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A PROTOCOL OF A STUDY TO MEASURE THE IMPACT OF GUINEA WORM DISEASE (DRACUNCULIASIS) ON AGRICULTURAL PRODUCTION IN NIGERIA

February 14 - March 6, 1988

by

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CE-026

Managed by Medical Service Corporation International
under contract to the U.S. Agency for International Development

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Acknowledgement

Preparation of this document was sponsored by the Vector Biology & Control Project under Contract No. DPE-5948-C-00-5044-00 to Medical Service Corporation International, Arlington, Virginia, U.S.A., for the Agency for International Development, Office of Health, Bureau of Science and Technology.

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I. INTRODUCTION

The imperative need for increased food production and the improvement of living standards in the developing world depend on implementation of safe water resources and on reclamation of land for agricultural purposes. Guinea worm disease, wherever it is endemic, variously inhibits the achievement of these absolute objectives. An accurate assessment of the economic effects of this devastating disease is needed before these effects on the afflicted populations can be fully understood.

A. Background to the Disease

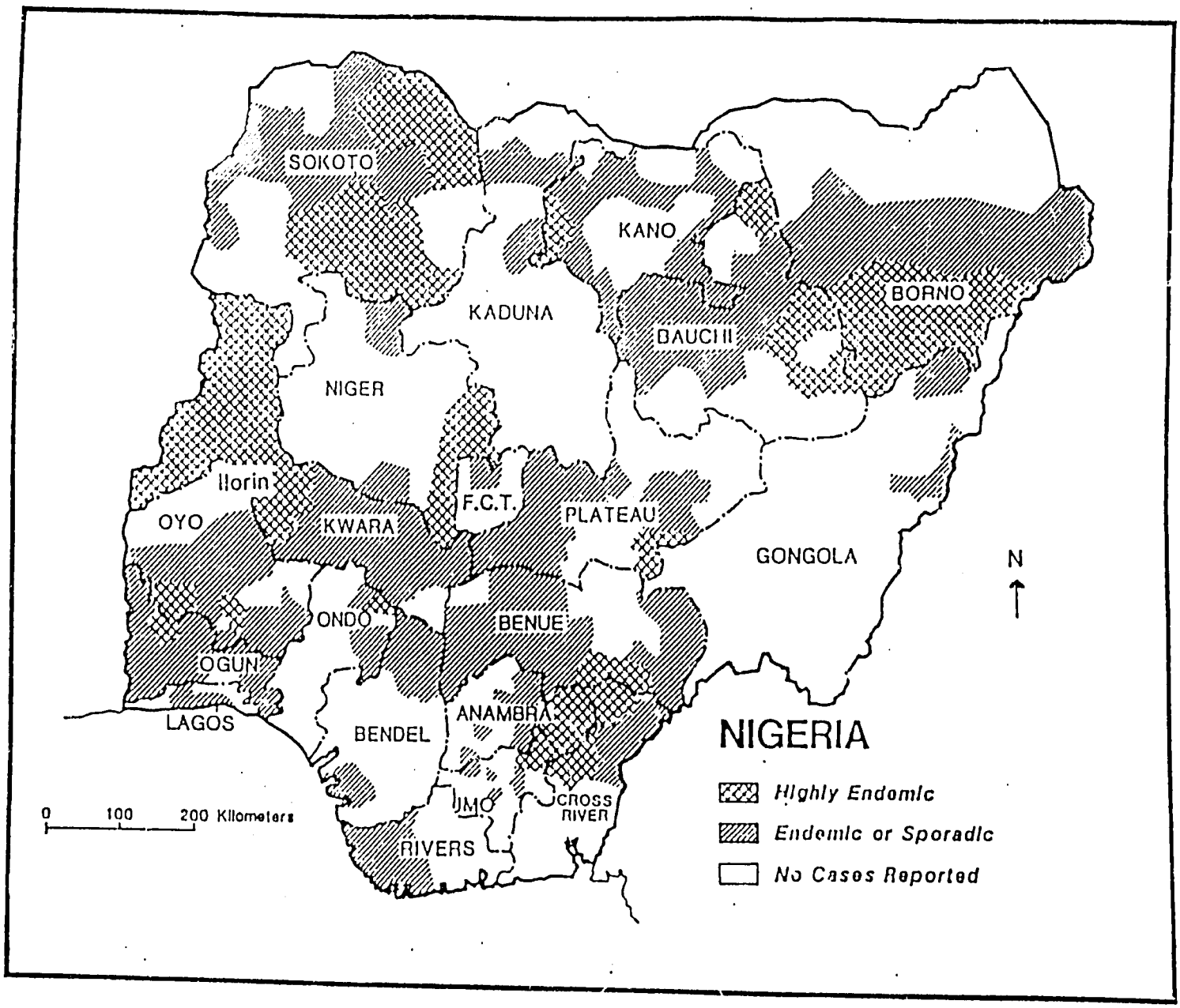
Dracunculiasis or Guinea worm disease is a crippling, yet easily preventable disease which affects 5 - 10 million people a year in Africa and Asia. Although it is not directly fatal, it causes considerable human misery, especially when a number of worms emerge from one individual, when an abscess forms, or when other complications occur. Individuals are infected with Guinea worm when they drink water containing Cyclops which contain the larvae of the Guinea worm, Dracunculus medinensis, in an infective state. The larvae are introduced into a pond when an individual with a Guinea worm ulcer on his or her arm or leg wades into the water to collect drinking water or to bathe. The infection can incapacitate a sufferer for up to three months. Because peak periods of patency (when the adult form penetrates the skin and is visible) often coincide with the main peaks of agricultural activity, Guinea worm infection is believed to have serious affects agricultural production as well as on other economic activities. A recent estimate put the annual global loss of marketable goods at between 300 million and one billion U.S. dollars (Golladay, 1982).

Greatest losses occur in Africa where 19 countries are known to be infected. Annual incidence is estimated to be 3.32 million and the at-risk population is approximately 120 million (Watts, 1987). In Nigeria, the most highly populated country in Africa, 30% of the 100 million people live at risk of developing the disease and an estimated 2.5 million become infected each year (Proceedings, National Conference on Dracunculiasis, 1985) (Figure 1).

Among parasitic diseases, Guinea worm is unique in that it can be entirely eliminated by providing a population with reliable protected sources of drinking water if it is used at alltimes by all members of the community and their visitors (Hopkins, 1983). The United Nations International Drinking Water Supply and Sanitation Decade, launched in 1981, has provided an impetus for research into and the control of diseases such as Guinea worm which are associated with poor quality drinking water.

FIGURE 1

MAP OF NIGERIA SHOWING THE DISTRIBUTION AND ENDEMICITY OF DRACUNCULIASIS BY LOCAL GOVERNMENT AREAS OF EACH STATE AND THE FEDERAL CAPITAL TERRITORY OF ABUJA (MARCH 1985)



Source: Edungbola and Watts, 1986.

B. Effect of Guinea Worm on Ability to Work

Clinical studies have demonstrated repeatedly that emergence of Guinea worms is often associated with severe morbidity and may cause prolonged disability or incapacity to work (Reddy et al., 1969; Belcher et al., 1975; Role, 1977; Nwosu et al. 1982; Rao 1981; Bildhaiya et al., 1969; Edungbola, 1983; Bukenya, 1987). The period of disability due to Guinea worm is quite variable, usually reported as 30 to 90 days, the longer periods being associated with secondary bacterial infection which occurred in 68% of patients seen in Anambra State, Nigeria (Nwosu et al., 1982). Fifty-eight percent of episodes in 59 patients studied in Imo State, Nigeria resulted in severe disability (unable to leave their compound) lasting a mean of 4.2 weeks (range 2 - 12) (Smith et al., unpublished). Because the disease mainly affects adults and because worm emergences coincide with the season of greatest agricultural activity (i.e., field preparation and planting), Guinea worm disease is widely believed to have an adverse impact on agricultural productivity. The fact that 40% to 90% of adults in each household were incapacitated due to Guinea worm for an average of three to four weeks, suggests the potentially devastating impact of the disease on agricultural production (Nwosu et al., 1982). However, this impact has not been well documented nor quantified. A brief pilot study (financed by UNICEF, with the results still in draft form only) conducted in late 1987 by a team of researchers from the Nigerian Institute for Socioeconomic Research (NISER) and the Universities of Ilorin and Calabar concluded that Guinea worm disease did indeed cause serious production and income losses among rice farmers in southeastern Nigeria. The broad objective of the study was to mount a convincing argument that the infection is a serious threat to agricultural production in the important "rice belt" of Nigeria, and thereby obtain funds to eliminate the disease. The rice study suffers some serious deficiencies of method that are fully recognized by the implementing researchers. (In only ten days, twelve enumerators retrospectively elicited on-farm data on product and input prices, yields, area planted, labor use, disease-related labor incapacitation, etc., from eighty-seven households through single-visit interviews with the household head). The peculiar nature of both rice cultivation and Guinea worm disease, however, may have mitigated those deficiencies to a degree. Nevertheless, the study is of sufficient merit to further suggest a significant relation between the disease and agricultural production. Moreover, the results seem to have alerted a few Nigerian politicians and administrators to the possible dire consequences of the disease for agricultural production, the increase of which is a cornerstone of current governmental policy.

There are multiple factors that contribute to individual and family morbidity and productivity losses in Nigerian villages

and the relative contribution of Guinea worm disease compared with other factors has not been measured. Demonstration of the magnitude of the impact on productivity is important for mobilizing attention and resources to stimulate control efforts.

A study to examine the impact of Guinea worm disease on agricultural productivity in Nigeria is proposed. It will focus holistically on the entire gamut of crops produced by the household so as to investigate the effect of the disease on total household agricultural income and production. Data will be collected to measure the supply and efficiency of labor, compensatory practices (e.g., hired labor, diversion of women and children from other tasks of schooling) which replace labor lost within households. Crop specific yields will be related to labor input and area of land tilled. Finally, costs of material and traditional treatment will be documented to estimate their impact on cash available to invest in agricultural production.

C. General Description of Study

The study will be carried out in three geographically distinct endemic regions representing different Nigerian systems of subsistence agriculture. These are Kwara, Anambra and Sokoto States. The study will be carried out in two major phases. The first phase will involve the survey of 10 villages in a single local government area (LGA) within each of the three states. These initial surveys will provide data on the prevalence of infection, the number of person-days of labor lost due to Guinea worm disease and the locally prevailing forms of agriculture. Labor losses will be converted to economic losses (U.S. dollar equivalent) and extrapolated to estimate total losses at the village and LGA levels. The second phase will be carried out in a single selected village within each of the three States and will involve much more intensive survey and direct measurement carried out prospectively during the course of a year to document actual disability due to Guinea worm disease and to quantitate its effect on labor availability and crop yields in household production units. Within each village, data will be collected by frequent visits to 25 households. Data collected in this second, more intensive phase will permit measurement of both the direct (total incapacity and reduced work efficiency), and indirect (compensation for loss of diseased individual's labor by hired labor or other external source of labor) effects of Guinea worm disease on labor as well as outcome (crop yields) and costs of treatment.

The second phase will also permit the measurement of labor losses due to Guinea worm disease in comparison to those caused by other forms of illness and accidents. A more detailed description of the research plan and activities follows.

II. RESEARCH PLAN

A. Phase I: June 1, 1988 (Retrospective to November 15, 1987) to November 15, 1988

a. Selection of the particular LGA's within Kwara, Anambra and Sokoto States will be based on (1) prior knowledge of the presence of Guinea worm infection; (2) the presence of receptive LGA administrators and village leaders; and (3) the availability of data on agricultural systems and yields.

b. Villages will be selected within the chosen LGA's by the following criteria: Guinea worm prevalence $\geq$ 40%, total population between 350 and 500. Ten villages from each LGA will be identified by random selection from a list of those that meet the above criteria.

c. Guinea worm prevalence will be determined in each village by house-to-house search at the end of the transmission season. From infected household, 10 will be selected randomly for collection of data on the person-days labor lost due to Guinea worm, the crops cultivated, amount of crops harvested, investments in production and other information related to agricultural product.

d. Data will also be collected from the Local Grains Board, grains mills and other sources to determine the recorded crop-specific yields from the study villages and the market value of the crops.

e. These data will then be used to calculate the manpower lost due to Guinea worm disease and the associated monetary values. These economic losses can then be extrapolated to the village and LGA levels based on known rates of Guinea worm infection. The approach and methods used for this study have been used for estimation of losses in rice production due to Guinea worm disease (see Edungbola et al., 1988 "Guinea Worm Control as a major Contribution to Self Sufficiency in Rice Production in Nigeria", in press).

B. Phase II: November 15, 1988 to January 15, 1989

a. Three villages, one each from those studied in Phase I in Kwara, Anambra and Sokoto States, will be selected for the second, more intensive, data collection phase.

b. The study will begin at the beginning of the agricultural production cycle and involve continuous data collection through the season of worm emergence until the end of the harvest, that is, the full production season.

c. Twenty-five households in each village will be selected randomly and baseline demographic data will be collected using a standardized questionnaire.

d. Each household will be revisited at appropriate intervals (varying between 1 - 4 weeks depending on the period of the agricultural or worm emergence season) to collect data on agricultural activities, Guinea worm disease incidence and associated incapacity.

e. At a date toward the end of the worm emergence season, the remainder of the household in the villages will be visited to document the occurrence of Guinea worm disease in the entire village.

f. At the end of the production cycle for each crop, a measured area will be harvested to determine the crop-specific yields in each of the 25 households.

g. These data will then be analyzed to describe the patterns of Guinea worm transmission, document the associated morbidity and to measure the agricultural impact. The methods and types of epidemiologic and agricultural analyses are described in greater detail below.

C. <u>Demographics, Guinea Worm Infection, Agricultural Labor and Productivity Parameters to be Measured/Documented by Questionnaire or other Survey Instruments</u>*

1. Demographics

State, Local Government Area, Village

Household members

Date of initial interview

Name, age, sex and occupation of each household member**

Indicator of wealth (size of farm***, No. of rooms, No. of windows, type of roof, travel to Mecca, total income, amount of palm wine ingested, motorcycle, television, etc.).

Religion

Source(s) of water (distinguish persons who use only single source and those who use alternative sources).

* Annex 4 presents Phase I and Phase II Survey Forms.
** Categories to include: Peasant farmer, school teacher, student, wage-earning migrant worker, petty traders.
*** Indicate if owned exclusively by household or shared with others.

2. Guinea Worm Infection and Disease

Data will be collected on Guinea worm infection for each household occupant for the transmission seasons 1983-87 retrospectively and, for 1988-89, prospectively. The details will vary for the different years.

For transmission seasons 1983-84, 84-85, 85-86, 86-87:

- Presence or absence of infection (e.g., Yes/No)

For transmission seasons 1987-88 and 88-89:

- Presence or absence of infection (e.g., Yes/No)
  Number of emergent worms by location
  Approximate dates of onset
  Degree, duration and dates of disability associated with infection

Treatment: Type, source (medical clinic, traditional healer, self), cost.

3. Agricultural Productivity

For each household member:

- Time lost in agricultural labor due to total incapacitation caused by
  (a) Guinea worm
  (b) other disease

- Reduction in work efficiency (when not completely incapacitated) by
  (a) Guinea worm
  (b) other disease

- Amount of labor lost because of the need to care for another household member due to
  (a) Guinea worm
  (b) other disease

Amount of labor compensated to agriculture either by other household members (who defer household activities or schooling) or by hired labor.

- Separate these measures according to thcse caused by
  (a) Guinea worm
  (b) other disease

Crop-specific yields (per unit of land; per capita)

4. Epidemiologic Analysis

The data collected in Phase II of the study will permit quantification of Guinea worm transmission and associated morbidity within 3 villages. Age-specific, water-specific and household attack rates will be calculated. The spatial distribution of infected individuals by household unit will be plotted on village maps showing relationships to water sources. The data will be analyzed to identify socioeconomic, occupational and other possible risk factors for infection. Statistical tests will be applied to test for the significance of the above mentioned associations and for possible "household clustering" of cases. Data on infection in past and present observation years will be analyzed to determine the proportion of persons never infected and those repeatedly infected. The data collected on Guinea worm disease and morbidity will be analyzed to look for associations between host age and the numbers and location of worms with the degree and duration of symptoms and incapacity to work.

The epidemiologic analysis will, in certain respects be unique and provide information not previously available for Guinea worm disease (e.g., testing for household clustering, socioeconomic risk factors and identification of highly resistant or highly vulnerable individuals in the population). The analysis is also necessary to look for possible confounding variables that might inject bias into the analysis of the interactions between Guinea worm disease and agricultural productivity.

5. Disability Rating for Dracunculiasis

Grade	Functional Disability
0	Does not have dracunculiasis.
1	Has dracunculiasis, but no disability. Can still do normal work, etc.
2	Has dracunculiasis and mild disability. Pain or limping - still able to go to work.

3 Has dracunculiasis and moderate disability. Pain or limping, with activities moderately affected or limited - still able to leave compound for certain activities but only with difficulty.

4 Has dracunculiasis and severe disability, but not confined to bed. Unable to go to work or school and unable or unwilling to leave the compound.

5 Has dracunculiasis and is confined to bed.

III. ECONOMIC ANALYSES

A. Unit of Study: The Agricultural Production Unit

The social focus of agricultural production is the "household", which must be the focus for data collection. In the Yoruba area of Kwara State, the household is composed of a man and often several wives. The man has a farm, which may consist of several dispersed plots on which he practices crop rotation. He works these plots with the help of his wives; hired labor also is common. Each wife will typically have her own farm as well, which she works without her husband's help. Her farm often is described as a garden, and in it she raises vegetables for sale (e.g., spinach, peppers, tomatoes, and onions). Carefully tended by the women, these gardens are an important source of household income.

The man's plots may be separated by several kilometers, and the gardens of his wives are clearly not contiguous. This dispersion of farm sites has implications for the study: severe Guinea worm disease reduces the ability of farmers to commute between house and field; and the enumerators, or persons detailed to the villages to gather data, for a given household, will need to monitor agricultural operations over a wide area.

The household structure of Ibo farmers in the Abakaliki area, near Enugu in Anambra State, appears similar to that of the Yorubas of Kwara State, but it seems that there is considerably less dispersion of farm sites in Ibo country. This may simplify data-gathering as well as make the process less costly.

B. Duration of the Study

The study will encompass at least one complete agricultural cycle, lasting from nine to twelve months. Once a sample of study households has been randomly selected, each household in the sample will be followed closely throughout the agricultural cycle. The presence of incapacitating Guinea worm infection at any point in the cycle can have consequences at some subsequent point in the cycle.

C. Labor: The Critical Variable

To the extent that Guinea worm disease affects agricultural production, it does so indirectly, through incapacitation of the labor force. The study, therefore, requires careful measurement of agricultural labor and labor lost by Guinea worm disease--labor that otherwise would have been committed to agriculture.

Using a combination of observations and open-ended informal interviews, trained enumerators, located for much of the time in the study villages, will collect data on quantity (in man-hours) of labor committed by study households to agricultural production. Using the same technique, the enumerators will also collect data on individuals incapacitated by Guinea worm disease and who otherwise would have been working in agriculture. The enumerators will determine a figure for man-hours lost by incapacitated labor, and that figure will be based on empirical labor patterns of the able-bodied members of the household (or hired labor) who do work during the study season.

Labor values will be weighed to account for differences in age and sex. A male from 15 to 50 years of age, for example, may be assigned a value of 1.0 (the standard), whereas a child of from 5 to 15 years of age may be assigned a value of 0.5. Women are by convention assigned a value less than that of men, although given their paramount role in agriculture throughout Africa, the convention is probably questionable. Some other modifications may have to be considered in devising an appropriate weighing scheme, but this is not a major problem.

Infected labor will be factored into the model described below by weighing it in accordance with the "Disability Rating for Dracunculiasis" presented earlier in this document.

A potential problem is that the model presented below measures only direct effects of Guinea worm disease on agricultural production. Some indirect effects may occur as well. For example, a woman with a totally incapacitating Guinea worm infection can do no work. Usually it is her responsibility to provide water to the household. Substitution by other women free of infection may result in less production because of neglect of their own gardens, etc. The model does not capture this effect.

D. Measurement of Yield

Guinea worm disease, operating through a direct effect on the labor force, should be reflected in agricultural yields, or quantity of food produced. Therefore, the proposed study will measure yields, and will do so for each crop, because the human activities are distributed over the full range of farm enterprises.

Reliable data on yields will be obtained from measurement rather than from interviews. In the case of grains such as rice and guinea corn (sorghum), the procedure is straightforward: one

measures a portion of the harvest taken from a sample of known size to establish a ratio, which is then used, after measuring field size, to calculate total quantity harvested (in pounds, kilograms, tubs, or some other unit).

In the case of root crops, such as cassava and yams, which are harvested as needed over a period of time (mature cassava can remain in the ground a year before being harvested), some ingenuity is called for. Valid techniques exist for estimating (sometimes through measurement of a proxy variable, such as number of yam heaps) on-farm yields of root crops; an agronomist with on-farm research experience with these crops (as opposed to research-station experience, where conditions are far removed from those on peasant farms) will be consulted. Ideally the agronomist may be used to train the study enumerators in making the estimates. Such specialists are available at the National Cereals Research Institute (for the Kwara area), the National Root Crops Research Institute (for the Anambra area), or at IITA in Ibadan. All of these centers have on-farm research teams.

E. Input and Product Prices

The study will require the collection of product prices throughout the agricultural cycle, as farmers decide to market products for cash. These prices may vary considerably during the cycle, ranging from a low at the time of harvest, when the market is glutted, to a high on harvest even when supplies are low. For purposes of economic analysis, even that fraction of product destined for domestic use will be given a price, which could be an average of prices over the agricultural cycle.

The study also will require input prices. Inputs include land, mechanical services (tractor service), capital (agricultural loans), labor, and commodities such as seeds, fertilizer and pesticides. Prices will not be assigned to either land (unless rented) or to household labor.

Evidence suggests that the major factor limiting increased production in peasant households in both Kwara and Anambra areas is labor instead of land. It is possible that Guinea worm disease may have little effect on agricultural production because the household labor force is redundant -- there are enough idle members to replace those incapacitated. This seems unlikely. Despite the government's efforts to reverse more than a decade of oil-induced rural-to-urban migration, there remains a serious labor shortage in the countryside. With a serious labor shortage there, the poorest farmers may hire themselves out for cash as well as cultivate their own fields. The team visited one village near Abakaliki, Anambra State, where this seems to be happening. If poor farmers usually purchase inputs such as fertilizer for their own farms with money earned from their labor, then incapacitating Guinea worm disease could deny them this income

and thus indirectly reduce production levels on their own farms. The model described below does not capture this effect. Nevertheless, information on household sale of labor and its relation to Guinea worm infection will first be gathered in order to learn whether there is a problem, and if so, what its magnitude is, before trying to expand the model.

Similarly, the costs of traditional treatment of Guinea worm disease could divert income that otherwise would be invested in agricultural production. This would be another indirect effect of the disease. The study enumerators will collect information regarding treatment costs, so that if they do emerge as significant, they can be factored into the model.

F. The Analytical Model

The model is based on the premise that labor lost because of Guinea worm disease is the crucial analytical variable; what the contribution of this labor to production and household income would have been under conditions of non-infection must be determined. The amount of this contribution is precisely the economic impact of the disease on agriculture.

The analysis involves the following steps for each household:

First, convert total farm product (the sum of the several enterprise products) to monetary units. (To convert an enterprise product to monetary units, simply multiply quantity harvested by its unit market price, remembering that market price may vary throughout the agricultural cycle). Whether a given product is actually sold or not is immaterial; a value based on local market price is inputed to the fraction of product consumed domestically. In mathematical terms, total product value, V, is given by the following equation, where q(n) is quantity harvested of crop n and p(n) its market value:

$$(1) \qquad V = p(1)q(1) + p(2)q(2) + \ldots + p(n)q(n)$$

Second, consider L, the amount of labor (in man-hours) that generated total product for the given household. Divide total value product by the labor that generated it. This quotient is the gross average value product, GAVP, of a man-hour of labor. It is the valuation of the product return to labor (at the particular level of household technology) as reckoned by society beyond the farm gate. It is a way of expressing labor's contribution to gross product. The relationship is expressed mathematically by equation (2).

$$(2) \qquad GAVP = V/L$$

Third, multiply gross average value product by LL, the quantity (in man-hours) of labor lost from Guinea worm disease. The result is PS, the production shortfall, or total average value product lost to society because of the disease.

(3) PS = (GAVP) (LL)

Fourth, consider again the amount of labor, L, that generated total product for the household. Consider also the cost of all production inputs <u>except labor</u> and call this cost C. Dividing total product value (=V) less input costs (except labor) by L gives the net average value product (NAVP) of a man-hour of labor. NAVP is a crude (crude in that technically it also includes returns to fixed capital and management) approximation of the return to labor at the particular level of household technology.

(4) NAVP = (V - C)/L, where C = c(1) + c(2) +...+c(n), and c(n) is the cost of input n.

Fifth, multiply the net average value product, NAVP, by LL, or man-hours of labor lost from Guinea worm disease. This figure, IS or income shortfall, is the total average value product lost to the household because of Guinea worm disease.

(5) IS = (NAVP)(LL)

Perform steps one through five for each household in the study sample. The sum of the production shortfalls for each household is the total production shortfall attributable to Guinea worm disease for the sample; and in a like manner, the sum of the household income shortfalls is the total income shortfall for the sample. If the random study households represent a 45% sample, then the corresponding losses for the universe (the village) are found by multiplying the sample losses by 100/45.

1. Five Clarifying Cases

To illustrate its use, the above model is applied to five household cases. These cases differ from each other (or appear to) in important ways. A case may represent a class of households that will likely occur with frequency in the study sample, and some of the cases present what appear to be obstacles to application of the model.

<u>Case One</u>

The circumstances: Incapacitation from Guinea worm disease reduces household labor, none is hired to compensate, and there is a decline in production. There is <u>some</u> production.

The analysis: This case, which could be predicted as a model case, is handled in a straightforward fashion. There are no complications: both PS and IS are calculated by equations (3) and (5) above.

Case Two

The circumstances: Guinea worm infection causes incapacitation of household labor force, but household compensates pari passu through hired labor.

The analysis: Since no labor is lost to production (labor that would have been lost has been replaced by hired labor), PS = 0. Here, however, IS cannot be calculated from equation (5), but becomes instead the cost of the hired compensatory labor.

Case Three

The circumstances: The household employs hired labor even under conditions of non-infection. Assume infection sets in and part of the domestic labor complement drops out.

The analysis: This case represents only a slight modification of Case (1). PS and IS are calculated accordingly, using equations (3) and (5).

Case Four

The circumstances: Because severe Guinea worm disease results in high labor incapacitation, the household produces nothing and loses an entire agricultural cycle.

The analysis: This is a degenerate case, for the model requires the presence of some production in order that a relation, or ratio, be established (for the particular household) between labor and product. That same ratio applied to labor lost from disease, is then used to measure impact of the disease on income and production. One way out of this seeming impasse is to compare the "degenerate" household to another household in the sample, one as similar to it as can be found. The compared household should be similar at least in the following parameters:

a. Have a Guinea worm induced production shortfall (to choose a healthy household could introduce error, since healthy ones may differ from infected ones in unknown but important ways).

b. Have about the same household labor profile (age, sex, number of persons).

c. If the degenerate household would normally hire labor, then compared one should do likewise (and not just to offset infected workers). If the degenerate one would not, then the compared one must not.

d. The compared household must have used the same kinds of inputs as the degenerate one would have used.

For the compared household, both L and LL would be known. Their sum, L + LL, should approximate total labor lost by the degenerate household. The following two equations can then be used to calculate PS and IS for the degenerate household:

$$PS = (GAVP)\ (L+LL) \qquad IS = (NAVP)\ (L+LL)$$

Case Five

The circumstances: A household with no Guinea worm incapacitation.

The analysis: The case is trivial; PS = IS = 0.

G. A Note on Method

The model employed for this analysis bears a different structure from that of models commonly used in biological research, where the consequences of change in a research variable of an experimental population are reckoned by comparing that population to a control population identical to the experimental one except that the research variable is constant. This method of controlled comparison is easier to use in a laboratory than in a field setting, where the population units are human households and the phenomena to be measured are the result of a complex interplay of psychological, economic, sociocultural, and agro-ecological variables.

An attempt to compare two household groups, with the experimental group being the one with Guinea worm disease and the control group being the one without it, becomes unrealistic in a population among which the prevalence of the infection is so high that almost every household has at least one infected individual. The model employed in this analysis tries to circumvent this problem by using each household as its own control. For an infected and incapacitated household, this is achieved by "sampling" the relation between labor and product for those individuals that do work. Once this relationship is established, it is then applied to that complement of the work force incapacitated in order to know what its contribution otherwise would have been.

H. Data to be Collected and Analyzed

The method of analysis described above indicates the categories of data to be collected. In consultation with Dr. Aloy Nwosu, the agricultural economist with NISER who worked with our team in Ilorin, survey forms have been prepared for use in recording the field data required for the analysis (see Appendix 1). These forms and the data collection categories on them are standard for farm-management surveys. It is agreed, that data of high quality is a sin qua non of this study. This implies that the field workers must be well-trained, competent, responsible, and well-supervised throughout the duration of the study.

A tenative Table of Organization is proposed in Annex 1. Annex 2 expands this table to include the names of potential national counterparts in the three proposed project sites.

IV. COMMENTS ON THE PROPOSED STUDY SITES

A. Agricultural Activities and Disease Transmission in the Study Sites

The crucial factor influencing both the occurrence and transmission of Guinea worm infection and specific agricultural activities is the length of the dry season. The three proposed study sites were chosen to represent different agricultural systems and patterns of disease transmission determined by the varying lengths of the dry season. Sokoto State is characteristic of the north, which has a dry season of seven months or more, usually between October/November and April/May. Transmission commonly occurs when ponds are filling up at the beginning of the short wet season. Thus, patent infection is highest during the very brief agricultural season.

The areas of Kwara and Anambra States proposed for study are representative of the south/central region which is characterized by a dry season of between four and seven months between about November and March. Here, transmission commonly occurs when ponds and water courses are drying up toward the end of the dry season. However, the time of maximum patency and transmission varies with the onset of the rains and with local hydrological conditions. Everywhere in this region the peak of agricultural activity, the preparation of new farm land and the planting of new crops, occurs at the end of the dry season and the beginning of the wet season, thus coinciding with the peak prevalence of Guinea worm emergences.

A third zone in the extreme south has a short dry season of less than four months, with transmission occurring year round from permanent, open ponds. However, this zone has relatively few cases because adequate, year-round water sources are apparently less vulnerable to Guinea worm transmission This area has not been selected for the agricultural impact study.

1. Kwara State

The sites selected in Kwara State include Asa and Moro local government areas. These LGA's lie immediately to the north (Moro) and the south (Asa) of the city of Ilorin, the state capital. The people in rural areas are predominantly Moslem Yoruba. Belief in the Yoruba gods is widespread. The rural communities are small, with a median size of between 250 and 350. Village consist of clusters of houses mostly of mud with corrugated iron roofs; larger villages have a primary school, a mosque (in some cases a church), a four-day periodic market, and

more rarely a clinic or dispensary. The basic social unit is the extended family (idile) under the authority of a male household head who provides the food for all the members. Polygamy is common, and the number of wives is a function of wealth.

The main crops grown are yams, maize, cassava, guinea corn, ground nuts and vegetables such as melon, peppers, spinach, okra and tomatoes.

2. Anambra State

The site proposed for the study in Anambra State is the Abakaliki zone, which is comprised of four LGA's in which recent surveys have revealed prevalence varying from 60% to 80%. This state, like Kwara State, is part of the south/central region, which is characterized by a dry season of between four and seven months, between about November and March. Transmission most commonly occurs when ponds and water courses are drying up towards the end of the dry season. The time of maximum patency and transmission varies with the time of onset of the rains, and with local hydrological conditions. Infection rates are minimal or nonexistent among those who drank clean, piped water and highest on those dependent on the "okpuro" for their drinking water (artificial ponds).

The Abakaliki plain is a major food producing area of Anambra State and supports a total population of approximately 1.3 million people scattered throughout the numerous rural villages. The people are Ibos and mostly Christians with some adherence to the traditional religion.

The population is distributed in patrilineal households of 8-24 members, dominated by the elder members. Houses are of two types, the traditional mud-walled houses with thatched roofs, and the cement-walled houses with roofs of corrugated iron sheets. The latter, which are usually better ventilated, indicate the household's improved socio-economic status. The villagers live by farming plots of land (3-8 ha) adjacent to their houses. Food crops are intensively cultivated on these farms and a few animals (poultry, sheep and goats) are also kept. The main cultivated crop is yams, which are planted in large mounds (heaps) that characterize the farmlands in these localities. Yams may be combined with cocoyam and cassava in a multi-cropping rotational system. Rice has also emerged as an important local crop. Vegetables are also commonly planted in the same farm plots.

Farming activity is seasonal. The typical pattern is for the ground to be tilled with hoes and prepared for the planting of crops just before and/or after the first rains. This energy-intensive farm work is carried out almost exclusively by the males. There is a lull of three to four weeks followed by a peak in farming activities during the rainy season as the farms are

"remolded" and weeded repeatedly, using hoes. The process of remolding or rehilling is also energy exacting. Taking place after two or three months of crop growth, it requires the participation of all adolescent and adult members of the household, irrespective of sex. It is proceeded by manuring of the farms with animal droppings, compost, and extensive human defecation. The period following remolding is a rest period marked by food scarcity. The harvest period (usually yams are first) is marked by festivities in the villages. The men are involved in the more exhausting forms of labor such as tillage and making of heaps and the women and children are occupied with household duties and the lighter farm duties such as planting of vegetables and weedings.

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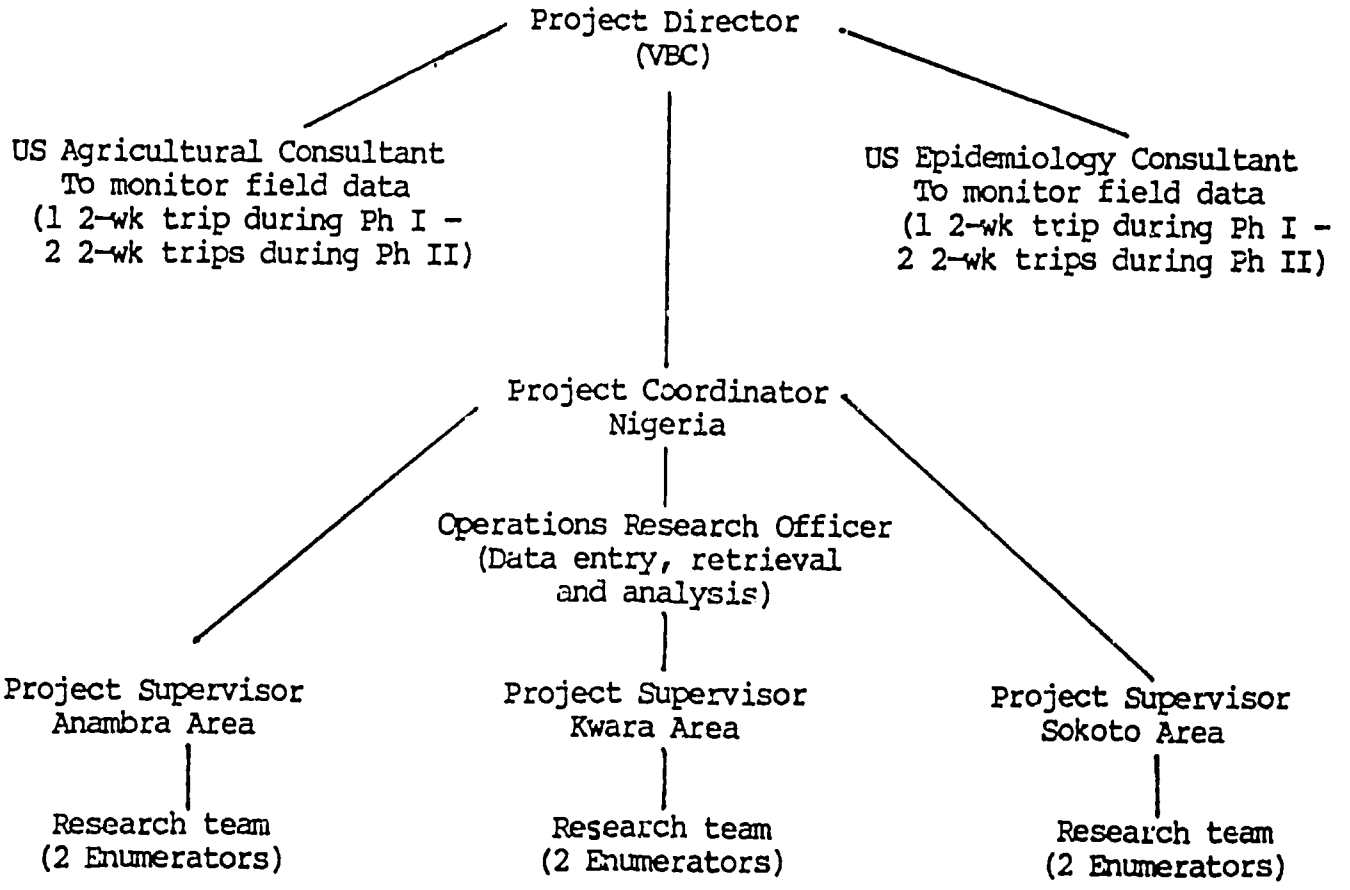
ANNEX 1

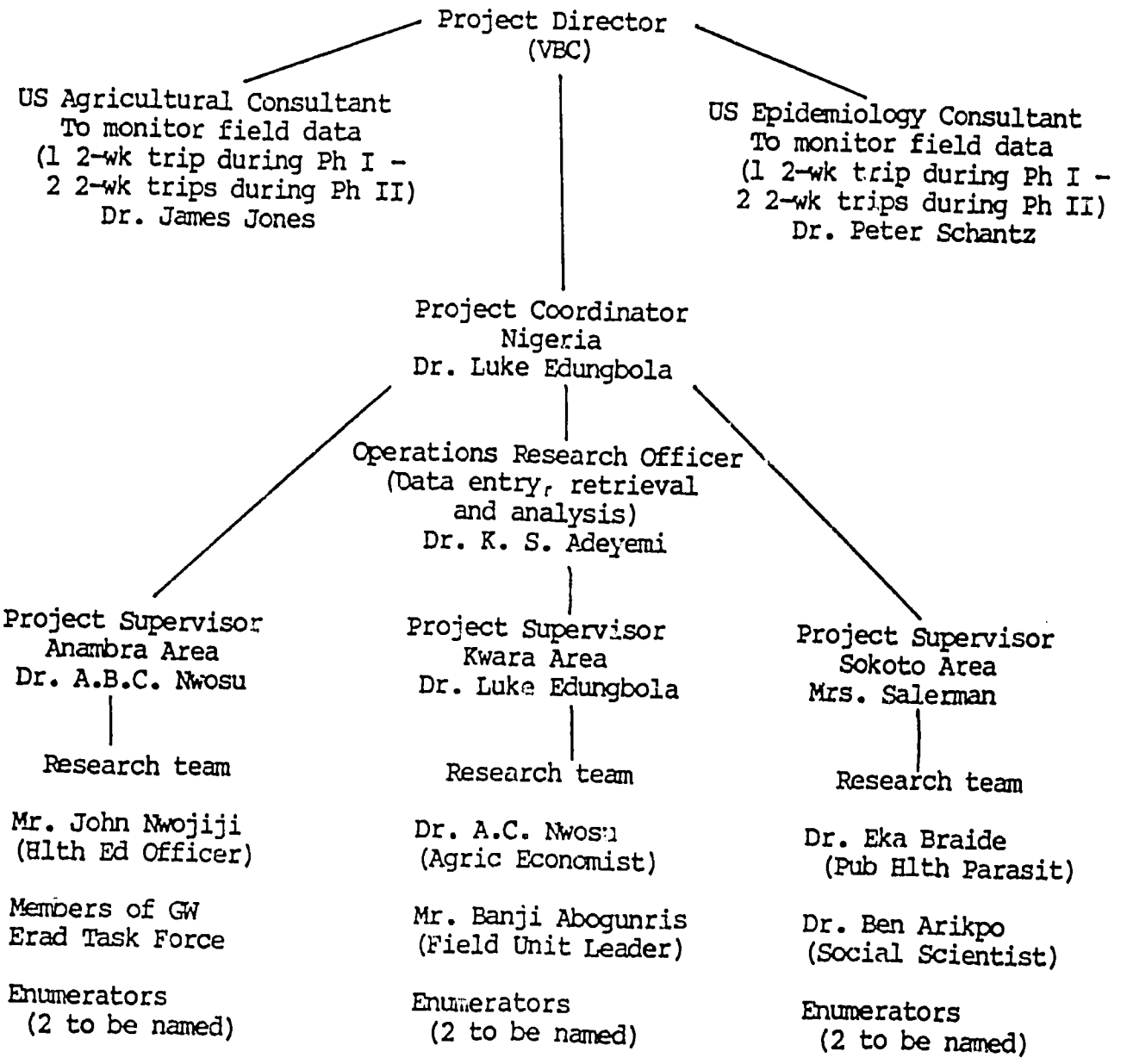
TENTATIVE TABLE OF ORGANIZATION



ANNEX 2

TENTATIVE TABLE OF ORGANIZATION

(EXPANDED TO INCLUDE NAMES OF POTENTIAL NATIONAL COUNTERPARTS IN THE THREE PROPOSED PROJECT SITES)



ANNEX 3

PERSONS CONTACTED

LAGOS

Dr. Keys McManus
USAID Representative - Lagos

IBADAN, OYO STATE

Dr. O. Kale - Chairman
Department of Social and
Preventive Medicine
University of Ibadan

Dr. George Abalu
Agricultural Economist

Dr. K. A. Dvorak
International Institute of Tropical Agriculture

Dr. W. D. Itahu
International Institute of Tropical Agriculture

ILORIN, KWARA STATE

Prof. Luke D. Edungbola
Department of Microbiology and Parasitology
University of Ilorin

Prof. O. Ogunbode
Dean, Faculty of Health Sciences
University of Ilorin

Dr. J. R. Idowu
Chief Epidemiologist
Ministry of Health
Kwara State

Dr. Abdullahi Ibrahim
Hon. Commissioner for Health
Kwara State

ANNEX 3 cont.

Mr. Harry Abe
Project Manager
UNICEF - Assisted Water and Sanitation Projects

ENUGU, ANAMBRA STATE

Prof. A. B. C. Nwosu
Commissioner for Health
State Ministry of Health

Dr. Chris Obionou
Chief Medical Officer
State Ministry of Health

Mr. John Nwojiji
Health Education Officer
State Ministry of Health

Mr. J. I. Itewi
Permanent Secretary
State Ministry of Health

Members of Guinea Worm Eradication Task Force

ANNEX 4

SURVEY FORMS FOR PHASE I AND PHASE II

HOUSEHOLD DEMOGRAPHIC INFORMATION

Date: State: LGA: Village: HH No.:

Send No	Names	Relationship To HHH	Age	Sex	Occupation	History of GW 1988	1987	1986	Comments

1. NAME, IN THE ORDER OF IMPORTANCE, THE THREE MAJOR CROPS CULTIVATED IN YOUR VILLAGE.

1ST_____ 2ND_____ 3RD_____

PLEASE GIVE THE FOLLOWING INFORMATION ABOUT YOUR FARM, LAST CROPPING SEASON.

PLOT NO.	PLOT SIZE	NAMES OF CROPS

3. PLEASE GIVE ESTIMATES OF THE QUANTITIES OF THE CROPS YOU PRODUCED LAST CROPPING SEASON.

NAME OF CROP	QUANTITY PRODUCED						
	KG	JUTE SAC	50KG FERTILIZER	TIN	DRUM	ROWS a HEAPS	OTHER

4. PLEASE INDICATE THE AMOUNT OF MONEY YOU DERIVED FROM THE SALE OF THE CROPS YOUR PRODUCED LAST CROPPING SEASON.

NAME OF CROP	PROPORTION SOLD IN THE MARKET	AMOUNT OF MONEY DERIVED FROM THE SALE OF EACH CROP

5. PLEASE INDICATE BELOW THE AMOUNT OF MONEY YOU SPENT ON YOUR FARM LAST CROPPING SEASON.

RENT PAID ON LAND (N)	VALUE OF PLANTING SEEDS a SEEDLINGS (N)	COST OF FERTILIZER AND CHEMICALS (N)	COST OF HIRED LABOR (N)	COST OF IMPLEMENTS AND EQUIPMENT OR HIRED MACHINES (N)

6. PLEASE INDICATE THE TIME SPENT BY EACH OF YOUR WIVES, CHILDREN, AND RELATIONS LIVING WITH YOU, WORKING ON THE HOUSEHOLD FARM LAST CROPPING SEASON.

HOUSEHOLD MEMBERS	CROPS PRODUCTION		
	DAYS WORKED PER WEEK	HOURS WORKED PER DAY	DURATION OF PARTICIPATION IN FARMWORK
1. Head of Household			
2. Wives:			
(i)			
(ii)			
(iii)			
(iv)			
3. Children and other relations 7 years and above:			
(i)			
(ii)			
(iii)			
(iv)			
(v)			
(vi)			
(vii)			

Form Y2

INDIVIDUAL FIELD CROP YIELD ESTIMATES (UNIT METHOD) (PARTICULARLY FOR GRAINS)

LGA: _____ NO. OF FIELD: _____ ENUMERATOR: _____

VILLAGE: _____ SIZE OF FIELD: _____ SUPERVISOR: _____

HH CODE NO. _____

Date	Kinds of Crops	Condition of Crop	Units	Total No. Units Harvested	Weight of 5 Units 1	2	3	4	5	Total Weight 5 Units	Average Wt One Unit	Total Weight Of Harvest	Remarks

7. PLEASE GIVE AN ESTIMATE OF THE LENGTH OF TIME YOU OR ANY MEMBER OF YOUR HOUSEHOLD WAS UNABLE TO WORK ON YOUR FARM IN THE PAST TWO CROPPING SEASONS.

NAME OF HOUSEHOLD MEMBER	TYPE OF DISEASE		ESTIMATED NUMBER OF DAYS UNABLE TO WORK	
	1987	1986	1987	1986

FORM A

MASTER SAMPLE NAMES AND CODE NUMBERS

State:

(1) LGA: _____ (4) NAME OF ENUMERATOR: _____

(2) VILLAGE: _____ (5) NAME OF SUPERVISOR: _____

(3) DATE: _____

Code No. of HH	Name of Head of Household	Location of Residence in Village

Form A2

DEMOGRAPHIC INFORMATION ON HOUSEHOLD MEMBERS

(1) Code No.	(2) Names	Household Members				
		No.	Name	Age	Sex	Occupation (s)
1.		i				
		ii				
		iii				
		iv				
		v				
		vi				
2.		i				
		ii				
		iii				
		iv				
		v				
		vi				
3.		i				
		ii				
		iii				
		iv				
		v				
		vi				

Form A3

FIELD FARMED BY HOUSEHOLD

LGA: _____ HH NAME AND CODE: _____

VILLAGE: _____ NAME OF ENUMERATOR: _____

DATE: _____ NAME OF SUPERVISOR: _____

FIELD No.	DESCRIPTION OF FIELD	KINDS OF CROPS	DIRECTION OF FIELD FROM THE HOUSE	SIZE OF FIELD	DISTANCE FROM HOUSE	
					TIME	KM

FORM A4

CURRENT PRICE COLLECTION

LGA: _____ VILLAGE: _____ ENUMERATOR: _____

			MONTH:			MONTH			
			1ST - 3RD 1ST FORTNIGHT	15TH - 18TH 2ND FORTNIGHT	MONTHLY AVERAGE	1ST - 3RD 1ST FORTNIGHT	15TH - 18TH 2ND FORTNIGHT	MONTHLY AVERAGE	QUARTERLY AVERAGE
CROPS	UNIT	CONDITION	WT PRICE (N)	WT PRICE (N)	WT PRICE	WT PRICE (N)	WT PRICE (N)	WT PRICE	WT PRICE (N)

Form A5

FERTILIZER AND SEED INPUTS

LGA: _____ FIELD NO.: _____

VILLAGE: _____ ENUMERATOR: _____

HH CODE NO.: _____ SUPERVISOR: _____

	FERTILIZERS						SEEDS OR CUTTINGS			OTHER INPUTS e.g., SPRAY, CHEMICALS		
	ORGANIC			INORGANIC								
DATE	TYPE	QTY	UNIT	TYPE	QTY	UNIT	KIND	QTY	COST PER UNIT	NAME	QTY	COST PER UNIT

Form A6

FIELD OPERATION SHEET

LGA: _____ FIELD NO.: _____

VILLAGE: _____ ENUMERATOR: _____

HH CODE NO.: _____ SUPERVISOR: _____

Operation	FAMILY LABOR						NON-FAMILY LABOR																	
	MALE OVER 15 YEARS		FEMALE OVER 15 YEARS		YOUTH UNDER 15 YEARS		DAILY PAID LABOR									GROUP LABOR					TASK LABOR		MACHINE	
							MALE OVER 15 YRS			FEMALE OVER 15 YRS			YOUTH UNDER 15 YRS			ARO		OWE						
	No.	Hrs Wkd.	No.	Hrs Wkd.	No.	Hrs Wkd.	No.	Hrs Wkd.	Ttl. Pd (N)	No.	Hrs	Ttl Pd (N)	No.	Hrs	Ttl. Pd (N)	No.	Hrs Wkd.	Cost(N) Food,etc	No.	Hrs Wkd.	Cost(N) Food,etc.	No.	Ttl Pd (N)	Ttl Hrs Worked	Cost (N)

Form L1

RECORDS ON THE LENGTH OF TIME MEMBERS OF THE HOUSEHOLD ARE UNABLE TO WORK OR ATTEND SCHOOL OWING TO DISEASE INFECTION

LGA: _____ HH CODE NO.: _____

VILLAGE: _____ ENUMERATOR: _____

WEEK NO	HOUSEHOLD MEMBER INFECTED NAME	AGE	OCCUPATION	TYPE OF DISEASE GW	ANY OTHER	NO. DAYS UNABLE TO WORK OR ATTEND SCHOOL
1						
2						
3						
4						

Form L2

RECORDS ON THE LENGTH OF TIME MEMBERS OF THE HOUSEHOLD ARE UNABLE TO WORK OR ATTEND SCHOOL BECAUSE THEY HAVE TO TAKE CARE OF OTHER SICK MEMBERS OF THE HOUSEHOLD

LGA: _____ HH CODE NO.: _____

VILLAGE: _____ ENUMERATOR: _____

WEEK NO	HOUSEHOLD MEMBER HINDERED FROM DOING WORK OR ATTENDING SCHOOL NAME	AGE	OCCUPATION	TYPE OF DISEASE GW	ANY OTHER	NO. DAYS UNABLE TO WORK OR ATTEND SCHOOL
	i)					
	ii)					
1	iii)					
	iv)					
	v)					
	vi)					
	i)					
	ii)					
2	iii)					
	iv)					
	v)					
	vi)					
	i)					
	ii)					
3	iii)					
	iv)					
	v)					
	vi)					
	i)					
	ii)					
4	iii)					
	iv)					
	v)					
	vi)					

Form TI

COST OF TREATMENT OR MEDICATION

LGA: _____ HH CODE NO.: _____

VILLAGE: _____ ENUMERATOR: _____

WEEK	NAME OF INFECTED HOUSEHOLD MEMBER	TYPE OF DISEASE GW	ANY OTHER	COST OF TREATMENT OR MEDICATION (N)	TRANSPORTATION COST TO TREATMENT CENTER (N)
1					
2					
3					
4					

Form YI

INDIVIDUAL FIELD CROP YIELD ESTIMATES (YIELD PLOT METHOD) (PARTICULARLY FOR ROOTS AND TUBERS)

LGA: _____ NO. OF FIELD: _____ ENUMERATOR: _____

VILLAGE: _____ SIZE OF YIELD PLOT: _____ SUPERVISOR: _____

HH CODE NO. _____ SIZE OF FIELD: _____

Date	Kinds of Crops	Condition of Crop	Yield Plot 1		Yield Plot 2		Yield Plot 3		Yield Plot 4		Total Yield Plots		Avg Wt Yld.Plots	Avg.No. Stands	Remarks
			Wt	No Stands	Wt	No Stands	Wt	No Stands	Wt	No Stands	Wt	No Stands			