Typifying guinea pig (*Cavia porcellus*) farmers in urban and peri-urban areas in central and southern Côte d'Ivoire

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Abstract: *Guinea pig production is practised by all strata of society in Côte d'Ivoire, without regard to gender, age, religion, instruction level or community. It is essentially a source of income, but socioeconomic and cultural background significantly influence the approach to guinea pig production. Adult owners use animals as a source of income. Children eat a significant part of the production themselves. Adolescents progress from consumption to marketing. This preliminary study opens the way for future work that could measure changes over time in the socioeconomic profile of guinea pig farmers and the attitude of the population towards guinea pig breeding.*

Keywords: *rural sociology; guinea pig; mini-livestock; Côte d'Ivoire*

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Poverty rose dramatically in Côte d'Ivoire after the political crisis of September 2002, from 33.6% in 1998 to 49% in 2009. Consequently, energy-protein malnutrition increased, especially in young children, reducing their physical activity, growth and development, their ability to learn and their individual resistance to infections (Latham, 2001). Although neglected in many developing countries until 1990 by scientists, political leaders and institutions, guinea pigs have historically contributed to the alleviation, albeit indirectly, of protein deficiency in the diets of poor people in South America, the Philippines and Sub-Saharan Africa (Hardouin and Thys, 1997; Bindelle *et al*, 2007; Lammers *et al*, 2009). The meat of guinea pigs resembles that of rabbit in terms of colour, texture, consistency and taste. Its protein content is about 21% higher and fat nearly 8% lower than those of conventional meats (Huss and Roca, 1982). Guinea pig meat is an important source of animal protein in Peru for poor families whose basic diet is potatoes and rice (Morrow, 1997). With 20 breeding females and two males, a family of six can be provided with an adequate year-round supply of meat (NRC, 1991). The guinea pig's small

size is one of its biggest advantages because it can be kept on a small plot (Thys, 2001). It can also contribute a substantial income for many families or serve as savings for children. In addition, the faeces of guinea pigs can be used as fertilizer as they do not 'burn' the roots of the plants (N'Goupayou *et al*, 1994). They can be collected daily and buried in the ground until the planting season.

For all these reasons, guinea pigs are recognized as one of the most suitable livestock species for post-conflict areas such Côte d'Ivoire (ONU, 2005). Nevertheless, to our knowledge, very little information is available on guinea pig production systems in Côte d'Ivoire, although such production is known to be practised (Avit *et al*, 1999). It would be useful, therefore, to know the main groups of people interested and involved in breeding and their purpose in wanting to start guinea pig farming. This paper reports on an exploratory study conducted in Côte d'Ivoire. There were three objectives: (i) to understand why guinea pig breeding is being adopted, (ii) to assess the level of technical knowledge of guinea pig farmers, and (iii) to characterize guinea pig farmers on their socioeconomic profile and level of technical knowledge.

Material and methods

Location of the study

Côte d'Ivoire is a West African country. Its surface area is about 322,500 km^2, supporting a population estimated at 20,227,850 in 2007. Given the partition of the country, the survey was conducted in the government-controlled southern part, and more specifically in the following randomly selected locations: Adiaké, Adzopé, Akoupé, San Pedro, Dimbokro, Yamoussoukro and Daloa.

Survey methodology

The study consisted of a cross-sectional survey combined with a retrospective survey. It was conducted in 2006, when all necessary questions were asked during face-to-face interviews. The target population consisted of all people owning at least a male and a female guinea pig and having some type of housing for the animals.

Sampling

In Côte d'Ivoire, there is no exhaustive list of breeders of guinea pigs for the study area. The sample could not be random and was constructed using a non-probabilistic method known as the 'snowball' method. The first selected subjects identified other breeders of guinea pigs, who in turn became further informants (Salganik and Heckathorn, 2004). Given the non-probability sampling method used, all guinea pig farmers encountered were interviewed (Berteau, 2006). A pilot study was conducted among farmers located in two cities (Yamoussoukro and Bouaflé) before the main cross-sectional survey to validate the questionnaire

Data processing and statistical analysis

The questionnaire consisted of responses to qualitative and quantitative variables including closed, open and semi-closed questions. Space was available on the forms to record alternatives to the options given. The socioeconomic profile of farmers was recognized by a descriptive analysis. The 'type of neighbourhood' was classified according to the equipment level of the plots (water and electricity supply, and telephone) and the state of the roads in the quarter (Table 1). The analysis of the aims and ambitions of the guinea pig breeders used the classification and regression tree (CART) method on the socioeconomic data. The CART is obtained by a binary recursive partitioning. The process is binary because parent nodes are always divided into two descendant nodes and recursive because the process is repeated by considering each node as a parent node (Speybroeck *et al*, 2004). The classification tree obtained by the CART method allows the visualization of the variables known as active, which directly take part in its construction, and hence with the procedure of discrimination and of the corresponding forecast (Nakache and Confais, 2003). The assessment of the level of knowledge of the guinea pig breeders began with the selection of the most discriminating variables (Table 2). A classification (very good, good and average) was attributed to each response. The types of technical knowledge were identified through a multiple correspondence analysis (MCA) of the raw data, followed by an ascending hierarchical classification (AHC) with standard settings (Euclidean distance, Ward's method, automatic truncation). The inputs of the AHC were the coordinates of the weighted percentages of inertia axes, reduced off-centre (Salem and Lebart, 1994). The type of technical knowledge was then linked with

Table 1. Main socioeconomic characteristics and aims of farmers.

Variables	Descriptions	Number	(%)
Sex	1. Males	258	96.3
	2. Females	10	3.7
Type of neighbourhood/ community	1. Residential	33	12.3
	2. Popular	107	39.9
	3. Precarious or slum	66	24.6
	4. Village	62	23.1
Age class	1. Child (7 to 13 years old)	102	38.1
	2. Adolescent (14 to 17 years old)	92	34.3
	3. Adult (18 or older)	74	27.6
Religion	1. Christian	140	52.2
	2. Muslim	95	35.4
	3. No religion	33	12.3
Education	1. Primary	86	32.1
	2. College	98	36.6
	3. At least high school	33	12.3
	4. No schooling	51	19.0
Number of children	1. None	235	87.7
	2. One or two	11	4.1
	3. More than two	22	8.2
Marital status	1. Family member	239	89.2
	2. Head of family	29	10.8
Number of guinea pigs	1. 0–4 guinea pigs	93	34.7
	2. 5–10 guinea pigs	94	35.1
	3. > 10 guinea pigs	81	30.2
Production purpose	1. Marketing	164	61.2
	2. Marketing and consumption	48	17.9
	3. Consumption	32	11.9
	4. No particular aim	24	9.0

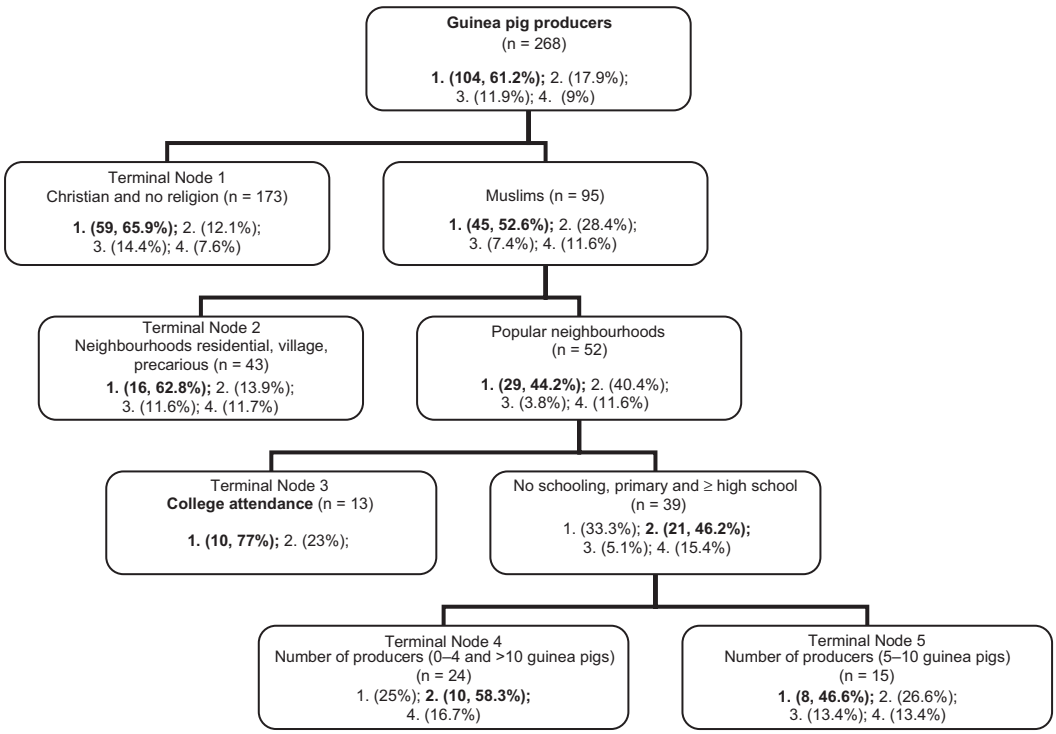

Figure 1. Classification tree with 'purpose of production' as target variable.
Note: 1 = Marketing; 2 = Marketing and consumption; 3 = Consumption; 4 = No particular aim.

socioeconomic data to produce a comprehensive typing of breeders of guinea pigs using the MCA and the AHC. Statistical tests were performed using R 2.8.0 and XLSTAT (2009.3.01) software.

Results

Socioeconomic attributes of guinea pig breeders

The final sample contained 268 guinea pig farmers. The main socioeconomic characteristics of the farmers are listed in Table 1. Consisting mainly of men (96.3%), most farmers (72.4%) were young (under 18) and still within the family unit. Of all the farmers over 18 years, 40% were heads of household. Eating guinea pig does not seem to suffer from taboos in the study area since the sample is well distributed between the major religious groups in the country, with 52.2% Christians, 35.4% Muslims and 12.3% atheists. The literacy level is very high (81%), with the majority of farmers having a primary (32.1%) or college (36.6%) level of education. The distribution of farmers is relatively less important in residential neighbourhoods (12.3%) than in others (23.1 to 40%). During the survey, the population size of guinea pigs about which reports were offered was 2,416, out of which 889 were males. The number of guinea pigs on farms varies from 2 to 60, with an average of 9.0 ± 7.4 guinea pigs and a ratio of one male to two females. About 70% of farms have 10 or fewer guinea pigs. The objectives of farmers are: to sell their production (61.2%), selling and combining with personal consumption (17.9%) and solely for personal consumption (11.9%). Finally, there is a relatively large group of 'undecided' who rear animals without a specific purpose (9%).

Major determinants of guinea pig production by classification analysis

The classification tree with 'purpose of production' as the target variable is shown in Figure 1. The main determining variables and their indices can be ordered according to their level of importance as follows: type of neighbourhood (20.1), education level (17.1), religion (14.6) and actual guinea pigs (12.7). As shown in Figure 1, the farmers were initially divided into two nodes based on their religion. Terminal node 1 (TN1) includes 173 farmers without religion, or Christians. This group is in the majority (65.9%) and considers guinea pigs as a source of financial revenue through marketing. TN2 contains farmers who live in areas with low population densities, such as residential areas and precarious areas, and villages near the cities. The majority of them aim to sell their production (62.8%). The third intermediate node includes farmers who were not enrolled at school and those who obtained primary or high school education. These people consume a part of the production and sell the rest (46.2%). TN4 includes farmers who have small numbers of guinea pigs (< 5) or above average (≥ 10 guinea pigs). These are farmers who mainly market and consume their production (58.3%). TN5 includes farmers who have five to ten guinea pigs. Marketing their production is their most important aim (46.6%). The prediction rate of the classification tree is 64.2%.

Table 2. Description of modalities of variables used to assess the knowledge of guinea pig farmers.

Variables	Descriptions	Modality[a]	Number	(%)
Livestock	Breeders ratio	RAT001: 1 male/3 females or 1 male/4 females	25	9.3
		RAT002: 1 male/7 females or 1 male/1 female	209	78
		RAT003: other	34	12.7
	Number of guinea pigs	PET001: 3 or 4	11	4.1
		PET002: 2	196	73.1
		PET003: 1 or 2	61	22.8
Livestock management	Pregnancy diagnosis	DIAG001: females flee the approach of male	48	17.9
		DIAG002: the breasts grow and become red	71	26.5
		DIAG003: palpation of the lower abdomen, or don't know	149	55.6
	Separation of males and females	IRF001: during gestation or days before parturition	26	9.7
		IRF002: just after parturition	31	11.6
		IRF003: no	211	78.7
Diet	Diet according to the physiological status of animals	ALI001: yes	62	23.1
		ALI002: no	206	76.9
Housing and maintenance	Type of housing	INF001: grill and plates or rabbit house	48	17.9
		INF002: house, cement, container, a half-barrel	176	65.7
		INF003: simple shelter, basket, box, cardboard, earth house, free in the yard, unfinished house	44	16.4
	Housing maintenance	ENT001: daily cleaning or a box under the habitat	141	52.6
		ENT002: cleaning 1 to 3 times a week	98	36.6
		ENT003: cleaning less than once a week	29	10.8

Note: [a] Suffixes: 001 = very good; 002 = good; 003 = average.

Evaluating technical and husbandry skills of farmers

The frequencies of the seven variables used to assess the technical abilities of farmers are shown in Table 2. The multiple correspondence analysis performed on these variables identified a scatter of individuals in six factorial axes. This representation helps to explain 72.0% of the total variability. The hierarchical clustering on the basis of the coordinates of individuals results in three groups of farmers. By decreasing order of ability, the first group is the best and includes the following characteristics: appropriate nutrition provided to achieve breeding condition of the females, best litter size, daily maintenance of premises, and the separation of breeding stock just after parturition. The second group includes those maintaining male/female breeding groups of 1/3 or 1/4, better pregnancy diagnosis, reproductive isolation before parturition, but irregular maintenance of the animals' accommodation. The final group includes the following characteristics: a system better suited to livestock farming, but a poor diet for intended breeding females, a litter size more related to young animals and virtual ignorance of pregnancy diagnosis (see Figure 2).

Types of guinea pig breeding

The multiple correspondence analysis performed on these variables identified a scatter of individuals in nine factorial axes. This representation helps to explain 72.7% of the total variability. The hierarchical clustering on the basis of details of individuals shows that five classes of farmers can be distinguished by affinity (classes C1, C2, C3, C4 and C5). The first division into two sets appears to be related to the age of the breeders. The first set (C1 and C4) includes adult producers. This set is divided into two classes (C1) and (C4). The class (C1) is composed of men belonging to the Muslim community (47.4%). They are experienced in breeding guinea pigs, and are heads of families, some of which consume a portion of their production. Class (C4) is characterized by the presence of women, not educated for the most part, and with only a limited knowledge of farming techniques. In this class, farmers mainly sell their livestock products. The second set is divided into two categories, one containing the class (C2), the other classes (C3) and (C5). Class (C2) includes mainly teenagers who have 'college' or 'school' levels of education. They live in residential areas or in outlying villages and they market and consume some of their production. The second group, composed mainly of children, is divided into two classes: (C3) and (C5). Class (C3) is characterized by membership of the Christian community, the number of guinea pigs kept being up to 10, a regular consumption of guinea pigs and a fairly good knowledge of techniques for breeding guinea pigs. Class (C5) includes Muslim and atheist farmers. They have a very high level of technical skills and have fewer than five guinea pigs because their products are mainly sold (see Figure 3).

Discussion

Methodology

The character of confinement of guinea pig production and its low density suggested 'snowball' as the method of sampling. Although this non-probability sampling units method presents biases, it is useful to interview specific populations (Salganik and Heckathorn, 2004). On the other hand, this method could have the disadvantage of confining sample units in primary schools interfering with

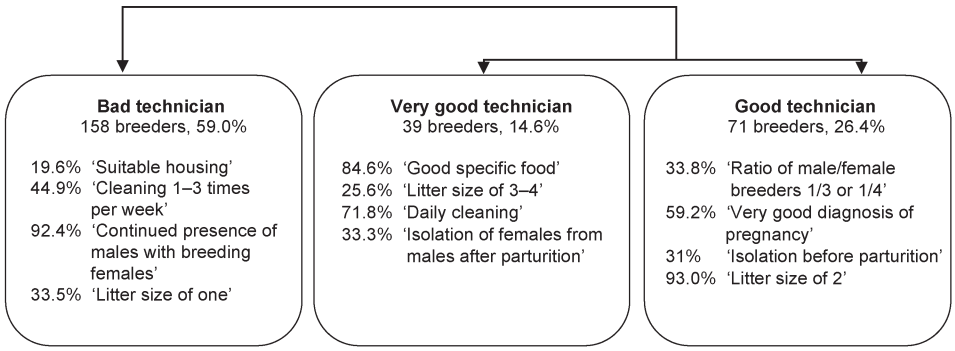

Figure 2. Evaluation of technical abilities of guinea pig farmers.

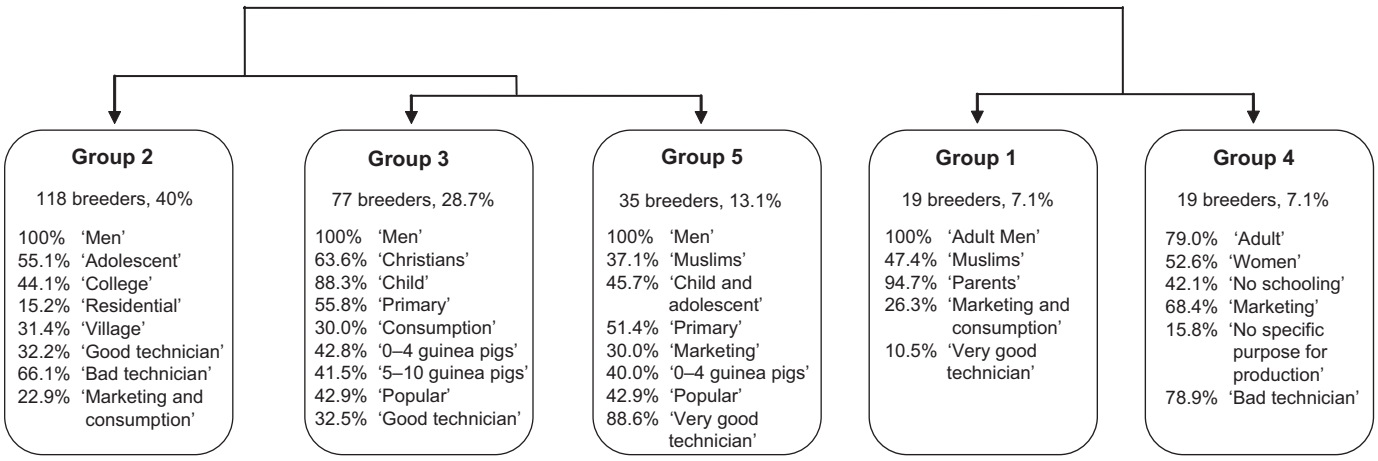

Figure 3. Classification of guinea pig farmers (frequency mode in each group).

the representativeness of farmers (Berteau, 2006). The resolution of the difficulty of possible interference from confining sample units with other representational units has been achieved by querying the maximum number of sampling units that might be encountered.

Socioeconomic character of guinea pig production

Like 55% of farmers in Cameroon (N'Goupayou *et al*, 1994), the majority of breeders (72.4%) of guinea pigs in our sample were under 18 years of age. Moreover, in this latter group, guinea pig breeding is essentially an activity of males (84%) (N'Goupayou *et al*, 1994). The involvement of housewives remains limited (less than 2%), in contrast to Peru, where breeding guinea pigs is an activity mainly performed by women (63%) and to a lesser extent by children (10%) (Chauca de Zaldivar, 1997). In Peru, moreover, this animal is above all a guarantee of food security, which is not the case in Côte d'Ivoire. In our study area, guinea pigs are mainly produced for commercial purposes. However, in other countries such as Cameroon, the guinea pig has a more important social function. It is a guarantee of food security for many small farmers with low incomes. Guinea pigs are also used for animal sacrifices, witchcraft, or offered to visitors. For these farmers, the commercial value is negligible (CCNC, 2003).

Determinants of the purpose of breeding

The fact that the regression model retained the variables 'type of district', 'educational level', 'religion' and 'number of guinea pigs' as principal variables is related to the ranks that they occupy in the hierarchy of all socioeconomic variables. Indeed, some variables with no apparent role when the tree is built could be the active variables for the competitor nodes. The knowledge of these competitor variables allows the possibility of establishing a hierarchy of all socioeconomic variables (Nakache and Confais, 2003). The relevance of the standard variable 'type of district' in the context of this study could be related to the purchasing power of the population. Indeed, the wealthiest people or those having other sources of animal protein for their food are more likely to sell their guinea pigs than those who are less affluent. So, the standard of living appears to be the major determinant for selling or not.

Types of farmers

The analysis of type confirms that cultural context plays an important role in the development of guinea pig breeding. In Côte d'Ivoire, the Muslim community comprises 95% Voltaic or Gur. They are people who live mainly on trade. This group has been raising guinea pigs for decades, which explains their skill. Given the types of guinea pig producers reported on in this study, it is clear that unlike in Cameroon and Peru (N'Goupayou *et al*, 1994), guinea pig breeding does not play a significant role in food security. Also, contrary to what happens in those countries, women in households that produce guinea pigs in Côte d'Ivoire do not seem to introduce this meat into the usual family diet to any extent. They produce the guinea pigs without a particular aim or for commercial purposes. This could be due to their ignorance of the nutritional qualities and value of guinea pig meat and the role of protein in the development of children, or from general lack of knowledge due to the high rate of illiteracy in this fringe of the population.

The non-involvement of women in household guinea pig production is unfortunate as their role in achieving food security and reducing poverty is important in disadvantaged areas (Aromolaran, 2004). Indeed, when women control the production and marketing of animals or plant products, the nutritional status, schooling and health of the household are significantly improved.

There is, therefore, an advantage from women being in charge and there are even benefits from having children involved in small-scale guinea pig production (Morales, 1994). However, one might ask whether, in the African context, children should be given responsibility for livestock without any parental control. One might also wonder if a child should be involved in raising income for household needs, including energy supply. A further analysis of the parent–child relationship related to guinea pig production in Côte d'Ivoire may be worthwhile.

Conclusion

This study has shown that guinea pig producers are found in all strata of society, without respect to gender, age, religion, education level or community. They are divided into three classes differentiated by socioeconomic and cultural background. Adult owners use animals for financial reward; children eat a significant part of the production themselves. Adolescents progress from being consumers to having an interest in sales because their financial needs increase with age. This preliminary study opens the way for future work that could measure changes over time in the socioeconomic profile of guinea pig farmers and the attitude of the Ivorian population towards guinea pig breeding.

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