Colegio de Postgraduados

Agricultural Backyard Production in the Food Security Framework: A Case Study of a Microregion of Chicontepec Veracruz, Mexico

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ABSTRACT

Objective: This study evaluated the impact of agricultural backyard production on the well-being of producing families in the context of food security in a Microregion of Chicontepec Veracruz, Mexico, highlighting the substantial economic advantages of this practice.

Design/methodology/approach: Through probabilistic sampling, a structured survey on availability, accessibility, and nutrition was designed and applied to backyard-producing families. A multinomial logistic regression model was employed to analyze the relationship between a dependent variable and a set of independent variables.

Results: In the microregion of study, backyard production is distributed in 55.4% of fruit trees, 25.4% of regional crops, and 19.2% of vegetables. The two crops that add the most to the basic basket are corn and Chichimeken beans. 98% of producers estimate that backyard production (livestock and agriculture) saves the family economy 10% to 50% of its costs.

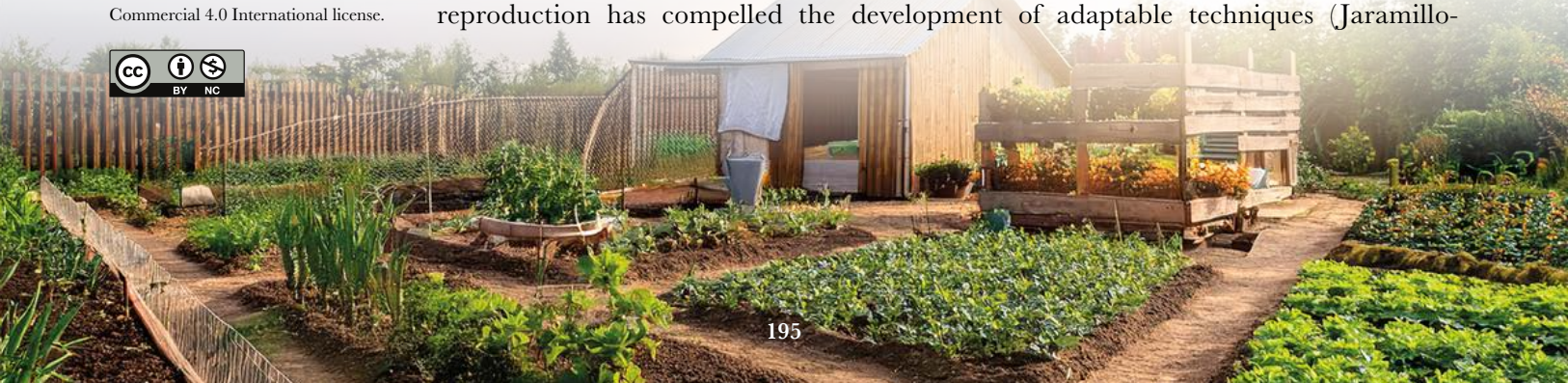
Limitations on study/implications: Knowledge of the backyard production of the microregion under study will allow the development of municipal policies that will link producers with the local market.

Findings/conclusions: Backyard production has been shown to contribute significantly to food security since different fruit trees, vegetables, and local crops substantially contribute to the household economy through sales and self-consumption.

Keywords: Food self-sufficiency, high-priority development communities, responsible consumption and production.

INTRODUCTION

The rural workforce in Mexico is concentrated in the countryside, where social reproduction has compelled the development of adaptable techniques (Jaramillo-



Villanueva *et al.*, 2017). Backyard production is an informal activity that draws from the expertise and experience of indigenous people and peasants (López *et al.*, 2012). By providing rural families and communities with goods and services that meet their fundamental requirements, backyard agriculture helps to ensure food security (FAO, 2019; Hernández *et al.*, 2010). Food during periods of scarcity, savings, and revenue are produced by this practice (Jaramillo-Villanueva *et al.*, 2017). According to definitions, food security is when people have timely and continuous access to food —quantity and quality— for their biological needs and adequate consumption, ensuring a well-being that supports their nutritional development (FAO, 2019). The three fundamental pillars supporting food security are access to, availability of, and sufficient intake of food (FAO, 1996).

Food security and poverty are linked. Twenty-three percent of Mexicans are food insecure, 53% of Veracruz residents experience food insecurity, and 61.8% of the population is poor, with 17.7% living in extreme poverty and 44.1% in moderate poverty (CONEVAL, 2021).

Because backyards are important as productive systems and because they help low-income families in the state of Veracruz be self-sufficient and eat well, studies that quantitatively evaluate backyard activities within the context of food security in areas where poverty, marginalization, and cultural diversity are commonplace are crucial. The findings will aid in formulating public policy initiatives to address poverty.

Studies conducted in the states of Puebla and Veracruz highlight the following research approaches: backyard production as a survival strategy (López *et al.*, 2012), backyard production's economic significance and its connection to food security in high-priority development communities (Jaramillo-Villanueva *et al.*, 2017; Urquía-Fernández, 2014), and backyard production's ability to boost the local economy (Sánchez-Galván *et al.*, 2019, 2020).

In this context, the following inquiries served as the foundation for this study: What savings do backyard farmer families realize from this activity in their economy? What additional benefits do your products offer in terms of food security and your well-being? According to the theory above, families who engage in backyard production greatly benefit from increased food availability, accessibility, and quality.

MATERIALS AND METHODS

Study area. Chicontepec, the municipal seat of the homonymous municipality, is a significant location for this study. It is located northwest of Veracruz, Mexico, and is part of the Chicontepec microregion under study. This microregion includes the communities of Ahuimol, Akichzintla, Alashcuatitlan, Ateneo, Cuatzapotl, Tecuapa, and Tenexaco. These communities represent diverse rural settings, each with unique challenges and opportunities for agricultural backyard production (Figure 1).

Field work. The research methods used were interviews, structured questionnaires, and observation. Through in situ observation, data regarding backyard production methods and products, areas set aside for this purpose, and conventional agricultural techniques were gathered.

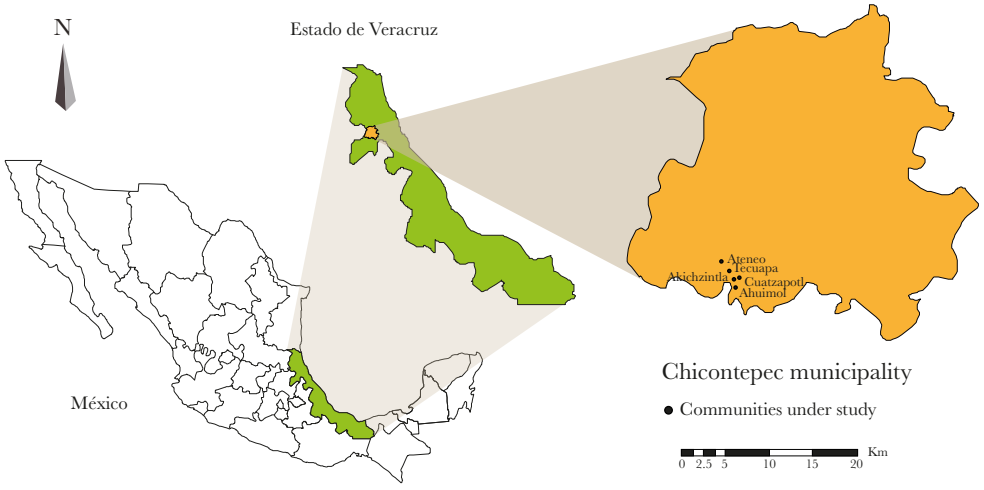


Figure 1. Study location. Source: own elaboration based on data obtained from INEGI (2010, 2016 and 2019). They are prepared in QGIS (2021) Desktop 3.10.8. Microregion designed in (Bautista-Santos *et al.*, 2021).

Survey design, construction, and implementation. A structured survey was created and implemented to gather data on product types (fruit trees, vegetables, backyard animals), accessibility (product sales, savings to the family economy from the product sale, average monthly income), and nutritional aspects (product variety, consumer products). Using data from the most recent population and housing census, a probabilistic random sampling was used, considering the number of families in the studied communities (INEGI, 2010). The household leader was regarded as the head of the peasant domestic group or the backyard producer (González *et al.*, 2014). Cronbach's alpha statistical method was used to validate the data (Tuapanta Dacto *et al.*, 2017). A case study of households in backyard farming and residing in a Chicontepec, Veracruz microregion was investigated as part of the research methodology (Bautista-Santos *et al.*, 2021).

One hundred forty-three backyard producers were surveyed, accounting for 36% of the study population and 246% more of the sample size. The above is according to the maximum variance equation Eq.1 (Gil & Zarate Lara, 2012). Each family was taken as a production unit. Total families (401): Ahuimol (192), Akichzintla (45), Alasxcuatitlan (36), Atenol (41), Cuatzapotl (20), Tecuapa (50) and Tenexaco (17).

$$n = \frac{NZ^2_{\alpha/2}pq}{Nd^2 + Z^2_{\alpha/2}pq} \qquad \text{Eq. 1}$$

Where n=sample size; N=population size (N=401); $Z^2_{\alpha/2}$ =value of Z distribution tables ($Z^2_{\alpha/2}$ =2.6896); p=proportion of the population with a binomial characteristic, q=1−p (pq=0.25); d^2=maximum desired absolute error (set as a fraction of p) (10%) (d^2=0.01).

This study employed a multinomial logistic regression model to analyze the relationship between a dependent variable and a set of independent variables. This model

is instrumental in understanding the impact of multiple factors on a definite outcome, which in this case is the well-being of the producing families. The model, constructed with the IBM SPSS statistics 25 statistical packages, estimates the probability of a multinomial event represented by the dependent variable $\left(\widehat{Y}_i\right)$ based on a series of discrete or continuous predictor or prognostic variables $\left(X_i\right)$. Model validation utilized the maximum likelihood ratio and Cox and Snell's R square. The Pearson correlation matrix was also used to determine the degree of correlation among the independent variables Eq.2. This rigorous analysis was crucial in drawing meaningful conclusions from the data collected.

$$\widehat{Y}_i = Pr\left(Y = 1 / X\right) = \frac{1}{1 + e - \left(\hat{\beta}_0 + \hat{\beta}_i X_i + ... \hat{\beta}_n X_n\right)} \qquad \text{Eq. 2}$$

Where: $\widehat{Y}_i$ =Probability of producing regional crops (i=0 (not making anything), 1 (producing corn and/or beans)); e=Base of the natural logarithm; $\hat{\beta}_0, \hat{\beta}_i$ =Intercept and estimators of the independent variables (X_i); and X_i=Independent variables (X_1=vegetable production; X_2=fruit tree production).

RESULTS AND DISCUSSION

In the study area, the primary backyard production is fruit trees (55%), and in that exact order are regional crops (25%) and vegetables (20%) (Table 1). Backyard production (agricultural and livestock) contributes 15% to the family economy since this percentage is for sale. In this savings area, regional crops are the most destined for sale (18%). Of all production, fruit trees are the one that contributes the most to self-consumption (92%) (84%, 82%, and 87% for vegetables, regional crops, and livestock, respectively). In regional crops, 75% of production is corn (52%) and chichimekel bean (23%), while vegetable production is dominated by cilantro (24%) and mint (23%). The data confirm that the production of these last two products dominates the area's agricultural economy (*e.g.*, corn: 86% consumption and 14% for sale; chichimekel beans: 82% consumption and 18% sale) (Basurto *et al.*, 2018). Production is carried out in an approximate area of 1.19 hectares, one of the largest compared to others reported (*e.g.*, 520% more than in Puebla) (González *et al.*, 2014; López *et al.*, 2012). Those surveyed say 95% of agricultural and livestock products are obtained without fertilizers or processed foods. This represents a comparative advantage in terms of savings in food production and quality.

The fruit tree production as the main product obeys the social policy promoted by the federal government in its "sembrando vida" (sowing life) project (https://www.gob.mx/bienestar/acciones-y-programas/programa-sembrando-vida). The production of fruit trees requires minimal investment, a benign climate, accessibility, and availability of land, which makes it the state with the largest fruit-growing area in the country (Cruz-Delgado *et al.*, 2013).

The investment is more significant for regional crops than the other two activities (fruit trees and vegetables) (Olvera-Hernández *et al.*, 2017). The order of importance of backyard

Table 1. Main backyard products and by-products.

Product (%)	By-product (%)	%	Self consumption %	Sale %
Fruit trees (55.4)	Avocado creole (*Persea americana* var. Mexicana)	6	92	8
	lime/lemon (*Citrus limon*)	9	91	9
	tangerine (*Citrus reticulata*)	5	100	0
	mango (*Mangifera indica*)	11	94	6
	orange (*Citrus sinensis*)	15	88	12
	banana (*Musa paradisiaca*)	15	87	13
	others	38	94	6
Average			92	8
Vegetables (19.2)	cilantro (*Coriandrum sativum*)	24	70	30
	mint (*Mentha spicata*)	13	83	17
	cassava (*Manihot esculenta*)	7	92	8
	chayote (*Sechium edule*)	6	88	12
	garlic (*Allium sativum*)	3	100	0
	pumppkin (*Cucurbita*)	4	100	0
	sweet potato (*Ipomoea batatas*)	6	68	32
	papatla (*Heliconia schiedeana*)	8	62	38
	epazote (*Dysphania ambrosioides*)	4	100	0
	others	27	77	23
Average			84	16
Regional crops (25.4)	Corn (*Zea mays*)	52	86	14
	chichimenkel bean (*Phaseolus vulgaris*)	23	82	18
	creole chili (*Capsicum annuum*)	9	74	26
	pemuche (*Erythrina coralloides*)	6	92	8
	others	10	77	23
Average			82	18
Livestock	poultry (*Gallus gallus domesticus*)	68	86	14
	bovine (*Bos taurus*)	24	90	10
	pig (*Sus scrofa domesticus*)	8	85	15
Average			87	13

Source: Own elaboration based on information collected in fieldwork.

production coincides with (López *et al.*, 2012; López *et al.*, 2013) in the states of Puebla and Hidalgo; these authors conclude that corn and beans are food bases for rural communities. Rainfed corn and chichimekel beans are two foods that provide the body with the primary sources of calories and proteins of non-animal origin (GOB-MEX, 2017). In the region, these two plants contain a very particular syncretism that permeates the maintenance of the social fabric since their agricultural cycle is closely related to the diet of this Huasteca population (Basurto *et al.*, 2018).

Backyard livestock farming involves raising birds, horses, cattle, pigs, goats, sheep, and cattle (Jaramillo-Villanueva *et al.*, 2017). Backyard animals complement the protein

intake since 87% is for self-consumption (availability), and the remaining (13%) is for sale (accessibility).

For the construction of the logistic model, 111 data were considered. The fit shows a lower maximum likelihood ratio compared to that which only includes the intercept (β_0). This is corroborated by the likelihood ratio, which indicates a very significant difference ($p \leq 0.001$) between including all variables in the model versus not including any. That is, the variables contribute to explaining the backyard production of regional crops (corn and/or beans). The Pseudo R^2 of Cox Snell and Nagelkerke suggests that between 22% for the first and almost 25% for the second variation in the dependent variable is explained by the independent variables included in the model. Although this value is not high, in social research, it is considered acceptable (Cruz-Huerta *et al.*, 2015), providing a solid foundation for our findings. Additionally, Pearson's goodness of fit indicates no correlation between the independent variables by showing values close to zero. The estimated multinomial logistic model generally presents a satisfactory goodness of fit (Table 2).

Table 2. Results of the multinomial logistic model.

A) Summary of processing of nominal variables cases			
Variable	**Valor nominal**	**n**	**Marginal (%)**
Regional crops (Y_i)	0 no crops	12	10.9
	1 corn and/or beans	90	81.8
	2 other	8	7.3
Vegetables (X_1)	0 no crops	68	61.8
	1 some crop	42	38.2
Fruit tres (X_2)	0 no fruit tree	31	61.8
	1 orange and/or mangoes and/or banana	72	65.5
	2 other	7	6.4

B) Likelihood ratio tests			
Variables	**X^2**	**g.l.**	**p**
Vegetables (X_1)	25.656	2	0.672
Fruit trees (X_2)	8.8893	4	0.031

c) The goodness of fit of the model				
Adjustment criteria		**Likelihood ratio**		
Model	**Log. of likelihood -2**	**X^2**	**g.l.**	**p**
Intersection only	606.017	64.716	33	0.001
Final	541.301			
		Goodness of fit		
Pseudo R cuadrada		Parson	708	0.104
Cox and Snell 0.223		755.641		
Nagelkerke 0.246		Desvianza	708	1
			541.301	

Source: elaboration with data collected from a survey and outputs from the logistic regression model on a database previously created in Microsoft Excel 2001.

The model indicates that the probability of producing corn and/or beans and other products is only significant in fruit trees ($p<0.05$) (Table 3). That is to say, the probability of producing corn and/or chichimenkel beans is 3.51 times greater if there are no fruit trees and 2.9 times more significant if oranges and/or mangoes and/or bananas are produced. Regional crops can be produced without fruit tree production (see Parameter Estimation Table). Considering the variables above, this can establish public policies to promote the production of fruit trees or corn and/or beans.

Regarding the economic component, families earn income through the sale of surplus production; they save money and time by avoiding purchasing products that families consume and produce (Olvera-Hernández *et al.*, 2017). Backyard production is significant for the family economy (contribution to the basic basket). 98% of producers indicate a saving of between 10 and 50% due to backyard production (agriculture and livestock) (Table 4).

Backyard produce is an essential resource for the economy of families living in high-priority development communities. The minimum monthly income (in July 2019 pesos) for a rural community fluctuates between 141.71 and 356.84 USD (GOB-MEX, s. f.); these

Table 3. Matrix of coefficients of significant independent variables ($p<0.05$).

Regional crops		B	Significance (<0.05)	Exp(B)
Corn and/or bean	Intersection	19.128	.000	
	[vegetables=0]	.182	.777	1.199
	[vegetables=1]	0	.	.
	[fruittrees=0]	−17.151	.000	3.561
	[fruittrees=1]	−17.347	.000	2.927
	[fruittrees=2]	0	.	.
Others	Intersección	17.095	.000	
	[vegetables=0]	.893	.403	2.441
	[vegetables=1]	0	.	.
	[fruittrees=0]	−17.842	.000	1.78
	[fruittrees=1]	−18.466	.	9.553
	[fruittrees=2]	0	.	.

Source: Own elaboration. IBM SPSS Statistics software package (V. 25.0, 64-bit Edition) on a database previously created in Microsoft Excel 2001.

Table 4. Perception of respondents about saving the family economy on backyard production.

Variable	Interval (%)	Frequency	(%)
Perception of contribution to the family economy through backyard production	between 10 and 25	104	73
	between 25 and 50	36	25
	between 50 and 75	3	2
Average monthly income (USD/month)	$\overline{x}$ =216.86* d.s=77.73*		

Source: own elaboration.

* 1 USD=19.05340 Mexican pesos. Average exchange rate during July 2019 (BANXICO, 2019).

data coincide with the average income reported by respondents of 216.86 USD per month on average: 37% of the salary considered by Below the poverty line, this is 592.55 USD (CONEVAL, 2021). The income coincides with studies in other countries' rural regions, especially in the State of Mexico in the Mazahua and Otomi and forest communities (Rodríguez-Zúñiga *et al.*, 2023).

CONCLUSIONES

In the resilient system study region, 55.4% of backyard production is distributed among fruit trees, 25.4% among regional crops, and 19.2% among vegetables. Chichimeken beans and corn, the backbone of the basic basket, demonstrate this resilience. Based on vegetables and fruit trees, it is possible to predict the production of regional crops probabilistically.

98% of producers indicate that backyard production (agricultural and livestock) saves the family economy between 10% and 50%. This is significant since the average monthly income of producers is around 37% less than the salary considered below the poverty line. Backyard agricultural and livestock products are crucial in improving food availability: 86% for self-consumption, while accessibility (product sales) is around 14%. The nutritional part of backyard production is that most are organic, representing a competitive advantage. Carry out regional market studies (development of production and demand functions) supported by a detailed analysis of investment costs and their benefits; likewise, determine the nutritional value and traditional intake of backyard production.

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