

Beekeeping Regions, Technical Assistance, and Development Policy in Peru

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INTRODUCTION

Beekeeping is a positive tool in rural areas of developing countries. Requiring little capital or land, beekeeping is accessible to those with limited financial resources, and it can, as well, improve agricultural yields through pollination; it is also dependent on renewable natural resources (Dreacher and Crane 1982). Few studies, however, have assessed the critical variables that affect the success of beekeeping development or evaluated them in a particular regional or national context (Commonwealth Secretariat 1979; Drescher and Crane 1982; Manley 1982). This paper addresses the need for specific studies that focus on key variables affecting the success or failure of beekeeping development and assistance programs. The study identifies the key variables that influence the success of beekeeping in developing countries and examines their regional variation in Peru.

Little is known about beekeeping and the characteristics of its practice in Peru. The national agricultural census of 1961 reported the number of beehives and honey production, but the data--especially with respect to honey production--are dubious (Peru 1963). Subsequent agricultural censuses have not enumerated statistics on beekeeping (Peru 1976a), and the few studies on Peruvian beekeeping that exist within Peru are difficult to obtain (Bullon 1978; Corporación de Racionalización y Consultoría 1979; Dávila et al. 1980; Hurtado 1980). Peru is commonly divided into three principal ecological regions: the *costa* (the coast), the *sierra* (the Andean highlands), and the *selva* or *montaña* (the tropical rainforests and savannas of the Amazon basin's watershed). This eastern, Amazonian region is generally subdivided into the *selva alta* (high jungle) and the *selva baja* (low jungle) (Aramburu 1982; Smith 1974).¹

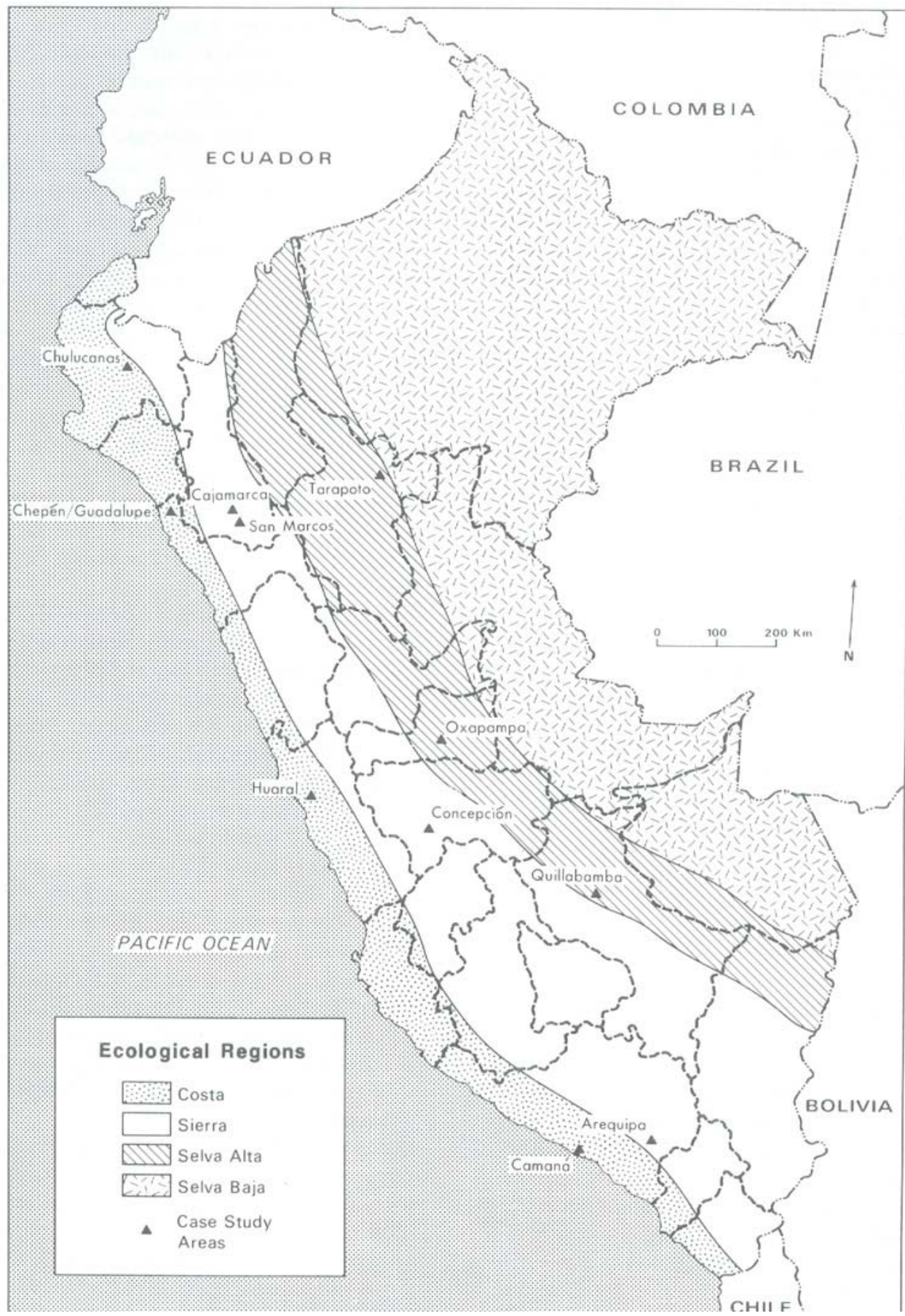
Beekeeping is practiced throughout most of the country but principally on the *costa*, in the *sierra*, and in the *selva alta*. The coastal region runs along the Pacific littoral with elevations between sea level and 500 m. Except in the extreme north, all beekeeping in this arid subtropical desert region is dependent on row crops and orchards grown in the irrigated river valleys of the coast and on the remaining natural riparian vegetation. Pre-eminent as a honey source throughout almost all of the 2,000 km coastline is the *algorrobo* (*Prosopis* sp.). The area between 500 m and 2,000 m is transitional between the *costa* and the *sierra* and contains little beekeeping.

The *sierra* region lies between 2,000 and 3,500 m elevation and includes all of Peru's temperate intermontane basins. Eucalyptus (*Eucalyptus globus*), alfalfa, clover, and other cultivated plants represent the primary nectar and pollen sources for honeybees in the *sierra*. Beekeeping is widespread, but near the region's upper elevations colder temperatures, which inhibit the honeybee's flight activity, and an impoverished honey flora restrict beekeeping. Extremely high rainfall in the region's eastern margin, which also limits foraging by honeybees, further constrains beekeeping activity.

The *selva alta* or high jungle, lies on the eastern Andean watershed between 2,000 and 500 m elevation with most beekeeping found between 1,500 and 500 m. Melliferous tree crops, particularly coffee and citrus, annual crops, and in some areas a rich natural honey flora, combine with warm temperatures and moderate rainfall to make this region extremely favorable for beekeeping. In contrast, farther to the east below 500 m in the *selva baja*, heavy rainfall, high humidity, an inadequate natural honey flora, and few cultivated honey plants discourage the successful development of honeybee colonies.

METHODOLOGY

In order to compare levels of beekeeping and its development potential in the principal beekeeping regions, variables crucial to the success of beekeeping were selected, and a questionnaire and an apiary observation report for field surveys were designed. The development of these survey instruments was based on an analysis of similar instruments used in field research in Brazil and [end p. 22]



Ecological Regions

- Costa
- Sierra
- Selva Alta
- Selva Baja
- ▲ Case Study Areas

[end p. 23]

Costa Rica (National Science Foundation 1972; Kent 1979), and the work of Drescher and Crane (1982). The questionnaire and apiary observation report gathered data on management practice, honey production, apiary characteristics, ownership status, and training in beekeeping.

Study areas were selected in each of the three principal Peruvian beekeeping regions--costa, sierra, and selva alta. Sites were selected in the northern, central, and southern portions of these narrow north/south trending zones (Figure 1). A total of eleven case studies were conducted--four on the coast, Chulucanas, Chepén/Guadalupe, Huaral, and Camaná; four in the highlands, Cajamarca, San Marcos, Concepción, and Arequipa (Tiabaya); and three in the high jungle, Tarapoto, Oxapampa, and Quillabamba (Figure 1). A total of 112 interviews were conducted between October 1981 and August 1982--38 on the coast, 36 in the sierra, and 38 in the selva alta. The sampling procedure used in the study required that all beekeepers within a 3 km radius of each case study center be interviewed. The principal roads and trails in each study area were traversed, and farmers, residents, and passersby were asked if they knew beekeepers or where honeybees were kept. Beekeepers within each study area were located and interviewed. The completion of the interviews in each study area required between three and six days. A bias toward more technically sophisticated beekeepers may have affected the data gathered in the field owing to transportation constraints and the need to be located where lodging and food were available. All case studies were centered on provincial or district centers with medium-sized populations (1,000 to 5,000).

RESULTS

Management Practices

Strong differences in management practice exist among the three beekeeping regions of Peru. This regional distinctiveness manifests itself in hive types, the use of supers (additional boxes for honey storage that are placed over the brood chamber or bottom box), method of colony reproduction, extraction technology, and the use of protective equipment - mask, smoker, and gloves. The selva alta stands out as the region with the best beekeeping equipment and the most advanced management practices. The sierra occupies an intermediate position and, curiously, the beekeepers of the more economically developed costa may well be the least prepared in equipment and management skills to exploit honeybees productively.

The predominant hive type varies regionally and may represent the single most significant difference between regions. Standard Langstroth-type hives employing modern, movable frames are used by more than 60 percent of the beekeepers in the selva alta, whereas in both the sierra and costa, standard hives are used by about 18 percent and 26 percent of beekeepers, respectively (Table 1). A variety of hive types employing movable frames, but of non-standard measurements and designs, are used by 44 percent of beekeepers in the sierra but are used by few in the costa, and selva alta. Beekeepers in the coastal region have, surprisingly, the most antiquated hive equipment. About 60 percent work with fixed-comb hives, technically the least sophisticated and least productive hive type. This stands in stark contrast to the situation in the remainder of the country. No fixed-comb hives were reported in the selva alta and slightly less than 18 percent of the beekeepers in the sierra use these inefficient hives.

An individual beekeeper combining different hive types is infrequent. Beekeepers using fixed-comb hives rarely use any other hive type. In the sierra and in the selva alta, however, about 20 percent of the beekeepers in each region use a combination of standard and non-standard movable-frame hives. Statistically, the difference between the regions in the use of hive type is highly significant (Table 1).²

Contrast is also evident in the use of supers. In the sierra and costa, only 35 to 40 percent of the beekeepers who use movable frame hives use supers (Table 1). In the selva alta this proportion is more than double--81 percent. As is the case with hive types, the regional differences in the use of supers are statistically highly significant (Table 1).

Colony reproduction and honey extraction techniques reveal dissimilarities between the selva alta and the other two regions. Hive division, a practical and efficient method of colony reproduction, is practiced by more than 70 percent of the beekeepers in the selva alta (Table 1). This technique is used, however, by only 44 and 36 percent of the beekeepers in the Sierra and costa, respectively. The capture of natural swarms, a traditional and haphazard technique, is used by half of the beekeepers on the coast and by one-third in the sierra. In the selva alta, [end p. 24]

Table 1. Management practices and percentage of beekeepers by region.

Management Practices	<i>Costa</i> (%)	<i>Sierra</i> (%)	<i>Selva Alta</i> (%)	Total (%)
^a Hive Type				
Standard	26.3	17.6	63.2	36.4
Non-Standard	10.5	44.1	15.8	22.7
Fixed Comb	60.5	17.6	0.0	26.4
Mixed-Standard and Non-Standard Movable Frame	2.6	20.6	21.1	14.5
	100.0 (N = 38)	100.0 (N = 34)	100.0 (N = 38)	100.0 (N = 110)
^b Use of Supers				
Yes	38.5	35.7	80.8	51.2
No	61.5	64.3	19.2	48.8
	100.0 (N = 26)	100.0 (N = 28)	100.0 (N = 26)	100.0 (N = 80)
^c Reproduction Technique				
Hive Division	36.1	43.8	71.4	50.5
Swarm Capture	50.0	34.3	14.3	33.0
Both Division and Swarm Capture	13.9	21.9	14.3	16.5
	100.0 (N = 36)	100.0 (N = 32)	100.0 (N = 35)	100.0 (N = 103)
^d Extraction Technique				
Centrifuge				
Extractor	18.4	22.9	66.7	100.0
Comb Cutting	78.9	77.1	30.6	100.0
Other	2.6	0.0	2.8	100.0
	100.0 (N = 38)	100.0 (N = 35)	100.0 (N = 36)	100.0 (N = 109)
^e Smoker				
Yes	51.4	47.2	94.7	65.1
Other Device	47.7	25.0	0.0	9.2
Nothing	2.9	27.8	5.3	25.7
	-----	100.0 (N = 35)	100.0 (N = 36)	100.0 (N = 38)
		100.0 (N = 109)		

^aChi Square = 55.46 with 6 d.f., significance = 0.00

^bChi Square = 13.47 with 2 d.f., significance = 0.00

^cChi Square = 12.50 with 4 d.f., significance = 0.01

^dChi Square = 24.12 with 4 d.f., significance = 0.00

^eChi Square = 34.43 with 2 d.f., significance = 0.00

Source: Author's Field Surveys

[end p. 25]

however, only 14 percent depend on swarms to increase the size of their apiaries. In all three of the zones, groups of roughly equivalent size (14 to 22 percent) use both hive division and swarm capture. The regional variations in the methods of colony reproduction are also statistically significant (Table 1).

Honey extraction techniques are more sophisticated in the selva alta than in the other two regions. Centrifugal honey extractors are used by two-thirds of the beekeepers in the selva alta but by only 18 and 23 percent in the costa and the sierra, respectively. Similarly, comb cutting, an inefficient and destructive extraction technique, is practiced by more than 75 percent of the beekeepers in both the costa and sierra but by less than 33 percent in the selva alta. A small number of beekeepers practice other extraction methods. The differences between the regions in the extraction methods used by beekeepers are, again, highly significant statistically (Table 1).

The ownership and use of protective equipment by beekeepers in Peru reflect similar regional variations. For example, 95 percent of the beekeepers in the selva alta own smokers, compared to approximately 50 percent in the other two regions (Table 1). In the costa and sierra, the use of crude or provisional smoking devices--cans, clay pots, burning corn cobs, cigarettes, or even small fires in the vicinity of the hives--is common. Nearly one-half of the beekeepers on the costa and almost one-third in the sierra use these alternative smokers. Surprisingly, one-quarter of the beekeepers in the sierra do not use a smoker or smoking device when working their bees (Table 1).

Ownership and use of masks or bee veils is nearly universal in the three beekeeping regions. Nevertheless, a modest trend occurs with the least frequent ownership and use on the coast (80 percent), increasing in the sierra (92 percent), and reaching nearly 100 percent in the selva alta. Statistically, however, the differences are only moderately significant (table 2).

Glove ownership and use are not as ubiquitous as that for masks and, statistically, more significant variations are present between the regions (Table 2). In the highlands and high jungle about two-thirds of all beekeepers own gloves and about half use them regularly when working their bees. Comparable figures for beekeepers on the coast are about one-third and one-quarter, respectively.

Honey Production

It is difficult to draw from this study definite conclusions about regional variation in honey production in Peru. The primary problems are the variety of hive types employed, their differing concentrations in each region, and the small size of the sample used in the survey.

An analysis of the productivity of colonies kept in standard movable-frame hives is used to compare annual honey production in the three regions. The greatest per colony yields appear in the selva alta, where production averages 39 kg annually. These yields drop slightly to 36 kg in the sierra, and then sharply to 20 kg per colony in the coastal region. Little confidence can be placed in these data, unfortunately, especially for the highlands and the coast, since only three and six respondents, respectively, reported honey yield data for standard, movable-frame hives. An analysis of variance test (ANOVA) showed that, based on this data, there was no significant difference between the production figures for the three regions (F ratio 1.212, significant at 0.3146). With 19 beekeepers reporting production figures for the selva alta, however, considerably more confidence can be placed in the production averages for that region.

Interviews with knowledgeable beekeepers and a familiarity with the regional environmental conditions suggest the honey production data are not representative, especially for the sierra. Yields in that region in all likelihood are much less than the average 36 kg per colony indicated by beekeepers interviewed in the study areas. Most beekeepers in the sierra who use standard, movable-frame hives probably receive yields of between 15 to 30 kg per hive, depending on management practices, equipment, and local environmental conditions. Some beekeepers in the Callejon de Huaylas of the north central sierra reported yields of 50 to 80 per hive, but these accounts are difficult to believe. Bullon (1978) suggested maximum yields of up to 50 kg per hive are possible with a high level of technical and management skill, 25 kg per hive at intermediate levels, and 10 to 15 kg per hive for those with little or no technical or managerial sophistication. A successful commercial beekeeper with about 200 standard hives in Caráz in the Callejon de Huaylas estimated his annual hive yields at 20 kg (Aguilar 1976). The latter estimate and those of Bullon seem to be fairly representative of the actual situation in most of the Peruvian sierra.

The coastal honey production figures of 20 kg [end p. 26]

Table 2. Protective equipment ownership use and percentage of beekeepers by region.

Equipment Ownership and use	Costa (%)	Sierra (%)	Selva Alta (%)	Total (%)
^a Mask				
Yes	81.1	91.7	97.4	90.1
No	18.9	8.3	2.6	9.9
	100.0 (N=37)	100.0 (N=36)	100.0 (N=38)	100.0 (N=111)
^b Mask Use				
Yes	77.1	91.4	97.3	88.8
No	20.0	8.6	2.7	10.3
Sometimes	5.9	0.0	0.0	0.9
	100.0 (N=35)	100.0 (N=35)	100.0 (N=37)	100.0 (N=107)
^c Gloves				
Yes	36.1	62.9	67.6	55.6
No	63.7	37.1	32.4	44.4
	100.0 (N=36)	100.0 (N=35)	100.0 (N=37)	100.0 (N=108)
^d Glove Use				
Yes	26.5	52.8	52.8	44.3
No	67.6	44.4	36.1	49.1
Sometimes	5.9	2.8	11.1	6.6
	100.0 (N=34)	100.0 (N=36)	100.0 (N=36)	100.0 (N=106)
^a Chi Square = 5.72 with 2 d.f., significance = 0.06				
^b Chi Square = 8.30 with 4 d.f., significance = 0.08				
^c Chi Square = 8.43 with 2 d.f., significance = 0.01				
^d Chi Square = 9.32 with 4 d.f., significance = 0.05				

Source: Author's Field Surveys

per hive can be compared to the yields reported by a separate group of beekeepers surveyed by mail. These beekeepers, who also used standard movable-frame hives, reported average colony yields of 28 kg (n8). In the coastal areas of the far north such as Piura and Tumbes, however, large-scale commercial beekeepers claim much higher yields, 40 to 50 kg (Lizárraga 1981).

Economic Characteristics

Beekeeping is a hobby for most Peruvian beekeepers. Nationally, nearly three-quarters of all beekeepers consider themselves to be hobbyists, but there are differences among the three regions that are statistically significant (Table 3). All beekeepers in the sierra consider beekeeping to be a hobby, whereas in the selva alta only 42 percent are hobbyists and 50 percent consider beekeeping a part-time or full-time business. Five percent see it as a combination of the two. Beekeeping in the coastal region occupies an intermediate position, with one-quarter keeping bees as a business activity and the remainder being hobbyists (Table 3).

Most beekeepers in Peru own ten or fewer colonies. The average number of hives owned is greatest in the costa (x 51), intermediate in the selva alta (x 34), and least in the sierra (x 6). Statistically, these differences are only moderately significant (Table 3).³ Small-scale beekeeping operations predominate in the sierra where 86 percent of the beekeepers own ten or fewer colonies. This figure drops to 55 [end p. 27]

Table 3. Economic characteristics and percentage of beekeepers by region.

Economic Characteristics	<i>Costa</i> (%)	<i>Sierra</i> (%)	<i>Selva Alta</i> (%)	Total (%)
^a Ownership Status				
Hobby	69.7	100.0	42.1	69.2
Business	27.7	0.0	50.0	27.0
Business & Hobby	0.0	0.0	5.3	1.9
Institutional	2.6	0.0	2.6	1.9
	100.0 (N = 33)	100.0 (N = 33)	100.0 (N = 38)	100.0 (N = 104)
^b Number of Beehives				
1 to 5	39.5	61.1	13.2	37.4
6 to 10	15.8	25.0	21.0	20.5
11 to 20	7.9	5.6	26.3	13.4
21 to 50	18.4	8.3	26.3	17.9
51 to 100	10.5	0.0	7.9	6.3
101 or more	7.9	0.0	5.3	4.5
	100.0 (N = 38)	100.0 (N = 36)	100.0 (N = 38)	100.0 (N = 112)
Income				
Percent Reporting Income from Beekeeping	39.5 (N = 38)	8.3 (N = 36)	50.5 (N = 28)	33.0 (N = 112)
^c Percent of Income From Beekeeping				
Less than 25%	53.4	66.7	52.6	54.1
26 to 50%	33.3	33.3	36.8	35.1
51 to 75%	0.0	0.0	5.3	2.7
More than 75%	13.3	0.0	5.3	8.1
	100.0 (N = 15)	100.0 (N = 3)	100.0 (N = 19)	100.0 (N = 37)
^a Chi Square = 29.70 with 6 d.f., significance 0.000				
^b Analysis of variance, F ratio = 1.857, with 2 d.f., significance = 0.161				
^c Chi Square = 2.01 with 6 d.f., significance 0.918				

Source: Author's Field Surveys

percent among beekeepers on the coast, and to approximately 33 percent of the beekeepers in the selva alta. The largest apiaries are located on the coast and in the selva alta, where 18 and 13 percent of the beekeepers, respectively, own more than 50 hives (Table 3). None of the beekeepers in the sierra owned more than 20 hives.

Nationally, about one-third of the beekeepers reported personal income from their beekeeping activities. Nevertheless, the proportion of personal income from this source is small. More than one-half of the respondents in this group estimated that less than 25 percent of their income was attributable to beekeeping, and most of the remainder earned less than 50 percent of their income from this activity. Only 11 percent received more than 50 percent of their income from the commercialization of honeybee products--honey, pollen, and wax-- in order of commercial importance in Peru (Table 3). Regional differences are not significant statistically.

Experience and Training

Three-fourths of Peruvian beekeepers have worked with honeybees for four years or more, and the majority have between

Table 4. Beekeeping experience and training, percentage of beekeepers by region.

Experience & Training	<i>Costa</i> (%)	<i>Sierra</i> (%)	<i>Selva Alta</i> (%)	Total (%)
^a Years Experience with Honeybees				
1 to 3	15.8	27.8	36.9	26.8
4 to 10	28.9	22.8	26.3	25.9
11 to 15	7.9	13.9	15.8	12.5
16 to 20	18.4	25.0	10.5	17.9
21 to 30	10.5	8.3	2.6	7.1
31 or more	18.4	2.8	7.9	9.8
	100.0 (N=38)	100.0 (N=36)	100.0 (N=38)	100.0 (N=112)
^b Number of Beekeepers Known				
None	18.4	16.7	5.3	13.4
1	29.0	38.8	7.9	25.0
2	18.4	16.7	23.7	19.6
3	15.8	22.2	23.7	20.5
4	15.8	5.6	28.9	17.0
5 or more	2.6	0.0	10.5	4.5
	100.0 (N=38)	100.0 (N=36)	100.0 (N=38)	100.0 (N=112)
^c Number of Publications				
0	59.3	48.4	35.2	46.4
1	11.1	30.3	18.9	20.6
2	7.4	6.1	5.4	6.2
3	7.4	6.1	18.9	11.3
4	0.0	6.1	8.1	5.2
5 or more	14.8	3.0	13.5	10.3
	100.0 (N=27)	100.0 (N=33)	100.0 (N=37)	100.0 (N=97)
^d Training or Coursework				
Yes	23.1	3.1	23.7	16.7
No	76.9	96.9	76.3	83.3
	100.0 (N=26)	100.0 (N=32)	100.0 (N=38)	100.0 (N=96)
^a Analysis of variance, F ratio = 4.300, with 2 d.f., significance = 0.016				
^b Analysis of variance, F ratio = 15.629, with 2 d.f., significance = 0.000				
^c Analysis of variance, F ratio = 1.117, with 2 d.f., significance = 0.332				
^d Chi Square = 6.34, with 2 d.f., significance = 0.042				

experience. About 17 percent have kept honeybees in excess of twenty years (Table 4). Nationally, beekeepers reported an average of 14 years of experience with honeybees, but this varied considerably among the regions. Beekeepers in the costa had an average of 19.5 years, those in the sierra 12 years, and those in the selva alta 11 years of experience.

An analysis of the data shows the differences to be statistically significant (Table 4). The selva alta has the greatest

proportion of new beekeepers (one to three years of experience), 37 percent, against 26 percent for the sierra and 16 percent for the costa. Correspondingly, fewer individuals have long beekeeping experience in the selva alta. [end p. 29]

Contact with other beekeepers represents a useful mechanism for beekeepers to learn from each other's experience and to obtain equipment or share its use. At the national level, more than 85 percent of all beekeepers have knowledge of, or are in contact with, other practitioners. Pronounced differences that are statistically significant do exist between the regions (Table 4). As in a number of previous instances, the principal variations are between the selva alta and the other two beekeeping regions. Only 5 percent of the beekeepers in the high jungle do not know other practitioners, in contrast to 17 and 18 percent in the sierra and costa. Beekeepers in the selva alta know more beekeepers (x 2) than their colleagues in the costa and the sierra (x 1.2 and x 1.0, respectively).

Books, pamphlets, manuals, and other printed materials about apiculture represent an auxiliary source of information for the improvement of beekeepers' knowledge and management skills. Throughout the country, slightly more than half of all beekeepers have such materials, but beekeepers in the highlands are less likely to have these materials at their disposal than beekeepers in other regions. Individuals in the sierra own an average of one publication, while their colleagues in the high jungle and coast average about three each. Statistically the differences between the three regions are not significant (Table 4). It is unclear why beekeepers in the sierra used printed materials less than their colleagues in the selva alta or the costa, but it may be that illiteracy is more common in that region.

Only about 17 percent of the beekeepers interviewed nationally had completed a course or formal training in apiculture. Moderate variations in beekeepers' training between the three regions are evident and these are statistically significant. Beekeepers in the sierra demonstrate a clear lack of formal instruction or training (less than 5 percent), whereas about one-quarter of the beekeepers on the coast and in the high jungle reported some instruction or training (Table 4).

INTERPRETATION AND ANALYSIS

Peruvian beekeeping is characterized by a diverse range of tools, techniques, and problems. Many of these exhibit distinct regional variations. Beekeeping in Peru occurs in a developed or modern context in the selva alta and in an underdeveloped or traditional context in the sierra and the costa. This is clearly demonstrated with regard to the hive type, reproduction technique, extraction method, use of supers, and the ownership and use of a smoker. By a wide margin, beekeepers in the selva alta use more advanced equipment and sophisticated techniques to keep bees. Standard, movable-frame hives, supers, centrifuges, and smokers are all commonly utilized, as is hive division for colony reproduction. In contrast, in the underdeveloped sierra and costa regions, most beekeepers' practices are rudimentary. Most beekeepers in these two regions use fixed comb or non-standard movable-frame hives and do not use supers or centrifuges. The use of smokers is frequent, but not predominant, and many keepers depend entirely on swarm capture to increase hive numbers.

Although the statistical significance of the regional variations may not be as strong with respect to many of the remaining variables, a definite pattern emerges, with beekeepers in the selva alta being more prosperous, more commercially oriented, and better educated than their counterparts in the other regions.

Within the so-called underdeveloped beekeeping region, however, there are differences between the sierra and the costa. Beekeepers using fixed-comb hives, for instance, predominate on the costa, as do those using swarm capture to insure hive increase. This is not the case in the sierra, where the use of both standard and non-standard movable-frame hives is common as is the practice of hive division. In addition the infrequent use of the smoker, the lack of commercially oriented operators, and the low average number of colonies per individual in the sierra contrast with the situation of beekeepers in the costa.

Why are these natural or geographic regions so different with respect to their beekeeping characteristics? Ecological conditions are an obvious difference, but the fact that fine beekeeping conditions can be found in at least some places in each of three regions suggests that the benefits of modern beekeeping tools and techniques could yield positive benefits throughout the country. Moreover, there do not seem to be any ecological or geographical factors that might account for the distinct interregional technological and methodological differences. Indeed, modern beekeepers in all three regions use the same techniques and methods.

Socioeconomic factors, rather than ecological ones, appear responsible for the differences in beekeeping technologies and development levels in Peru. Beekeeping with honeybees is not indigenous to Peru or even to the Western Hemisphere, but rather is a direct result of the arrival of Europeans. It is possible that the Jesuits who established large haciendas on the coast during the 1700s brought honeybees with them from Europe, although there is no concrete evidence to support this suggestion. Whatever the case, it seems that beekeeping on the costa first occurred mainly on haciendas and large [end p. 30] estates, with peasants later taking up beekeeping on a more limited and technologically primitive basis. A similar pattern continues to dominate on the costa where most individuals have only a few hives and use traditional techniques and a few wealthy or landed beekeepers have substantial operations (50 to 500 hives) and use modern equipment and technology. In

the sierra a more traditional, and perhaps more egalitarian, socioeconomic system apparently encouraged the development of a slightly more modern beekeeping technology, using non-standard movable-frame hives, and has given rise to a more homogenous group of beekeepers. The selva alta is a region of active rural colonization and is more egalitarian, in a socioeconomic sense, than either of the other two regions. It has experienced immigration from Italy and Germany in the past and present centuries. In addition to the fact that environmental beekeeping conditions in the selva alta are excellent, it may be that the influence of late nineteenth- and early twentieth-century European immigrants contributed to the widespread use of movable-frame hives, supers, and other modern beekeeping equipment and techniques. The comparative lack of established or traditional socioeconomic divisions also may have facilitated the diffusion and acceptance of modern tools and methods.

APPLICATIONS FOR DEVELOPMENT POLICY

What significance do these conclusions have for the promotion or implementation of beekeeping as a rural development tool in Peru? First, they suggest that development efforts should be focused primarily in the costa and in the sierra and only secondarily in the selva alta. The least costly and most long lasting means of making improvements in the beekeeping technology and practice in underdeveloped regions is through a combination of educational programming and extension services, and this is a long-term process. While the inability to purchase modern equipment hinders many beekeepers on the coast and in the highlands, the simple lack of technical information is equally constraining. Dramatic improvements could be made with the broad dissemination of basic technical information on hive division, the use of smokers, centrifuges, and supers. Both smokers and centrifuges could be constructed by craftsmen in provincial centers and sold for a reasonable price if adequate plans were available. Standard, movable-frame hives require precision work and are expensive, but the widespread and long-term distribution of plans for a "Peruvian Standard," movable-frame hive could yield positive results.

This kind of development requires a broad-based, long-term commitment which is best provided through some kind of extension service. In the early 1950s the Peruvian government and foreign assistance groups implemented a comprehensive extension program, SIPA (Servicio de Investigación y Promoción Agropecuaria), which provided beekeeping instruction, field visits to beekeeper's apiaries, and in some cases the provision of Italian bee stock imported from the United States. Many of the nation's most progressive beekeepers received early assistance from SIPA. In the past five years, unfortunately, most development efforts--including some supported by foreign donors--have been short-term in focus, isolated in application, and of little impact.

Perhaps more productive assistance might be directed to the agronomy and animal husbandry programs in the national universities located throughout the country. Seven of these institutions regularly offer courses in beekeeping, have some faculty expertise in apiculture, and have a network of contacts with beekeepers and a knowledge of beekeeping in their respective regions (Kent 1983). Similar efforts also could be directed to the ESEPs (*Escuelas Superiores de Educación Profesional*), secondary schools that train students for agricultural, trade, clerical, and manufacturing occupations.

Development efforts in the selva alta, although not nearly so urgently needed, probably should be organized in the same fashion, but should be focused on different problems. The most serious concerns there center on organizational and business problems; the overcrowding of apiaries and the lack of credit are often cited as problems by beekeepers. The coordination of apiary locations, the development of credit sources, bee breeding, and the formation of marketing cooperatives are examples of the kinds of problems an extension or technical assistance service could address.

During the past ten years, the disruptive influence of the Africanized honeybee has been felt in all three of Peru's principal beekeeping regions (Abejas asesinas en Pacasmayo? 1981; Alata 1976; Dávila et al. 1980; Kent 1983). While the diffusion of this aggressive hybrid from Brazil into Peru has been bothersome, most of those few who have been forced to abandon their beekeeping activities because of it, kept few colonies and used unsophisticated tools and techniques. Overall, most beekeepers have adapted to the bee's aggressive behavior, and the Africanized honeybee does not seem to present a serious threat to beekeeping development efforts in Peru (Kent 1983).

Enormous potential for the expansion of apiculture exists in Peru. The most cost-effective development assistance should be directed toward the [end p. 31] sierra and costa. A thriving demand for honey exists throughout the country and the product usually commands a price on the domestic market above that offered on the export market. With domestic prices stable over the past three to four years at about U. S. \$2 per kg, high by the living standards of most Peruvians, there would appear to be a demand that could support large increases in domestic production and sales. Nevertheless, in the context of the Peruvian agricultural economy, production increases do not seem likely, nor do extension efforts to promote beekeeping. If this is the case, the technological and methodological differences between the three beekeeping regions, costa, sierra, and selva alta, will persist for many years.

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NOTES

1. Most geographers and ecologists, however, recognize a more complex set of ecological zones. Pulgar Vidal (1981), for instance, identifies a series of eight zones---the *costa* (0-500 m), the *yunga* (500-2,300 m), the *Quechua* (2,300-3,500 m), the *suní* (3,500-4,000 m), the *puna* (4,000-4,800 m), the *cordillera* (4,800-6,768 m), the *selva alta* (400-1,000 m), and the *selva baja* (83-400 m). Pulgar Vidal notes, however, that the exact definition of these zones varies somewhat in different parts of the country and that the divisions between the zones are not abrupt; rather they are characterized by transitional zones. A much more detailed ecological zonation of the country, reflecting its complex nature, is portrayed on the *Mapa Ecológico del Perú* prepared by the Oficina Nacional de Evaluación de Recursos Naturales (Peru 1976b). Using a system of ecological classification developed by L. R. Holdridge, 84 life-zones and 17 transitional zones are identified for the country.

2. The chi-squared statistics reported in Tables 1, 2, 3 and 4 have been calculated using the raw data values in each category and not the percentage values reported in the Tables. Only the percentage values are reported in the tables to facilitate comparisons between the regions and to keep the tables straightforward and readable.

3. The analysis of variance statistics (ANOVA) reported here in Table 3 and in table 4 are based on an analysis of the raw data values and sample means. The data are presented as percentages and grouped in the tables to facilitate their analysis by the reader.

REFERENCES CITED

- Abejas asesinas en Pacasmayo? 1981. *La Prensa* (Lima) 31 March 1981, p. 7.
- Aguilar Bernadino. 1976. Letter to Director del Proyecto de ORDEZA, Huaráz, Peru, 27 April, 1976, Caraz, Peru. 4 pp.
- Alata, Julio. 1976. Las abejas africanas y/o su híbridos y su posible presencia en el Valle de Chanchamayo (CRIA-I). Lima: Ministerio de Alimentación, Dirección General de Investigación. *Informe Especial* No.3, 10 pp.
- Aramburi, Carlos E. 1982. Expansión de la frontera' agraria y demográfica en la selva alta Peruana. In *Colonización en la Amazonia*, ed. Carlos E. Aramburi et al., 1-450. Lima: Centro de Investigación y Promoción Amazónica.
- Bullon, Humberto F. 1978. Estudio de prebilidad técnico-económico de la producción e industrialización de la miel de abeja y polén en el distrito de Huaylas. Tesis, Universidad Nacional Agraria, La Molina, Lima, Peru. 308 pp.
- Commonwealth Secretariat. 1979. *Beekeeping in rural development: Unexploited beekeeping potential in the tropics with particular reference to the Commonwealth*. London: Commonwealth Secretariat.
- Corporación de Racionalización y Consultoría. 1979. *Estudio de pre-factibilidad para establecer un complejo de explotación apícola*. Toma 8. Lima: Plan de Desarrollo para la Central de Emmpresas de Cajamarca Lta. No. 003-C-II. Informe Final.
- Davila, Miguel et al. 1980. Presencia de la abeja africanizada en Perú. *Revista Peruana de Entomología* 23 (1): 125-27.
- Drescher, Wilhelm, and Eva Crane. 1982. *Technical cooperation activities: Beekeeping, a directory and guide*. Eschborn, West Germany: German Agency for Technical Cooperation.
- Hurtado, Luis S. 1980. Estudio de pre-factibilidad para la instalación de un apiario en la irrigación de San Lorenzo (Piura). Tesis, Universidad Nacional Agraria La Molina, Lima, Peru. 280 pp.
- Kent, Robert B. 1979. Diversidad ecológica y las regiones apícolas en Costa Rica. *Revista Geográfica* 90: 65-95. [end p. 32]
- _____. 1983. *Beekeeping in rural development: The Africanized honeybee in Peru*. Ph.D. dissertation in Geography, Syracuse University.
- Lizárraga, Emilio. 1981. Personal communication, 21 March. Lima, Peru.
- Manley, M. J. D. 1982. Some restricting factors experienced in developing beekeeping programmes in non-industrialized

countries. *Apiacta* 17(1):21-24.

National Science Foundation. 1972. *Final report: Committee on the Africanized honeybee*. Washhington, D.C.: National Academy of Sciences.

Peru. 1963. *Primer censo nacional agropecuario*. Lima: Instituto Nacional de Planificación, Dirección General de Estadística y Censos.

_____. 1976a. *II censo nacional agropecuario, 4 al 24 de setiembre 1972*. Lima: Instituto Nacional de Estadística.

_____. 1976b. *Mapa ecológico del Perú: Guía explicativa*. Lima: Oficina Nacional de Evaluación de Recursos Naturales.

Pulgar Vidal, Javier. 1981. *Geografía del Perú: Las ocho regiones naturales del Perú*, 8th ed. Lima: Editorial Universo S.A.

Smith, Clifford T. 1974. The central Andes. In *Latin America: Geographical perspectives* eds. Harold Blakemore and Clifford T. Smith. London: Methuen. **[end p. 33]**