BEE-KEEPING IN WELAITA, NORTH OMO

BY

EDWARD HOYLE
ROYAL AGRICULTURAL COLLEGE

FARMERS' RESEARCH PROJECT (FRP)
FARM AFRICA

P. O. Box 5746
Addis Ababa
Ethiopia

JULY 1993
BEE-KEEPING IN WELAITA, NORTH OMO

BY

EDWARD HOYLE
ROYAL AGRICULTURAL COLLEGE

FARMERS’ RESEARCH PROJECT (FRP)
FARM AFRICA

P. O. Box 5746
Addis Ababa
Ethiopia

JULY 1993
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page number</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PREFACE</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>1. INTRODUCTION AND METHODOLOGY</strong></td>
<td>2</td>
</tr>
<tr>
<td>- Introduction</td>
<td>2</td>
</tr>
<tr>
<td>- Methodology</td>
<td>2</td>
</tr>
<tr>
<td><strong>2. THE PRODUCTION SYSTEM</strong></td>
<td>5</td>
</tr>
<tr>
<td>- Extent of bee-keeping</td>
<td>5</td>
</tr>
<tr>
<td>- The bees</td>
<td>9</td>
</tr>
<tr>
<td>- The bee-keepers</td>
<td>10</td>
</tr>
<tr>
<td>- The hives</td>
<td>13</td>
</tr>
<tr>
<td>- The bamboo hive</td>
<td>13</td>
</tr>
<tr>
<td>- The pot hive</td>
<td>15</td>
</tr>
<tr>
<td>- The wooden hive</td>
<td>17</td>
</tr>
<tr>
<td>- The box hive</td>
<td>18</td>
</tr>
<tr>
<td>- Feeding bees</td>
<td>19</td>
</tr>
<tr>
<td>- Watering bees</td>
<td>21</td>
</tr>
<tr>
<td>- Obtaining bees</td>
<td>21</td>
</tr>
<tr>
<td>- Absconding and swarming</td>
<td>24</td>
</tr>
<tr>
<td>- The bee-keeping calendar</td>
<td>25</td>
</tr>
<tr>
<td><strong>3. PROBLEMS IN BEE-KEEPING</strong></td>
<td>28</td>
</tr>
<tr>
<td>- Major problems</td>
<td>28</td>
</tr>
<tr>
<td>- Ants and spiders</td>
<td>28</td>
</tr>
<tr>
<td>- Heat</td>
<td>28</td>
</tr>
<tr>
<td>- Rain</td>
<td>29</td>
</tr>
<tr>
<td>- Overcrowding</td>
<td>29</td>
</tr>
<tr>
<td>- Chameleons</td>
<td>30</td>
</tr>
<tr>
<td>- Thieves</td>
<td>30</td>
</tr>
<tr>
<td>- Minor problems</td>
<td>30</td>
</tr>
<tr>
<td>- Birds</td>
<td>30</td>
</tr>
<tr>
<td>- Tobacco and DDT</td>
<td>30</td>
</tr>
<tr>
<td>- Disease</td>
<td>30</td>
</tr>
<tr>
<td>- Reasons limiting the size of current apiaries</td>
<td>30</td>
</tr>
<tr>
<td>and discouraging newcomers to bee-keeping</td>
<td>30</td>
</tr>
</tbody>
</table>
4. HARVESTING .................................................. 33
   - The impact of the environment and the
     seasonality of harvesting .......................... 33
   - Methods of harvesting .............................. 34
   - Yields: honey and larvae .......................... 34
     - Honey ........................................... 34
     - Larvae ........................................ 36

5. MARKETING AND USE OF HIVE PRODUCTS ............... 37
   - Honey ................................................. 37
   - Larvae .............................................. 40
   - Beeswax ............................................... 40
   - The financial importance of honey sales
     to beekeepers ....................................... 40
   - Transport and storage of hive products ......... 42

6. CONCLUSIONS AND IMPLICATIONS .......................... 44
   - Conclusions .......................................... 44
   - Implications for extension and research ......... 44

APPENDIX I: REPORT OF THE PILOT SURVEY ON APIARIES .. 46

APPENDIX II: CALCULATIONS OF HONEY YIELDS .......... 49

APPENDIX III: EQUIVALENCE OF ETHIOPIAN AND
               GREGORIAN CALENDARS ......................... 50

APPENDIX IV: REFERENCES ................................. 51
LIST OF TABLES

Table 1. The price of honey .................................. 39

LIST OF FIGURES

MAP 1. NORTH OMO WITHIN ETHIOPIA, WELAITA WITHIN NORTH OMO, AND TWO PAS WITHIN WELAITA ... 4

FIGURE 1. DISTRIBUTION OF HIVES AMONG BEE-KEEPERS: KOKATE AND ABELE AJEJA .................. 6

FIGURE 2. CATEGORISATION OF BEE-KEEPERS BY APIARY SIZE: KOKATE AND ABELE AJEJA ............ 7

FIGURE 3. DISTRIBUTION OF HIVES BETWEEN SMALL-SCALE, MEDIUM-SCALE AND LARGE-SCALE BEE-KEEPERS: KOKATE AND ABELE AJEJA .................... 8

FIGURE 4. APIARY SIZE AND LENGTH OF BEE-KEEPING EXPERIENCE IN KOKATE ....................... 11

FIGURE 5. THE BAMBOO HIVE .................................. 14

FIGURE 6. THE BEE-KEEPING CALENDAR IN KOKATE ........ 26

FIGURE 7. THE BEE-KEEPING CALENDAR IN ABELE AJEJA; AWAY FROM THE RIVER ....................... 27

FIGURE 8. VARIATIONS IN HONEY PRICES THROUGH THE ETHIOPIAN CALENDAR ....................... 38

FIGURE 9. THE FINANCIAL IMPORTANCE OF HONEY SALES TO THE BEE-KEEPERS OF KOKATE ............ 41

FIGURE 10. THE FINANCIAL IMPORTANCE OF HONEY SALES TO THE BEE-KEEPERS OF ABELE AJEJA .... 43
FARM Africa is a non-government organisation, registered as a charity in Britain, and in 1993 working on projects in Ethiopia, Kenya and Tanzania. One of the projects it is working on in Ethiopia is the Farmers Research Project carried out in the North Omo zone of south-west Ethiopia. The aim of this project is to promote farmers' participatory research, ie research in which farmers play leading roles in identifying and designing research as well as in carrying it out and evaluating it.

Early in the life of the project it became clear that one of the problems hindering agricultural extension and research is a shortage of basic information on many of the important crops and other agricultural commodities and activities in North Omo. It was, therefore, decided that one of the activities of the project should be to produce a number of technical pamphlets on important agricultural commodities and other farming issues about which information is difficult to obtain from other sources.

This pamphlet on bee-keeping is the fourth of these technical pamphlets to be produced. Its author is Edward Hoyle who spent part of a year while he was a student at the Royal Agricultural College Cirencester, UK, working with the Farmers Research Project.

In the preparation of this pamphlet the author was greatly helped by a number of people, including: Stephen Sandford with his general guidance throughout the study; Kefale Alemu, Alemayehu Shanka, Eyassu Lemago and Abaynesh Elfineh for support and encouragement during field work; Elfinesh Atske and Alemayehu Konde for back-up support; and to Pippa and other members of the Sandford family for support in Addis Ababa and elsewhere. The author takes this opportunity to express his gratitude to them all. The author also gratefully acknowledges a review of the draft of this pamphlet by Ato Nuru Adaba. As a consequence several amendments have been made. The author alone has responsibility for any remaining errors.

In the course of the work the author interviewed a large number of farmers in North Omo, either in groups or on their own. These farmers are too numerous to acknowledge individually. As will be apparent from what follows, they are the real authors and I hope that I have correctly interpreted their views.

Edward Hoyle

March 1993
CHAPTER 1. INTRODUCTION AND METHODOLOGY

Introduction

Ethiopia's farmers have a long history of bee-keeping. For hundreds of years they have supplied the nobility and social elite with honey, the main ingredient of tej (a type of mead), a drink ingrained in the culture and tradition of the country. Today Ethiopia is thought to be among the top ten producers of honey in the world. An accurate figure on output is unavailable. The great majority of honey is fermented and consumed in small tej houses. Only a tiny proportion is processed into table honey for a domestic and export market which is consequently small.

This is the second report undertaken during the author's six month stay in Ethiopia and follows a short pilot survey carried out in a wider series of Welaita Peasant Associations (PAs). The decision to conduct the information gathering surveys in two PAs of varying altitude was taken on the basis of the findings of the pilot survey which indicated that altitude was an important factor affecting the nature of the region's bee-keeping. The complete findings of the pilot survey are included in Appendix I. The report aims to provide a detailed summary of the current situation regarding all aspects of bee-keeping in the two Welaita PAs where research took place. The position of North Omo in Ethiopia, of Welaita within North Omo, and of the two PAs within Welaita are shown in MAP 1 of this report.

Although the report is confined to two PAs, it is hoped that the information given will have relevance to the bee-keeping of a wider area, especially the Welaita region where it is the first such study.

Methodology

Information was gathered by conducting the following two questionnaires:

1. Farmers were asked to state if they kept bees and, if yes, how many hives occupied by bees were currently in their possession. The aim was to locate bee-keepers in order to determine the proportion of the population keeping bees and to find the density and distribution of colonies.

2. Most of the farmers visited in the initial survey who were keeping bees, were asked a detailed formal questionnaire to obtain both quantitative and qualitative data on all aspects of local bee-keeping. They were also encouraged to divulge any other information they found important or interesting which was not brought out during the questionnaire.
Unfortunately it was not possible to interview all the bee-keepers visited during the initial survey due to absence. Consequently, the sample who answered the formal questionnaire was somewhat different to that found during the initial survey.

The formal questionnaire was presented to as many bee-keepers as were available in order to collect the maximum amount of information in the given time (19 in Kokate and 10 in Abele Ajeja). The average time spent to complete the formal questionnaire was over one and a half hours and many bee-keepers could not afford this amount of time. Consequently, it was not possible to ask all the questions on each occasion. Further to the questionnaires, various measurements were made in order to find additional quantitative data.
Area enclosed by thick lines is Welaita
CHAPTER 2. THE PRODUCTION SYSTEM

Extent of bee-keeping

During the initial survey, occupied beehives were found at 8% of households visited in Kokate (n=183) and 7% of households visited in Abele Ajeja (n=99). The density of beehives (per unit area) in Abele Ajeja is, like the human population, much lower than in Kokate. However the results of this initial survey suggest that a similar proportion of the population keep bees. Figure 1 shows the distribution of occupied beehives among the bee-keepers of Kokate and Abele Ajeja.

The mean number of occupied hives per bee-keeping household is 3.6 in Kokate and 3.8 in Abele Ajeja. However, these values are misleading as an indication of the typical ownership situation because they are distorted, in both PA's, by a small number of apiaries containing many more occupied hives than those owned by the large majority of bee-keepers (see Figures 1, 2 and 3). The true situation is better illustrated by the mode which is 2 occupied hives in Kokate and 1 in Abele Ajeja.

Bee-keepers in Kokate and Abele Ajeja can be divided into three main categories:

(i) Small-scale producers with one to two occupied hives.
(ii) Medium-scale producers with three to six occupied hives.
(iii) Large-scale producers with more than six occupied hives.

(N.B. all the large-scale producers who answered the formal questionnaire had more than nine occupied hives).

Figure 2 (see page 7) shows that the majority of bee-keepers are small-scale producers in both PA's with large-scale producers forming the smallest group in both instances.

It should be noted that small-scale, medium scale and large scale are terms devised purely to clarify the hive ownership situation. There are no significant differences between the groups in terms of production techniques. Moreover, small-scale, medium-scale and large-scale only describe the level of production of bee-keepers in relation to their counterparts in Kokate and Abele Ajeja.

Figure 1 (see page 6) shows that the distribution of beehives is very uneven with a small number of bee-keepers owning a disproportionate number of occupied hives. Figure 3 (see page 8), which shows the distribution between the above categories, illustrates this more clearly.
FIG. 1. DISTRIBUTION OF HIVES AMONG BEE-KEEPERS:
Kokate and Abele Ajeja
(% of hives in different sizes of apiary)

Kokate

Abele Ajeja

No. of bee-keepers = 19
No. of occupied hives = 69

No. of bee-keepers = 10
No. of occupied hives = 38

(X) = No. of hives per bee-keeper
FIG. 2. CATEGORISATION OF BEE-KEEPERS BY APIARY SIZE: KOKATE AND ABELE AJEJA
(% of bee-keepers with different sizes of apiary)

Kokate

57%

33%

Small-scale bee-keepers

Medium-scale bee-keepers

Large-scale bee-keepers

70%

20%

10%

No. of bee-keepers = 19

Abele Ajeja

33%

10%

No. of bee-keepers = 10
FIG. 3. DISTRIBUTION OF HIVES BETWEEN SMALL-SCALE, MEDIUM-SCALE AND LARGE-SCALE BEE-KEEPERS: KOKATE AND ABELE AJEJA
(% of hives owned by different categories of bee-keeper)

Kokate

Abele Ajeja

No. of occupied hives = 69

No. of occupied hives = 38
The bees

All the indigenous bees of Ethiopia are Apis Mellifera Adansonii. Bee-keepers in both PAs agreed that there are two varieties of bees used in local bee-keeping. Their description of each variety was as follows:

(i) Red bees or bad bees were said to be small and thin and of a reddish colour. They are also known as bad bees as their behaviour is found to be particularly ferocious. It was said by one farmer that bees are only dangerous when engaged in honey making. Red bees were thought to work "too hard" at this time resulting in their aggression. The term bad bees is slightly misleading as they were universally found to be higher yielding than the black bees.

(ii) Black bees were said to be long and fat in relation to red bees. Farmers agreed unanimously that black bees have more passive characteristics than the red bees. However, it was stated that their perceived relaxed attitude results in a lower yield than that of the harder working red bees.

Bee-keepers did not consider either variety to be more prevalent than the other and neither was one variety more favoured for bee-keeping than the other. None of the bee-keepers said that they deliberately sought a particular variety of bee, apparently using whichever variety is available. That neither variety appears to be preferred may be explained by the significant and contrasting advantages and disadvantages of red bees and black bees described above.

EDITOR’S NOTE

A reviewer has commented here as follows:-

a) "In Ethiopia there are at least three geographical races of bees, A.M. manticola, A.M. scutlata and A.M. adnsonii."

b) "It is very difficult to consider the varieties of bees according to their colours, because it is common to get red and black bees in one colony in one hive which are reared from a single queen. When these single bees are morphometrically checked they did not show significant variation".

[END OF EDITOR’S NOTE]
The bee-keepers

Only the male populations of Kokate and Abele Ajeja were found to participate actively in bee-keeping. The majority of women, including those whose husbands and/or sons were keeping bees, displayed little or no knowledge on the subject.

Experience is one of the key requirements for a successful apiary (an apiary is a collection of hives in a place where bees are kept) according to the bee-keepers of Kokate and Abele Ajeja (see reasons, given later in this report, dissuading newcomers to bee-keeping and limiting existing apiaries). During the initial survey bee-keepers were asked to say when they first started keeping bees, stating their experience in years. Figure 4 graphs experience against apiary sizes in Kokate.

The intention was for bee-keepers to state the number of years from when they had first taken full responsibility for a new apiary. The author acknowledges that the number of years since recommencing bee-keeping, following a period of absence, may have been mistakenly recorded on some occasions.

Figure 4 suggests that a relatively large number of hives can be kept by a Kokate bee-keeper no more than three years after starting an apiary. Furthermore, it seems likely that a knowledgeable bee-keeper would need a three year period in order to build up a large apiary from scratch; all but the richest farmers being unable to buy more than a small number of bamboo hives at any one time. The availability of bees and working time might also restrict more rapid expansion. Thus the steady rise in the line between two and five years from commencing bee-keeping may well be a result of gradual expansion of means rather than experience.

During the formal interviews it became apparent that many Kokate bee-keepers had been originally introduced to the occupation during childhood; normally by their fathers. This was especially true of those managing the comparatively large apiaries. Consequently it appears that "serious" bee-keeping is often an inherited speciality in Kokate, chiefly undertaken by those with a family background in bee-keeping. Bee-keeping experience, seen as a vital requirement for success, appears to be principally acquired during the formative years. In Kokate all but two of the bee-keepers interviewed were men over eighteen years old. Furthermore both the boys who were involved appeared to be receiving some assistance from adults within their households and were not completely responsible for their hives. It seems likely that bee-keeping is an occupation concerning more than one male member of many bee-keeping households. N.B. The term bee-keeper is used to describe the person with overall responsibility for the apiary.
FIG. 4. APIARY SIZE AND LENGTH OF BEE-KEEPING EXPERIENCE IN KOKATE

No. of occupied hives

Experience (years since apiary was started)

No. of bee-keepers = 15
In contrast, the majority of bee-keepers in Abele Ajeja were under eighteen years with boys as young as twelve years found to be keeping bees with seemingly little or no assistance from older members of their households. Moreover, unlike Kokate, there was no evidence of bee-keeping being a skill passed from father to son (even the bee-keeper with 24 occupied hives insisted that he had adopted the profession himself without any paternal assistance). Despite this apparent lack of inter-generational continuity it was noticeable that a surge of interest had been stimulated among some of the boys in Abele Ajeja by an experienced bee-keeper returning to bee-keeping, who was more than happy to offer his advice and example to others. None of the boys had an intact bamboo hive although one was using a broken bamboo hive which was reportedly inferior to a pot hive. The rest had only a single pot hive each. Some of the pots were cracked and so unsuitable for other uses. The merits of the pot hive as opposed to the bamboo hive are discussed in the section on hives.

Figure 4 shows that many Kokate bee-keepers have been continuously involved in bee-keeping for less than the past five years. This is mirrored in Abele Ajeja where the majority had begun their present apiaries less than a year before the survey. This implies that there is a tendency among bee-keepers in both PAs to discontinue their apiaries a few years after starting them. It seems that bee-keeping is often an occupation taken up and dropped at the whim of a farmer. This is confirmed by the fact that 6% of the households visited in Kokate and 4% of the Abele Ajeja sample had residents who said that they had previously kept bees.

It would appear that a high proportion of Kokate bee-keepers obtain bees only opportunistically (i.e. if a swarm happens to be found on a tree near their houses). If the colony subsequently absconds no attempt is made to retrieve it or to search for a replacement.

The proportion of the population of both PAs who had previously kept bees (but were not doing so at the time of the survey) was nearly as high as that which was occupied in bee-keeping at the time of the survey. This supports the conjecture that a significant number of farmers become involved in bee-keeping only to discontinue their apiaries after a period of a few years.
The hives

The bamboo hive (see Figure 5)
Made of three layers of woven bamboo, bamboo hives are reportedly made in the bamboo growing areas of the Kambata and Damota awrajas and are unanimously regarded by bee-keepers as the most efficient type readily available. This was not disputed by any bee-keepers using pot or wooden hives. The advantageous features of the bamboo hive were said to be its size, shape and interior texture, which provides good adhesion for the combs, along with the ease with which it can be handled.

It should be noted that the bamboo hive is found to be efficient when compared to the available alternatives. The pot and wood hives are discussed later in this section where their shortcomings are compared with the strengths of the bamboo hive.

Bamboo hives are purchased new at the markets of Soddo (by Kokate bee-keepers) and Humbo (Abele Ajeja bee-keepers). The price ranges between 2 to 5 birr with 3 birr being the most usually quoted price. Bamboo hives are said to come in small, medium and large sizes although the differences are small and probably not a deliberate policy of the manufacturers to produce a range. Larger hives which are well woven to exclude holes are the most expensive. Small, badly woven hives are the cheapest. Bargaining would appear to be a key factor affecting the price. Some farmers complained about sharp rises in the price of bamboo hives which were said to have cost only 1 birr in the previous year.

All but two of the bee-keepers interviewed (n=19) in Kokate were using bamboo hives. In contrast, only four of the Abele Ajeja bee-keepers interviewed (n=10) had intact bamboo hives. Bamboo hives are regarded as the most advanced type of hive readily available to the bee-keepers of Kokate and Abele Ajeja. They are also the most expensive. The higher investment in these hives found in Kokate is an indication of the greater importance (in terms of relative contribution to cash income) of bee-keeping in that PA.
**Figure 5. The Bamboo Hive**

Volume (approx.)

\[ V = \pi r^2 h \]

\[ 3.142 \times 13.5^2 \times 75 = 429 \text{ cm}^3 \]

\[ V = \frac{1}{3} \pi r^2 h \]

\[ \frac{1}{3} \times 3.142 \times 13.5^2 \times 34 = 65 \text{ cm}^3 \]

Total volume = 429 + 65 = 494 cm\(^3\)
The pot hive
It was said that the pots were the only form of hive in use until about 30 years ago when the more efficient and purpose-made bamboo hives started to become available. In Kokate only two of the bee-keepers (n=19) were using pot hives. The first had recently returned to bee-keeping after an absence of five years. He had stopped bee-keeping and given away his bamboo hives after a colony had absconded, attacked and killed three of his sheep. His decision to use pot hives was taken as his wife made the pots at no cost. The second bee-keeper had bought his pot hives off the first for 1 birr each. The use of pot hives was found to be far more usual among the bee-keepers of Abele Ajeja than of Kokate.

Despite their low price, the pot hives have many disadvantages when compared to both the bamboo and wooden hive. These are as follows:

(i) Heat.
unlike bamboo and wood, pottery is a material which, when subjected to intense sunlight, heats up to extremely high temperatures said to be detrimental to bees. The problem is particularly serious from the month of Tir to Ginbot when the weather is hottest. If the hive is allowed to become too hot the bees are likely to abscond. The problem can be partially or totally alleviated by covering the hive with grasses or enset leaves to screen the sun or by placing the pot in a shaded area (e.g. against the house, in a bush or under the branches of trees). However, unless very well protected a pot hive is still liable to heat up to temperatures unsuitable for bees.

(ii) Size.
Locally made pots were found to be too small to house a large colony, resulting in lower production per hive than from bamboo and wooden hives. Absconding was said to be a major problem, with bees reportedly leaving when the population of the colony becomes too large for the pot. It is not clear as to whether these desertions involve the entire colony or, as seems probable, a proportion of the bees on the emergence of a second queen (see later). Making larger pots was discounted as a possible solution as they would be too fragile, being liable to breakage during harvesting or even due to the heat of the sun.

(iii) Shape and adhesion.
The narrowing towards the neck, a feature essential to give a pot the necessary rigidity, was said to be disadvantageous for both the bee-keeper and the bees. The problem was said to be most troublesome at harvesting as the narrow neck makes the removing of honey and larvae awkward. This is accentuated by the lack of adhesion of the wax combs to the pot often causing them to break inside the pot during the harvesting operation. Badly broken combs are subse-
quently hard to remove, an inconvenience in turn worsened by the narrow neck. It is not clear as to whether the bees are seriously affected if the combs left by the bee-keeper are broken and loose in the hive.

(iv) Fragility.
In Abele Ajeja, all but one of the pot hives observed were placed on the ground despite the increase in the chances of pests (e.g. ants) entering the hive. The explanation was that pots were difficult to suspend securely above the ground. It was also said that during harvesting of a bamboo hive, it would normally fall to the ground. Obviously, this would have disastrous consequences for a pot hive. Conversely, both the Kokate bee-keepers using pot hives had managed to suspend them in bushes. Another, in Abele Ajeja, had tied the hive against his house. There were no examples of pot hives being placed on the wooden forks used to hold bamboo and wood hives. The forks are apparently unable to provide sufficient stability, particularly at harvesting.

(v) Hard or impossible to divide colonies.
Unlike those using bamboo and wooden hives there were no examples of bee-keepers trying to divide colonies from occupied pot hives into vacant pots or to retrieve swarming bees.

Removing larvae from a vacant pot hive and placing it inside an empty pot, without breaking the combs, would obviously be very difficult or impossible due to the narrow necks and lack of adhesion characteristic of the pots used. However, it is unclear why previously domesticated swarms cannot be retrieved and placed into empty pots.

(vi) The rigidity and fragility of pots.
The rigidity and fragility of pots means that they are not placed in trees to capture bees as described in method (ii) of obtaining bees. Bee-keepers using pot hives are thus restricted to method (i) for catching bees (see section on "Obtaining bees" below).

Although pot hives are clearly technically inferior to bamboo hives some bee-keepers insisted that there are also some counter-acting advantages;

(a) Price.
Pots are cheap. In Kokate one of the bee-keepers using pots had obtained them from his wife who makes them. The other had bought his pot from the first for 1 birr, a price substantially lower than for a bamboo hive. All the bee-keepers using pot hives in Abele Ajeja said that they could not afford to invest in bamboo hives.
(b) Good larvae production.

One Kokate bee-keeper said that although he expected a low honey yield from the pots, larvae (the harvesting of bees larvae is widespread in both PAs) production would be high. It is illogical that more larvae are produced inside a pot hive than a bamboo hive and it appears that this reportedly high output is really a result of the bee-keeper taking a greater proportion. It was found that those bee-keepers who harvested the largest quantities of larvae were generally keeping pot hives.

A number of bee-keepers, with both bamboo and pot hives, said that one of the reasons for taking larvae is to limit the population of a hive in order to prevent the loss of bees by swarming. As a queen bee will lay the same amount of eggs regardless of the size of the hive, swarmings are more common from pot hives due to their low capacity. It might thus be seen as expedient for the owner of a pot hive to utilise larvae instead of risking the loss of adult bees (see uses of hive products, larvae). However, there is also evidence that tampering with the brood can cause absconding (see section on "absconding and swarming" below).

(c) One of the Kokate bee-keepers using pot hives had previously kept occupied bamboo hives. He felt that colonies occupying pot hives were less dangerous than those occupying bamboo hives. This may be due to there being a smaller bee population inside a pot hive. The rate of honey production per hive is also lower as a greater proportion of the hive is filled with combs containing larvae. It is during honey production when bees are reportedly most dangerous.

The wooden hive

A hive made of twigs and branches of the carivincha (Amh.) and Gircha (Amh.) trees is constructed to the same design as the bamboo hive. This type of wooden hive was only found in Abele Ajeja. Thin newly cut branches are twisted together emulating the woven affect of the bamboo hive. The advantage of the wood hive is that it is made by the bee-keepers at no financial cost. However, to make a wooden hive would appear to be a task requiring a high degree of skill and a lot of time. Also, the life of a wooden hive was said to be shorter than that of a bamboo hive due to the aging of the wood which dries and cracks leaving holes. A new wooden hive, although superior to the pot hive, has an irregular interior less favourable for honeycomb adhesion than the more uniform inside of a bamboo hive.
In Abele Ajeja, wooden hives are apparently used in preference to bamboo hives for obtaining bees by method (ii) described below in the section on obtaining bees. It is perhaps less essential to use a high quality hive for this purpose. Bees may be transferred to a bamboo hive after entry into the wooden hive. One bee-keeper who was keeping 18 occupied bamboo hives, along with 6 occupied wooden hives, had a further 6 vacant wooden hives in trees. He ensures that all the superior bamboo hives are fully utilised inside the apiary.

The box hive

One Kokate bee-keeper had an apiary containing two wooden box hives of a modern design (along with two older bamboo hives which he had established before his introduction to the box hive). This bee-keeper was not found at random but visited after other farmers reported that this farmer was using such a hive. The bee-keeper had seen and learned of the box hive system at the state managed apiary at Holeta Genet, the workplace of his brother.

In contrast to the other bee-keepers in Kokate and Abele Ajeja this bee-keeper exclusively produces pure honey. Pure honey can be regarded as a different product from the mixture of honey, wax and other impurities which results from the current, more traditional systems operated by other bee-keepers in the two PAs. The bee-keeper separated the honey from the wax by placing the combs onto a metal grill so that the honey runs down into a container placed underneath. It is interesting to note that the bee-keeper was apparently able to extract pure honey from the combs taken from the bamboo hives using the same method employed when separating pure honey from the combs inserted into the box hives. The efficiency of this method when applied to the naturally produced combs (i.e. not wax remolded by the bee-keeper) is not known. The bee-keeper did not appear to regard his two bamboo hives as being very important.

The advantages of the box hive are clear. From two harvestings in the months of Hidar and Tahsas the farmer expected to get 25 kg of pure honey from each box hive (which were both containing red bees). In addition, it was thought that a single smaller harvest would be possible sometime between the months of Tir and Sene yielding around 5 kg of pure honey from each hive. In comparison, the bee-keeper only anticipated a yield of 5 kg of pure honey per bamboo hive which would be taken in two harvestings to be carried out in Hidar and Tahsas. That the bamboo hives were occupied by colonies of the apparently less productive black bees should be taken into account when comparing the production of bees kept in box hives against that of bees occupying bamboo hives. The bee-keeper felt that the bamboo hives would yield 7-8 kg of pure honey if they were occupied by red bees.
Pure honey was said to fetch 10 birr per kg if sold during or soon after the harvesting season. The price reaches 12-14 birr per kg in Hamle, Sene and Nehassie when demand is maintained while supply is low. If both the bee-keeper's yield and price estimates are accurate each box hive generates between 300 and 420 birr annually; a figure far exceeding the cash returns from a bamboo hive.

However, the cost of entering into this method of honey production is high; box hives are quoted at 200 birr each if bought from a manufacturer or trader. This price would appear to be considerably beyond the purchasing power of most farmers. However this farmer, who obviously possessed considerable carpentry skills, had been able to make a major economy by building the hives himself from locally obtained wood. He had also saved on buying the artificial honey combs used in modern bee-keeping by buying locally produced beeswax at 10 birr/kg from a Soddo tej house. After melting and rolling the wax he used a special stamp to print the hexagonal honey storing chambers into the wax. The resulting honeycombs are then placed onto trays inside the hive as is done elsewhere in modern bee-keeping enterprises. The stamp, a metal grill for separating the honey from the honeycombs, some protective gloves and a face mask were apparently the only items imported from outside Welaita (protective clothing may well be of greater necessity to a box hive keeper as his bees are mainly occupied in honey production. It is during honey production that bees are said to be most dangerous.

The bee-keeper said that he takes all the honey and substitutes purchased sugar solution along with milled beans and peas. He claimed to spend 100 birr per annum on feeds; a level of input far exceeding that of any other bee-keeper interviewed.

There were no other examples of such methods being employed elsewhere in either Kokate or Ahele Ajeja. Modern bee-keeping methods will not be discussed elsewhere in the report as, other than this solitary example, they are not relevant in a report aiming to describe the present nature of bee-keeping in the two PAs visited.

**Feeding bees**

It was generally accepted, by most of the bee-keepers asked, that a colony must be left a proportion of it's honey or otherwise be given suitable substitute foods if it is to survive or remain in the apiary. The amount of honey left for the bees and/or the type and levels of feeding were found to vary considerably. Bees store honey made when forage is plentiful (e.g. Hidar, Tahsas, Tir in Kokate) in order to sustain themselves through the rest of the year when flowers are scarce or unavailable.
Of the nineteen bee-keepers interviewed in Kokate seventeen definitely feed or/and leave the bees a proportion of their honey (the answers of the remaining two are unclear from the interview notes and cannot be reliably used). One bee-keeper in Abele Ajeja denied ever leaving honey or feeding his bees. He felt that the bees are still able to feed themselves, even if all the honey is taken and that water is the only essential input. This bee-keeper, who had only one occupied hive at the time of the survey, reported that two further colonies had recently absconded. This may be connected to over exploitation by the bee-keeper.

Those bee-keepers who leave honey in the hive usually quoted figures of leaving between a quarter (the most common figure) and one tenth of the honey available. It was unanimously agreed that the proportion taken is the same at each harvesting.

Some bee-keepers said that they save a little honey which is reintroduced to the hive during the "rainy season" when the need is reportedly greatest. The quantity returned to the bees is very small; for example half a tea glass diluted with water per hive. A small number of small-scale bee-keepers said that they leave from one half to three quarters of the honey. It was thought that leaving a high proportion of the honey would stimulate the bees to produce more larvae. Larvae appeared to be a very sought after product, if not as important as honey, for some bee-keepers.

A high proportion of bee-keepers supplement their bees' diet with bought foods such as teff, beans, chick peas and peas which are milled before being placed either inside or immediately outside the entrance of the hives. The threat of the bees and the watchful bee-keeper was said to deter other insects and animals from stealing the food by those who leave it outside. One bee-keeper in Abele Ajeja switches from giving bought foods to domestically grown maize as soon as the harvest becomes available around the month of Sene. A single bee-keeper in Kokate feeds his bees a mixture of crushed beans and honey.

The amount of money spent on feeds varies dramatically. For example, one bee-keeper said that he would spend ten birr buying feed for his single hive while another quoted the same expenditure for his apiary of six occupied hives. Two cupfuls of bean powder a week (costing 15 cents) were thought to be sufficient by one bee-keeper with one occupied hive. He also said that it is unnecessary to feed routinely and that discretion and experience can be used to judge when the feed is needed.

It is important to note that by far the largest bee-keeper in Abele Ajeja, with 24 occupied hives, said that he never feeds his bees as it is too expensive to do so (a view repeated by others who also do not feed their bees). He believes that the honey left at harvesting (one quarter) provides enough food to maintain his
colonies throughout the year. His apparent success seems to support this belief. It should be taken into account that living by the river may mean that this bee-keeper's colonies have a larger honey supply, than those situated away from the river, due to a greater and more prolonged access to flowers.

Watering bees

All the bee-keepers interviewed agreed that unless there is a natural water source near the apiary a colony must be given water if it is to remain in the hive. In Abele Ajeja, even those living close to a river said that this is necessary during the hottest months of Megabit, Yekatit, Miazia and Ginbot when water courses often dry up. Water is administered in tins or on pieces of broken pot placed either inside the hive or on the ground immediately outside it. Water placed outside the hive can apparently be prevented from evaporation by shading it from direct sunlight. It was said that the bees provide a big enough deterrent to stop animals drinking the water.

Obtaining bees

The term wild bees is used only to describe non-domesticated colonies (i.e. those not being used in bee-keeping). However, it is possible for wild bees, captured from their natural habitat, to have been previously domesticated.

All the bee-keepers interviewed said that one method of obtaining bees was by capturing a wild colony during the reproductive swarming stage.

In Kokate, the month of Tikemt was said to be a good month for finding swarms although examples of newly caught swarms were found during the survey which took place in Hidar. No honey was expected until the following year from a colony obtained so late into the harvesting season.

One Abele Ajeja bee-keeper had recently obtained a colony when he was visited by the survey team during Tahsas. There is no information on whether swarms are easier to find in any specified season in Abele Ajeja.

There were two approaches to capturing wild swarming bees;

(i) The bee-keeper either searches for or inadvertently discovers a swarm of wild bees. Wild swarms were said to be found hanging on trees in wooded areas, especially where there is nearby access to a river or other source of water.

Once a swarm has been found the queen, known locally as the "king", must be located and removed. Some bee-keepers said that they spray water onto the swarm in order to disperse the other bees which surround the queen. The queen can be
distinguished from the other bees by her longer, thinner body. Obtaining a colony in fact only involves actively capturing the queen as the others will always follow wherever she is taken.

During the operation to catch the queen there is the risk of the queen flying away. If this happens the bee-keeper will be unable to capture the colony unless the queen is again tracked down. Bee-keepers in both Kokate and Abele Ajeja have a common method for preventing the queen escaping at this time. Firstly the bee-keeper uses thread to tie the queen in a way preventing flight and movement of her wings. This allows her to be conveniently carried back to the apiary. There her wings are cut by the bee-keeper; using his teeth.

The disabled queen is thus permanently prevented from flying and presumably unable to leave the hive in which she is placed (see absconding and swarming). Bee-keepers emphasised the special care needed when carrying out this operation. An absence of care can lead to the injury or death of the queen resulting in the eventual loss of the whole colony (adult workers are unable to secrete royal-jelly which is necessary to rear a new queen).

All the bee-keepers interviewed said that they obtain some or all of their bees in the way described above. For the majority (small-scale) this was the only method.

(ii) The second method of obtaining wild bees is when bamboo or wood hives (see hives) are placed and left in trees. When occupied, a hive is removed from the tree and introduced to the apiary where it can be better protected from the sun and rain; and where the bee-keeper can observe it more closely and effectively. In Kokate, trees near to or surrounding the bee-keeper's land are often used. In Abele Ajeja, where suitable trees are scarce, the hives normally have to be left further from the bee-keeper's land and especially near the river.

It was said that bees are less likely to enter a new bamboo hive than one which has been exposed long enough to lose its bright colour and to gain the natural smells of its surroundings. Some bee-keepers believe that fumigating a hive with the smoke of burning Weira (Amh.) wood leaves an attractive scent which entices bees to enter. Placing the leaves of the Weira (Wogera. Wei.) tree inside hives in order to induce bees to enter was a ploy used by one bee-keeper in Abele Ajeja. Surprisingly, to the author, no bee-keeper said that he used honey as a bait to attract wild bees into vacant hives.

It seems probable that hives left in trees are likely to be occupied by unwanted intruders such as other insects, spiders and birds. When this likelihood was suggested to a bee-
keeper he said that he blocked the hive's entrance with straw leaving only a small hole for the bees to enter. This method was observed to be used by others also and presumably prevents larger animals if not insects and spiders. A possible drawback is that entering the hive is made more difficult for bees. A large open entrance was cited as a major advantage of bamboo and wooden hives and some, but not all, bee-keepers leave it completely open once a hive is introduced into the apiary.

It was normally the larger-scale bee-keepers who were involved in method (ii) of obtaining bees.

This second method of catching bees described above explains why a number of bee-keepers in both PAs had a significant number of empty bamboo and wooden hives in their possession. In Abele Ajeja three of the bee-keepers asked (n=7) had one (bamboo), one (wooden) and six (wooden) empty hives, respectively, left in trees at the time of the survey. In Kokate six of the bee-keepers (n=19) had from between one and eight empty bamboo hives in trees. One of these bee-keepers had a further six empty hives which he used for other purposes, such as storing maize. Another bee-keeper had three empty hives which were all used for storing grain as opposed to capturing bees.

The answers of the majority of bee-keepers suggest that wild bees are only captured when they swarm. However, one elderly Kokate bee-keeper, with six occupied hives, and a long experience of bee-keeping said that smoke of the Weira tree can be used to chase wild bees into a hive. Although this method may be used only for capturing swarms it is possible that non-swarming wild bees may be chased out of their nest in order to capture them. This method of capturing wild nesting bees, although not mentioned elsewhere in either PA, is supported by some literature and could well be the one employed by this and possibly other bee-keepers. The bee-keeper described this method of obtaining bees as being less desirable than method (ii).

Bee-keepers living by riversides, in both PAs, are the most conveniently placed to obtain swarms which tend to head towards rivers where trees, water and flowers are generally most abundant.

In Abele Ajeja the lack of trees, water and flowers around the houses away from the river make it necessary for residents to travel the furthest distances in order to find swarms. Consequently more time and effort is required.

One possible explanation for the number of young boys involved in bee-keeping, in Abele Ajeja, is that they are more likely to find swarms than the senior men who tend to spend most of their time around the houses and cultivated land.
The young boys appeared to show a level of enthusiasm for bee-keeping almost completely absent in the more senior men. It is probable that this lack of interest among the senior men could be a result of the low, unreliable returns from bee-keeping in a lowland area.

Absconding and swarming

Absconding, when an entire colony deserts the hive, is a characteristic of all African and tropical bees. All the bee-keepers in Kokate and Abele Ajeja said that absconding is a problem although some had been affected more than others. Some of the causes of absconding are discussed individually in the section on problems.

Swarming is characteristic of all bees. It is part of the natural process by which colonies multiply, and occurs when a second queen emerges to rival the established one. The new queen commands the loyalty of a proportion of the colony. The response of the older queen is to leave the hive, along with several hundred drones and thousands of workers, (i.e. a swarm) in order to set up a new colony. The swarming of a domesticated colony is seen as undesirable by bee-keepers in Kokate and Abele Ajeja as it involves the loss of up to half of the honey-producing adult workers.

There are several techniques used in attempts to prevent or at least postpone absconding and swarming.

(i) Most bee-keepers break, clip or cut the queen's wings in order to stop her leaving the hive and causing the colony to abscond (see obtaining bees). This method can also prevent swarming as when the original queen tries to fly from the hive she falls to the ground and dies. Her swarm, realising that they have no queen, will then return to the hive. Despite this practice both absconding and swarming persist; albeit possibly to a less extent.

The author assumes that more than one new queen must emerge for a colony with a clipped queen, to swarm. The problem of absconding may be accentuated by clipping as the return of an aborted swarm may lead to the absconding of the entire colony due to overcrowding.

(ii) Some bee-keepers said that removing larvae can prevent both absconding and swarming. These bee-keepers admitted that this policy is not always successful. One possible explanation for this is that the larvae removed do not include the future queen. The queen continues to be reared as normal by the workers. After her emergence, and the failed swarming of the clipped queen, the new queen leaves the hive and causes the rest of the colony to abscond. Interfering with a colony's brood is an acknowledged cause of absconding in bee-keeping literature.
Several bee-keepers from Kokate, along with one from Abele Ajeja, were clearly aware that swarming and absconding occurs on the emergence of a second queen. It is important to note that, with one exception, each of the bee-keepers with this knowledge had relatively large apiaries containing more than five occupied hives; a fact which may be interpreted as success. The exception, who had two occupied hives, had only recently begun to keep bees and was planning to expand. The following techniques are the ways in which these bee-keepers attempt to prevent absconding and swarming:

(i) Two Kokate bee-keepers, who at the time of the survey owned six and thirteen occupied hives respectively, shared the belief that a colony will produce twelve new queens before the original one dies. Their response to the emergence of a second queen is to immediately kill her possibly stopping the established queen attempting to swarm. Although high yields may be maintained this appears a rather wasteful ploy when compared to (ii).

(ii) Two Kokate bee-keepers with ten and two occupied hives respectively along with one, who with twenty four occupied hives was by some margin the largest bee-keeper in Abele Ajeja, were apparently able to use the emergence of a second queen to their advantage. Their method is to ensure that the second queen enters another hive within the apiary to start her colony and by so doing increasing the number of occupied hives. It has not been clearly understood as to precisely how this is done. However it was stated by one of the bee-keepers that he takes larvae from the first hive and places it in an empty hive; anticipating the emergence of a second queen.

(iii) One Kokate bee-keeper said that leaving vacant hives in trees (i.e. method (ii) for obtaining bees) also acts as a way of recapturing absconding and swarming bees in order that they may be reintroduced to the apiary as a new colony.

The bee-keeping calendar

Figures 6 and 7 show the contrasting seasonal progression through the various stages of the bee-keeping calendar in Kokate and Abele Ajeja. Figures 6 and 7 are further explained in the sections on feeding watering and harvesting.
FIG. 6. THE BEEKEEPING CALENDAR IN KOKATE

Low season for flowers

Feeding

Watering

Plentiful flowers

Harvesting

* This bar only represents those bee-keepers who give their bees feed supplements
FIG. 7. BEE-KEEPING CALENDAR IN ABELE AJEJA:
AWAY FROM THE RIVER

Earliest estimates

Low season for flowers
Feeding
Watering
Plentiful flowers
Harvesting

Latest estimates

Low season for flowers
Feeding
Watering
Plentiful flowers
Harvesting

* These bars only represent those bee-keepers who give their bees feed supplements
CHAPTER 3. PROBLEMS IN BEE-KEEPING

Major problems

Bee-keepers in both PAs were asked to state the various factors which threaten the well being of their bees and how best they can be addressed. The following major problems, which were all said to lead to absconding, emerged from the ensuing discussions:

**Ants and spiders**
These were blamed for entering hives. If allowed to do so the spread is reportedly fast eventually leading to the colony absconding. Bee-keepers said that they would repeatedly search and dig the area surrounding their hives for ants and spiders. If they are found one of the following methods of control is used;
(i) Pouring boiling water onto the ants or spiders.
(ii) Burning off the area occupied by the ants or spiders.
(iii) Spreading DDT powder over the area occupied by the ants or spiders. This method was not being practised at the time of the survey due to the unavailability of DDT. It was also said that DDT spread near hives also exposed the bees to the possibility of poisoning and is thus an unsuitable approach to controlling their enemies.

Each of these applications were said to be effective in destroying both ants and spiders. However it is very difficult to find and intercept each attack and infestations cannot be avoided using these methods alone.

In both Kokate and Abele Ajeja bamboo and wooden hives are suspended on wooden forks about one metre from the ground. Keeping hives off the ground was said to be the most effective method of avoiding infestations as it is difficult for ants and spiders to climb the forks. Invading ants and spiders are also easier to observe when attempting to climb the forks than when entering a hive at ground level.

**Heat**
It was said that bees are likely to abscond if sunlight is allowed to shine directly onto the hive. This problem is potentially most serious from Tir to Ginbot which are the hottest months in the Ethiopian calendar. All the apiaries visited in Kokate were situated in shaded areas (i.e. under trees and behind houses). In addition all the hives observed were covered with layers of enset leaves or straw in order to shield them from the sun. Kokate bee-keepers felt that the sun's heat should not cause any problems if due care is taken to exclude it.
The climate in Abele Ajeja is hotter than in Kokate and the sun's heat is subsequently more of a problem. This is exacerbated by the lack or absence of trees around the bee-keepers' houses to provide shading. Most hives were covered with straw and placed in the shade of the house (one hive was tied to the side of the bee-keeper's house in order to maximise the shading). In Abele Ajeja suitable covering materials for beehives are also less plentiful than in Kokate. This may explain why a couple of young bee-keepers had not covered their hives.

**Rain**

Bee-keepers emphasised the importance of preventing rainwater from leaking into hives. If this occurs, absconding is likely to result. Obviously the problem is most threatening during the "rainy season" months of Ginbot to Nehassie/Meskerem.

When buying bamboo hives or making wooden hives it is very important to ensure that they are well made with no gaps where water can penetrate. The layers of enset and straw which protect against the sun double as waterproofing in the rains and it was generally agreed that if this is done correctly, with a sufficiently water tight hive, there should be few problems.

It is possible that suspending hives above the ground prevents run-off surface water from seeping in at the entrance.

Rain was also said to prevent bees from leaving their hives to collect pollen. The "rainy season" preceding the survey had been unusually long, extending well into the month of Tikemt (the beginning of Meskerem is locally regarded as the beginning of the "dry season"). A number of bee-keepers in Kokate thought that the prolonged rains had significantly interfered with their bees during Meskerem and Tikemt which, due to flower emergence, are two of the most important months for pollen collection. The result was said to be a poor year for honey yields.

**Overcrowding**

If a colony is allowed to continue rearing its brood without restriction the hive will gradually become overcrowded. The likely result of overcrowding is swarming after the emergence of a second queen or the absconding of the entire colony.

Overcrowding can be alleviated by removing larvae from the hive either for consumption or in order to create a new colony. Overcrowding is a more serious problem when using the smaller pot hives (see hives). The problem of overcrowding was only mentioned by bee-keepers in terms of individual hives. However, it is also written that colonies are likely to abscond from an area which is overpopulated by bees and cannot satisfy their combined forage needs.
Chameleons*
Bee-keepers in both Kokate and Abele Ajeja said that chameleons sometimes enter their hives, stealing honey and causing the bees to abscond.

Thieves
Virtually all the bee-keepers interviewed said that thieves were a serious problem although only a handful had actually had hives and/or honey stolen. However, the damage to the victims' apiaries is apparently devastating with some, if not all, of their hives being broken beyond repair in crude attempts to steal the honey.

Minor problems

Birds
Some birds were said to sometimes eat bees. The actual extent of their impact is unknown and seems unlikely to be very significant.

Tobacco and DDT
Some bee-keepers said that they had past experience of bees being poisoned by DDT applications and pollen from tobacco plantations. At the time of the survey there was reportedly no DDT usage or tobacco cultivation in either Kokate or Abele Ajeja.

Disease
There were no reports of any bee diseases in either Kokate or Abele Ajeja.

Reasons limiting the sizes of current apiaries and discouraging newcomers to bee-keeping.

It has been shown that only a small proportion of farmers in both PAs participate in bee-keeping. In addition 64% of those bee-keepers who answered the formal questionnaires have less than three occupied hives.

Each of the bee-keepers who answered the formal questionnaire were asked to state why a larger number of farmers do not keep bees, given the relatively high potential profits of honey production, and why they themselves do not increase the number of hives in their apiaries. The general response was that a loosely defined "lack of interest" is to blame. Further questioning uncovered the following reasons behind this perceived lack of enthusiasm:

(i) A shortage of expertise. Some bee-keepers said that their fathers had taught them the skills necessary to become successful bee-keepers. Others had gradually gained enough knowledge by observing and emulating other bee-keepers in

* Editor's comment, "Chameleons" may be a mistranslation for "lizards".
their neighbourhoods. The ability and willingness to learn were cited as vital characteristics of an aspiring bee-keeper. It was said that even after tuition, proficiency only results from trial and error. The behaviour of the bees can apparently only be fully understood after gathering personal experience. Experience was also thought important in order to acquire and develop individual techniques and methods which are found to be convenient.

(ii) Fear. Gaining bee-keeping experience requires courage as being stung is an inevitable occurrence. Although apprehension tends to be higher in unconfident and inexperienced beginners the dangers discourage not only novices. The bee sting was said to have either caused or contributed to most of the PAs' former apiarists stopping keeping bees. The story of one Kokate bee-keeper suggests that fear of Welaita's bees is certainly not irrational. Three of his sheep had apparently been killed by a swarm of bees which had absconded from a bamboo hive. This event resulted in him selling and giving away his entire apiary of eight bamboo hives. Five years after the incident his confidence has returned sufficiently to allow his son to keep bees next to the house using two pot hives. He felt that bees occupying pot hives are less dangerous.

Stephen Adjare writes that bees are more aggressive in hot weather. Abele Ajeja, a lowland area, has a hotter climate than Kokate. It is, therefore, possible that bees living there are more ferocious; discouraging people from bee-keeping. It was noticeable that bee-keepers in Abele Ajeja dwelled on the subject of the bee sting longer than those in Kokate. They were also quick to make the distinction between the relatively passive black bees and the more militant red or bad bees (this distinction was also made in Kokate but only after the bee-keepers were asked to state the differences between colonies in their PA).

Bee-keepers often remarked that they would expand their apiaries if they had access to "modern equipment". When asked to expand on what was meant by "modern equipment" they expressed a strong desire for items of protective clothing. Introducing other elements of modern bee-keeping was not suggested. The impression given by those people aware of modern bee-keeping was that they felt such methods to be completely beyond their capabilities.

(iii) Money. Money limits honey production in both PAs in two ways. Firstly, finance is required to make the initial investment in bamboo hives. Although cheaper alternatives are available none are as productive. Secondly, bee-keeping is not a source of fast money. It was said that farmers dislike making an investment which does not provide quick returns.
The high frequency of absconding in much of Abele Ajeja raises questions about whether the investment of money (and time) is worthwhile. The small and unreliable returns from bee-keeping appear not to justify risking capital. Apiculture is present only to a small extent in most of Abele Ajeja and that which exists is of low technology and receives little or no financial input.

(iv) Lack of bees. Only two bee-keepers (both in Kokate) said that a lack of bees prevented other farmers from bee-keeping. The general consensus, in both PAs, was that there are sufficient wild bees to allow a greater involvement in bee-keeping. Also, those bee-keepers who are able to divide colonies did not report a higher incidence of absconding as their apiaries increased in size.
CHAPTER 4. HARVESTING

The impact of the environment and the seasonality of harvesting

The environment and climate were found to be important issues which control the potential for bee-keeping in Kokate and Abele Ajeja. In both PAs wild bees were said to be mostly found around rivers due to their need for water and flowers which are more numerous at riversides. Although Kokate bee-keepers said that it is probably more convenient to keep bees near water there were examples of successful apiaries situated significantly beyond the vicinity of a river or other natural water source.

The effect of the river on bee-keeping in Abele Ajeja was much more pronounced. Two Abele Ajeja bee-keepers, with 24 and 3 occupied hives respectively, lived on farms immediately adjacent to the river flowing through the PA. The greater access to water and flowers offered by this location has an obvious impact. Both these bee-keepers use the superior bamboo and wooden hives and work to the same harvesting and marketing schedule found in Kokate.

Maize is the dominant crop in Abele Ajeja and virtually all of the bee-forage, away from the river, is obtained from maize flowers. The hot, dry conditions prevailing in Abele Ajeja mean that few wild flowers can survive there. The small number of sparsely distributed and mainly pot hives confirm that a much lower level of production is possible in such a dry and barren environment. Those bee-keepers with apiaries situated away from the river complained that absconding is an all too common occurrence with bees leaving for the more favourable conditions found by the river in Abele Ajeja and in the highlands. It appeared to the researcher that absconding is so prevalent in this environment that bee-keeping is not considered worthwhile by many senior men. Those individuals who, against the odds, attempt to keep bees seem to accept absconding as an inevitable consequence of the conditions and do not consider bee-keeping as being particularly rewarding.

EDITOR'S NOTE

A reviewer has commented here:

"It has been mentioned that maize is one of the dominant crops for honey production. But maize can only provide pollen for the bees. Pollen directly has no value for the production of honey. Pollen is used for rearing the brood and as a protein source for adult bees. For honey production there should be some plants in the area that secrete nectar which are not identified or are not mentioned in the report. Or some times in the same area maize can provide honey-dew honey only."

[END OF EDITOR'S NOTE]
In Kokate, the main harvesting season falls between the months of Tikemt and Tir due to the availability of flowers providing plenty of bee forage. Hidar and Tahsas were generally cited as the most productive months. A small number of Kokate bee-keepers said that it was possible to take a little honey sometime between Tir and Sene when some bee forage is available from the flowering of the upland maize crop. Eight out of the ten bee-keepers asked in Abele Ajeja said that Sene, Hamle and Nehassie were the months during which harvesting takes place due to the flowering of the maize crop.

The date of the harvesting season depends on the flora of the area surrounding the apiary. Flowers growing by the river in Abele Ajeja allow the two bee-keepers living nearby to work to a similar schedule as found in Kokate.

Methods of harvesting
Both honey and larvae are harvested using a long, flat knife (approx. 30cm) to cut the combs away from the sides of the hive. Most bee-keepers said that they burned wood and/or manure to disperse and sedate the bees before moving in to remove the combs.

Bee-keepers were in agreement that individual harvestings should be separated by a break of fifteen days. There was surprisingly little variation on this issue, with fifteen days being repeatedly quoted as the correct interval.

In Kokate, opinion was divided as to whether honey should be taken on two or three separate occasions during the harvesting season. All the Abele Ajeja bee-keepers, who gave an answer, said that they harvested twice in a season. The proportion of the honey removed at each harvesting varies considerably (see feeding bees).

Yields: honey and larvae

Honey
Accurately determining honey (i.e. the mixture of honey and wax obtained by the bee-keeping methods of both PAs) yields proved a difficult exercise as most bee-keepers were being unable to quantify harvestings in kg or any other weight scale. Those bee-keepers who did estimate the number of kg taken per hive, per harvesting, gave answers ranging from 1 kg up to 4 kg.

Several appointments were made by the researcher to be present at a harvesting in order to weigh the honey immediately after its removal from the hive to avoid any misunderstandings. Unfortunately all the bee-keepers with whom arrangements were made were, for various reasons, unable to keep to the agreed dates. It was
therefore necessary to weigh stored honey, when availability and permission allowed, relying on the bee-keepers' information regarding the number of hives and harvestings from which it was obtained. The complete results of these weighings, along with how they are derived, are listed in Appendix II.

In Kokate honey from three apiaries was weighed with the mean yields per hive, per harvesting, being 1.50 kg, 2.95 kg and 3.57 kg respectively. Each of the three apiaries contained only bamboo hives. These results show a considerable degree of variation with one bee-keeper apparently obtaining well over double the yield of another. The bee-keeper who obtained a mean of 1.50 kg per hive, per harvesting stated that this was a particularly disappointing yield.

The two Kokate bee-keepers using pot hives felt that they would obtain between one half and three quarters of the honey which would be produced using bamboo hives on the same sites.

Only one Abele Ajeja bee-keeper, who lived by the river, possessed honey at the time of the survey. He was unable to specify the number of hives and harvestings from which it was obtained. Honey purchased from this bee-keeper was used to fill a pot to the level stipulated, by another bee-keeper, as being an average harvesting from a single pot hive. The honey was then weighed. The results indicate that the pot hive yields only 0.9 kg of honey per harvesting; supporting the unchallenged view that colonies occupying bamboo hives are able to produce more honey. It should be noted that environment, harvesting policy, inputs, age and variety of bees are other factors which should also be considered in reaching this conclusion.

During a short visit to northern Kenya in January 1993 the author inquired about honey yields obtained by the nomadic Samburu tribesmen who harness bee colonies inside hollowed tree trunks; returning periodically to remove honey. It was said that the honey season lasts for six months during which it is possible to harvest twice a month; removing 8 kg of honey, per hive, on each occasion. If these figures are believed a single hive will yield as much as 96 kg of honey annually. The author accepts that these figures were obtained in a vastly different environment than found in Welaita and certainly does not endorse their accuracy. However, it is felt that the huge difference between the data (Samburu nomads apparently obtaining over ten times as much honey as Welaita bee-keepers) stresses the pitfalls of estimating yields without witnessing the harvest at first-hand.

It was noticeable that bee-keepers were often unwilling to let the researchers weigh their honey. In addition, they often became curiously cagey whenever asked to specify the financial returns of honey production. For this reason it was virtually impossible to make any attempt at assessing yields by asking bee-keepers the amount of money generated annually from selling honey.
It is hoped that the above weighings give a reasonably accurate account of honey yields but it is clear that there is considerable doubt over their credibility.

Larvae
In Abele Ajeja all but one of the bee-keepers asked (n=10) said that they harvested larvae (the bee-keeper with 24 occupied hives who said that he never removed larvae unless dividing colonies to increase the size of his apiary). Two Kokate bee-keepers (including the one using box hives) also abstain from harvesting larvae. Most of the bee-keepers in both PAs said that they took up to one quarter of the larvae during the honey harvest. The exact quantity reportedly depends on the circumstances (see uses of larvae) and the majority of bee-keepers said that only a negligible amount is taken if there is no necessity.

The author has been advised that it is impossible to harvest honey from a bamboo, pot or wooden hive without simultaneously removing some larvae. This is due to there being no restriction on the queen's movement inside these hives (i.e. she is able to lay her eggs randomly throughout the hive). However, it was also said that there is a tendency for the bulk of the brood to be situated around the middle of the hive, with honey at either side, in order to keep the larvae warm. During the interviews a number of bee-keepers said that they sometimes take larvae without harvesting honey. In Abele Ajeja, the researchers were offered larvae. None of the combs offered, which were shared among a group of more than ten people, contained any honey whatsoever.

Two bee-keepers in Abele Ajeja with only one occupied pot hive apiece, said that they remove as much as three quarters of the larvae twice a year at the same time as honey harvesting. In Kokate two bee-keepers, with four and one occupied bamboo hives respectively, claimed to remove between one half and three quarters of the larvae at each honey harvesting. Both Kokate bee-keepers using pot hives said that they will also take a high proportion of the larvae once it becomes available. The usual reason given for such heavy exploitation of larvae was that it is necessary in order to prevent the loss of bees in swarms (see swarming). Many of the other bee-keepers also said that one of the reasons for removing larvae is to prevent swarming. However, in their cases a much smaller extraction is apparently sufficient. It seems highly likely that removing such a high proportion of the larvae as three quarters must result in a decrease in honey yields. That all but one of these bee-keepers have only one occupied hive is perhaps an indication that they lack expertise or seriousness as honey producers.
CHAPTER 5. MARKETING AND DOMESTIC USE OF HIVE PRODUCTS

Honey

The major product of bee-keeping in both Kokate and Abele Ajeja is honey. All the bee-keepers agreed that honey is a product sold to raise cash. When asked to state what proportion of honey is consumed domestically answers of between 2% to 0% were given. The tiny proportion which is eaten is normally taken at harvesting and was often said to be the lowest quality part of the harvest. Honey is sold at the markets of Soddo (by the bee-keepers of Kokate) and Humbo (by the bee-keepers of Abele Ajeja). The buyers were said to be both the consumers (from tej houses) and traders who later resell at other markets. In addition, traders were said to sometimes visit the bee-keepers of Kokate to buy honey at their houses. The fact that traders were not reported to visit bee-keepers at their homes in Abele Ajeja is an indication of the lower production of that PA which perhaps does not justify the journey.

The price of honey was said to vary depending on the time of year. Figure 8 shows the general pattern of price fluctuation as described by the bee-keepers of both Kokate and Abele Ajeja.

The price of honey is intrinsically connected to supply as demand appears to remain relatively constant throughout the year. It is lowest between Hidar and Yekatit during and soon after harvesting takes place in areas of high and mid-altitude such as Kokate. Predictably the price gradually rises in the months following the harvesting season until it finally reaches a high in Hamle and Nehassie. Some Kokate bee-keepers save a proportion of their honey harvest in order to obtain the higher prices available later in the year. However, this policy is apparently impossible for the majority who cannot wait due to the pressing need for money earlier in the year. None of the bee-keepers could afford to put all their honey into storage.
FIG. 8. VARIATIONS IN HONEY PRICES THROUGH THE ETHIOPIAN CALENDAR

Price of honey
(Ethiopian Birr)

Ethiopian months
The bee-keepers of Abele Ajeja, with two exceptions, harvest and sell their honey in Sene, Hamle and Nehassie when the price is highest. Their level of production would appear to be insufficient to affect the market price which becomes almost static during this period. The two bee-keepers residing beside the river in Abele Ajeja sell their honey soon after the harvest which coincides with that in Kokate.

Honey was bought in varying quantities from a series of bee-keepers and weighed to deduce the price per kg. During the sale bee-keepers were also asked to estimate the price of the same quantity of honey during the low production season. N.B. The author took little part in the purchases as it was felt he that he would be unable to obtain a realistic price. The bargaining was conducted under the pretence that the honey was for the interpreter's personal use.

Table 1 shows the prices per kg derived from weighing honey samples bought from bee-keepers during the month of Tahsas 1985 (December 1992 G.C.).

Table 1. The price of honey

<table>
<thead>
<tr>
<th>Quality of honey</th>
<th>Hidar, Tahsas, Tir</th>
<th>Sene, Hamle, Nehassie</th>
</tr>
</thead>
<tbody>
<tr>
<td>High quality</td>
<td>1 kg = 4-6 birr</td>
<td>1 kg = 7-10 birr</td>
</tr>
<tr>
<td>Low quality</td>
<td>1 kg = 3-4 birr</td>
<td>1 kg = 3-6 birr</td>
</tr>
</tbody>
</table>

Source: bee-keepers in Tahsas 1985

Table 1 shows that the price of honey is influenced by its perceived quality. High quality honey should be low in wax content, light in colour and sweet in taste. Dark, bitter honey results from premature harvesting. Some bee-keepers explained that other bee-keepers are sometimes forced to harvest unripe honey, or "bread", in order to obtain money. Meskerem is reportedly a time when "bread" is often sold.

A known practice among bee-keepers is to fill the bottom half of a pot with low grade honey while covering it over with that of higher quality. Many bee-keepers professed to being aware of this form of deception but none admitted any personal involvement.
Larvae

Bees' larvae were unanimously cited as the second most important hive product after honey. They are eaten in varying quantities for their perceived medicinal value. Besides administering larvae to themselves and their immediate families, most bee-keepers also donate some to sick members of other households. Some said that they give away most of their larvae harvest in order to help those who would otherwise be unable to obtain it. While the majority of bee-keepers use larvae only in times of sickness others consume more liberally; apparently regarding it as a food which guarantees health rather than a medicine taken to restore it. Bees' larvae must be eaten fresh. They are never sold.

Beeswax

It has already been mentioned that beeswax and honey are crushed together into pots and sold as a single product generally purchased by tej makers. The one bee-keeper interviewed who sells pure honey reuses the honeycombs in order to maximise honey production. Pure beeswax was not marketed separately by any of the bee-keepers spoken to. After fermentation of the honey mixture the beeswax remains as a residue apart from the tej. The wax was said to be used only for candle-making and floor polishes and can be bought from tej houses for around 10 birr per kg. None of the wax is marketed outside Welaita.

The financial importance of honey sales to bee-keepers

Bee-keepers in both PAs were asked to state whether honey sales are among the five most important sources of money. If the answer was "Yes", the respondents were further requested to rank the importance of honey sales against the other products sold to generate cash.

Figure 9 graphs the financial importance of honey sales against the size of each apiary in Kokate. Figure 9 shows that all but two of the Kokate bee-keepers, who gave an answer, ranked honey among the top five sources of cash income. The modal response (i.e. that honey supplies the largest source of money) suggests that comparatively rich rewards are available to the minority of farmers active in bee-keeping.
FIG. 9. THE FINANCIAL IMPORTANCE OF HONEY SALES TO THE BEE-KEEPERS OF KOKATE

Importance of honey

(Rank as earner of cash in comparison to other sources)

No. of occupied hives in apiary

No. of bee-keepers = 15
Initially it appears surprising to find that some bee-keepers with only one occupied hive rank honey as being their most important source of cash while others, with much larger apiaries, consider it of lesser importance. It should be appreciated that the level of wealth (in terms of both land and capital) varies sharply between farmers and the amount of produce available for sale depends largely on each individual's financial position. For example, a bee-keeper with five occupied hives and three hectares of land may make more money from selling teff and coffee than he does from honey. Conversely, a bee-keeper with one occupied hive and only one hectare of land may only be able to produce enough crops to feed his family (i.e. no surplus) making honey his most important marketable product.

Figure 10 graphs the financial importance of honey sales against the size of apiaries in Abele Ajeja. As expected, Figure 10 shows that honey is most important to the two bee-keepers (with 1 and 24 hives respectively) living beside the river where the conditions for bee-keeping are most favourable.

Figure 10 suggests that honey sales do provide a significant source of income to the bee-keepers operating away from the river in Abele Ajeja (only one bee-keeper ranked honey sales below the fifth). However the author feels that the number (but not necessarily the total value) of all marketable commodities produced in Abele Ajeja is lower than in Kokate. If this assumption is correct, the fourth and fifth ranked product in Abele Ajeja may be of lower financial significance than the identically ranked product in Kokate.

In summary, a greater proportion of Kokate bee-keepers ranked honey sales as among the top two ways of raising money than in Abele Ajeja. No Abele Ajeja bee-keeper not situated beside the river ranked honey above fourth place.

**Transport and storage of hive products**

Honey is stored and transported in pots covered with either enset leaves or paper. Pots can be bought for less than 50 cents (100 cents = 1 birr) in both Kokate and Abele Ajeja. They are evidently good containers as honey spoilage during transport and storage was not listed as a problem. Larvae are never stored.
FIG. 10. THE FINANCIAL IMPORTANCE OF HONEY SALES TO THE BEE-KEEPERS OF ABELE AJEJA

Importance of honey

(Rank as earner of cash in comparison to other sources)

No. of occupied hives in apiary

No. of beekeepers = 5
CHAPTER 6. CONCLUSIONS AND IMPLICATIONS

Conclusions

The report shows that a small minority of farmers from Kokate and Abele Ajeja are keeping bees and that only a small proportion of these have more than two or three occupied hives. Nevertheless, honey sales were found to be of comparatively high financial importance to the large majority of bee-keepers.

A major aim of the report was to compare the bee-keeping of Kokate (mid to high altitude) with Abele Ajeja (low altitude). The researcher concludes that both the current extent and future potential for bee-keeping is much higher in Kokate than most of Abele Ajeja. This conclusion has been reached after considering the following evidence:

(i) The level of participation of senior men is much higher in Kokate than Abele Ajeja.
(ii) The level of financial investment in hives is much higher in Kokate than Abele Ajeja.
(iii) The environment in much of Abele Ajeja is less suitable for bees than that of Kokate (i.e. less water and forage).
(iv) In much of Abele Ajeja it is seemingly almost impossible to keep an apiary of more than two occupied hives. The addition of further colonies leads to absconding.
(v) Apiculture is generally of greater financial significance to the bee-keepers of Kokate than to those of Abele Ajeja.

Despite the generally more favourable environment of Kokate the author also concludes that it is possible to keep bees with equal success in Abele Ajeja providing the colonies have access to adequate forage and water. Sufficient flowers and water are apparently available near the river in Abele Ajeja for one bee-keeper to maintain an apiary of 24 occupied hives (the largest found in either PA).

Implications for extension and research

1. This report has been compiled almost completely on information divulged from interviews. The surveying approach has not succeeded in realising the number of colonies which can be supported by a specified area before saturation is reached. A further study is required to obtain such data before any potential for expansion can be reliably assessed.

2. Absconding has been observed to be the primary constraint in the bee-keeping of both Kokate and Abele Ajeja. Further research is required to identify the causes more precisely than has proved possible using surveying methods alone. Once the exact causes are known a better understanding of how best to reduce the problem may be reached.
3. Many bee-keepers said that they would keep more bees if they had access to protective clothing. The lack of available protection was also said to discourage possible newcomers to bee-keeping. It may be useful to introduce certain items of protective clothing into one or more trial areas in order to ascertain any changes in the extent of bee-keeping and to evaluate the usefulness of a larger scale distribution.

4. The majority of bee-keepers in Abele Ajeja are still using pot hives which are widely regarded as obsolete in Kokate. It may be useful to research whether an increased use of bamboo hives in Abele Ajeja could lead to a rise in the overall production of that PA.

5. The proportion of honey left in the hive and the amount of substitute feeds given vary substantially between bee-keepers. It seems likely that there is an optimum feeding level although this may vary in different environments. Information gathered from studying optimum feeding levels could be used in order to obtain maximum yields at a minimum cost and without over exploiting the bees.

6. The effect, on honey production, of removing larvae from beehives has not been fully understood. An investigation into the side-effects of larvae harvesting would partly indicate whether the practice is desirable or a serious constraint on honey production. The social and cultural implications of larvae harvesting to the farming community of Welaita should be considered in such a study.

7. It has been observed that virtually all the honey produced by the bee-keepers of both PAs is sold as a means of generating cash. Domestic consumption is negligible. Analysis of the changes in the price of honey, through the Ethiopian Calendar, reveals that the price is lowest when supply is plentiful and highest during times of shortage. Demand appears to remain fairly constant throughout the year. With this in mind it seems uncertain as to whether simply raising production of the crude mixture of honey and wax, currently produced and sold by the bee-keepers of Kokate and Abele Ajeja, would result in a significantly increased flow of capital to the bee-keeping community.

Pure honey commands a considerably higher price than crude honey. Research into the viability of on-farm purification or a purification plant (independent of the consumers) would ascertain the possibility of bee-keepers obtaining improved financial returns by selling a higher quality and more marketable product.
APPENDIX I: REPORT OF THE PILOT SURVEY ON APIARIES

Bee-keeping was described as a profitable exercise only practised by a minority of farmers. Those who were not keeping bees, while admitting that it could be possible to start, explained that it would be difficult and dangerous to do so without knowledge and experience. Farmers with hives said they had been taught by their fathers or, as in one case, attended a training course. Bee-keeping is undertaken only by men.

Bee-keeper 1
The farmer owned seven hives of which three were occupied. He thought that there were insufficient bees to justify owning more hives. Made of either wood or bamboo, the hives were rounded with a diameter of around 50 cm and placed on top of poles, approximately 1.5 m high, next to the house. Hive preparation was said to be vital. They should be watertight and kept shaded (the keeper felt that intense heat was bad for bees and suggested that more moist, higher altitude areas were more suitable in this respect).

Bees reportedly arrive voluntarily if empty hives are left available for occupation. Full hives can be split with some bees being introduced to another hive to begin a new colony.

Harvesting was said to take place every fifteen days after the beginning of September. It stops at the end of the flowering season when pollen levels decline. Both honey and larvae are taken using a long knife to scoop them out. Honey is sold raw, along with the wax, to tej makers. A little is consumed at the house where the wax is thrown away. Honey sales constitute an important source of income. The larvae are eaten for their apparent medicinal value. Quantities of larvae and honey are always left inside the hives, particularly near the queen, to help prevent the colony absconding.

Bee-keeper 2
This farmer possessed nine or ten occupied hives and planned to increase this during September and October. Bees were reportedly captured from tree branches where they swarm. The queen is located and has her wings broken. This operation must be carried out with great care and skill as to kill the queen would entail the loss of the entire colony. The branch is cut and placed, along with the grounded queen, in the hive intended for occupation. Absconding is thus normally avoided as the colony will usually remain loyal. Some desertions were admitted despite the preventative measures. They were attributed to hives being overcrowded.

The farmer displayed, with two empty hives as examples, two differing designs. One, which was described as a traditional Welaita hive, consisted of a single layer of bamboo reinforced with hay and enset leaves. It was home-made and regarded as
inferior to the second type which incorporated three layers of woven bamboo to give more effective water-proofing. This was said to be imported from another region. Both hives were of similar dimensions being about 1m in length. They were cylindrical with diameters of approximately 30 cm. Each hive was placed horizontally on two 1 m forked poles. The apiary was located immediately behind the house.

The keeper felt that bees were sometimes killed by excessive heat although he would not discount the possibility of a disease. Birds that eat bees and invading ants were also thought to be harmful.

Honey harvesting takes place twice in October and November and sometimes again in May. Some honey is left with the bees to sustain the colony throughout the year. Larvae are taken on four or five occasions with at least half always being left behind. The farmer said that sometimes he took no larvae.

During harvesting, dried manure is burned to create thick smoke which drives bees away sufficiently to allow honey and larvae to be scooped from the hive with a knife similar to that used by the first keeper interviewed. Some bees remain and have to be wiped off the produce.

A yield of between 8 to 10 kg of honey would be expected from every three hives during the main harvesting period. Afterwards bees become dormant until the following season. Some honey is eaten in the house along with a mixture of honey and larvae which provides strength.

Honey is sold to traders whenever money is required. It raises 6 to 9 Birr per kg. Wax is not removed prior to sale. It was said to be necessary in order to keep honey.

The keeper thought that bees under good management could probably be kept at all altitudes but thought that higher areas were advantageous.

Bee-keeper 3
The apiary contained five or six hives of a similar shape to those belonging to keeper 2. Some had been home-made using grasses and wood whereas others had been bought. The keeper expressed a desire to own more hives and gave shortage of money as the reason preventing him from doing so. Hives were said to cost between 3 and 5 birr each.

The farmer's prime concerns were ants and a fox which had ravished three of his hives. He said that he sometimes ventured out at night looking for the fox. He also thought that rain was bad for bees.
Honey is harvested three times between September and October and a further four times between October and November. Flowers are plentiful throughout this time. On all seven occasions honey is removed from each hive.

The farmer recommended burning dirty clothes and Juniper wood to produce a bad smell capable of evacuating the hive for harvest.

Keeper 3's procedure for discouraging colony desertion was to cut the queen's wings and to leave some honey and larvae to feed the bees.

Bee-keeper 4
The fourth farmer interviewed lived in a lowland area. The previous year his son had caught a colony of bees from a nearby wood. This was done by capturing the queen. The bees were kept in a pot hive suspended in a bush. The bush was considered a sensible place as it provided cool air and blocked some of the intense sunlight characteristic of such regions.

The farmer thought the pot hive to be inferior to more sophisticated hives he had seen at markets. It was too small and fragile. One advantage stated was that rain did not cause any problems.

Honey and larvae were to be harvested six times during the productive months of September and October. 3/4 of the bees' output would be taken. One large pot of honey was expected. Harvesting larvae was thought essential in order to prevent the colony outgrowing the hive and absconding.

At the time of the visit all honey was being eaten. Larvae was mixed into it to produce a food thought to be highly beneficial for health. Larvae was said to be edible only when fresh.

The farmer was not interested in keeping more bees as he felt that the low altitude with less flowers was detrimental. However, his son was reported to be planning on expanding and selling the honey. The farmer detected no losses due to animals or diseases.

Bee-keeper 5
The fifth keeper interviewed actually owned no hives. He told me they had all been stolen. He was hoping to resume using purchased bamboo hives. A pot hive would be used if none of the preferred type were available. The pot hives were thought easily breakable. The material was also believed to be unsuitable for larvae and honeycombs to adhere.

An interesting piece of information came from a source who did not keep bees. He said that it was traditional to place a mule bone on top of the hive to stop bees absconding.
Honey was bought from bee-keepers on four occasions. As honey from different hives is stored and accumulated in pots it was not possible to obtain a sample of a single harvesting from one hive. In order to obtain data on the varying yields obtained at a single harvesting the bee-keepers were asked to state how many harvestings were required to collect the sample along with the number of hives from which the honey was taken. The mean weight of honey obtained by each bee-keeper per hive, per harvesting was then calculated.

Kokate

1. 15.5 kg (pot + honey) - 3.7 kg (pot) = 11.8 kg (honey).
   11.8 kg = 2 harvestings from 2 bamboo hives.
   11.8 kg/4 = 2.95 kg honey per hive, per harvesting.
2. 4.1 kg (pot + honey) - 1.1 kg (pot) = 3.0 kg (honey).
   3.0 kg = 2 harvestings from 1 bamboo hive.
   3.0 kg/2 = 1.5 kg honey per hive, per harvesting.
3. 12.5 kg (pot + honey) - 1.8 kg (pot) = 10.7 kg (honey).
   10.7 kg = 1 harvesting from 3 bamboo hives.
   10.7 kg/3 = 3.57 kg per hive, per harvesting.

Abele Ajeja

1. 2.0 kg (pot + honey) - 1.1 kg (pot) = 0.9 kg (honey).
   0.9 kg = 1 harvesting from 1 pot hive.
   0.9 kg/1 = 0.9 kg per hive, per harvesting.
### APPENDIX III: EQUIVALENCE OF ETHIOPIAN AND GREGORIAN CALENDARS

<table>
<thead>
<tr>
<th>E.C.</th>
<th>G.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meskerem</td>
<td>September</td>
</tr>
<tr>
<td>Tikemt</td>
<td>October</td>
</tr>
<tr>
<td>Hidar</td>
<td>November</td>
</tr>
<tr>
<td>Tahsas</td>
<td>December</td>
</tr>
<tr>
<td>Tir</td>
<td>January</td>
</tr>
<tr>
<td>Yekatit</td>
<td>February</td>
</tr>
<tr>
<td>Megabit</td>
<td>March</td>
</tr>
<tr>
<td>Miazia</td>
<td>April</td>
</tr>
<tr>
<td>Ginbot</td>
<td>May</td>
</tr>
<tr>
<td>Sene</td>
<td>June</td>
</tr>
<tr>
<td>Hamle</td>
<td>July</td>
</tr>
<tr>
<td>Nehassie</td>
<td>August</td>
</tr>
</tbody>
</table>

(ii) Ethiopian months start approximately on the 8th day of the equivalent Gregorian months.

APPENDIX IV: REFERENCES

Two texts which proved useful to the author while compiling this report are:


APPENDIX IV: REFERENCES

Two texts which proved useful to the author while compiling this report are:


Objective
The wider aim of the project is to increase, in a sustainable way, the incomes of resource-poor farming families in North Omo (and neighbouring Konso), and ultimately, by example, in Ethiopia as a whole. The underlying assumptions are that improved agricultural technology is the key to improved productivity and incomes and that "farmers' participatory research", ie research in which farmers play leading roles in identifying, and designing research as well as in carrying it out, is a cost-effective way of generating and spreading improved agricultural technology.

The immediate objectives of the project are designed to promote farmers' participatory research (FRP) and are:-

i) Better linkages and understanding between farmers, researchers and extension staff.

ii) A better knowledge about ways in which FRP can be conducted in Ethiopia.

iii) Enhancement of the capacity of GOs (government organisations) and NGOs to enable farmers to do FRP.

iv) Incorporations by GOs and NGOs of FRP into their own activities.

Project Components
- **Studies.** Diagnostic studies to obtain understanding of complete farming systems; topical studies to understand and identify the problems in the production of specific commodities; special studies for in-depth investigation of particular problems.
- **Training.** Formal courses, informal workshops and look-and-learn visits in North Omo for staff of GOs and NGOs; some course and workshops abroad; workshops and look-and-learn visits for North Omo farmers; a project library specialising in FRP; a programme of dissemination of project experience.
- **On-farm trials.** A programme of on-farm trials designed to test both appropriate technology and different ways of organising effective collaboration between farmers, researchers and extension staff.
- **On-station trials.** Trials conducted by researchers under controlled conditions to underpin and support the programme of on-farm trials and other research efforts by farmers.
- **Monitoring.** A programme to monitor the impact and effectiveness of the FRP approach.
- **Review.** To evaluate the project.

Organisation
The project started in February 1991, was favourably reviewed by an independent team in mid-1992, and has now secured funding from the British government to carry on until March 1996. The coordinating agency is FARM Africa working in close collaboration with the Ministry of Agriculture and a number of other GOs and NGOs.

Further information
Further information about this publication and the Farmers' Research Project can be obtained from:
Either:
* FARM Africa, P.O.Box 5746, Addis Ababa, Ethiopia. Telephone (251-1-)16 10 16: Fax (251-1-) 65 25 66.

or
* FARM Africa, 40-42 Oxford Street, London W1A 3BB, UK. Telephone (44-) 071 637 2535: Fax (44-) 071 637 2543.