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RURAL MANAGEMENT AND MARKETING OF WILD EDIBLE MUSHROOMS IN MEXICO

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ABSTRACT

Mexican indigenous peasants have developed subsistence strategies at a household level in rural areas. These strategies comprise agricultural and extra-agricultural activities within the rural household system (RHS), which generate incomes for satisfying basic household needs. The rural gathering of wild edible mushrooms is an extra-agricultural activity which is traditionally carried out in central Mexico during the rainy season, either for household consumption and/or for commercialization in popular markets. Despite the importance of this activity, detailed descriptions of gathering processes within rural communities are not available. The community of San Andrés Hueyacatitla, Puebla, was selected in this study, and was socio-economically characterized. The consumption of wild mushrooms by gathering, buying, or a combination of both in this community was high (86.5%). Traditional management and marketing processes of wild mushrooms developed by RHSs are described (family organization, the process of mushroom gathering, household activities, marketing). A training course on a technology for canning wild edible mushrooms was performed using two acidified (pickled) Mexican recipes. The financial feasibility of the entire activity (mushroom picking and processing) was also studied. Mushroom gatherers were found to belong to poor RHSs lacking land tenure. Forty one popular names were recorded for wild mushrooms, as well as 29 places selected for gathering and 9 places for marketing. The ecological impact of traditional mushroom gathering is heterogeneous, as the amount of mushrooms gathered in typical journeys varied at each selected site (0.5-6 kg) and there were places where no mushrooms are picked. Mushroom gathering provided monetary, complementary, and potential incomes to RHSs studied, which represented a proportion of 0.2-19.2% from overall incomes obtained from agricultural and extra-agricultural activities. Wild mushrooms were gathered and canned by family members in the rural community studied. There was acceptance of the recipes studied indicating good marketing potential.

Key words: wild mushrooms, traditional management, mushroom canning, rural development, Mexico.

INTRODUCTION

Forest regions are commonly associated to rural communities in Mexico. These communities normally use forest resources for their own daily living. Wild edible mushrooms are managed traditionally to differing extents in many rural communities during the rainy season. This is a complex process in which diverse social, economic, and ecological factors are directly involved. However, most research work on the subject has been highly disciplinary, e.g. from the point of view of conventional taxonomy (Guzmán, 1977, 1984; Pérez-Silva, 1979; Villarreal and Pérez-Moreno, 1989a), ecology (Villarreal and Pérez-Moreno, 1989b; Zamora-Martínez, 1998), ethnomycology (Estrada-Torres and Aroche, 1987; Moreno-Fuentes et al., 1996), and technology transfer (Martínez-Carrera et al., 1998). In this research, we have started an interdisciplinary approach to study the main socio-economic aspects involved in the management and marketing of wild mushrooms, and explored the potential to incorporate canning technology for complementing these traditional processes in a rural community from Puebla, Mexico.

METHODOLOGY

Region of study

The reasearch work was carried out in the rural community of San Andrés Hueyacatitla, Puebla. Main social, economic, and ecological characteristics of this region are shown in Table 1. It is a mountainous region, showing a subhumid temperate climate, high precipitation, and poor levels of communication infrastructure and services (SEGOB, 1988). The community has a traditional rural diet based on maize, beans, broad beans, fruits, and chilli.

Table 1. Main social, economic, and ecological characteristics from the region studied (SEGOB, 1988).

Data		San Andrés Hueyacatitla, State of Puebla
Social	Municipality	San Salvador El Verde
	Population	3,153
	Number of households	541
	Language	Spanish
	Organization	Weak
	Diet	Rural: maize, beans, broad beans, fruits, chilli
	Land tenure	Private property; communal (ca. 2,199 ha)
Economic	Main agricultural activity	Fruit-trees, crop plants (maize, beans, oat), livestock
	Communication infrastructure	Poor
	Services (water, electricity, sewerage)	Poor
Ecological	Elevation	2,500-3,700 m
	Latitude; longitude	$19^{o}15'28''$, $19^{o}15'30''$ north; $98^{o}35'48''$, $98^{o}35'50''$ west
	Mean temperature	12^{o}-18^{o}C
	Precipitation	804 mm/year
	Climate	Subhumid temperate $C(w_o)(w)$; C(E)w2(W)
	Vegetation	Coniferous forest

Main community activities are: 1) Forest exploitation (timber and non-timber products); 2) Fruit crops (plums, apples, pears, peaches, nuts); 3) Subsistence agriculture (maize, beans, broad beans); 4) Livestock (cows, lambs, goats, fowls, turkeys); 5) Horticulture (gladioli); 6) Labouring (building materials: bricks, mud-bricks); and 7) Trading.

Consumption, marketing, and canning of wild mushrooms

The model of analysis, the rural household system (RHS) and its study, has been described (Aguilar et al., 2001). In this research, several aspects from RHSs were studied in order to understand the significance of gathering, consumption, and marketing of wild edible mushrooms in the selected community. Structured surveys were carried out in RHSs having the following elements: 1) Characteristics and life circumstances from family members; 2) Crop plants; 3) Livestock; 4) Gathering; 5) The making of produces; 6) Trading; and 7) Labouring. An interview protocol was developed containing variables studied within open-ended, short-answer open-ended, and closed items, as well items with adjectival and adverb responses. Appropriate measurement scales were assigned to each variable. The interview protocol was applied individually by formal interviews, followed by an observation protocol (Rojas, 1991). After interviews, during the rainy season (June-October), several traditional journeys to the communal forest for gathering wild mushrooms were carried out. At least three journeys were organized independently with family

members from each RHS. Several variables were assessed through participant observation: family organization, the process of mushroom gathering, household activities, and marketing. Wild mushrooms were identified using conventional textbooks (Guzmán, 1977; Arora, 1986; Lincoff, 1989; Pedraza et al., 1994). A training course for mushroom processing through canning technology was performed using two acidified (pickled) Mexican recipes: "Hongos comestibles silvestres en escabeche", and "Hongos comestibles silvestres en adobo" (Martínez-Carrera et al., 1998). Social acceptance of the canned product was assessed by sensory evaluation in rural and urban panels, and data were statistically analyzed by the Tukey's test (Watts et al., 1992). The financial feasibility of the entire activity (mushroom gathering, marketing, and processing) was studied according to Gittinger (1978).

RESULTS AND DISCUSSION

1) Family members

Characteristics and life circumstances from the RHSs studied in the community of San Andrés Hueyacatitla, Puebla, are shown in Table 2. Although the population of the community is high (3,153), only eight RHSs were found to develop consistently mushroom gathering during the rainy season. The four RHSs studied, have performed the gathering, consumption, and marketing of wild edible mushrooms independently from the wide ranges of age, level of studies, and the number of children and relatives. In general, these RHSs had a poor type of houses and services.

Table 2. Comparison of family members and their life circumstances within three rural household systems (RHSs) studied in the community of San Andrés Hueyacatitla, Puebla, during the year 2000.

Characteristic		Rural household system (RHS)		
		RHS-1	RHS-2	RHS-3
Age (years)	Husband	52	40	38
	Wife	40	32	30
Level of studies (years)	Husband	1	6	6
	Wife	2	3	6
Number of children and relatives	Total	7	8	5
	Age	0.5-20	5-16	3-11
	Level of studies	0-6	0-8	0-6
	Labouring	1	2	0
Type of house	Number of rooms	2	2	3
	Building materials	Cardboard, mud-bricks	Bricks, mud-bricks	Bricks, mud-bricks
	Services	Water, electricity	Water, electricity	Water, electricity

2) Conventional agricultural and extra-agricultural activities

Most RHSs in the community own agricultural land and have access to communal forest resources. In the RHSs studied, the balance between activities depended on the ownership of land (Table 3). The RHS-1 lacked agricultural land and only developed diverse extra-agricultural activities, devoting 344 days which generated yearly incomes for USD $ 5,970.89. The RHS-2 and RHS-3 owned different land area (0.75-2.25 ha), which allowed them to carry out agricultural (144-240 days) and extra-agricultural activities (90-200 days) to differing extents. These activities generated total yearly incomes for USD $ 2,987.15 (RHS-2) and $ 5,959.41 (RHS-3). Although incomes appear to be similar in RHS-1 and RHS-3, family members from the RHS-1 still had to buy their daily foods, whereas those from RHS-2 and RHS-3 produced their basic foods for own consumption in the agricultural land.

Table 3. Main agricultural and extra-agricultural activities developed yearly by the rural household systems (RHSs) in the region studied.

Activity		Rural household system (RHS)		
		RHS-1	RHS-2	RHS-3
Property		No land	Land (0.75 ha)	Land (2.25 ha)
Governmental subsidy		-	-	Granted
Family members involved		4	5	1
A	Crop plants (own consumption)	-	Maize	Maize, squash, broad beans, peas
	Fruit crops	-	Plums	Pears, peaches
	Horticultural plants	-	Gladioli	-
	Livestock	-	-	Calves, fowls
	TA (days/year)	-	144	240
	Costs of production (USD)	-	$ 861.14	$ 1,541.97
	Incomes (profits, USD)	-	$ - 289.12	$ 304.66
E-A	Utilization of the forest	Firewood, bushes	-	Timber products
	Gathering of mushrooms	4 months	3 months	2 months
	The making of produces	Brooms, coal	-	Bricks
	Trading of diverse produces	Extra-agricultural	Agricultural and extra-agricultural	Agricultural and extra-agricultural
	Labouring	Horticultural or agricultural labourer , communal work	Worker, agricultural labourer	-
	TE-A (days/year)	344	200	90
	Costs of production (USD)	$ 339.90	$ 601.87	$ 1,567.67
	Incomes (profits, USD)	$ 5,970.89	$ 3,276.27	$ 5,654.75

A= Agricultural. E-A= Extra-agricultural. TA= Overall time devoted to all agricultural activities. TE-A= Overall time devoted to all extra-agricultural activities.

3) Traditional management and marketing of wild edible mushrooms

The consumption of wild mushrooms during the rainy season by gathering, buying, or a combination of both, is an extra-agricultural activity carried out by a high proportion (86.5%) of RHSs in the community studied (Table 4). Forty one edible species were recorded as well known by RHSs (Table 5). Most RHSs (78%) consuming wild mushrooms gather them in the communal forest, whereas a small proportion (22%) is used to buy them to one or several local gatherers.

Table 4. Consumption and marketing of wild edible mushrooms by rural household systems (RHSs) from San Andrés Hueyacatitla, Puebla.

Community (total RHSs: 541)		RHSs studied (13.6%; n= 74)
No mushroom consumption		10 (13.5%)
Mushroom consumption	Total	64 (86.5%)
	By gathering	32
	By buying	14
	By gathering and buying	18
	Number of species known	41
Mushroom gatherers	Total	50
	For own consumption	43

	For own consumption and marketing	7
Mushroom buyers	Total	32
	Purchasing to one gatherer	2
	Purchasing to several gatherers	30

Table 5. Popular names given by local gatherers to the mushroom species recorded in the community of San Andrés Hueyacatitla, Puebla, as well as their seasonal availability according to traditional knowledge.

Popular name	Scientific name	Seasonal availability (Month)
“Cepamil”	*Lentinula lepideus* Fr.	April
“Tlalcocomo”	(not identified)	April-May
“San juanero”	*Agaricus campestris* L. : Fr.	June
“Barbecho”, “tecach”	*Amanita tuza* Guzmán	June-August
“Tecomate”, “amarillo”	*Amanita caesarea* (Scop. ex Fr.) Grev.	June-August
“Pancita”	*Suillus brevipes* (Peck) O. Kuntze	June-August
“Pananacatl”, “burras”	*Boletus edulis* Bull. ex Fr.	June-August
“Mantecada”	*Amanita rubescens* (Pers. ex Fr.) S. F. Gray	June-August
“Venado”, “cuatlalito”	*Amanita fulva* (Schaeff.) Pers.	June-August
“Oreja de ailite”	*Pleurotus smithii* Guzmán	July-August
“Orejas de oyamel”	*Pleurotus* spp.	July-August
“Orejas de ocote”	*Pleurotus* spp.	July-August
“Orejas de encino”	*Pleurotus* spp.	July-August
“Oreja de puerco”	*Pleurotus* spp.	July-August
“Amargo”	(not identified)	July-August
“Azul”	*Lactarius indigo* Schw. ex Fr.	July-September
“Borrego”, “blanco”	*Russula brevipes* Peck	July-September
“Trompeta sencilla y doble”	*Gomphus floccosus* (Schw.) Singer	July-September
“Xolete de oyamel”	*Lyophyllum decastes* (Fr. ex Fr.) Singer	July-September
“Xolete morado”	(not identified)	July-September
“Xolete de ailite”	(not identified)	July-September
“Hongo de oyamel”	(not identified)	July-September
“Xocoyol”	*Laccaria laccata* (Scop. ex Fr.) Berk. & Br.	July-September
“Ocoxalero”	*Psathyrella spadicea* (Schaeff. ex Fr.) Singer	July-September
“Campanita”	Clitocybe gibba (Fr.)Kummer	July-September
“Tejamanil”, “güeras”	*Gymnopus dryophilus* (Bull. ex Fr.) Murrill	July-September
“Santiaguitos”	*Russula lepida* Fr.	July-September
“Tezombote”	*Lycoperdon perlatum* Pers.	July-September
“Cuije de oyamel”	*Lactarius salmonicolor* Heim & Leclair	August-September
“Cuije de pino”	*Lactarius deliciosus* Fr.	August-September
“Gachupín negro”	*Helvella lacunosa* Fr.	August-September
“Gachupín blanco”	*Helvella crispa* Scop. ex Fr.	August-September
“Gachupín rojo”	*Gyromitra infula* (Schaeff. ex Fr.) Quél.	August-September
“Escobeta amarilla”	*Ramaria flava* (Fr.)Quél.	August-September
“Escobeta morada”	*Ramaria botrytis* (Fr.) Rick.	August-September
“Olote”	*Morchella esculenta* Pers. ex St. Amans	August-September
“Enchilado”	*Hypomyces lactifluorum* (Schw. ex Fr.) Tul.	August-September

“Barroso”	*Bondarzewia berkeleyi* (Fr.)Bondartsev et Singer	August-September
“Borracho”	(not identified)	August-September
“Tecosita”	*Cantharellus cibarius* Fr.	September-October
“Nixtamalito”	*Hygrophorus chrysodon* (Fr.) Fr.	September-October

The traditional management and marketing of wild mushrooms were studied in four RHSs having different socio-economic conditions. Four main activities were identified: 1) Family organization, 2) The process of mushroom gathering, 3) Household activities, and 4) Marketing (Table 6). RHSs devoted 2-80 days yearly to the whole activity, in which 1-3 family members participated. There was a division of work amongst the members of a family. Most activities are carried out by men, who normally get their sons involved in this activity since childhood (eight years old or older). The process of mushroom gathering started early in the morning (ca. 4:00 AM). There was usually a selection of 2-10 sites out of 29 recorded for RHSs in the community, which may be visited 1-5 days per week. It was recorded that the amount of mushrooms gathered varies at each site (0.5-6.0 kg), and that there are places where no mushrooms are picked (Table 7). This showed that the ecological impact of traditional mushroom gathering is highly heterogeneous. An average of 27 mushroom species are usually picked using a knife, and placed in a bucket during journeys. However, only 4-10 of them are highly appreciated in the region. Mushroom gathering also depended on seasonal availability, fruit-body quality, consumers demand, and the personal preference of gatherers. Adults can pick about 6 kg of wild mushrooms after having walked 15-30 km in a day (7-9 h), while children pick around 4 kg. This may also be associated to the gathering of firewood and timber products, as well as to the making of coal, when there is a very low natural production of mushrooms. Household activities involved the choosing, cleaning, cooking, and marketing of mushrooms gathered, which are normally performed by women (wives). About 35% of clean mushrooms are kept for own consumption, while the rest is marketed locally or in other nearby communities reached by public transportation (7-40 min). Mushrooms are sold directly to other RHSs, or to consumers in popular markets. Mushroom prices varied from USD $ 0.50-3.10, and can be sold per kilogram or per pile.

Table 6. Main activities developed by the RHSs studied in the community of San Andrés Hueyacatitla, Puebla, which are related to the traditional management and marketing of wild edible mushrooms (data from four journeys).

Activity			RHS-1	RHS-2	RHS-3	RHS-4	Average
Period (months/year)			4	3	2	2	2.7
TM (days/year)			80	36	2	8	31.5
Family organization	Total members (no.)		9	10	7	10	9
	Gathering (no.)		3	1	1	1	1.5
	Marketing (no.)		1	1	-	1	1
	Learning age	Husband	8	12	10	-	10
		Wife	28	12	-	25	21.6
		Children	8	8	-	-	8
The process of mushroom gathering	Number of places selected		10	7	6	2	6
	Visiting frequency (days/week)		5	3	1	1	2.5
	Mushroom species (no.)	Known	38	38	31	23	32.5
		Normally picked	31	30	24	23	27
		Favourite	10	6	6	4	6.5
	Amount (kg/day)	Adult	9.1	-	4.0	6.0	6.3
		Child	2.2	6.7	-	-	4.4
	Overall journey	km/day	25-30	20-25	25-30	15-20	21-26
		h/day	9	7	9	7	8

	Associated activities		Firewood, coal	-	Timber products	Firewood	3
Household activities	Mushrooms gathered (kg/day)		20.5	6.7	4	6	9.3
	Mushrooms after choosing and cleaning (kg/day)		20	6.4	3.7	5.5	8.9
	Mushrooms for own consumption (kg/day)		6	1.7	3.7	1.5	3.2
	Mushrooms for marketing (kg/day)		14	4.7	-	4	7.6
Marketing	Locally or in other communities directly to RHSs (days/week)		1-5	1-3	-	-	1-4
	Popular markets (h/day)		9	9	-	6	8
	Public transportation (min/day)		7-40	7-40	-	40	7-40
	Mushroom Price (USD)	Per kg	$ 1.5-3.1	$ 1.5-3.1	-	-	$ 2.07
		Per pile (ca. 250 g)	-	-	-	$ 0.5	$ 0.50

TM= Overall time devoted to mushroom gathering.

Table 7. Typical journey on foot for gathering wild edible mushrooms in the community of San Andrés Hueyacatitla, Puebla. Participants: 3 members (2 adults, 1 child).

Place	Forest	Altitude (m)	Time spent (h)	Amount of mushrooms gathered (kg)
1) RHS-1	Community	2,500	Starting-point	-
2) “Palo obispo”	*Pinus*, *Quercus*	2,900	1	0
3) “Cañada verde”	*Abies*, *Quercus*	3,000	1	2.0
4) “Tepitongo”	*Abies*	3,200	0.5	6.0
5) “Las golondrinas”	*Pinus*, *Abies*	3,200	3.5	1.0
6) “El cargadero”	*Abies*	3,100	0.25	0
7) “Tepitongo”	*Abies*	3,200	0.25	1.5
8) “Siete vueltas”	*Pinus*, *Abies*, *Quercus*	3,000	0.8	0.5
9) RHS-1	Community	2,500	End-point (1.8)	-
Overall data		2,500-3,200	9.1	11

Most RHSs carry out diverse agricultural and extra-agricultural activities in order to generate basic incomes for daily life. In fact, their incomes can be grouped into three categories: 1) Monetary incomes consisting of money provided by the main RHS activities; 2) Complementary incomes which also consist of money but provided by supplementary RHS activities; and 3) Potential incomes which are not monetary but satisfy RHS needs, such as food crops cultivated for own consumption (Stavenhagen, 1978). In this context, the perception of the significance of mushroom gathering by RHSs studied varied from low to very high. This perception depended on the actual contribution of wild mushrooms to the overall incomes within the RHS (Table 8). Those RHSs (2-3) owning agricultural land considered mushroom gathering a little important activity, as it only provided 0.2-7.3% of total incomes (i.e., potential and complementary incomes). By contrast, the RHS-1, which lacked land, devoted more time to mushroom gathering, which provided 5.5% and 13.7% of total incomes (i.e., high potential and monetary incomes), respectively. An estimated financial analysis indicated a high overall cost-benefit ratio (1.9-3.2) for RHSs in a year, considering costs of mushroom gathering, choosing, cleaning, and marketing, as well as potential incomes and profits (Table 9).

Table 8. Contribution of mushroom gathering to the total incomes obtained from agricultural and extra-agricultural activities within the RHSs studied in the community of San Andrés Hueyacatitla, Puebla.

Incomes		RHS-1	RHS-2	RHS-3	Average
Agricultural activities (%)		-	- 8.8[a]	5.1	6.9
Extra-agricultural activities (%, others)		80.8	92.7	94.7	89.4
Mushroom gathering (%)		19.2	7.3	0.2	8.9
Type of income from mushroom gathering (%)	Monetary	13.7	-	-	13.7
	Complementary	-	5.8	-	5.8
	Potential	5.5	1.5	0.2	2.4
Perception of significance from the whole activity		Very high	High	Low	-

[a] This negative balance from agricultural activities is covered from extra-agricultural incomes.

Table 9. Estimated financial analysis from the traditional management and marketing of wild edible mushrooms developed yearly by the RHSs studied in the community of San Andrés Hueyacatitla, Puebla.

Factor		RHS-1	RHS-2	RHS-3	RHS-4	Average
Average amount of mushrooms gathered (kg, after choosing and cleaning)		807.6	230.4	7.4	44.0	272.3
Costs (USD $)	Mushroom gathering and Cleaning	175.0	78.3	4.2	16.5	68.5
	Mushroom marketing	182.3	82.0	-	18.2	94.2
Mushrooms for own consumption	kg/year	242.0	61.9	7.4	12.0	80.8
	Potential incomes (USD $)	326.6	49.9	11.2	8.2	99.0
	Potential cost-benefit ratio	2.8	1.6	3.6	1.5	2.4
Mushrooms for Marketing	kg/year	565.4	168.4	-	32.0	255.3
	Profits (USD $)	814.4	188.7	-	31.5	344.8
Overall cost-benefit ratio		3.2	2.1	-	1.9	2.4
Profits and potential incomes (USD $)		1,141.0	238.7	11.2	39.7	357.7

4) Canning of wild edible mushrooms

Several rural workshops were carried out with the participation of six RHSs involved in mushroom gathering (10 participants). After the process of gathering accomplished in the same day, mushroom gatherers arrived with about 7 kg of wild mushrooms. About ten different mushroom species were selected, prepared, cooked, and canned in glass containers. It was shown that a safe, stable, tasty, nutritive, and economic canned product can be produced using wild mushrooms in rural conditions, according to standard regulations. A financial analysis indicated profitability of the whole process, as reasonable cost-benefit ratios (1.56-1.57) and value added (178-206%) can be obtained (Table 10). Technology transfer programmes for canning wild edible mushrooms can therefore be developed in rural communities. There was acceptance of the recipes studied in comparison with commercial samples indicating good marketing potential (data not presented).

Table 10. Financial analysis from the process of canning wild edible mushrooms carried out in the rural community of San Andrés Hueyacatitla, Puebla.

Factor	Recipe 1 (HCSE)	Recipe 2 (HCSA)
Number of jars	30	30

Cost of production per jar (USD)	$ 1.73	$ 1.73
Estimated market value (USD)	$ 2.70	$ 2.70
Gross incomes per year (USD)	$ 2,596.48	$ 2,596.48
Profits per year (USD)	$ 934.25	$ 938.01
Cost-benefit ratio	1.56	1.57
Value added (%)	206	178

HCSE= Hongos comestibles silvestres en escabeche. HCSA= Hongos comestibles silvestres en adobo.

5) Prospects

As population density is rapidly increasing in forest areas, and considering the complex social, economic, and ecological factors involved, it is fundamental to develop sustainable strategies for the traditional management, processing, and marketing of wild edible mushrooms in rural communities. These strategies should be based on further interdisciplinary approaches. Specific actions are also important, such as: 1) The establishment of management and conservation policies to regulate commercial picking and to avoid over-exploitation; 2) Training to improve the whole traditional process of mushroom gathering; 3) The transfer of processing technologies to avoid mushroom losses and to increase RHSs incomes (monetary, complementary, potential); and 4) To develop marketing strategies for promoting the social consumption of processed mushrooms at a national or international level.

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