

# Agricultural rotation crops: adaptive strategies of two farming communities in Champotón, Campeche

Huicab-Pech, Zulema G.<sup>1</sup>, Bautista-Ortega, J.<sup>2</sup>, Santillán-Fernández, A.<sup>3</sup>, Flota-Bañuelos, C.<sup>3</sup>, Fraire-Cordero, S.<sup>3</sup>, Rosales-Martínez, V.<sup>3\*</sup>

<sup>1</sup> Investigador independiente, Calle Enrique Arias, No. 7 Cd. Concordia, Campeche, CP. 24085.

<sup>2</sup> Colegio de Postgraduados Campus Campeche Carretera Haltunchén-Edzná Km. 17.5, Sihochac, Champotón, Campeche. México. C. P. 24450.

<sup>3</sup> CONACyT-Colegio de Postgraduados Campus Campeche. Carretera Haltunchén-Edzná Km. 17.5, Sihochac, Champotón, Campeche. México. C. P. 24450.

\* Correspondence: vrosales@colpos.mx

## ABSTRACT

**Objective:** To identify the agricultural rotation crops grown throughout a year by the producers of two farming communities in Champotón, Campeche, Mexico.

**Design/Methodology/Approach:** This exploratory-descriptive research was conducted in 2019, in Santo Domingo Kesté and Sihochac, Champotón, Campeche. Documentary research was conducted and a survey with a total of 200 questionnaires was applied, following the snowball technique. The resulting data were analyzed with descriptive statistics using Excel's statistical package.

**Results:** Chihua pumpkin (*Cucurbita argyrosperma* Huber) and sugarcane (*Sacharum officinarum*) are the most economically important crops. The former is specific to Santo Domingo Kesté and the latter, to Sihochac. Maize is grown in May in Sihochac, and in different months in Kesté. Chihua pumpkin, peanut (*Arachis hypogaea*), bean (*Phaseolus vulgaris*), sesame seed (*Sesamum indicum*), sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*), and hibiscus (*Hibiscus sabdariffa*) are grown only in Kesté, in different times of the year.

**Study limitations/Implications:** Since this research is of a local nature, its results cannot be generalized, although they may be similar to other regions of the country.

**Findings/Conclusions:** Some agricultural relay crops are grown in Kesté and not in the Sihochac community. The way in which each community organizes its crops depends on socio-cultural factors and available resources.

**Key words:** Rotation crops; Agriculture; Survey; Santo Domingo Kesté; Sihochac.

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## INTRODUCTION

Over the last ten years, the Mexican population grew by 13.7 million inhabitants; currently, Mexico has a population of 126 million (INEGI, 2020). Meanwhile, the agricultural surface grew by 22%: from 17.99 million ha in 1980 to 22.2 million ha in 2015. However, the available agricultural land per capita decreased by 31%. The scenario for 2050 is even more alarming. Considering a population of 140 million for the said year, the available agricultural land could diminish to 0.16 ha per inhabitant per year. Agriculture will face its greatest challenge: meeting the food supply needs of an ever-increasing population (Sosa and Ruiz, 2017).

Food security is important in this scenario, but it is even more relevant in these times of pandemics and the COVID-19 health crisis. Consequently, it is necessary to ensure that agriculture will continue on all levels, fulfilling its role as the main source of food, as a source of energy, and as a factor in the adequate development of humankind (Luque-Zúñiga *et al.*, 2021).

Therefore, as posited by Rojas *et al.* (2014), the producers' strategies are part of a greater reproduction system that has a social, economic, cultural, and environmental nature. Previous research has shown that, by way of crop diversification, producers use their abilities and potentialities as a survival strategy; this mainly includes the growth of maize, bean, wheat, alfalfa, tomato, barley, sorghum, oat, jalapeño, and onion (Sosa and Ruiz, 2017), in order to obtain more profitable and sustainable agricultural produce (Caicedo *et al.*, 2020).

Moreover, multiple advantages can be gained from crop rotation —different crops succeed each other in the same soil throughout time (Silva *et al.*, 2015)—, including: production sustainability; a better use of the land; positive effects on organic matter, soil structure, and erosion; fight against disease and pests; and nutrient availability, among other things (Silva *et al.*, 2015).

Particularly, the State of Campeche, Mexico, is characterized by the production of different crops. Maize is the most important crop (65.9%), followed by Chihua pumpkin (14.4%) and cowpea (7.1%) (Morán *et al.*, 2020). Most farmers practice family farming which, at the same time, are production and social reproduction units (Jiménez-Barbosa *et al.*, 2019).

Therefore, the objective of this research was to identify the agricultural rotation crops grown in one year by producers in two rural communities of Champotón, Campeche, as a survival strategy within a context of economic-productive fluctuations, resulting from their own needs, as well as the demands of the local and regional markets.

## **MATERIALS AND METHODS**

### **Location of the study area**

The research was conducted in 2019, in Santo Domingo Kesté and Sihochac, two communities in the municipality of Champotón, located in the center of the State of Campeche (17° 49' and 19° 41' N; 89° 32' and 91° 08' W). Champotón borders with the municipalities of Campeche and Hopelchen to the north; the municipality of Escárcega to the south; the municipality of Calakmul to the east; and the municipality of Carmen and the Gulf of Mexico to the west. It has a territorial extension of 6,856.04 km<sup>2</sup> and an altitude of 27 m.a.s.l. The climate is warm sub-humid, with an annual average temperature of 26 °C (INEGI, 2020).

This research was exploratory and descriptive. Documentary research was conducted in order to get acquainted with part of the history of the studied communities. Most of the results were obtained through a survey consisting of 100 questionnaires for each of the communities, with a total of 200 questionnaires. The participants in the in-depth interviews were chosen based on a random sample using the “snowball” technique (Taylor and Bogdan, 1987), and took part freely in the study. The sample size was heuristically

established at the moment when the information became redundant (Baker and Edwards, 2013). The survey results were analyzed by means of descriptive statistics using Excel’s statistical package.

## RESULTS AND DISCUSSION

### Santo Domingo Kesté: a territory with history

To study the agricultural transition of Santo Domingo Kesté, we had to consider the age of its territory and its main historical processes. This town was founded by Guatemalan refugees who fled from the war in their country during the 1980s. They traversed the Guatemalan rainforest and crossed the Mexican border until they reached Chiapas. Subsequently, the Mexican government relocated them to different points of Campeche. A group from Huehuetenango and Quiché, in Guatemala, settled in a place they named Santo Domingo Kesté. In 1994, the UNHCR (United Nations High Commissioner for Refugees) registered 11,010 Guatemalans in Campeche who received support from the international community, several non-governmental organizations (NGOs), and ecclesiastical entities. The aid was allocated to health, education, and sustainable development projects that aimed to achieve self-sufficiency among refugees and their integration to the local society (CCBNB, BSA) (Brito, 2013).

By 2006, the state government counted a total of 3,760 inhabitants in this place; 1,360 of them had become Mexican citizens, 140 kept their Guatemalan citizenship, and 2,260 had already been born in Mexican territory (Brito, 2013). By 2013, Santo Domingo Kesté had a total of 3,763 inhabitants; 1,862 were women and 1,901 were men, which indicates that the total population remained stable during the past seven years (Brito, 2013). Currently, there are 4,461 inhabitants: 2,219 women and 2,242 men (INEGI, 2020).

The average age of the interviewees in Santo Domingo Kesté was 48.77 years; 42% had barely completed primary school. Santo Domingo Kesté had a larger percentage of people with no schooling than the Sihochac community. In this regard, Rosales *et al.* (2019) also reported differences in schooling among the populations of both communities. The interviewees in Santo Domingo Kesté have more family members (5.55) and less land to work (5.43 ha). It is necessary to mention that, when the government granted political asylum to these refugees, it only allocated each family 3.5 ha to work (Rosales-Martínez *et al.*, 2019). However, as the years have gone by, the inhabitants of this community have sold and bought land among them. The community of Santo Domingo Kesté works more daily hours than the community of Sihochac (Table 1).

**Table 1.** Socioeconomic variables of the interviewed producers.

Community	E	ES	IF	ST (ha)	DT	HT	TC
Sihochac	53.33	Elementary education: 58; Secondary education: 22; High school: 18; bachelor’s degree: 5 and without studies: 3	3.77	6.75 ha	6.19	6.16	1.16
Santo Domingo Kesté	48.77	Elementary education: 42; Secondary level: 19; High school: 6; Bachelor’s degree: 3 and without studies: 32	5.55	5.43 ha	5.67	6.95	2.31

A (E)=Age; S (ES)=Schooling; FM (IF)=Family members; TS (ST)=Total surface; WD (DT)=Worked days; WH (HT)=Worked hours; TC=Total of crops.

### **Sihochac**

Currently, Sihochac has 2,756 inhabitants: 1,353 men and 1,403 women (INEGI, 2020). Although Sihochac is a neighboring community of Santo Domingo Kesté, its population's culture is different. This affects both their lifestyles and the way they manage their agroecosystems. Most of the population is native to Campeche. Their main agricultural crop is sugarcane, with at least 1,200 producers belonging to the Unión Cañera de Sihochac (Sihochac Sugarcane Union), which is divided into five groups: Cañeros de Sihochac, Roque Espinoza, Benito Juárez, Nueva Manera, and Unión y Libertad (Head of the CNC; personal communication). These groups deliver their production to the La Joya Sugarcane Mill, which is located in the La Joya community. The production of sugarcane is the most important agricultural activity in this community.

In the sugarcane industry, a contract is established between the producer and the mill. The production of sugarcane thereby becomes an alternative for the producers to achieve their collective goals, the most immediate of which would be developing their activity and commercializing their crop at a determined price —this differs from “unprotected” vegetable crops. However, these producers must adapt to the quality needs and controls, as well as to the planting and harvesting times established by the sugarcane mill (Parral, 2015). The average age of the interviewees in Sihochac was 53 years and they had barely completed primary school. The average number of family members is 3.77 and families have more land to work (6.75 ha) than Santo Domingo Kesté. The interviewees reported working 6.19 days per week and 6.16 hours per day (Table 1).

### **Agricultural activities carried out throughout a year in Sihochac and Santo Domingo Kesté**

Table 2 shows that both communities grow various crops throughout the year; some of them are even grown during the same period. Defumier (1990) explains that this happens when market conditions are favorable for product commercialization. Farmers might be interested in specializing their agricultural system according to each region's comparative advantages. Nevertheless, this cannot be applied to every region. The crops in Sihochac and Santo Domingo Kesté, for instance, are grown both for self-consumption (43%) and for sale (57%), and the percentage varies according to the specific crop. For example, almost 100% of Chihua pumpkin and sugarcane is commercialized.

Meanwhile, although maize (*Zea mays*) is grown in both communities, Sihochac only grew it in May, while Santo Domingo Kesté grew it in different times of the year: on January, February, August, and September (*i.e.*, the rainy season), since this community practices rainfed agriculture (Uzcanga *et al.*, 2015). However, on more drastic occasions, producers change the land use, based on factors such as low prices of produce (at that moment the price of maize remained 5 pesos per kg), increased prices of agrochemical products, and the presence of pests and disease (Casanova-Pérez *et al.*, 2019).

Another economically important crop that stands out in Santo Domingo Kesté is the Chihua pumpkin (*Cucurbita argyrosperma* Huber), with a yield of 500 kg/ha. Chihua seeds are washed and home-dried to be sold mainly by retailers and/or local traders, with no commercialization mechanisms in the regional and national markets (Ireta-Paredes *et al.*,

**Table 2.** Crop sowing calendar for Santo Domingo Kesté and Sihochac.

Crop	Kesté	Sihochac	Es* kesté	Es* sihochac
Corn ( <i>Zea mays</i> )	X	X	Late January, early February, August-September	May
Chihua Pumpkin ( <i>Cucurbita argyrosperma</i> Huber)	X		May-June	NC
Sugarcane ( <i>Sacharum officinarum</i> )		X	NC	June-July, August, September-October
Peanut ( <i>Arachis hypogaea</i> )	X		May, June, August, after the corn	NC
Hibiscus ( <i>Hibiscus sabdariffa</i> )	X	X	May, July, August, September, November	Not specific
Beans ( <i>Phaseolus vulgaris</i> )	X		August, September	NC
Sesame seed ( <i>Sesamum indicum</i> )	X		July	NC
Sweet potato ( <i>Ipomoea batatas</i> )	X		May	NC
Jicama ( <i>Pachyrhizus erosus</i> )	X		May	NC
Cedar ( <i>Cedrela odorata</i> )		X	NC	June-July
Fruit trees	X	X	All year	All year
Cassava ( <i>Manihot esculenta</i> )	X		May	NC

X=Grown in the community; SS\* (ES\*)=Sowing season; NG (NC)=Is not grown; Fruit trees (Frutales)=includes mango, mammee, soursop, and bananas.

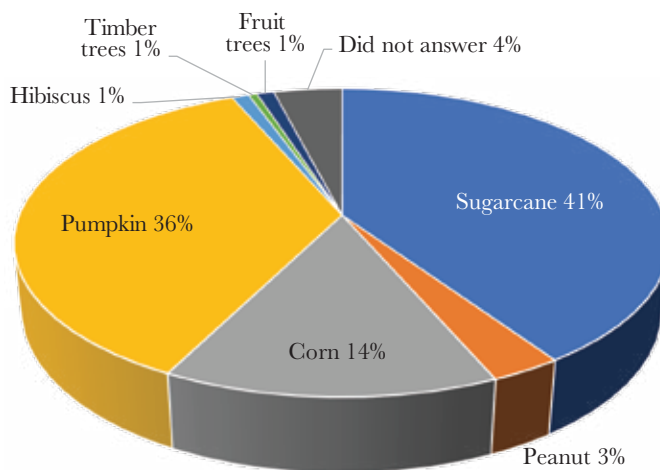
2018). The price of this seed fluctuates between 25 and 30 pesos per kg. This community grows other types of crops in smaller areas and in other times of the year. Examples of this are peanuts (*Arachis hypogaea*), beans (*Phaseolus vulgaris*), sesame seeds (*Sesamum indicum*), sweet potatoes (*Ipomoea batatas*), cassava (*Manihot esculenta*), and hibiscus flowers (*Hibiscus sabdariffa*). Sugarcane (*Sacharum officinarum*) is only grown in Sihochac; it is the main economic crop for families in this community. It has an average yield of 60 t/ha and a price per ton that fluctuates between 700,000 and 800,000 pesos. This product is delivered to the La Joya sugarcane mill, located in the La Joya community.

The sowing date is one of the most important decisions that producers must make at the beginning of each agricultural cycle. This is particularly important for seed producers, since several factors directly and indirectly affect the yield of the different varieties (Noriega-Carmona *et al.*, 2019). In these dynamics, we recorded an average of 2.31 and 1.16 crops for Santo Domingo Kesté and Sihochac, respectively. In both Sihochac and Santo Domingo Kesté, the percentage of fruit trees is lower and most of the time there are only two or three individuals in the backyard gardens. However, these trees are important for the diet of rural families, since they provide affordable fruits and spare the families from having to travel in order to buy these products in the market.

### Income per agricultural crop

The crops that generated the highest income were sugarcane (41%) and Chihua pumpkin (36%). The former is only grown in Sihochac, while the latter is exclusive of Santo Domingo Kesté (Figure 1).





**Figure 1.** Economic importance per crop in the communities of Santo Domingo Kesté and Sihochac, Champotón, Campeche, Mexico.

When asked why they grow more than one crop a year, Santo Domingo Kesté's producers explained that, in first place, they do it to support their families (39%), both by selling products (economic reasons) and providing food for self-consumption throughout the year; second, because crops produce income (21%); third, to make good use of their land (8%), for food and consumption (7% each), to rent the land (6%), did not answer (5%), to make the most of the rainy season (4%), because they like it (2%), and finally because it is a habit or family tradition (1%).

## CONCLUSIONS

Chihua pumpkin (*Cucurbita argerysperma* Huber) and sugarcane (*Sacharum officinarum*) are the two economically relevant crops of these communities. The former is exclusive of Santo Domingo Kesté and the latter of Sihochac. The way in which each community organizes how it grows its crops and commercializes its produce depends on the socio-cultural factors of their hometowns and the available resources. Therefore, it is necessary to draw crop rotation and implementation strategies that befit the geographic, cultural, social, and economic characteristics of rural communities such as Sihochac and Santo Domingo Kesté.

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