



A Report from Gemu-Gofa Province, Ethiopia

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Gemu-Gofa is one of the 14 provinces of Ethiopia and is located in the extreme south-west of the country. Its population is estimated to be 668 000 residing in an area of almost 40 000 square kilometres. This report of activities was presented at the WHO Seminar on Smallpox Eradication, 18-22 September, 1972.

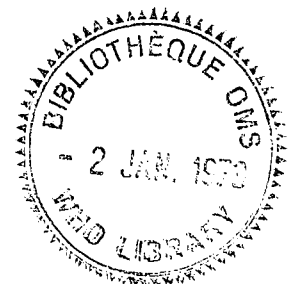
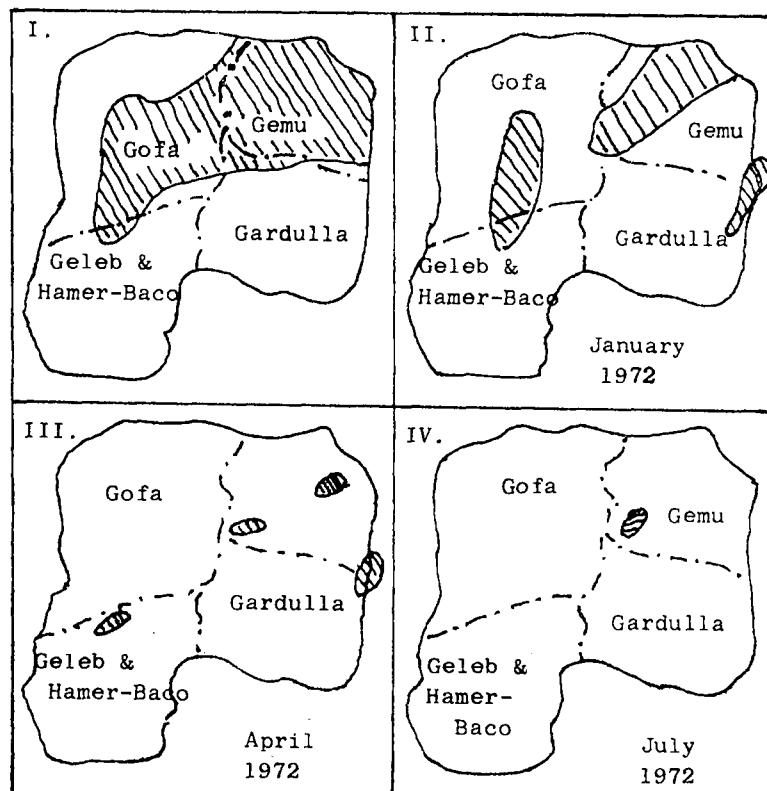
Overview of activities

Prior to September 1971 some headway had been made in the programme, particularly in the difficult Dorso area of Gemu awraja (county or district) and the population had become acquainted with our presence. After September, activities quickly accelerated.

In October, after the rains, a preliminary reconnaissance in Gofa awraja indicated massive outbreaks throughout the area. It was decided that Ato Kassa and Scott Holmberg should work in Gofa awraja while Lee Hackman and Ato Girma concentrated on controlling Gemu awraja. (These were the two most populous and endemic awrajas.)

Figure 1 gives some idea of the progressive course of smallpox in Gemu Gofa after September 1971.

FIG. 1. COURSE OF SMALLPOX IN GEMU GOFA: SEPTEMBER 1971 - SEPTEMBER 1972



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Work in the last months of 1971 and early months of 1972 convinced us that the decrease in the major rains in September was followed by extremely large outbreaks that touched virtually every northern town in the province. It was not rare, for example, to hear a villager tell that, although there was smallpox in his town, we should have seen the contagion in Meskerem. At first, we had had little idea of how widespread the outbreaks were. Because smallpox was almost under control in Chencha woreda (Gemu), the habitual trouble spot of Gemu, it was tacitly assumed that the whole awraja might be coming under control as well. Little was known about Gofa. Later we found smallpox in every woreda of Gofa, every woreda of Gemu (except Chencha) and in the northern, most populous woreda of Geleb and in Hamer-Baco awraja. To a lesser extent, smallpox transmission was also found in the two woredas of Gardulla contiguous with Gemu awraja.

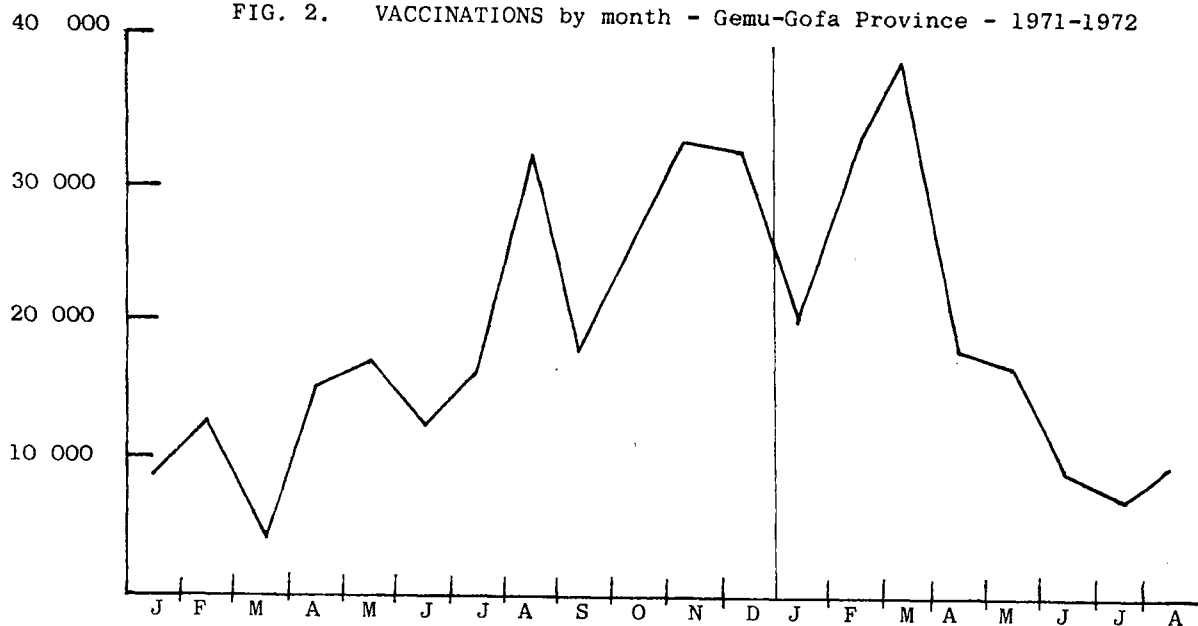
By surveillance and containment activities, Gofa awraja was slowly brought under control by February 1972; Baco-Gazer woreda in Geleb and Hamer-Baco was also heavily vaccinated by February. While Atos Girma and Kassa, plus dressers, kept a constant check on transmission in Gardulla awraja, work on all of Gemu awraja began in earnest after February. The rest of the team (Messrs Kraushaar and Holmberg) took turns sweeping through the woredas in order: Kucha, Mirab Abay and Arba Minch, Boreda, Chencha, Dita and Mallo.

The technique employed throughout was "surveillance and containment", which was found to be most effective. In many areas, however, smallpox was so endemic that we had to make repeated visits to every town in the area, performing almost a "mass vaccination". This sort of activity only occurred in places so endemic that "mass vaccination" and "surveillance and containment" really ended up meaning the same thing.

As of September 1972, no smallpox cases had been discovered in over eight weeks, despite active surveillance. We are keeping close watch on some potential "danger zones", particularly Dita woreda of Gemu awraja where there may be a hidden case or two still. Our check of past outbreak areas, however, has so far uncovered nothing, and we feel safe in saying that three awrajas - Gemu is the exception - are now definitely smallpox-free. We are watching for any importations of the virus, and feel particularly cautious right now as the rains are letting up and the population as a whole becomes more mobile again.

The course of the vaccination schedule itself has been erratic. Like the number of cases of smallpox, vaccinations increase after the rains, remain high during the dry season, then taper off again during the rainy season as the wet season hinders movement of both smallpox and the smallpox eradication workers. Below, our records for vaccinations (Fig. 2) and for discovered cases (Table 1, Fig. 3) are summarized.

FIG. 2. VACCINATIONS by month - Gemu-Gofa Province - 1971-1972



Total vaccinations 1971: 242 735

Total vaccinations 1972: 151 389

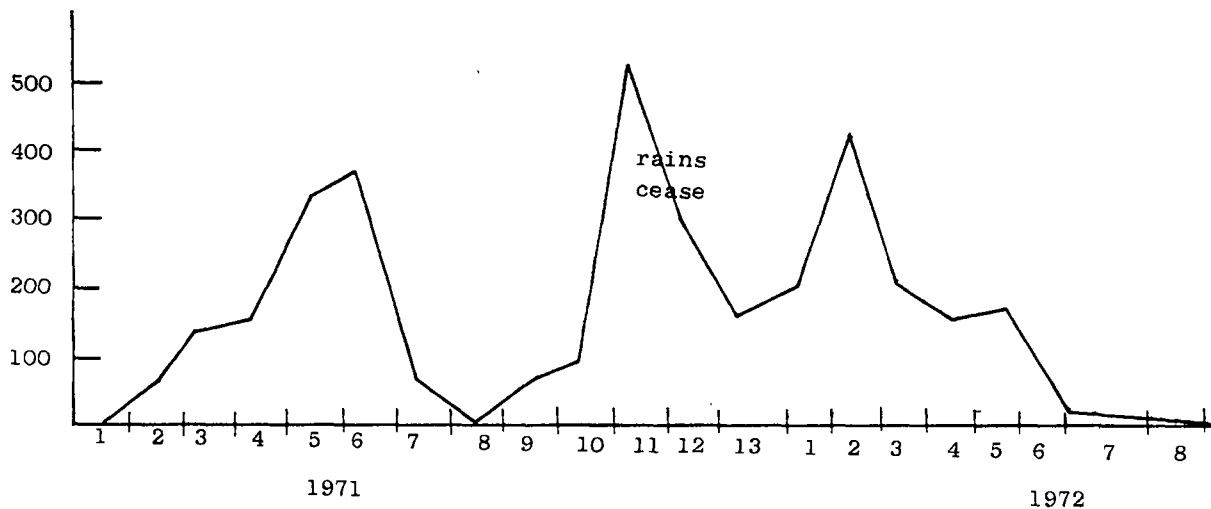
TABLE 1. INVESTIGATED CASES, GEMU GOFA: JANUARY 1971 - SEPTEMBER 1972\*  
4 WEEK PERIODS

	1	2	3	4	5	6	7	8	9	10	11	12	13	Total 1971	1	2	3	4	5	6	7	8	Total 1972
Gemu	1	48	53	156	68	372	65	1	55	73	306	148	36	1 382	37	417	80	106	154	25	2	0	821
Gofa	-	6	-	-	-	-	-	-	-	-	156	141	119	422	158	9	-	7	0	-	-	0	174
Gardulla	-	2	85	2	260	-	-	-	7	17	40	-	-	413	-	-	10	43	0	0	0	0	53
Geleb & H-B	-	-	-	-	-	-	-	-	-	-	-	15	-	15	7	-	130	0	-	-	-	0	137
TOTAL	1	56	138	158	328	372	65	1	62	90	502	304	155	2 232	202	426	220	156	154	25	2	0	1 185

\* "-" no surveillance.

"0" no cases.

FIG. 3 SMALLPOX CASES, GEMU GOFA. JANUARY 1971 - SEPTEMBER 1972



Problems encountered

At the outset of the Smallpox Eradication Programme in this province, a multitude of problems emerged which now have been more or less solved or worked around.

Transportation was a major difficulty, since only one all-weather road exists in the province. The other roads are not only hazardous to drive, but repeatedly induce mechanical failure of the vehicle. Driving skill and knowledge of the trails has, of course, improved over the past year, but the major reason for fewer repairs during last year is that the vehicle is now used only for ferrying people and supplies to some focal point easily accessible by car. Almost all surveillance is now being done by foot or mule. Planes and boats are sometimes used in order to get team members to especially remote areas, where they walk or ride to the outbreak. The increased use of mules and walking has increased the thoroughness of investigation and surveillance.

Another problem was lack of food and other needed supplies too heavy to carry when the vehicle could not be used - e.g. cans, tents, kerosene, lanterns, stoves, bedding, etc. In recent months, team members have carried letters from provincial, awraja and woreda officials ordering the local leaders to provide housing and food for SEP workers for the short time they are in any one "chikashoominet". This practice, while a tax on the chikashoom or balabat (local leaders) for a few days, allows the SEP teams to travel quickly with minimum equipment and to cover much more territory. This practice also ensures the local leader's support and active help since team members are stationed at his house. These same letters which are presented to the chikashoom also order him to gather his people or at least to accompany the team members if they are vaccinating house to house.

Our experience indicates that two is an ideal number for one team; partly because the community leader can easily accommodate this number; partly because there is no duplication of effort with team members crossing some areas several times and missing others; partly because there is no confusion of plans; and partly because a two-man team can travel quickly. In addition, it was found that the ideal two-man team consists of one surveillance officer and one hired vaccinator or dresser as an assistant. In this manner, surveillance officers can spread thinly throughout the province, providing a wide coverage of the province at any given time. Further, it allows each surveillance officer to exercise his own initiative and preferred mode of operation. In less than 10% of 1972's field trips were two or more surveillance officers teamed together.

The "army of young vaccinators" concept was more or less abandoned, as of last year. We found it difficult to check the work of large numbers of vaccinators which was often slovenly when we could check, and they were expensive to maintain. Further, we could not guarantee them steady work.

The most difficult problem, as elsewhere, is getting local people to cooperate with the programme. Even in a province that is generally cooperative and friendly, there are a few large tribes which stubbornly refuse vaccination; for example, many workers were suffering at one time from human bites. While each situation (village) demands its own solution, some standard approaches have frequently been effective.

We find, for example, that bright, colourful, preferably grotesque pictures of smallpox at least make the people curious; and while they may not want vaccination initially, they will often crowd around to see the picture. In this manner, some always get vaccinated and, hopefully, these can be encouraged to tell the rest that the vaccination does not hurt. In general, having a crowd around saves countless repetitions of the same assurances and explanations, encourages others to come over and see the cause of the gathering, and reinforces whatever group pressure there is to accept vaccination.

Balabats, chikashooms and government officials should be with the vaccinators at all gatherings - funerals, weddings, markets, etc. They sometimes have weight in the community. Police, however, we found to be a problem, often frightening many and transforming "getting a vaccination" into a game of hide-and-seek from the rest.

There is still no simple, rapid way to turn an uncooperative area into a cooperative one. A lot of success in bad areas depended and still depends on the teams' ability and willingness to stay in one area for long periods of time and to return when necessary. This problem does not seem to vary from province to province. In a way, it is the lack of health knowledge that has been our greatest problem.

Variolation has not been a problem. However, it has been observed in older individuals who received it as infants in northern provinces. Some of them claim that during their infancy it was common practice to variolate every newborn infant.

#### Reporting units

Generally, cooperation in reporting and in vaccinating by provincial health units has been mediocre. Special gratitude must go to the Ghidole Hospital (42 000 vaccinations) and the Bulki Mission Clinic (15 000 vaccinations) who protected their areas as of the summer of 1971. These centres also report regularly and are being very cooperative during the initial stages of the BCG programme.

The larger government health centres in Folege Newai, Chencha, Arba Minch and Jinka have also been cooperative to the extent of informing us of rumours of outbreaks in their areas.

However, despite repeated visits by our teams and various letters from health officials, almost none of the smaller government health stations report regularly or vaccinate their areas. Sometimes, after a recent warning or visit, they will report for a month or two, but regular reporting still only comes from the four bigger health centres and the mission clinics. Among other problems seems to be the assumption that they are only obliged to report when we visit them. It is difficult to explain that we can't be visiting them every month and that, in any case, the idea of reporting is to let us know the smallpox situation without having to personally go to each area of the province. Also, almost all health stations operate on the assumption that they are only obliged to vaccinate their village and will not travel to nearby areas even when there is an outbreak. Some are even reluctant to

vaccinate the villages in which their clinics are located. At this point the question is academic since most of the villages in the province have been visited at least once and since the areas around the clinics have now been vaccinated by us.

Nevertheless, in the coming months, we need a good reporting system more than ever in order to check any reintroduction of smallpox. Consequently, we have tried to use local school teachers, asking them to contact us immediately when they hear of smallpox. We have also informed young students throughout the province to notify their teachers if they see or hear of the disease which we illustrate with pictures. While the schools do not constitute the kind of smooth, continuous reporting network we would like, they have tipped us off to two outbreaks (Kucha and Wubhammer) and we now personally know a network of teachers who from time to time keep us informed verbally. In addition, there may be some possibility of getting regular reports from government woreda offices since they too seem to show interest in our work and want to cooperate.

We must personally walk around the province, though, if we want to be sure that any area is "clean". Our reporting system is still far too unreliable.

#### Observations

By the technique of "surveillance and containment", smallpox in the province began to come under control by the time we had vaccinated 30% of the population. At the present time, with 42-47% of the population vaccinated (roughly 400 000 vaccinations), the province now appears to be completely under control. Similarly, in Illubabor Province, when a little over 40% of the population was vaccinated, the disease was brought under control. Apparently, where one vaccinates is as important as how many are vaccinated.

From the beginning of 1971, and the inception of the SEP programme in Gemu Gofa, up to the present, a total of 3533 cases have been found and recorded in the province. This figure represents about 9% of all the smallpox cases found in Ethiopia since January 1971; the small size of Gemu Gofa and the high rate of incidence ranks it among the most endemic of Ethiopian provinces. Information regarding all cases has been recorded - specifically, age, sex, previous vaccination/variolation status, and dates of rash onset and mortality. At Arba Minch we have information on 3345 of these cases, from which can be constructed the following Tables 2 and 3.

TABLE 2. DISTRIBUTION OF SMALLPOX CASES BY AGE, SEX AND VACCINATION STATUS, GEMU GOFA: JANUARY 1971 - SEPTEMBER 1972

Age group	Number of cases			Vaccination status			Deaths	Case-fatality ratio %
	Male	Female	Total	Yes	No	Unknown		
Under 1	64	75	139	-	135	4	13	9.4
1 - 4	236	261	497	-	484	13	13	2.6
5 - 14	795	791	1 586	5	1 551	30	17	1.1
15 +	530	593	1 123	12	1 081	30	42	3.7
Total	1 625	1 720	3 345	17	3 251	77	85	2.5

TABLE 3. SUSCEPTIBILITY AND ATTACK RATES AMONG THE RESIDENTS  
IN THE 1377 AFFECTED HOUSEHOLDS

Age group	Total	Non susceptibles		Total non-sus.	Total sus.	% sus.	No. of cases	Attack rate (%)	
		Previous smallpox or variolation	Vacc.					Sus.	Total
Under 1	294	-	1	1	293	99.7	139	47.4	47.3
1 - 4	761	5	12	17	744	97.8	497	66.8	65.3
5 - 14	2 506	11	62	73	2 433	97.1	1 586	65.2	63.3
15 +	2 721	487	122	609	2 112	77.6	1 123	53.2	41.3
Total	6 282	503	197	700	5 582	88.9	3 345	59.9	53.2

Table 2 corresponds well with findings for Ethiopia as a whole. Almost half the cases occurred among children aged five to 14 years; there was no difference in the attack rate for males and females. Only 17 of the 3345 cases had been vaccinated before; and there is question in many of these cases whether they ever did receive the vaccination or whether the vaccination was administered during the incubation period. The case fatality rate is similar to that observed in the rest of Ethiopia during 1971.

Table 3 shows some significant differences from data collected from the 9819 households affected in Ethiopia in 1971. In Gemu Gofa, the per cent. susceptible was much higher than for Ethiopia as a whole (88.9% vs. 71.4%). This difference reflects the relatively small number of people in Gemu Gofa who had been variolated in childhood or vaccinated before the inception of our programme. The overwhelming majority of "Non-susceptibles" received their immunity from having had smallpox before. In the 15+ age group, fully 18% of the residents interviewed had had smallpox as children: this is actually a minimum estimate since many adults do not bother to tell the interviewer that they had smallpox previously, and since many interviewers did not tabulate smallpox infections which had occurred more than a year before. In short, the proportion of people in Gemu Gofa who had smallpox in childhood may be well over 30% and possibly as high as 40%. This indicates the magnitude of the smallpox problem in Ethiopia.

The principal field observations coincide with those made in other provinces. For example, at the end of the rainy season, the increased mobility of the population leads to more active transmission of smallpox and to more outbreaks. Energetic surveillance must take place in the months of September, October and November if there is to be any success for SEP that year. Also, children tend to be more mobile, less cautious of the disease and (statistically) more susceptible: hence, the large numbers of them who catch smallpox, compared with other age groups.

In addition to the cycle of smallpox incidence that follows the seasons, one observation regarding transmission in Gemu Gofa deserves special note. We find that smallpox seems to "incubate" in densely populated areas during the rainy season (e.g. cities), to spread into the more rural areas as the rains let up. As the villages and farms become affected, the transmission within the cities becomes quicker and more widespread outbreaks are observed. As the rainy season begins again, the decreased movement of the population causes smallpox to undergo localized extinction in the countryside, but it remains in the cities. It would seem that only a few cases in high population density areas are sufficient to allow smallpox to survive till the next dry season. The smallpox in the cities during the rains apparently

transmits slowly, but sufficiently. In fact, the pattern of smallpox, when viewed on a map of Gemu Gofa, shows distinct oscillations with cities (or roads) at the centres. From these focal points, the virus transmits to the surrounding rural areas.

The findings of other teams in other areas of Ethiopia are the opposite with smallpox tending to move in the opposite direction, from rural areas to urban areas. One can only guess at the reasons for this discrepancy. In Gemu Gofa, only 1533 vaccinations were performed before the SEP teams began work. Perhaps, in some other provinces, there were more vaccinations performed around the health centres in major towns. In this way, the immunity of the cities in some provinces may have been increased, while the rural areas could still maintain smallpox transmission and occasionally infect the cities. Likewise, it was easiest for the Ethiopian programme as a whole to vaccinate the major towns along the all weather roads first as, during the rainy season, vaccination must necessarily take place on or near the major roads. In short, it is possible that the two contradictory theories are equally valid - depending on what province one chooses to observe.

We have made some calculations on attack rates for different population densities using the data available. Presumably, if our observations are correct, attack rates should increase geometrically with an increase in population density. Further, smallpox would be observed in the densely populated areas and not in the sparsely settled ones during the rainy season.

Gofa awraja was selected to evaluate these hypotheses. Before September 1971 no SEP team had visited this awraja, and virtually all work was done in a five month period (October 1971 - February 1972). During this time, Gofa experienced effectively one large single outbreak extending throughout the awraja. Each town in Gofa was visited once, with only a few towns being visited twice or not at all. In short, the cases recorded are a discreet sample from almost all the towns.

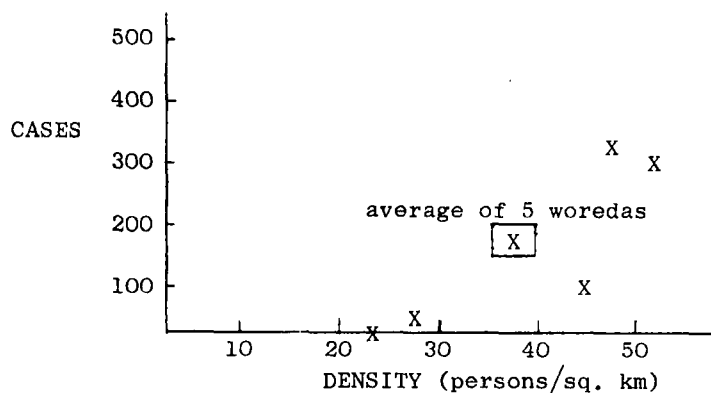
Gofa awraja was divided into five areas, namely the woredas, the population density for each woreda was calculated roughly. Population estimates for each woreda were obtained from the Ministry of Public Health and provincial government offices. These estimates were in good agreement with our own. Next, knowing the area in square kilometres of the awraja, we made a grid map and determined the total areas for each woreda. In the case of Benka Mosketo woreda, the western half is uninhabited desert so that this area was omitted in performing our calculations. Simple division then yielded a crude estimate of population density. The following results were obtained (Table 4, Fig. 4):

TABLE 4. POPULATION DENSITIES IN GOFA AWRAJA AND NUMBERS OF DISCOVERED CASES, GEMU GOFA; OCTOBER 1971 - FEBRUARY 1972

Woreda	Inhabited area (sq. km)	Pop.	Density (persons/sq. km)	Cases	Vaccinations
Gofa	1 264	55 000	43.5	311	54 070
Zala	1 343	35 500	26.5	10	16 174
Mallo-Koza	2 370	52 100	22.0	0	9 648
Debre Tsehai	948	36 500	38.5	71	10 773
Benka Mosketo	1 975	77 000	39.0	334	27 947
Total	7 900	256 100	32.4	726	118 612



FIG. 4. POPULATION DENSITIES VERSUS DISCOVERED CASES, GOFA AWRAJA



The data suggests the possibility of a "threshold level" for smallpox transmission of between 27 and 37 persons per square kilometre. With a less concentrated population transmission seems to be slow, difficult and not likely to lead to an endemic area. It suggests that woredas like Zala and Mallo-Koza have a very minimal attack rate during the dry season and it is questionable that these rural areas could sustain transmission during the rainy season. This is corroborated by surveillance in other awrajas. In Geleb and Hamer-Baco awraja, active surveillance has failed to turn up any cases south of Jinka. The density is around eight persons/sq. km. Similarly, the woredas of Gardulla awraja with 15-20 persons/sq. km have experienced little or no smallpox. At the other extreme Gemu awraja heavily populated had to be worked from the very beginning of the programme until now to bring the disease under control.

While these correlations can be seen on the overall woreda or awraja level, there is not enough reliable population data on which to observe city-countryside interaction. We can only add the following observations: (1) when the most dense woredas were under control, subsequent visits to nearby sparsely populated woredas showed smallpox rapidly decreasing or gone; (2) after vaccination of several large towns in Gemu Gofa (e.g. Arba Minch, Felege Newai, Gelilla, Ghidole, Jinka), we often found that the surrounding areas underwent a natural decrease in smallpox incidence; and (3) it was not until all the towns with populations over 3000 (est.) were vaccinated that smallpox was controlled in Gemu Gofa.

It would appear that on the basis of our experience, provincial teams must first thoroughly vaccinate the high density population areas which are undergoing outbreaks before they concentrate on the surrounding more rural areas.

#### Future plans

Future work in Gemu Gofa will be based on the following goals:

1. Active surveillance and continued vaccination for smallpox with the intention of stopping the spread of smallpox importations;
2. Distributing to health centres BCG vaccine and starting a BCG programme;
3. Surveillance for yellow fever; and
4. When possible, teaching health principles at the schools and to the general population.

Our priorities follow the order above.