Vincent Koch
Marleen de Kok

Department of Environmental and Tropical Health

A health survey of the population of Ponan, Ivory Coast

Children under five and the population associated with them

April 1990

Wageningen Agricultural University

A HEALTH SURVEY OF THE POPULATION OF PONAN, IVORYCOAST

Children under five and the population associated with them

A RECONNAISSANCE

- census of the population
- diarrhoeal surveys
- nutritional status
- intestinal parasites
- water quality

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Wageningen, Agricultural University

Preface

This is the place to thank all the people who have helped to carry out the study. In the first place we like to thank all inhabitants of the village Ponan, without them and their help this report would not be in front of you. We like to thank Samm Koula and Thérèse Bogny who have assisted during the field work from March 1989 to August 1989. We owe them a lot.

We also like to thank Joep Slaats, who lived in a village nearby, we'll never forget his hospitality, and Henk van Reuler, Fred Vooren and all the others of "Centre Néerlandais", Dr. Messou and Mr. Le Corre of the National Institute of Public Health and all the people who made it possible for us to work in Ivorycoast.

In the Netherlands we like to thank J. Lelyveld, W. Docters van Leeuwen, A. Jansen and A. Bijl for their devotion and inspiration.

Vincent en Marleen, 1990

Summary

In September 1988 the department of Public Health of the Agricultural University, Wageningen together with the National Institute of Public Health (I.N.S.P.), Abidjan started a study on the health of the population in the Taï region.

The objective of the study was to analyse the relation between functioning and use of the water supply and sanitation facilities and the health status of the children under five. For several reasons it was impossible to carry out this study. Therefore, new objectives were formulated.

- " To carry out an inventory on the general health status of the population in a village in the Taï region."
- " To formulate questions for futher research."

The indicators used were nutritional status and the incidence of diarrhoeal diseases of children under five and prevalence and distribution of intestinal parasites within the population.

As basis of the study the results of the census were used which was carried out in March and April 1989. One thousand eight hundred eighty six people were counted, distributed over 282 households. The four major ethnical groups are the Guéré (23.8%), the Baoulé (8%), the Dioula (9%) and the Mossi (55%). The population is dominated by men (56.2%) as a result of migration into the region. Of the population 25.5% percent is under five. The Guéré and the Dioula live exclusively in the village center and the Baoulé live exclusively on the compounds. Five percent of the Mossi live in the village center. The results were used for sampling and generalisation of the results of the other activities.

A survey on the incidence of diarrhoeal diseases was carried out in March and April 1989. Four hundred four children out of 481 were reached. In July a verification on the validity of the findings of the March/April survey was carried out. The results of the survey are not very valid due to the length of the recall period and definition of diarrhoea used. Significant differences were found between the girls in the village center and the girls on the compounds who suffer more often from diarrhoea and between the ethnical groups in the village center and between them on the compounds. The Guéré and the Mossi suffer more often from diarrhoea than the Dioula and the Baoulé.

In May and June 1989 288 children were measured and weighed. One hundred ninty six were also recensed. Of 54 percent of these children only the birth year was known. This subgroup is excluded from the analysis. The used indicators to measure the nutritional status were height for weight (wasted) and height for age (stunted). For both indicators 11 percent of the children was found malnourished. Significant differences were found between the boys and the girls in the village center, especially the Guéré are malnourished

and on the compounds between the Mossi and the Baoulé. The Mossi are more often malnourished than the Baoelé. The differences found may be explained by differences in nutrition and nutrition habits of the ethnical groups. When the results were compared to the results of December 1988 a decline in weight for height was found. This is possibly due to seasonal influences.

In June and July 1989 the faeces of 389 persons were examined on eggs and cystes of intestinal parasites. Eleven species of intestinal parasistes were found. Only the three most prevalent and pathogene parasites, Ascaris lumbricoïdes, hookworm and Entamoeba histolytica were used in the analysis. For hookworm significant differences were found between the village center and the compounds and between the ethnical groups outside the village. Especially the Mossi are infected with hookworm. They live in an environment, shadowed and moist, which is favourable for the transmission of hookworm. This in contrast to the Baoulé and the groups in the village center. For A.lumbricoïdes and E. histolytica significant differences are found between the men and the women in the village center and between the Baoulé and the Mossi. The women in the village center and the Mossi are more often infected with these parasites. No explaination is found for this distribution. Both parasites are faecal-oral transmitted in contrast to the hookworm which is faecal-disposal transmitted. Possibly tasks of women in relation to the removal of faeces are of influence.

In the village center a survey is carried out on the quality of water by means of the pollution of the sites with faecal coliforms. Two of the 13 water points were not contaminated according to the norms. The water of these points is followed into the households. In the households the quality of the water was as bad as the quality of the contaminated sites.

Several questions for further research are formulated. The questions are based on the results of the survey on nutritional status of the children under five and on the survey on prevalence and distribution of intestinal parasites.

To continue some activities such as measuring and weighing of the children, we recommend to make them more attracktive for especially the mothers to participate. This can be of much value to the project and the village.

Résumé

Depuis septembre 1988 l'Unité de la Santé et l'Hygiene Tropical en collaboration avec l'Institute National de Santé Publique exécutent un projet de recherche dans la région de Taï en Côte d'Ivoire.

Premièrement la recherche concernait la rélation entre la qualité et l'usage des approvisionnements en eau et des assainnissements et la santé des enfants jusqu'à l'âge de 5 ans. Néanmoins, cet objectif n'était pas practicable.

Pour cette raison nous avons definié les nouveaux objectifs:

- Exécuter une reconnaissance de l'etat général de la santé de la population de Ponan.
- Définier des nouvelles questions de recherche à reponse aux résultats des études.

La reconnaissance concerne l'état nutritionel et l'incidence de la diarrhée des petits enfants jusqu'à l'âge de 5 ans et la prevalence et la distribution des parasites intestinaux.

Les données du recensement de mars 1989 sont utilisées pour la recherche. Totalement il y a 1186 personnes, divisé entre 282 ménages, qui habitent le village Ponan. Les quatre ethnies importantes sont les Guéré (23.8%), les Dioula (9%), les Baoulé (8%) et les Mossi (55%). La population est dominée par les hommes (56.2%), à cause de la migration vers la région. Les Guéré et les Dioula habitent exclusivement dans le centre du village et les Baoulé exclusivement aux campements. Seulement 5% des Mossi habite dans le centre du village. Vingt cinq et demi pourcent des habitants est puîné que 5 ans. Toutes les données sont utilisées pour tirer des échantillons d'épreuve et pour la généralisation des résultats des études.

Au même temps du recensement une enquête est exécutée sur l'incidence de la diarrhée chez les petits enfants. Au totale 404 des 481 enfants sont touchés. Plus récent on a exécuté une verification pour contrôler la validité des données. Cette validité était très limitée à cause de la longueur de la période de "recall" et la définition de la diarrhée. On a trouvé des différences significantes entre les enfants féminins dans le village et ceux aux campements. Les denières ont eu plus d'attaques de diarrhée. Entre les ethnies dans le village et ceux aux campements. Les Guéré et les Mossi ont eu plus d'attaques de diarrhée que les Dioula et les Baoulé.

En mai et juin 1989 288 enfants sont pesés et mésurés. Cent quatre-vingt six enfants de cette groupe sont recensés. De 54 pourcent de cette groupe seulement l'année de naissance est connue. On a excludé cette dernière groupe parce que l'inconnaissance des dates de naissance peut causer une surestimation des nombres des

enfants malnutritionnés. Les indicateurs pour la malnutrition sont la taille pour l'âge (stunted) et les poids pour la taille (wasted). La malnutrition est 11% pour les deux indicateurs. Quelques différences significantes sont trouvées entre les enfants masculins et féminins au village. Les enfants masculins sont les plus malnutritionnés, spéciallement les Guéré. Aux campements les enfants de Mossi sont plus malnutritionnés que les Baoulé. Les différences sont probablement causées par les habitudes et la nutrition différentes entre les ethnies.
Si on compare les résultats de décembre 1988 avec les résultats de juin 1989, il se trouve que les enfants sont mésurés plus légèr en juin dont en décembre, probablement à cause d'une influence saisonière.

En juin et juillet 1989 on a examiné les matières fécales des 389 personnes sur les cystes et les oeufs des parasites intestinaux. Au totale 11 parasites différentes sont trouvé. Les résultats sont analysé seulement pour les trois parasites les plus prevalents et pathogenes; L'Ascaris lumbricoïdes, L'Ankylost et L'Entamoeba histolytica. Des différences significantes sont trouvées pour l'ankylost entre village et campement, spéciallement chez les Mossi parce qu'ils habitent dans un environnement qui est ideal pour la transmission d'ankylost, contrairement à la situation des Baoulé et des ethnies dans le village. Pour A. lumbricoïdes et E. histolytica les différences significantes sont trouvées entre les hommes et les femmes dans le village et aux campements entre les Mossi et les Baoulé. Les femmes au village et les Mossi sont plus infectés avec ces parasites. On ne peut pas explicer pour cette distribution. Les deux parasites sont distribués par la route fécale-orale au contraire de l'ankylost (fécale-défaite). Probablement l'éloignement des matières fécales par les femmes joue un rôle important.

Dans le centre du village on a contrôlé la qualité de l'eau à partir des coliforms faecaux. Deux points d'eau des 13 points ne sont pas contaminés avec les coliforms. L'eau de ces points est suivie dans les ménages. Dans les ménages la qualité de l'eau était la même qualité mauvaise que les autres points.

Quelques questions pour la recherche suivante sont formulées. Les questions sont basées sur les résultats des études sur l'état nutritionnel des petits enfants et la prevalence et la distribution des parasites intestinaux.

Quant aux activités de mésurer et peser les petits enfants dans la recherche suivante, nous recommendons de les faire plus attractives afin de stimuler la participation de la population, les mères spéciallement. Cette participation peut être précieuse pour le projet et le village.

Samenvatting

In de Taï-regio in Ivoorkust wordt sinds september 1988 een onderzoek uitgevoerd door de vakgroep gezondheidsleer in samenwerking met het Institute National de Santé Publique, Abidjan.

Het onderzoek was in eerste instantie gericht op de relatie tussen gebruik van drinkwater en sanitaire voorzieningen en de gezondheid van met name de kinderen onder de 5 jaar.
Deze doelstelling bleek echter niet practisch uitvoerbaar.

Om deze redenen zijn er nieuwe doelstellingen geformuleerd:

- Uitvoeren van een verkenning naar de algemene gezondheidssituatie van de bevolking in Ponan.

- Formuleren van nieuwe onderzoeksvragen op grond van de bevindingen.

Deze verkenning was gericht op de voedingsstatus en diarree-incidentie van kinderen onder de 5 jaar en op de prevalentie en distributie van intestinale parasieten.

Als uitgangspunt voor het onderzoek zijn de censusgegevens van maart 1989 gebruikt. In het totaal werden 1886 mensen geteld verdeeld over 282 huishoudens. De vier belangrijkste ethnische groepen zijn de Guéré (23.8%), de Baoulé (8%), de Dioula (9%) en de Mossi(55%). De bevolking wordt gedomineerd door mannen (56.2%) als gevolg van migratie naar het gebied. De Guéré en de Dioula wonen uitsluitend in het dorp, de Baoulé uitsluitend buiten het dorp. Slechts 5% van de Mossi woont in het dorp. 25.5% is jonger dan 5 jaar. Deze gegevens dienden voor het trekken van steekproeven en het generaliseren van de resultaten.

Tijdens de census is tevens een diarreeënquête uitgevoerd om een idee te krijgen van de incidentie van diarree onder de kinderen. In het totaal werden 404 kinderen van de 481 bereikt. Later is een verificatie uitgevoerd on de validiteit van de verzamelde gegevens te achterhalen. De validiteit van de gegevens bleek laag te zijn als gevolg van de lengte van de recall-periode en de gehanteerde definities van diarree. Significante verschillen zijn gevonden tussen meisjes in het dorp en buiten het dorp. De meisjes op de campements hebben meer aanvallen van diarree gehad dan de meisjes uit het dorp. Tussen de ethnische groepen in het dorp en tussen de ethnische groepen buiten het dorp zijn ook verschillen gevonden. De Mossi en Guéré kinderen hebben meer diarree-aanvallen gehad dan de Dioula en de Baoulé.

In mei en juni 1989 zijn 288 kinderen gemeten en gewogen. 196 kinderen van de groep waren gerecenseerd. Van 54% van deze kinderen was alleen het geboorte jaar bekend. Deze groep is niet betrokken in de analyse omdat het niet bekend zijn van de geboorte datum leidde tot een overschatting van het aantal ondervoedde kinderen. De gebruikte indicatoren zijn; lengte voor leeftijd en

gewicht voor lengte. Voor beide indicatoren is 11% ondervoeding gemeten. Significante verschillen zijn gevonden tussen jongens en meisjes in het dorp. Hier waren met name de Guéré jongens het meest ondervoed. Buiten het dorp zijn er verschillen gevonden tussen de etnische groepen. De Mossi hebben een slechtere voedingsstatus dan de Baoulé. De verschillen zijn mogelijk te verklaren op grond van voedsel en voedingsgewoontes die per ethnische groep anders zijn. Uit de vergelijking met de resultaten van de eerste meting (dec. 1988) blijkt dat de kinderen gemiddeld lichter werden bevonden. Dit kan het gevolg zijn van seizoensinvloeden.

In juni en juli 1989 is van 389 mensen de faeces onderzocht op eieren en cysten van intestinale parasieten. In het totaal werden 11 verschillende parasieten aangetoond. Alleen een analyse van de prevalentie en distributie van Ascaris lumbricoïdes, mijnworm en Entamoeba histolytica, de meest pathogene en prevalente, is uitgevoerd. Significante verschillen zijn gevonden voor mijnworm tussen dorp en campements voornamelijk bij de Mossi. De Mossi leven in een omgeving die ideaal is voor de transmissie van mijnworm dit i.t.t. de Baoulé en de bevolking in het dorp. Voor A. lumbricoïdes en E. histolytica zijn significante verschillen gevonden tussen de mannen en vrouwen in het dorp en tussen de Mossi en de Baoulé. de vrouwen in het dorp en de Mossi zijn meer geïnfecteerd met deze twee parasieten. Voor deze verschillen is geen verklaring gevonden maar mogelijk zijn taken van vrouwen m.b.t. de verwijdering van faeces van invloed op de overdracht van deze parasieten.

In het dorp zijn wateranalyses uitgevoerd. De waterkwaliteit werd gemeten aan de hand van de faecale coliformen. Van de 13 waterpunten waren er 2 niet faecaal verontreinigd. Water van deze 2 punten, de pomp en een put, hebben we gevolgd tot in de huishoudens. Op het moment van consumptie is het water even verontreinigd als het water in de 11 verontreinigde punten.

Op grond van de gevonden verschillen zijn diverse vragen geformuleerd voor verder onderzoek. Deze vragen hebben betrekking op de prevalentie en distributie van intestinale parasieten en de voedingsstatus.

Tevens wordt aanbevolen om de activiteiten meer aantrekkelijk te maken voor de bevolking van Ponan. Dit om de medewerking van de bevolking te blijven garanderen.

Contents

1 Introduction

In 1984 a research project started entitled "Analysis and design of land use systems in the Taï region of Ivorycoast". This project is carried out by the Agricultural University of Wageningen, The Netherlands in collaboration with the Ministery of Scientific Research of the Republic of Ivorycoast.

Within this project the Section of Tropical Hygiene of the Department of Public Health of the Agricultural University together with the National Institute of Public Health (I.N.S.P.), Abidjan is carrying out a study on the health of the population of the Taï region. The study started in september 1988 and this report reviews the second phase of six months of research within this project.

The research was focussed on the health effects of the improved water- and sanitation facilities in Ponan village. Health effects should be measured by means of three indicators which are related to the quality, quantity and use of water facilities and the quality and use of the sanitation facilities. These indicators are:

the incidence of diarrhoea
the growth retardment
the intestinal parasites

However, before the second phase of the research project started, we found it no longer possible to continu the investigation as formulated in the beginning (Docters van Leeuwen et al., 1988). This is based on practical reasons.

First, there are to many water supply facilities which are used for drinking. In the village center alone there are already 13 waterpoints. Outside the village (in the compounds) there are another 150 water points. Measuring all points was impossible because we hadn't enough time. Obtaining a sample of all points was impossible, because of variation in the characteristics of the water points made it impossible to generalise.

Second, the people of Ponan are very mobile. When they work on their fields (during the weeks) they often sleep near their fields and make use of the wells or water points near that site. In the weekends or on marketday (Friday) they are coming to the village center and sleep in their second houses in the village center and they use the water points in the village. They are not only mobile between the compounds and the village center but also between the villages in the neighbourhood. In this way it is hard to find out who makes use of which waterpoint.

In July 1989 we've carried out a study to analyse the water quality in the village (chapter 6). The results of these analysis subscribed the rejection of the first objective by the two arguments, because at time of consumption the water quality in the households is as poor as the points which are already polluted.

Based on the two practical arguments and with the results of the analysis of the water quality, we have decided to change the original goals and partial changed the activities for the research.

The new objectives are:

- To carry out an inventory on the general health status of the population in a village of the Taï region.
- To formulate questions for further research.

The investigation is carried out in the households with children in the age beneath 5 years and belonging to the four major ethnical groups. This, because the general health status will be based on the data of the growth retardment, the incidence of diarrhoea and the prevalence of intestinal parasites of the children aged between 0 and 5 years. The following activities are carried out:

1. A second census on the population of the village in the region.
2. A diarrhoea survey in small children.
3. An anthropometric survey in the small children.
4. A survey on intestinal parasites of 20 percent of the population of the village.
5. Analysis of the water quality of all waterpoints used for drinking water in the village center of Ponan.
6. A survey to verify the data collected during the diarrhoeal survey.

The first two activities were carried out simultaneously. During the census of the households (chapter 2), questions were asked about diarrhoea of the children beneath the age of 5 years who live in the household.

The third activity was also carried out by our predecessors in the first phase of six months of the study. We used the same method, so comparison became possible with the first data (chapter 4).

The fourth activity was primairly based on the age group of 0-4 years and enlarged with the older age groupes associated with thses children (chapter 5).

The fifth activity in the second phase of 6 months was the analysis of the water quality of which we've already spoken in the beginning of this chapter (chapter 6).

The last activity was intented to verify the method of the diarrhoeal survey (chapter 3).

Finally we will discuss the conclusions and give recommendations for further research (chapter 7 and 8).

2 Census on the population of Ponan

2.1 Introduction

The village Ponan is situated 6 kilometers north of the sous-prefecture Taï, in the south-west of Ivorycoast. Like nearly all the villages in this region, Ponan is situated at the border of the non-paved road from Guiglo to San Pedro (annex I).

It is possible to separate the village in two parts; the village center, close to the non-paved road, and outside this center or on the compounds (small settlements in the surrounding fields). The surface of Ponan is about 50 km^2. At the beginning of the research nothing was known about the population of the village, so there was carried out a census (Sept/Okt. 1988). However in March 1989 it had became necessary to update the results of the first census, because of the (im)migration of the people in the region.

2.2 Objectives

To make an inventory on name of the population of Ponan in order to obtain a good base for sampling and generalisation of the results of the samples studied.

2.3 Method

We have tried to visit all the Ponan households. The questions asked concerned the composition of the household. We asked if any babies were born or people had joined the household since the first census. We also asked if any persons died or moved away from the household. All questions were directed to the head of the household (chef du ménage). Birthdate, sexe etc. were checked using of the 'acte de naissance' (birth certificate), 'carte d'identité' (identity card) and 'carnet de santé '(registration card, used for notes concerning the health of the child like vaccinations, birthweight).

2.4 Results

The total number of persons counted was 1886, divided over 282 households. frequently people from outside the village found absent, because they were travelling. If we include the peole who are on journey and those of whom the birthdate wasn't known, we come to an estimation of 2125 inhabitants.

There are four major ethnical groups; the Guéré, the Dioula, the Baoulé and the Mossi. The Guéré are the original inhabitants and form 23.8 percent of the total population of the village (fig. 2.1). The others are coming respectively from the northern and middle part of Ivorycoast and from Burkina Faso.

Figure 2.1: Division of the ethnical groups of the population of Ponan

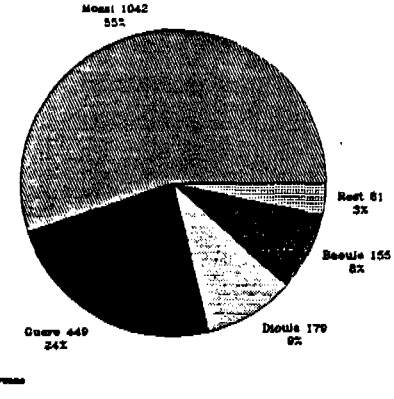


Figure 2.2 shows the population of Ponan divided over age groups of 5 years. It is possible to see that some age groups are not so numerous. These are the groups in the age 5-10 years, 10-15 years and 40-60 years.

Searching for an explanation we've split up the curve for the four major ethnical groups. The curve of the Guéré is shown in figure 2.3. Figure 2.4 shows the curve of the Baoulé, who are the first migrants into the region. In figures 2.5 and 2.6 the curves of the Dioula and the Mossi are shown, who are the last groups of (im)migrants (Janmaat and Schrikkema, 1989). Looking at these curves, it is possible to see that the curves of the (im)migrants who are living in the region for a longer time show more resemblance to the curve of the original inhabitants, with the only remark that there are relatively more men than women. The curve of the last groups of (im)migrants (esp. the Mossi), show the reason for the differences of representation of the different age groups in the figure 2.2. It is clear that the (im)migrants households are merely families with young children with relatively more men than women.

Figure 2.2: The population of Ponan divided over age groups

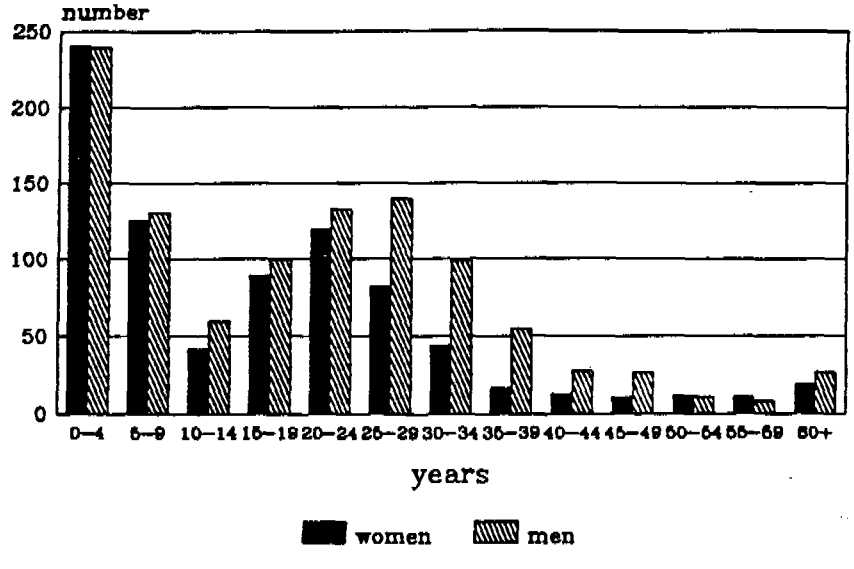


Figure 2.3: The ethnical groups of Ponan: The Guéré

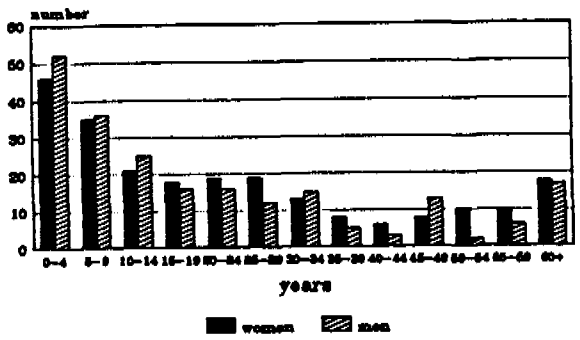


Figure 2.4: The ethnical groups of Ponan: The Baoulé

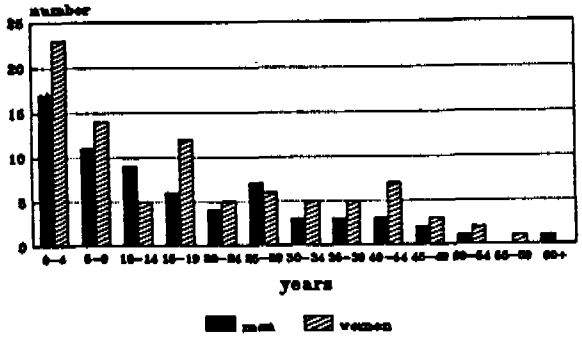


Figure 2.5: The ethnical groups of Ponan: The Dioula

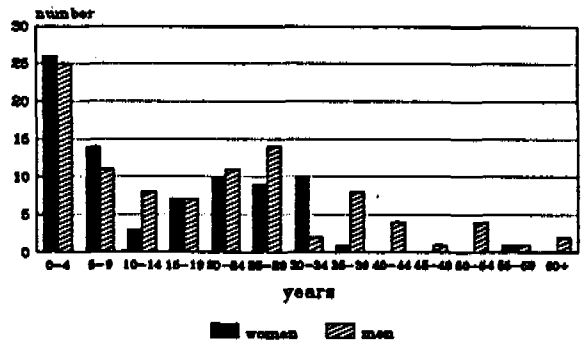
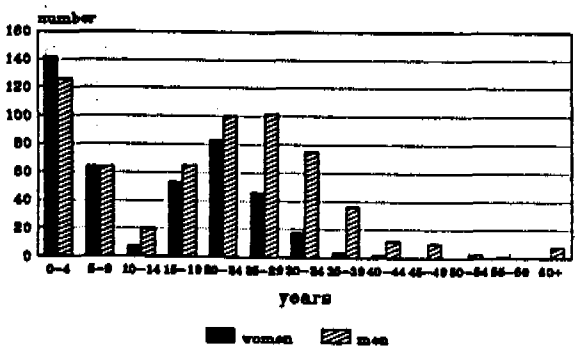


Figure 2.6: The ethnical groups of Ponan: The Mossi



The large number of (im)migrants results in a majority of men in the village (56.2 percent men and 43.8 percent women)(table 2.1).

Table 2.1:General view of the number and percentages of the population of Ponan, men, women and children. Devided per ethnical group.

	Total		men		women		children	
	#	%	#	%	#	%	#	%
Guêrê	449	23.8	218	11.6	231	12.2	98	5.2
Dioula	179	9.5	98	5.2	81	4.3	51	2.7
Baoulê	155	8.2	88	4.7	67	3.6	40	2.1
Mossi	1042	55.2	621	32.9	421	22.3	268	14.2
Others	61	3.2	34	1.8	27	1.4	24	1.3
Total	1886	100	1059	56.2	827	43.8	481	25.5

Nearly 40 percent of the 1886 people live in the village center and the others live in the compounds.

De Guêrê and the Dioula are living exclusively in the village center while the Baoulê are living exclusively outside the village. The Mossi live mainly on the compounds only 5 percent of all Mossi live in the village center (table 2.2).

An other consequence of the large group of migrants is the low average age of the population in general; 19.7 year. The Guêrê are the relative old (23.5 year) and the Mossi the very young (18.5 year) (table 2.3).

Table 2.2: Division of the ethnical groups over the two residences.

	compound		village	
	#	%	#	%
Guêrê	0	0	449	23.8
Dioula	0	0	179	9.5
Baoulê	155	8.2	0	0
Mossi	948	50.3	94	5.0
Others	38	2.0	23	1.2
Total	1141	60.5	745	39.5

Table 2.3: The average age of the four major ethnical groups

	average age
Guéré	23.5 years
Dioula	18.6 years
Baoulé	19.0 years
Mossi	18.5 years
Total	19.7 years

The population involved in the study are the households with small children (between 0 and 5 years old) belonging to the four major ethnical groups. The total number of the children beneath the age of 5 years is 481 and that is 25.5 percent of the total inhabitants.

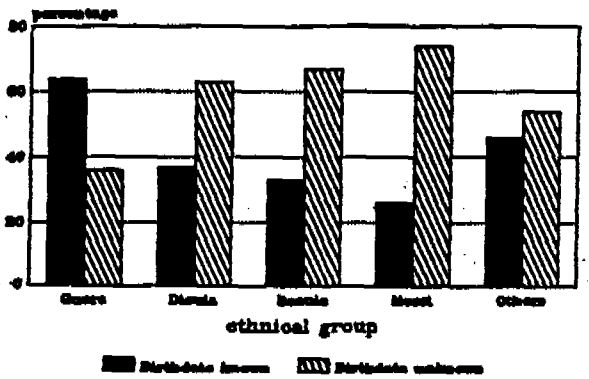
There are 214 households with children of that age. The average number of per household is 2.2 children (table 2.4).

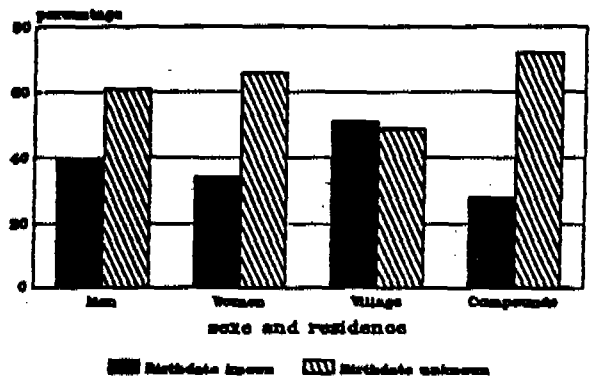
Table 2.4: The average number of children (under 5) per household.

ethn. gr.	# househ.	# chil/hh
Guéré	46	2.1
Baoulé	19	2.1
Mossi	118	2.3
Dioula	23	2.2
other gr.	8	3.0
Total	214	2.2

Of 309 children the birthyear is known (63 percent), because not all the children have an 'acte de naissance' or a 'carnet de santé'. Table 2.11 shows these percentages for the variables sexe, ethnical groups and residence. Most remarkable is the percentage Mossi children of whom we don't known the exact birthdate (74 percent), in contrast with the Guéré (36 percent).

Figure 2.7: Birthdates of children under five known and unknown. ethnie, sexe and residence.





3 Diarrhoeal surveys

3.1 Introduction

Diarrhoeal diseases are one of the major causes of death of small children in developing countries. A lot of research has been done to estimate the incidence of diarrhoeal diseases. Several methods are used and criticized on validity (annex II) (Blum and Feachem, 1983).

Following the March and April survey on the incidence of diarrhoeal diseases in the group of children in the age of 0 - 4 years a survey was caried out to verify the validity of the data gathered earlier.

In this chapter the objevtives and implementation of the survey on the incidence of diarrhoeal diseases are given before verification and its consequences for the results will be discussed. In the end only the results which seem to be valid are analyzed.

3.2 Diarrhoeal survey of March/April

3.2.1 Objectives of the survey

To estimate the incidence and distribution of diarrhoeal diseases of children younger than 5 years.

3.2.2 Design and implementation

During the census in April a survey on diarrhoeal diseases was carried out, to make it possible to gather data from as many children as possible. The mothers were asked whether their children had suffered from diarrhoea the last two weeks before our visit. When the children had suffered from an attack of diarrhoea we asked for how many days and how many stools he/she had produced per day. These questions were asked to make it possible to distinguish the data obtained according to three different definitions[1]. Four hundred four children out of 481 were reached.

[1] The definitions of the WHO are used.
At least one day of diarrhoea with at least 3 liquid stools.
The definition of severe diarrhoea:
At least 3 days of diarrhoea with at least 3 liquid stools per day.

3.3 Verification of the diarrhoeal survey

3.3.1 Objectives of the verification

To verify the validity of the 2 week recall-period used in the survey of April.

To verify the definition of diarrhoea used by the mothers and to compare this to definitions used to analyse the data of April.

3.3.2 Design

The survey was split up in two parts.

The first part was to verify the recall-period. Two groups of 23 households were visited. One of the groups was followed every day for two weeks. The other group has been visited once, the day after we finished to follow-up the first group. This was done because we had to gather the data over the same period. The first group we asked every day if there were any children who had suffered from diarrhoea since our last visit and if they had suffered from diarrhoea how many stools per day they had produced. The second group we asked the same questions as used in April; if there were any children who had suffered from diarrhoea the last two weeks and for how many days and how many stools per day they had produced.

A sample of 46 households was taken out of 214 households with children younger than five years and belonging to the four major ethnical groups. This sample was divided in two groups of 23 households each.

The second part was to verify the validity of the definitions of diarrhoea used. Therefore we used a questionnaire of ten questions (annex III). The questionnaire was set up for several purposes:
- To verify the definition of diarrhoea according to the mothers;
- To verify how they know their children suffer from diarrhoea;
- What they know about the causes of diarrhoea;
- What they do to cure their children from diarrhoea; and
- What they do to prevent their cildren from getting diarrhoea.

These questions were asked in the households which we visited every day.

3.3.3 Implementation

The sample was divided at random in two groups of 23 households. After one day it was clear that it was impossible to follow the households of the first group every day. So we had to create two new groups out of the sample of 46 households. The group households which we have visited every day was less hard to reach

than the group we have visited just once. The first group of households included 43 children and the second group 60.

3.3.4. Results of the recall-period verification.

Table 3.1: The results of the verification of the recall-period.

group	number	cases	days	incidence ± var.90%
I	43	14	36	8.6 ± 2.8
II	60	14	30	6.1 ± 2.3

group I = group of households visited for 14 days,
group II = group of households visited once.
number = number of children in the groups,
cases = number of cases mentioned during the survey,
days = number of days of diarrhoea during the survey.

Table 3.1 shows the data collected during the survey. In both groups 14 cases were found. A case is defined as at least one day of diarrhoea according to the person interviewed during the survey. When testing the results with a chi-square test no significant difference was found ($p = 0.152$) (annex IV.5).

In the first group 36 days of diarrhoea were mentioned. In the second group 30 days. The groups counted resp. 602 and 840 person days. Testing the results with a chi-square test a significant difference was found ($p = 0.016$).

3.3.5 Results of the verification of the definition

All the persons who were interviewed told us that the stools of children who suffered from diarrhoea were liquid. Two mothers of the 23 told us also that there were non-digested particles in the stools like corn or rice. Everybody told a child with diarrhoea produced about 3 or 4 stools per day.

The persons interviewed said they know when their child suffered from diarrhoea because in that case the children go often into the bush or they defaecate on the court. About 50 percent said that they did not know the number of stools per day actualy produced.

According to the persons interviewed the change in health status caused by diarrhoea was losing weight and force.

Only 5 persons interviewed (22%) told that diarrhoea is not

dangerous. The others said that diarrhoea is dangerous but 50 percent did not know why.

Fifty percent was unable to mention a cause of diarrhoea. The others mentioned the food as cause of diarrhoea. To prevent the child from getting diarrhoea they change the food. The others did not know how to prevent diarrhoea.

When a child has diarrhoea 17 percent does not do anything to cure the child. Fourty four percent gives an enema to cure the child. The others give their child something to drink[1].

When the diarrhoea does not stop everybody told that they'll visit the health post in Taï.

3.4 Consequences for the March/April survey

The results of this verification have several consequences for the use of the data obtained during the survey of April.

The used recall-period of two weeks is to long to gather reliable information on the incidence of diarrhoea. Although the difference found between the two groups is not significant for the number of cases, we think that the length of the recall-period leads to an underestimation of the incidence.
It seems impossible to use the data of the length of diarrhoea attacks in days. The results show that it is not admissible to use that kind of data. So it is impossible to distinguish the results according to three different definitions of diarrhoea as proposed.

Although all the persons interviewed gave a good definition of diarrhoea the definition measured is only valid for diarrhoea when the children defaecate on the court. In most of the other cases it is not known exactly to the mother whether her child suffers from diarrhoea.

3.5 Results of the March/April survey

As a result of the verification only those results are presented which seem to be valid. The definition of diarrhoeal diseases used is the definition according to the mothers. An episode of diarrhoea is defined as at least one day of diarrhoea during the two weeks before our visit.

[1] Most of the time the drinks are composed of leaves, peper and water.

Table 3.2: Results of the diarrhoea survey. Incidence[1] and 90%-confidence interval (annex V).

	Incidence	N
Itotal	4.2 (3.1 - 5.0)	404
Iboys	4.3 (3.1 - 5.4)	200
Igirls	4.1 (3.0 - 5.2)	204
Io	4.5 (3.2 - 5.9)	127
I1-4	4.0 (3.1 - 4.9)	277
Ivill	3.2 (2.1 - 4.3)	153
Icomp	4.1 (3.2 - 5.0)	251

ethnie	Incidence	N
Iguërë	4.4 (2.5 - 6.3)	76
Imossi	4.8 (3.7 - 5.9)	238
Idioula	2.3 (0.5 - 4.1)	46
Ibaoulé	1.3(-0.8 - 3.4)	21
Iothers	2.3(-0.2 - 4.8)	23

Although the data are not really independed, because they were gathered per household a chi-square test is used to analyse the data (annex IV.5).

Some differences are being found significant. When the girls in the village and on the compounds are compared a difference is found for the incidences of diarrhoeal attacks. resp 2.3 apcpy and 4.9 apcpy ($p = 0.024$).

In the village a difference is found between the Dioula and theGuërë resp. 2.3 apcpy and 4.4 apcpy ($p = 0.099$) and outside the village between the Mossi and the Baoulé resp 4.8 apcpy and 1.3 apcpy ($p = 0.058$).

3.6 Discussion.

Although the differences in the incidence of diarrhoeal diseases found should be handled with care, we can say that the some groups do suffer more from diarrhoeal diseases than other groups do. Especially the results of the comparison of the ethnical groups in the village and outside the village focus the attention on the differences in habitat and care for their children.

[1] $$\text{incidence} = \frac{\text{number of cases found}}{\text{number of children interviewed}} * \frac{52 \text{ weeks}}{2 \text{ weeks}}$$

incidence = number of attacks of diarrhoea per child per year (apcpy)

The data gathered in this way gives an indication of the incidence of diarrhoea but will be an underestimation of the real incidence.

In this kind of research it is very difficult to work with a definition of diarrhoeal diseases other than the definition of the mothers. The length of the 2 week recall-period influences the results in that way that we underestimate the incidence. Because of this it is impossible to give a definition of an episode of diarrhoea or to distinguish the data according to other definitions than the definition of the mothers. We think that information gathered by just visiting the households is not very valid. Data obtained in a health post is more valid because cases will be real cases although several biasis due to accessebilty of the clinic and distance to the clinic are introduced. In the health post in Taï, however, the registration of diarrhoeal diseases is very poor.

It is not possible to compare the data gathered on individual basis to other activities, like the data of intestinal parasites or the antropometric measurements. Only by relating them on a group basis to environmental and social-economical influences or other diseases some indication of possible causes of diarrhoea can be given.

3.7 Conclusions and recommendations.

The distribution of diarrhoeal diseases is not the same for all groups of children in Ponan. Therefore, it is recommended to do further research to find out why. The ethnical groups should form the basis for this survey. We recommend a KAP (Knowledge Attitude and Practice)-survey to found out more about the subject of diarrhoea. Putting more emphasis on estimating the incidence of diarrhoeal is not recommended.

Data gathered on this subject seems to be not valid. A smaller sample which can be followed more intensively could be taken. In that case it will be difficult to gather sufficient cases to analyse. Better is it to use information gathered in a health post because cases of diarrhoeal diseases will be real cases. Also the cases can be distinguished according to several definitions of diarrhoea. However, the registration of diarrhoeal diseases of the clinic in Taï is very poor.

4. Anthropometry

4.1 Introduction

It is widely accepted that anthropometry is a useful tool for assessing the nutritional status of children (WHO working group, 1986) (annex V). In the Taï region hardly anything is known about the nutritional status of the children under 5.

4.2 Objective

To follow the nutritional status of an open cohort of children under the age of 5 years. To formulate questions for further investigation on the subject of nutritional status.

4.3 Design

For gathering the measurements on the nutritional status, a Salter balance and a board with a measuring-line were used. Nine reunions were organised for the mothers, two in the village center and seven at several locations on the compounds. The news of the reunions was spread by the village chief, the chiefs of the different ethnical groups and the people of the compounds where the reunions were organised. The first measurements were carried out in December and January 1988/1989 and the second ones in June 1989. In December there were 353 children measured and in June 196 (who are also represented in the census of April 1989). Ninety eight children were measured in both periods.

4.4 Elaboration

4.4.1 Method

After collecting the measurements we elaborated these in the CASP-program (Anthropometric Software Package by The Centers for Disease Control(CDC), 1985) in which the NCHS growth curve for children (U.S., series 11-number 165) is used as reference.

Stunted and wasted were chosen for the two general growth retardments of the WHO[1]; stunted and wasted (WHO working group, 1986). A child is stunted when he/she is to short for his/her age and wasted when the child is to light fot her/his length. Based on the outlines of the WHO (WHO working group, 1986) the stunted and wasted children are defined with the z-score cut-off point at

[1].World Health Organisation

-2.00 and less (-2 SD[1]).

4.4.2 Correction

The number of children measured in June 1989 is 288. Of 196 children the data of the census are known. It appeared that in 54 percent only the year of birth was known. We compared the results of the group of whom the birthyear was known, to the results of the group of whom the birthdate was known. The results differ significantly for both indicators of the anthropometry (stunted and wasted), resp. $p < 0.0002$ and $p = 0.082$ (with a chi-square test)(annex IV.5). Therefore, we've excluded the group children of whom only the birthyear is known. This means that 91 children were left of a total of 172 children of whom the exact birthdate is known.

The composition of the measured group wasn't the same as that of the total group of children of Ponan. Before generalisation a correction was needed. We've corrected the results by means of the data of the census of April 1989 (chapter 2). The correction was based on the variables sexe, residence, ethnical group and age-groups (0 year and 1 year and older)(annex IV.1).

Before the comparison of the anthropometric data of Dec/Jan and June 1989 we've done the same test between the children with and without exact birthdate as we've done earlier with the 196 children. It was seen that with both indicators (stunted and wasted) the results were significantly different ($p < 0.0002$ and $p < 0.0002$). Excluding the children of whom only the birthyear is known became necessary. Fifty one children were left of the 98 children who were measured in both periods.

4.4.3 Statistical elaboration

As following both corrections we tested the children measured in June 1989 on the most striking differences of the indicators height for age (stunted) and weight for height (wasted) for the variables for which we've corrected the sample (annex VI.2). Although a few Mossi are living in the village, we've compared the prevalences in the village center only between the Guéré and the Dioula. On the compounds this comparison was made between the Mossi and the Baoulé.

For the comparison of the anthropometric data of the 51 children who were measured in both periods we've used the sign-test. We compared the z-scores of the height for age in both periods per child and tested if they were significantly lower in June 1989 than in Dec/Jan 1988/89. This is also done for the indicator weight for height (annex VI.4).

[1]. Standard Deviation

4.5 Results

4.5.1 Results of the period June 1989

Table 4.1:Overall prevalences of malnourishing for the indicators height for age and weight for height, June 1989 (annex VII)

indicator	prevalence
H/A	0.11
W/H	0.11
sample	91
populat.	172

Weight for Height

The girls on the compounds are more wasted than the girls in the village center ($p = 0.019$), due to the nutritional status of the Mossi, because in the age-group 1 year and over on the compounds the Mossi children are more wasted than the Baoulé children ($p = 0.046$).

In the village center the Guéré boys are more wasted than the girls of this ethnical group ($p = 0.043$). The age-group 1 year and over is more wasted than the age-group 0 year of the Guéré ($p = 0.038$), especially the boys ($p = 0.045$).

Height for Age

The boys in the village center are more stunted than the girls in the same situation ($p = 0.034$). This higher prevalence is probably caused by the Guéré boys which are more stunted than the girls of this ethnical group ($p = 0.039$).

On the compounds the Mossi children are more malnourished than the Baoulé children ($p = 0.012$). This is also true for the girls of these ethnical groups ($p = 0.044$) aswell for the 1 year and over age-group of both ethnical groups ($p = 0.023$) (annex VI).

4.5.2 Results of the comparison Dec/Jan 1988/89 and June 1989

Generally it is seen that the z-scores of the indicator weight for height are decreased in the six months. In June 1989 the z-scores are significantly lower than in Dec/Jan '88/'89 (reliability of 5 percent). This decrease is significant for the ethnical groups Guéré, Baoulé and Dioula, for both sexes and for the population of

both the village center aswell as the compounds (annex IV.4).

4.6 Discussion

4.6.1 Method

Various factors have interfered with the study and have possibly influenced the results.

It was difficult to reach all the children of the village. In the village center a reasonable percentage was reached (60 percent of the group of children corrected for age), but the children on the compounds were hard to reach (44 percent of the group of children of the compounds). This may influence the results, because the children of the ethnical groups Mossi and Baoulé are poorly represented in contrast with the children of the Dioula and the Guéré.

The composition of the population of Ponan changes very rapidly due to migration into and out of the Taï region.

These two reasons make it difficult to follow the same cohort of children and the result is that the group of children who were measured twice is very small (51 out of 172 of whom the exact birthdate is known). This makes the comparison of the anthropometric data of both periods less valid for all the children of Ponan.

Table 4.2:Division and percentages of the children with and without knowning their birthdate.

population examined	known		unknown	
all children # 481	309	27%	172	63%
measured chil. 196	105	54%	91	46%

Not knowning the exact birthdate had shown a direct influence on the results of the analysis of the anthropometric data. Of 54 percent of the 196 children only the birthdate was known (table 4.2). This resulted in an overestimation of the percentages of both weight for height (stunted) and height for age (wasted) (par. 4.3.2).

Of the 105 children of whom only the birthyear is known there are 42 percent Mossi children (of the 91 children only 32 percent). These children are more malnourished than the children of the other ethnical groups. Excluding these 105 children means therefore that the children measured in June 1989 are a subgroup of the 172 children and do not represent all the 481 children of Ponan. This can lead to an underestimation of the percentage malnourishment, which is now based on the 172 children of whom the birthdate is more specified.

Also it can be said that children of whom the exact birthdate

is known are getting more attention from their mother or parents, which may result in a better nutritional status than children of whom only the birthyear is known. This means again an possible underestimation of the percentage of nutritional status for the children of the village.

4.6.2 Results

Inspite of these methodological problems for weighing and measuring the children, we can still say something about the prevalence of the nutritional status of the children measured in June 1989 and of the group measured in both periods (Dec/Jan '88/'89 and in June 1989).

In the village center the boys are more malnourished for both indicators than the girls. The poor nutritional status of these boys is primairly found with the Guërë boys in the age-group of 1 year and older.

It is possible that the boys of that age are getting less attention than the girls, e.g. they are getting different food or have to work harder than the girls. This in contrast to the general opinion that in Africa girls are inadequatly fed, because they are eating last (van Wijk Sijbesma, 1985).

On the compounds the largest differences are found between the Mossi and the Baoulë. In the age-group 1 year and older large differences are found for both wasted and stunted. The girls further more for the indicator height for age. It is remarkable that none of the Baoulë children are stunted. However, the percentages of wasted of the girls of the age-group 0 year is high (67 percent; 2 out of 3 children).

It could be possible that the Mossi, who are originally from a total different environment with other nutritional habits, are having difficulties with the different ingredients for their nourishment. This is possible not hold for the Baoulë, who are already living longer in the region. An other possibility is the total different child care of these two ethnical groups.

The difference in wasted between the two age-groups only exist among the Guërë. In the other ethnical groups the malnourishment of the babies isn't different from the malnourishment of the age-group 1 year and older. The difference with the Guërë is however remarkable and is possibly caused by a later switch from breastfeeding to weaning food. Therefore, the babies are longer protected against diseases as diarrhoea and better nourished than the age-group 1 year and older (Feachem et al., 1984).

Overall the z-scores of wasted are decreased in the period December - June 1988/1989. Only for the Mossi children the difference is not significant.

The decrease of the z-scores is probably caused by seasonal influences. The first period of measuring was during the harvest

season, when there isn't a shortess of nourishment, in June, however, it is the wet season and not yet the harvest time, so there is a situation of relative foodshortage. This seems a reasonable explination for the worsening of the nutritional status of the children in Ponan.

4.7 Conclusions and recommendations

Generally the percentage malnourishing of the children in Ponan isn't very high for both anthropometric indicators, stunted and wasted. Large differences are found between sexes, the different ethnical groups and age-groups on the two residences (compounds and village center).

The most remarkable differences are between sexes and between the ethnical groups in the village center aswell as on the compounds. Why these differences exist, we can't explain of the data present.

The following questions can be posed for further research on the subject of nutritional status of the children in the under 5 years age-group:

- Why are the Guéré boys more malnourished than the Guéré girls?;
- How it is possible that none of the Baoulé children is stunted but the baby girls are very wasted?;
- Why a difference in malnourishment is found between the age-groups (0 year and 1 year and over) of the Guéré?;
- Why are the Mossi on the compounds more stunted than the Baoulé, particularly at the one hand the girls and at the other hand the age-group 1 year and older?

It is necessary to investigate the remarkable differences found in these general results of our anthropometric survey in a future reasearch project. Our view is to concentrate this research on the social- and cultural habits around the subject nourishment between the different ethnical groups, sexes and age-groups on the two residences.

Also we think that the measuring must continue to follow the changes in the nutritional status of the children, to find out if the changes of the z-scores have a seasonal character.

The exact knowning of the birthdate of the children is very important to get reliable results in anthropometry. More attention to get this valuable information is, therefore, necessary.

Further more we think it necessary to improve the reunions of the mothers to reach more children. Some recommendations for these reunions are:

- To organise more reunions, especially on the compounds to measure more Mossi and Baoulé children;
- To try to find out the exact birthdate of the children;
- To make the reunions more attractive for the mothers by for

example the organisation of an extension- or vaccination program at the same time.

5 Intestinal parasites

5.1 Introduction

In June and July 1989 we have caried out a study of the prevalence and the distribution of intestinal parasites in the population of Ponan. The study was basicly a reconnaissance because nothing was known about the subject in this region.
To analyse the distribution of intestinal parasites in the population we have chosen those which are most prevalent and pathogene, hookworm (Ankylostoma duodenale and Necator americanes), Ascaris lumbricoïdes and Entamoeba histolytica.
Hookworm is a parasites which can be transmitted by the faecal-disposal route and A.lumbricoïdes and E. histolytica can be transmitted by the faecal-oral route (annex VIII) (Cairncross et al., 1980).

5.2 Objectives

To study the prevalence and the distribution of intestinal parasites within the population of Ponan.
To formulate questions for further research on this subject.

5.3 Design

Of the 214 households[1] in Ponan with children in the age of 0-4 years and belonging to one of the four major ethnical groups, 164 households were included in the study.

Of every household at least three samples were taken. One from a childn the 0-4 years age group, one in the 5-15 years age group and one in the age group 16 or over.
Persons in the 5-15 years age group were not present in some households. In that case two samples were taken.

To gather sufficient data to compare the results of the analysis of the faeces with results of other activities proportionately more children were included in the study. In case there was one child present in a household just one sample was taken. If there were 2,3 or 4 children, 5 or 6 children or 7 or more children in the age group 0-4 years old present in a household respectively 2, 3 or 4 samples were taken.

[1] The population examined is defined as all the households in Ponan with children under five and belonging to one of the four major ethnical groups, the Guéré, the Mossi, the Dioula and the Baoulé.

5.4 Collection of the sample

To collect the samples small containers were used which were especially designed for this purpose. Before the distribution they were filled with several ml. SAF[1] and marked with two codes. One code refered to the person from whom the sample was taken. The other code (a colour code) was used to explain to the head of the household from whom we wanted to have a sample. This code was used because most of the people could not read. At the time of distribution, the head of a household was explained several times which colour refered to which person. During the collection the code was verified once again. This system worked very well.

5.5 Method of faecal examination

A small amount of faeces was mixed on a glass object slide with IKI to facilitate the detection of eggs and cystes. The slide was then screened by microscope (Olympus EC) on using 10 X 10 or 10 X 40. One slide was made of every sample. Only in case of doubt we checked each other.

5.6 Results

5.6.1 The non-respons

Of the 164 household selected 18 could not be find anymore because they had moved, were on journey or could not be traced. In the end 430 pots were distributed over 146 households.

Three hundred eighty nine containers were left for examination. Reasons for not returning the pots were: broken (1 pot); on journey (33 pots); or absent (7 pots).

[1] SAF is a solution use to conserve the eggs end cystes of intestinal parasites .
SAF = Sodium acetate 15 gr, acetate (concentrated) 20 ml, Formaldehyde 40% 40 ml and destilated water 925 ml.

5.6.2 Results of the survey

Table 5.1: Parasites found in sample (Number and %).

	Total				
A. lumbricoïdes	40	10.4	Iodamoeba Bütschlii	2	0.5
Hookworm	36	9.3	Whipworm	2	0.5
E.histolytica	40	10.4	Enterobius vermicularis	1	0.3
Entamoeba coli	69	17.9	Giardia Lamblia	5	1.3
Endolimax nana	5	1.3	Strongyloïdes stercoralis	2	0.5
			Chilomastix mesnilii	2	0.5

The sample examined, was not representative for the population. So the findings were corrected to estimate the prevalence and the distribution of intestinal parasites in the population. The correction is based on the results of the census of April 1989. The results for both, de census and the sample were split up according to the dependent variables and compared (annex IV.1).

The dependent variables which are chosen, are ethnical group, age group, sexe and residence (inside or outside the village). The independent variables which are chosen, are A. lumbricoïdes, E.histolytica and Hookworm (Ankylostoma duodenale and Necator americanes).

Table 5.2: Prevalence of intestinal parasites of the population (Corrected) (annex IX).

	Total
A.lumbricoïdes	0.09
Hookworm	0.11
E.histolytica	0.15
Size	1644

5.7 Statistical analysis

A test was used to elaborate the corrected data (annex IV).

Significant differences are found between the prevalences of intestinal parasites for several categories of the population.

Hookworm.

The prevalence of the hookworm is high on the compounds. Especially the men on the compounds are infected (16%). Significant differences were found between the men on the compounds and the men in the village ($p = 0.047$) and between the boys in the age group of 0 - 4 years old on the compounds and in the village ($p = 0.013$).

When we look at the men and the women in the age group of 16 and over the men are found more often infected than the women ($p = 0.017$).

When we compare the two ethnical groups on the compounds, the Baoulé and the Mossi, differences are found for the groups in the age group of 16 and over ($p = 0.002$). The adults of the Baoulé are not infected at all. The same difference is found in these ethnical groups for the girls in the age of 0 - 4 years old ($p = 0.006$). (annex IV.3.1)

A. lumbricoïdes

Of the childeren in the age group of 0 - 4 years old, the girls are more often infected with A. lumbricoïdes than the boys ($p = 0.036$). On the compounds the difference for this group stays the same ($p = 0.037$).

The Guéré are more frequently infected with A. lumbricoïdes than the Dioula ($p = 0.022$). Differences are also found in these groups for the women ($p = 0.046$) and for the men in the age group of 5 -15 years old ($p = 0.027$), the Guéré are more often infected for both groups.

When we look outside the village a difference is found only between the men of the age group 5 - 15 years old of the Baoulé and the Mossi. The Mossi are more often infected ($p = 0.026$). (annex IV.3.1)

E. histolytica.

The women who are living in the village are more often infected than the women who are living on the compounds ($p = 0.046$) and the first group is more frequently infected with E. histolytica than the men who are living in the village ($p = 0.029$). Especially the women of the Dioula are heavily infected (75%). But due to small sample size differences are not found significant.

When we look at the compounds the Mossi are far more infected the the Baoulé. Especially those in the age group of 16 and over ($p = 0.000$). This difference is the same for both men ($p = 0.003$) and women ($p = 0.021$).
Overall the men of the Mossi are more frequently infected than those of the Baoule ($p = 0.014$).

Of the women in the age group 5 - 15 years old the Mossi are more often infected than the Baoulé ($p = 0.021$). (annex IV.3.1)

No infections were found in the group of Baoulé of 16 and over for neither A. lumbricoïdes, Hookworm nor E. histolytica.

5.8 Discussion

The method used to examine the faeces is not very to estimate the real prevalence of intestinal parasites in the population. Examening just one sample of a person and using only the method of direct examination lead to an underestimation of the real prevalence (Meulenman et al. 1985).

Reasons for this are that the excretion of eggs and cystes is irregular. The production of eggs is influenced by the age of the parasite and the health status of the person. By using the method of direct examination only the persons with a high burden of intestinal parasites will be detected (Koch and de Kok, 1989).

Although methods greatly influence the analysis it is possible to obtain insight in the distribution of the intestinal parasites in the population. Only the great differences in prevalences will be found significant. Because as a result of the underestimation of the prevalence the differences between the them will be underestimated aswell.

The distribution of hookworm in the population shows that especially the men who are living on the compounds are infected. In the village no boy was found infected in the age group of 5-15 years old.

Several reasons can be mentioned why the people living outside the village are more infected with hookworm. Around the compounds cacao- and coffee-trees are planted. The surface under these trees is shaded, covered with leaves and always moist (Ilardi et al., 1987). These factors create a good climate for the development of the larvae of the hookworm. Defaecating habits and not wearing of foot-wear can influence the transmission Cairncross et al., 1980). On the contary the surface in the village is open so sunshine easily reaches the ground. In the village also latrines can be found.

The ethnical groups who are living on the compounds also differ in the in infection loads of hookworm. Especially the older people of the Baoulé are not infected. The Baoulé live in small groups of several families outside the village. The surface around their houses is also open and dry in contrast with the compounds of the Mossi. This can be of influence on the transmission of hookworm. Althouhg the boys younger than 5 years old are infected with hookworm. Defaecating habits, wearing of foot-wear and possible the use of drugs could also explain the differences found between the Baoulé and the Mossi.

The distribution of A. lumbricoïdes in the population shows that the Guérê are more infected than the other groups. This is particulary true for the women of the Guërë. Also the infection rate of small children shows that girls are more often infected with A. lumbricoïdes than the boys. Only for the boys in the age group 5 - 15 years old differences are found between the two major ethnical groups in the village and also for the two major ethnical groups on the compounds. Of both groups a very small sample was taken.

The women in the village are more often infected with E. histolytica than the women on the compounds and they are more often infected than the men in the village. This observation can be explained by the infection rate of the Dioula women (75%) but does not give an answer on the question why the women are more freguently infected than the men in the village. On the compounds especially the Mossi are often infected with E. histolytica when compared to the Baoulë.

Probably the same causes are relevant for the distribution in the population for both A. lumbricoïdes and E. histolytica. Both parasites are faecal-oral transmitted. We think that especially the contact with faeces influences the transmission of these parasites for women. We can not give a reason for the same differences between the Mossi and the Baoulë (Cairncross et al. 1980).

5.9 Conclusions and recommendations

Clear differences were found in the distribution of several intestinal parasites in the population of Ponan. We did not gather sufficient data to explain these differences but we have given several suggestions for further research.

The results justify the selection of the variables such as age group, ethnical group, residence and sexe. These variables should form the bases for further research of prevalence and distribution of intestinal parasites.

Several questions for future research are the following:

- Why is hookworm more prevalent on the compounds than in the village ?;
- What are the reasons to explain the differences found in distributions of hookworm and E. histolytica between Mossi and Baoulé ?;
- Why are women in the village more often infected with A. lumbricoïdes and E. histolytica ?

We recommend to use concentration methods for detecting eggs and cystes to gather more valid information about the prevalence

and distribution of the intestinal parasites. Also more samples of one person should be taken and a quantitative method should be used. This gives also the opportunity to estimate the burden of intestinal parasites which determines greater the health status of a person than just the sort parasite (Feachem et al., 1983).

6 Water analysis

6.1 Introduction

In July 1989 we've implemented an analysis of all water points used for drinking in the village center of Ponan. The water quality was examined on the present of faecal and total coliforms. The faecal coliforms are used as indicators for all other faecal contamination of the sites. The standards for water quality are based on their prevalences. When a water point was not contaminated, we followed the quality of water during transport and in the household untill the time of consumption.

6.2 Objective

To establish the water quality of the water points, used for drinking water and to follow the quality untill consumption.

6.3 Design

Use was made of the Millipore method (Water Microbiology, 1986). This is a very simple method to detect the faecal and total coliforms in the water.

6.4 Implementation

There are 13 water points in the village center which are used for drinking, one pomp and 12 wells. The pomp is situated in the Guéré area, 5 wells on the area of the Dioula and 7 wells devided on three areas of the Mossi (annex I).

In our situation it was impossible to follow exact the method descriped above.

The laboratory is to far away from the village to treat the water samples within an hour. We've used, therefore, an cool-box with ice to store the samples until further analysis. In the morning we collected the samples and in the afternoon they were incubated.

To sample the points we used empty beer bottles (30 cl. because they fitted in the pressure cooker). The pomp sample was collected by just holding the bottle in the waterflow of the pomp and for the wells we've used a rope to let the bottle down. After filling the bottles were put in the cool-box for transport to the laboratory. All the water samples were taken in duplo.

Principally a 100 ml. sample was drown from all water points according to Millipore standards. From some water points less than a 100 ml. water sample was filtered. Of the wells a 5 ml. sample was taken, because we expected a high contamination of coliforms. For the analysis of the water quality in the housholds we expected the same, so we sampled 100 ml.from the source, 20 ml. from the basin or bucket and 1 ml. from the cup used for

drinking (van Gelderen and Marseille, 1985).

When the water wasn't contaminated with faecal coliforms we implemented a test on total coliforms,because in cases where the water is polluted with faecal coliforms, the contamination with total coliforms doesn't say anything more about the water quality.

When the water quality was good, which means not more than 5 colonies of faecal coliforms per 100 ml. (annex X) two themes were implemented.

First, the water quality of the clean points were followed into the household. The water was tested on faecal coliforms.

Second, the water of these points were tested on total coliforms. The norm for this is that the water do not contain more than 50 colonies of total coliforms per 100 ml.(annex X).

All the materials used (except the filter holder), were sterilised in a pressure cooker for 15 minutes at a temperature of 118 °C. After three filtrations we've filtrated a blanco to control the sterilisation of the filter holder, the materials used and the sterile water.

6.5 Results

Table 6.1:The water quality of all water points used for drinking water using the total of faecal coliform colonies per 100 ml. sample in Ponan (* followed into the household).

source + number	ave. Fc	Fc 1	Fc 2
Guérê pomp *	0	0	0
Dioula 1	140	180	100
Dioula 2	50	20	80
Dioula 3	720	220	1220
Dioula 4	1520	1940	1100
Dioula 5	130	20	240
Mossi Dioulab. 1	860	400	1320
Mossi Dioulab. 2	580	400	760
Mossi Sud 1	530	540	520
Mossi Sud 2 *	10	20	0
Mossi Sud 3	6450	9060	3840
Mossi Nord 1	100	140	60
Mossi Nord 2	130	40	220

All the points except the pomp and one well in the area of Mossi Sud are contaminated with faecal coliforms and in accordance to the norm are polluted.

Table 6.2:The quality in total coliforms per 100 ml. of the pomp and one well.

source + number	ave.Tc	Tc 1	Tc 2
Guéré pomp	2	3	1
Mossi well	402	430	375

The total coliforms of the two clean points are shown in table 6.2. In accordance to the norm the Mossi well is polluted and the Guéré pomp remained clean.

Table 6.3: The water quality in two Guéré households and two Mossi households in faecal coliforms per 100 ml.

	source	bucket	cup
Guéré pomp1	2	65	1050
Guéré pomp2	2	95	1800
Mossi well1	0	115	800
Mossi well2	0	60	200

6.6 Discussion

It was astonishing to find one open well (without cover) wasn't contaminated with faecal coliforms. This is probably due to the less intensive use of this well. However, the number of total coliforms was to high in accordance to the norm.

The rapid augmentation of the coliforms in the household untill time of consumption is due to a pollution during transport. Some pollution results are transportation because of the use of basins and buckets without cover, or not sufficient cleaning of the buckets, basins and storages and/or not cleaning the cup after drinking.

6.7 Conclusions and recommendations

Only two points in the village center of Ponan are not contaminated whith faecal coliforms, one well and the pomp. The well is, however, polluted with total coliforms.

When we followed the clean water of the pomp and well into the household we saw an increase of the colonies per 100 ml. water sample. The quality at time of consumption is as bad as the water directly sampled from the other wells.

These results supports our original observation that it was not conducive to obtain a better understanding of water quality in relation to health indicators.

7 Conclusions and recommendations.

The population of Ponan changes very rapidly due to migration. For this reason it is necessary to repeat the census every year, to obtain a reliable basis for sampling and generalisation of the findings. It is difficult to obtain exact birthdates. Of most of the people just the birthyear is known. For some activities such as measuring and weighing of children, it is necessary to have more exact dates.

A diarrhoeal survey has been carried out to estimate the incidence of diarrhoeal diseases of the children under five who are living in Ponan. Also a small survey to verify the validity of the data obtained was carried out. Although, the results of the survey are not very reliable due to the length of the recall-period and the definition of diarrhoeal diseases used, we think that they give an indication of the distribution of the incidence. The incidence reported, however, is an underestimation of the real one. It is possible to generalise the results on a group basis when they are used in comparison to other diseases or social and environmental determinants. Such results should be handled with care.

In December 1988 and June 1989 a program to measure and weigh children under five has been carried out to estimate the prevalence of malnutrition (stunting and wasting). Some differences in nutritional status were found between the ethnical groups and sexes, between children living inside or outside the village.
Especially the Guéré boys when compared to the Guéré girls and the Mossi children, mainly the girls, when compared to the Baoulé children suffer from malnutrition.
A decline in height for weight of the children was recorded when the results of December 1988 were compared to the results of June 1989. This can be due to seasonal influences.
Not knowing the exact birthdates of many children influences the results in such way that we had to exclude these children from analysis.

Intestinal parasites are not equally distributed in the population of Ponan. Hookworm is mainly found outside the village center and especially in the group of the Mossi. They live in circumstances which are favourable for the larvae of hookworm, high humidity and shade. Women who are living in the village are more often infected with Ascaris lumbricoïdes and Entamoeba histolytica. The Mossi, men aswell as women are frequently infected with E. histolytica.
The methods of collecting and examening the faeces used, are not very precise to estimate the prevalence of intestinal parasites. Therefore, more accurate methods are recommendated to verify the results. Also futher research is necessary to explain the differences found.

The drinking water situation in Ponan and the results of the analysis of the water quality show that it is impossible to relate water quality and the use of water to the health status of the population.

To correlate the results in this stage of the research is not possible. To relate the nutritional status of the children to the infections with intestinal parasites, the children should be followed more intensely and a quantative method to detect the burden of intestinal parasites should be used. A correlation of the intestinal parasites or nutritional status with the incidence of diarrhoeal diseases is not possible. The results of the diarrhoeal survey are not reliable enough for that purpose.

For both intestinal parasites and nutritional status differences are found between the ethnical groups. Therefore, it seems justified to put more emphasis on explaining the differences between those groups in social and environmental circumstances which can influence the nutritional status of the children and transmission of the intestinal parasites. In relation to the nutritional status we think that differences in child care, nutrition and nutritional habits (quantitative and qualitative) between the ethnical groups is of great importance.

The variables age group, sexe, residence and ethnical group seem to be valid. We think that they should form the basis for futher research. The variables residence and ethnical group are strongly correlated. The Guéré and the Dioula are living exclusively in the village center and the Baoulé are living exclusively on the compounds. Five percent of the Mossi are living in the village center. Therefore, only comparisons are made between Guéré and Dioula and between the Mossi and the Baoulé.

To continue some activities such as measuring and weighing of children, we recommend to make them more attractive for especially the mothers to participate. More can be done in the field of extention in relation to nutrition or intestinal parasites, by using of the results of the investigation. Collaboration with the health workers in Taï (e.g. vaccination) can be of much value to the project and is in the interest of the population of Ponan.

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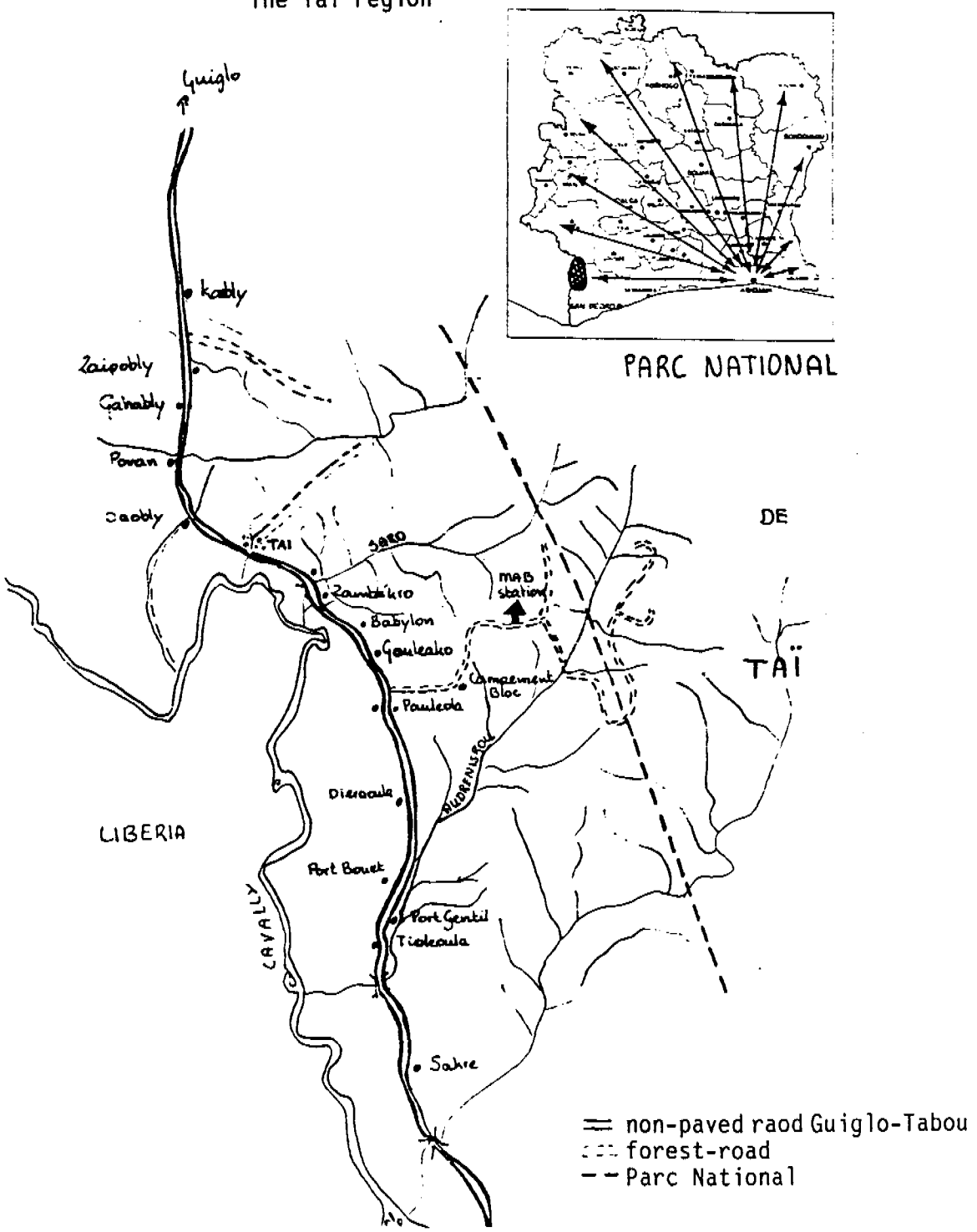
ANNICES
I - X

Annex I

Figure I.1: Map of the South-Western part of Ivorycoast.
The Taï region



Source: Laar, van de M.J.W., sept. 1986

Figure I.2: The situation of the settlements surrounding Ponan

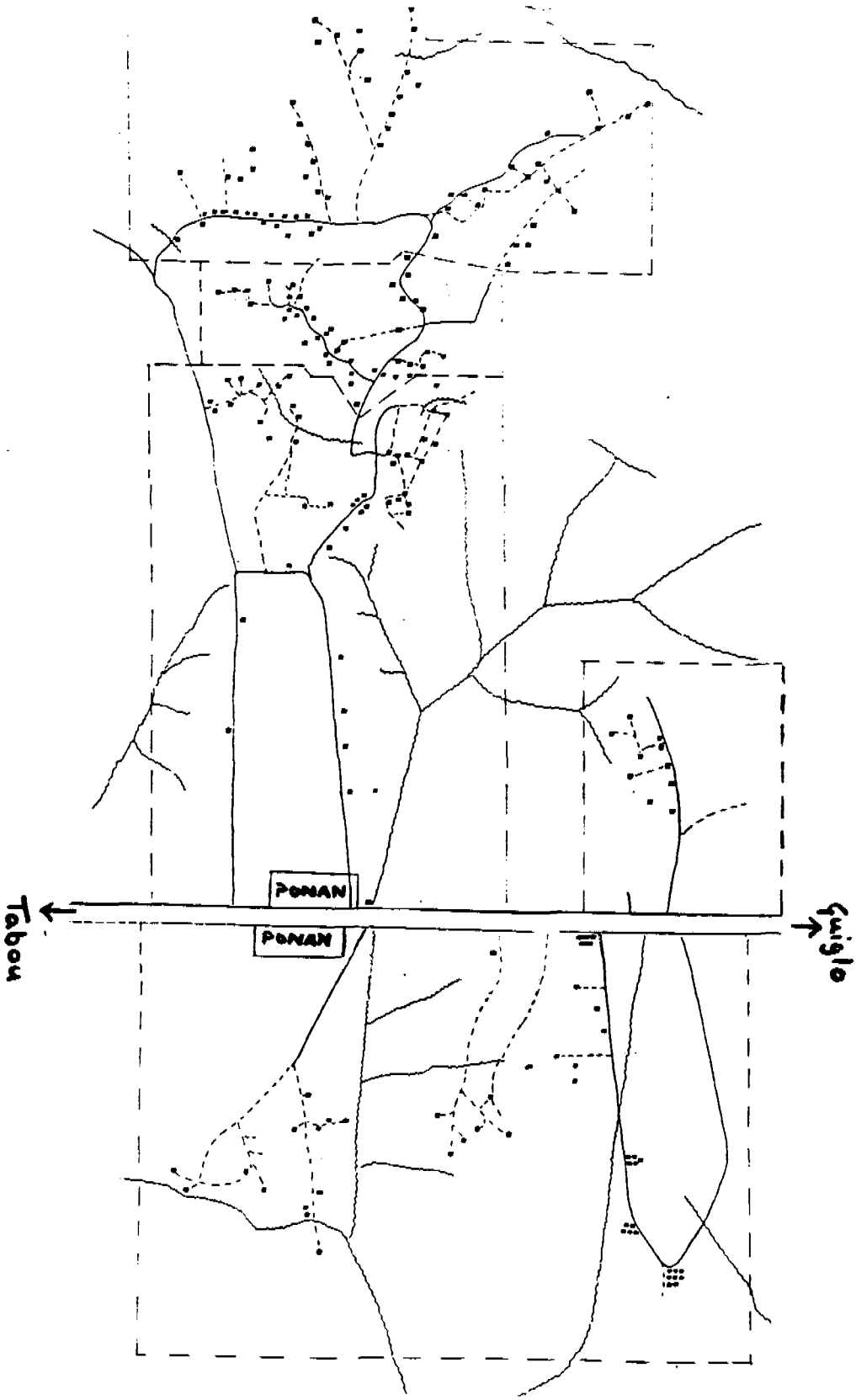
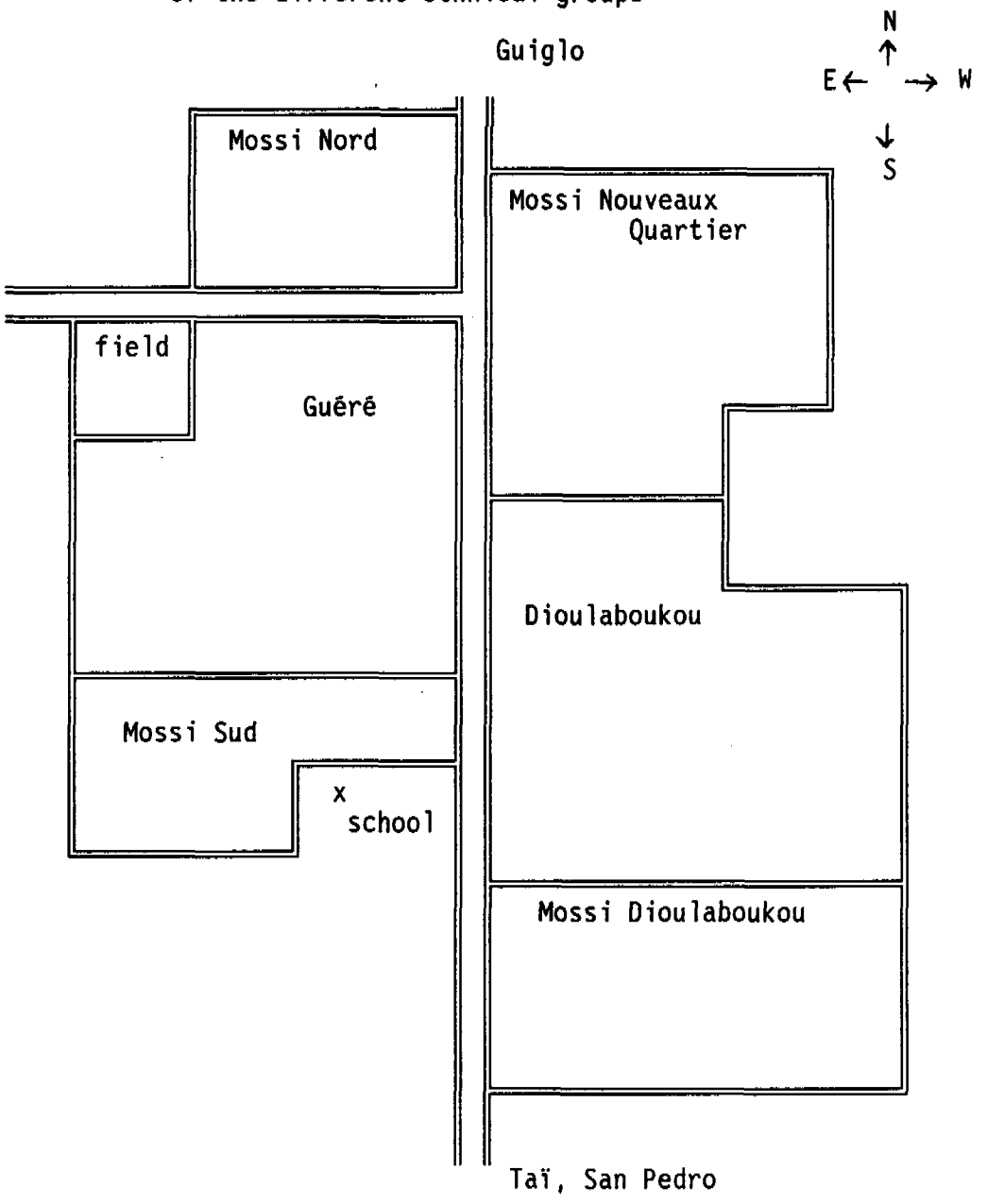


Figure I.3: Overview of the village center, divided in quarters of the different ethnical groups



Mossi Nord = the northern quarter of the Mossi
Mossi Nouveaux quartier = the news Mossi quarter
Guĕré = the quarter where the Guĕré are living
Dioulaboukou = the quarter where the Dioula are living
Mossi Sud = the southern quarter of the Mossi
Mossi Dioulaboukou = the quarter of the Mossi in the neighbourhood of the Dioula.

Annex II

Diarrhoeal diseases are one of the major causes of mortality in developing countries (Blum and Feachem, 1983). Every year at least five million of children die of dehydratation due to diarhoea (Walsh and Warren, 1982). The worlds average of diarrhoeal attacks of children under 5 is 2.2 attacks per child a year (Overbeek and van Vree, 1989). For Africa the average is estimated on 4 attacks per child a year (Baya et al, 1987).

There are a lot of agents which cause diarrhoea. Diarrhoea can be caused by bacteria, virus, intestinal parasites of other infections of the intestine or body (Walsh and Warren, 1982).

In the past a lot of research has been done on diarrhoeal diseases. Not only on circumstances and social and environmental determinants which are related to diarrhoea but als on the validity of the data obtained. The types of research can be distinguished in hospitaly based and cross sectional surveys. Both types have some problems in common but they have also their own methodological problems.

Three important problems of diarrhoeal surveys are:

- The definition of diarrhoea;
- The definition of an episode of diarrhoea;
- The length of the recall period used.

The definition of diarrhoea can be different to the person interviewed and the interviewer. Some diarrhoeal diseases can be difinied as diarrhoea according to the interviewer but not according to the person interviewed (Blum and Feachem, 1983).

Some infections can cause several attacks of diarrhoea. These attacks can be seen as several episodes of diarrhoea but can also be seen as one episode of diarrhoea (Carson et al, 1986).

Sometimes it is difficult to remember if the child has suffered from diarrhoea. Most studies use a recall period of 2 weeks. In most of the cases 2 weeks is to long to obtain reliable information about the prevalence and incidence of diarrhoeal diseases (Blum and Feachem, 1983).

Annex III

Questionnair.

Date:
Name of the head of the household:
Name of the person interviewed:
Sector:
Number:

Introduction: We have been visiting your household for two weeks. Today it is the last time we'll visit your household. We like to ask you some questions on the subject of diarrhoea.

1. What do the stools of a child who suffers from diarrhoea look like ?

2. How many stools per day produces a child who suffers from diarrhoea ?

3. How do you know your child suffers from diarrhoea ?

4. How do you know how many stools are produced per day by your child who suffers from diarrhoea ?

5. What are the changes in health status of your child when he/she suffers from diarrhoea ?

6. According to you, are diarrhoeal diseases dangerous ?

7. Which causes of diarrhoeal diseases do you know ?

8. According to you, is it possible to prevent your child from getting diarrhoea ?

   Yes, how ?
   No, why not ?

9. What do you do to cure your child from diarrhoea ?

10. When the diarrhoeal attack does not stop within a few days, what do you do ?

Annex IV

All statistical methods used for the anthropometric survey and the survey on intestinal parasites.

IV.1 Correction of the prevalences

Before testing the most striking differences of the prevalences of malnutrition and parasites, we had to correct the prevalences to the research group. Therefore we devided the sample group aswell as the research group in smaller groups according to the following strata:

- age (parasite survey; 0-4 years; 5-15 years; 16 and more years)
  (anthropometry;0 years; 1-4 years);
- ethnical groups (guërë; dioula; mossi; baoulë);
- sexe (male; female);
- residence (village; compounds).

To estimate the prevalence of more total groups like of all the women we weighed the prevalences for the size of the distingished groups:

$$PRa = 1/A * \Sigma Nj * kj/nj$$

$A = \Sigma Nj$
Nj = Size of stratum j in the population.
kj = Number of cases found in stratum j of the sample.
nj = Size of stratum j of the sample.
PRa= The estimated prevalence.

IV.2 Statistical test

After the calculations to the estimated prevalences, we've implemented a test to compare two chances (two estimated prevalences), with

H0: PRa = PRb and
H1: PRa <> PRb.

The quantity used = t.
t is the difference in the estimated prevalence between two groups quoted by the square root of the summ of the variances of these estimated prevalences or

$$t = (PRa - PRb) / \sqrt{(varPRa + varPRb)}.$$

This quantity is Poisson disributed.

The variance is:

$var(PRa) = 1/A^2 \Sigma Nj^2 * kj/nj^2$

A = Σ Nj
Nj = Size of stratum j in the population.
kj = Number of cases found in stratum j of the sample.
nj = Size of stratum j of the sample.
PRa= The estimated prevalence.

Assumption:

In this case t is normaly distibuted (Breslow and Day, 1987).

IV.3 The prevalences and the p-values of the most striking differences of the intestinal parasites and the anthropometric data, with a reliabilty of 5%.

IV.3.1 Intestinal parasites

Hookworm

region	sex	age group	height	compared	prevalence	p
-	m	-	-	vil/comp	7% / 16%	0.047
-	m	04	-	vil/comp	0% / 15%	0.013
-	-	16+	-	men/wom	15%/ 3%	0.017
-	-	16+		bao/mos	0% / 14%	0.002
-	m	16+	-	bao/mos	0% / 19%	0.005
-	f	04	-	bao/mos	0% / 9%	0.006

A. lumbricoides

residence	sex	age group	ethnie	compared	prevalence	p
-	-	04	-	men/wom	4% / 15%	0.036
c	-	04	-	men/wom	4% / 13%	0.037
-	-	-	-	dio/gue	4% / 17%	0.022
-	f	-	-	dio/gue	3% / 20%	0.046
-	m	515	-	dio/gue	0% / 24%	0.027
-	m	515	-	bao/mos	0% / 14%	0.026

E. histolytica

residence	sex	age group	ethnie	compared	prevalence	p
-	f	-	-	vil/comp	25%/ 9%	0.046
v	-	-	-	men/wom	8% / 25%	0.029
-	-	-	-	bao/mos	4% / 15%	0.008
-	-	16+	-	bao/mos	0% / 19%	0.000
-	m	-	-	bao/mos	4% / 19%	0.014
-	m	16+	-	bao/mos	0% / 22%	0.003
-	f	515	-	bao/mos	0% / 21%	0.036
-	f	16+	-	bao/mos	0% / 15%	0.021

IV.3.2 Anthropometric data

Weight for Height

residence	sex	age group	height	compared	prevalence	p
-	f	-	-	vil/comp	0% / 21%	0.019
-	-	1+	-	gue/dio	11%/ 0%	0.038
-	m	1+	-	gue/dio	21%/ 0%	0.045
-	-	-	gu	0 / 1+	0% / 11%	0.038
-	m	-	gu	0 / 1+	25%/ 36%	0.045
-	-	-	gu	men/wom	16%/ 0%	0.043
-	-	1+	-	bao/mos	0% / 17%	0.046

Height for age

residence	sex	age group	height	compared	prevalence	p
v	-	-	-	men/wom	29%/ 8%	0.034
-	-	-	gu	men/wom	33%/ 6%	0.039
-	-	-	-	bao/mos	0% / 18%	0.012
-	f	-	-	bao/mos	0% / 18%	0.044
-	-	1+	-	bao/mos	0% / 24%	0.023

Strata used:

residence c = compounds v = village

sexe m = men f = women

age group parasites: 04 = in the age of 0 - 4 years old
515 = in the age of 5-15 years old
16+ = in the age of 16 or more years old.
anthropometry: 0 = in the age of 0 years old
1+= in the age of 1 year and older.

ethnie Ethnical group, b = Baoule, g = Guere, m = Mossi and d = Dioula.

compared Compared groups within the given stratum.
vil = village, comp = compound, men = men, wom = women, dio = Dioula, gue = Guere, bao = Baoule, mos = Mossi.

p chance.

Prevalences are given in percentages.

IV.4 The use of the sign-test for the comparison between the anthropometruc data of Dec/Jan '88/'89 and June '89 of 51 children measured.

We've compared the z-scores of both periods for the parameters weight for height and height for age. When the z-scores of one child is decreased in June, it was given a minus sign. After comparing all z-scores of the children of the group investigated, we counted the signs and checked of this number was falling in the critical area.

Table IV.1 shows the summary of all groups on which we've done this test with the number of signs, the total number of the groups investigated with the critical area belonging to this group. This is done for the indicators height for age and weight for height.

Table IV.1: Overview of the results of the sign-test for both parameters

Investigated group name	number	# minus-signs H/A	W/H	critical area (5%)
all	51	29	39*	< , 19] & [32, >
women	22	11	17*	< , 6] & [16, >
men	29	18	22*	< , 9] & [20, >
village	38	21	28*	< , 13] & [25, >
compound	13	8	11*	< , 3] & [10, >
guéré	24	12	17*	< , 7] & [17, >
dioula	13	8	10*	< , 3] & [10, >
mossi	10	7	8	< , 1] & [9, >
baoule	4	2	4*	< , 0] & [4, >

H/A = Height for age
W/H = Weight for height
* = number fit in the critical area.

IV.5 Chi-square

RESULTS

A	B	A+B
C	D	C+D
A+C	B+D	A+B+C+D

ASPECTED

(A+B)*(A+C)/(A+B+C+D)	(C+D)*(B+D)/(A+B+C+D)	(A+B)
(C+D)*(A+C)/(A+B+C+D)	(C+D)*(B+D)/(A+B+C+D)	(C+D)
(A+C)	(B+D)	(A+B+C+D)

$X^2 = (Ar - Aa)^2/Aa + (Br - Ba)^2/Ba \ldots (Dr - Da)^2/Da.$
Ar = A result
Aa = A aspected
Normal distribution.

Annex V

Table V.1: Diarrhoea-cases for girls and boys in two age-groups

age	t	t+	w	w+	m	m+
0	127	22	60	12	67	10
1-4	277	43	144	20	133	23
total	404	65	204	32	200	33

[1])

Table V.2: Diarrhoea-cases of girls,boys and age-groups in the two residences

	t	t+	w	w+	m	m+
village	153	19	78	7	75	12
compounds	257	46	126	25	125	21
total	404	65	204	32	200	33

t0	t0+	t1	t1+
43	6	110	13
84	16	167	30
127	22	277	43

1. t = total children who were questioned about diarrhoea
   t+ = total of children who suffered from diarrhoea
   t0 = total of children aged 0 year
   t0+= children aged 0 year who suffered from diarrhoea
   t1 = total of children aged between 1-4 years
   t1+= children aged between 1-4 years who suffered from diarrhoea
   w = total of female children
   w+ = female children who suffered from diarrhoea
   m = total of male children
   m+ = male children who suffered from diarrhoea

Table V.3: Diarrhoea-incidences (in attacks of diarrhoea per child per year) and their variances

	incidence
Imen;0	3.9 (2.0 - 5.8)
Iwom;0	5.2 (3.0 - 7.4)
Imen;1-4	4.5 (3.1 - 5.9)
Iwom;1-4	3.6 (2.4 - 4.8)
Ivil;wom	2.3 (0.9 - 3.7)
Icom;wom	4.9 (3.4 - 6.4)
Ivil;men	4.2 (2.4 - 6.0)
Icom;men	4.4 (3.0 - 5.8)

	incidence
Ivil;o	3.6 (1.3 - 4.9)
Ivil;1-4	3.1 (1.8 - 4.4)
Icom;o	5.0 (3.2 - 6.8)
Icom;1-4	4.7 (3.4 - 6.0)

[2])

[2]. men = male children
wom = female children
0 = children aged 0 year
1-4 = children aged between 1-4 years
vil = village
com = compounds

Annex VI

Anthropometry

In most of the third world countries an average of 21,5 percent of the children are malnourished (IFAD, 1989). The malnourishing is a serious treat to the health of the children especially the young ones. The nutritional status can be influenced by several diseases like diarrhoea or intestinal parasites. Therefore, it seems that the anthropometry is a good indicator of the health of a child.

The nutritional status of children can be measured in numerous ways. Weighing and measuring of the children is one of the most valide and useful method to measure this status (WHO working group, 1986).

To define whether a child is malnourished, three variables are needed: the weight, the length and the age of a child. The weight and height of a child are easy to measure with a measuring-line and a balance. The age of the child has to be as correct as possible to avoid influences of the results.

The World Health Organisation has defined two parameters of malnourishing; stunting and wasting (WHO working group, 1986). A child is stunted when it is to short for his/her age, this is a long term parameter. A child is wasted when it is to light for his/her length and the effects b.e. of changes in nourishment can be seen in a short time.

It is difficult to give just one cause which result in malnutrition of the children. A lot of variables can influence the nutritional status of a child:

1. Ethnical group. Between ethnical groups differences can exist habits, preparing food, taboo's etc.

2. The standard of living depends on the social and economic status of the mother or parents. When the parents earn more money it is possible that the child is better nourished than when they are poor. Better housing can lead also to a better health of the child with less diseases and ,therefore, a better nutritional status.

3. The season can influence the nutritional status also. Just before harvest time there can be a relative foodshortess, which can lead to more malnourishing in that period.

4. Breastfeeding can protect the child against several diseases like diarrhoea and can ,therefore, protect the child against malnourishing.

5. Personal and environmental hygiene affect the distribution of diseases b.e. the wast-disposal and the use of soap.

More specific influences on the anthropometry are the Low Birth Weight, malabsorption due to infection with intestinal parasites, the composition of the nourishment an diarrhoea (Koch and de Kok, 1989; proposition unpubl.).

Annex VII

Tables of the gathered anthropometric data [3])

Table VII.1: Prevalences of malnourishing (H/A and W/H) per sexe, residence, age-group and ethnical group

	Men in the village					
	0 y.			1+ y.		
	gu	di	mo	gu	di	mo
H/A	0.25	0	0.17	0.36	0.25	0
W/H	0	0.50	0.11	0.21	0	0
sampl.size	4	2	1	14	8	1
size	8	4	1	24	9	3

Table VII.2: Prevalences of malnourishing per sexe, residence, age-group and ethnical group

	Women in the village					
	0 y.			1+ y.		
	gu	di	mo	gu	di	mo
H/A	0	0	0	0.14	0	0.17
W/H	0	0	0	0	0	0.11
sampl.size	4	1	1	14	4	1
size	9	1	1	24	6	1

[3]. y. = years
H/A = Height for Age
W/H = Weight for Height
M = men
W = women
gu = Guéré
di = Dioula
mo = Mossi
ba = Baoulé

Table VII.3: Prevalences of malnourishing per sexe, residence, age-group and ethnical group

	Men on the compound				Women on the compound			
	0 y.		1+ y.		0 y.		1+ y.	
	mo	ba	mo	ba	mo	ba	mo	ba
H/A	0	0	0.33	0	0.17	0	0.20	0
W/H	0	0	0.17	0	0.17	0.67	0.20	0
sampl.size	5	2	6	2	6	3	10	2
Size	13	2	17	6	15	3	22	3

Table VII.4: Prevalences of malnourishing per residence, sexe and age-group

residence	Village				Compound			
sexe	Women		Men		Women		Men	
age	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.
H/A	0	0.11	0.17	0.31	0.14	0.18	0	0.24
W/H	0	0	0.16	0.14	0.25	0.18	0	0.13
sampl.size	6	19	7	23	9	12	7	8
size.	11	31	13	36	18	25	15	23

Table VII.5: Prevalences of malnourishing per residences and age-group

Residence	Village		Compound	
Age	0 y.	1+ y.	0 y.	1+ y.
H/A	0.09	0.08	0.08	0.21
W/H	0.09	0.08	0.14	0.16
steek.gr	13	42	16	20
size.	24	67	33	48

Table VII.6: Prevalences of malnourishing per sexe and age-group

sexe	Women		Men	
age	0 y.	1+ y.	0 y.	1+ y.
H/A	0.09	0.14	0.09	0.28
W/H	0.17	0.08	0.07	0.14
sampl.size	15	31	14	31
size.	29	56	28	59

Table VII.7: Prevalences of malnourishing per residence and sexe

residence	Compound		Village	
sexe	Wom.	Men	Wom.	Men
H/A	0.16	0.15	0.08	0.29
W/H	0.21	0.08	0	0.15
sampl.size	21	15	25	30
size.	43	38	42	49

Table VII.8: Prevalences of malnourishing per residence

residence	Compound	Village
H/A	0.16	0.08
W/H	0.15	0.08
sampl.size	36	55
size.	81	91

Table VII.9: Prevalences of malnourishing per sexe

sexe	Women	Men
H/A	0.12	0.22
W/H	0.11	0.12
sampl.size	46	45
size.	85	87

Table VII.10: Prevalences of malnourishing per age-group

age	0 y.	1+ y.
H/A	0.08	0.13
W/H	0.12	0.11
sampl.size	29	62
size.	57	115

Table VII.11: Prevalences of malnourishing per sexe, ethnical group and age-group

sexe	Men							
ethn.gr.	Guéré		Dioula		Baoulé		Mossi	
age	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.
H/A	0.25	0.36	0	0.25	0	0	0.01	0.28
W/H	0	0.21	0.50	0	0	0	0	0.05
sampl.size	4	14	2	8	2	2	6	7
size.	8	24	4	9	2	6	14	20

Table VII.12: Prevalences of malnourishing per sexe, ethnical group and age-group

sexe	Women							
ethn.gr.	Guéré		Dioula		Baoulé		Mossi	
age	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.
H/A	0	0.14	0	0	0	0	0.16	0.20
W/H	0	0	0	0	0.67	0	0.16	0.20
sampl.size	4	14	1	4	3	2	7	11
size.	9	24	1	6	3	3	16	23

Table VII.13: Prevalences of malnourishing per ethnical group and age-group

ethn.gr.	Guéré		Dioula		Baoulé		Mossi	
age	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.	0 y.	1+ y.
H/A	0.12	0.25	0	0.15	0	0	0.09	0.24
W/H	0	0.11	0.40	0	0.40	0	0.09	0.17
sampl.size	8	28	3	12	5	4	13	18
size.	17	48	5	15	5	9	30	43

Table VII.14: Prevalences of malnourishing per ethnical group and sexe

ethn.gr.	Guéré		Dioula		Baoulé		Mossi	
sexe	M	W	M	W	M	W	M	W
H/A	0.33	0.06	0.17	0	0	0	0.17	0.18
W/H	0.16	0	0.15	0	0	0.34	0.09	0.18
sampl.size	18	18	10	5	4	5	13	18
size.	32	33	13	7	8	6	34	39

Table VII.15: Prevalences of malnourishing per ethnical group

ethn.gr.	gu	di	ba	mo
H/A	0.19	0.11	0	0.18
W/H	0.08	0.10	0.15	0.14
sampl.size	36	15	9	31
size.	65	20	14	73

Annex VIII

Hookworm

Hookworm infection is an infection of the small intestine with one of the two species of hookworms: Necator americanes and Ankylostoma duodenale.
Hookworm is most of the time symptomless. When it does produce illness, the most important features are anaemia and its resulting debility and other consequences. Hookworm is seldom reported as cause of death. Although, the disease is undoubtedly a common contributory cause of death when other normaly non-fatal infections attack a severly anaemic debilitated person.
Definitive diagnosis depends on finding eggs in faecal samples.

Transmisson.

Man is reservoir for human hookworms. If faeces are deposited on the soil, eggs can develop into infective larvae in about 6 days.
Infection occurs when the larvae penetrates the skin, usualy between the toes or on the feet and ankles.
Optimum conditions are e.g.: shade, a light sandy loan, adequate moisture and temperature between 20 and 32 °C.

Control measures

Control measures can be wearing of shoes, improvement and use of sanitation facilities.

Ascaris lumbricoïdes

About 85 percent of the infections with A.lumbricoïdes are symptomless. Heavy burdens of them in the small intestine may cause digestive disorders, nausea, abdominal pain, vomiting, restlessness and disturbed sleep. Death is due to migration of the adult worms to the liver, gall blader or appendix and, rarely, due to perforation of the intestine. Diagnosis is by identification of the eggs in the faeces.

Transmission

The eggs are passed in the faeces and become infective after development of a larvae after 10 - 15 days. Ideal conditions for transmission are moist, shady soils at 22 - 33 °C . The larvae develop after ingestion into adults in about 60 - 75 days.
The larvae can be transmitted by contaminated fingers, objects that have been placed on the ground, dirt from the ground and contaminated vegetables.

Control measures

Environmental and behavioral changes can have a sustained impact on A. lumricoïdes.

Entamoeba histolitica

E. histolytica causes amoebic dysentry. It is a parasite of the large intestine. Symptoms are diarrhoea, sometimes bloody and mild purexia with or without abdominal pain. Trophozoites of an invasive E. histolytica are concentrated in the colon and colonize the submuscual tissues. Ulcers are formed. E. histolytica may migrate from ulcers via hepatic portal vein to the liver and other organs. Here an amoebic abcess may develop. Diagnosis of the diarrheric stools can identify hemaetiphagous trophozoites.

Transmission

Direct faecal-oral transmission due to lack of hygiene, inadequate water supply and sanitation and contaminated hands.

Control measures

Environmental and behaverial changes, improved water supply and sanitation can influence the transmission of E. histolitica.

Annex IX

Summary of all the tables of the distribution and prevalences of the three major pathogene intestinal parasites [4]).

Table IX.1: Prevalences of the intestinal parasites (Ascaris lumbricoïdes, Hookworm and Entamoeba histolytica) per sexe, age-group, ethnical group and residence

	Men in the village								
	0 - 4 years			5 - 15 years			16 years		
	gu	di	mo	gu	di	mo	gu	di	mo
A. lumbr.	0.15	0.08	0	0.24	0	1	0.07	0.08	0
Hookworm	0	0	0	0.12	0	0	0.07	0.08	0
Ent. hist.	0	0	0	0	0	1	0.13	0.19	0
gr. size	52	25	13	49	19	5	84	48	28

Table IX.2: Prevalences of the intestinal parasites per sexe, age-group, ethnical group and residence

	Women in the village								
	0 - 4 years			5 - 15 years			16 years		
	gu	di	mo	gu	di	mo	gu	di	mo
A. lumbr.	0.26	0.08	0	0.33	0	-	0.10	0	0
Hookworm	0	0.08	0	0.33	0	-	0.05	0	0
Ent. hist.	0.09	0.08	0	0.33	0.25	-	0.15	0.74	0.33
gr. size	46	26	13	54	16	9	108	35	21

4. gu = Guérè
   di = Dioula
   mo = Mossi
   ba = Baoulé
   M = Men
   W = Women
   0-4 = aged between 0 and 4 years
   5-15= aged between 5 and 15 years
   16+ = 16 years over

Table IX.3: Prevalences of the intestinal parasites per sexe, age-group, ethnical group and residence

	Men on the compounds					
	0 - 4 y.		5 - 15 y.		16+ years	
	mo	ba	mo	ba	mo	ba
A. lumbr.	0	0.23	0.07	0	0.09	0
Hookworm	0.11	0.32	0.07	0.20	0.21	0
Ent. hist.	0.08	0	0.15	0.20	0.24	0
gr. size	114	22	67	17	307	38

Table IX.4: Prevalences of the intestinal parasites per sexe, age-group, ethnical group and residence

	Women on the compounds					
	0 - 4 y.		5 - 15 y.		16+ years	
	mo	ba	mo	ba	mo	ba
A. lumbr.	0.13	0.18	0.05	0.20	0.04	0
Hookworm	0.10	0	0.21	0.40	0.04	0
Ent. hist.	0	0.18	0.21	0	0.13	0
gr. size	132	17	61	18	174	26

Table IX.5: Prevalences of the intestinal parasites per sexe, residence and age-group

sexe	Men					
residence	Village			Compounds		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.11	0.23	0.06	0.04	0.06	0.08
Hookworm	0	0.15	0.06	0.15	0.10	0.19
Ent. hist.	0	0.07	0.13	0.07	0.15	0.21
gr.size	90	73	160	136	84	345

Table IX.6: Prevalences of the intestinal parasites per sexe, residence and age-group

sexe	Women					
residence	Village			Compounds		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.16	0.23	0.07	0.13	0.10	0.04
Hookworm	0.03	0.23	0.03	0.09	0.25	0.04
Ent. hist.	0.07	0.28	0.30	0.02	0.16	0.11
gr.size	85	79	164	149	79	200

Table IX.7: Prevalences of the intestinal parasites per residence and age-group

Residence	Village			Compounds		
Age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.14	0.23	0.14	0.09	0.07	0.06
Hookworm	0.01	0.19	0.10	0.12	0.17	0.13
Ent. hist.	0.06	0.18	0.21	0.05	0.16	0.11
gr.size	175	152	324	285	163	545

Table IX.8: Prevalences of the intestinal parasites per sexe and age-group

sexe	Men			Women		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.07	0.14	0.08	0.15	0.14	0.05
Hookworm	0.09	0.12	0.15	0.06	0.21	0.03
Ent. hist.	0.04	0.11	0.19	0.06	0.20	0.20
gr.size	226	157	505	234	178	364

Table IX.9: Prevalences of the intestinal parasites per sexe and residence

sexe	Men	
residence	Village	Compounds
A. lumbr.	0.11	0.07
Hookworm	0.07	0.16
Ent. hist.	0.08	0.17
gr.size	323	565

Table IX.10: Prevalences of the intestinal parasites per sexe and residence

sexe	Women	
residence	Village	Compounds
A. lumbr.	0.13	0.08
Hookworm	0.08	0.09
Ent. hist.	0.25	0.09
gr.size	328	428

Table IX.11: Prevalences of the intestinal parasites per residence

residence	Village	Compounds
A. lumbr.	0.12	0.07
Hookworm	0.07	0.13
Ent. hist.	0.16	0.14
gr.size	651	993

Table IX.12: Prevalences of the intestinal parasites per sexe

sexe	Men	Women
A. lumbr.	0.08	0.10
Hookworm	0.13	0.09
Ent. hist.	0.14	0.16
gr.size	888	756

Table IX.13: Prevalences of the intestinal parasites per age-group

age	0-4	5-15	16+
A. lumbr.	0.11	0.15	0.06
Hookworm	0.10	0.18	0.10
Ent. hist.	0.05	0.17	0.19
gr.size	460	315	869

Table IX.14: Overall prevalences of the intestinal parasites

	Total
A. lumbr.	0.09
Hookworm	0.11
Ent. hist.	0.15
gr.size	1644

Table IX.15: Prevalences of the intestinal parasites per sexe, ethnical group and age-group

sexe	Men					
ethn.gr.	Guérê			Dioula		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.15	0.24	0.07	0.08	0	0.08
Hookworm	0	0.12	0.07	0	0	0.08
Ent. hist.	0	0	0.13	0	0	0.19
gr.size	52	49	84	25	19	48

Table IX.16: Prevalences of the intestinal parasites per sexe, ethnical group and age-group

sexe	Men					
ethn.gr.	Baoulé			Mossi		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.23	0	0	0	0.14	0.08
Hookworm	0.32	0.18	0	0.10	0.14	0.19
Ent. hist.	0	0.18	0	0.08	0.21	0.22
gr.size	22	17	38	127	72	335

Table IX.17 : Prevalences of the intestinal parasites per sexe, ethnical group and age-group

sexe	Women					
ethn.gr.	Guérê			Dioula		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.26	0.33	0.10	0.08	0	0
Hookworm	0	0.33	0.05	0.08	0	0
Ent. hist.	0.09	0.33	0.15	0.08	0.25	0.75
gr.size	46	54	108	25	16	35

Table IX.18: Prevalences of the intestinal parasites per sexe, ethnical group and age-group

sexe	Women					
ethn.gr.	Baoulé			Mossi		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.18	0.22	0	0.12	0.05	0.04
Hookworm	0	0.39	0	0.09	0.21	0.04
Ent. hist.	0.18	0	0	0	0.21	0.15
gr.size	17	18	26	145	61	195

Table IX.19: Prevalences of the intestinal parasites per ethnical and age-group

ethn.gr.	Guéré			Dioula		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.20	0.29	0.09	0.08	0	0.05
Hookworm	0	0.23	0.06	0.04	0	0.05
Ent. hist.	0.04	0.17	0.14	0.04	0.11	0.42
gr.size	98	103	192	51	35	83

Table IX.20: Prevalences of the intestinal parasites per ethnical group and age-group

ethn.gr.	Baoulé			Mossi		
age	0-4	5-15	16+	0-4	5-15	16+
A. lumbr.	0.21	0.11	0	0.06	0.10	0.07
Hookworm	0.18	0.29	0	0.10	0.17	0.14
Ent. hist.	0.08	0.09	0	0.03	0.21	0.19
gr.size	39	35	64	272	133	530

Table IX.21: Prevalences of the intestinal parasites per ethnical group and sexe

ethn.gr.	Guĕrĕ		Dioula	
sexe	M	W	M	W
A. lumbr.	0.14	0.20	0.07	0.03
Hookworm	0.06	0.11	0.04	0.03
Ent. hist.	0.06	0.18	0.10	0.41
gr.size	185	208	92	77

Table IX.22: Prevalences of the intestinal parasites per ethnical group and sexe

ethn.gr.	Baoulé		Mossi	
sexe	M	W	M	W
A. lumbr.	0.06	0.11	0.07	0.07
Hookworm	0.13	0.11	0.16	0.08
Ent. hist.	0.04	0.05	0.19	0.10
gr.size	77	61	534	401

Table IX.23: Prevalences of the intestinal parasites per ethnical group

ethn.gr.	gu	di	ba	mo
A. lumbr.	0.17	0.05	0.09	0.07
Hookworm	0.09	0.04	0.12	0.13
Ent. hist.	0.12	0.24	0.04	0.15
gr.size	393	169	138	935

Annex X

Table X.1: The norms on the quality of drinking water used in the Ivorycoast

Total coliform # col. per 100ml	Faecal coliform # col. per 100ml	Interpretation
0 - 50 col.	0 - 5 col.	drinking water
> 50 col.	0 - 5 col.	dubious water
0 or > 1 col.	> 5 col.	polluted water

These interpretations on the norms are not absolute strict and should be handled with intelligence (Sangbé, K.,1986).

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