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Published online: 30 May 2014.

To cite this article: Hector Calix de Dios, Heather Putnam, Santos Alvarado Dzul, Wendy Godek, Susanne Kissmann, Jean Luckson Pierre & Steve Gliessman (2014) The challenges of measuring food security and sovereignty in the Yucatán Peninsula, *Development in Practice*, 24:2, 199-215, DOI: [10.1080/09614524.2014.884540](https://doi.org/10.1080/09614524.2014.884540)

To link to this article: <http://dx.doi.org/10.1080/09614524.2014.884540>

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The challenges of measuring food security and sovereignty in the Yucatán Peninsula

Hector Calix de Dios, Heather Putnam*, Santos Alvarado Dzul, Wendy Godek, Susanne Kissmann, Jean Luckson Pierre, and Steve Gliessman

(Received September 13, 2012; accepted October 3, 2013)

In a study of food security and sovereignty (FSS) in 22 indigenous Mayan communities in Yucatán State, Mexico, a participatory action research (PAR) methodology was combined with an analytical framework comprised of 10 FSS indicators to measure food security in the study area and identify strengths and weaknesses of the analytical framework. While some of the FSS indicators were approaching satisfactory, the majority were only partially satisfied, and food self-sufficiency was for the most part unsatisfactory. It was also found that food security indicators are relatively easier to measure, while sovereignty indicators present challenges in terms of defining progress.

Dans le cadre d'une étude sur la sécurité et la souveraineté alimentaires (SSA) menée auprès de 22 communautés autochtones mayas de l'État du Yucatán, au Mexique, une méthodologie de recherche-action participative (RAP) a été conjuguée à un cadre analytique composé de 10 indicateurs de SSA pour mesurer la sécurité alimentaire dans la zone étudiée et identifier les points forts et les points faibles du cadre analytique. Si quelques-uns des indicateurs de SSA n'étaient pas loin d'être satisfaisants, la majorité d'entre eux n'étaient satisfaits qu'en partie, et l'autosuffisance alimentaire était en grande partie insatisfaisante. Il a par ailleurs été constaté que les indicateurs relatifs à la sécurité alimentaire sont relativement plus faciles à mesurer, tandis que les indicateurs de la souveraineté présentent des défis au moment de définir les progrès effectués.

En un estudio sobre la seguridad y la soberanía alimentarias (SSA) realizado en 22 comunidades mayas del estado mexicano de Yucatán, se combinó una metodología de investigación-acción participativa empleando un marco analítico integrado por diez indicadores de SSA. Dicho estudio tuvo como objetivo la medición de la seguridad alimentaria en el área de estudio y la identificación de fortalezas y debilidades en dicho marco de análisis. Si bien algunos indicadores reportaron resultados que se acercaban a ser satisfactorios, el desempeño de la mayoría de los mismos fue solo parcialmente satisfactorio, mientras que la autosuficiencia alimentaria en general resultó insatisfactoria. Asimismo, el estudio demostró que los indicadores de seguridad alimentaria son relativamente más fáciles de medir y que los indicadores de soberanía alimentaria encierran retos a la hora de definir los avances logrados.

Keywords: Environment (built and natural) – Food security; Agriculture; Civil society – NGOs; Participation; Latin America and the Caribbean

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Introduction

Food insecurity in rural communities continues to be a critical focus of social and agricultural development policy in Latin America in light of the myriad of social, political, and economic challenges faced by these communities. In particular, indigenous rural communities face distinct obstacles in achieving food security. As noted by the Food and Agriculture Organization (FAO), “[i]ndigenous peoples are disproportionately impacted by environmental degradation, politico-economic marginalisation and development activities that negatively impact their ecosystems, livelihoods, cultural heritage and nutritional status” (FAO 2010, 7).

This article draws on the findings from a case study of 22 predominantly Mayan communities in 13 municipalities of Yucatán State in Mexico (Figure 1; Table 2). The purpose of the study was to identify the immediate and systemic causes of food insecurity. To measure these challenges to food security, we employed an analytical framework of food security and sovereignty. Our rationale behind this framework echoes distinctions between the concepts of food security and food sovereignty; while food security represents a set of goals, food sovereignty represents an approach to achieving food security (Windfuhr and Jonsén 2005) by putting control over food systems at the local level.

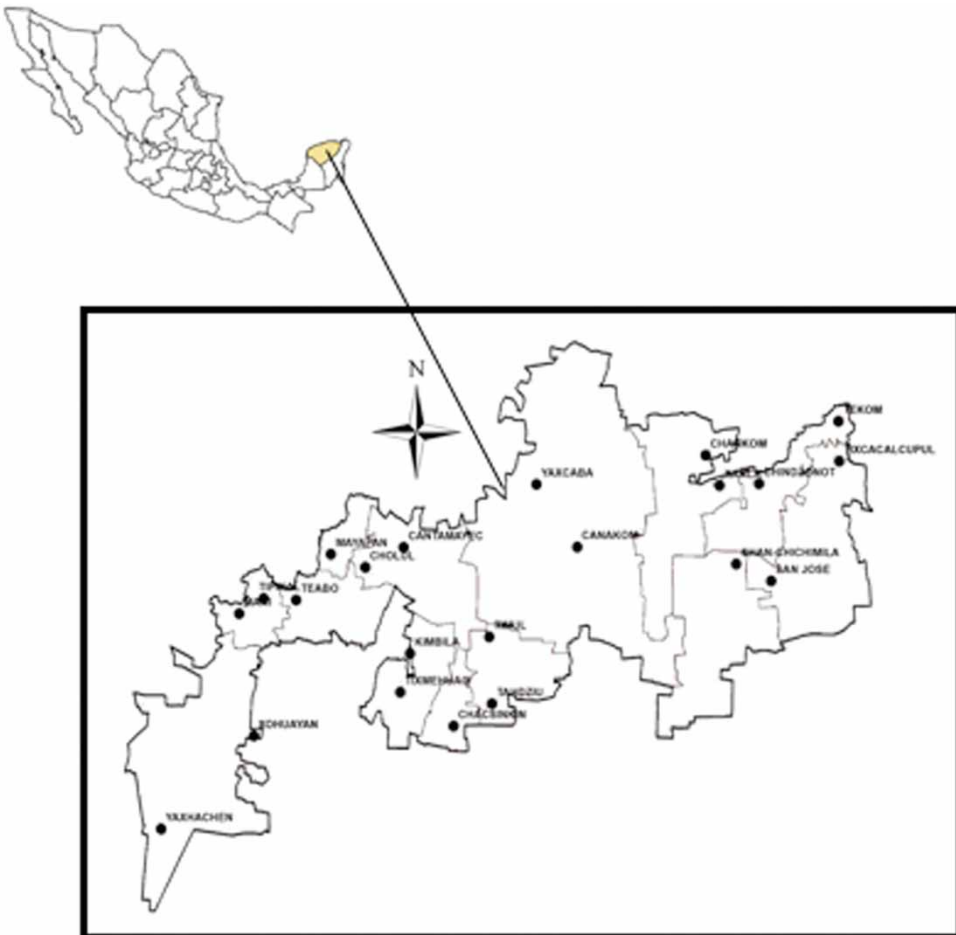


Figure 1. Location of study area.

The Yucatán has one of the highest proportions of indigenous peoples in Mexico with approximately 59.2% of the population self-identifying as indigenous, predominantly Mayan (Bracamonte et al. 2002). While lack of access to food and household food insecurity are less significant in Yucatán State relative to other Mexican states, statistics have not taken indigenous populations into account as a specific group (CONEVAL 2010). A full 80% of families involved in this study do in fact have adequate access to land to produce a variety of food for a locally available nutritious diet, and it would seem that they should already possess food sovereignty. Why do they, in fact, not?

The answer is that the importance and effectiveness of local control, a central concept in food sovereignty, may in fact be contingent upon cultural preferences and mitigated by changes in cultural preferences: if people (and especially young people in the context studied here) increasingly prefer cheap processed foods that come from external sources, they will choose not to consume local traditional foods. The food sovereignty problem in the Yucatán is one of cultural changes that result in a devaluing of Mayan foods, a homogenisation of production, a resulting homogenisation of diet, and finally, a change of values among rural Mayan youth who migrate to tourist areas in search of money, modernity, and other livelihoods. Thus the problem of food insecurity and non-sovereignty must be seated within the larger context of culture change; this of course makes measuring food sovereignty problematic, as the manifestation of sovereignty will effectively be a response to the political context at different scales.

While numerous studies have sought to measure food security among individuals, communities, regions, and nations, studies focused on measuring food sovereignty are only beginning to emerge. Most of the growing body of literature in this field has examined it conceptually while scant attention has been paid to empirically examining dimensions of food sovereignty in practice. One recent study by Ruelle, Morreale, and Kassam (2011) of the Standing Rock Nation in the Great Northern Plains of the United States examined the potential of local food assistance programmes and farmers markets to enhance access to culturally-appropriate, nutritious food for community elders and overall food sovereignty on the reservation. Another empirical study by Isakson (2009) focused on examining interactions of peasant farmers in the north-western highlands of Guatemala (predominantly Mayan) with market-oriented activities and associated implications for agrobiodiversity and food sovereignty. Finally, and of particular relevance to the question of how to measure food security and sovereignty (FSS), research undertaken at the Universidad Central de las Villas in Cuba in conjunction with Cuba's Campesino to Campesino National Agroecology Movement (MACAP) and Cuba's National Association of Small Producers (ANAP) identified social, economic, and environmental indicators of food sovereignty using the methodology of participatory action research (PAR), and this set of indicators was approved for use at the national level in Cuba by MACAP/ANAP in 2009 (Reardon and Pérez 2010).¹

We first provide an overview of the framework of FSS used in this research. We then describe the study area, the research methodology, and the methods of data collection. We present our findings as per the FSS analytical framework and conclude with a critical assessment of the framework in light of the study, highlighting its strengths, weaknesses, and contributions.

Analytical framework of food security and sovereignty (FSS)

The value of the combined food security and sovereignty approach is that it permits both the measurement of food security goals, as per the FAO approach described below, and allows for the consideration of other factors and processes that enable the sustainable and long-term achievement of these goals.

One of the most widely used definitions of food security is that of the FAO, which states that food security “exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” and, furthermore, “[h]ousehold food security is the application of this concept to the family level, with individuals in households as the focus of concern” (FAO 2010, 8). Discussions of the concept of food security have been extensively treated in the literature (e.g., Schanbacher 2010), and thus we focus here on the four dimensions of food security identified by the FAO that need to be maintained simultaneously in order to achieve food security. These include access, availability, utilisation, and stability, and are explained in Table 1.

More recent definitions of food security, including the one above, refer to culture by way of mentioning the significance of food preferences, noting that these are either “culturally or socially determined” (FAO 2003, 27), though some argue that this link is quite weak (Schanbacher 2010, 30) and requires more nuance to define how food preferences interact with other factors in food security.

Food sovereignty is a concept that has increasingly gained the attention of scholars and development practitioners in recent years, and it has not only become a core focus of many civil society organisations but is also included in the national food and agriculture policies of several nations. Formulated and introduced by the transnational peasant organisation Vía Campesina in 1996, food sovereignty represents an alternative approach to achieving food security in the sense that it focuses on locally-controlled food systems rather than large-scale market-driven strategies, and values cultural preferences as human rights.

The 2007 Forum for Food Sovereignty defines food sovereignty as “the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems” (Declaration of Nyéléni 2007). What this looks like in reality will depend on the context and it must be acknowledged that this definition leaves the question of scale open for “peoples” to define themselves. Windfuhr and Jonsén (2005, 13) summarise 10 elements common to most definitions of food sovereignty:

- 1) priority of local agricultural production to feed people locally
- 2) access of smallholder farmers, pastoralists, fisherfolk, and landless people to land, water, seeds, and livestock breeds and credit
- 3) the right to food
- 4) the right of small holder farmers to produce food and a recognition of farmers’ rights
- 5) the right of consumers to decide what they consume, and how and by whom it is produced

Table 1. FAO’s four dimensions of food security.

Availability	Denotes the physical availability of food and is determined by the level of food production, food reserves, and the food trade.
Access	Refers to the economic and physical access to food and is determined not only by the availability of food but also the income of individuals, the prices of food, and markets.
Utilisation	Refers to the biological ways that the body makes the most of the nutrients in food; satisfactory utilisation is the result of good care and feeding practices, food preparation, diversity in the diet, and the distribution of food among members of the household.
Stability	Connotes the stability of the other three dimensions over time, which implies the uninterrupted availability, access, and utilisation of food with potential disruptions being caused by a variety of climactic, political, and social and economic factors.

(Adapted from FAO 2008, 1).

Table 2. Analytical framework – dimensions of FSS.

Availability	Refers to the uninterrupted supply of food in the required quantity and quality (nutritious and safe). Sources include national production, food reserves, and food aid.
Access	Signifies that the entire population can acquire food without interruption, which depends on the purchasing power to buy food if they do not produce it, the existence of infrastructure and transportation systems to enable the transfer of food, and other adequate food distribution channels.
Consumption	Indicates that individuals have the knowledge required to choose foods with high nutritional content, the best combinations of food, and exercise hygiene in the handling, preparation, and preservation of foods.
Biological advantage	Means that people have the necessary health conditions to benefit from the nutritional content of the foods they eat. This implies health conditions, safe water, and basic sanitation.
Agricultural production systems and agroecological practices at the local level	Refers to both the creation and strengthening of production systems at the local level to feed people living in these areas and emphasises the establishment of sustainable agroecosystems that take into account the complex interactions between all components of the agroecosystem.
Local access to productive resources	Refers to all the resources necessary to sustain production at the local level and includes access to land, water, seeds, and compost/fertiliser.
The role of gender in agricultural production and food preparation	Refers to the division of labour between men and women in food production and preparation.
The preservation of indigenous knowledge	Implies the importance of preserving indigenous knowledge, traditions, and value systems in the processes of food production and preparation.
Food self-sufficiency	Means that communities have the capacity to produce all the food required to sustain them.
Community participation	Refers to the civic participation of community members, including opportunities to participate in community projects, community decision-making, and initiatives to strengthen community relations as well as other forms of community engagement.

- 6) the right of countries to protect themselves from under-priced agricultural and food imports
- 7) the need for agricultural prices to be linked to production costs and to stop all forms of dumping
- 8) the populations' participation in agricultural policy decision-making
- 9) the recognition of the rights of women farmers, who play a major role in agricultural production in general and in food production in particular
- 10) agroecology as a way not only to produce food but also to achieve sustainable livelihoods, living landscapes, and environmental integrity

Two characteristics of these elements stand out. First, they focus overwhelmingly on peoples' *rights to decide*, without limiting them to the strict confines of sovereignty as self-sufficiency; this is often in contrast to the social movement discourse on food sovereignty that often implicitly

assumes self-sufficiency or food autonomy as the goal. Second, the food sovereignty discourse emphasises the rights of indigenous peoples to retain traditional production systems and food cultures (Declaration of Nyéléni 2007; Ruelle, Morreale, and Kassam 2011). This acknowledgement of the value of culture in attaining food security is of particular importance as it expands the reference to cultural preferences included in the FAO's definition of food security to that of a right of (indigenous) communities and nations to establish their own food systems that are reflective of cultural values and traditions (Ruelle, Morreale, and Kassam 2011, 164). It also inadvertently inserts (changing) cultural preferences as a potential limitation to food sovereignty.

Food sovereignty's focus on rights is perhaps the most fundamental distinction between food security and food sovereignty. As Pimbert (2009, 50) explains, "*The mainstream definition of food security ... doesn't talk about where that food comes from, who produced it, or the conditions under which it was grown*". Drawing on Pimbert's observation, our analysis in this study sought to include contextual factors underlying the processes by which individuals, households, and communities produce and procure food, giving importance to the context and "culture" of food production. The analytical framework used in this study identified 10 dimensions, and these are presented and elaborated in Table 2. Establishing food security must take into account a more complex web of interacting elements which at the centre respects the breadth and depth of community participation in defining and shaping their food security. The table we offer provides a base from which to explore food security in relation to food sovereignty.

Overview of the study area

The Yucatán has the highest percentage of indigenous peoples in Mexico, based on language as the indicator for indigenous identification. Social indicators point to a number of critical challenges facing the population of the Yucatán. In spite of a decrease in the fertility rate (29.78% in 1990 to 19.82% in 2005), in 2000 the state recorded one of the highest rates of child mortality in Mexico (Duran and Méndez 2010). Malnutrition was one of the principal reasons for mortality in 2005 in the Yucatán; indigenous populations in general face higher risks of malnutrition (especially children under the age of five) as well as high rates of obesity among adults and children (CONEVAL 2010). In 2006, 74% of the population of adults 20 years and older was classified as overweight; thus except for children under five, the food insecurity problem in the region seems to be one of overnutrition rather than undernutrition. Rural communities suffer from high rates of unemployment and unskilled labour and note a high migration rate to urban areas and to the United States in search of employment.

Agricultural production comprises a large part of the state's economy. There is a tendency for rural families to abandon the *milpa* and subsistence agriculture in exchange for more intensive commercial production, which has been historically encouraged by government policies that emphasise commercial agriculture and market-led growth. Rural producers are highly dependent on rainfall, as there is a low rate of water access in the region.

Methodology

Our study employed a participatory action research (PAR) approach. PAR is a research approach that emerged in the 1990s with the rise of alternative rural and agricultural development initiatives. PAR is rooted in a cycle of looking, reflecting, acting, and sharing among researchers and the local population, resulting in a process of knowledge production in which reflections about the actions are constantly monitored and actions adjusted in a dialogic process (Bacon, Méndez, and Brown 2005, 2). How PAR is implemented in the field varies, but fundamental to the

approach is the participation of interested or affected stakeholders in setting the research agenda, exploring and examining the identified problems, and defining actions to address them.

In the case of this study, men and women, youth, and local political leaders took part in describing the challenges and opportunities represented by the food insecurity and hunger that exist in their communities. It must be acknowledged that the geographic scope of the study was initially defined by the donor (W.K. Kellogg Foundation), and that the research agenda was defined collaboratively by the donor, the NGO Community Agroecology Network (CAN), and by the local institution the Intercultural Maya University of Quintana Roo (UIMQRoo), and did not involve consultations with community level organisations or members. However, after recognising these limitations, the rest of the research process was designed to integrate community voices into the design of research instruments, data collection, and analysis. Data collection was performed collaboratively with youth from the region studying at UIMQRoo, and included family-level surveys, participatory workshops, and individual in-depth interviews. Community members and local leaders participated in data interpretation through participation in participatory workshops, to arrive at a consensus understanding of the condition of food insecurity in their communities and possible strategies.

Mayan UIMQRoo students conducted field surveys in the summer of 2011. This area is largely comprised of indigenous communities whose principle economic activity is subsistence agriculture. In selecting the geographic scope of the study, UIMQRoo, The Kellogg Foundation, and CAN included the primary population and political centres, known as *cabeceras municipales*, for each of the 13 municipalities in the study, as well as smaller communities in most of the municipalities. All of the communities have as their principal economic activity subsistence production and are rated high for marginality based on the Human Development Index, which takes into account housing and access to health and education.

To determine the sample size of the study, we employed the formula used by the FAO's Special Programme for Food Security (SPFS), which we consider to be accurate as it takes into account the context of rural communities and does not merely use a fixed percentage of the population for all communities. In accordance with the SPSF formula, a sample size of 6% was used for communities with under 2000 residents, 5% was used for communities with between 2000 and 5000 residents, and 2.3% was used for communities with over 5000 residents. Only one of the communities selected for the study had a population of over 5000 with the rest falling into the categories of under 2000 residents or between 2000 and 5000 residents. The 22 communities included in the study were divided into three regions (Table 3) based on the predominant type of soil found in these communities, which was the strongest distinguishing factor among the communities, as all shared similar characteristics for rainfall and vegetation as well as similar socio-economic, cultural, and demographic characteristics. A total of 802 surveys were completed with 401 families. The distribution of surveys among families was as follows: one survey for the male head of the family, or the person in charge of (field) *milpa* production, and one survey for the female head of family, or the person in charge of garden or *patio* (a small plot next to the house) production, *solar* (a small garden further away from the house) production, and decisions regarding food preparation. The surveys included 151 questions organised around the following themes: family structure, food consumption and diet, family income, family expenses, water availability, food production, and values.

Five community participatory workshops were conducted in the three regions of the study and for each workshop three principal groups were invited to participate: males working the *milpa*, females working in the *solar* and *patio*, and youth aged 25 years and younger. Each focus group session lasted one day and focused on developing a shared understanding of the condition of food insecurity, defining needs, and developing a vision for the communities as per the perspectives of the participants. The workshops also included several plenary discussions with

Table 3. Three regions of the study by community and municipality.

	Community	Municipality
Region I	Chaksinkin	Chacsinkin
	Yaxhachén	Oxkutzcab
	Xohuayán	
	Tahdziú	Tahdziú
	Tixmehuac	Tixmehuac
	Kimbilá	
Region II	Canakom	Yaxcabá
	Chankom	Chankom
	Xanlá	
	Chikindzonot	Chikindzonot
	Chan-Chichimilá	
	Maní	Maní
	Tipikal	
	Mayapán	Mayapán
	Timul	Tahdziú
	Teabo	Teabo
	Tekom	Tekom
	Tixcascalcupul	Tixcascalcupul
	San José	
Region III	Cantamayec	Cantamayec
	Cholul	
	Yaxcabá	Yaxcabá

participation by all groups concerning issues and solutions associated with production systems and food security. The results of these workshops corroborated the results of surveys. Additionally, participants drew maps of production systems with men and youth community members drawing maps of the *milpa* and women of the *solar*.

In-depth interviews were conducted with rural community members and youth. Maps of social actors and organisational structure and local policy-making actors were developed using three sources: information gathered through interviews, the results of workshops with community members, and the synthesis of that information through joint analysis with community members.

Findings

In this section, we describe the results of these studies as per the 10 dimensions of FSS described above.

Availability

The primary sources of food observed in the area of the study are the *solar* and *patio, parcelas* (larger plots that are farmed often including perennial crops such as bananas or fruit trees), and the *milpa* (field where corn, beans, and squash are grown together and the location may change each season). Although a variety of foods are produced from these sources, production is mainly centred on corn, beans, squash, chilli, poultry, eggs, and, to a lesser extent, fruit. Vegetables are rarely grown, being limited to tomatoes, chilli, and culinary herbs. We can say that production diversity is low and focused on staple foods that provide calories. Furthermore, while most of the families in the study area produce food and consume most of what they produce, the amount of food they produce is not sufficient to meet their annual food needs. As

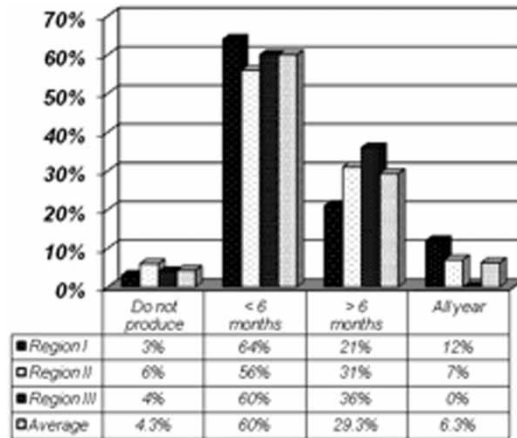


Figure 2. Food self-sufficiency through *milpa* production.

per Figure 2, the vast majority of families in all three regions (60%) sustain themselves from *milpa* production for less than six months, 29% sustain themselves for six months or more but not the entire year, and only about 6% of families sustain themselves for the entire year. *Milpa* production is not constant throughout the year, with May through November being the main production period. Although families preserve and save harvested foods to use during months of scarcity, and also save seeds to plant during subsequent seasons, families must procure food from other sources when saved food runs out.

Access to land is high. Between 76% and 82% of producers own their *milpa* plots, while the remaining rent land for production. The average area of production is 2.7 ha per person in regions I and III, but lower in Region II (1.9 ha). In these areas, most producers are men (<5% women), while in Region II more producers are women (11%). A secondary source of available food is local markets. The data also revealed that only a small percentage of harvests are sold commercially, which implies a lack of availability of locally grown food for those who do not produce or produce on a smaller scale.

To sum up, the limitation of seasonal production, and low yields as defined by farmers, and not lack of land, is the main factor contributing to scarcity; availability of food is also limited by low production diversity. Availability of foods like vegetables to purchase is also low for those who do not produce them.

Access

As Figure 3 illustrates, 82% of those surveyed report problems acquiring food. For the vast majority of those who have problems acquiring food (about 74%), the reason is a lack of money, while distance is also a secondary factor. This implies that the majority of families must find alternate ways of fulfilling their food needs through various means of procurement. As Figure 4 shows, the trends throughout the three regions are to borrow money to buy food (52%), buy food with credit (38%), or exchange food with other producers (10%). Remittances from family members working outside the locality also provide an economic means of obtaining food. Approximately 41% of the total annual expenditures of families in the study area are spent on food (see Figure 5), revealing that procuring food represents the largest family expenditure, and this amount is disproportionately high when compared with other annual expenses. The

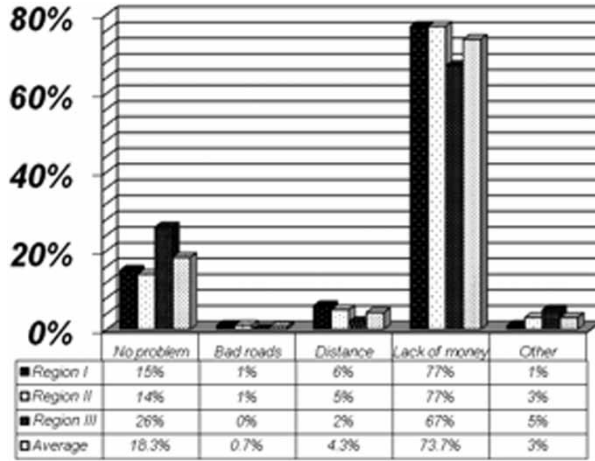


Figure 3. Reasons for difficulty acquiring foods.

income to purchase this food comes from wage employment; people are working to purchase food. A significant resource to improving food access is government programmes: between 70 and 90% of the population surveyed benefit from government subsidies through various programmes such as *Oportunidades* and *Procampo*.² Purchasing food at markets presents its own set of challenges: not all foods required by families can be purchased at markets, the prices of foods at local markets are high, and some must travel to neighbouring communities to access markets, which thus requires transportation and the added cost of travel. Most of those surveyed reported that they prefer to acquire foods from local markets (82%). Furthermore, local food transport systems (from both the *milpa* to the home and from the *milpa* to markets) are inadequately developed.

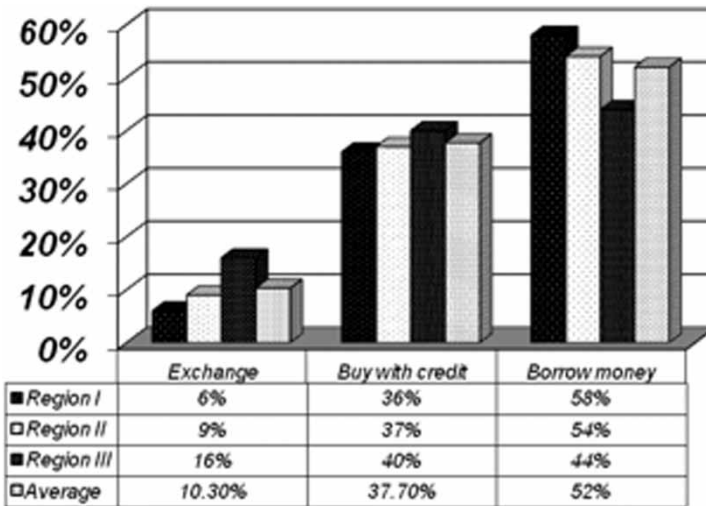


Figure 4. Alternative ways of obtaining food.

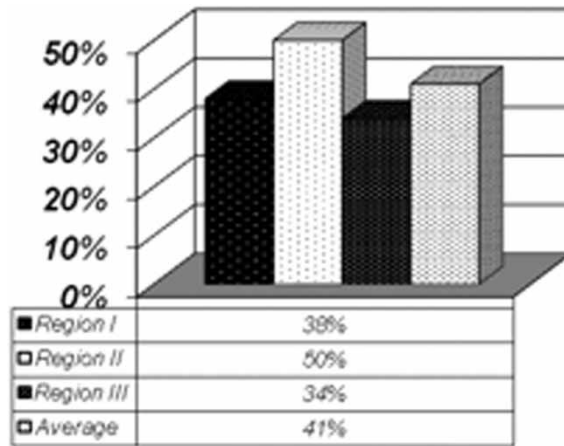


Figure 5. Per cent of annual expenses spent on acquiring food.

Putting all of this together we can see that access to food is precarious and dependent on various strategies. It must also be pointed out that there is a contradiction, albeit a commonly recognised one: 82% of people have problems accessing food, but there is a 70% obesity rate among adults. The problem lies in a combination of what is being produced and is available (calorie-laden basic grains); what is accessible through local markets, government programmes, and trade (again, calorie-laden basic grains, not vegetables and fruits); and changing cultural preferences for foods that are high-calorie and often purchased processed foods. All of this together creates obesity and a precarious food security situation [Figure 5](#).

[Table 4](#) shows a summary of problems identified and discussed during the participatory workshops in the three study regions.

Consumption

This study focused on examining the diets of the individuals of Region I of the study area to ascertain the degree to which individuals consume nutritious foods in balanced combinations between three food groups: fruits and vegetables, cereals and tubers, and legumes and animal proteins. Data shows that most individuals eat a balanced diet (64%); however, 34% do not meet the

Table 4. Breakdown of identified problems in food access and availability according to participatory workshops in the three regions.

Topics	Region I	Region II	Region III
Local practices and lack of diffusion of local knowledge	X	X	
Infrastructure	X		
Problems with crops (low yields, pests, etc.)	X	X	X
Access and source of water	X	X	
Climate change	X	X	X
Transportation	X	X	
Resources (local, economic)	X	X	
Market for the sale of local products	X		
Lack of systematic support		X	

fruit and vegetable requirement, thus demonstrating diets that are disproportionately high in the cereal and tuber group and legume and animal protein group. Government-supported Diconsa stores supply staple foods like basic grains, but do not contribute significantly to the availability of fruits and vegetables, and the cultural linkage of social status with purchased foods that are often sugar-laden and processed, high-calorie foods, diminish the motivation to consume locally produced fruits and vegetables, even if they are available. All of these factors could be major contributions to the high rate of obesity.

Biological advantage

Almost 100% of those surveyed reported having access to potable water. This is an important finding with regard to biological advantage as it demonstrates that the population has access to safe drinking water for consumption and also for the preparation of foods thereby limiting the potential of water-related illnesses.

Agricultural practices and access to productive resources at the local level

The data revealed some important challenges to developing successful local production systems that incorporate agroecological principles. First, small-scale irrigation and the use of compost and fertiliser is very limited in the study area and those surveyed report that land is not as productive as it was in past years nor is the soil as fertile. Second, as mentioned above, transport systems do not meet the needs of residents and thus getting the harvest from the *milpa* to the home or from the *milpa* to the market can be a challenge. Third, study participants report problems with production systems in the *milpa* and the *solar* across several areas (some of which echo previously mentioned concerns), including local production and the dissemination of local knowledge, infrastructure, crops, access to water for irrigation, climate change, transportation systems, and access to local productive and economic resources. Fourth, rural migration to urban areas and to tourist localities in the northern Yucatán peninsula results in the loss of an important source of labour for *milpa* communities, especially because the workers on the *milpa* are usually family members. Fifth, government policies are focused on commercial production and market-led economic growth and are much less concerned with promoting subsistence production or developing local agriculture and food systems. Sixth, the use of chemical pesticides and fertilisers in some of the communities studied (often subsidised by government programmes) poses challenges to both the health of community residents and biodiversity and soil health in the region. Finally, youth are encouraged by their families to leave the *milpa* behind and look for higher-status wage labour in tourist zones, which results in the loss of locally-adapted knowledge from one generation to the next and an undervaluing of subsistence agriculture as a viable livelihood.

Local access to productive resources is mixed. A notable strength is that access to land is remarkably high for those surveyed; an average of 79% of families own land in the three regions and 97% of those who have access to land report that they possess the land. However, access to water for irrigation is a significant challenge. An average of only 9% of producers in the three regions of the study has access to water for irrigation, leaving the vast majority without access to this resource. Of the 9% of producers with irrigation systems, the most common method is micro-aspersion, while other irrigation methods include gravity irrigation, sprinklers, and drip irrigation. The issue of access to water for production is becoming increasingly important as participants report that droughts have lasted longer, and the duration and intensity of the rain season have decreased in recent years. As mentioned above, there is a culture of saving seeds for future planting, though seeds are not saved for many crops and thus there is a need to obtain seeds from other sources (an added expense). Furthermore, the use of compost

and fertiliser is mixed. In Regions II and III of the study, less than a quarter of producers report using compost and fertiliser, while in Region I, 75% report making use of these resources. Not using these resources would contribute to low yields and diminished food availability.

The role of gender in agricultural production and food preparation

For the most part men and women continue to follow the traditional labour pattern with 95% of men in charge of *milpa* production and 94% of women focused on food preparation and tending the *solar* and *patio*. The implications of this for food security need to be explored further, but given that fruits and vegetables are traditionally produced on the *solar*, there would seem to be a gendered explanation for low production and consumption of these foods that merits further study. From the focus groups we gleaned that the biggest obstacle to higher production in the *solar* and *patio* is a lack of time available to women given their household responsibilities, and further study of the dynamic of women's labour and food security is necessary.

The preservation of indigenous knowledge and culture

The history of food insecurity in these communities is difficult to trace, as they have experienced centuries of different production systems from the colonial period to the modern; the fact is that the traditional food systems that exist are in fact hybrids long in development. We note several important challenges facing the communities in this study in terms of preserving cultural traditions and knowledge. One of the most significant challenges is migration to urban areas, especially of people 25 years old and younger, in search of better jobs and education. This was attributed to the lack of employment and the absence of institutions of higher education in rural areas. This is a serious challenge for indigenous communities in terms of retaining and strengthening knowledge as it weakens the cultural links young people have with their communities. Older generations are unable to transmit the values and traditions specific to their cultures to young people during the period of migration, which is often a formative time in the lives of young people. The result is the loss of the traditional diet from one generation to the next, which according to our study is more diverse and nutritious (relying on a variety of locally-available plants in addition to basic grains) than the diet consumed by younger generations exposed to the pressures of migration, media, and processed foods provided in government-subsidised stores. The loss of traditional agricultural knowledge can be attributed not only to migration of youth to tourist zones, but also to the ease of access to chemical inputs, which for their low labour requirement are increasingly attractive to families who can depend less and less on the younger generation for agricultural labour.

Food self-sufficiency

As mentioned above, the majority of families in the communities of the study are unable to produce the food they require on an annual basis. According to the results of the surveys, productivity levels have decreased in recent years, implying that families need to cultivate larger areas of land to harvest the same quantity of food that was harvested from less land in the past. The pressure of expanding livestock production has also affected the amount of land dedicated to crop production as more pasture is needed.

Community participation

The data showed that there are three principle spaces of community participation across the three regions of the study area: for men, the *asamblea ejidal*, which is the organisation that governs the

ejido, with an average participation of 44% of inhabitants; for women, *Oportunidades* programme committees with 39% of inhabitants; and the church, with an average of about 16% of inhabitants. It is noted that the participation of young people in community activities is not significant; however, civil society organisations are creating new spaces for participation and focus on young people and women with projects focused on production and entrepreneurship.

Discussion and conclusions

The study had two principle objectives: to measure food security in indigenous communities of the Yucatán using the hybrid FSS framework, and to test the strength of this framework to inform future research.

Regarding the first objective, this study produced a rich set of data on the state of food security in the study area. Our approach of using the hybrid FSS framework allowed us to address the issue of food security more comprehensively using a systemic approach to determining factors that impede household and community food security. The PAR methodology allowed us to measure food security in a way that was meaningful to the participants of the study, as they were key in describing the challenges to FSS in their own communities, as well as defining appropriate solutions to problems. As per the findings, we found that while a few of the indicators of FSS were approaching satisfactory for achieving food security (such as availability and, to an extent, consumption), the majority were only partially satisfied (biological advantage, development of local level production systems that incorporate agroecological principles, local access to productive resources, preservation of indigenous knowledge and culture, and community participation), and food self-sufficiency was for the most part unsatisfactory.

Certain elements of the FSS analytical framework used in this study were under- or unobserved. These included overall health conditions apart from the availability of potable water; nutrition and food sanitation knowledge possessed by community members; the nature and distribution of markets, other sources for the purchasing of food, and the more specific dynamics of the overall food distribution channels; local and nonlocal sources of seeds, compost, fertiliser, livestock, and credit; the specific means by which local and traditional agricultural production knowledge is transmitted inter-generationally; and broader factors that impede the realisation of agroecological production, such as the extent of use of chemical fertilisers and pesticides and the use of genetically-modified seeds that affect local agrobiodiversity. These gaps in the data collection can help inform the design of future studies to improve this particular FSS framework, or help generate new sets of indicators to more accurately measure the elements that have not been sufficiently developed.

However, we found that looking at the 10 dimensions separately does not totally reveal the dynamics of food insecurity manifested as obesity and tenuous access to a variety of foods in these communities. It is clear that changing cultural preferences towards high calorie, processed foods are linked to what government programmes provide in terms of production inputs and subsidised foods; to the view that farming is low on the social status ladder while wage labour is high, and to gendered distribution of land access in which women may have less access to land to produce vegetables due to increased pressure from the expansion of livestock production for sale. Another overarching realisation emerging from this study is that food sovereignty is not food autonomy – we cannot assume that local control universally translates to food autonomy or self-sufficiency. The larger context and roles of food subsidies that promote productive and dietary homogenisation as well as production for external markets, must be considered, and this consideration must beg the question of whether food sovereignty means a politically-driven separation from those structures, or the search for a way to balance local control within this context. The finding is that we need to expand our emphasis on local control to include

local interactions with scalar politics and policies. In this way food sovereignty can more effectively address the assurance of local culturally preferred food as a human right, by including scalar threats to this right within its strategies to promote food security.

As a result of this study, the UIMQRoo-CAN research team were able to devise a set of strategies to strengthen food security and food sovereignty with the communities studied that were context oriented, culturally appropriate, and locally relevant due to the participation of community members through the PAR methodology. Strategies focused on production diversification and the promotion of agroecological and traditional techniques to reduce dependence on inputs and increase yields, and the involvement of youth in community and culture. They included, but were not limited to, creating a local seed bank to preserve local creole varieties of seeds, incorporating traditional practices into production systems, improving public transportation systems to make markets more accessible, establishing demonstration farms for the purposes of disseminating agroecological best practices identified in the study, increasing local opportunities for employment and civic participation of young people under the age of 25, and the re-valorisation of traditional foods and their consumption. The strategies do not address all of the problems contributing to food insecurity in the region, but do seek to address the underlying problems of cultural devaluing of food production as a livelihood and the production and consumption of local foods.

This study of communities in the Yucatán not only expands the literature on empirical studies of food sovereignty in general, and specifically food security and food sovereignty in the Yucatán, but also provides a foundational analytical framework to expand upon in terms of generating new research on the practice and measurement of food security and sovereignty. In terms of the food sovereignty framework, this study underemphasised or excluded a number of elements that we found are critical to take into consideration in future studies. These include a greater emphasis on local control over food systems; the effects of dependence on production and food subsidy programmes in local communities; the link between food prices and production costs; local citizen participation in formulating and implementing food and agriculture policy; and the rights of women as food producers and preparers. The challenge ahead is to include these elements and define how to measure them.

Given the complexity of the FSS framework, initiatives to measure its practice in an effort to create food secure communities will surely need to become more sophisticated in order to take these numerous variables into account. It is towards this end that this study aimed to take a formative step.

Notes

1. Reardon and Pérez (2010, 919) explain that Universidad Central de las Villas, MACAP/ANAP, and La Vía Campesina are currently devising a set of indicators of food sovereignty based on conventions and documents by La Vía Campesina to be used to measure food sovereignty in other countries, including but not limited to Cuba, Venezuela, and Brazil, and will be adjusted for national context.
2. Procampo is a government programme that provides assistance to all *grain producers*, through per hectare payments (see Fox and Haight 2010, 16–17). It also benefits corn producers by assisting them in purchasing chemical fertilisers and herbicides as well as providing economic aid. Oportunidades is a means-tested government programme that benefits individuals and families by providing economic assistance depending on the number of children in the family (see SEDESOL 2013).

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