory community workshops and the application of a survey. Participatory community workshops were carried out with the objective of exploring the community point of view, using the Focal Groups Discussion (FGD) method. This method consists of interviewing more than one person at the same time-typically at least four, allowing identifying several income strategies and topics related to food security and livelihoods of these communities.

To obtain more detailed information on livelihoods and food security, 51 semi-structured interviews were applied to the DGs to randomly select members of the two communities from July to September 2013. The survey consisted of two sections. In the first section, data related to socio-economic aspects of the DGs was recorded. In the second section, we addressed food security and food consumption of the DGs during the seven days prior to application of the survey. Food was standardized in kilograms and calorie content (kilocalories) was calculated using conversion factors based on food composition tables (Instituto Nacional de Nutrición Salvador Zubirán [INNSZ], 2005). Once the total calorie consumption of the DGs was obtained, calorie requirements of each member of the DGs were determined based on gender, age, and type of physical activity, according to criteria of the World Health Organization (WHO). The obtained data allowed constructing a caloric sufficiency index (CSI). For this study, the CSI was considered as an indicator of food security, but additional indicators such as food variety or micro-nutrient content were not included (FAO, 2013; Barrett, Beaulieu & Shewfelt, 2010). In this context, there is a need of future research to cover a more integral vision of food security and nutrition. CSI was calculated by dividing calorie consumption by caloric requirement, such that CSI $\geq 1$ indicates caloric sufficiency and CSI $< 1$ caloric insufficiency. Survey data was analyzed with the Statistical Package for the Social Sciences (SPSS), version 20.

With the CSI values, analysis of conglomerates was carried out using the K-means grouping method. This multivariate method groups homogenous data within groups (minimum variance) and allows for differentiating heterogeneous data among the groups (maximum variance). In this manner, three homogenous CSI groups were identified according to the similarity among the cases (Pardo & Ruiz, 2005). With the groupings, a classification was carried out by assigning CSI values to a group of gradients for each community and for each income strategy, considered in a high significance ($p \leq 0.05$).

The annual income of the DGs that apply the identified strategies was calculated and used analysis of variance (ANOVA) and the post hoc Tukey test of comparison of averages among strategies. To evaluate factors influencing food security, multiple linear regressions to determine the relation between CSI, access to land, access to productive subsidies, formal education and agricultural equipment were applied.

# RESULTS

## Identification of income strategies

Of the 51 DGs surveyed in the two communities, 20 (39%) mainly depend on non-agricultural activities, receiving most of their income from employment as wage laborers, remittances and small stores. The remaining 31 DGs (61%) depend on cattle raising as their main income source, or as a complementary source, combining it with income from other activities such as agriculture, self-employment from small general stores and construction, or from remittances. Furthermore, 19 DGs cultivate oil palm, all of them were from the community of Conquista Campesina. According to the economic activities and income sources, two principal strategies were identified (figure 1):

1. Non-agricultural Strategy: practiced by DGs whose principal income source is wages or self-employment from construction, furniture making, auto mechanics, or small general stores.

2. Agricultural Strategy: practiced by DGs whose income depends principally on cattle raising and agriculture.

To identify the influence that the oil palm crop may have on the DGs, the income strategy identified as "Agricultural Strategy" was sub-divided (figure 1) in the following manner:

1. General Agricultural Strategy: practiced by DGs whose incomes depend mainly on cattle raising or agriculture with crops other than oil palm.

2. Oil Palm Strategy: practiced by DGs that cultivate oil palm, an activity that they may combine or not with another crop or economic activity.

## CSI conglomerates

CSI was calculated for each DG. From the values obtained for the CSI (51), three conglomerates were formed, each representing a different level of CSI. Conglomerate 1, with an average value of 0.65 consists of DGs that lack caloric sufficiency or are considered as food insecure. Conglomerate 2 has an average value of 1.00 and consists of DGs that consume sufficient calories. Finally, conglomerate 3, with an average value of 1.35, consists of DGs that cover their calorie requirements and have the greatest food security (table 1). Of the 51 DGs surveyed, 27% was considered to be food insecure; 57% was barely food secure, at the limit of their caloric requirements; and 16% was food secure. There was a similar distribution of DGs over the CSI categories in the two communities.


**Figure 1**

Identification of income strategies.
**Source:** Aurhor's own elaboration.

**Table 1** CSI by conglomerates within and between income strategies

| | C1 | C2 | C3 | N |
|---|---|---|---|---|
| Group/CSI | 0.65 ± 0.069 [a] | 1 ± 0.045 [b] | 1.35 ± 0.088 [c] | |
| Non-Agricultural | 0.81 ± 0.0178[a] | .98 ± 0.0178[b] | 1.18 ± 0.0229[c] | |
| | 11 (55%) | 7 (35%) | 2 (10) | 20 |
| General Agricultural | 0.78 ± 0.0645 [a] | 1.04 ± 0.0161 [b] | 1.30 ± 0.0403 [c] | |
| | 3 (19%) | 9 (56%) | 4 (25%) | 16 |
| Oil Palm | - | 1.01 ± 0.0149 [b] | 1.20 ± 0.0550[c] | 0.055 |
| | - | 13 (87%) | 2 (13%) | 15 |

Columns with different letters are different ($p < 0.05$).
Source: Aurhor's own elaboration.

## Relationship of income strategies to food security

The income strategies identified as Non-agricultural, General Agricultural and Oil palm were classified according to the CSI conglomerates (table 1). Within this classification, a significant difference was observed among the strategies. Fifty-five percent of the DGs that practice the Non-agricultural strategy was food insecure, while 35% belonged to conglomerate 2% and 10% to conglomerate 3. This indicates that farmers' families are better off than the families that do not have access to the land, reflecting the lower incomes of the families that depend on wage labor and other activities. Meanwhile, 19% of DGs that practice the General Agricultural strategy was found to be food insecure, while 56% fell into conglomerate 2 and 25% within conglomerate 3. Those DGs practicing the Oil Palm strategy were homogenous; 100% of these DGs had a high level of caloric sufficiency.

## Livelihood strategies and their capitals

Significant differences in income were found according to strategies of the DGs in the studied communities ($p \leq 0.05$). The DGs cultivating oil palm had a 23% higher average income than those applying the general agricultural strategy, and 49% higher than the non-agricultural DGs (table 2).

**Table 2** CSI by conglomerates within and between income strategies

| Strategy | Monthly income Average ($) | Standard deviation |
|---|---|---|
| Non Agricultural | 1515 | 668 |
| General Agricultural | 2261 | 793 |
| Oil Palm | 2950 | 996 |

Note: in concordance with Tukey´s test, the incomes per strategy are statistically different ($p \leq 0.05$) among them.
Source: Aurhor's own elaboration.

To identify the key elements influencing these outcomes, we carried out lineal regressions to see if CSI relates with various capital components among all DGs and their income strategy. The factors that influenced food security of the DGs significantly were land access and production subsidies. Education level and agricultural equipment did not show a significant relation with CSI. Caloric sufficiency measured according to CSI clearly varied with all livelihood strategy (table 3). The indicated regression model did not show multicollinearity, as shown by the factors of tolerance and variance inflation (VIF). The model also did not show autocorrelation, as demonstrated by the Durbin-Watson statistic (table 3).

One of the most notable characteristics of the DGs that practice the Non-Agricultural strategy is lack of land, which limits their economic capacity and income. This indicates that farmers' families are better off than the families that do not have access to the land, reflecting the lower incomes of the families that depend on wage labor and other activities.

## DISCUSSION

### Income strategies and CSI

Findings show that there is a significant statistical difference among groups of CSI and the economic strategies. Additionally, it shows that the media incomes of the different strategies are statistically different (table 2).

This agrees with the findings of Maluf (1998), suggesting that problems of food insecurity in Latin American nations have been reduced as a direct result of increased income levels and investment in social infrastructure. However, we also found that there is still a high level of food insecurity in rural communities and that as much as 30% of the DGs are food insecure. Indeed, the rural crisis in Mexico is evident. In this context, the more affected people are those without access to land, and consequently no access to production subsidies.

Findings also show that DGs whose principal income source is agriculture are more food secure than those that work as wage laborers or in other economic activities. Pat *et al.* (2011) also found that income and CSI rise when DGs change from a strategy based on labor or services to an agricultural strategy. This confirms that economic activities including food self-provisioning remain important for food access and availability in the context of the new rurality.

The DGs that follow the Non-Agricultural strategy principally work as wage laborers, bricklayers, carpenters, mechanics, or have small general stores as a part of their income strategy. Nevertheless, these DGs have little diversity of income sources; 45% of the DGs ($\sigma = 0.83$) practicing this strategy has only one economic activity.

DGs that practice the Non-Agricultural strategy generally do not own land, although some exceptions exist. Few wage laborers have a steady job, the majority works from three to five days a week, mainly during the rainy season and when cropland or grasslands are weeded, fertilized, and sprayed with pesticides. Large palm plantations, established on private lands near the community Conquista Campesina, also generate jobs all over the year. Although these jobs assure work six days a week, their wages are similar or lower than those paid by farmers who hire labor within the communities, considering plantation workers' meal expenses. Income of workers on oil palm plantations barely covers the basic needs. This phenomenon has been observed in several emerging economies. Whereas some companies are able to integrate into the global economy, they generate "low quality business projects" and subsistence-wage or poverty-level jobs (Mazza, 2004).

**Table 3** CSI by conglomerates within and between income strategies

| Capital components | Coefficient | Sign | p-values | Significance | Tolerancia | VIF |
|---|---|---|---|---|---|---|
| Land access. Hectare quantity (Natural capital) | 0.005 | + | 0.006 | *** | .734 | 1.363 |
| Productive subsidies (Financial capital) | 0.001 | + | 0.002 | *** | .734 | 1.363 |
| Education level (Human capital) | -0.153 | - | 0.157 | NS | 1 | 1 |
| Productive equipment (Physical capital) | 0.116 | + | 0.340 | NS | .798 | 1.253 |
| Constante | 0.854 | + | 0.000 | *** | | |

Dependent variable: Caloric Sufficiency Index (CSI).
Significance level: *,**,*** 10, 5 and 1%, NS: Not Significant, $R^{2v}$= 0.44, valor Durbin-Watson = 1.72
Source: Aurhor's own elaboration.

The DGs that follow the Agricultural strategy mainly use their land for cattle raising, and some additionally grow agricultural crops other than oil palm. Their income mainly comes from marginal and extensive cattle raising, selling live calves for intensive meat production elsewhere. For the majority of these DGs, the daily expenses are covered by combined income from the sale of milk or its derivatives and other types of self-employment, while cattle are family savings used as a last resource in case of emergency.

The DGs that practice the Agricultural strategy are the most diversified in their economic activities, since they include not only agricultural income sources, but also incomes from construction, furniture making, own general stores and remittances. This pluri-activity provides this group of DG with several income sources: the local cattle market, a demanding oil palm market, and other complementary sources, offering them socio-economic stability. This concords with the observation by Ellis (2000) that many DGs that rely on farming depend on a broad array of economic activities and income sources, with agriculture being only a part of this gamut which contributes to the family's well-being.

The oil palm crop is rapidly expanding in these communities, substituting other agricultural products which have lower yields; furthermore, it is nowadays more dependable and resilient than other crops or cattle raising, as it is less vulnerable to natural phenomena such as floods and droughts. This has been observed in other nations where oil palm is cultivated; for example, Rist *et al.*, (2010) explain that in Malaysia, some communities have adopted palm cultivation as their principal economic activity due to its profitability. With increased prices of crude palm oil in Malaysian communities, oil palm production is more profitable than rubber production and the lumber industry, so producers have preferred this crop.

Many oil palm DG producers generate sufficient income with oil palm to fulfill their basic needs during harvest time (January to August); depending on their maintenance of the plantation and oil palm prices, they may generate extra capital. Furthermore, they create employment for other community members, contributing to local economic growth. This has been observed in other cases (Basiron, 2007; Sheil *et al.*, 2009) where government programs promoting this crop have generated employment, income sources, a multiplier effect, and an increased access to services in rural areas.

## Factors determining life strategies and food security

With respect to the income strategies analyzed, those DGs that practice the Non-Agricultural strategy are the most vulnerable in terms of food security. All DGs that practice the General Agricultural and Oil Palm strategies are ejido members. This is a determining factor in the social capital. Being an ejido member allows for access to land and participation in ejido decision making, and this facilitates acquiring government economic support. By having access to land, DGs can access to productive subsidies that allow them to have a better performance in their productive activities. Similarly, Narayan & Cassidy (2001) provide evidence which suggests that a high level of social capital is correlated with higher per-capita income in their study community. Pat *et al.* (2011) suggests a relationship between the number of farmer organizations to which a DG is affiliated and the amount of land they have under production, such that the more organizations to which a DG belongs, the more land they have. As the government provides subsidies only to those who belong to agricultural organizations, DGs are pressured to join organizations.

Social capital allows individuals to increase their ability to solve problems through collective action (Fukuyama, 2001). According to Ostrom, Ahn & Olivares (2003), three aspects should be taken into account when studying collective action: 1) trust and norms of reciprocity, 2) networks and civic participation, 3) rules and organizations. When this is not fulfilled, the effect may be negative. This has occurred with oil palm growers in the communities analyzed; only one of 15 growers surveyed is a member of the Union of Palm Growers. Growers' principal reason for not joining this organization is lack of transparency in managing resources, and consequently lack of trust.

DGs practicing all three strategies showed very similar levels in human capital. An average educational level is 6.8 years ($\sigma = 0.07$) for all DGs. Therefore, this capital is not a determining factor in the difference in income levels among those practicing different livelihood strategies in these rural communities. This contradicts the findings by several authors who indicate that education and human capital in general are determining factors in the poverty level in Mexico; the lower the educational level, the greater the probability of being poor (Iniguez, 2014). Nevertheless, in some DGs in our study communities, young adults were studying for a profession or working as professionals in nearby cities. These family members rarely return to live in the communities, leaving the communities with few people with advanced educational levels. Thus, the positive effects of education are lost to the communities as the returns of education in wages only begin to increase with high school or higher levels of education (Attanasio & Székely, 2001).

The high levels of financial capital owned by those practicing the General Agricultural and Oil Palm strategies have two important variables: income earned and

land ownership. With respect to the first, income generated by the DGs practicing these two strategies has a stable market for their products. In this manner, their production, whether through sale of cattle or oil palm, provides constant income given the demanding market for these products. With respect to land ownership, the fact that the DGs, practicing these strategies own their land, provides them with an advantage over those DGs practicing the Non-Agricultural strategy, as they have access to government agricultural subsidies.

In this case, all DGs are similarly equipped, especially with regards to the heavy machinery that they share. This explains why the possession of agricultural equipment does not determine the difference in CSI among DGs practicing the different strategies. In recent years, the State Government of Campeche has placed an emphasis on farm equipment, especially for organized groups of farmers or ejido members (GEC, 2013). This could benefit rural communities, since local economic infrastructure can determine income levels (Ellis, 2000).

Land access or ownership is the most important natural capital for rural communities in general; those DGs practicing the Non-Agricultural strategy have the lowest incomes *per capita* and the highest level of food insecurity. As Ellis (2000) explains the case for poor families in rural areas, those DGs practicing this strategy lack land, which limits their income sources and economic independence.

Land ownership is key to obtaining government subsidies, as observed with the most widespread programs in the region. Land ownership is a requisite for participating in these programs. Public policy favors those who have access to land. Pat *et al.* (2010) mention that in the northern Campeche state, government agricultural programs are oriented toward commercial agriculture; therefore, they provide support to those DGs with more and better quality land. In this manner, these DGs have the opportunity to increase, not only their financial capital but also their physical capital by acquiring agricultural equipment, which may likely lead to greater production and higher income.

## CONCLUSIONS

The agricultural sector in the region is complex given the varied typology of producers and their interaction with the socioeconomic environment including public policy. This study shows that those DGs that economically depend on agriculture have greater economic stability and food security than those depending on non-agricultural economic activities.

Those DGs that practice the Non-Agricultural Strategy have a lower level of food security and lower incomes than the other DGs due to lack of land ownership or access. This is one of the most valuable resources for rural DGs, as their economic independence strongly depends on agriculture, which in turn depends on access to land. Besides this, access to government agricultural subsidies are also based on land ownership. Therefore, with respect to planning agricultural public policy, efforts should be made to benefit those families that lack access to land.

Oil palm cultivation can contribute to better the economy of rural communities, as long as the DGs keep control of these productive activities and the ownerships of their land. Involvement in oil palm cultivation has diversified income opportunities from wage labour in the communities and has increased income of the DGs with an agricultural strategy. However, it is also important to maintain the common agricultural activities (maize cropping under the diversified milpa system, home gardens, animal husbandry) that contribute to food security, and these activities should not be displaced completely by oil palm. Thus, the tendency of a regional integration of oil palm cultivation, that triggers land concentration in a few owners through land leasing or selling, could cause opposite effects in the rural communities of the region as those found at the start of the oil palm boom in the region.

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