Kenya - Health, Nutri- 671-73
tion and Worker Productivity
Studies

THE WORLD BANK / INTERNATIONAL FI CE CORPORATION

OFFICE MEMORANDUM

DATE: July 7, 1987

TO: Mr. Dennis de Tray, Research Administrator, PPR

FROM: Phi Anh Plesch, PPRRA

EXTENSION: 33484

SUBJECT: Evaluation of Completed Research Project, RPO 671-73
Kenya: Health, Nutrition, Worker Productivity and Child Development Studies

1. All the individual evaluation reports for the above research project have now been received from the reviewers, namely

(1) Internal Reviewer: Avi Dor

(2) External Reviewer: John Strauss

(3) OED Representative: OED is not participating

2. I am attaching a set of the individual evaluation reports for your use. A set was circulated to the project sponsor, Alan Berg, who indicated to us that he has no objection to or comments on the reviewers' reports.

3. Our goal is to complete this evaluation exercise in time for inclusion in the next Annual Report on Research. As we have to make allowance for a margin of time to deal with potential snags further down the process (e.g., sponsor's appeal, etc.), it would be appreciated if you could send your draft overall evaluation report as soon as possible, and preferably no later than July 30, 1987.

Attachments: Evaluation Reports

THE WORLD BANK/INTERNATIONAL F NCE CORPORATION

OFFICE MEMORANDUM

DATE April 2, 1987

TO Mr. Alan Berg, PHNDR

FROM Phi Anh Plesch, VPERS PAP

EXTENSION 33484

SUBJECT Evaluation of Completed Research Project

Please find enclosed the reviewers' comments on your completed research project, RPO 671-73, "Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies".

You may wish to respond in writing to these reviews before the REPAC panel chairman drafts his overall evaluation report. We would appreciate receiving your response, if any, before April 11, 1987. If you have any problem with this deadline, please let us know. You will still get a chance to look at the panel chairman's draft evaluation report before it is finalized.

For your information, I also enclose the revised circular on evaluation rules and procedures dated March 30, 1987.

Enclosures

cc: Mr. Dennis de Tray, DRDDR
Messrs. D. Lal, H. Cortes (VPERS)

671-73

The World Bank
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

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April 1, 1987

Professor John Strauss
Department of Economics
Yale University
New Haven, Connecticut 06520

Dear Professor Strauss:

I would like to thank you for your evaluation report for the completed research project on "Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies" which you recently sent me. I am sure that it will be of great help to the panel chairman in putting together an overall evaluation report for the project. If the chairman has any questions concerning your report, he will get in touch with you directly.

I have passed on your "Request for Payment for Professional Services" form to the Accounting Department for processing. Please do not hesitate to let me know if any problems arise in connection with this matter.

Once again, let me say how much I appreciate your help in evaluating this research project. I certainly hope that you will be willing to help the Bank again in the future.

Yours sincerely,

Hernan Cortes
Deputy Research Administrator
Economics and Research

Enclosure

cc: Mr. Dennis de Tray

671-73

cc: D. Lal w/ att ✓

Yale University

DEPARTMENT OF ECONOMICS
Economic Growth Center

27 Hillhouse Avenue
P.O. Box 1987, Yale Station
New Haven, Connecticut 06520

March 27, 1987

Dr. Dennis DeTray
World Bank
Room S-10
1818 H Street NW
Washington, DC 20433

Dear Dennis:

Finally, here is the report. I am sorry for the delay. This project, or rather the part I reviewed, is somewhat difficult to judge within the context of Bank research. Of its genre it seems reasonable, mostly because of quasi-experimental conditions it tried to ensure in a longitudinal study. Still, the narrowness of being discipline bound comes through in that a number of interesting questions, such as interactions of treatments with socioeconomic variables such as income or education, were not explored. In addition, when the study tries to do more than the simplest ANOVA of changes in different variables related to treatment group, the results are flawed because of not appreciating endogeneity of various behavioral choices or outcomes. Still it is much better than many other such studies I have seen.

The other question of course is policy relevance. This I find very hard to judge because of my lack of knowledge of what the burning policy issues are related to health and nutrition in Kenya. For instance, if ascaris control is considered for whatever reason to be vital, then the fourth study may have some relevance in designing a reasonable intervention. On the other hand, these studies are clearly not sufficient for such a task as no true cost effectiveness (or better yet, benefit-cost) comparisons were made. On ther other hand, I don't want to come down too strongly on this, given the nature of my current work.

Once again I survived Sudan. We are actually beginning to enter data onto PC's now, training our best Ministry interviewers to do so. Not only is this seen as a reward, but will hopefully provide them with a much better understanding for the importance of quality control in field work.

My best wishes,

John Strauss

/sh
Enclosure

Report on "Kenya: Research on Health, Nutrition and Worker Productivity Study"

This project undertook four field studies in rural Kenya related to relationships among nutrition, health and roadworker productivity. The first study examines the impact of calorie supplementation on worker productivity among roadworkers. The second study investigates the effectiveness of using direct iron supplementation, iron-rich feeding supplementation, and treatment for various parasitic infections in raising blood hemoglobin levels. The third study is a descriptive comparison of certain health and nutrition indicators of roadworkers in four different ecological zones of Kenya. The fourth study was a longitudinal examination of the effectivenss of certain drugs in treating ascariacis (roundworm) in children.

The studies, which are intended largely for nutritionists, have resulted in papers which have been published in prominent journals of nutrition. Most of the materials are somewhat technical in nature, rather than being policy oriented. They have contributed to our knowledge in some important ways and would be useful for cost-effectiveness studies. To the extent that there are weaknesses in the studies they result from ignoring the behavioral responses of individuals and households, which can confound interpretation of results, and from the inherent difficulties in attempting to provide pseudo-experimental conditions in the field.

In general, two types of questions can be asked regarding nutrition and health. The first has to do with quantifying the biological process which results in nutrition and health outcomes. This is inherently difficult since the outcomes occur over time and may depend on one's status in prior time periods. Consequently longitudinal data are ideally required. Identifying the technology can be of enormous policy relevance, particularly if one's interest

is in gaging the effectiveness of a new medical treatment or food supplement on nutrition or health outcomes. However, in order to quantify the biological processes in non-experimental conditions, it is necessary to account for individual and household behavior. This gives rise to the second type of question which can be asked, namely what effects can policies and programs have on individual nutrition and health outcomes when account is taken of the mutually reinforcing or conflicting actions taken by households and individuals. Answering this class of question is of direct policy relevance. Unfortunately many past studies have mixed up the two types of questions, and hence answered neither well. The Kenyan studies has a mixed record regarding this, but some of the studies have succeeded in coming close to maintaining the distinction, trying to qualify the second question of what impacts do different nutrition and health interventions have on nutrition and health outcomes over time.

The best and most careful of these studies is the first which tries to look at the effect of calorie supplementation on roadworker productivity. Two factors distinguish this study from the others done as part of this project. First, far more care is taken in the field work to achieve comparability and yet randomness between the control and treatment groups. Second, the statistical work is much more careful and sophisticated. This can be attributed to the involvement of Andrew Chesher, a good applied econometrician, in this study.

This study randomly divided roadworkers into two groups: one receiving a calorie supplement of 200 calories per day and a second with a 1000 calorie per day supplement. The study randomized group assignment over a number of relevant characteristics, such as the daily attendance record for the first month of the study, and initial productivity measurements. The one weakness of

the study, which the authors recognize, is the large attrition during the study. This could invalidate the results if the attrition was related to which treatment group a worker was assigned to. Randomizing treatment assignemnt based on initial attendance record reduces, but does not eliminate, this risk.

This study also takes care to measure food consumption at home, finding a net increase of 500 kilocalories per day for the supplemented group and no net change for the low-level supplemented group. Comparing mean productivity gains between the groups they find a 13% incremental increase by the supplemented group which is statistically significant at the .075 level. Thus evidence is found supporting a nutrition-productivity effect, one of the few studies to do so.

Besides some very interesting descriptive material, a number of other regressions are reported in this first study, however they suffer the same shortcomings as much of the nutrition literature. For instance, in Table 1-19 estimates are reported for regressions of baseline productivity on such variables as blood hemoglobin levels and arm circumference. Both are found to have significnatly positive coefficients, however the causal interpretation made must be in doubt since it is quite probable that high productivity workers will have higher incomes leading to better nutritional outcomes such as not having low hemoglobin levels.

In general, the regressions of individual productivity change on different variables are more believable, but even they rely on a strong assumption, that unobserved individual-specific variables which don't vary over time are the sole cause of correlation between endogenous variables such as days worked on the project and the regression error terms. Thus in the regression of productivity gain on days worked, the total calorie supplement over the period (which is a function of days worked), plus changes in a nutrition outcome such

as weight-for-height, for the coefficients to be consistently estimated requires zero correlation between regressors and unobserved error terms. This seems unlikely. For instance, unobserved factors leading to greater productivity gain may lead to less weight gain if more total energy is expended. Indeed the report does use the change in nutritional outcome variables, such as weight-for-height, as dependent variables in separate regressions (though they get no significant results). The equations are explicitly modeled as a recursive system, in which case the ordinary least squares estimates would suffice. The absence of correlation between the error terms of the weight gain and productivity gain equations seems an overly strong assumption, however. Without it the strategy of using OLS is inadequate. Moreover, it is not even clear how the productivity gain equation could be identified given a simultaneous structure. Finally, I would note that using the calorie supplement received as an exogenous variable is not a good idea since it is a function of labor supply. Using the (random) treatment group is fine, however, and that is done as mentioned earlier.

Lest this review sound too critical, I want to repeat that the regression of productivity gains on treatment group is valid so long as the sample attrition is not related to the treatment group. Furthermore in many respects the study was quite carefully conducted given the inherent difficulties of field work. In particular it is much better than the INCAP studies.

Studies 2b and d try to exmaine the impact of iron supplement, feeding supplements, and treatment of intestinal diseases on blood hemoglobin levels of roadworkers. Iron levels have been shown to be related to worker productivity by Basta and Churchill, with a reasonable methodology similar to the first study here. Still quantifying the benefits in a benefit-cost framework is not easy, and was not attempted here.

The structure of these studies was to randomly assign workers to treatment groups and follow them longitudinally. In the first study the impact of iron pills was examined. In addition both groups were treated for hookworm. The treatment group had a significant rise in blood hemoglobin levels reported whereas the placebo group did not. On the other hand, when fed an iron-rich food supplement (vs. an iron-poor supplement), both groups had rises in hemoglobin levels with no significant difference between them. In principle the treatment of both groups for hookworm could lead to this result, however the hookworm treatment did not lead to a rise in blood hemoglobin for the placebo group in the iron pill experiment, so there remains a puzzle here.

Finally, some limited impact of hookworm treatment plus a malaria prophylaxis was found on changes in hemoglobin levels and hookworm counts. The study also showed a significant correlation between levels of hookworm counts and anemia (study 2d). The study claims that effectiveness of hookworm treatment is greater the more anemic the initial state. This is difficult to substantiate with the reported evidence because of a flawed methodology. The problem is that the dependent variable, hemoglobin levels, is truncated at a certain level. That is only observations with low hemoglobin levels are included in the regression. In general, this is a mistake, unless there exists a priori information that the process is fundamentally different for the two groups. No such information exists here. Essentially the problem is one of choice based sampling. What the authors want to do is better accomplished by including all observations and choosing a functional form which can give a nonlinear relationship.

Again in this study, changes in outcome levels are regressed against initial characteristics. This makes sense in terms of the biology, however probable correlation between initial conditions and unobserved disturbances

will lead to inconsistent parameter estimates. This issue is not addressed, and is in general poorly understood in the nutrition literature.

Study 3 is a descriptive cross sectional study of nutrition and health differences of workers in four agro-climatic zones. The intent was to judge the generality of the experiments conducted in only two zones. As a descriptive study it is interesting, however not much of substance regarding the experiments can be concluded.

One is left with the impression from the three experiments that the study stopped before it should have. In particular no cost effectiveness study was done of the three interventions. Even had that been done, limiting such a study to only the three treatments considered is itself very limited. One might also want to include much more general investments such as in education, especially female, in general income raising measures, etc. Furthermore there may well exist interactions between particular health interventions and certain socio-economic variables. The result that hemoglobin levels can be affected by certain nutrition or health interventions is useful, but rather limited.

The fourth study was an attempt to control ascaris (roundworm) in children, by drug treatment. What was found was that the drug used was effective, however reinfection occurred rapidly. Repeated use of the treatment only reduced village roundworm levels to a base level of some 12% because of such reinfections, possibly from houses with dirt floors. This suggests a positive interaction between treatment success and income level which would need to be considered. What the potential impact of ascaris control is on other outcomes is unclear, except for the impact on hemoglobin blood levels which was examined in study 2d. The study does demonstrate, however, that a low cost treatment of ascaris is possible.

In sum, certain fairly narrow questions have been addressed in these studies. I will leave for others the task of assessing how well these fit into Bank objectives. The studies seem to have been competently handled in the field. The simplest of analyses, the differential impact of treatment on treatment and control groups seems reasonable, except for the inherent difficulty of attrition. The major question unexplored are possible interactions between treatments and socio-economic conditions. The analyses beyond the question of treatment impacts are flawed because of account not being taken of behavioral responses of households and individuals.

The World Bank
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March 17, 1987

Professor John Strauss
Department of Economics
Yale University
New Haven, Connecticut 06520

Dear Professor Strauss:

If you have not already done so, I would very much appreciate your sending me your evaluation report for the research project on "Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies" (RPO 671-73) as soon as possible. Your report is badly needed to complete the evaluation for the project.

I look forward to receiving your report and would like to thank you in advance for it.

Yours sincerely,

Hernan Cortes
Deputy Research Administrator
Economics and Research Staff

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE: March 3, 1987

TO: Mr. Dennis de Tray, DRDDR

FROM: Deepak Lal, VPERS

EXTENSION: 33481

SUBJECT: Evaluation of Completed Research Project - RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

I am attaching for your information a memorandum from Mr. Donaldson of OEDD1, indicating that the above completed research project under your chairmanship will not be evaluated by OED.

Attachment

cc: Mrs. P.A. Plesch, VPERS

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE: February 26, 1987

TO: Mr. Deepak Lal, VPERS

FROM: Graham Donaldson, Chief, OEDD1

EXTENSION: 32893

SUBJECT: Evaluation of Completed Research Projects - RPO 673-08 "Agricultural Pricing Policies in Senegal"; RPO 673-27 "Sociological Aspects of Dairy Cooperative Development Projects"; and RPO 671-73 "Kenya: Health, Nutrition, Water Productivity and Child Development Studies".

1. This refers to your memos of February 25, 1987, to Messrs. Ablasser, Myren and Nawaz.

2. We regret to inform you that, because of staff constraints, we will be unable to undertake an evaluation of the above research projects.

cc: Messrs. Ablasser, Myren, Nawaz

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE February 25, 1987

TO Mr. Tawhid Nawaz, OED, Consultant

FROM Deepak Lal, VPERS

EXTENSION 33481

SUBJECT Evaluation of Completed Research Project - RPO 671-73
"Kenya: Health, Nutrition, Water Productivity and Child Development Studies"

1. With regard to the above completed research project which you have kindly agreed to evaluate (see memorandum from John Burrows dated November 14, 1986), let me say first of all that I fully appreciate the time and effort that you have to put into it. I would, however, like to stress that a great deal depends on the evaluation report which you have agreed to write for us. In view of the tight deadline that we face, I hope that you do not mind my asking you to let me have your evaluation report for the above project as soon as possible, and preferably no later than March 17, 1987.

2. I very much appreciate your help in the evaluation exercise.

cc: Mr. J. Burrows (OED)
Mr. D. de Tray (DRDDR)
Mrs. P.A. Plesch (VPERS)

The World Bank
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
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February 18, 1987

Professor John Strauss
Department of Economics
Yale University
New Haven, Connecticut 06520

Dear Professor Strauss:

If you have not already done so, I would very much appreciate your sending me your evaluation report for the research project on "Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies" (RPO 671-73) as soon as possible. Your report is badly needed to complete the evaluation for the project.

I look forward to receiving your report and would like to thank you in advance for it.

Yours sincerely,

Deepak Lal
Research Administrator
Economics and Research Staff

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE January 21, 1987

TO Mr. Avi Dor, DRDLS

FROM Hernan Cortes, VPERS

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project - RPO 671-73
Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies

1. I would like to thank you for your evaluation report for the above research project. I am sure that it will be of great help to the panel chairman in putting together an overall evaluation report for the project.

2. As explained in the Procedures for the Evaluation of Completed Research Projects, the project sponsors will have a chance to respond to the chairman's overall evaluation report (based on the reports of the internal, external and OED reviewers) before it is finalized. The chairman may need to contact you around that time if he has any further questions.

3. I very much appreciate your help in the evaluation exercise, and I certainly hope that you will be willing to help us again in the future.

cc: Mr. Dennis de Tray
Mr. D. Lal, Mrs. P.A. Plesch (VPERS)

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE: January 15, 1987

TO: Oey Astra Meesook, VPERS

FROM: Avi Dor, DRDLS A. Dor

EXTENSION: 33475

SUBJECT: **Evaluation of Completed RPO 671/73 - "Kenya Health Nutrition, Worker Productivity, and Child Development Studies"**

A. Objectives, strategy, results.

The authors of the proposal formulated their objectives clearly. The experience they had gained from a previous related RPO allowed them to be very specific about their intended work program. They promised to undertake The following four studies or groups of studies in rural Kenya.

Study 1. An evaluation of health and nutrition effects on the productivity of casual laborers in rural civil work.

Study 2. Evaluation of practical interventions to improve health and worker productivity of casual laborers in rural civil work. A series of studies of alternative feeding methods of workers; prevalence of parasitic diseases and relation to anemia; an evaluation of feasibility of routine parasitic control.

Study 3. Survey of health and nutrition factors from a sample of rural road workers in two ecological areas.

Study 4. An evaluation of the feasibility and effectiveness of a parasite control program targeted at children.

All of these studies did in fact take place. Studies 1-3 provide descriptive details, in some cases overlapping, regarding The health and nutrition of roadside workers. These include caloric intake (particularly study 1), weight for height frequencies, arm circumference measurements and hemoglobin levels (anemia). Similar information for children is given in study no. 4. Baseline statistics show that malnutrition, parasitic infection and anemia are prevalent. Additional results are summerized below.

Study 1. The declared purpose of this study was to analyze the effect of various intervention programs on worker productivity. Analysis by ordinary least squares (OLS) showed that a 1,000 calory supplementation increases productivity directly as well as indirectly via increases in arm circumference, muscle area etc. I am inclined to agree with the researcher (Mr. Chesher) that the calculated gain of about 13 per cent in productivity is an underestimate of the benefit from intervention. Underestimation may be attributed partly to a likely substitution away from home foods by workers in the sample, and partly to the empirical specification chosen by the researcher.

Study 2. The component of the study referred to as 2a identified several calory-rich food supplements based on local foods which were acceptable to the workers. The study also provided evidence that cost-recovery was possible.

Study 2b identified severe malnutrition and high levels of parasitic infection in the sample. Nearly half of the male workers had anemia by WHO standards (although only about 10 per cent had severe anemia). This was attributed to (a) low iron intake (b) high rates of parasitic infection. The study sought to identify the most effective way of providing iron in order to raise hemoglobin levels (various tablets, iron-rich snacks) over a 12 week period. Using analysis of variance techniques, it was concluded that two interventions were effective feasible and inexpensive. These were a high iron, high ascorbic acid meal or daily doses of ferrous sulphate tablets.

Study 2d (study 2c was integrated into study 3) The authors tested controls of various parasitic diseases and reported The most effective dosages. Using analysis of variance they identified hookworm as the parasitic infection most significantly associated with anemia. OLS regressions confirmed this result. The proscribed treatments resulted in improved hemoglobin counts.

Study 3. The study sought to gain information of health and nutritional status of 880 roadside workers in four ecological zones. A descriptive analysis showed that while most indicators varied widely from region to region high parasitic infection rates were common to all.

Study 4. This study sought to evaluate a four year program for control of Ascariasis (roundworm) in children. "Deworming" produced a decline in prevalence of 43 percent among The 241 children that received uninterrupted treatment. Reinfection was associated with hygienic conditions within The household. Children with infected mothers and children from households with earth floors were more likely to be reinfected. This explains why a 11 percent prevalence remains despite treatment.

One of the stated purposes of the proposal was to to provide the Kenyan Ministry of Works with information which will help it evaluate the labor component of The Rural Access Road Program. The final report indicates that the researchers were in communication with MOW throughout the project and they received material support from MOW. Officials from The Ministry of Health and The Ministry of Finance were also kept abreast of progress being made. According to Mr. Berg`s evaluation dated 12.9.85, preliminary recommendations for nationwide feeding and deworming programs were made to The Government of Kenya.

Nutrition policy in developing countries is an area of great concern to The Bank and other development agencies. It is likely to become even more relevant in The future given The Bank`s renewed interest in poverty alleviation. In addition to raising humanitarian concerns, pervasive ill health and malnutrition among rural workers found in studies 1-3 have an adverse effect on productivity. Policy makers in different sectors ought to consider dietary interventions such as those undertaken in The above studies.

B. Design

Study 1, 2 and study 4 required analysis of combined longitudinal and cross-sectional data. Baseline samples were quite small to begin with and final samples were even smaller due to high dropout rates. Study 1, for instance, gave baseline statistics for 229 workers, but only 84 observations were available for the productivity analysis. Similar sample sizes appear in the pre-intervention and post intervention stages of study 2. Nevertheless the researchers were able to obtain meaningful results. Study 3 was based on cross-sectional data and was descriptive in nature.

With the exception of study 1 which relied on multivariate regression analysis statistical inference was based mainly on simple univariate and bivariate analysis of variance. In general, multivariate regressions are preferable since they control for spurious correlations if properly specified. However, this was not always feasible given the small samples. I should note that analysis of variance is standard in the field.

Studies 1-3 were based on samples of casual daily laborers in rural areas. In retrospect it would have been better to select a more stable employment group with an anticipated low dropout rate.

Furthermore, casual laborers do not represent a random sample in rural areas. Health and nutrition levels found in these studies may not be true for the rest of the population and should be interpreted with caution.

On the other hand, results regarding the success or failure of various intervention measures are independent of "sample selection bias" and may be generalized to other groups in the population.

I am unable to comment on the scientific design of these studies. This includes the selection of control groups, the choice of experimental dosages, composition of food interventions, etc. although it is my impression that the highly qualified research team paid great attention to technical details. It might be usefull to secure comments about scientific design from a health professional (nutritionist, epidemiologist, etc.).

C. Organization

The research program followed a logical sequence. A significant amount of intermediate output was made available to project officers. The consultants constituted a multidisciplinary team suitable for the research tasks. Periodic reports were made on request and studies were carried out in a cost-effective manner. Bank staff in The Population, Health and Nutrition Department and Transportation, Water and Telecommunications Department provided the usual supervisory role, which was sufficient for meeting the objectives of the research proposal.

The researchers complied with requests made by Bank reviewers with regard to the design and implementation of studies. At a later stage the

researchers relied heavily on local laboratory facilities and received advice and assistance from officials from several Kenyan government ministries. Only field workers were recruiting locally. However, only study 4 included a locally based co-investigator.

D. Dissemination

The research outputs were written and presented in a manner which makes them accessible to their intended audiences. Periodic reports and seminar presentations were made to Bank staff and a final comprehensive report is available. Several publications were made in professional health journals.

C. Cost

Bank funding amounted to approximately $97,000. Matching funds were available from The British Overseas Development Ministry. These funds covered field work, intervention materials, examination of and blood and stool specimens, statistical analysis and reports. Remaining funds allowed The Bank to undertake a benefit-cost analysis.

cc: Dennis de Tray, DRDDR

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

Wls. Meesook

DATE November 14, 1986

TO Mr. Deepak Lal, Chairman, REPAC

FROM John Burrows, Research Evaluation Coordinator, OED

EXTENSION 32906

SUBJECT **Evaluation of Completed Research Projects FY87 - Round 1**

The following OED staff have been asked to review the six projects listed below:

No. 671-73	Kenya: Health, Nutrition, Water Productivity and Child Development Studies (Mr. Tawhid Nawaz, Consultant, Ext. 32892).
No. 672-58/91	An Evaluation of Industrial Location Policies for Urban Deconcentration (Ms. Carole Carr, Ext. 32179).
No. 672-59	Participant/Observer Evaluation of Urban Projects (Ms. Carole Carr, Ext. 32179).
No. 673-08	Agricultural Pricing Policies in Senegal (Mr. Gottfried Ablasser, Ext. 32891).
No. 673-27	Sociological Aspects of Dairy Cooperative Development Projects (Mr. Delbert Myren, Ext. 32889).

We do not wish to participate in the evaluation of the remaining nine projects:

No. 671-66	Research Support for the World Development Report
No. 673-40	Bank-UNCTAD Studies of NTB
No. 672-32	The Direction of Developing Countries' Trade: Patterns Trends and Implications
No. 673-32	Conf. International Debt and Developing Countries
No. 673-49	Macroeconomic Analysis of Foreign Aid
No. 672-42	Determinants of Fertility in Egypt
No. 673-70	Indicators and Pol. Instru. Med. Prog. Debt Restructure
No. 672-85	Liberalization With Stabilization in the Southern Cone
No. 673-23	Social-Accounting-Matrix-Based Computable General Equilibrium Model for Cameroon

I understand from Ms. Meesook that the review of project No. 672-60, Determinants of Fertility in Rural Bangladesh, has been deferred from FY86 to FY87. We hope to let you have our assessment of this project early in the new year.

Cleared with and cc: Mr. Chopra

cc: Messrs. Donaldson, Maiss, Shields
Ms. Carr, Messrs. Ablasser, Myren, Nawaz, van der Lugt
Ms. Meesook, VPERS

THE WORLD BANK/INTERNATION FINANCE CORPORATION

OFFICE MEMORANDUM

DATE November 6, 1986

TO Mr. Avi Dor, DRDLS

FROM Oey Astra Meesook, VPERS

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project - RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

1. I would like to thank you for agreeing to serve as a member of the evaluation panel for RPO 671-73 under the chairmanship of Mr. Dennis de Tray.

2. I am attaching (i) materials from the project files, of which the most relevant for the evaluation would be the research proposal and the completion report; (ii) outputs from the project; (iii) a copy of the Guidelines for the Evaluation of Completed Research Projects; and (iv) a copy of the Procedures for the Evaluation of Completed Research Projects.

3. It would be very helpful if you could let me have your evaluation report on the project by December 31, 1986. The project sponsors will have a chance to respond to the chairman's overall evaluation report for the project (based on the individual reports from the internal, external and OED reviewers) before it is finalized.

4. Your participation in the evaluation exercise is greatly appreciated. Please do not hesitate to contact me if I can be of any help (Ext. 33482, Room S-9133).

cc: Mr. D. Lal, Mrs. P.A. Plesch (VPERS)
Mr. Dennis de Tray

Attachments:

Guidelines for the Evaluation of Completed Research Projects
Procedures for the Evaluation of Completed Research Projects
Project file materials
Project outputs

The World Bank
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

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November 6, 1986

Professor John Strauss
Department of Economics
Yale University
New Haven, Connecticut 06520

Dear Professor Strauss:

I would like to thank you for agreeing to serve as an external reviewer for the completed research project on "Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies" (RPO 671-73) under the chairmanship of Mr. Dennis de Tray.

I am enclosing some materials from the project file, of which the most relevant for the evaluation would be the research proposal and the completion report, and the outputs of the project. If there is anything else you need for the evaluation, please let me know.

I am also enclosing a copy of the Guidelines for the Evaluation of Completed Research Projects to assist you in the evaluation. As I explained in my previous letter, reviewers from inside the Bank will be expected to focus on the usefulness and relevance of the research project to Bank policies and operations, as well as the issue of the Bank's regional departments' support to, and participation in, the projects. Your comments would be most helpful if they could provide an evaluation of the quality of the research outputs. Specifically, they should address the questions under headings A. (Objectives, Strategy and Results), B. (Design) and D. (Dissemination) insofar as they pertain to the development community in general. However, please feel free to comment on any other issues that you think are relevant for evaluating this study.

I would appreciate receiving your report on this project by January 31, 1986. The Bank will pay you a modest honorarium for this assignment. We recognize that this in no way represents an adequate remuneration of your time spent on this review, but it is meant to reflect our appreciation to you for making your professional services available to the Bank. The Personnel Department will be writing to you to confirm these arrangements. If you have not already done so, please kindly send us an up-to-date copy of your curriculum vitae which is required for administrative purposes in connection with your fee payment.

I look forward to receiving your report and would like to thank you in advance for your assistance in evaluating this project.

Yours sincerely,

Oey Astra Meesook

Oey Astra Meesook
Deputy Research Administrator
Economics and Research Staff

cc: Mr. Dennis de Tray

Attachments:

Guidelines for the Evaluation of Completed Research Projects
Project file materials
Project outputs

FC NO. 80
-84)

THE WORLD BANK/IFC
MESSAGES

DATE 11/05

TIME

TO Dey.

FROM Dennis de Tray

DEPT./OFFICE

PHONE EXTENSION 3480

- [x] CALLED
- [ ] CAME TO SEE YOU
- [ ] RETURNED YOUR CALL
- [x] CALL BACK
- [ ] WILL CALL AGAIN
- [ ] REQUESTS APPOINTMENT
- [ ] URGENT

P.S. —

REMARKS

671-73 (F487) reviewers: —
Internal: Avi Dor, DRDLS
External: John Strauss, Yale
They've already agreed. Please
send stuff when you have a minute.
Thanks — D.

RECEIVED BY

OFFICE MEMORANDUM

DATE October 20, 1986

TO Mr. Dennis de Tray, DRDDR

FROM Oey Astra Meesook, VPERS

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project, RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

Please include the attached additional project outputs for the above completed research project with the materials I sent you on September 11th for the evaluation of the project.

Attachments

cc (w/attachments): Mr. John Burrows, OED

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE September 11 1986

TO Mr. Alan Berg, PHNDR

FROM Oey Astra Meesook, VPERS

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project - RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

1. The above completed research project be evaluated under the chairmanship of Mr. Dennis de Tray with an internal and an external reviewer, as well as a representative from OED. I attach for your information the Guidelines for the Evaluation of Completed Research Projects and the Procedures for the Evaluation of Completed Research Projects; these will be distributed to the chairman and the reviewers.

2. The Research Administrator's Office will provide the reviewers with relevant materials from the project files, at a minimum the research proposal, the report of the panel reviewing the proposal or the referees' reports, and the completion report, along with the outputs of the project.

3. After the reviewers' reports have been received, the panel chairman will put together the evaluation report for the project. You will have a chance to respond to the chairman's report before it is finalized. You may also request a meeting with the chairman to discuss the evaluation. If you are still not satisfied after meeting with the panel chairman, you may request a meeting with REPAC as a group.

4. I would be glad to answer any questions or discuss any aspect of the evaluation of the project with you. Please call (Ext. 33482) or drop by my office (S-9133).

cc: Mr. Dennis de Tray
Mr. D. Lal, Mrs. P.A. Plesch (VPERS)

Attachments:
Guidelines for the Evaluation of Completed Research Projects
Procedures for the Evaluation of Completed Research Projects

OFFICE MEMORANDUM

DATE September 11, 1986

TO Mr. Dennis de Tray, DRDDR

FROM Oey Astra Meesook, VPERS

EXTENSION 33482

SUBJECT Evaluation of Completed Research Projects, RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

1. For the evaluation of the above project, I am attaching (i) materials from the project file; (ii) the outputs of the research project; (iii) a copy of the Guidelines for the Evaluation of Completed Research Projects; (iv) a copy of the Procedures for the Evaluation of Completed Research Projects; and (v) a copy of the write-up of this project from the Abstracts of Current Studies.

2. I would appreciate your appointing internal and external reviewers for this project and letting me know by September 19th so that we can get the evaluation process under way.

Attachments:

Guidelines for the Evaluation of Completed Research Projects
Procedures for the Evaluation of Completed Research Projects
Project file materials
Project outputs
Project abstract

RPO 671-73

"Kenya: Research on Health, Nutrition and Worker Productivity Study"

Project Outputs

1. Final Report. "Kenya: Health, Nutrition and Worker Productivity Studies. (1) Nutritional and Health Status of Workers on the Rural Access Roads and (2) Control of Ascariasis in Children" by Michael C. Latham and Lani S. Stephenson, January 1981.

2. "Dietary and Health Interventions to Improve Worker Productivity in Kenya" by Michael C. Latham, January 1983.

3. "Parasitic Infections, Anaemia and Nutritional Status: A Study of Their Interrelationships and the EFfect of Prophylaxis and Treatment on Workers in Kwale District, Kenya" by M.C. Latham, L.S. Stephenson, Andrew Hall, J.C. Wolgemuth, T.C. Elliot and D.W.T. Crompton, 1983.

4. "Evaluation of a Four Year Project to Control Ascaris Infection in Children in Two Kenyan Villages" by Lani S. Stephenson, D.W.T. Crompton, Michael C. Latham, Susan E. Arnold and A.A.J. Jansen, June 1983.

5. "Intestinal Parasitic Infections of Men in Four Regions of Rural Kenya" by Andrew Hall, M.C. Latham, D.W.T. Crompton, L.S. Stephenson and J.C. Wolgemuth, 1982.

6. "A Comparative Study of the Nutritional Status, Parasitic Infections and Health of Male Roadworkers in Four Areas of Kenya" by M.C. Latham, L.S. Stephenson, Andrew Hall, J.C. Wolgemuth, T.C. Elliot and D.W.T. Crompton, 1982.

OFFICE MEMORANDUM

DATE September 5, 1986

TO Mr. John Holsen, ASNVP

FROM Oey Astra Meesook, VPERS O.A.M.

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project - RPO 671-91
"International Comparison Project (Kravis Project)"

REPAC would like to complete the evaluation of the above research project in time for the results to be included in the Report on the World Bank Research Program. This means that the chairman's overall evaluation report would have to be available by September 30. Thus I would appreciate it if you could submit your evaluation report by September 19. Please let me know if you anticipate having any difficulty in meeting this deadline.

cc: G. Pfeffermann, LCNVP
D. Lal, P. Plesch, VPERS

RPO 671-73

"Kenya: Research on Health, Nutrition and Worker Productivity Study"

Project File Materials

1. Completion Report dated December 1985, prepared by Alan Berg.

2. Memorandum from Samir Basta to Clell Harral dated March 17, 1981.

3. Memorandum from C.C. Harral and S.S. Basta to Mr. Armeane Choksi dated March 6, 1978.

4. Memorandum from I.M.D. Little To C. Willoughby dated February 23, 1978.

5. Memorandum from Clell G. Harral and Samir Basta to Mr. Armeane Choksi dated February 9, 1978.

6. Project Proposal dated November 16, 1977 (revised February 9, 1978).

7. Document dated November 16, 1977, "Kenya: Health, Nutrition and Worker Productivity Studies: Proposal to the World Bank Research Committee".

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE July 28, 1986

TO Mr. Alan Berg, PHNDR

FROM Oey Astra Meesook, VPERS O.A.M.

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project - RPO 671-73
Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies

I would like to thank you for providing us with the outputs for the above completed research project. We shall be contacting you concerning the evaluation process as soon as the review panel has been set up.

cc: Mr. Lal, Mrs. Plesch, VPERS

THE WORLD BANK/INTERNATIONA NANCE CORPORATION

OFFICE MEMORANDUM

A. Berg PHNDR

To: Oey Astra Meesook, VPERS

From: Lisa Collis

Date: July 14, 1986

Extension: 60160

Subject: Evaluation of Completed Research Project - RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

Attached are five copies of the Final Report of the above study.

ann:
send thank you memo

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE April 29, 1986

TO Mr. A. Berg, PHNDR

FROM Oey Astra Meesook, VPERS

EXTENSION 33482

SUBJECT Evaluation of Completed Research Project - RPO 671-73
"Kenya: Health, Nutrition, Worker Productivity, and Child Development Studies"

1. In order to initiate the evaluation process of the above completed research project, I would appreciate receiving five complete sets of the project outputs as quickly as possible.

2. Once the evaluation panel is set up, the outputs will be distributed to the panel members. In this regard, it will be of mutual benefit to you and the reviewers if you would indicate in a note to me the priority which should be given to each of the outputs in the evaluation. For example, if the research output consists of a number of discussion papers and Staff Working Papers which have also been put together into a book, the reviewers would appreciate knowing this so that they can concentrate on the book and ignore the intermediate papers.

3. Once we have received the project outputs, I will be contacting you concerning the evaluation process. If you have any questions, please feel free to contact me.

cc: Mr. Lal, Mrs. Plesch, Ms. Mataac, VPERS

FORM NO. 1889
(10-85)

WORLD B. : RESEARCH PROGRAM

COMPLETION REPORT

I. PROJECT IDENTIFICATION

PROJECT'S CLOSING DATE:	1/85
DATE OF SUBMISSION OF COMPLETION REPORT:	12/85

1. TITLE: 1) Kenya: Health, Nutrition and Worker Productivity Study; and 2) Benefit-Cost Analysis of Nutritional Interventions for Anemia Reduction

PREPARED BY: Alan Berg, PHNDR

2. PROJECT NUMBER:	3. DEPARTMENT:	4. DIVISION:
RPO 671-73	Transportation, Water and Telecommunications/ Population, Health & Nutrition	

5. STAFF PARTICIPATION:
(a) Principal Supervisors:* C. Harral (through 1981); A. Berg
(b) Others Responsible: S. Basta (through 1981)
(c) Administrative/Budgeting Officer: Lac Khanh Truong (since 1983)

6. DEPARTMENTAL APPROVAL

DIVISION CHIEF'S NAME *(Please type)*: Nancy Birdsall	SIGNATURE:	DATE: 12/9/85
DEPARTMENT DIRECTOR'S NAME *(Please type)*: J. North	SIGNATURE:	DATE: 12.13.85

II. OUTPUT AND DISSEMINATION

1. REPORTS – Publications and reports from project (specify author(s), title, date):**

Latham, Michael C. and Lani S. Stephenson, Kenya: Health, Nutrition and Worker Productivity Studies. Final Report for the World Bank. January 1981*

Levin, Henry M. A Benefit-Cost Analysis of Nutritional Interventions for Anemia Reduction. Final Report for the World Bank. January 1985.*1

East African Medical Journal. "Nutrition and Worker Productivity" (editorial). September 1979.

Brook, R.M., M.C. Latham and D.W.T. Crompton. "The Relationship of Nutrition and Health to Worker Productivity in Kenya." Ibid.

Hall, Andrew, M.C. Latham et al. "Intestinal Parasitic Infections of Men in Four Regions of Rural Kenya." Transactions of the Royal Society of Tropical Medicine and Hygiene. 76(6). 1982.

Latham, M.C., L.S. Stephenson et al. "A Comparative Study of the Nutritional Status, Parasitic Infections and Health of Male Road Workers in Four Areas of Kenya." Ibid.

Latham, M.C., L.S. Stephenson et al. "Nutritional Status, Parasitic Infections and Health of Road Workers in Four Areas of Kenya: Part 1, Kwale District - Coastal Lowlands." East African Medical Journal. January 1983.

(Continued)

2. DISSEMINATION – Seminars, Conferences, Training Sessions (topic, date, location and participation):

Seminar on Health, Nutrition and Worker Productivity Studies in Kenya. Michael Latham and Lani Stephenson. Given at the World Bank. May 14-15, 1981. Participation of relevant Bank staff and guests.

(Continued)

* If changed indicate dates.

** Indicate with asterisk the report(s) to be circulated to the Evaluation Panel and provide this office (S-9135) with 10 copies or indicate how they can be obtained.

1. Reports (continued)

Latham, M.C., L.S. Stephenson et al. "Nutritional Status, Parasitic Infections and Health of Road Workers in Four Areas of Kenya. Part III: Kisumu District - Lake Victoria Basin." East African Medical Journal. 60:221-227. 1983.

Latham, M.C., L.S. Stephenson and A. Hall. "Nutritional Status, Parasitic Infections and Health of Road Workers in Four Areas of Kenya. Part IV: West Pokot District - The Semi-Arid Highlands." East African Medical Journal. 60:282-289. 1983.

Latham, M.C., L.S. Stephenson et al. "Parasitic Infections, Anaemia and Nutritional Status: A Study of Their Interrelationships and the Effect of Prophylaxis and Treatment on Workers in Kwale District, Kenya.: Transactions of the Royal Society of Tropical Medicine and Hygiene. 77(1). 1983.

Stephenson, L.S., D.W.T. Crompton et al. "Evaluation of a Four Year Project to Control Ascaris Infection in Children in Two Kenyan Villages." Journal of Tropical Pediatrics. 29:175-184. 1983.

Stephenson, L.S., M.C. Latham and A.A.J. Jansen. A Comparison of Growth Standards: Similarities between NCHS, Harvard, Denver and Privileged African Children and Differences with Kenyan Rural Children. Cornell International Nutrition Monograph Series, No. 12. Ithaca, New York. 1983.

2. Dissemination (continued)

Latham, M.C.; L.S. Stephenson; A. Hall; J.C. Wolgemuth; T.C. Elliott and D.W.T. Crompton. "Interrelationships between Parasitic Infections, Anemia and Nutritional Status in Kenyan Workers." International Congress of Tropical Medicine and Malaria. Calgary, Canada. 1984.

Seminar on Benefit-Cost Analysis of Nutritional Interventions for Anemia Reduction. Henry Levin. Given at the World Bank. November 8, 1985, Participation of relevant Bank staff and guests.

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1. Journal articles by Levin are currently in preparation and will be submitted to pertinent journals in the development field.

III. FUNDING ('000)

FISCAL YEAR	ORIGINAL REQUEST (1)	REPAC AUTHORIZATIONS			BANK		OUTSIDE AMOUNT (7)	TOTAL (4)+(6)+(7)
		Initial (2)	Supplementary (3)	Total (4)=(2)+(3)	Department (5)	Amount (6)		
FY 78		25.8		25.8				25.8
FY 79		29.5		29.5				29.5
FY 80		42.0		42.0				42.0
FY								
FY								
FY								
FY								
TOTAL		97.3		97.3				97.3

IV. FINANCIAL EXPENDITURES ('000) AND STAFF TIME

FISCAL YEAR	ACTUAL EXPENDITURES			STAFF TIME						TOTAL COSTS (3+5+7+9)***
				Professional		Consultant*		Assistant		
	RPO (1)	Other (2)	Total (3)	Years** (4)	Costs*** (5)	Years** (6)	Costs*** (7)	Years** (8)	Costs*** (9)	
FY 78	24.5		24.5							
FY 79	21.1		21.1	.09						
FY 80	25.9		25.9	.03						
FY 81	10.4		10.4	.04						
FY 82	3.5		3.5	.03						
FY 83	5.0		5.0	.01						
FY 84 85	1.6 5.1		1.6 5.1							
TOTAL	97.1		97.1	.20						97.1

APPROVED BY RESEARCH ADMINISTRATOR *(print name)*:	SIGNATU	DATE:
		12-19-85

*Consultants paid for by departmental budgets ONLY.
**Staffyears (staff weeks ÷ 52) should be entered here.
***For REPAC use ONLY.

Narratives in the following sections summarize the results of the project in relation to its objectives and describe the design, organization, and dissemination strategy adopted. The categories and topics are intended to correspond closely to those of the "Guidelines for Evaluation of Completed Research Projects." Using additional space as necessary, the principal supervisor should give particular attention to the points listed.

V. OBJECTIVES, STRATEGY, AND RESULTS

1. What general questions did the study seek to answer? What answers did it find? How significant are these answers for a) Development policy in general? b) Bank operations?
2. To what extent did the study fulfill its objectives? Did the objectives change as the study was undertaken? If yes, why?
3. Who are the intended beneficiaries? (Bank staff; planning authorities and decision makers in developing countries; other researchers; general development community).
4. Has the project assisted in developing research or other analytical capacity in the countries under study?
5. Were efforts made to coordinate work with other studies underway in the Bank or outside, to enhance the comparability of results or avoid duplication?

1. Previous research supported by the Bank (RPO 671-15) indicated that undernutrition and anemia were common among road workers in Kenya, and that these deficiencies were related to work output. A separate study demonstrated, for the first time in a major field study, that roundworm infections retard the growth of children.

Work under the current project evaluated a number of possible interventions to address these problems. Four field studies and a benefit-cost analysis were conducted.

The first study sought to investigate the relationship between certain health and nutrition factors and worker productivity in road construction. It found that a supplementation program that can more than compensate for the high energy cost of road work can be beneficial in increasing productivity and in improving the nutritional status of road workers.

The second study sought to evaluate practical interventions. Among other findings, it showed that provision of mid-work day feeding was both feasible and popular, and that workers were willing to pay at least part of the cost of a feeding scheme. A supplement rich in iron and ascorbic acid was associated with a highly significant rise in hemoglobin levels, representing a reduction in the severity of anemia.

The third study sought to provide data for making recommendations for interventions appropriate to different ecological zones. Health and nutrition status of workers in varying zones was compared. Based on the findings, recommendations were made for worker feeding and for control of intestinal parasitic infections in each zone.

The fourth study sought to evaluate the control of Ascariasis (roundworm) in children through drugs. Antihelminthics administered every 4 months were associated with a significant reduction in prevalence (from 30% to 10%) and intensity of infections, but it appeared difficult to reduce prevalence rates much below 10 percent with administration of that frequency.

Based on these findings, preliminary recommendations for nationwide worker feeding and deworming programs were made to the Government of Kenya.

In an effort to analyze the economic implications of reductions in anemia, the fifth component of this project consisted of a benefit-cost

analysis of iron supplementation and fortification. This analysis revealed a marginal cost of $1.10 per person per year for iron supplementation with folate, delivered in the community or workplace. Adding ascorbic acid to increase absorption raised the cost to $3.00. When based on mounting a delivery system to be shared by 4 services, the same costs were $1.89-$3.17 without ascorbic acid and $3.79-$5.07 with it. Benefit-cost ratios for fortification under various scenarios ranged between 7 and 70, while those for supplementation ranged between 4 and 38.

1.a) The answers these studies found are significant for development policy in several ways: They give evidence that feeding programs can have positive effects in both productivity and nutrition status; that such programs are feasible and show promise for some cost-recovery; that the advisability of interventions varies across ecological zones; that roundworm infection is amenable to control through periodic drug administration; and that iron supplementation and fortification programs can be good investments.

Overall, the studies underscore the significant economic constraints that health and nutrition factors can represent, especially in certain seasons and for certain segments of the population. It experimented with practical ways of handling those constraints.

1.b) The Bank has been engaged in studies to assess the feasibility of labor substitution for equipment in certain aspects of civil construction. The Rural Access Roads Program of the Kenyan Ministry of Works, supported in part by IBRD, is one example. A major objective of the program was to utilize labor effectively and in preference to mechanical or motorized techniques, wherever feasible. The Bank, Ministry of Works and Ministry of Finance and Planning wished to identify those nutritional and health factors that may limit the productivity of road workers in Kenya. These studies did so and were successful in identifying viable interventions to enhance productivity.

Levin's benefit-cost analysis gave evidence that both iron supplementation and fortification — but particularly fortification — are sound investments. These findings have implications for Bank programs in population, health and nutrition as well as those in rural works. While Latham's findings show significant benefits from "medicine" delivery (treatment and control) within the health system, Levin's analysis indicates that it may be timely to intensify exploration and initiation of large-scale iron fortification programs, regarded by many as a more promising long-term solution.

While the Bank can chose to allocate resources to several interventions affecting iron status — e.g., food subsidies, improving health services delivery performance on deworming and iron tablets, nutrition education, etc. — fortification initiatives in selected countries may merit special attention at this time. Besides its high benefit-cost ratio,

fortification has the advantage of working through the food market, rather than the heavily-burdened health system. Large-scale implementation of such a strategy can be complicated and will require intersectoral and institutional development as well as additional field trials.

2. The objectives, as outlined above, were met as specified in the project proposal.

3. The intended beneficiaries are: .) Bank staff, for design of future projects in health/nutrition, rural works, agricultural development and related areas; .) policymakers and planners in developing countries faced with the dual concern of enhancing productivity and well-being and making sound allocations of resources; .) other donors with similar concerns such as the Ministry of Overseas Development of the UK, which co-financed the project; and .) nutrition, health and productivity researchers working in these areas.

4. The project has assisted in developing research capacity in Kenya by involving the collaboration of 28 Kenyan fieldworkers; the Director of Nutrition of the Medical Research Unit in Nairobi; the Head of Paediatrics of the Ministry of Health; and Kenyan consultants and key personnel from the Ministry of Works.

5. At the time of the studies, inadequate research existed on the relationship between nutrition/health status and productivity. Very few definitive studies had examined health/nutrition interventions as a way of enhancing productivity. While the relationship between calorie intake and work output was well documented, relatively few studies had demonstrated that increased calorie intake can result in increased work output or productivity. The project proposal showed a knowledge of the supporting evidence, as well as the lacunae in the literature. The work built on preceding research conducted by the principal investigators for the Bank and drew on the resources of Cornell University in the US and Cambridge and Birmingham Universities in the UK. The principal investigators had ongoing exchanges with other leading researchers in this field. Dissemination of results to Bank staff and others listed in 3 (above) similarly contributed to avoiding duplication.

VI. DESIGN

1. Was a specific methodology essential for the success of this project? If so, were theoretical approaches and the methodology employed in the study appropriate to its stated purposes? Were difficulties encountered in applying the methodology? If so, how were they overcome?
2. Did the project make the best and careful use of available data? Did it involve collecting primary data e.g. through surveys. If so, were such surveys properly designed and carried out, and their results adequately incorporated in the research?

1. Study 1. Study design consisted of a pretest (baseline survey of health and nutrition status), administration of two different dietary interventions during an 8-month period, and a post-test with the same examinations. This methodology allowed for an analysis of the relative effects of the 2 interventions on the variables measured, and a determination of the different effects of the two interventions. In practice some difficulties arose and were addressed by shortening the testing period (because of the high turnover rate among workers) and offering monetary incentives for completion of the regime. Labor productivity measurement proved challenging tb measure. Difficulties arose in uneven numbers of observations per subject and fewer subjects than was desirable had productivity measurements made on them.

Study 2. The salient part of this study design were the strict criteria set up for the selection of the meals. Meals had to be: made from easily obtainable, relatively non-seasonal local foods; nutritious; acceptable to the vast majority of workers; and inexpensive. In addition, an independent producer was tapped to prepare a meal to sell on a profit basis to the workers. These design considerations enhanced the feasibility of the interventions.

Study 3. This was a cross-sectional study in which workers were examined once. This examination, similar to the baseline one given in Study 1, helped indicate whether the types of interventions being suggested for the other regions of Kenya were appropriate or necessary in 2 new regions or areas similar to them.

Study 4. The study took advantage of baseline data on prevalence of worm infestations collected in previous work. A series of 12 doses of a safe, relatively low-cost antihelminthic was administered to all children in the target group. Stool specimens were periodically collected and examined and prevalence rates compared against the baseline. The methodology was based on 2 assumptions, both generally consistent with the literature: .) A single dose of the antihelminthic (levamisole) is 100 percent effective at the time of dosage; .) The first dose of levamisole does not affect the efficacy of doses given later.

Benefit-cost analysis. The analysis followed methodology consistent with the state of the art. Where hard data on costs and benefits were lacking, the investigator made conservative estimates. The effect of this may have been to overestimate the costs of the interventions and lower the benefit-cost ratio.

2. The investigators took full advantage of available data, as indicated above. Primary data was also collected through physical examination, anthropometry, stool analysis and related tests. The field team, consisting of specialists in medicine, nutrition, parasitology and statistics, possessed the requisite skills for designing and carrying out surveys, as well as incorporating their results into the research.

VII. ORGANIZATION

1. Did the research tasks follow a logical sequence? Were there opportunities to review progress at intermediate stages?
2. How effective were the consultants or consulting firms employed? How open were the channels of communication between Bank staff and consultants?
3. Was the extent of Bank staff involvement in design, implementation, and supervision adequate to meet the study's objectives?
4. What was the nature and extent of awareness, support, or participation among:
   --Bank operating departments, including regional departments?
   --Local research institutes?
   --Government agencies?
5. Main reasons for overruns or savings in cost and time.

1. Research tasks followed a logical sequence. Periodic reports were submitted to project officers, and all costs were fully accounted for.

2. The consultants employed were specialists knowledgeable in their fields. The principal investigator was very experienced in East Africa and known to Kenyan officials and research groups. He had also previously conducted work for the Bank and was familiar with Bank research requirements. The consultants communicated and consulted regularly with Bank project officers and complied with requests for special reports and other monitoring needs of project supervision.

3. The extent of Bank staff involvement was adequate to meet the study's objectives. Periodic Research Program Status Reports were filed and Bank staff remained in close communication with the field team. They reviewed research methodologies and data, approved study protocols, and collaborated in data analysis, among other forms of technical assistance. Project officers for the Kenyan studies consisted of a nutrition specialist as well as a transportation specialist. The Senior Nutrition Adviser oversaw the benefit-cost analysis. Other Bank specialists in nutrition and research were also called upon. Comments and suggestions raised by reviewers were addressed fully by the researchers. Bank staff also responded to outside requests for information on the research.

4. Involved in this project were Bank staff from the departments of Transportation, Water and Telecommunications; Population, Health and Nutrition; Agriculture and Rural Development; and Development Economics. Local research institutes included the Medical Research Center (Nairobi), the Institute for Development Studies of the University of Nairobi, and the Central Bureau of Statistics. A Kenyan economist served as a consultant to the project. Among the government agencies involved were the Ministry of Health, the Ministry of Transport and Communication (implementing agency for the Rural Access Roads Program), and the Ministry of Economic Planning and Development.

5. Savings in cost under the 4 Kenya studies enabled the Bank to undertake the benefit-cost analysis. The savings resulted from unexpended allocations for consultants and from unused travel and subsistence funds for Bank staff.

VIII. DISSEMINATION

1. Did the research project yield any publishable output for the World Bank Economic Review?
2. By what other means have findings been communicated to the intended beneficiaries?

1. The journal articles now under development on the benefit-cost analysis should be appropriate for the WBER. The findings of the other studies might also be appropriate, but have been in publication since 1981.

2. As outlined in Section II of this report.

THE WORLD BANK/INTERNATIONAL ANCE CORPORATION

OFFICE MEMORANDUM

DATE November 12, 1985

TO L. Truong, PHN

FROM V. Mataac, VPERS

EXTENSION 33487

SUBJECT Research Projects with Outstanding Completion Reports

According to the procedures in the "Guidelines for the Financial Administration of RSB-Funded Research Projects", the research supervisors are required to fill out Form No. 1889 called the "Completion Report". This must be submitted to this office no later than the mandatory closing date of the project.

The following are closed projects whose completion reports are outstanding:

Project Number	Principal Supervisor	Closing Date
671-49	D. Jamison	09/30/84
671-73	A. Berg	06/30/85
671-78	D. Jamison	09/30/84
672-03	K. Zachariah	06/30/84
672-09	D. Jamison	09/30/84
672-10	D. Jamison	09/30/84
673-58	N. Birdsall	06/30/85.

Please remind the sponsors to submit their reports as soon as possible. We would appreciate their returning the forms by December 6, c.o.b.

Thank you.

Attachments

cc: P. A. Plesch, VPERS

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

671-73

Please file in closed RPOs

DATE November 12, 1985

TO Mrs. Pilar San Jose, ACTBC
Mr. S. Panickaveetil, PBDBP

FROM Ms. Vilma Mataac, VPERS

EXTENSION 33487

SUBJECT Closure of Accounts of RSB-Funded Projects

I am sending to your respective offices a list of research projects which have been closed by REPAC along with two dates:

1) the date of the closing of the project after which no new commitments can be made against the project;

2) the date of the closing of the project's account after which no disbursements would be authorized.

The list contains projects whose accounts (or master organization codes) should be closed accordingly.

Attachment

cc: Messrs./Mmes. P. A. Plesch (VPERS), M. Tonson (PBDBP), W. Casson, Y. Rodrigo (ACTBC)

Project Code	Project Short Title	Principal Supervisor	Resp. Dept.	Project Closed by REPAC	Account to be Closed on
67292	BOOK MOD TAX THEORY IN DEVELOPING COUNTRIES	P. MITRA	DRD	28-Feb-85	31-Aug-85
67328	REVIEW OF MACRO-MODELLING	A. GELB	DRD	28-Feb-85	31-Aug-85
67166	W.D.R. RESEARCH SUPPORT	P. MIOVIC	EPD	31-Mar-85	30-Sep-85
67263	STANDARD ENERGY DEMAND MODEL	P. POLLAK	ASA	31-Mar-85	30-Sep-85
67315	SUPPLY RESPONSE AGGREGATE CROPS OUTPUT	R. DUNCAN	AGR	31-Mar-85	30-Sep-85
67232	TRADE AMONG DEVELOPING COUNTRIES	P. MIOVIC	EPD	30-Apr-85	31-Oct-85
67207	DETRMNTS RLWY TRFC FREIGHT MDL CHOICE	P. TABORGA	TRP	30-May-85	30-Nov-85
67026	SUBST LABOR AND EQUIP ROAD CONSTR	C. HARRAL	TRP	30-Jun-85	31-Dec-85
67155	RET OF LIT AND NUM SKILLS AMONG SCH LVRS	J. SOCKNAT	EMP	30-Jun-85	31-Dec-85
67168	KEY INST. AND EXPAN. OF MANUFAC. EXPORTS	D. KEESING	ASP	30-Jun-85	31-Dec-85
67173	HEALTH NUTRITION AND WORKER PROD.	A. BERG	PHN	30-Jun-85	31-Dec-85
67189	IMPACT AGR DEV EMP & POVTY-PHASE II	C. BELL	DRD	30-Jun-85	31-Dec-85
67202	SUPPLY MODELS FOR PERENNIALS	M. HARTLEY	DRD	30-Jun-85	31-Dec-85
67229	IMPACT OF T&V EXTENSION	G. FEDER	AGR	30-Jun-85	31-Dec-85
67233	AGRICULTURAL TRADE PATTERNS - TUNISIA	M. BALE	CPD	30-Jun-85	31-Dec-85
67245	DIVERSIFIED SECONDARY CURRICULUM	G. PSACHAROPOULOS	EDT	30-Jun-85	31-Dec-85
67249	DEV PATHS FOR OIL EXPORTERS	A. GELB	DRD	30-Jun-85	31-Dec-85
67259	EVALUATION OF URBAN PROJECTS	G. INGRAM	PPD	30-Jun-85	31-Dec-85
67260	DETERMINANTS OF FERTILITY - BANGLADESH	K. ZACHARIAH	PHN	30-Jun-85	31-Dec-85
67272	HEALTH AND SCHOOLING IN MALI	N. BIRDSALL	PHN	30-Jun-85	31-Dec-85
67282	AGRICULTURAL HOUSEHOLD MODELS	I. SINGH	CPD	30-Jun-85	31-Dec-85
67284	IRRIGATION MATAR TALUKA, INDIA	K. SIGRIST	AGR	30-Jun-85	31-Dec-85
67286	PROD CHANGE INFANT INDUSTRY	M. NISHIMIZU	IND	30-Jun-85	31-Dec-85
67294	RESEARCH PREP: SMALL SCALE CEMENT	J. DUVIGNEAU	IND	30-Jun-85	31-Dec-85
67303	INDIA STUDY INDUSTRIAL INCENTIVE	C. ROBLESS	ASA	30-Jun-85	31-Dec-85
67318	EXP INSTAB AND GROWTH IN SUB-SAH AFRICA	A. NOMAN	WAN	30-Jun-85	31-Dec-85
67323	SAM MODEL - CAMEROON	D. WHITE	WA2	30-Jun-85	31-Dec-85
67325	PRICING IN LARGE SCALE MANUFACTURING	M. NISHIMIZU	IND	30-Jun-85	31-Dec-85
67327	SOCIO ASPECTS OF DIARY COOP. DEVEL. PROJ.	R. SLADE	ASP	30-Jun-85	31-Dec-85
67329	CONTRIB. OF URB. INFRA. TO INDUS. PRDTVTY	D. ANDERSON	WAP	30-Jun-85	31-Dec-85
67358	COST RECOVERY HEALTH FP IN GAMBIA	N. BIRDSALL	PHN	30-Jun-85	31-Dec-85

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE June 20, 1984

TO Mr. A. Berg, PHN

FROM for Phi Anh Plesch, VPERS

EXTENSION 69013

SUBJECT Extension of Research Project "Kenya - Health, Nutrition and Worker Productivity" (RPO 671-73)

In reference to your memo dated June 12, 1984 addressed to Mr. Lal, this is to inform you that your request to delay the completion date of the above project has been granted. The revised closing date for this project is June 30, 1985.

Please note that a completion report must be filed with this office before June 30, 1985, i.e. the closing date for the project.

cc. and cleared with: Mr. Lal
cc: Messrs. J. North, J. Warford, Mmes. A. Fullerton, L. Truong, PHN
Mrs. M. General, VPERS

PAP:lt

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

DATE June 12, 1984

TO Mr. Deepak Lal, Chairman, REPAC

FROM Alan Berg, PHN

EXTENSION 6-1576

SUBJECT Extension of Research Project #671-73

The major part of this research project has been completed on schedule. A final small portion, dealing with the Economics of Iron-Deficiency Anemia, is behind schedule (in part due to hospitalization of the researcher). Accordingly, we would appreciate an extension of one year for this work.

Cleared with and cc: Ms. Truong
cc: Messrs. Warford (PHN), Selowsky (OPSVP)
Mss. Plesch (VPERS), Fullerton (PHN)

ABerg:am

671-73

THE WORLD BANK/INTERNATIONAL ANCE CORPORATION

OFFICE MEMORANDUM

DATE May 17, 1984

TO Mr. J. North, Director, PHN

FROM For Marcelo Selowsky, Acting Chairman, REPAC TAP

EXTENSION 76153

SUBJECT REPAC's Actions on Research Projects Which Have Extended Beyond Their Authorized Duration

1. The Research Projects Approval Committee (REPAC) is in the process of implementing Rule J of its Rules and Procedures which have been circulated Bankwide on April 9, 1984. Under that rule, REPAC will automatically close the account of any research project which is six months behind the authorized completion date, unless its sponsor(s) on the basis of proper justification obtain a time extension from REPAC. A grandfather clause will apply for projects approved prior to April 9, 1984, under which project books will be closed one year after their authorized completion date.

2. "Authorized completion date" is defined as:

(i) the date shown on the original research proposal; or

(ii) the revised date as shown on the most recent supplementary request where applicable, or if not shown, the last day of the final fiscal year for which funds were allocated; or

(iii) the date as amended and explicitly authorized by the office of the Research Adviser acting on specific requests from individual research supervisors.

3. Attached is the list of research projects for which your department is responsible and the accounts of which, under rule J, will be closed by REPAC on June 30, 1984, unless, as specified above, individual sponsors request and obtain a time extension from REPAC. As a matter of procedure, a completion report must be filed with the secretariat of REPAC prior to or upon the mandatory closing date of the project. Please note that REPAC will not entertain new proposals from departments with overdue completion reports.

4. The closing of a research project's account means that no expenditures can be charged to the project code, nor commitments disbursed from the project account. Any outstanding positive remainder of total authorizations as of June 30, 1984 will be transferred back to the External Research Budget. As for projects which have overspent

their total authorizations as of June 30, 1984, the responsible department will be required on July 30, 1984 to reimburse the External Research Budget by the equivalent amount. In order to ensure accurate accounting of this by our office, any discrepancies between your expenses records and PBD's/ACT's should be resolved directly with those departments before the end of this fiscal year. If you have already done so we expect that this will be automatically reflected in the end-June PBD report to the secretariat of REPAC. The financial status (as of end-March 1984) of each project on the attached list is shown for your information.

Attachment:

cc: Mr. D. Lal, VPERS
Ms. P.A. Plesch, VPERS
Mr. D. Jamison, PHN
Mr. K. Zachariah, PHN
Mr. A. Berg, PHN
Mr. R. Faruqee, WA1
Ms. S. Cochrane, PHN
Ms. A. Fullerton

PAP:lt

EXTERNAL RESEARCH PROGRAM

Research Projects Which Have Extended Beyond Their Authorized Duration

RPO #	Title	Principal Supervisor	Dept.	Authorized Completion Date	Positive Remainder of Total Authorization (as of 3/30/84)	Negative Remainder of Total Authorization (as of 3/30/84)
671-73	Kenya - Health, Nutrition and Worker Productivity	A. Berg	PHN	12/01/80	1.9	

671-73

Phil, notes
Please file

OFFICE MEMORANDUM

DATE: February 29, 1984

TO: Mr. Deepak Lal, Chairman, REPAC

FROM: John North, Director, PHN

EXTENSION: 61571

SUBJECT: Status of PHN "Problem Projects"

We have reviewed the problem projects individually and our comments on each of them are given in the attached note. The major cost overrun is in RPO 672-60. This is due to unexpectedly high computer cost which was not budgeted for in the initial proposal. We suspect that the computer charge was for storage of data files which was done without our knowledge. The issue was raised with the IMRD sometime back, and a decision is expected soon. If IMRD does not drop their computer cost for the project, we refer to the agreement that the cost overrun be met from the positive balance ($26,000) in related RPO 672-23AC which is already completed.

Attachment

cc: and cleared with J. Warford, PHNPR
K.C. Zachariah, PHNPR
K. Truong, PHNPR
R. Faruqee, WA1DB

cc: Mr. A. Berg, PHN
Mr. D. Jamison, PHND2

P-1866

Attachment

Status of PHN "Problem Projects"

RPO 671-49 Education and Rural Development in Nepal and Thailand - under D. Jamison.

Project completed waiting for two papers from Consultant. The project does not require any more funds.

RPO 671-60 Textbook Availability and Educational Quality - under S. Heyneman.

EDC is responsible for this project. They should be consulted.

RPO 671-78 Education and Other Determinants of Farm Household Response to External Stimuli - under D. Jamison.

Mr. Jamison is away on mission. On his return he will provide a statement on the project.

RPO 671-81 Determinants of Fertility in Egypt - under S. Cochrane.

The Project is completed. Actual overrun is $155.00 and not $700.00. The total authorization was $179,500 and total expenses as at FY83 was $179,655. The overrun ($155) will be met from PHN Department funds.

RPO 672-09 Mass Media and Rural Development - under D. Jamison.

Balance of $4,200.00 will be used to complete the project (Jamison is away on mission. On his return, he will provide a timetable for completion).

RPO 672-35A Policy Analysis of Fertility and Family Planning in Kenya - under R. Faruqee.

Project completed; report being edited for publication. Completion report is being written. The actual cost overrun according to our records is $1,084.92 and not $2,200 indicated in your memo. Overrun has been due to typing cost and will be met from PHN Department funds.

RPO 672-60 The Determinants of Fertility in Rural Bangladesh - under K. C. Zachariah.

Completion report is being written. As agreed, the positive balance in RPO 627-23AC (about $26,000) will be used to balance the account of this project.

RPO 671-70 Case studies of Determinants of Recent Fertility Decline in Sri Lanka and South India - under K. C. Zachariah.

Project reports have been completed and submitted to the Editorial Sub-committee. The positive balance in the budget (which according to our records was only $3,939 in December 1983, but much less today) is being used for editing the report for publication and dissimination of results of study. This will be doen before 30 June 1984.

RPO 671-73 Kenya - Health, Nutrition and Productivity - under A. Berg.

Balance of $1,900 will be used to complete report.

RPO 672-52P Impact of Selected Programs, Projects, and Policies on Food Consumption and Nutrition - under A. Berg.

Mr. Berg is on mission and will submit a report on the project on his return.

RPO 672-23AC Policy Analysis of Fertility and Contraceptive Behavior in Bangladesh - under R. Faruqee.

Project completed. The positive balance should be used to defray the cost overrun for the sister project RPO 672-60.

RPO 671-54C Economics of Educational Radio - under S. Futagami.

EDC Department should be consulted.

671-73

August 26, 1983

I called Mr. Berg's office today. He had a temporary secretary who returned my call with the following information:

> They are not sending in the Completion Report because the project is not complete. They will send an up date on this Kenya project.

Nancy Wolf

SB/BL

Have you seen this

heela

Sept. 8.

File
671-73

..ORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Ms. Barbara Lewis, DPS DATE: March 23, 1983

FROM: Vincent W. Hogg, TWD V.W.H.

SUBJECT: RPO 671-73 -- Kenya Nutrition, Worker Productivity and Child Development Research Study

As discussed and agreed with Mr. Alan Berg, Senior Nutrition Adviser, PHN Department, I am transferring to him the full authority and responsibility to manage and administer the funds (balance to-date $11,900) under budget No. 671-73. Mr. Berg has agreed to assume this responsibility. This transfer of authority takes effect immediately and all future communications and inquiries on this budget should therefore be referred to him.

CGHarral/efd

Cleared w/ & cc: Mr. Alan Berg, PHN

cc: PHN: Messrs. North, Berg, Prescott, Warford
P&B
ACT: Mr. K. Hannemann
TWD: Mr. Harral, Ms. P. Evans
VPERS: Ms. Phi Anh Plesch

Record Removal Notice

The World Bank Group Archives & Records Management

File Title	Barcode No.
Kenya - Health Nutrition and Worker Productivity Studies - RPO 671-73	30135024

Document Date	Document Type	
6/19/1981	Report	

Correspondents / Participants

Subject / Title
Commitment / Expense Detail Report

Exception(s)
Personal Information

Corporate Administrative Matters

Additional Comments

The item(s) identified above has/have been removed in accordance with The World Bank Policy on Access to Information. This Policy can be found on the World Bank Access to Information website.

Withdrawn by	Date
Bertha F. Wilson	30-Jun-21

OFFICE MEMORANDUM

TO: Mr. K. Hannemann, CTR and A. Virmani, VPD

DATE: June 19, 1981

FROM: Clell G. Harral, TWT

SUBJECT: Commitment/Expense Detail Report - May 1981

Further to Mr. Hannemann's memorandum of June 10, 1981, and Mr. Virmani's memorandum of June 16, 1981, we are forwarding herewith the attached corrected forms for External Research Projects 671-73 and 670-27.

I would like to offer a suggestion which, if implemented, could save us all a lot of non-productive paper work. Since we are held responsible for expenditures for these projects, TWT keeps exact records of expenditures on these projects which are periodically reported to the Research Committee in the Quarterly Progress Reports. We have routinely been correcting Controller's monthly commitment/expense sheets, but have noticed that often our corrections are not entered in the computer system. I suspect this is not an oversight but probably reflects a sensible decision to avoid wasting a lot of staff effort on very minor matters. However, we cannot have two unreconciled accounts for the same project; this practice has in the past contributed to some serious misunderstandings which then led to investment of inordinate amounts of staff effort to get straightened out. In the interests of simplicity and ease of administration, I would like to suggest that we henceforth dispense with these separate monthly printouts. If this is unacceptable, then I must respectfully request that our corrections be attended to promptly in the future.

Attachments

CGHarral:phm

cc: Ms. B. Lewis, VPD

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Miss Barbara Lewis, VPD DATE: May 20, 1981

FROM: Clell G. Harral, TWT phm for CGH.

SUBJECT: Health Nutrition & Worker Productivity Study

FY81 expenses for the Health Nutrition and Worker Productivity Study (Research Project 671-73) amounted to $9651.91. Could you please forward the balance of $16,148.09 from the FY81 allocation of $25,800 to FY82.

phm

1) file
2) [illegible]

OFFICE MEMORANDUM

TO: Mr. Clell Harral, TWT

DATE: March 17, 1981

FROM: Samir Basta, PHN

File

SUBJECT: KENYA: RPO-671-73, Research on Health, Nutrition and Worker Productivity Studies--Final Report

1. I have completed the review of the Final Report on this study which was carried out by Drs. Latham and Stephenson of Cornell University and which was jointly supervised by the former Nutrition Division of AGR and TWT. The report is on the whole satisfactory, and has produced a significant amount of nutrition and health information as outlined below, which will be of benefit to our operational programs, to the Government of Kenya, and to the Research community.

2. The report is divided per the research protocol into four primary studies. The first deals with the effect of nutrition and health parameters on road workers' productivity and the subsequent effect of treatment and worker feeding. The second study, divided into three parts, deals in more detail with the delivery, acceptability, logistics and costs of alternative dietary regimens on road workers, followed by a substudy on the distribution and significance of anemia and parasitic infections, and then lastly by a substudy assessing the effect of treatment of different parasitic infestations. The third major study deals with health and nutrition surveys on 800 adult workers in 4 different ecological zones in Kenya, and the fourth study evaluates longitudinally the effect and costs of mass treatment of ascariasis (roundworm) on approximately 1550 children over a 4 year period.

3. I have summarized the more pertinent results below. However, I would recommend that the full 300 page report be read in its entirety by all those who may be interested in these findings since it contains a great deal of additional information and detail. As I only have one copy of the full report it will be necessary to make a number of additional copies and I have requested Dr. Latham to do so from leftover funds. Out of US$74,500 budgeted for this study by the Bank, approximately US$18,500 are left over from funds originally earmarked but not used for Other Consultants and Travel Costs.

4. Study No. 1: Evaluation of Health/Nutrition Effects on Productivity.

A. The study demonstrates that there is evidence of significant undernutrition in male and female workers hired locally by the Ministry of Works for road building in the Central Highlands of Kenya. Forty one percent of the 229 subjects measured had a weight for height below 80% of the Jellife standard. The average male weight was only around 50 kg (110 lbs). There was a greater percentage of men (52%)

than women (22%) with weight for height below 80% of this standard. All the subjects were farmers or were from farm families with a mean farm size of 4.8 acres.

B. Seventeen percent of the females so hired were anemic. Only 10.6% of the males were anemic. This is probably because hookworm is not a serious problem in the central highlands (altitude and temperature).

C. The recommended FAO/WHO calorie requirements for active male and female adults is around 3,200 cal/day for males and 2,500 cal/day for females. The average dietary intakes recorded were around 2,100 for males and 1,350 for females. No group had an intake greater than 67% of the standard. For iron, the intakes were 71% of the recommended allowance in males and only 57% for women. Intakes of other nutrients were also recorded and these were, in general, satisfactory.

D. Pages 36 to 70 describe the worker productivity measurements, analysis, and results in significant detail. I recommend that TWT review these in depth since they are very technical and require a specialist background for a proper assessment of their validity and significance. Dropouts and replacements were larger than expected. Both "Ditching" and "Excavating" were measured using m^3/person hour of earth worked as the unit. Corrections were made for road, tasks, type of earth and sex. The statistical analysis used regression models designed by Dr. Andrew Chesher of Birmingham University. Many different models were used per Mr. Chesher's report to us on March 6, 1979. The results indicate that arm circumference (a measure of calorie status) and especially hemoglobin (a measure of anemia status) are strongly and significantly correlated to productivity. This confirms our results from our earlier research in Indonesia, India and Kenya, and some other productivity results from Guatamela and Sri Lanka. Note that weight, probably because of the tasks measured and the large variability in those, was not significantly related to productivity.

E. Raising arm circumference by one standard deviation raises the Z-score for productivity by 0.16 which implies a rise in productivity itself of about 0.033 m^3/man hour, an increase of 4%. For hemoglobin a one standard deviation rise (1.32 grams/100 ml) implies a rise of productivity by 0.027 m^3/man hour, also a rise of 4%. Female workers have productivities which are about 0.15 m^3/man hour (19%) lower than males corrected for height, weight, etc. Age and presence of infections are weakly correlated to productivity.

F. After intervention with a 1,000 calorie supplement (group II) and a 200 calorie "control" supplement (group I), weights rose modestly in the high calorie group but the increase was not statistically significant. The investigators indicate that this was because food consumption at home fell correspondingly. Thus a "substitution" effect seems to occur during food supplementation of adult workers. Had no substitution taken place, then one would have expected a weight gain of 4.81 kg over the three month period for the group given the high calorie supplement. Mean weight gains were however only a fraction of this.

G. An interesting offshoot from this study was the comparison of two standard methodologies for assessing food intake. The first method, termed 24 hour recall in which the respondent is asked what he/she consumed over the preceding 24 hours, gave consumption figures that were on average 25% lower than the home weighing methodology in which an observer spends a full day in the home of the subjects and weighs carefully all that is cooked and consumed during that day. Since most dietary surveys use the 24 hour recall because it is cheaper and easier, we should be aware that this measurement seriously underestimates consumption. FAO recommends the home weighing methodology as the method of choice, a decision that some of us fully support, despite increased time and costs, and recent Bank supported nutrition surveys (as in Senegal) have followed this methodology.

H. The unexpectedly poor attendance during the intervention period, mainly because of worker substitution as the road construction progressed over 3 months and moved further away from the baseline villages and farms, affected the subsequent productivity measurements. While the high calorie group had a significantly better attendance record (57 days as compared to 49 days for the low calorie group), and a higher productivity, small sample sizes and large variability in the productivity measurements were insufficient to measure any significant gains or differences in its productivity between both groups. From the regression models used and the small rise in productivity that were noted if "days worked" were corrected for, Dr. Chesher has calculated that a significant productivity effect could have been recorded if 2,500 calories/day/worker had been consumed. Obviously delivering this amount of calories under the conditions of the study were not feasible

I. The analysis of this intervention data is extremely complex. I doubt for example whether an increase in productivity of 0.1 of a cubic metre per man hour in the high calorie group compared to the controls is of any significance, even though this is a gain of about 13%. The authors conclude by stating that "in the present experiment the level of energy supplementation was not sufficient to compensate for the high energy cost of road work, of getting to work, and for substitution of food consumed in the home." This is certainly one explanation. But there may well be many others which deal with incentives, work conditions, the "steady state" that may be reached as regards work and caloric expenditures--a relationship in the human that is not precisely known. Finally, new evidence is now surfacing that shows that maintenance of body weight and utilization of calories varies greatly between individuals. With the small sample sizes used it would be impossible perhaps to detect a real trend. The investigation should have taken this into account and in hindsight carried out such studies in much more stable groups such as quarry workers or agricultural workers.

5. Study No. 2(a): An Evaluation of Different Types of Worker Feeding Regimens and of Different Delivery Systems.

A. These studies were conducted in the coastal areas of Kenya (Kwale District near Mombasa) on 149 rural access roads workers in order to test acceptance and costs of different delivery systems. Two isocaloric snacks of 625 calories were used. The first based on groundnuts and bread cost 0.97 Kenya shillings. The second consisting of maize meal, spinach and pigeon pea cost 0.60 Kenya shillings and was designed to provide a high iron and vitamin C intake, since anemia is a major problem in these coastal populations due mainly to hookworm infestations. The study also compared delivery of other feeding regimens partly subsidized by the Ministry of Works.

B. The results show that acceptability of all the diets was very high especially the maize meal snack (over 90%) and that workers will pay for full costs of these snacks (equivalent to one day's wage per month). In addition the delivery system using a local entrepreneur (a woman preparing food on site) proved to be the most popular and still enabled the entrepreneur to make a handsome profit of US$25 per month. This delivery system cost 1/3 as much as the system using a salaried Ministry of Works employee to produce the food.

C. The Ministry of Works has since early 1980 accepted some of the study's recommendations and has now introduced worker feeding in several districts of Kenya, according to Dr. Latham.

6. Study No. 2(b): Study of the Routine Provision of Iron to Improve Hemoglobin Levels in 114 Road Workers.

A number of important findings have emerged from this study:

A. It provides a good assessment of the distribution of anemia among adult males--some 45% were found to be anemic according to W.H.O. criteria.

B. The study provides a good indication of caloric and nutrient intakes in Coast Province households. About 30% of the households are consuming less than half of the estimated caloric requirements. Average weights of adult males are only two thirds of standards. Average caloric intake for male laborers was 2,427 calories/day as compared to recommended intake of 3,200 calories/day.

C. The results show that it is possible to increase blood hemoglobin levels after 12 weeks with a high iron, high vitamin C regimen such as the one used in Study 2(a). Iron capsules given daily were also effective of course in raising hemoglobin levels but the cost of delivery is relatively higher. There was a significant weight increase in some of the men consuming the high iron snacks.

D. About 75% of the road workers on the Coast suffer from hookworm infestation, 35% from schistosomiasis hematobium and 27% from malaria.

E. Treatment for hookworm and roundworms proved feasible and inexpensive. Treatment for schistosomiasis was well received but was costly and requires medical supervision. Studies 2(c) and 2(d) then followed to estimate in more detail the prevalence and effect of different treatments on these parasitological diseases.

7. Study No. 2(c)/2(d): Prevalence of Parasitic Diseases, Their Role as Causes for Anemia and An Evaluation of the Feasibility of Routine Parasitic Treatment and Prophylaxis.

A. This study tests the response of treatment on each of hookworm, schistosomiasis and malaria upon blood hemoglobin levels on the 161 road workers. The objective was to assess

how much of the anemia seen is contributed by these parasites and whether that removal would lead to a significant reduction in anemia.

B. The results first demonstrate that there is a statistically significant relationship between hookworm loads and hemoglobin levels. This linear relationship was also documented by the Bank's 1973-1974 studies on anemia in Indonesia. Conversely, the study could not detect any statistically significant relationship between blood hemoglobin and presence of schistosomes or malaria parasites, contrary to a few inconclusive reports in the literature. (There was however an effect of malaria treatment on hemoglobin levels.)

C. There seems to be a significant relation of body weight to schistosomiasis. This is not seen in the other two diseases.

D. Treatment resulted in hemoglobin improvements in the hookworm treated group. However, since only one dose was given, reinfection was found to reoccur within a few months and the drug used (combatrin) is not as effective in the type of hookworms seen in Africa (N. Americanus) as it is on that type seen in Indonesia (A. duodenale). In addition, treatment for malaria over a 6-month period was found to be somewhat effective in raising hemoglobin levels. There was no effect of schistosomiasis treatment on hemoglobin levels.

E. Treatment was as follows:

Schistosomiasis hematobium: Metrifonate (Bilarcil) (one dose of 10mg/kg body weight repeated 14 days later)

Hookworm: Pyrantel Pamoate (Combatrin) (one dose)

Malaria: Two 150 mg tablets of Chloroquine Phosphate per week.

F. The percent reduction in the different groups was as follows:

	Initial level	Final level
S. hematobium	38.9%	11.6%
Hookworm	59%	49%
Malaria	22.5%	20%

Although these results were not over-dramatic, treatment of hookworm with pyrantel and metrifonate was much more effective in lowering prevalence and ova counts for hookworm, than pyrantel alone. However, the results of the several different treatments and their combinations as presented in the report are not very clear. There is some confusion over conflicting results obtained from multiple regression analysis and analysis of variance. I recommend that this section be summarized more coherently.

8. Study No. 3: Study of Health and Nutritional Status of Adult Males in 4 Ecological Areas of Kenya.

A. This section of the report is essentially a description of the results obtained on a total of 800 men surveyed in 4 different areas of Kenya: Nyanza Province near Lake Victoria, West Pokot district (Rift Valley), Kwale (Coast Province), and Karatina (Central Highlands).

B. The results are tabulated in some detail with regard to different clinical, parasitological, nutritional, and hematological parameters. In brief, they indicate that the subjects from the Lake Victoria area show the highest weight for height while those with the lowest weight for height are in West Pokot in the Rift Valley (67% of men surveyed there are below 80% of weight/height norms).

C. With regards to anemia status, the highest prevalence was in the coastal province (45% prevalence) and the least was in Nyanza Province near Lake Victoria. Malaria was highest in Coastal and Lake Victoria areas, and lowest in the Rift Valley. Computer runs (analysis of variance) on a large number of variables showed, among other results, that hookworm is definitely correlated to anemia.

9. Study No. 4: Ascaris (Roundworm) Control in Children.

A. Over a 4-year period around 1,550 children were given Levamisole, a deworming drug, 3 times each year. The results were assessed in terms of reinfection rates, socio-economic correlates to presence or absence of ascariasis, type of housing, geographical location and costs of treatment. This study was a longer term extension of earlier Bank supported studies on the costs and benefits of short term ascariasis treatment in children (Bank staff working paper No. 271).

B. Over the 4-year period dropouts were very small. An 85% participation rate is reported. This is very high for a study of this sort. Mothers, teachers and local administrators were reported to be very supportive of the whole effort and the Ministry of Planning and Development has requested Drs. Latham and Stephenson to prepare an outline for a national program. The investigators, recruited local volunteers and teachers for the administration and supervision of the deworming medicine.

C. A large number of variables were measured and tested to investigate their relationship to ascariasis. The results are extremely interesting. Two variables were found to predict ascaris infection. These were income and type of flooring in the home. Earthen type floors were strongly associated with the infection (as opposed to homes with cement floors). Furthermore, children from households in which mothers had a variety of parasitological infestations were found to suffer more from both infection and re-infection (after treatment) with ascariasis.

D. Children who had ascaris at baseline were found also to have 4 times as much chance of reinfection during the 4 years of treatment, than children who were initially free of the worms. Homes which were situated near communal sources of water (rivers, streams, etc.) were also found to have many more cases of infection. Surprisingly, there was no association between presence or absence of latrines and the disease.

E. After the 4 year treatment period there was overall a 43% reduction in prevalence (from 24% to 14%). A plateau was reached when prevalence reached about 11%. This is taken to mean that perhaps at that point the socio-economic, cultural and environmental variables which predispose to infection need to be tackled, since administration of deworming medicine by itself is insufficient to prevent re-infection.

F. Plotting of foci of infection on a map was carried out. These results showed not only that areas near water sources have the highest infection rates, but so did areas of highest population density.

G. The results of a substudy on mothers who also had their stools examined for intestinal parasites revealed that ascaris infestations in mothers were perhaps less important than other infestations. These were as follows: Entramoeba cysts were present in 68% of the mothers; Hookworm 36%; Schistosomiasis 26% and Ascaris 17%. Since however 1/3 of the mothers may be pregnant at any one time and one cannot advise worm treatment for these, it will be important to seek for this group other means of control including better environmental sanitation and education. Selective deworming procedures during non-pregnant phases may also be undertaken in adult females, of course, but administratively this may prove to be very difficult.

H. It is also interesting to note that as children get older their species of intestinal parasites begin more to resemble those of their mothers. Entamoeba cysts for instance become much more prevalent. Hookworm also increases, and there is a relative decline in ascaris loads.

I. While the statistical computations are complex, I feel the investigators have done a first rate job of analysis. The cost figures for treatment (including delivery) will be very helpful to many of us in the Bank as well as to the Kenyans. The per capita cost of approximately US$0.40 per year for deworming is certainly low. What is more important to assess, however, is whether it is worth doing, in view of (a) the high incidence of reinfections, (b) the relatively mild nature of ascariasis in comparison to other disease. While the studies we initially supported had shown earlier that there may indeed be a growth deficit in children with high ascaris loads, Ministries of Health may find, with some justification perhaps, that other diseases may be more important and more cost-effective to eradicate.

10. Recommendations: The last part of the Final Report contains three articles dealing with detailed recommendations for:

A. Worker Feeding

B. Anemia Control

C. Mass deworming and parasite control for (i) adult workers and (ii) children.

As stated earlier, two Kenyan Ministries, Public Works and Planning/ Development, have requested and received copies of these, and are said to be in the process of implementing some of the recommendations. The

Bank's proposed Kenya health project (FY 82) and a possible nutrition sector study should also make use of these.

11. The next steps should be:

A. To make available additional copies of the report for dissemination and comment within the Bank, bilateral and U.N. organizations and the Government of Kenya.

B. To invite Drs. Latham and Stephenson to the Bank for a presentation of their results to a general audience.

C. To agree to Drs. Latham and Stephenson's request that they publish in professional journals a series of papers on each of the four or five studies that were undertaken. Since publication may take one or two years, we should also recommend that they provide the Bank, as soon as possible, with a rewritten draft of Study No. 2 and Study No. 4 (on the effects of treatment, feeding, and the Ascariasis study respectively) which would be issued as Bank Working Papers. Studies No. 2 and 4 are those I judge to have the greatest relevance.

cc:

Mr. van der Tak, CPSVP
Mr. Willoughby, TWT
Mr. Golladay, TWT
Mr. Jaycox, AEA
Mr. Churchill, URB
Mr. Christoffersen, AGR
Mr. B. King, DED
Mr. S. Burki, PPR
Mr. Merriam, IPA
Mr. S. Acharya, VPD
Mr. Hendry, EAP
Mr. L. Miller, URB
Mr. Tsui, EA1
Mr. D. Jamison, DED
Mr. Faruqee, DED
Miss Ho, DED
Mr. Reutlinger, DED
Miss Ethna Johnson, DED
Mr. D. Keare, DED

Dr. Evans, PHN
Mr. North, PHN
Mr. Berg, PHN
Dr. Kanagaratnam, PHN
Mr. Warford, PHN
Mr. Messenger, PHN
Mrs. Husain, PHN
Mr. Schebeck, PHN
Dr. Pillet, PHN
Mr. Diaz, PHN
Dr. Pratt, PHN
Dr. Clarkson, PHN
Mrs. Hall, PHN
Mr. Prescott, PHN

SBasta:mt

Record Removal Notice

The World Bank Group Archives & Records Management

File Title	Barcode No.
Kenya - Health Nutrition and Worker Productivity Studies - RPO 671-73	30135024

Document Date	Document Type	
10/19/1981	Memorandum	

Correspondents / Participants

To: Susan Harmon

From: Clell G. Harral

Subject / Title

Payment to Dr. Michael C. Latham (671-73)

Exception(s)

Personal Information

Corporate Administrative Matters

Additional Comments

The item(s) identified above has/have been removed in accordance with The World Bank Policy on Access to Information. This Policy can be found on the World Bank Access to Information website.

Withdrawn by	Date
Bertha F. Wilson	30-Jun-21

671-73

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Mr. Samir Basta, AGR

DATE: October 17, 1979

FROM: Rashid Faruqee, DEDPH

SUBJECT: Kenya: Research on Health, Nutrition and Productivity Studies - RP0671-73

1. I have reviewed the above document and found it a good status report of the research project. It clearly details the activities that have been going on under the project. Still, from reading it, it is difficult to evaluate the progress and offer suggestions for future directions (as desired by your memo dated October 4, 1979 on the subject), because the research goals and the underlying designs of the studies are not included in the report. The research activities, as outlined in the report, represent a mixed bag. Clearly these have many dimensions, and it would have been helpful to know their core objective and to understand how these dimensions were unified by a central theme. 1/

2. First, I find that there are elements of both basic and operational research in the listed studies. Second, some of the research tasks aim at measuring the effectiveness of certain drug-treatment to given diseased conditions (e.g. anemia); in a few others, it is the effect of food/nutrition supplement that is studied. Third, in some studies, the focus is on adults, in others, children. Also, the ecological dimension enters in some of the studies. It will be useful to indicate the underlying basis of studying all these dimensions.

3. In the case of basic research, it is clearly important to relate it to the state of knowledge about it. If some of these relationships are already known in the context of other countries, the issue then is to find out what holds in the Kenyan setting. For this, it is essential that studies build on, and relate to, other nutrition studies in Kenya. For example, it will be of interest to many, to know how the four studies in RP0671-73 compare to the findings of the nutrition survey by the Central Bureau of Statistics (this was held in February/March 1977 and its findings are summarized in Social Perspective, Vol. 2, #4, Sept. 1977).

4. For policy research aspects of the studies (e.g. effectiveness of alternative nutrition interventions), it would be useful to relate the research to the policy and programs of GOK in the field of nutrition. How will this research, for example, help the Nutrition Plan which is being prepared as a part of the Basic Needs strategy of GOK for the current plan period?

1/ Without a central theme it is difficult to see how the four studies are related to each other and why they were particularly selected.

5. From what I understood about the underlying research design of the studies, I wondered how one issue, which was only briefly mentioned in the report (page 36) but not analyzed, affected the research design. The issue is the interrelatedness of personal attributes of the subjects studied in the surveys. For example, the occurrence of disease is strongly associated with nutritional status; in many cases parasitic infections explain low haemoglobin levels and small arm circumference (health and nutrition indicators); often malnutrition creates susceptability to diseases. This point has not been reflected in the research design because in the regression equations the fact that there can be a synergistic effect of the disease conditions and malnutrition is not considered. No interaction terms are included as explanatory variables. Also dichotomous variables have been used in the regression analysis for situations where intensity appears to be more relevant (e.g. infection). The researchers seem to be aware of the problems (p. 33) but they have not indicated whether and how they will attempt to correct it.

6. Both in Study 1 and Study 2 interventions were introduced in the form of food supplements. It is clear from Table 4 that these were not uniformly accepted by the workers. About 55% of the workers attended 70 days or more whereas only 14% of them availed the supplement for as many days. This differential use of supplements would significantly affect the results in relating productivity to food supplements. It is not clear how the stated specification handled this problem.

7. In Study 2, there is a brief mention of cost and price of the food supplement for workers but the discussion do not go very far in analyzing the issues of measuring and comparing benefit, and cost (both private and public) of such food supplements.

8. On the whole, the account of the project activities is impressive. In future directions of these studies, if some of the above points are effectively addressed the results of these studies should prove extremely valuable to the Kenyan planners.

RFaruqee:cslc

cc: T. King, Chief, DEDPH
B. King, DED
M. Selowsky, DED
G. Nankani, DED
H. Messenger, POP
A. Berg, AGR
E. Schebeck, AGR
J. Greene, AGR
C. C. Harral, TWT

671-73

OFFICE MEMORANDUM

TO: See Distribution

DATE: October 4, 1979

FROM: Samir S. Hanna, AGRKE

SUBJECT: KENYA: Research on Health, Nutrition and Productivity Studies: RPO 671-73

grey box

1. Please find enclosed Dr. Michael Latham's progress report on Phase I of the above study, which is on schedule.

2. Phase II is to commence as planned in January 1980. This will include nutrition surveys on the two remaining ecological areas of Kenya (Northern and Western Provinces). In order to make this study even more relevent to Kenya's national planning objectives, we have proposed, and Dr. Latham has accepted, that the survey should also examine the feasibility of calculating optimal low-cost, nutritious diets for each of the ecological zones studied.

3. Phase II will also include the completion of the child growth and deworming studies. The costs for Phase II are as previously budgeted (US$34,500 for the study, plus US$7,500 for Bank staff travel and subsistence).

4. If no objections or suggestions are received from you by c.o.b. October 15, 1979, we will proceed with Phase II as planned.

Waived Till B. King informs, + Basta returns from mission late November

DISTRIBUTION

Mr. R.R. Vasuqez, DED
Mr. B. King, DED
Mr. G. Manbeni, DED ✓
Mr. H. Neuenger, POP
Mr. A. Berg, AGR
Mr. E. Schuebeck, AGR
Mr. J. Greene, AGR

Cleared with and cc: Mr. C.G. Harral, IWT

SSHanna

671-73

RLD BANK / INTERNATIONAL FINANCE CORP TION

OFFICE MEMORANDUM

TO: Mr. Emmerich M. Schebeck, AGRNU DATE: April 11, 1979

FROM: Samir S. Basta, AGRNU

SUBJECT: KENYA: Nutrition/Productivity Research Study (RPO #671-73)

1. I have just received the report and statistical analysis of stage 1 of this project by Dr. Andrew Chesher, Statistician, Birmingham University. Dr. Chesher as you probably recall is serving as an independent consultant to this research project per the Research Committee's recommendation.

2. The results of his analysis of the data sent from Kenya and Cornell University, N. Y., reveal that hemoglobin levels (an index of anemia), are positively and linearly correlated to the productivity (ditching and excavation) of both female and male road workers in Kenya. Thus a one standard deviation rise in hemoglobin (1.32g/100 c.c.) is associated with a 4% increase in output per man-hour.

3. In practical terms, since many such populations suffer from hemoglobin levels 4 to 5 points below "normal", their productivity could be said to be some 20% below what it should be because of anemia. There are important implications in this for countries, such as Indonesia, Egypt, Thailand, Senegal, etc., where anemia is a significant problem.

4. While these results and figures confirm precisely my earlier (1973) observations on Indonesian labourers (Bank Working Paper No. 175), those of Latham in Kenya in 1976, as well as those undertaken by the University of California in 1976 in Sri Lanka, Dr. Chesher's conclusions go even further. His analysis also reveals that arm circumference, a good indicator of protein/calorie status is also significantly correlated in both men and women to work output ($r = 0.59$), and that caloric status (weight for standard height) in males is also positively correlated to work output, independently of hemoglobin (iron) status.

5. The analysis also reveals that presence of parasitic infections (either hookworm, trichuris, schistosomiasis and/or strongyloides stercoralis) are also associated with reduced work output. The presence of such infections are estimated to reduce productivity (output) by some 4% to 8% per man-hour according to his analysis independantly of the other variables. Severity of infection was unfortunately not analysed.

6. The complete report with the statistical methodology (linear and multiple regression and analysis of covariance) is on file in my office. It will be interesting to see whether the diets given subsequently to these workers have any influence on these results. That second report should be due in a few months time.

cc: Messrs. King (DED); Keare (DED); Harral, Coukis (TRP); Miller and Ward (EDI); Koch-Weser (EXC); Golladay, Lee, Leise (PAS); Lethem (PAS); Berg, Christoffersen and Yudelman (AGR); Churchill (URB); Hall (POP); Selowsky and Reutlinger (DED); Greene, Amla, Wilkie, Carriere, (Ms. Hamann), (AGRNU); de Leede (WA2); Ikram (EM1); Shilling (AEA); Ms. Hadler (AEA); Faruqee (DED); Bery (VPO); Ms. Goris (Nairobi); van der Tak (PAS); Scandizzo (AGR); Knudsen, Davis and Donaldson (AGR)

SSBasta:jm

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

File (671-73)

OFFICE MEMORANDUM

TO: See distribution below. DATE: February 2, 1979

FROM: M. A. Hazzah, VPD MAHazzah

SUBJECT: Status Report Reminder

The Status Report requested several weeks ago is overdue. Would you please see that it is completed and submitted to this office (F 1219) no later than Friday February 9. Thank you.

Distribution:
Mr. C. Harral
Ms. P. Moses

✓ cc: Mr. S. Bery

yellow 671-73

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Mr. C. Harral, TRP

DATE: January 4, 1979

FROM: Mona A. Hazzah, VPD MH

SUBJECT: Research Project Status Report

1. I would appreciate it if you could have the attached Status Reports completed for each of the research projects listed below. The information provided should be current as of December 31, 1978. To this end, I attach where necessary a copy of the latest Commitment Report printout, which provides a summary and itemization of expenses recorded through November.

2. Since this Status Report covers only two sections of the Report (I and II), I urge you to complete and return the report to this office (F 1219) no later than Friday, January 26, 1979.

3. I would appreciate it if you could attend to this matter as soon as possible to avoid unnecessary delays.

Project Code	Staff Member Responsible
670-27	C. Harral
✓671-73	-do-

cc: Ms. P. Moses (w/att.)
Mr. S. Bery

Attachments
MHazzah:tr

Record Removal Notice

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File Title	Barcode No.
Kenya - Health Nutrition and Worker Productivity Studies - RPO 671-73	30135024

Document Date	Document Type
10/5/1978	Letter

Correspondents / Participants
To: Peter Hopcraft
From: Sheila C. Wilkerson

Subject / Title
World Bank Research Project Appointment Letter

Exception(s)
Personal Information

Additional Comments

The item(s) identified above has/have been removed in accordance with The World Bank Policy on Access to Information. This Policy can be found on the World Bank Access to Information website.

Withdrawn by	Date
Bertha F. Wilson	30-Jun-21

WOF BANK / INTERNATIONAL FINANCE CORPORA

white

OFFICE MEMORANDUM

TO: Mr. C. Harral, TRP

DATE: August 10, 1978

FROM: Mona A. Hazzah, VPD

SUBJECT: Research Project Status Report

1. I would appreciate it if you could have the attached Status Reports completed for each of the research projects listed below. The information provided should be current as of June 30, 1978. To this end I attach where necessary a copy of the June 1978 Commitment Report printout, which provides a summary and itemization of expenses recorded through June.

2. Since this Status Report covers all expenses incurred throughout FY78, I would be grateful if you could complete all four sections of the report and return to this office (F1219) no later than Monday September 11, 1978.

Project Code	Staff Member Responsible
670-27	C. Harral/P. Fossberg
✓ 671-73	C. Harral

Attachments

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Mr. C. G. Harral, Highway Design and Maintenance Advisor, TRP

DATE: August 17, 1978

FROM: Samir Sanad Basta, Nutrition Expert, AGRNU

SUBJECT: KENYA: Nutrition and Productivity Research Project 671-73
Back-to-Office Report

1. I arrived in Kenya on July 5, 1978, per terms of reference dated June 22, 1978, to review the initiation of Studies 1 and 2. Study 1 deals with the effect of calorie supplementation upon productivity of road workers. Study 2 is exploring the benefit/cost of alternative delivery mechanisms for the reduction of anemia. Study 1 is taking place in an area with low parasitic loads in the Kenya highlands (Nyeri) and Study 2 is situated in a heavily infested lowland area south of Mombasa.

2. After meeting briefly with Mr. B. Nilssen at the Ministry of Works (MOW), I proceeded immediately by MOW vehicle to the Study 1 sites near the Keratina work camp in Nyeri District. At Keratina, I met with Mr. Mark Sharrock (consultant engineer) and discussed in some detail the baseline productivity measurements he is undertaking for the study, at Roads No. 12 and 7. This was followed by a visit to Road No. 12 to observe in more detail the methodology and the physical status of the road workers.

3. Dr. Michael Latham (principal investigator) had already selected 120 of the workers in both road sites for the Study 1 research and Mr. Sharrock was conducting the individual measurements on sloping, ditching and excavating. Each worker is measured some 8 to 10 times over a period of four weeks. Measurements are combined to give individual time/output data (man hours/cubic meter). Corrections for weather and soil types are applied per methodology perfected during the Bank's labor-substitution studies. An amount of work roughly equivalent, depending on soil conditions, to the excavation of 4 cubic meters of earth is selected by Mr. Sharrock for each worker. The area is then demarcated by stakes, and when the road worker finishes the task he is free to go home.

4. Despite Mr. Sharrock's considerable efforts to increase sample sizes by selecting additional rural access roads per Mr. Andrew Chesher's (consultant statistician) recommendations, it appears that the number of workers on which detailed work output measurements can be undertaken will not exceed the 120 figure. One reason is that Mr. Sharrock cannot measure more than that number in the period allotted to him. A second related reason is that normal work on the road sites would be considerably disrupted if the study team undertook a greater number of individual measurements. Foremen and supervisors are opposed to lengthening the time taken to finish these roads because they are under some pressure to stick to a deadline by the rural access roads donor agencies. Since most of these roads rarely exceed 20 km, and team--rather than individual work--is necessary at most stages, the reluctance of the MOW supervisors to further disrupt the work is understandable. Considerable adjustment to their schedule

has already been undertaken to suit the needs of this study, and Messrs. Sharrock and Latham are reluctant to antagonize the MOW whose cooperation for Studies 2 and 3 is also needed.

5. Even if these constraints were not in such evidence a further problem arises, that is, the shortage of local labor. It seems that a combination of factors such as low wages, migration to urban center, social customs and season, has considerably affected MOW ability to hire and retain road workers. Wage rates are less than 8 Kenyan shillings a day, compared to the average wage rate of KSh20 to 25 per day for agricultural labor in the coffee growing Nyeri area. Secondly, most able-bodied males are migrating out of that area to Nairobi some 150 to 200 km away leaving most of the "chamba" (farm) work to women, who are as a result the vast majority that can be recruited for road work. Thirdly, alcoholism is becoming, according to one foreman interviewed, such a serious problem that it is difficult to find a "serious" worker. Finally, most of the population in these very rich cash crop areas prefer to work on their fields, than to do road construction work under conditions of heavy rainfall, thick mud, strict discipline and low wage rates. For these reasons it appears that the Nyeri region, one of the richest in the country, should not have been chosen for this study, and serious consideration must be given to shifting the study to another region as discussed in paragraph 14 below.

6. Dropout rates, because of the instability of labor, will no doubt reach relatively high proportions during the feeding and post-feeding period. As a result, Dr. Latham has undertaken to cut the calorie supplementation period from 6 to 3-1/2 months. 1/ Secondly, in the initial design of Study 1 and in keeping with our earlier studies, only adult males were to be studied. Since around 50% of the labor force is now women (and many of the remaining males have had to be rejected because they are too old), considerable adjustment will have to be made in balancing out control and experimental groups in terms of sex, physiological status (pregnancy, lactation), and finding enough women who are not anemic. While most of these problems are surmountable, they also generate further need for increasing the sample size.

7. The predominance of female labor is not necessarily a disadvantage to the study, although clearly the researchers should have predicted this much earlier (i.e. in January 1978 when they visited Kenya), and adjusted some aspects of the study design accordingly. The number of female workers may be an advantage because increasingly this is the pattern in many developing countries and hence the study may be more representative. Secondly, because women are also the gatherers of firewood and water, and tend to work longer hours both in the fields and at home, the implications of studying constraints on maximal female productivity are nutritionally and economically significant. Dr. Latham also indicated that the women

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1/ This time period for studying a calorie effect is, in my opinion, still adequate provided sample sizes can be maintained which is, however, doubtful.

are in poorer calorie status and hence the effect of calorie supplementation, if any, will be more marked. 1/ Nevertheless, sample sizes would have to be increased well beyond the 120 figure, and this is currently impossible.

8. In regards the caloric supplement, and in consultation with Dr. Latham and Miss June Wolgomuth who will be in charge during the intervention period, it was decided that two fortified maize gruels (ouji) will be administered. The experimental group will be given 1,000 calories per day for three months, and the control group will be given 200 to 300 calories per day. It is not possible to give the latter a "calorie free" mixture because trials undertaken the previous months have shown that the taste of saccharine is detectable and rejected by the target population. In addition, they do not drink unsweetened "ouji".

9. Miss Wolgomuth has also prepared a socio-economic questionnaire which I reviewed and which will attempt to correct for variables such as incomes, land holdings, family size, location, etc., among the different workers. Dr. Peter Hopcraft, economist and senior research fellow at the Institute of Development Studies in Nairobi, is currently also reviewing the questionnaire. During my meetings with him he agreed to participate as a co-investigator to the study per the Bank's recommendations. I stressed to both him and Dr. Latham that he should be fully involved in all of Studies 1, 2, 3 and 4 (see attached terms of reference). His main contribution should be during the design phase of each study (preparation of questionnaire) and also during the analysis, implication and recommendation for each of the studies. He also suggested that he would like to examine the costs and implications of different types of social benefits that may be recommended by the Lathams and, using the results of Studies 1 and 2, examine implications for different scenarios such as labor abundant versus labor constrained localities. (Economically believable data was a phase he used...).

10. Study 2: This is taking place in the coastal district of Kwale, some 50 miles south of Mombasa. The primary objective is to study the cost and effects of different nutritional and parasitological treatments on groups of road workers, and is a follow-up of the earlier studies linking anemia to lowered productivity. Stage (a) of the study (the effect of different dietary interventions) was in the process of being initiated when I arrived.

11. Road 35 is being used for short feeding trial (2 to 3 weeks) on a group of some 50 road workers (all males) to test preliminary costs and acceptability of different food mixtures before the definitive study begins in late summer. The two main foods that were being tested during my presence there was a cold (uncooked) snack costing around KSh0.90 per day per worker (US$0.13) and cooked hot meal costing some KSh0.40 per day per worker (US$0.06).

1/ It must be stated, however, that during my field visit, I found little evidence that the women were more undernourished.

12. The cold snack which consists of 4 slices of local bread with margarine and a bag of peanuts provides some 600 calories and 1.5 mg of iron, and the hot iron-rich meal consists of the traditional "ugali" (maize, amaranth leaves, pigeon peas and oil) provides some 700 calories and 11 mg of iron. Acceptability for both was found to be good, although most workers preferred the cheaper but more nutritious "ugali". Since most of the workers there are fond of gambling, a simple system of drawing lots out of a hat will determine who gets hot and cold meals, when the definitive study begins in early September after Ramadan. By September the feasibility of using other dietary combinations will also be decided.

13. The hematological and clinical effect of these dietary regimes will be compared to treatments that will be carried out in road No. 3 and the quarry site also in Kwale district. These consist of providing iron sulphate tablets (600 mg daily) and placebo to some 110 workers. During January 1979, other interventions will be carried out in further groups of workers to test the cost and effects of drug treatments for each of bilharzia, malaria, and hookworm and the hematological results and costs will be compared to the above food supplement groups. Hematological, clinical and stool samples have already been carried out on these coast workers. They reveal a high incidence of anemia, malaria, schistosomiasis, and ankylostomiasis (hookworm), with very heavy parasitic egg loads, unlike the workers in the Nyeri highland district who are suffering mainly from calorie under-nutrition. The physical appearance of the road workers in Kwale is also much poorer. Unlike Nyeri, nearly all road workers are male farmers or farm laborers, and there are no labor shortages, quite the contrary, because of the poorer economic status of the region.

14. For these reasons, Mr. John Simpson (MOW), Mr. Hopcraft and I have recommended to Dr. Latham that productivity studies would be more meaningful and more feasible in these coastal areas than in the highlands. This would, however, necessitate some redesigning of Studies 1 and 2. However, since the former has been funded completely by the British Ministry of Overseas Development (O.D.M.) and Dr. Latham and O.D.M. have been insistent on studying the effect of calorie supplementation in workers with the minimum of parasitological and hematological complications, it seems difficult at this stage to simply transfer Study 1 to the coastal areas. In addition, it would necessitate the immediate extension of Mr. Mark Sharrock's (engineering consultant) contract by some 8 man-weeks at least. Dr. Latham did however give me assurances that he would explore this alternative further. Another alternative is to use farm laborers or plantation workers for the productivity studies. This would minimize dropouts and the logistic problems associated with road workers. If this is acceptable, Mr. Sharrock in my opinion, should then return to Kenya around September 1978.

15. On July 11, I met with Mr. John Simpson (Senior Superintendent Engineer in charge of the Rural Access Roads Program, MOW) along with Mr. Sharrock and Dr. Wolgomuth to discuss the progress of Studies 1 and 2, and to bring-up some issues affecting Study 1. Mr. Simpson showed continued interest in all facets of the study and was very forthcoming in

his desire to overcome bottlenecks both in transportation and in the work distribution that were affecting Study 1. MOW also gave their approval to the provision of a monetary bonus of KSh100 for each subject who completes the feeding study; they also released the Range Rover, purchased under the Bank's labor substitution study, to Dr. Latham's team. However, this comes too late to defray costs already incurred in May/June by Mr. Sharrock for the hiring of a land rover. Mr. Simpson also dispatched a senior supervisor to Nyeri to investigate earlier unwillingness of some foremen to reallocate workers or tasks on some roads. (This, according to Mr. Sharrock, should have been done sooner.)

16. Mr. Simpson also requested that the results from the studies be presented to him in more simple form than the working papers and technical memorandum previously sent to him, and that no recommendations be made until these were previously discussed with him. In his opinion, because of costs and organizational implications, the Ministries of Health and Planning should carry the responsibility on how to apply the results of the studies.

17. On July 12, I had a meeting in the Ministry of Finance and Planning with Mr. J. Otieno, Chairman of the section on Basic Needs and Nutrition for the forthcoming Kenyan National Plan document. Also present were Ms. H. Goris of the Bank's Nairobi Office, and Dr. Desmond McArthy, Nutrition Planner, seconded to the Ministry for a period of one year by FAO, from M.I.T. Dr. McArthy and Mr. Otieno are preparing the section on nutrition and agriculture for the forthcoming Kenyan five-year plan. This document is supposed to be ready in December 1978, and Mr. Mule (Permanent Undersecretary, Ministry of Finance and Planning) had recommended that I meet with Mr. Otieno to discuss study progress. Mr. Otieno had been well briefed by Dr. Latham on the study, and informed us that some of the earlier and current results will be incorporated in the plan document and that he had also asked Dr. Latham to help his ministry review a number of recommendations for a National Nutrition Plan. He informed us that he would also appreciate it if the Bank could forward him copies of one of our Nutrition Project appraisal reports, and we discussed several possible approaches to a Nutrition Planning exercise.

18. I also briefed Mr. J. North, Bank Resident Representative, on study progress. He requested that Dr. Latham brief him more fully on some administrative matters regarding the use of the Bank vehicle. This was duly communicated to Dr. Latham. Dr. Latham was also informed of the Bank's preference for the inclusion of an economist such as Dr. Hopcraft on the study tea, and my concern over the calorie study financed by O.D.M. in Nyeri (paragraph 4-7).

19. I departed from Kenya on July 12. Separate reports are forthcoming at the end of August from Mr. Sharrock and Dr. Latham on work output studies and overall progress report respectively.

20. Action Recommended:

(a) After reviewing Mr. Sharrock's report, his recommendations, and the statistical significance of the results he has obtained so far, the Bank should decide whether to recommend to O.D.M. and Dr. Latham that the calorie supplementation studies be continued (using farm or plantation workers) or be transferred to the Kwale road workers or, if necessary, dropped.

(b) If more of Mr. Sharrock's time is needed because of the issues mentioned in paragraphs 4-7, then reallocation of contingency funds or labor-substitution study funds to this purpose should be undertaken as soon as possible.

(c) If Study 1 is dropped altogether, some productivity data can still be obtained from Study 2. Dr. Latham should therefore return to Kenya with Mr. Sharrock to set these up as soon as possible, and incorporate these into the design of the anemia studies. Conversely, we may drop productivity studies altogether and concentrate instead on the cost/benefit studies of Study 2.

(d) Mr. Hopcraft should be immediately sent a letter from the Bank confirming his terms of reference (see attached).

(e) A copy of the Colombia Nutrition Project should be sent to Mr. Otieno, Ministry of Finance and Planning, and the Bank should study the possibility of participating in a Kenyan National Nutrition Plan if this is so requested.

Attachments:
(1) Draft Terms of Reference for Dr. Peter Hopcraft, Consultant Economist.

(2) Draft letter for Dr. Latham indicating concern over Study 1 and alternatives.

(3) Outline of field staff.

Distribution:

Messes. van der Tak (PAS) 3
Lethem (PAS)
Christoffersen (AGR)
Schebeck (AGRNU)
Berg (AGR)
Coukis (TRP)
Central Files

Messrs. Chernichovsky (DED)
Faruqee (DED)
Bery (VPD)
Lee (PAS)
Sandberg (EA1)
Miller (EDI)
North (Nairobi, Kenya)
Ms. Goris (Nairobi, Kenya)

SSBasta:ap

People Met in Kenya July 5 - July 12, 1978

Mr. J. D. North - Bank Resident Representative - Nairobi
Miss H. Goris - Deputy Resident Representative
Mr. J. Otieno - Senior Planner, Ministry of Finance and Planning
Mr. E. McArthy - FAO/MIT consultant - Ministry of Finance and Planning
Mr. B. Nilssen - Bank secondment staff - MOW
Mr. John Simpson - Director, Rural Access Roads Program - MOW
Mr. M. Sharrock - Consultant, Work Output Studies
Dr. M. Latham - Principal Investigator, Professor of International Nutrition, Cornell University
Dr. L. Stevenson-Latham - Co-investigator, Cornell University
Dr. Peter Hopcraft, Senior Economist, Institute of Development Studies, Kenya
Ms. June Wolgomuth, Mr. Terry Elliot, Co-investigators, Cornell University
Mr. Andrew Hall - Parasitologist, Cambridge University
Mr. Michael Gathu - Oversear, MOW (Keratina)
Mr. John Mwangi - Officer in charge, (Nyeri Rural Access Roads Program, MOW)
Mr. Joshua - Kwale field staff.

DRAFT
SSBasta:CHarrall:ap
Aug. 15, 1978

TO: Mr. Peter Hopcraft, Economist

FROM: Samir Sanad Basta, AGRNU

SUBJECT: KENYA - Research in Nutrition & Productivity (RP0671-73): Terms of Reference

1. This will confirm our understanding of your contribution to the above project as we discussed during my recent visit to Kenya. We request that you work directly with Dr. Michael Latham but please copy all reports and substantive correspondence to me and Clell Harral at the Bank. We expect you to play a major role in sorting out the effect of broader socio-economic parameters from the nutritional factors in these series of studies and in delineating specific practical recommendations for future nutrition programs in Kenya. To this end we expect you to assist in (i) data collection; (ii) data analysis; and (iii) report preparation, as outlined below.

2. Initially, you should review and, if necessary, prepare a list of the socio-economic indicators which should be monitored during the data collection phase of studies 1 and 2. You should review the overall statistical design of these two components to ensure that sufficient non-clinical variables are measured, so that social and economic conditions are taken into account when explaining productivity changes in control and target populations.

3. You will also be involved in a review of the different dietary interventions proposed for studies 1 and 2, and advise Dr. Latham and his research team, on the suitability of proposed diets from both the cost point of view as well as the feasibility of their introduction into long term programs.

4. Given your experience in Kenya's agriculture sector, you will also advise as necessary on alternative choices and sites for study 1, including the possibility of replacing study 1 road workers with agricultural laborers on plantations or farms.

5. You will also be involved in data analysis during the latter phases of these components. You should help Dr. Latham to differentiate between real and apparent effects of the various interventions. Careful screening of non-nutritional or clinical effects upon productivity, income, and overall weight gains in the various populations under study will be necessary.

6. Implications and Recommendations are a third area of responsibility that you should be deeply involved with. You should play a key role in advising the research team and the Bank what long and short term economic implications of the results of studies 1 and 2 are, in both, for example, labor abundant as well as labor constrained scenarios.

7. Finally, with your knowledge of Kenyan government plans and policies, the limitations of some Ministries and the cost/benefit results of these studies, you should carefully study practical recommendations that would emerge from the various studies (including studies 3 and 4). Along with Dr. Latham and in consultation with officials from the Ministry of Planning and Finance you should also advise government and the Bank on how best to implement study results in Kenya's national development plans.

8. You will prepare a first progress report outlining your findings and recommendations no later than February 1979. A second report would be due by February 1980 and a final report by December 31, 1980.

To be cleared and cc: Mr. Michael Latham

Record Removal Notice

The World Bank Group Archives & Records Management

File Title	Barcode No.
Kenya - Health Nutrition and Worker Productivity Studies - RPO 671-73	30135024

Document Date	Document Type
4/18/1978	Letter

Correspondents / Participants
To: Michael Latham
From: Samir Basta

Subject / Title
World Bank Research Program Consultant fees

Exception(s)
Personal Information

Additional Comments

The item(s) identified above has/have been removed in accordance with The World Bank Policy on Access to Information. This Policy can be found on the World Bank Access to Information website.

Withdrawn by	Date
Bertha F. Wilson	30-Jun-21

Attachment (3)

OUTLINE OF FIELD STAFF

After the initial departure of Dr. M. Latham at the end of July 1978, and until his return in January 1979, field responsibility will be divided as follows:

Dr. June Wolgomuth (Cornell University) will be in charge of the Nyeri calorie feeding studies and will remain in Keratina until January 1979;

Mr. Terry Elliott, also of Cornell, will remain in Kwale and be in charge of the anemia studies;

Mr. Andrew Hall (Cambridge University) will continue with parasitological studies at both Keratine (Nyeri) and Kwale;

Mr. Peter Hopcraft (economist, University of Nairobi) at my recommendation will also undertake some field supervision for both studies and will receive the necessary reports from Dr. Wolgomuth and Mr. Elliot. He has also undertaken to report to Mr. John Simpson (Director, Rural Access Roads Program, MOW) at regular intervals, as well as to the Bank;

Mr. Mark Sharrock, according to the original schedule, will return to Kenya in November 1978 for the final (post-intervention) productivity studies in Nyeri; and

Dr. and Mrs. Latham will return in January 1979 to begin the anemia and parasite treatment studies in Kwale.

W(BANK / INTERNATIONAL FINANCE CORPOR/ N

OFFICE MEMORANDUM

TO: Mr. Samir S. Basta, Nutrition Expert, AGRNU DATE: June 22, 1978

FROM: Clell G. Harral, Highway Design and Maintenance Advisor, TRP

SUBJECT: KENYA: Nutrition and Productivity Studies (RES671-73) - Terms of Reference - Supervision Mission

1. You will arrive in Nairobi on or around July 5, 1978, for a period of one week to review in the field the Nutrition and Productivity Studies funded by the Bank's Research Committee.

2. In more detail, you will review with Drs. Michael and Lani Latham (Consultants), the final draft of the first inception report, paying particular attention to clarification of those points raised by you in Dr. Latham's circulated draft of May 24, 1978.

3. You will review with Messrs. Sharrock (Consultant), and Nilssen (Bank Secondment Staff), the methodology for the work output studies, paying attention to the statistical considerations raised by Dr. A. Chesher (Consultant, University of Birmingham). In addition, you will advise on and help formulate, the types of nutritional interventions that will be used in Study No. 2, making the final choice for the appropriate delivery mechanisms.

4. During the time you will be in Nairobi, you should meet with Mr. J. D. North (Bank Resident Representative), Mr. John Simpson (Ministry of Public Works), and Mr. Harris Mule (Deputy Permanent Secretary, Ministry of Finance) in order to brief them more fully on the latest development of these studies. You should also discuss with Mr. Mule and a representative of the Ministry of Health, Kenya's latest plans for an overall nutrition strategy, which would try to incorporate some of the findings from this and earlier studies, per Mr. Mule's earlier suggestions.

5. On your return from Kenya, you will write a brief back-to-office report outlining your findings and recommendations.

Cleared with and cc: Mr. E. Schebeck, AGRNU
Ms. H. Goris, EA1

cc: Mr. H. van der Tak, PAS
Mr. F. Lethem, PAS
Mr. J. D. North (Nairobi)
Mr. A. Berg
Mr. S. Bery, VPD
Mr. J. Greene, AGR
Mr. T. King, DED
Mr. N. Wilkie, AGR

SSBasta:jm

7 671-73

Cornell University
DIVISION OF NUTRITIONAL SCIENCES
Savage Hall
Ithaca, New York 14853

A DIVISION OF THE NEW YORK STATE COLLEGES OF
HUMAN ECOLOGY AND AGRICULTURE AND LIFE SCIENCES
Statutory Colleges of the State University of New York

May 24, 1978

Mr. Clell Harral
Transportation Department
The World Bank
1818 H Street N.W.
Washington, D. C. 20433

grey box

Dear Clell:

I enclose for you a "Preliminary Draft Inception Report" as required for the "Kenya: Health, Nutrition and Worker Productivity Studies". The final draft is due in August 1978.

As you know we will be leaving for East Africa on June 1, 1978. Lani and I will both be presenting papers on the Kenya project at the 25th Jubilee Conference of the Association of Physicians for East and Central Africa in Dar es Salaam to be opened by President Nyerere on June 4. I have also been invited to be the main speaker at a special symposium there.

From June 10 we will be in Kenya and can be contacted as follows: c/o Dr. A. Jansen, Medical Research Centre, P. O. Box 20752, Nairobi. We plan to return to Cornell on about July 25, 1978. We expect to leave Nairobi for London on the weekend of July 23.

As indicated previously a visit by Samir Basta would be very welcome. We hope that this can be late June or in early July, but should definitely be before say July 20.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. Samir Basta ✓

 7-671-73

OFFICE MEMORANDUM

TO: Mr. Armeane M. Choksi, DED

DATE: March 6, 1978

FROM: C. G. Harral, TRP, and S. S. Basta, AGR

SUBJECT: KENYA: Review Panel Discussion on Health, Nutrition and Productivity Studies (671-73)

1. A review panel consisting of Messrs. Berg, Casazza, Greene and Schebeck met on March 2, 1978 to consider implementation of the recommendations for the above project as set forth in Mr. B. B. King's memorandum of January 31, 1978. Also present were Dr. M. Latham, and L. Stephenson (Cornell University), and Messrs. Beenstock, Basta and Harral, as well as yourself.

2. The reviewers, the sponsors and the primary investigators all agreed that the issues mentioned in Mr. King's memorandum were or are in the process of being resolved. Specifically, it was first agreed that in study 1, since the objectives were to measure productivity changes accurately, the caloric vehicle and placebo should be as simple as possible, and for that reason an acceptable drink or maize gruel would be used. For study 2a which would focus on the effectiveness of feasibility of worker feeding, more elaborate mixtures would be used and the effectiveness of each evaluated in terms of cost, acceptability, and physiological impact.

3. The panel then addressed itself to questions 4, 5, and 6 in Mr. King's memorandum dealing with logistics and objectives for study 2a. It was agreed that Dr. Latham would carry out certain procedures in choosing the 700 Calorie supplement which would involve surveying what is currently being consumed, and what additional foods in that specific region could be consumed. In addition, an investigation would be made as to choice of food vehicle (in the case of fortification), and effective means of distribution involving different levels of subsidy, free-food etc. Actual consumption and acceptability over time would be carefully monitored.

4. In regards to question 8 of the King memorandum, Dr. Latham discussed his recent meeting with the Deputy Permanent Secretary of the Kenya Ministry of Finance and Planning, as outlined in his letter to Mr. Harral of February 23 (attachment 1). The Government of Kenya finds the study relevant, and extremely useful for the formulation of strategies in its next 5-year plan. The study would also affect Bank lending policies by helping to define nutritional status and strategies in Kenya, and by obtaining the only known data on longitudinal growth of Kenya children. It would also determine the feasibility and cost effectiveness of deworming large population groups, and assess reinfection rates in rural areas, at present unknown. This series of data would be essential to helping define a national nutrition project. In addition, by helping to define methods to improve worker productivity, the research could affect the efficiency of many of the Bank's future projects.

5. In regards the need to define more clearly the statistical methodologies to be used, the Bank has engaged Dr. Andrew Chesher (University of Birmingham), to work closely with Dr. Latham in the application of an optimal statistical design. Dr. Chesher's preliminary conclusions were discussed (see attachment 2). He has already met with Dr. Latham and approved the overall design of the project. Currently, he and Dr. Latham are investigating the possibilities of increasing the sample sizes for study 1.

6. In regards question 10, which recommends the hiring of an economist for the research staff, Dr. Latham is consulting with two economists. These are Dr. Peter Hopcraft at IDS, Nairobi and Dr. Maarten Immink at Cornell University. As noted in the enclosed letter, Dr. Latham is optimistic that they will join the study. In any case, the panel gave him the names of other economists familiar with these types of studies, and Dr. Latham stressed that he fully intends to provide an economic analysis of the various components in the project.

7. After the discussions, we conferred with each of the above members of the review panel who indicated that the questions previously raised had been satisfactorily resolved or would be in the course of the work, and it was agreed that the Bank will proceed to finalize contractual arrangements with Dr. Latham.

cc: Messrs. Berg, Schebeck and Greene (AGR); Casazza (PAS); Beenstock(PPR); Faruquee and Chernichovsky (DED)

SSBasta:jm

Mr. C. Willoughby, TRPDR

February 23, 1978

I. M. D. Little, VPD

Research Committee Action on the Research Proposal:
Kenya - Health, Nutrition and Worker Productivity Studies

1. At its meeting on February 17, the Research Committee approved funding for this proposal as requested, subject to the proviso that a panel be constituted to ensure that the issues raised in the panel recommendation memorandum of January 31, 1978 are satisfactorily resolved in a meeting with Dr. Latham. The panel is expected to report the outcome of its meeting to the Research Advisor.

2. The project identification code and authorizations are as follows:

(i)	Identification Code:	671-73
(ii)	Total Authorization:	$97,250
(iii)	FY Allocations - FY78:	$25,750
	- FY79:	$29,500
	- FY80:	$42,000
(iv)	Date Final Report Expected:	December 1980

3. Please use the identification code in all financial documents and other communications concerning this project, including letters of appointment to consultants.

cc: Messrs. Basta, Harral, Panickaveetil, Benitez
Mrs. Hazzah

AMChoksi:gm

Attachment 1
Logged 3/2/78

Cornell University
DIVISION OF NUTRITIONAL SCIENCES
Savage Hall
Ithaca, New York 14853

A DIVISION OF THE NEW YORK STATE COLLEGES OF HUMAN ECOLOGY AND AGRICULTURE AND LIFE SCIENCES
Statutory Colleges of the State University of New York

February 23, 1978

Mr. Clell Harral
Transportation Department
The World Bank
1818 H Street N.W.
Washington, D. C. 20433

Dear Clell:

I have just returned to Ithaca, extremely pleased with the progress made in Kenya, very confident that the Government of Kenya would like to implement our recommendations, and quite satisfied with meetings in London with Sharrock, Chesher, and staff at ODM.

The day before I left Kenya I had a long and fruitful discussion with Mr. Harris Mule (Deputy Permanent Secretary of the Ministry of Finance and Planning) and some of his senior advisers. Far from seeing our World Bank/ODM supported proposal as academic, Mr. Mule believes that our earlier findings already justify action. He was familiar with both the roundworm and worker productivity studies. He would like us to make some suggestions for incorporating plans for a broad deworming project into appropriate parts of the Kenya development plan. He hoped that routine deworming could be tried on a much wider scale in a number of projects including whole districts or large communities. He felt that existing staff such as health inspectors who were currently underutilized could be used for such projects so that delivery costs would be low. He also said that the government would be most eager to utilize the findings of our worker feeding investigation in a broad range of programs where labor was employed. He believed that funds from the World Food Program could soon be used to implement specific recommendations that we might make. He was therefore keen that our Study 2a be completed as soon as possible so that plans could be made for large scale intervention projects. He also wants to see our recommendations concerning means to control the underlying causes of anemia (such as iron deficiency, hookworm and malaria) because the stress of the government will be on preventive medicine, and improving the quality of life of the people.

Mr. Mule prior to our meeting had said that he wanted my advice on the current draft of the five year national development plan especially with regard to the sections on nutrition and on health. These still confidential documents were given to me, and Mr. Mule asked if I could make some recommendations including those emanating from our research. This I will do shortly.

In summary then I am very encouraged that the Ministry of Finance and Planning does intend to utilize the findings from our studies in Kenya. Those very influential in formulating the new five year development plan have asked me to help with that plan so that our recommendations might be included.

I should also mention that the Central Bureau of Statistics has just published the findings of a Rural Kenyan Nutrition Survey, and that this has suggested that answers to certain questions can only be obtained from longitudinal,

rather than cross sectional growth studies. The nutrition-roundworm study in Machakos district which we are undertaking longitudinally will be the first rather large longitudinal study of growth and of malnutrition in children in Kenya. This is a side dividend to our project the importance of which has not previously been adequately stressed. When completed in 1980 we will have measurements of growth and nutritional status of children for 5 consecutive years. We believe that this will be very important for Kenya.

I was not able to see Dr. Peter Hopcraft at IDS in Nairobi after your cable arrived. He was away. However I have discussed the project with him before, and I have now asked him if he will be willing to provide economic advice. I have no doubt that he will agree to do this. I concur that this will be important for Study 2. I do intend also to use economists at Cornell. Maarten Immink, an economist at Cornell recently appointed to work in the Program in International Nutrition which I direct, will provide continuing advice. He has considerable experience in problems relating nutrition to economics, and also in nutrition worker productivity studies. He previously spent 5 years working with Dr. Viteri at INCAP in Guatemala.

I should also mention that prior to meeting with Mr. Mule, I had a discussion with Mr. North, the World Bank Director in Nairobi, about our project and about the inclusion of nutrition in other World Bank activities in Kenya. The purpose was to make him aware of our presence and intentions.

As you know I have now left behind in Kenya Ms. June Wolgemuth from Cornell and Mr. Andrew Hall from Cambridge University. They are both Research Assistants who will be working on the projects in Kenya for the next 18 months or thereabouts.

In London Lani and I held a very useful meeting with Mark Sharrock, Phil Green and Andrew Chesher. Details of the proposed timing and actual work of Mark Sharrock in Kenya later this year were agreed upon. Andrew Chesher discussed in some depth the statistical analysis of the data that would be generated by the research. He was most helpful, and seems entirely satisfied with our proposals. He agreed to write a short outline of the proposed statistical analysis and to let you have it before our meeting on March 2. In London I also held talks with officials at the Ministry of Overseas Development, and I believe that this will lead to a smooth and more speedy disbursement of funds by them. These officials expressed some surprise that the World Bank still had not funded their part of the project.

All in all then I am pleased with the progress we have made, with the attitude of the Kenyan government, and with the assistance that we are getting as a result of your efforts. The main concern I now have is that after all this effort on all our parts we are still hampered by not having Bank funds, and are still working in this atmosphere of uncertainty. This issue has, surely, to be resolved very very soon.

With all good wishes.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

cc: Dr. Samir Basta

Attachment 2

KENYA HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDY

Comments on statistical aspects of the study: Andrew Chesher*

STUDY NO.1

My understanding is that the experiments involving iron supplementation and anthelminthic treatment are not proceeding. These comments therefore relate to the dietary intervention study alone.

In my view it is essential to have a control group who will receive a "placebo' meal - i.e. a meal with limited nutritional content. This is necessary because of the relatively long duration of the experiment and the associated possibility of changing environmental conditions. It is my understanding that Dr Latham now intends to include such a group. Site and environmental conditions should be recorded at the time when work output is measured.

Care should be taken when assigning individuals to control and treatment groups to ensure that in important respects the groups are similar. The variable under study here is the change in time taken to complete a task between the beginning and end of the study. Variables which might be expected to affect this are: (i) Initial weight as % of nominal weight for height; (2) Health status including degree of parasitic infection and severity of anaemia; (3) Age; (4) Time taken to complete task before intervention. I would expect (1) and (2) to be the most important variables - these should be made as similar as possible in the treatment and control groups. I would not expect (4) to be particularly important - any difficulty here would probably be resolvable at the analysis stage by using proportionate change in time taken to complete the task as the object of the analysis.

Care should be taken not to overstate the effect of dietary intervention. This might happen if, in the experiments, workers were given large incentives to finish work quickly. The effect of dietary intervention on the output in "normal working" is what is of interest.

---

* University of Birmingham, England. Report written 22 February 1978.

The major problem with this study is the sample size. Experience with previous Labour Substitution Study data shows that the relationships between productivity and environmental parameters are obscured because of considerable variability in productivity (a) from person to person and (b) from time to time. In their previous work (World Bank Labour Substitution Study Technical Memorandum No.26, May 1977) Drs Latham and Latham find that the % of the variance in task time attributable to variation in weight as % of weight for height is 4% for the Kwale District data and 14% for Nyeri District. The effect of the calorific content of diet on task time cannot be expected to be much stronger than this. To measure accurately the average effect of dietary change on task time when the former only explains perhaps 20% of the latter is not impossible but may well require quite large samples. My feeling is that 120 men is rather small for this purpose. I would anticipate that with 120 men an effect attributable to dietary intervention will be detected but that the magnitude of the effect will be difficult to determine.

In as much as some of the variability in observed task time is due to temporal changes taking repeated observations on the workers will help. My understanding is that 20 days data on each man at each of three stages of the intervention will be obtained and I expect this to be adequate. The variability in task time due to differences between workers can only be reduced by looking at more workers - perhaps this is not possible. The possibility of a high dropout rate should be considered.

STUDY NO.2

It should be realised that since no control groups are proposed in this section of the study, unambiguous association of changes in health status with treatment will not be possible. I believe that Dr Latham is aware of this.

STUDY NO.3

Study results are apparently to be used to infer health and nutritional status for roadworkers in large regions of Kenya. The workers studied for this purpose should in some sense formally or informally make up a representative

sample of these workers. Is this to be the case? Also, since treatment will be given when workers are examined, is it not possible that disproportionately large numbers of sick people will be observed?

STUDY NO.4

Villages to be used are already familiar with investigators and their procedures - perhaps this will lead to overstating the ease with which parasitic control can be performed.

STATISTICAL ANALYSIS OF THE KENYA HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDY

Andrew Chesher*

STUDY NO.1 (Dietary Intervention)

The aim of this study is to detect and measure the effect upon the productivity of Kenyan road workers involved in heavy manual work of increasing their calorific intake by provision of a mid-day meal/snack. The following data will be collected.

(1) Time to complete set task on each of 20 days for each of 120 men. Measurement taken at start of experiment but after essential medical treatment has been provided.

(2) Clinical and anthropometric data on each of the 120 subjects.

(3) Dietary recall information.

(4) Time to complete set task on each of 20 days at half way stage in experiment for all men still participating.

(5) Limited clinical and anthropometric data on these subjects at halfway stage.

(6) Dietary recall information at halfway stage.

(7) Time taken to complete set task on each of 20 days at termination of experiment.for all men still participating.

(8) Limited clinical and anthropometric data on these subjects at termination.

(9) Dietary recall information at termination of experiment.

Analysis

(3), (6) and (9) (dietary recall information) will be used for monitoring purposes only. Evidence of substitution of experimental food for food at home will be presented in order that results may be interpreted correctly but will not be used directly in the analysis.

---

* University of Birmingham, England. Report written 22 February 1978

(4), (5) and (6) (halfway stage data) will be used only if terminal data is seriously lacking. It is collected only to insure against early termination of the experiment though it may be used to make parity checks on the initial and terminal data.

The main body of the analysis will concern items (1), (2), (7) and (8). The object of interest is the change in task time between the beginning and end of the project. First a measure of task time for each man at the beginning and end of the project is required. For each man participating in the experiment at its termination, the 20 days data from the start and end of the project will be inspected for outliers. Certain days' data may be deleted if it is felt that they are not representative. Care should be taken to treat the initial and terminal data consistently in this respect. Thus if all data gathered on Mondays are deleted from the initial data then similar action should be taken with the terminal data. It is not necessary to use the same amount of data for each man though the analysis is a little more complicated when unequal amounts of data are used. For each man average task times for the start and end of the experiment will be computed using the selected data. Denote these x_{Ijk} and x_{Tjk} where I and T denote initial and terminal data, j indicates the man and k the group (control and treatment). Associated with these are estimates of the variances of the mean task times, S_{Ijk}^2* and S_{Tjk}^2 and the number of days of data used to produce the mean task times, n_{Ijk} and n_{Tjk}.

For each man $d_{jk} = x_{Tjk} - x_{Ijk}$, the difference in mean task time between the beginning and end of the project is calculated.

Assume that across individuals in group k task time is distributed approximately normally** with variance σ_{Ik}^2 at the start of the experiment and

---

* $S_{Ijk}^2 = \frac{1}{n_{Ijk}} \left\{ \frac{1}{n_{Ijk}-1} \sum_{1}^{n_{Ijk}} (x_{tIjk}-x_{Ijk})^2 \right\}$ where x_{tIjk} is the original daily data. S_{Tjk}^2 is defined similarly.

** Inspection of the raw data may indicate that the distribution of task time is skewed and that applying the logarithmic transformation eliminates this skewness. In this case x_{Ijk} and x_{Tjk} should be interpreted as mean log task times. Similarly S_{Ijk}^2 and S_{Tjk}^2 should be redefined.

σ_{Tk}^2 at the end of the experiment. Then d_{jk} is distributed normally also with variance

$$\frac{\sigma_{Ik}^2}{n_{Ijk}} + \frac{\sigma_{Tk}^2}{n_{Tjk}}$$

which is estimated by $S_{Ijk}^2 + S_{Tjk}^2$ and mean denoted by D_k. Let k = 0 denote the control group and k = 1 denote the treatment group. Several hypotheses are of interest - they are listed below.

Hypothesis (a): $D_o = 0$ (mean task time does not alter during the experiment for the control group)

If the quantities $S_{Ijo}^2 + S_{Tjo}^2$ are approximately constant this is tested simply by calculating the mean of the d_{jo}'s and applying a t-test. If the $S_{Ijo}^2 + S_{Tjo}^2$'s differ greatly from man to man a weighted analysis is necessary - this is however quite simple to perform.

Hypothesis (b): $D_1 = 0$ (mean task time does not alter during the experiment for the treatment group)

Proceeds as hypothesis (a) using d_{j1}'s

Hypothesis (c): $D_1 = D_o$ (mean task time alters identically over the experiment for the control and treatment groups)

If the $S_{Ijk}^2 + S_{Tjk}^2$'s are approximately constant this is tested by calculating the difference between the mean of the d_{jo}'s and the d_{j1}'s and applying a t-test. If the $S_{Ijk}^2 + S_{Tjk}^2$'s differ greatly a weighted analysis is appropriate.

The relationships between task time and clinical and anthropometric attributes of workers are also of interest. These may be examined by considering the following schematic model.

$$(1) \quad x_j = \alpha_o + \alpha_1 C_j + \alpha_2 H_j + \alpha_3 W_j + \alpha_4 A_j + \varepsilon_j$$

Here x is mean task time, C_j is a measure of calorific intake, H_j measures the health status, W_j the weight as % of weight for height and A is other anthropometri data, all relating to worker j. The term ε_j is a disturbance. Data items (1), (2), (7) and (8) will yield up to 240 observations on this model.

We can expect to observe C at only two levels C_I and C_T and at this latter level we will have at most 60 observations (treatment group, terminal data). H can be expected to vary across individuals but not greatly across time. W will vary because for untreated workers weight will drop as work proceeds while for treated workers it will increase or remain constant. If the mean levels of W for the control and treatment group are respectively W_o and W_1 then the effect of dietary intervention could be measured by $\alpha_1 + \alpha_3(W_1 - W_o)$. Since observations on this model are not independent (two observations being obtained on each worker) (1) should be estimated as an error components model.

The analysis could be simplified here by estimating (1) for subsets of the data. The precise functional form of (1) will be determined at the analysis stage.

Presentation of results

This will consist of:

(a) Tabulations and summary statistics describing attributes of workers and site conditions at times of observation and distribution of task times.

(b) Results of statistical tests described above.

(c) Graphs of estimated relationships.

STUDY NO.2 (Evaluation of interventions to improve health, nutritional status, and worker productivity)

(a) Evaluation of different types of mid-work day snacks and delivery systems

This experiment will provide descriptive statistical information concerning participation rates under alternative snack/delivery systems. This will be summarised in tabular form. Information concerning costs of alternative snack/delivery systems will also be given.

(b) Study of routine provision of iron

This experiment generates clinical measurements on approximately 150 men before and after provision of iron supplementation by two alternative methods. Records of participation will also be available. For those men participating

key clinical variables pertaining to iron deficiency will be compared before and after intervention. The hypotheses that mean values of clinical variables considered one at a time show no change over the experimental period under each delivery system will be tested using conventional t-tests. The hypothesis that the mean values of all relevant clinical variables regarded as a set do not change over the intervention period under each delivery system can be treated using conventional F-tests.

Presentation of results

These will consist of:

(a) Tables and summary statistics describing clinical and other characteristics of workers before and after intervention, including correlations amongst clinical characteristics.

(b) Information concerning participation rates under alternative delivery systems.

(c) Results of statistical tests described above.

(c) Prevalence of parasitic diseases

This sub-study generates clinical and anthropometric data on approximately 200 workers prior to and after medical treatment for parasitic infestation. Information on work attendance (no. of days absent per month) prior to and during the experiment will also be obtained. Analysis and presentation of results is similar to that in (b) above. Multiple regression analysis will be employed to measure the relationship between clinical and anthropometric attributes. A binomial multiple regression model will be appropriate for the relationship between number of days of absence from work and clinical and anthropometric attributes. Results will be presented in tabular and graphical form.

(d) Evaluation of routine parasitic treatment and prophylaxis

This sub-study consists of three projects.

(i) Treatment of intestinal parasites

Stool examinations of 80-100 men will be performed at the start of and during a period during which an anthelminthic drug is provided. Data on levels of infection, health status and absenteeism will be obtained at the start of and during the experiment. Descriptive statistical analysis relating levels of infection etc. to length of treatment will be performed and reported in tabular and graphical form.

(ii) Treatment of malaria

Clinical and other information on 80-120 men including level of infestation with malaria parasites will be obtained before and after regular treatment with choroquine. Effects of treatment on clinical and other attributes will be analysed and summarised as in (b) above.

(iii) Treatment of urinary schistosomiasis or bilharzia

Clinical and other information on approximately 50 men before and after treatment for schistosomiasis will be obtained. Effects of treatment on clinical and other attributes will be analysed and summarised as in (b) above.

STUDY NO.3 (Health and nutritional factors related to productivity in two new ecological areas)

This study generates descriptive statistical information concerning clinical and anthropometric attributes of workers at four road sites in two areas of Kenya. This information will be summarised and presented in tabular form. The areas studied will be compared with each other and with areas already studied in Kenya.

STUDY NO.4 (Evaluation of a programme to control intestinal parasites in a community)

This study generates statistical information concerning clinical, nutritional and anthropometric attributes of children in two villages during a period in which anthelminthic treatment is regularly provided. Descriptive statistical methods will be applied to this data and the results will be presented in tabular and graphical form. More formal and technically difficult statistical analysis will be necessary if inferences are to be drawn concerning the relationships between anthropometric attributes and nutritional attributes and levels of infestation. These are not discussed here.

OFFICE MEMORANDUM

TO: Mr. Armeane Choksi

DATE: February 9, 1978

FROM: Clell G. Harral and Samir Basta

SUBJECT: KENYA: Health Nutrition & Worker Productivity Studies

1. In his memorandum to Mr. King of January 17 Mr. Waide, although complimenting the quality of this research proposal, inquired whether WHO, UNICEF (or possibly other international organizations) might more suitably sponsor this particular research rather than the Bank. Several factors explain why this would not be so. First, there are several components of the project (particularly studies 2 and 3) which are designed primarily to assist the Bank in developing the methodology and particularly empirical basis for economic analysis of nutrition projects.1/ We specifically invited Prof. Latham to prepare proposals to the Bank on these matters because we felt that it would unlikely be of interest to other organizations. Second, WHO Research Division is hampered by lack of funds and has not initiated significant new research recently; also UNICEF does not normally finance research activities. Third, even if other funding might be found, the time delays would be critical. All the studies (and programming of staff) are designed as an integral whole to be undertaken simultaneously, and Prof. Latham's team is already in the field under ODM funding for study 1. It would not be sensible or feasible (and certainly much more costly) to schedule studies 2-4 at a later date. We note that our successful effort to obtain parallel financing from U.K. Overseas Development Ministry for about $71,500 (or almost 60% of the costs of Phase I and 45% of total costs) required a significant effort by Bank staff, and more importantly the lapse of several months. Even then, ODM was not interested in the components of the project of greatest relevance to Bank needs. Thus we believe there is a compelling case for Bank financing of the small additional funds required.

2. Taking into account the comments of the review panel (paragraph 10, Mr. King's January 30 memorandum to you) concerning the need to add an economic analyst, we wish to add an additional $4,000 for this purpose. We have also corrected some minor errors which occurred in the November 16 proposal and the corrected cover sheets are attached herewith.

3. We have initiated arrangements for the meeting with Professor Latham as requested by the review panel and I expect to confirm the date to you within a few days.

1/ Which, it should be noted, will be helpful in other countries, not only in Kenya.

CGHarral:

cc: Messrs. B. WAide, ASNVP
H. van der Tak, PAS
C. Willoughby, B. Coukis, TRP

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Exception(s)
Personal Information

Corporate Administrative Matters

Additional Comments

The item(s) identified above has/have been removed in accordance with The World Bank Policy on Access to Information. This Policy can be found on the World Bank Access to Information website.

Withdrawn by	Date
Bertha F. Wilson	30-Jun-21

OFFICE MEMORANDUM

TO: Mr. Armeane M. Choksi DATE: January 31, 1978

FROM: Benjamin B. King

SUBJECT: Kenya - Health, Nutrition and Worker Productivity Studies

1. A panel consisting of Messrs. B. King (Chairman), L. Casazza, R. Faruqee, J. Greene and S. O'Brien considered this proposal on January 12. Messrs. S. Basta, C. Harral and A. Choksi were also present.

2. The consensus of the panel was to approve the research proposal. There were, however, several reservations which the researchers agreed to take account of in their study.

3. The panel supported the overall purposes of this line of research in Kenya and felt that the initial research projects, of which this proposal represents a continuation, were well conceived. Nevertheless, they had a concern whether the focus of these four new studies was specific enough and whether, at their conclusion, there will be a significant increase in the sum of knowledge, in particular about the cost-effectiveness and replicability of particular interventions.

4. They were not so concerned about Study No. 1; there the proposal clearly states that "a careful analysis will be made of the costs of the intervention" and that "these costs will be compared with the benefits to be gained as a result of the intervention in terms of worker productivity." However, when confronted with the difficulties of obtaining conclusive results in other countries, and the failure of the earlier exercise in Kenya due to insufficient study period and the poor general health status of the workers, one is uncertain whether one will actually obtain such a cost-effectiveness measure from Study 1. Finally, a critical element in a study of this type is the food supplement to be fed for the eight to ten months intervention period. The panel would be interested in details of the control and intervention menus as well as the logistics for providing the food, when these are available.

5. There was strong consensus that the proposal should be explicit about what will be evaluated in Part (a) of Study No. 2 (page 11) and how it will be done. For example, it is not clear whether the intention is to evaluate:

(a) differences in work output ascribable to different kinds and levels of food intervention;

(b) the feasibility of delivering hot vs cold meals;

(c) which delivery systems are most effective and least costly in getting food to workers;

(d) the effect of different kinds and amounts of worker snacks on family food behavior; or

(e) some combination of the above or other factors.

6. It was felt that the study would be particularly useful, but fairly complicated, if its principal purpose were to identify an optimum combination of a snack and a delivery system producing a given nutritional punch at minimum cost among the workers. In that case, the evaluation would have to proceed from a methodology appropriate for such analysis. The development of that methodology would have merit in its own right as a useful corollary output of the study, since relatively little systematic analysis of such feeding programs has taken place.

7. Further, if a significant proportion of the workers in the above study were ascaris-infected, would it not make sense to administer anti-helminthics to a portion of the experimental group? The study then could evaluate the work output effects of food and anti-helminthics when combined, administered separately or foregone. The results would probably more than offset the modest cost of adding this dimension to the study.

8. For all parts of Study 2, the research team had not made clear the proposal's relevance to current or planned public programs and policies in Kenya, and to the Bank's lending priorities in that country. This is particularly true for Study 4, when the feasibility of controlling parasitic infections in a community is tested using a delivery system that could not be afforded on a national scale. Specifically, the support of the Kenyan Government for continuing this research and its intention to utilize its findings should be ascertained as far as possible.

9. On the issue of method of analysis, the panel felt that the researchers should indicate more clearly the methodologies, including the statistical techniques, to be used in the research. Based on earlier research and the design for the present phase, the team should describe more succinctly the variables to be constructed, the statistical techniques to be used and also the formats to be chosen for presenting the results.

10. The panel was also struck by the absence of any specific reference to economic analysis in the proposal, although a good deal is implied in Study No. 2. It would be useful to add an economist to the staff. Perhaps one from the Institute for Development Studies could serve as a consultant.

11. There was the question of whether the Bank should be sponsoring this kind of research at all. One might argue that this proposal would be better suited to WHO or UNICEF, and if there is to be any division of labor between international organizations this would be a good example of a project the Bank could forego even though it could offer a lot towards the design of a successful basic needs strategy - at least for Kenya and maybe for other countries as well, if the results are transferable. The researchers replied that the other international organizations had not previously concerned themselves with effective and cost-effective methods of supplementing nutritional intake, especially under working conditions, and that the Bank had a comparative advantage in this field of work. However, since this question was raised again, outside the panel meeting, the sponsors were requested to provide a written response.

12. The panel recommends that the Research Committee approve the proposal subject to a satisfactory resolution of these issues. The sponsors replied that this could be achieved at a meeting with Dr. Latham in late February or early March.

cc and cleared with: Messrs. Casazza, Faruqee, J. Greene, O'Brien

cc: Messrs. Basta, Harral

cc: [illegible]

Basle House

[illegible]

Mr. Chaksi.

KENYA: HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDIES

PROPOSAL TO THE WORLD BANK RESEARCH COMMITTEE

NOVEMBER 16, 1977

(Note: pages ii, 23, 28, 31-32 amended to include costs for Bank travel and page 23 to show revised reporting schedule.)

Changes to original proposal → 4/7/78

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SUMMARY

Research Project 671-15 ("Studies on the Effects of Health and Nutrition on Worker Productivity"), carried out in 1976 by a group headed by Professor Michael Latham of Cornell University, has investigated health and nutrition factors related to the productivity of road workers, as well as the relationship of parasite infection to child health and growth, in certain parts of Kenya. The research findings have been reported in two IBRD documents attached to this proposal.

The research indicated that undernutrition and anemia were common among road workers, and that they were related to work output. Separately, it was demonstrated, for the first time in a major field study, that roundworm infections retard the growth of children.

It is now proposed to extend this work and to evaluate a number of possible interventions. The studies, which are proposed to be undertaken in Kenya by the same group that carried out Research Project 671-15, are as follows:

(a) Evaluation of Health/Nutrition Effects on the Productivity of Casual Laborers in Rural Civil Works. In this study, the effects of an intervention (provision of calories on work output)will be determined.

(b) Evaluation of Practical Interventions to Improve Health and Worker Productivity. In a series of studies, an evaluation will be undertaken of alternative methods for feeding the workers; of the routine provision of iron and calorie rich foods or medicinal iron to road workers; an investigation will be made of the prevalence of parasitic diseases and their relation to anemia; and an evaluation will be carried out of the feasibility of routine parasitic control.

(c) Survey of Health and Nutrition Factors in Two New Ecological Areas. This investigation on road sites in two new ecological areas, not covered during the 1976 research, will serve to show whether health and nutrition problems are similar to those found in the Highlands or at the Coast and will allow recommendations to be made for Kenya-wide interventions.

(d) Evaluation of the Feasibility and Effectiveness of a Parasite Control Program. This is a continuation of the study on roundworms and other intestinal parasites in children and is designed to maintain control in two villages, to investigate

reinfection rates, and to evaluate simple methods of control which are likely to be applicable elsewhere in Kenya. This study may serve to heighten the awareness of the Government of Kenya to this problem, and will provide guidelines for practical measures to control or contain intestinal parasitic infections.

The Government of the United Kingdom has expressed great interest in the proposed work and, specifically, in Study 1. According to information received in Washington on November 16, 1977 the Ministry of Overseas Development is about to enter into a contract with Professor Latham and his group so that work can begin in January 1978. The ODM financial support will amount to about $71,500.

The proposed work will span a 3-year period and the four studies, although differing in focus, are closely inter-related. Study 1 will deal with the establishment of empirically-based relationships between health/nutrition factors and productivity. Studies 2, 3, and 4 are "intervention-orientated" and are specifically relevant to Kenya. The group under Professor Latham is considered by the Transportation Department as eminently qualified to carry out the work because of the professional excellence of its members, because of its past research in Kenya, and because of the contacts it has established with Government, University and community authorities there.

The total cost of all four studies is estimated at $164,750 over the January 1978-January 1981 period. The work is distinguishable into two phases: January 1978-December 1979 ($124,750) and January 1980-December 1980 ($40,000). Out of the $124,750 for Phase I, about $71,500 will, as noted above, be forthcoming from the Overseas Developing Ministry of the United Kingdom. Thus, Research Committee approval is hereby requested for the Phase I balance, i.e. $53,250 Subject to satisfactory results from Phase I, approval for Phase II by the Research Committee will be requested (for $40,000) (including $7,500 for Bank supervision) in the middle of calendar year 1979.

The Transportation Department, which has been working closely with the Ministry of Overseas Development on the Kenyan Rural Access Roads Program, has undertaken to provide, out of funds from the "Study of Labor and Capital Substitution in Civil Construction", the services of one Statistician and one Work Study Engineer. In addition, the Transportation Department will perform liaison functions between the research team and the East Africa Region Project and Programs Departments.

Direct involvement by IBRD staff in the proposed studies is expected to be minimal: not exceeding four man/weeks per year. Staff involvement will include routine administration, organization of reporting activities (seminars, workshops, etc. on interim findings), and preparation of research results for publication. It is expected that a principal

function of the IBRD staff will be to maintain regular contact with the ODM staff supervising the U.K.-financed portion of the work.

I. OBJECTIVES AND STRATEGY

A. General

(1) Nutrition and Worker Productivity

There is general agreement that nutritional and health factors are important determinants of the human ability to perform hard work and prolonged physical activity. Optimum or maximum labour productivity are assumed to be dependent on an adequate dietary intake and good health in those performing strenuous work (1). *

Despite these widely held assumptions there has been inadequate research to demonstrate the extent of the relationships between nutritional status and health on the one hand and work output or productivity on the other. Very few studies have attempted to show the effects on labor productivity of a dietary or health intervention, and to demonstrate the economic return of such an intervention.

The literature on the apparently straightforward relationship between calorie intakes and work output is fairly extensive. It is, of course, clear that humans have to burn calories in order to live and to perform work. But a careful perusal of the literature shows that relatively few experiments have demonstrated that increased calorie intakes result in increased work output or productivity. The important studies in Germany during and after World War II (2) are often quoted, but are by no means definitive. The so-called Minnesota starvation study of Keys et al. (3) increased our knowledge but did not address this question. The recent work in Guatemala by Viteri and his colleagues (4), in which the effects of calorie and iron deficiencies were studied, has broken new ground. Viteri, in one study of the energy expenditure of two groups of Guatemalan peasants, one supplemented and the other unsupplemented, showed a marked increase in energy expenditure in the supplemented group. Both groups, however, had a negative energy balance, the time was short, and the type of work performed was not identical in both groups.

The IBRD study (5) in Indonesia has shown that fairly severe anemia does affect productivity. Treatment of anemia for a period of 60 days led to an increase in productivity of 15 percent for rubber tappers and 25 percent for weeders. An earlier report by the same group showed no difference in Harvard Step Test results with those whose haemoglobin was above and below 13 g/%, but significantly lower Harvard Step Test scores in the group with hemoglobin levels below 11 g/%.

Caution is necessary, however, in distinguishing between results based on measures of work capacity and physical fitness and those in which work output or productivity is determined.

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* See references at the end of this proposal.

An investigation of the relationship of certain nutritional and other factors to the productivity of Jamaican sugar cane cutters has recently been completed. This was a cooperative study involving the Caribbean Food and Nutrition Institute and our group at Cornell University, and was carried out with the approval of the Jamaican Government, the trade unions and the sugar growers (6). One of the important findings in this study was that cane cutters whose weight for height was below 85 percent of the standard, cut significantly less cane than those whose weight for height was above 95 percent. This significant relationship remained when factors such as age, weight and height were controlled. Weight for height provides an index of fatness or thinness, and therefore of energy stores or reserves. It is postulated that energy stores may be a major determinant of a worker's ability to sustain a high level of productivity over a period of several weeks of heavy work (7).

In India a study of the effect of health and nutrition status on productivity of road workers has recently been conducted. This project supported by the IBRD has some similarities to the Kenya Rural Access Roads Program. The results of the Indian study are stated to show that "hematocrit and iron do correlate with output".

A variety of surveys and special studies show that nutritional deficiencies are very prevalent in East Africa in general (8) and in Kenya in particular (9). It is now agreed that the problem is in part a general failure to consume adequate quantities of available foods, and in part due to a deficient intake of certain nutrients owing to the nutritional quality of the diet. Among the problems most commonly cited are dietary deficiencies of calories, protein and iron. While protein deficiencies occur mainly in children and are seldom divorced from calorie deficiencies, it is evident that iron and calorie deficiencies occur commonly in both children and adults. There is no point in reviewing here the literature dealing with malnutrition in East Africa.

(2) Nutrition and Roundworm Infection

Roundworm (Ascaris lumbricoides) is the world's most prevalent human intestinal parasitic infection (10). It is estimated that about a billion people harbour this parasite. The worm is by far the largest of the common intestinal parasites measuring often about 20 cms (some 8 inches) and sometimes as much as a foot in length. Its size and appearance are superficially similar to a common earthworm. Some persons have very heavy infections numbering over 100 adult worms.

Ascariasis (the medical term for the infection) is spread from person to person. The female worm in the small intestine produces copious numbers of eggs. These are passed out in human feces and can withstand adverse conditions and survive in the environment for many months. If human feces are not properly and safely disposed of, then there will be transmission of the condition. The most important environmental factor,

then, is sanitation, and disposal of human excreta (11). Children tend to be more frequently and heavily infected in part because they tend more often to put soiled objects, contaminated food and dirty fingers into their mouths. Very young children may also spend more time, at "ground level", in the microenvironment of household yards where the ova of Ascaris are desposited. The condition is diagnosed by microscopic examination of the stool to reveal the characteristic ova. Parents often become aware that their children are infected by observing worms passed in the stool or when a child vomits one or more worms.

Pediatricians and public health workers are concerned about this widespread parasite, which is generally believed to cause debility in children. A variety of digestive disturbances, abnormal pain, vomiting, restlessness and poor sleep are all commonly reported. One serious complication is bowel obstruction due to a heavy infection in which the worms become entangled as a bolus. This condition has a high fatality rate in tropical areas. Other complications result from the migration of worms to sites such as the common bile duct (leading to jaundice), to the appendix, to the liver, etc.

The ova when ingested have already embryonated in the soil, and soon hatch in the intestinal tract. The larvae penetrate the wall of the small bowel, travel to the liver and lungs by way of the blood vessels. The larvae in the lung alveoli or air spaces, ascend the bronchial tract, and pass down the esophagus to reach the small intestine where they develop into adult worms. It is known that their passage through the lungs may cause respiratory symptoms including cough, possibly bronchitis and also pneumonia, and an allergic response. This latter condition is manifested by the development of eosinophilia.

There is little human research to demonstrate pathological lesions in the intestine, liver or lungs as a result of ordinary ascaris infections. However the almost identical parasite in pigs, Ascaris suum has been shown to cause fibrotic lesions, known as milk spots, in the liver of young pigs, and the worm is considered an important cause of respiratory problems in the pig industry.

Most doctors, veterinarians and nutritionists would agree that Ascaris is likely to have nutritional implications for the host, if for no other reason than that a large worm must have its own nutritional and metabolic needs. When 100 or more worms are present in the gut of a young malnourished child, and may weigh 5 percent of the weight of the child, then there is little doubt that nutritional status must be affected.

Relatively little research has been done to prove the effect of Ascariasis on nutritional status of children. A study in Cali, Colombia (12, 13) using a metabolic ward has demonstrated that Ascaris appears adversely to affect nitrogen balance. After treatment nitrogen retention was improved. Therefore Ascaris in this study did result in poor utilization of dietary protein.

In an earlier study concerning nutrient absorption Venkatachalam and Patwardhan (14) found a significant decrease in fecal nitrogen excretion following deworming of 9 children with heavy Ascaris infections.

No well controlled study has been conducted in the community and demonstrated the effect of roundworm infection on nutritional status of pre-school age children.

A study conducted at Cornell by one of the investigators (LSSL, 15, 16) using well nourished and malnourished growing pigs has shown that Ascaris results in reduced nitrogen utilization and poorer growth in undernourished infected compared with undernourished Ascaris free pigs. Another important finding was that Ascaris infected pigs had hypertrophy of the tunica muscularis of the small intestine. This is the first time that this type of pathology has been reported.

Ascaris has been known for many years to be prevalent in Kenya (17, 18, 19). Although no specific programs have been initiated for its control, there have been efforts to improve sanitation, campaigns for latrine construction, and health education concerning disease transmission. That the people are concerned about the infection is clearly illustrated by the huge market in a variety of worm medicines, some good and some probably ineffective, most sold without prescription in village shops and often improperly utilized. These medicines frequently have a high price mark up when sold retail in small quantities. Their cost is very high in relation to the incomes of the poor. Mothers when questioned are often very concerned about this health problem for their children. They will go to considerable lengths to try and rid their children of worms.

B. Kenya Rural Access Roads Program

The IBRD is engaged in studies to assess the feasibility of labor substitution for equipment in certain aspects of civil construction. Essentially this means that an evaluation is being made of labor intensive, in place of capital intensive civil construction where appropriate in certain third world countries (20).

The Rural Access Roads Program was initiated by the Kenyan Ministry of Works (MOW) in 1975 to expand on the rural road network and to provide access to areas not previously served by a road. The Program receives support from IBRD, UNDP and several bilateral aid agencies. In 1975 there were two construction units established, one in Nyeri District in the highlands, and a second in Kwale District near the coast. Expansion is now taking place into other districts and by 1978 it is proposed that units be established in some 22 districts. One of the major objectives of the program is to utilize labor as effectively as possible while at the same time using human work in preference to mechanical or motorized techniques wherever feasible.

A number of studies are under way to evaluate various labor engineering organisational, management training, and other aspects of the program. Another feature of the program is the development and testing of appropriate and alternative tools and hardware.

One objective included in the plan was an "evaluation of the nutritional standard of workers involved in labor-intensive construction projects". It was further stated that "An assessment will be made of the health and nutritional status of road construction workers and its effect on labor productivity in the RAR program. Recommendations will be made on suitable nutrition supplementation programs if needed".

The World Bank, the Ministry of Works and the Ministry of Finance and Planning wish to identify those nutritional and health factors which may limit the productivity of road workers in Kenya.

(1) Nutrition and Worker Productivity

While in Kenya on a year of sabbatical leave and while serving as a visiting professor at the University of Nairobi, the Principal Investigator cooperated with the Kenyan Ministry of Works and the World Bank in a study of nutritional status and worker productivity. 1/ On Rural Access Road sites in Nyeri and Kwale Districts the health and nutritional status was determined of workers doing labor-intensive road construction work.

Detailed work output studies were carried out at four road construction sites, two in each district. The types of measures used were times taken (1) to excavate a given volume of earth, (2) to move a given number of filled wheelbarrows a set distance, and (3) to dig a trench of set length, depth, and width in sandy soil. The incentive in each case was that when the task was completed the individual was able to leave work. As most workers are small farmers, this was a real incentive. Task work is much more popular than daily work lasting a set number of hours.

In summary, the findings were that:

(1) Evidence of undernutrition in men was common. Forty-one percent of 281 road workers in the study had a weight for height below 85 percent of the standard. The majority of men were losing weight at work.

(2) Anemia was common in workers in Kwale District but not in Nyeri District. In Kwale 34 percent of men had a hemoglobin level below 13 grams per 100 ml.

1/ See Report to IBRD, 1977 for details and full results.

(3) Many health abnormalities were found. Intestinal parasites and urinary schistosomiasis were common in Kwale workers, and may contribute to anemia.

(4) Low weight for height was strongly and significantly associated with a lower work productivity (Regression $p < .0001$; $N = 220$).

(5) Workers with anemia were found to be less productive and to take longer to complete a task than men who had normal levels of hemoglobin.

The feasibility of intervening with an energy containing supplement and with provision of medicinal iron was investigated. It was felt that the length of intervention was not sufficient to demonstrate its effect on worker productivity nor to determine the economic implications of such a strategy.

(2) Effects of Roundworm Infection on Nutrition and Health

In Machakos District in the Eastern Province of Kenya a separate study was undertaken to investigate the effect of roundworm infections on the nutritional status and health of preschool age children. This was carried out in collaboration with the Medical Research Centre 1/ in a part of the District where they were conducting a longitudinal study of health and related factors.

Two villages known to have a rather high prevalence of roundworm infections and without many other intestinal parasites were selected. All preschool children in the two villages of Kanzalu and Mwatati were asked to come for examination and medical treatment on three occasions each four months apart. At each visit histories were taken, a short questionnaire completed, stools collected for subsequent parasitic examination, anthrompometric measurements made, a clinical examination conducted by a physician, and appropriate treatment given. Social, environmental and economic data from households were also obtained.

At visits II and III, and after the results of the first stool examinations were known, all children, both infected and non-infected, received an anthelminthic (Levamisole) which is effective against Ascaris and some other intestinal parasites. The 375 stools collected at visit I were examined in the parasitology laboratory of the Molteno Institute of Cambridge University in England by Dr. David Crompton and his group. This took nearly four months, and so the Ascaris group could not be identified or treated until visit II. Twentyseven percent of the stools were positive for Ascaris.

The experimental design allowed a comparison of baseline data at visit I between Ascaris infected and non-infected children. It was also

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1/ Based in Nairobi, this is a branch of the Royal Tropical Institute (Amsterdam).

possible to assess the subsequent growth and health of Ascaris children in the four months while they were infected with roundworm and to compare this with these same measures four months after they had been dewormed. Comparisons between Ascaris and control children during these periods and using the same parameters were also done.

Attendance at each visit was very good. At visit I approximately 375 preschool age children attended, which is 81 percent of all the children in the two villages. As these "villages" are rural farming communities scattered over the hillsides of the Kanzalu Range and with poor communications, this was considered an excellent turnout. There were inevitable losses of 10 to 20 percent of children at each of the next two visits.

The main findings of this study are:

(1) All social, environmental, economic, health and anthropometric data were essentially similar in control and Ascaris infected children at the start of the study.

(2) Subcutaneous fat (an index of calorie status) is measured by skinfold thickness showed very highly significant differences between control and Ascaris infected children. Skinfold thickness significantly decreased in children with Ascaris, and significantly increased in Ascaris infected children in the period following deworming.

(3) Weight gain was not significantly different in the control and Ascaris children before deworming, but after deworming Ascaris infected children showed a significant gain in weight compared with control children.

(4) Ascaris infection was significantly associated with signs of protein-calorie malnutrition, and these signs significantly improved after treatment in the Ascaris compared with the control group.

(5) Some association was apparent between Ascaris infection, and clinical evidence of anemia and ariboflavinosis. Hookworm infection was also significantly associated with clinical signs of anemia.

The conclusion was reached that Ascaris infections were having a significant effect on growth, nutritional status and health of preschool children. It was quite evident too that mothers considered these worms to be an important health problem. Deworming was so popular that pressures were placed on the research team to deworm all children in both schools in the areas, and to provide worm medicines to many adults and others not resident in the villages studied.

An estimation has been made of the economic costs of this ubiquitous parasite both to families and to the nation. It is quite clear that

common roundworm infections have important economic implications, and yet the cost of its treatment and its control using simple and safe medications like Levamisole is relatively cheap. Initial benefit/cost estimates for all of Kenya indicate a ratio of 10:1. The need now is for a demonstration to illustrate that control is feasible, and that lowering of parasite loads will in a short time markedly reduce the rates of re-infection. The evaluation of such a pilot control program, including the nutritional status of children, is necessary. It is believed that the demonstration in pilot control program, including the nutritional status of children, is necessary. It is believed that the demonstration in pilot villages of a successful and cheap control of this and other intestinal parasites will be necessary before the government of Kenya and other developing countries institute national programs to control intestinal parasitic infections.

II. Design

1. Proposed Studies

The health, nutrition and worker productivity research proposed to be undertaken in Kenya between 1978 and 1980 will be carried out under four study headings:

(1) Evaluation of Health/Nutrition Effects on the Productivity of Casual Laborers in Rural Civil Works.

(2) Evaluation of Practical Interventions to Improve Health Nutritional Status and Worker Productivity.

(3) Study of Health and Nutritional status in Two New Ecological Areas.

(4) Evaluation of the Feasibility and Effectiveness of a Program to Control Intestinal Parasites (especially Ascaris) in a Community.

2. Materials and Methods

Study (1) Evaluation of Health/Nutrition Effects on the productivity of Casual Laborers in Rural Civil Works.

This includes further research to determine the effects on worker output or productivity of providing extra calories as a high energy, nutritious, mid-work day snack to road workers. One or two Districts will be selected for the research. Both will be those where the Kenyan Ministry of Works is involved in the construction of Rural Access Roads using labor-intensive methods. Both Districts will probably be in the Rift Valley, Central or Eastern Province. The Districts will be selected in the hope that, as in Nyeri District, workers will not have serious infections with parasites or much anemia, but a significant percentage will have evidence of undernutrition (caloric deficiency) as judged by low weight for height.

In each District suitable road sites will be selected where adequate numbers of men are employed, and where appropriate task work can be performed and measured. At each site all workers will be examined and the following procedures undertaken:

(1) Clinical nutrition and health examination;

(2) Anthropometric measurements;

(3) Blood taken for determination of hemoglobin and hematocrit levels, and in some areas for examination for malaria parasites;

(4) Stools collected for examination for intestinal parasites, and in some areas urine for Schistosoma hematobium ova.

From among the men examined approximately 120 will be selected for the intervention study. The research will involve mainly a determination of the effect on work output of a dietary intervention.

Short feasibility and acceptability studies will be conducted on the interventions prior to their introduction in the actual research. The intervention study will last 8 to 10 months. This will be followed by special studies which are expected to include some detailed parasitological investigations; testing of alternate dietary supplements for different populations or circumstances; investigation of the question of substitution of supplementary feeding for home food, etc. The actual foods to be used will be decided after the sites have been selected.

The majority of men selected for the intervention study will be those with a low weight for height. But some with normal weight for height will serve as controls. Prior to the intervention, work output measurements of the kind described earlier will be made on each worker for several days. The intervention will include the provision of a nutritious dietary supplement at work to provide about 700 kilocalories per work-day. Repeat measurements of worker productivity and physical examinations will be undertaken 3 months later and again at the end of the study period (probably about 6 months after the introduction of the intervention). In all cases the measure of work productivity will be the time taken for each man to complete an assigned measurable task. This will be done for each man for several days. Kenyan field assistants under supervision will be responsible for recording the consumption of the dietary supplements by each worker, and for detailed recording of the times taken to complete a daily task. A Work Study Engineer (Mark Sharrock) will take responsibility for designing and conducting measurements of work output.

In Study 1, a 24-hour dietary recall will be used to determine food intake prior to the intervention and will be repeated 3 months after the dietary supplement. Because of the relative inaccuracy of this method a sub-sample of the group will be selected and the more time-consuming food weighing method will be used to determine food consumption in the home in the period before and after the intervention. The difficulties of these methods and the fact that no method is fool-proof are realised. However it is believed important to try to discover if the dietary supplements simply serve to reduce food consumption at home. Allied to this part of the study will be the monitoring of the weight of all workers. Weights will be determined at least every 3 months, and at all times just prior to the introduction of an intervention. The 1976 study showed that unsupplemented workers lose weight while actively engaged as road workers.

Finally a careful analysis will be made of the costs of the intervention. These will be translated from the research setting to that kind of intervention that the Ministry of Works might find feasible. These costs will be compared with the benefits to be gained as a result of the intervention in terms of worker productivity. The effects on nutritional status and health will also be evaluated.

Study (2) Evaluation of Practical Interventions to Improve Health, Nutritional Status and Worker Productivity

The 1976 project in Kenya clearly demonstrated that poor nutritional status and anemia were associated with a lower level of worker productivity in the Rural Access Roads Program. Interventions carried out were of short duration and, because of this, provided inconclusive results. For this reason a more detailed investigation of the effects on labor productivity of interventions is planned and described in (1) above.

However the Ministry of Works, the World Bank, and the research team all believe that it is desirable to move ahead with practical interventions that will benefit the workers, and which can be anticipated to increase worker output. These interventions need to be designed, tested and evaluated prior to their general recommendation for wide or universal use.

In Kwale District (or some other suitable District) it is proposed that:

(a) An evaluation be undertaken of different types of mid-work day snacks and of two or more alternate delivery systems. This evaluation will consist in selecting certain snacks, meals or dishes. Two of those being considered are (1) a maize based gruel (uji) with added sugar, oil and a protein source (milk powder or a legume), and (2) a cold snack consisting of enriched bread (possibly mandazis--a maize meal based donut-like product) or chapatis, with fruit and peanuts. Delivery systems might include the snack being taken to the worker at the place where he is working; a lunch break (not now given) where workers attend for their snack at a convenient location; or the collection of the cold snack from the foreman when they report for work. Evaluation will be undertaken of participation when the snack is free compared with when a small charge is made. These snacks will be designed to provide between 300-700 calories per person per day.

(b) Study of routine provision of iron. A study will be undertaken of the feasibility, participation rate, costs and effects on hemoglobin levels of (i) the routine provision of iron (probably ferrous sulphate) tablets to road workers using foremen or field workers, and (ii) the daily provision of an iron rich dietary supplement.

On two road sites base-line data will be obtained on a total of about 150 men. This will include determinations of hemoglobin and hematocrit levels. On one road site iron tablets (ferrous sulphate 300 mg. daily, containing 60 mg. of elemental iron) will be provided to each worker each working day. Records of consumption will be maintained. On the second road site a mid-work day snack will be provided which will be designed to increase iron consumption and iron absorption. The actual foods to be used will be decided in Kenya and will depend on which road site is selected, what local foods are consumed, and what the local customs and preferences are. The foods chosen might include local dark green leafy vegetables (such as cassava leaves), chick peas or some similar legume, and possibly also a fortified product. It would also be desirable in the same snack to include a rich source of ascorbic acid such as guava or other fruit. Recent evidence makes it clear that ascorbic acid consumed at the same meal as iron containing foods will increase iron absorption.

On both road sites blood will be taken again approximately 12 weeks later, and hemoglobin and hematocrit determinations performed. Data will be collected to help evaluate the feasibility, the acceptance and the costs of these two different interventions. The effectiveness will be judged mainly in terms of the effect of the intervention on hemoglobin and hematocrit levels of those men judged to be anemic at the beginning of the study period.

This study of the routine provision of iron is designed especially to evaluate the practicality and costs of delivering more iron to road workers, and to discover the problems inherent in such delivery systems. The study is based on the assumption that it is desirable to take practical steps to increase iron consumption, and to improve iron absorption in subjects where there is a high prevalence of iron deficinecy anemia.

(c) The prevalence of parasitic diseases and their role as causes of anemia, of lack of physical fitness and of absenteeism. The point prevalence of certain parasitic diseases notably hookworm, schistosomiasis (both S. hematobium and S. mansoni), ascariasis and also malaria in road workers in two districts will be determined. Total number of workers examined will be approximately 200. Examinations will be done of stool, urine and possibly blood.

The relationship of the parasitic infections to hemoglobin levels will be determined. An attempt will be made to relate physical fitness, health, and work attendance to different parasitic infections. In those men involved in productivity studies or on task work this too will be related to type and level of parasitic infections.

All men found to have parasitic infections will receive the appropriate medical treatment and examinations will be repeated to see if improvements occur in physical fitness, health, work attendance and productivity.

(d) An evaluation of the feasibility and effectiveness of routine parasitic treatment and prophylaxis. Related to the study described in (c) above, it is proposed to evaluate the feasibility, cost and effectiveness of routine measures to treat, control or prevent certain parasitic infections in adult workers.

On one road site in an area where intestinal parasites are known to be common, stool examinations will be done, and about 80 to 100 men will be routinely examined. Then at four monthly intervals a trained field worker will provide each man with a safe anthelminthic drug. Evaluation will be done to determine rates of re-infection, health status, job absenteeism and symptomatology. The cost of the program will be determined, and the attitudes of workers and staff to the program will be assessed.

On a second road site in an area known to be endemic for malaria 80 to 120 men will be enrolled for the study. A medical examination will be conducted, blood slides for malaria parasites will be taken and spleen size will be determined by palpation. This will provide baseline data. Then for a period of 3-6 months each work man will receive two chloroquine tablets (to provide 300 mg. chloroquine base) on one day per week. The tablets will be administered either by a trained field worker or foreman. The actual swallowing of the tablets will be watched and recorded. After 3-6 months the same examination of health status, blood slide and spleen will be repeated. Where possible, data on work productivity, absenteeism and symptomatology will also be obtained. The cost of the routine administration of this malaria prophylaxis will be calculated.

On a third road site in an area known to have a high prevalence of urinary Schistosomiasis or bilharzia (due to Schistosoma hematobium) approximately 50 men at one road site will form the study population. When first seen medical examinations will be conducted, health history obtained (including a history of observed blood in the urine), urine will be collected for parasitic examination, and blood taken for hematological determinations. All men found to be infected with Schistosomiasis will receive the new one dose treatment consisting of a calculated dose of Hycanthone methane sulphonate (Etrenol) based on the weight of the subject. After a period of 4-6 months the examinations will be repeated. The effectiveness of treatment of this important and debilitating disease will be determined including its effect on symptoms, general health, hemoglobin, and work performance (where possible) will be determined.

Study (3) Study of Health and Nutritional Status in Two New Ecological Areas. A small study has been completed on the relationship of nutritional status and health to worker productivity in two Districts of Kenya. Four road sites, two each in Nyeri and Kwale Districts, were utilized. These represent two quite different ecological zones inhabited by different tribal groups. Nyeri is representative of a fertile highland area where the temperate climate results in a lower transmission of several important parasitic diseases. Kwale District is coastal, hot and humid

with a relatively high prevalence of diseases such as Schistosomiasis, hookworm disease and malaria.

The two Districts studied are to a limited extent representative of important ecological zones in Kenya. They both differ however from (a) the arid drought-prone areas of the country including certain parts of populous Districts such as Machakos and Kitui, the sparsely populated areas of northern Kenya, and the areas inhabited by cattle raising or nomadic peoples, (b) the very heavily populated Nuanza and Western provinces which are endemic for malaria, schistosomiasis, hookworm and other parasitic diseases, have an altitude which is lower than the highland and higher than the coastal areas, and a diet which is different from the other three regions mentioned.

It is proposed that a preliminary study be made of health and nutritional status of workers on Rural Access Roads in two areas of the arid regions and two areas of the Western or Nyanza provinces. This study will not include an attempt to relate nutrition and health factors to work output. The investigation will however indicate whether the types of intervention being suggested for the other regions of Kenya are appropriate or necessary in these two regions.

A total of four road sites, two in each of the ecological zones, will be selected in consultation with the Ministry of Works. At each road site approximately 70 men (total 280) will be asked to volunteer for examination. The examination will consist of a medical and health history, a routine health examination, evaluation of nutritional status using anthropometry (height, weight, arm circumference, triceps skinfold thickness, chest circumference at inspiration and expiration) and clinical examination for evidence of deficiency states; and, perhaps, a sub-sample examination of stool and urine for parasites, and blood for hemoglobin and hematocrit.

Where necessary appropriate treatment will be given, or the worker will be referred to a hospital. These examinations will not be repeated but are designed to provide a rapid assessment of the nutritional and health picture in the workers in these ecological zones.

The purpose as stated is to allow recommendations to be made concerning interventions in these Districts. The examinations will provide data to tell us whether a District is similar to Nyeri or similar to Kwale, or different from both in terms of nutritional status, anemia, etc. There would be no particular point for example of recommending the routine administration of iron where there was practically no anemia; or the regular deworming of men where parasites were rare; or even the feeding of men where no undernutrition was detected.

Study 3 will be the least time consuming and therefore the least costly of the four studies proposed. The research carried out in Kenya in 1976, and the studies proposed here, will lead to concrete recommendations to the Bank, the Ministry of Works and to other branches of the government concerning action that might be taken to improve nutritional status, health and productivity of road workers, and others, in Kenya.

Study 3 is designed to provide clues, or answers, to assist in filling in important gaps in information. It will be a simple cross-sectional study, and will not involve time consuming work output studies. The point prevalence surveys to be conducted in these two new ecological zones will, it is estimated, consume less than 5 percent of the total budget, and less than 10 percent of total staff time (probably about 8 percent of the Principal Investigator's effort).

From past experience a team of two examiners (one physician and one nutritionist) with two field assistants can examine 20-30 workers per day. Therefore the actual examinations at each road site can be conducted in one week or less provided that proper prior arrangements have been made.

These examinations will not be repeated, nor will they be related to work performance. It is believed that a one day visit to each District and road site by the Principal Investigator will be necessary to get agreement for the arrangements. One of the Graduate Research Assistants, together with a Kenyan field worker, may then spend approximately one week at each site making the organizational arrangements and identifying those to be examined. The Principal Investigator together with the Research Assistants and two field workers will complete the examinations at each site in about one week.

The examinations will be conducted at times set aside for this work. As currently planned this would be in February and in May 1979. For example, the Principal Investigator might devote 2 weeks of his time in Kenya in February 1979 and another 2 weeks in May 1979 to this part of the project. This then is 4 weeks out of 38 weeks spent in Kenya. The analysis and interpretation of the data collected from this cross-sectional study will also be easier than that for the other semi-longitudinal studies in which there are treatment groups, interventions, work studies, and hypotheses to be tested. The study in the new ecological zones will yield largely "descriptive" data and results.

Measures recommended to the Ministry of Works to improve health, nutritional status and productivity will almost certainly have relevance to farmers and others besides road workers. Therefore results from several ecological zones will be useful also for this purpose.

Study (4) Evaluation of the Feasibility and Effectiveness of a Program to Control Intestinal Parasites in a Community. This fourth part of the proposed program is unrelated to the Rural Access Roads project. It is however quite closely related to the other investigations included in this proposal, and it will be undertaken by the same senior staff. Like some of the other parts of the research, it is related to the effects of parasitic infections on nutritional status, and it concerns an evaluation of the feasibility and effectiveness of control.

As indicated above, a very detailed study was completed in the field in Kenya in 1976 by the Bank on the role of roundworm infection (Ascariasis) on nutritional status and health. That research has produced unexpected and important results. For the first time, a well controlled study has demonstrated that roundworm is having a significant effect in retarding the growth of children. Other health effects were also noted.

The study was conducted in the villages of Kanzalu and Mwatati in the Machakos District of Kenya. These are not tight little villages with houses in close proximity, but are rural areas each covering perhaps 12 square miles and with a combined population of around 3000 people. These farming communities are quite typical of Kenya. Infections with intestinal parasites, whether they are found in road workers, school children or toddlers, are mainly contracted in the communities in which people live.

The Ascaris project in Kanzalu and Mwatati villages included the deworming of all preschool age children on two occasions using Levamisole hydrochloride (Ketrax). On the last visit, at the request of the community and the school teachers, all school children in the two village primary schools were also dewormed.

It is now intended that a three year evaluation of the feasibility, cost and effectiveness of controlling roundworm (and other parasites) infection in the two villages be undertaken. The objective is to determine the feasibility of this, to test a simple delivery system, to examine its effects on health and nutritional status, and to do detailed studies of reinfection rates.

Each January (1978, 1979 and 1980) all preschool age children (about 350 in number) will be invited to come for examination and treatment. The examination, similar to that in the original study, will include collection of a stool specimen for microscopic examination for parasites; anthropometric measurements (weight, height, arm circumference, triceps skinfold thickness); clinical and nutritional examination; treatment of conditions found; and administration of an anthelminthic drug. Also in January all primary school children attending Kanzalu and Mwatati primary schools will have anthropometric measurements taken and will receive an

anthelminthic drug. These January examinations will be conducted by a team consisting of a nutritionist (Lani Stephenson from Cornell), a parasitologist (David Crompton or Jean Martin from Cambridge), and a physican (Michael Latham from Cornell) supported by a full-time Kenyan field worker (Mutinda Munyao), and a team of temporary field workers. The study will be conducted in collaboration with, and with assistance from, Dr. A. Jansen, the head of the Nutrition Section of the Medical Research Center in Nairobi.

All children, both preschool age and those attending the primary schools, will also receive an appropriate dose of the anthelminthic (Levamisole) every four months. The doses other than those given in January will be administered by the field worker in April-May, and again in September-October. The field worker will visit each household and will personally administer the anthelminthic to each child, will record this, and will obtain information concerning worms passed. School children will receive the anthelminthic at the same intervals from the field worker in their schools. The headmasters and other teachers at each school have agreed to cooperate fully in this program as they have in the past.

The plan outlined here was executed in January 1977, and has been continued this year with funds available to the study team from Cornell University and to Dr. Crompton from Imperial Chemical Industries. However this modest funding is inadequate to complete the next two years of this project.

In the third year of the project health education measures will be included in the program and the results of the project will be presented to the Ministry of Health. Discussions will be held concerning the feasibility, cost and desirability of a much larger pilot or national program to control ascariasis and other intestinal helminthic infections.

3. Note on Statistical Design and Sampling Procedures

The importance of statistical advice is fully recognized and it is proposed that the services of a statistician be utilized before any work begins. The IBRD Transportation Department will make available to the Study Team the services of Mr. Andrew Chesher, Lecturer in Statistics at Birmingham University for a period of up to 10 days so as to ensure that statistical design and sampling procedures are satisfactory. In Kenya, once the locations of the study have been decided upon, and some knowledge has been gained on the size of the work force on each road, then a very early activity will be to obtain real involvement of a competent statistician or biostatistician preferably from Cornell University and possibly from the Kenyan Central Bureau of Statistics or the University of Nairobi. This will be done in January 1978, at the time that detailed local plans are made and when the Kenyan staff are being recruited. The statistician will have the responsibility for providing essential inputs from the beginning in terms of local sampling design and problems, the evaluation system and subsequent analyses of the data.

For Study 4 Mr. V. Gemert, a statistician with the Dutch Medical Research Center, has been involved from the beginning in the design and analysis of the parasite study. He will continue to provide this service, and may also be consulted about Studies 1, 2 and 3.

It should be noted that the Research Assistants and Research Associate from Cornell will be persons who have considerable training in statistics, who have familiarity with computer data analysis, and who know how to handle data and to resolve ordinary design questions. All will have had experience with similar field projects which generated data and required complex analysis including the use of SPSS.

Sampling procedures to be followed are in general quite straightforward and relatively simple. The logic for selection of particular sample sizes is a much more difficult question, and is based on several considerations. These include practicality and feasibility, and on knowledge of the likely variability of measures used and the likely response which may result from the interventions.

Of the three related studies on nutrition, health and worker productivity it is clear that Study 1 is the major and critical research study. It is the core of the "research" component whereas Studies 2 and 3, though of great importance, are evaluations, are more applied, and in the case of Study 3 are more descriptive. This is not a value judgment. In fact Studies 2 and 3 may be of more practical interest and importance for Kenya. Study 1 is an attempt to answer some questions of very broad international concern and interest.

The sampling procedures and statistical design though important for all studies, are more critical for Study 1. More consideration is given here, for the above reasons, to Study 1.

In Study No. 1 the sites selected will not be randomly made. Sites will be purposively chosen which meet the special needs of the research. These are to locate groups of workers where at least 30 percent have a "weight for height" of less than 85 percent of the standard, and where at least 30 percent have a "weight for height" of more than 90 percent of the standard. The conditions required for this study were easily met at the road sites in Nyeri District in the 1976 Study.

In Study 1 the following sample sizes are proposed:

(i) Dietary intervention to determine effects on productivity etc.; 150 men

Study 2

(a) Evaluation of mid-day feeding N = 150

(b) Study of routine provision of iron N = 150

(c) Prevalence of parasitic diseases and their role as causes of anemia, of lack of physical fitness and of absenteeism N = 200

(d) Evaluation of the feasibility and effectiveness of routine parasitic treatment and prophylaxis N = 200

Study 3 Health and nutritional factors related to productivity in two new ecological zones N = 300

Study 4 Evaluation of feasibility and effectiveness of a community parasite control program N = 950 children

It should be noted that the N for each study is the number now proposed. It is not an inflexible number and may be changed for a number of reasons. For example the fact that insufficient subjects are available in a particular area or satisfying a particular criterion to meet the total number proposed, may be a reason for reducing the sample size. If variation in a particular parameter being measured is smaller than expected, this may be a reason for increasing a particular sample size.

It should also be noted that the same subjects in one study might serve as subjects in a second study. Therefore the total N is not necessarily the sum of the N of each study. For example a group of men might serve as subjects for determination of prevalence of a parasitic infection, and also perhaps for an evaluation of the feasibility of routine parasitic treatment, or for the evaluation of mid-day feeding.

Wherever feasible and appropriate it is proposed to use fairly basic statistical procedures for the analysis of the data. Multivariate statistical techniques for the analysis of the data will be used sparingly. The validity of these techniques is based on a set of assumptions about the data which may not be relevant. Analyses using these techniques are often difficult to interpret. Decisions about the effectiveness of an intervention with for example calories or iron supplements may be based upon fairly simple considerations such as whether or not an intervention has increased work output (or in this case decreased the time to complete a task), whether it has increased the hemoglobin levels of the subjects, whether it has increased the weight of workers, etc. The same principles apply to the analysis of data on, for example, the effectiveness of a treatment program such as an anthelminthic given for hookworm or an injection of Etranol for schistosomiasis.

Testing the significance of the differences between several classes with respect to a polychotomous random variable such as the prevalence of a clinical sign or of high or low hemoglobin levels will, when appropriate use the Chi-square test. In some situations it cannot be assumed that

the basic data follow the normal distribution. Those situations can be handled by means of non-parametric procedures which make no assumptions about the distribution of the data. The disadvantages of the non-parametric procedures is that they are generally less powerful than the ones based on say the Students' T-test, that is they are less likely to detect the effectiveness of an intervention as significant, when in fact the intervention has had a significant effect.

When testing the significance of differences between the means of two groups with respect to a continuous (normally distributed) random variable such as calorie or iron intakes and skinfold thickness or hemoglobin levels then the Students' T-test will often be used.

These are the guiding principles. In Study 1 comparisons will be of work output as the dependent variable, and selected independent variables. The latter will include weight for height, hemoglovin levels, and presence of parasites (especially hookworm and Schistosoma hematobium). Similar analyses will be repeated after the intervention.

Pearson correlation coefficients and linear regressions will be computed to detect linear relationships between variables such as weight for height and time taken to complete a task, or hemoglobin levels and work output.

III. ORGANIZATION

1. Timetable

For ease of description the work to be undertaken is shown as Studies (1), (2), (3) and (4). However Studies (1), (2) and (3) are not completely separate and all are connected with the Rural Access Roads Program. Some will be conducted on the same road sites, and on occasion will involve the same group of study subjects. All 4 studies will be conducted more or less concurrently and by the same senior scientific and medical staff.

The following provides a preliminary guide to the proposed timing for each of the 4 studies.

Study 1

January-March 1978

Preparation, selection of sites, preliminary clinical examinations, etc.

April-May 1978

Feasibility of intervention and pre-testing of productivity assessments.

June-December 1978

Intervention in the 2 Districts.

January-March 1979

Final clinical assessments and beginning of special studies.

April-September 1979

Completion of intervention study and special field studies in Kenya.

Data Analysis at Cornell

October-December 1979

Completion of data analysis at Cornell. Preparation of report and publications.

Study 2

January-May 1978

Evaluation of mid-work day snacks.
Prevalence study of parasitic diseases.

June-December 1978

Study of routine provision of iron.

January-May 1979

Evaluation of routine parasitic treatment and prophylaxis.

June-December 1979

Completion of intervention studies and data analysis at Cornell.

January-June 1980

Complete data analysis and prepare reports on intervention study.

Study 3

January-May 1979

Undertakes examinations and collect data in new ecological zones.

June-December 1979

Data analysis at Cornell.

January-June 1980

Complete data analysis and prepare reports.

Study 4

January 1977. Investigators visit Kenya and undertake detailed examination of preschool age and primary school children in Kanzalu and Mwatati. Provide anthelminthics.

February-December 1977. Field Assistant will follow subjects and provide anthelminthics in May-June and September-October.
Data coding at Cornell and preparations for January 1978 visit.
Stool examinations performed in Molteno Institute, Cambridge University
Note: These activities have been completed or are underway.

January-February 1978, 1979 and 1980

Investigators will repeat examination of preschool age and primary school children in Kanzaly and Mwatati and provide anthelminthics.

March-December 1978 and 1979

Field assistant will follow subjects and provide anthelminthics in May-June and September-October.

Data coding and analysis.

Stool examinations performed in Molteno Institute, Cambridge University on stools collected previous January-February.

March 1980-June 1980

Data analysis at Cornell and in Cambridge.

Completion of stool examinations at Cambridge.

July-December 1980

Final analysis, preparation of reports and publications.

2. Reports

1. Inception Report: Preliminary Draft by June 1978; final draft August 31,197
2. Progress Report by December 1, 1978.
3. Second Progress Report by June 30, 1979.
4. Final report on Study 1 and on progress of Studies 2, 3 and 4 by December 30, 1979.
5. Final Report Studies 2, 3 and 4 by December 1, 1980.

3. Staff

(1) Principal Investigator--Dr. Michael C. Latham, O.B.E., Professor of International Nutrition, Cornell University, Ithaca, New York. He is a physician and nutritionist, trained in Public Health and Tropical Medicine, and with extensive work experience in East Africa including a knowledge of Swahili.

(2) Co-Investigator--Dr. David Crompton, Fellow, Sidney Sussex College and Senior Lecturer in Parasitology, Molteno Institute, Cambridge University, England, and Adjunct Associate Professor, Cornell University. Experienced in parasitology. Visited Kenya on two occasions in 1976 and undertook all parasitological examinations for previous study.

(3) Co-Investigator--Ms. Lani Stephenson Latham, Research Associate, Cornell University, holder of a National Institutes of Health Traineeship. Experienced nutritionist with training also in parasitology. Spent 1975-76 academic year in Kenya and directed the field study on the relationship of ascariasis to nutritional status. Expected Ph.D in 1978.

(4) Dr. A. A. Jansen, Co-Investigator of the Ascaris study in Machakos. Director of the Nutrition Section of the Medical Research Center. He is a physican and nutritionist with extensive international experience.

(5) Mutinda Munyao, Field Worker in Kenya. Recruited in 1976, he has worked with the Ascaris project, and is employed full time on the project.

(6) Graduate Research Assistants, These cannot be recruited until funding is assured. One Graduate Research Assistant is likely to be a Cornell nutritionist with experience in Zambia and the Philippines, and with training in Public Health. A second one will be a parasitology graduate student from Cambridge University.

(7) Field Assistants, These will be recruited in Kenya. For short term assignments medical and other university students will, where possible, be recruited.

(8) Consultants, A number of Kenyan professionals will serve as short term consultants. These will include physicans from the Medical School and faculty from the Institute for Development Studies of the University of Nairobi, etc.

(9) Work Study Engineer, Mark Sharrock will spend up to 6 months in Kenya in 1978 and 1979. He will take responsibility for designing and conducting measurements of work output for Study No. 1. He will be provided by Transportation Department of IBRD out of funds held by them.

(10) Statistician, Andrew Chesher, Statistician at Birmingham University, England will serve as a consultant in statistics. He will assist with statistical questions of study design and sampling, and will provide continuing advice on data analysis. His services will be provided by the Transportation Department of IBRD out of funds held by them.

Time and Effort of Principal Investigator and Staff

The estimates of time to be spent by the Principal Investigator, the Co-Investigators and other senior staff is illustrated in the attached bar graph. This reflects present intentions. Not included is the work time in Kenya of staff to be recruited there, of effort spent at Cambridge University by parasitology laboratory technicians and staff (estimated at 15 person months), and of time devoted by Cornell Graduate Research Assistants and other staff (estimated at 20 person months). These Cambridge

and Cornell assistants will not be paid for by the funds requested in this grant application.

Principal Investigator

If funded this project will be by far the major research undertaking of the Principal Investigator. The Principal Investigator will spend 6-8 weeks at the beginning of each year (1978, 1979 and 1980) and 8-9 weeks from mid-May in 1978 and 1979 in Kenya working full time on the project.

In general, the Principal Investigator will devote 20 percent of his time to the project while not in Kenya. This will of course vary, and in some months more, and at others less, time will be needed.

Time of Principal Investigator (M.C.L.) to be devoted to the project

In Kenya		Weeks
1978	Jan.6 -Feb. 24	7
	May-July	9
1979	Jan.-Feb.	6
	May-July	8
1980	Jan.-Feb.	8

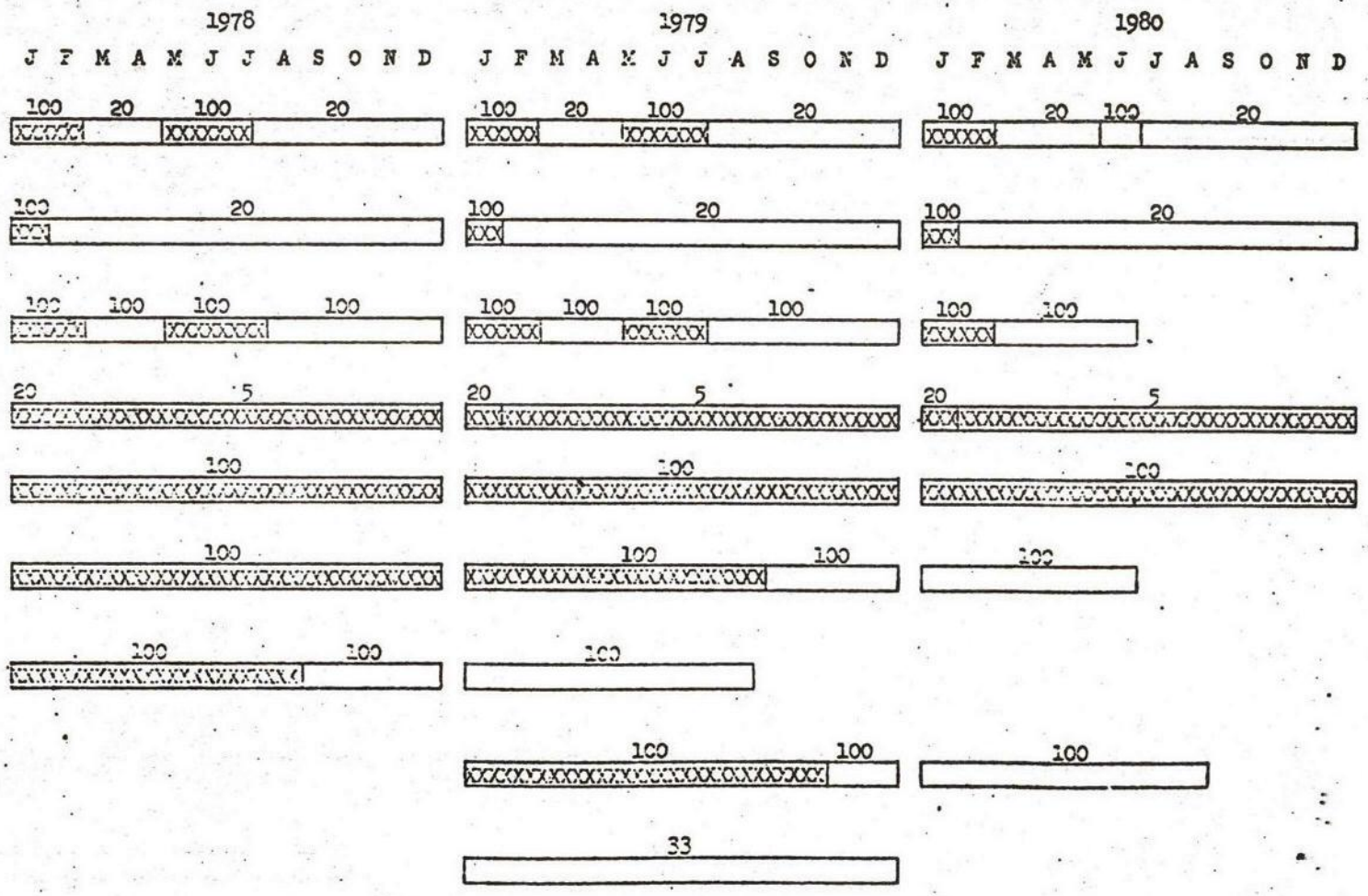
Total 38 weeks

In U.S.		% of time	Week equivalents of full time effort
1978	March-May	20	6
	Aug.-Dec.	20	
1979	March-May	20	6
	July-Dec.	20	
1980	March-May	20	
	June	100	12
	July-Dec.	100	

24 weeks

Grand total for 3 years = 62 weeks

Proposed Staff Time Devoted to Project



IV RESOURCE REQUIREMENTS

1. Budget

The total estimated cost of all four studies is $161,000 ($146,000 for study plus $15,000 Bank travel and supervising) over the January 1978-January 1981 period. For budgeting purposes, total costs are split into:

Phase I (Jan. 1978 - Dec. 1979)

$124,750

Phase II (Jan. 1980 - Dec. 1980)

$40,000

Out of the total of $124,750 for Phase I approximately $71,500 will be forthcoming through a grant from the U.K. Ministry of Overseas Development. IBRD Research Committee approval is hereby requested for the balance, amounting to $53,250 including $11,250 for Bank travel and subsistence.

Subject to satisfactory results from Phase I, approval for Phase II by the IBRD Research Committee will be requested in the middle of calendar year 1979.

Study Budget - Year 1

A. Personnel	U.S. $
(1) 1 Research Associate (6 months at $1000.00 p.m.)	$ 6,000
(2) 2 Graduate Research Assistants (1 for 12 months and 1 for 8 months). Stipend and Living expenses at $500.00 p.m. x 20 person months	10,000
(3) 8 Field Assistants (4 for 12 months and 4 for 6 months) 72 person months x $100.00 p.m.	7,200
(4) Daily paid workers in Kenya	2,000
(5) Consultants in Kenya etc.	2,000
B. Overseas Travel	
(1) Travel to and from Kenya for 2 Investigators and 1 Research Assistant from U.S. (Cornell)	5,000
(2) Travel to and from Kenya for 1 Investigator and 1 Research Assistant from England (Cambridge)	2,000

C. Transport and Local Travel	U.S.$
(1) Mileage and/or car hire and local transport	$ 3,500
(2) Per diem for investigators etc.	2,000
D. Equipment and Materials	
(1) Dietary supplements for snacks	
(2) Ferrous sulphate tablets	
(3) Other medical supplies	
(4) Laboratory materials for stool, urine and blood examinations	
(5) Reimbursement for lab determinations	
(6) Stool, urine and blood containers	
(7) Miscellaneous	4,000
E. General	
(1) Office expenses, typing, data analysis, computer expenses, stationery, clerical assistance, Xeroxing, postage, phone, etc.	3,000
F. Contingency	3,000
Total Year 1	$49,700

Study Budget - Year 2

A. Personnel	U.S.$
(1) Research Associate with doctorate (12 months at $1250.00 p.m.)	$15,000
(2) 2 Graduate Research Assistant in Kenya (10 months at $500.00 p.m.)	5,000
(3) 1 Graduate Research Assistant at Cornell (Stipend etc. for 12 months)	6,000
(4) 4 Kenyan Field Assistants (2 for 10 months and 4 for 3 months) 32 months at $125.00 p.m.	4,000

A. Personnel (cont.)	U.S. $
(5) Daily paid workers in Kenya	$ 1,500
(6) Consultants in Kenya etc.	1,500
B. Overseas Travel	
(1) Travel to and from Kenya for 2 Investigators and 1 Research Assistant from U.S.(Cornell)	5,000
(2) Travel to and from Kenya for 1 Investigator from England (Cambridge)	1,000
C. Transport and Local Travel	
(1) Mileage and/or car hire and local transport	3,000
(2) Per diem for investigators etc.	1,800
D. Equipment and Materials	
Items similar to year 1	2,500
E. General	
(1) Office expenses etc. (Items as in year 1)	1,000
(2) Data analysis, keypunching, computer analysis, etc.	2,500
(3) Publication costs	1,000
(4) Contingency	3,000
Total Year 2	$63,800

Study Budget - Year 3

A. Personnel	U.S.$
(1) Research Associate with doctorate (10 months at 1500.00 p.m.)	15,000
(2) 1 Kenyan Field Assistant (12 months at $125.00 p.m.)	1,500
(3) Daily paid workers in Kenya	1,000

	U.S. $
B. Overseas Travel	
(1) Travel to and from Kenya for 2 Investigators from U.S.	$ 3.500
(2) Travel to and from Kenya for 1 Investigator from England	1,000
C. Transport and Local Travel	
(1) Mileage and/or car hire and local transport	1,500
(2) Per diem for investigators etc.	1,200
D. Equipment and Materials	
Items similar to year 1	1,500
E. General	
(1) Office expenses (items as in year 1)	1,000
(2) Data analysis, keypunching, computer analysis, etc.	2,500
(3) Publication costs	1,000
(4) Contingency	1,800
Total Year 3	$32,500

Budget Total by Year

Year 1	$49,700.00	
Year 2	63,800.00	- Phase I
Year 3	32,500.00	- Phase II
Total (3 years)	$146,000.00	

Plus,

Phase I Bank Staff Supervision

2 round trips to Kenya per year (1 in FY78; 2 in FY79) @ $2,500 per trip	= 2,500 x 3 = 7,500
3 trips @ $1,250 per trip	= 1,200 x 3 = 3,750
Total, Phase I	= 11,250

Phase II Bank Staff Supervision

2 round trips to Kenya per year	=	2,500 x 2 = 5,000
Subsistence @ $1,250/trip	=	1,250 x 2 = 2,500
Total	=	7,500

Phase I and Phase II Bank travel and subsistence = $18,750

Total Budget contracted sum	=	$146,000
Bank staff travel and subsistence	=	$ 18,750
GRAND TOTAL PROJECT COST=		$164,750

2. Proposed Payment Schedule

Phase I

(1) First payment of 75 percent of first year budget well prior to beginning of work on January 1, 1978 (to allow purchase of tickets, equipment etc. needed before work which begins in Kenya in January 1978).

(2) Second payment of 25 percent of first year budget on June 30, 1978.

(3) Third payment of 75 percent of second year budget on December 1, 1978.

(4) Fourth payment of 25 percent of second year budget on June 30, 1979.

Phase II

(5) Fifth payment of 75 percent of third year budget on December 1, 1979.

(6) Sixth and final payment of 25 percent of third year budget on June 30, 1980.

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WORLD BANK STUDY OF THE SUBSTITUTION OF LABOR AND EQUIPMENT IN CIVIL CONSTRUCTION

Technical Memorandum No. 26 *

The Relationship of Nutrition and Health To Worker Productivity in Kenya

May 1977

Undernutrition was shown to be common in 281 road workers surveyed in highland and coastal areas of Kenya. Using low weight for height as evidence of undernutrition, it was shown that this is significantly correlated with lower worker productivity. An intervention with 700 extra calories per day for 3 to 4 weeks (average 25 days) reversed this trend. It led to significant gains in weight, in arm circumference and in skinfold thickness. The intervention therefore had a positive impact on nutritional status of the workers, as compared to a sacharine placebo, but because of time constraints, showed no effect on increased worker productivity. Anemia was very common in the coastal areas. It was associated with parasitic infections particularly with hookworms in the intestinal tract, and with urinary schistosomiasis. Both of these parasites cause a loss of blood and therefore of iron. Worker productivity was significantly correlated with hemoglobin levels. An intervention with iron (600 mg. ferrous sulphate) resulted in a rise in hemoglobin and in hematocrit levels, and a small increase in worker productivity, as compared to groups given vitamin C tablets. The interventions to supply approximately 700 extra calories and to provide regular iron therapy were found to be acceptable and feasible.

Clearly the provision of food at work to the laborers working on the Rural Access Roads would be beneficial to them. It would be expected to improve their health and nutritional status, to reverse the weight loss that they are suffering, and it could be expected over time to increase worker productivity. There is a need for a trial of different foods and alternate delivery systems for worker feeding. Conversely, in areas of Kenya where anemia may be common, the regular use of iron tablets by workers is likely to have a beneficial effect on both health and worker productivity. Similarly the treatment of common parasitic diseases such as hookworm and schistosomiasis will improve health, reduce the prevalence of anemia, and probably increase productivity. However, treatment of these parasitic diseases is only a temporary control measure. In the long run appropriate public health measures in the community are needed to control these diseases.

Transportation Department
Agricultural Rural Development Department
Nutrition Division

*Available from Clell Harral

DRAFT

This paper is prepared for staff use.
The views are those of the authors
and not necessarily those of the Bank.

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

STAFF WORKING PAPER NO. 271*

THE NUTRITIONAL AND ECONOMIC IMPLICATIONS OF ASCARIS INFECTION IN KENYA

September 1977

Roundworms are believed to affect a quarter of the world's population. This study was undertaken to determine the effect this disease may have, as well as its treatment, both from a nutritional and an economic viewpoint. The study was carried out in Kenya by consultants from Cornell University, U.S.A. (L. Latham and M. C. Latham) and has been under the direction of Samir S. Basta, Agriculture and Rural Development Department. It was part of a much larger worker productivity study, sponsored by the Transportation Department under the direction of Clell Harral. Although the results presented here largely pertain to children, its implications are equally valid to the well-being and productivity of adults, as is discussed. Thus, from the foregoing research, children with light infections in Ascariasis absorb less nutrients, and this is translated into a food loss of an average of 3% of ingested calories. Heavy infections could lead up to non-utilization of 25% of ingested calories. This may have important repercussions for nutritional programs. The paper also calculates costs of medication, hospitalization, and loss of income from Ascariasis in the general population based on hospital statistics. Deworming undertaken on an average of twice a year could lead to a benefit cost ratio as high as 10:1. Additional studies will explore the feasibility and costs of large scale treatment.

Prepared by: L. Latham, M. Latham (Consultants)
S. S. Basta, Agriculture and Rural Development Department
(Nutrition Division)
Transportation Department

*Available from the Publications Unit

OFFICE MEMORANDUM

TO: Mr. A. M. Choksi, VPD

DATE: January 23, 1978

FROM: F. Stephen O'Brien, EACPI

SUBJECT: Research Proposal: Kenya - Health, Nutrition and Worker Productivity Studies

This memo recapitulates points made at the review meeting January 12, 1978, on the above subject.

1. I do support the overall purposes of this line of research in Kenya and I believe that the initial research projects, of which this proposal represents a continuation, were well conceived. Nevertheless, I do have a concern whether the focus of these four new studies is specific enough and whether, at their conclusion, we will have significantly increased our sum of knowledge, in particular about the cost-effectiveness of particular interventions.

2. I am not so concerned about Study No. 1 where the proposal clearly states that "a careful analysis will be made of the costs of the intervention" and that "these costs will be compared with the benefits to be gained as a result of the intervention in terms of worker productivity." Still, when confronted with the difficulties of obtaining conclusive results in other countries, and the failure of the earlier exercise in Kenya due to insufficient length of time for the study, one is uncertain whether we will actually obtain such a cost-effectiveness measure from Study 1.

3. For Study No. 2, I would simply support Mr. Greene's remarks in his memo of January 18. It seems to me that too many things are being tested simultaneously; we may well have inconclusive evidence from some of these sub-studies because differences in work output, receptivity of workers to different interventions, feasibility of delivery systems and cost-effectiveness of interventions are all being judged at the same time.

4. I would also support Mr. Greene's suggestion that an economist from the Kenya Institute of Development Studies could be useful as a consultant to this research.

cc: Messrs. Casazza, Faruqee, J. Greene, B.B. King, Basta, Harral, Willoughly, Schebeck

FSO'Brien:rbc

OFFICE MEMORANDUM

TO: Mr. A.M. Choksi, VPD

FROM: James Greene, AGRNU

DATE: January 18, 1978

SUBJECT: Research Proposal: Kenya - Health, Nutrition and Worker Productivity Studies

This memo recapitulates points made at the review meeting January 12, 1978, on the above proposal:

1. Latham's Proposal should be explicit about what will be evaluated in Part (a) of Study No. 2 (page 11) and how it will be done. It is not clear whether, for example, the intention is to evaluate:

   (a) differences in work output ascribable to different kinds and levels of food intervention;

   (b) the feasibility of delivering hot vs cold meals;

   (c) which delivery systems are most effective and least costly in getting food to workers;

   (d) the effect of different kinds and amounts of worker snacks on family food behavior; or

   (e) some combination of the above or other factors.

The study would be particularly useful but fairly complicated if its principal purpose were to identify an optimum combination of a snack and a delivery system producing the highest nutritional punch at lowest cost among the workers. In that case, the evaluation would have to proceed from a methodology appropriate for such analysis. The development of that methodology would have merit in its own right as a useful corollary output of the study, since relatively little systematic analysis of such feeding programs has taken place outside industry in LDCs.

2. If a significant proportion of the workers in the above study were ascaris-infected, would it not make sense to administer anti-helminthics to a portion of the experimental group? The study then could evaluate the work output effects of food and anti-helminthics when combined, administered separately or foregone. The results probably would more than offset the modest cost of adding this dimension to the study.

3. I was struck by the absence of any specific reference to economic analysis in the proposal, although a good deal is implied in study No. 2. It would be useful to add an economist to the staff. Perhaps one from the Institute for Development Studies could serve as a consultant.

Distribution:

Messrs. Casazza, Faruqee, O'Brien, B.B. King, Basta, Harral, Willoughby, Schebeck

JGreene:wb

OFFICE MEMORANDUM

TO: Mr. B.B. King, VPD

DATE: January 17, 1978

FROM: E. Bevan Waide, ASNVP

SUBJECT: Research Proposal - Kenya: Health, Nutrition and Worker Productivity Studies

Many thanks for taking my place in the panel review of this proposal. The research seems to a layman to be beautifully designed -- although it is possible to ask a few detailed questions, for example, would the provision of food during work result in a reduction in food intake in the home? Such questions could, I am sure, be satisfactorily answered by the principal researcher.

The main points that occur to me are really more for the Research Committee than the Review Panel. Firstly, should the Bank be sponsoring this kind of research at all? I have never seen a proposal better suited to WHO or UNICEF, and if there is to be any division of labor between international organizations this is a good example of a project we could forego, despite the fact that it doubtless could offer a lot towards the design of a successful basic needs strategy - at least for Kenya and maybe for other countries as well if the results are transferable.

Secondly, there is the question of the balance of cost: another research proposal is forthcoming on the behavior of Public Sector Industry, the cost of which is $80,000 or half that of the work on nutrition. Given the relative importance of these subjects to the Bank it might be possible to conclude that our research priorities should seek to give more weight to public industry, world-wide than nutrition, in Kenya.

cc: Mr. Choksi

OFFICE MEMORANDUM

TO: Those listed below DATE: January 5, 1978

FROM: Armeane M. Choksi, VPD

SUBJECT: Panel to Review Research Proposal

1. A panel consisting of Messrs. E. B. Waide (Chairman), L. Casazza, R. Faruqee, J. Greene and F. S. O'Brien has been established to review the attached research proposal on Thursday, January 12, at 9.30 a.m. in Room A620.

Proposal	Staff Responsible
Kenya: Health, Nutrition and Worker Productivity Studies	C. G. Harral S. Basta

2. The panel is expected to consider issues such as: (i) Is the proposed research of interest to the Bank? (ii) What is the expected usefulness of this research for Bank operations? (iii) Is the study designed to deal with the issues that it raises? A set of guidelines designed for the preparation and submission of research proposals is attached. It highlights many of the issues that may be relevant for the panel discussion. It may, therefore, be a useful aid in considering this proposal.

3. The recommendations of the panel should be sent to me by Thursday, January 19.

Attachments

Distribution: Messrs. Casazza, Faruqee, Greene, O'Brien, Waide, B. B. King
cc (guidelines only): Messrs. Basta, Harral
cc (Information): Messrs. Willoughby, Schebeck

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World Bank Research Program - Project Proposal

Exception(s)
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Corporate Administrative Matters

Additional Comments

The item(s) identified above has/have been removed in accordance with The World Bank Policy on Access to Information. This Policy can be found on the World Bank Access to Information website.

Withdrawn by	Date
Bertha F. Wilson	30-Jun-21

KENYA: HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDIES

PROPOSAL TO THE WORLD BANK RESEARCH COMMITTEE

NOVEMBER 16, 1977

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SUMMARY

Research Project 671-15 ("Studies on the Effects of Health and Nutrition on Worker Productivity"), carried out in 1976 by a group headed by Professor Michael Latham of Cornell University, has investigated health and nutrition factors related to the productivity of road workers, as well as the relationship of parasite infection to child health and growth, in certain parts of Kenya. The research findings have been reported in two IBRD documents attached to this proposal.

The research indicated that undernutrition and anemia were common among road workers, and that they were related to work output. Separately, it was demonstrated, for the first time in a major field study, that roundworm infections retard the growth of children.

It is now proposed to extend this work and to evaluate a number of possible interventions. The studies, which are proposed to be undertaken in Kenya by the same group that carried out Research Project 671-15, are as follows:

(a) Evaluation of Health/Nutrition Effects on the Productivity of Casual Laborers in Rural Civil Works. In this study, the effects of an intervention (provision of calories on work output)will be determined.

(b) Evaluation of Practical Interventions to Improve Health and Worker Productivity. In a series of studies, an evaluation will be undertaken of alternative methods for feeding the workers; of the routine provision of iron and calorie rich foods or medicinal iron to road workers; an investigation will be made of the prevalence of parasitic diseases and their relation to anemia; and an evaluation will be carried out of the feasibility of routine parasitic control.

(c) Survey of Health and Nutrition Factors in Two New Ecological Areas. This investigation on road sites in two new ecological areas, not covered during the 1976 research, will serve to show whether health and nutrition problems are similar to those found in the Highlands or at the Coast and will allow recommendations to be made for Kenya-wide interventions.

(d) Evaluation of the Feasibility and Effectiveness of a Parasite Control Program. This is a continuation of the study on roundworms and other intestinal parasites in children and is designed to maintain control in two villages, to investigate

reinfection rates, and to evaluate simple methods of control which are likely to be applicable elsewhere in Kenya. This study may serve to heighten the awareness of the Government of Kenya to this problem, and will provide guidelines for practical measures to control or contain intestinal parasitic infections.

The Government of the United Kingdom has expressed great interest in the proposed work and, specifically, in Study 1. According to information received in Washington on November 16, 1977 the Ministry of Overseas Development is about to enter into a contract with Professor Latham and his group so that work can begin in January 1978. The ODM financial support will amount to about $71,500.

The proposed work will span a 3-year period and the four studies, although differing in focus, are closely inter-related. Study 1 will deal with the establishment of empirically-based relationships between health/nutrition factors and productivity. Studies 2, 3, and 4 are "intervention-orientated" and are specifically relevant to Kenya. The group under Professor Latham is considered by the Transportation Department as eminently qualified to carry out the work because of the professional excellence of its members, because of its past research in Kenya, and because of the contacts it has established with Government, University and community authorities there.

The total cost of all four studies is estimated at $161,000 over the January 1978-January 1981 period. The work is distinguishable into two phases: January 1978-December 1979 ($121,000) and January 1980-December 1980 ($40,000). Out of the $121,000 for Phase I, about $71,500 will, as noted above, be forthcoming from the Overseas Developing Ministry of the United Kingdom. Thus, Research Committee approval is hereby requested for the Phase I balance, i.e. $49,500. Subject to satisfactory results from Phase I, approval for Phase II by the Research Committee will be requested (for $40,000) (including $7,500 for Bank supervision) in the middle of calendar year 1979.

The Transportation Department, which has been working closely with the Ministry of Overseas Development on the Kenyan Rural Access Roads Program, has undertaken to provide, out of funds from the "Study of Labor and Capital Substitution in Civil Construction", the services of one Statistician and one Work Study Engineer. In addition, the Transportation Department will perform liaison functions between the research team and the East Africa Region Project and Programs Departments.

Direct involvement by IBRD staff in the proposed studies is expected to be minimal: not exceeding four man/weeks per year. Staff involvement will include routine administration, organization of reporting activities (seminars, workshops, etc. on interim findings), and preparation of research results for publication. It is expected that a principal

function of the IBRD staff will be to maintain regular contact with the ODM staff supervising the U.K.-financed portion of the work.

I. OBJECTIVES AND STRATEGY

A. General

(1) Nutrition and Worker Productivity

There is general agreement that nutritional and health factors are important determinants of the human ability to perform hard work and prolonged physical activity. Optimum or maximum labour productivity are assumed to be dependent on an adequate dietary intake and good health in those performing strenuous work (1). *

Despite these widely held assumptions there has been inadequate research to demonstrate the extent of the relationships between nutritional status and health on the one hand and work output or productivity on the other. Very few studies have attempted to show the effects on labor productivity of a dietary or health intervention, and to demonstrate the economic return of such an intervention.

The literature on the apparently straightforward relationship between calorie intakes and work output is fairly extensive. It is, of course, clear that humans have to burn calories in order to live and to perform work. But a careful perusal of the literature shows that relatively few experiments have demonstrated that increased calorie intakes result in increased work output or productivity. The important studies in Germany during and after World War II (2) are often quoted, but are by no means definitive. The so-called Minnesota starvation study of Keys et al. (3) increased our knowledge but did not address this question. The recent work in Guatemala by Viteri and his colleagues (4), in which the effects of calorie and iron deficiencies were studied, has broken new ground. Viteri, in one study of the energy expenditure of two groups of Guatemalan peasants, one supplemented and the other unsupplemented, showed a marked increase in energy expenditure in the supplemented group. Both groups, however, had a negative energy balance, the time was short, and the type of work performed was not identical in both groups.

The IBRD study (5) in Indonesia has shown that fairly severe anemia does affect productivity. Treatment of anemia for a period of 60 days led to an increase in productivity of 15 percent for rubber tappers and 25 percent for weeders. An earlier report by the same group showed no difference in Harvard Step Test results with those whose haemoglobin was above and below 13 g/%, but significantly lower Harvard Step Test scores in the group with hemoglobin levels below 11 g/%.

Caution is necessary, however, in distinguishing between results based on measures of work capacity and physical fitness and those in which work output or productivity is determined.

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* See references at the end of this proposal.

An investigation of the relationship of certain nutritional and other factors to the productivity of Jamaican sugar cane cutters has recently been completed. This was a cooperative study involving the Caribbean Food and Nutrition Institute and our group at Cornell University, and was carried out with the approval of the Jamaican Government, the trade unions and the sugar growers (6). One of the important findings in this study was that cane cutters whose weight for height was below 85 percent of the standard, cut significantly less cane than those whose weight for height was above 95 percent. This significant relationship remained when factors such as age, weight and height were controlled. Weight for height provides an index of fatness or thinness, and therefore of energy stores or reserves. It is postulated that energy stores may be a major determinant of a worker's ability to sustain a high level of productivity over a period of several weeks of heavy work (7).

In India a study of the effect of health and nutrition status on productivity of road workers has recently been conducted. This project supported by the IBRD has some similarities to the Kenya Rural Access Roads Program. The results of the Indian study are stated to show that "hematocrit and iron do correlate with output".

A variety of surveys and special studies show that nutritional deficiencies are very prevalent in East Africa in general (8) and in Kenya in particular (9). It is now agreed that the problem is in part a general failure to consume adequate quantities of available foods, and in part due to a deficient intake of certain nutrients owing to the nutritional quality of the diet. Among the problems most commonly cited are dietary deficiencies of calories, protein and iron. While protein deficiencies occur mainly in children and are seldom divorced from calorie deficiencies, it is evident that iron and calorie deficiencies occur commonly in both children and adults. There is no point in reviewing here the literature dealing with malnutrition in East Africa.

(2) Nutrition and Roundworm Infection

Roundworm (Ascaris lumbricoides) is the world's most prevalent human intestinal parasitic infection (10). It is estimated that about a billion people harbour this parasite. The worm is by far the largest of the common intestinal parasites measuring often about 20 cms (some 8 inches) and sometimes as much as a foot in length. Its size and appearance are superficially similar to a common earthworm. Some persons have very heavy infections numbering over 100 adult worms.

Ascariasis (the medical term for the infection) is spread from person to person. The female worm in the small intestine produces copious numbers of eggs. These are passed out in human feces and can withstand adverse conditions and survive in the environment for many months. If human feces are not properly and safely disposed of, then there will be transmission of the condition. The most important environmental factor,

then, is sanitation, and disposal of human excreta (11). Children tend to be more frequently and heavily infected in part because they tend more often to put soiled objects, contaminated food and dirty fingers into their mouths. Very young children may also spend more time, at "ground level", in the microenvironment of household yards where the ova of Ascaris are desposited. The condition is diagnosed by microscopic examination of the stool to reveal the characteristic ova. Parents often become aware that their children are infected by observing worms passed in the stool or when a child vomits one or more worms.

Pediatricians and public health workers are concerned about this widespread parasite, which is generally believed to cause debility in children. A variety of digestive disturbances, abnormal pain, vomiting, restlessness and poor sleep are all commonly reported. One serious complication is bowel obstruction due to a heavy infection in which the worms become entangled as a bolus. This condition has a high fatality rate in tropical areas. Other complications result from the migration of worms to sites such as the common bile duct (leading to jaundice), to the appendix, to the liver, etc.

The ova when ingested have already embryonated in the soil, and soon hatch in the intestinal tract. The larvae penetrate the wall of the small bowel, travel to the liver and lungs by way of the blood vessels. The larvae in the lung alveoli or air spaces, ascend the bronchial tract, and pass down the esophagus to reach the small intestine where they develop into adult worms. It is known that their passage through the lungs may cause respiratory symptoms including cough, possibly bronchitis and also pneumonia, and an allergic response. This latter condition is manifested by the development of eosinophilia.

There is little human research to demonstrate pathological lesions in the intestine, liver or lungs as a result of ordinary ascaris infections. However the almost identical parasite in pigs, Ascaris suum has been shown to cause fibrotic lesions, known as milk spots, in the liver of young pigs, and the worm is considered an important cause of respiratory problems in the pig industry.

Most doctors, veterinarians and nutritionists would agree that Ascaris is likely to have nutritional implications for the host, if for no other reason than that a large worm must have its own nutritional and metabolic needs. When 100 or more worms are present in the gut of a young malnourished child, and may weigh 5 percent of the weight of the child, then there is little doubt that nutritional status must be affected.

Relatively little research has been done to prove the effect of Ascariasis on nutritional status of children. A study in Cali, Colombia (12, 13) using a metabolic ward has demonstrated that Ascaris appears adversely to affect nitrogen balance. After treatment nitrogen retention was improved. Therefore Ascaris in this study did result in poor utilization of dietary protein.

In an earlier study concerning nutrient absorption Venkatachalam and Patwardhan (14) found a significant decrease in fecal nitrogen excretion following deworming of 9 children with heavy Ascaris infections.

No well controlled study has been conducted in the community and demonstrated the effect of roundworm infection on nutritional status of preschool age children.

A study conducted at Cornell by one of the investigators (LSSL, 15, 16) using well nourished and malnourished growing pigs has shown that Ascaris results in reduced nitrogen utilization and poorer growth in undernourished infected compared with undernourished Ascaris free pigs. Another important finding was that Ascaris infected pigs had hypertrophy of the tunica muscularis of the small intestine. This is the first time that this type of pathology has been reported.

Ascaris has been known for many years to be prevalent in Kenya (17, 18, 19). Although no specific programs have been initiated for its control, there have been efforts to improve sanitation, campaigns for latrine construction, and health education concerning disease transmission. That the people are concerned about the infection is clearly illustrated by the huge market in a variety of worm medicines, some good and some probably ineffective, most sold without prescription in village shops and often improperly utilized. These medicines frequently have a high price mark up when sold retail in small quantities. Their cost is very high in relation to the incomes of the poor. Mothers when questioned are often very concerned about this health problem for their children. They will go to considerable lengths to try and rid their children of worms.

B. Kenya Rural Access Roads Program

The IBRD is engaged in studies to assess the feasibility of labor substitution for equipment in certain aspects of civil construction. Essentially this means that an evaluation is being made of labor intensive, in place of capital intensive civil construction where appropriate in certain third world countries (20).

The Rural Access Roads Program was initiated by the Kenyan Ministry of Works (MOW) in 1975 to expand on the rural road network and to provide access to areas not previously served by a road. The Program receives support from IBRD, UNDP and several bilateral aid agencies. In 1975 there were two construction units established, one in Nyeri District in the highlands, and a second in Kwale District near the coast. Expansion is now taking place into other districts and by 1978 it is proposed that units be established in some 22 districts. One of the major objectives of the program is to utilize labor as effectively as possible while at the same time using human work in preference to mechanical or motorized techniques wherever feasible.

A number of studies are under way to evaluate various labor engineering organisational, management training, and other aspects of the program. Another feature of the program is the development and testing of appropriate and alternative tools and hardware.

One objective included in the plan was an "evaluation of the nutritional standard of workers involved in labor-intensive construction projects". It was further stated that "An assessment will be made of the health and nutritional status of road construction workers and its effect on labor productivity in the RAR program. Recommendations will be made on suitable nutrition supplementation programs if needed".

The World Bank, the Ministry of Works and the Ministry of Finance and Planning wish to identify those nutritional and health factors which may limit the productivity of road workers in Kenya.

(1) Nutrition and Worker Productivity

While in Kenya on a year of sabbatical leave and while serving as a visiting professor at the University of Nairobi, the Principal Investigator cooperated with the Kenyan Ministry of Works and the World Bank in a study of nutritional status and worker productivity. 1/ On Rural Access Road sites in Nyeri and Kwale Districts the health and nutritional status was determined of workers doing labor-intensive road construction work.

Detailed work output studies were carried out at four road construction sites, two in each district. The types of measures used were times taken (1) to excavate a given volume of earth, (2) to move a given number of filled wheelbarrows a set distance, and (3) to dig a trench of set length, depth, and width in sandy soil. The incentive in each case was that when the task was completed the individual was able to leave work. As most workers are small farmers, this was a real incentive. Task work is much more popular than daily work lasting a set number of hours.

In summary, the findings were that:

(1) Evidence of undernutrition in men was common. Forty-one percent of 281 road workers in the study had a weight for height below 85 percent of the standard. The majority of men were losing weight at work.

(2) Anemia was common in workers in Kwale District but not in Nyeri District. In Kwale 34 percent of men had a hemoglobin level below 13 grams per 100 ml.

1/ See Report to IBRD, 1977 for details and full results.

(3) Many health abnormalities were found. Intestinal parasites and urinary schistosomiasis were common in Kwale workers, and may contribute to anemia.

(4) Low weight for height was strongly and significantly associated with a lower work productivity (Regression $p \leq .0001$; $N = 220$).

(5) Workers with anemia were found to be less productive and to take longer to complete a task than men who had normal levels of hemoglobin.

The feasibility of intervening with an energy containing supplement and with provision of medicinal iron was investigated. It was felt that the length of intervention was not sufficient to demonstrate its effect on worker productivity nor to determine the economic implications of such a strategy.

(2) Effects of Roundworm Infection on Nutrition and Health

In Machakos District in the Eastern Province of Kenya a separate study was undertaken to investigate the effect of roundworm infections on the nutritional status and health of preschool age children. This was carried out in collaboration with the Medical Research Centre 1/ in a part of the District where they were conducting a longitudinal study of health and related factors.

Two villages known to have a rather high prevalence of roundworm infections and without many other intestinal parasites were selected. All preschool children in the two villages of Kanzalu and Mwatati were asked to come for examination and medical treatment on three occasions each four months apart. At each visit histories were taken, a short questionnaire completed, stools collected for subsequent parasitic examination, anthrompometric measurements made, a clinical examination conducted by a physician, and appropriate treatment given. Social, environmental and economic data from households were also obtained.

At visits II and III, and after the results of the first stool examinations were known, all children, both infected and non-infected, received an anthelminthic (Levamisole) which is effective against Ascaris and some other intestinal parasites. The 375 stools collected at visit I were examined in the parasitology laboratory of the Molteno Institute of Cambridge University in England by Dr. David Crompton and his group. This took nearly four months, and so the Ascaris group could not be identified or treated until visit II. Twentyseven percent of the stools were positive for Ascaris.

The experimental design allowed a comparison of baseline data at visit I between Ascaris infected and non-infected children. It was also

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1/ Based in Nairobi, this is a branch of the Royal Tropical Institute (Amsterdam).

possible to assess the subsequent growth and health of Ascaris children in the four months while they were infected with roundworm and to compare this with these same measures four months after they had been dewormed. Comparisons between Ascaris and control children during these periods and using the same parameters were also done.

Attendance at each visit was very good. At visit I approximately 375 preschool age children attended, which is 81 percent of all the children in the two villages. As these "villages" are rural farming communities scattered over the hillsides of the Kanzalu Range and with poor communications, this was considered an excellent turnout. There were inevitable losses of 10 to 20 percent of children at each of the next two visits.

The main findings of this study are:

(1) All social, environmental, economic, health and anthropometric data were essentially similar in control and Ascaris infected children at the start of the study.

(2) Subcutaneous fat (an index of calorie status) is measured by skinfold thickness showed very highly significant differences between control and Ascaris infected children. Skinfold thickness significantly decreased in children with Ascaris, and significantly increased in Ascaris infected children in the period following deworming.

(3) Weight gain was not significantly different in the control and Ascaris children before deworming, but after deworming Ascaris infected children showed a significant gain in weight compared with control children.

(4) Ascaris infection was significantly associated with signs of protein-calorie malnutrition, and these signs significantly improved after treatment in the Ascaris compared with the control group.

(5) Some association was apparent between Ascaris infection, and clinical evidence of anemia and ariboflavinosis. Hookworm infection was also significantly associated with clinical signs of anemia.

The conclusion was reached that Ascaris infections were having a significant effect on growth, nutritional status and health of preschool children. It was quite evident too that mothers considered these worms to be an important health problem. Deworming was so popular that pressures were placed on the research team to deworm all children in both schools in the areas, and to provide worm medicines to many adults and others not resident in the villages studied.

An estimation has been made of the economic costs of this ubiquitous parasite both to families and to the nation. It is quite clear that

common roundworm infections have important economic implications, and yet the cost of its treatment and its control using simple and safe medications like Levamisole is relatively cheap. Initial benefit/cost estimates for all of Kenya indicate a ratio of 10:1. The need now is for a demonstration to illustrate that control is feasible, and that lowering of parasite loads will in a short time markedly reduce the rates of re-infection. The evaluation of such a pilot control program, including the nutritional status of children, is necessary. It is believed that the demonstration in pilot control program, including the nutritional status of children, is necessary. It is believed that the demonstration in pilot villages of a successful and cheap control of this and other intestinal parasites will be necessary before the government of Kenya and other developing countries institute national programs to control intestinal parasitic infections.

II. Design

1. Proposed Studies

The health, nutrition and worker productivity research proposed to be undertaken in Kenya between 1978 and 1980 will be carried out under four study headings:

(1) Evaluation of Health/Nutrition Effects on the Productivity of Casual Laborers in Rural Civil Works.

(2) Evaluation of Practical Interventions to Improve Health Nutritional Status and Worker Productivity.

(3) Study of Health and Nutritional status in Two New Ecological Areas.

(4) Evaluation of the Feasibility and Effectiveness of a Program to Control Intestinal Parasites (especially Ascaris) in a Community.

2. Materials and Methods

Study (1) Evaluation of Health/Nutrition Effects on the productivity of Casual Laborers in Rural Civil Works.

This includes further research to determine the effects on worker output or productivity of providing extra calories as a high energy, nutritious, mid-work day snack to road workers. One or two Districts will be selected for the research. Both will be those where the Kenyan Ministry of Works is involved in the construction of Rural Access Roads using labor-intensive methods. Both Districts will probably be in the Rift Valley, Central or Eastern Province. The Districts will be selected in the hope that, as in Nyeri District, workers will not have serious infections with parasites or much anemia, but a significant percentage will have evidence of undernutrition (caloric deficiency) as judged by low weight for height.

In each District suitable road sites will be selected where adequate numbers of men are employed, and where appropriate task work can be performed and measured. At each site all workers will be examined and the following procedures undertaken:

(1) Clinical nutrition and health examination;

(2) Anthropometric measurements;

(3) Blood taken for determination of hemoglobin and hematocrit levels, and in some areas for examination for malaria parasites;

(4) Stools collected for examination for intestinal parasites, and in some areas urine for Schistosoma hematobium ova.

From among the men examined approximately 120 will be selected for the intervention study. The research will involve mainly a determination of the effect on work output of a dietary intervention.

Short feasibility and acceptability studies will be conducted on the interventions prior to their introduction in the actual research. The intervention study will last 8 to 10 months. This will be followed by special studies which are expected to include some detailed parasitological investigations; testing of alternate dietary supplements for different populations or circumstances; investigation of the question of substitution of supplementary feeding for home food, etc. The actual foods to be used will be decided after the sites have been selected.

The majority of men selected for the intervention study will be those with a low weight for height. But some with normal weight for height will serve as controls. Prior to the intervention, work output measurements of the kind described earlier will be made on each worker for several days. The intervention will include the provision of a nutritious dietary supplement at work to provide about 700 kilocalories per work-day. Repeat measurements of worker productivity and physical examinations will be undertaken 3 months later and again at the end of the study period (probably about 6 months after the introduction of the intervention). In all cases the measure of work productivity will be the time taken for each man to complete an assigned measurable task. This will be done for each man for several days. Kenyan field assistants under supervision will be responsible for recording the consumption of the dietary supplements by each worker, and for detailed recording of the times taken to complete a daily task. A Work Study Engineer (Mark Sharrock) will take responsibility for designing and conducting measurements of work output.

In Study 1, a 24-hour dietary recall will be used to determine food intake prior to the intervention and will be repeated 3 months after the dietary supplement. Because of the relative inaccuracy of this method a sub-sample of the group will be selected and the more time-consuming food weighing method will be used to determine food consumption in the home in the period before and after the intervention. The difficulties of these methods and the fact that no method is fool-proof are realised. However it is believed important to try to discover if the dietary supplements simply serve to reduce food consumption at home. Allied to this part of the study will be the monitoring of the weight of all workers. Weights will be determined at least every 3 months, and at all times just prior to the introduction of an intervention. The 1976 study showed that unsupplemented workers lose weight while actively engaged as road workers.

Finally a careful analysis will be made of the costs of the intervention. These will be translated from the research setting to that kind of intervention that the Ministry of Works might find feasible. These costs will be compared with the benefits to be gained as a result of the intervention in terms of worker productivity. The effects on nutritional status and health will also be evaluated.

Study (2) Evaluation of Practical Interventions to Improve Health, Nutritional Status and Worker Productivity

The 1976 project in Kenya clearly demonstrated that poor nutritional status and anemia were associated with a lower level of worker productivity in the Rural Access Roads Program. Interventions carried out were of short duration and, because of this, provided inconclusive results. For this reason a more detailed investigation of the effects on labor productivity of interventions is planned and described in (1) above.

However the Ministry of Works, the World Bank, and the research team all believe that it is desirable to move ahead with practical interventions that will benefit the workers, and which can be anticipated to increase worker output. These interventions need to be designed, tested and evaluated prior to their general recommendation for wide or universal use.

In Kwale District (or some other suitable District) it is proposed that:

(a) An evaluation be undertaken of different types of mid-work day snacks and of two or more alternate delivery systems. This evaluation will consist in selecting certain snacks, meals or dishes. Two of those being considered are (1) a maize based gruel (uji) with added sugar, oil and a protein source (milk powder or a legume), and (2) a cold snack consisting of enriched bread (possibly mandazis--a maize meal based donut-like product) or chapatis, with fruit and peanuts. Delivery systems might include the snack being taken to the worker at the place where he is working; a lunch break (not now given) where workers attend for their snack at a convenient location; or the collection of the cold snack from the foreman when they report for work. Evaluation will be undertaken of participation when the snack is free compared with when a small charge is made. These snacks will be designed to provide between 300-700 calories per person per day.

(b) Study of routine provision of iron. A study will be undertaken of the feasibility, participation rate, costs and effects on hemoglobin levels of (i) the routine provision of iron (probably ferrous sulphate) tablets to road workers using foremen or field workers, and (ii) the daily provision of an iron rich dietary supplement.

On two road sites base-line data will be obtained on a total of about 150 men. This will include determinations of hemoglobin and hematocrit levels. On one road site iron tablets (ferrous sulphate 300 mg. daily, containing 60 mg. of elemental iron) will be provided to each worker each working day. Records of consumption will be maintained. On the second road site a mid-work day snack will be provided which will be designed to increase iron consumption and iron absorption. The actual foods to be used will be decided in Kenya and will depend on which road site is selected, what local foods are consumed, and what the local customs and preferences are. The foods chosen might include local dark green leafy vegetables (such as cassava leaves), chick peas or some similar legume, and possibly also a fortified product. It would also be desirable in the same snack to include a rich source of ascorbic acid such as guava or other fruit. Recent evidence makes it clear that ascorbic acid consumed at the same meal as iron containing foods will increase iron absorption.

On both road sites blood will be taken again approximately 12 weeks later, and hemoglobin and hematocrit determinations performed. Data will be collected to help evaluate the feasibility, the acceptance and the costs of these two different interventions. The effectiveness will be judged mainly in terms of the effect of the intervention on hemoglobin and hematocrit levels of those men judged to be anemic at the beginning of the study period.

This study of the routine provision of iron is designed especially to evaluate the practicality and costs of delivering more iron to road workers, and to discover the problems inherent in such delivery systems. The study is based on the assumption that it is desirable to take practical steps to increase iron consumption, and to improve iron absorption in subjects where there is a high prevalence of iron deficinecy anemia.

(c) The prevalence of parasitic diseases and their role as causes of anemia, of lack of physical fitness and of absenteeism. The point prevalence of certain parasitic diseases notably hookworm, schistosomiasis (both S. hematobium and S. mansoni), ascariasis and also malaria in road workers in two districts will be determined. Total number of workers examined will be approximately 200. Examinations will be done of stool, urine and possibly blood.

The relationship of the parasitic infections to hemoglobin levels will be determined. An attempt will be made to relate physical fitness, health, and work attendance to different parasitic infections. In those men involved in productivity studies or on task work this too will be related to type and level of parasitic infections.

All men found to have parasitic infections will receive the appropriate medical treatment and examinations will be repeated to see if improvements occur in physical fitness, health, work attendance and productivity.

(d) An evaluation of the feasibility and effectiveness of routine parasitic treatment and prophylaxis. Related to the study described in (c) above, it is proposed to evaluate the feasibility, cost and effectiveness of routine measures to treat, control or prevent certain parasitic infections in adult workers.

On one road site in an area where intestinal parasites are known to be common, stool examinations will be done, and about 80 to 100 men will be routinely examined. Then at four monthly intervals a trained field worker will provide each man with a safe anthelminthic drug. Evaluation will be done to determine rates of re-infection, health status, job absenteeism and symptomatology. The cost of the program will be determined, and the attitudes of workers and staff to the program will be assessed.

On a second road site in an area known to be endemic for malaria 80 to 120 men will be enrolled for the study. A medical examination will be conducted, blood slides for malaria parasites will be taken and spleen size will be determined by palpation. This will provide baseline data. Then for a period of 3-6 months each work man will receive two chloroquine tablets (to provide 300 mg. chloroquine base) on one day per week. The tablets will be administered either by a trained field worker or foreman. The actual swallowing of the tablets will be watched and recorded. After 3-6 months the same examination of health status, blood slide and spleen will be repeated. Where possible, data on work productivity, absenteeism and symptomatology will also be obtained. The cost of the routine administration of this malaria prophylaxis will be calculated.

On a third road site in an area known to have a high prevalence of urinary Schistosomiasis or bilharzia (due to Schistosoma hematobium) approximately 50 men at one road site will form the study population. When first seen medical examinations will be conducted, health history obtained (including a history of observed blood in the urine), urine will be collected for parasitic examination, and blood taken for hematological determinations. All men found to be infected with Schistosomiasis will receive the new one dose treatment consisting of a calculated dose of Hycanthone methane sulphonate (Etrenol) based on the weight of the subject. After a period of 4-6 months the examinations will be repeated. The effectiveness of treatment of this important and debilitating disease will be determined including its effect on symptoms, general health, hemoglobin, and work performance (where possible) will be determined.

Study (3) Study of Health and Nutritional Status in Two New Ecological Areas. A small study has been completed on the relationship of nutritional status and health to worker productivity in two Districts of Kenya. Four road sites, two each in Nyeri and Kwale Districts, were utilized. These represent two quite different ecological zones inhabited by different tribal groups. Nyeri is representative of a fertile highland area where the temperate climate results in a lower transmission of several important parasitic diseases. Kwale District is coastal, hot and humid

with a relatively high prevalence of diseases such as Schistosomiasis, hookworm disease and malaria.

The two Districts studied are to a limited extent representative of important ecological zones in Kenya. They both differ however from (a) the arid drought-prone areas of the country including certain parts of populous Districts such as Machakos and Kitui, the sparsely populated areas of northern Kenya, and the areas inhabited by cattle raising or nomadic peoples, (b) the very heavily populated Nuanza and Western provinces which are endemic for malaria, schistosomiasis, hookworm and other parasitic diseases, have an altitude which is lower than the highland and higher than the coastal areas, and a diet which is different from the other three regions mentioned.

It is proposed that a preliminary study be made of health and nutritional status of workers on Rural Access Roads in two areas of the arid regions and two areas of the Western or Nyanza provinces. This study will not include an attempt to relate nutrition and health factors to work output. The investigation will however indicate whether the types of intervention being suggested for the other regions of Kenya are appropriate or necessary in these two regions.

A total of four road sites, two in each of the ecological zones, will be selected in consultation with the Ministry of Works. At each road site approximately 70 men (total 280) will be asked to volunteer for examination. The examination will consist of a medical and health history, a routine health examination, evaluation of nutritional status using anthropometry (height, weight, arm circumference, triceps skinfold thickness, chest circumference at inspiration and expiration) and clinical examination for evidence of deficiency states; and, perhaps, a sub-sample examination of stool and urine for parasites, and blood for hemoglobin and hematocrit.

Where necessary appropriate treatment will be given, or the worker will be referred to a hospital. These examinations will not be repeated but are designed to provide a rapid assessment of the nutritional and health picture in the workers in these ecological zones.

The purpose as stated is to allow recommendations to be made concerning interventions in these Districts. The examinations will provide data to tell us whether a District is similar to Nyeri or similar to Kwale, or different from both in terms of nutritional status, anemia, etc. There would be no particular point for example of recommending the routine administration of iron where there was practically no anemia; or the regular deworming of men where parasites were rare; or even the feeding of men where no undernutrition was detected.

Study 3 will be the least time consuming and therefore the least costly of the four studies proposed. The research carried out in Kenya in 1976, and the studies proposed here, will lead to concrete recommendations to the Bank, the Ministry of Works and to other branches of the government concerning action that might be taken to improve nutritional status, health and productivity of road workers, and others, in Kenya.

Study 3 is designed to provide clues, or answers, to assist in filling in important gaps in information. It will be a simple cross-sectional study, and will not involve time consuming work output studies. The point prevalence surveys to be conducted in these two new ecological zones will, it is estimated, consume less than 5 percent of the total budget, and less than 10 percent of total staff time (probably about 8 percent of the Principal Investigator's effort).

From past experience a team of two examiners (one physician and one nutritionist) with two field assistants can examine 20-30 workers per day. Therefore the actual examinations at each road site can be conducted in one week or less provided that proper prior arrangements have been made.

These examinations will not be repeated, nor will they be related to work performance. It is believed that a one day visit to each District and road site by the Principal Investigator will be necessary to get agreement for the arrangements. One of the Graduate Research Assistants, together with a Kenyan field worker, may then spend approximately one week at each site making the organizational arrangements and identifying those to be examined. The Principal Investigator together with the Research Assistants and two field workers will complete the examinations at each site in about one week.

The examinations will be conducted at times set aside for this work. As currently planned this would be in February and in May 1979. For example, the Principal Investigator might devote 2 weeks of his time in Kenya in February 1979 and another 2 weeks in May 1979 to this part of the project. This then is 4 weeks out of 38 weeks spent in Kenya. The analysis and interpretation of the data collected from this cross-sectional study will also be easier than that for the other semi-longitudinal studies in which there are treatment groups, interventions, work studies, and hypotheses to be tested. The study in the new ecological zones will yield largely "descriptive" data and results.

Measures recommended to the Ministry of Works to improve health, nutritional status and productivity will almost certainly have relevance to farmers and others besides road workers. Therefore results from several ecological zones will be useful also for this purpose.

Study (4) Evaluation of the Feasibility and Effectiveness of a Program to Control Intestinal Parasites in a Community. This fourth part of the proposed program is unrelated to the Rural Access Roads project. It is however quite closely related to the other investigations included in this proposal, and it will be undertaken by the same senior staff. Like some of the other parts of the research, it is related to the effects of parasitic infections on nutritional status, and it concerns an evaluation of the feasibility and effectiveness of control.

As indicated above, a very detailed study was completed in the field in Kenya in 1976 by the Bank on the role of roundworm infection (Ascariasis) on nutritional status and health. That research has produced unexpected and important results. For the first time, a well controlled study has demonstrated that roundworm is having a significant effect in retarding the growth of children. Other health effects were also noted.

The study was conducted in the villages of Kanzalu and Mwatati in the Machakos District of Kenya. These are not tight little villages with houses in close proximity, but are rural areas each covering perhaps 12 square miles and with a combined population of around 3000 people. These farming communities are quite typical of Kenya. Infections with intestinal parasites, whether they are found in road workers, school children or toddlers, are mainly contracted in the communities in which people live.

The Ascaris project in Kanzalu and Mwatati villages included the deworming of all preschool age children on two occasions using Levamisole hydrochloride (Ketrax). On the last visit, at the request of the community and the school teachers, all school children in the two village primary schools were also dewormed.

It is now intended that a three year evaluation of the feasibility, cost and effectiveness of controlling roundworm (and other parasites) infection in the two villages be undertaken. The objective is to determine the feasibility of this, to test a simple delivery system, to examine its effects on health and nutritional status, and to do detailed studies of reinfection rates.

Each January (1978, 1979 and 1980) all preschool age children (about 350 in number) will be invited to come for examination and treatment. The examination, similar to that in the original study, will include collection of a stool specimen for microscopic examination for parasites; anthropometric measurements (weight, height, arm circumference, triceps skinfold thickness); clinical and nutritional examination; treatment of conditions found; and administration of an anthelminthic drug. Also in January all primary school children attending Kanzalu and Mwatati primary schools will have anthropometric measurements taken and will receive an

anthelminthic drug. These January examinations will be conducted by a team consisting of a nutritionist (Lani Stephenson from Cornell), a parasitologist (David Crompton or Jean Martin from Cambridge), and a physican (Michael Latham from Cornell) supported by a full-time Kenyan field worker (Mutinda Munyao), and a team of temporary field workers. The study will be conducted in collaboration with, and with assistance from, Dr. A. Jansen, the head of the Nutrition Section of the Medical Research Center in Nairobi.

All children, both preschool age and those attending the primary schools, will also receive an appropriate dose of the anthelminthic (Levamisole) every four months. The doses other than those given in January will be administered by the field worker in April-May, and again in September-October. The field worker will visit each household and will personally administer the anthelminthic to each child, will record this, and will obtain information concerning worms passed. School children will receive the anthelminthic at the same intervals from the field worker in their schools. The headmasters and other teachers at each school have agreed to cooperate fully in this program as they have in the past.

The plan outlined here was executed in January 1977, and has been continued this year with funds available to the study team from Cornell University and to Dr. Crompton from Imperial Chemical Industries. However this modest funding is inadequate to complete the next two years of this project.

In the third year of the project health education measures will be included in the program and the results of the project will be presented to the Ministry of Health. Discussions will be held concerning the feasibility, cost and desirability of a much larger pilot or national program to control ascariasis and other intestinal helminthic infections.

3. Note on Statistical Design and Sampling Procedures

The importance of statistical advice is fully recognized and it is proposed that the services of a statistician be utilized before any work begins. The IBRD Transportation Department will make available to the Study Team the services of Mr. Andrew Chesher, Lecturer in Statistics at Birmingham University for a period of up to 10 days so as to ensure that statistical design and sampling procedures are satisfactory. In Kenya, once the locations of the study have been decided upon, and some knowledge has been gained on the size of the work force on each road, then a very early activity will be to obtain real involvement of a competent statistician or biostatistician preferably from Cornell University and possibly from the Kenyan Central Bureau of Statistics or the University of Nairobi. This will be done in January 1978, at the time that detailed local plans are made and when the Kenyan staff are being recruited. The statistician will have the responsibility for providing essential inputs from the beginning in terms of local sampling design and problems, the evaluation system and subsequent analyses of the data.

For Study 4 Mr. V. Gemert, a statistician with the Dutch Medical Research Center, has been involved from the beginning in the design and analysis of the parasite study. He will continue to provide this service, and may also be consulted about Studies 1, 2 and 3.

It should be noted that the Research Assistants and Research Associate from Cornell will be persons who have considerable training in statistics, who have familiarity with computer data analysis, and who know how to handle data and to resolve ordinary design questions. All will have had experience with similar field projects which generated data and required complex analysis including the use of SPSS.

Sampling procedures to be followed are in general quite straightforward and relatively simple. The logic for selection of particular sample sizes is a much more difficult question, and is based on several considerations. These include practicality and feasibility, and on knowledge of the likely variability of measures used and the likely response which may result from the interventions.

Of the three related studies on nutrition, health and worker productivity it is clear that Study 1 is the major and critical research study. It is the core of the "research" component whereas Studies 2 and 3, though of great importance, are evaluations, are more applied, and in the case of Study 3 are more descriptive. This is not a value judgment. In fact Studies 2 and 3 may be of more practical interest and importance for Kenya. Study 1 is an attempt to answer some questions of very broad international concern and interest.

The sampling procedures and statistical design though important for all studies, are more critical for Study 1. More consideration is given here, for the above reasons, to Study 1.

In Study No. 1 the sites selected will not be randomly made. Sites will be purposively chosen which meet the special needs of the research. These are to locate groups of workers where at least 30 percent have a "weight for height" of less than 85 percent of the standard, and where at least 30 percent have a "weight for height" of more than 90 percent of the standard. The conditions required for this study were easily met at the road sites in Nyeri District in the 1976 Study.

In Study 1 the following sample sizes are proposed:

(i) Dietary intervention to determine effects on productivity etc.; 150 men

Study 2

(a) Evaluation of mid-day feeding N = 150

(b) Study of routine provision of iron N = 150

(c) Prevalence of parasitic diseases and their role as causes of anemia, of lack of physical fitness and of absenteeism N = 200

(d) Evaluation of the feasibility and effectiveness of routine parasitic treatment and prophylaxis N = 200

Study 3 Health and nutritional factors related to productivity in two new ecological zones N = 300

Study 4 Evaluation of feasibility and effectiveness of a community parasite control program N = 950 children

It should be noted that the N for each study is the number now proposed. It is not an inflexible number and may be changed for a number of reasons. For example the fact that insufficient subjects are available in a particular area or satisfying a particular criterion to meet the total number proposed, may be a reason for reducing the sample size. If variation in a particular parameter being measured is smaller than expected, this may be a reason for increasing a particular sample size.

It should also be noted that the same subjects in one study might serve as subjects in a second study. Therefore the total N is not necessarily the sum of the N of each study. For example a group of men might serve as subjects for determination of prevalence of a parasitic infection, and also perhaps for an evaluation of the feasibility of routine parasitic treatment, or for the evaluation of mid-day feeding.

Wherever feasible and appropriate it is proposed to use fairly basic statistical procedures for the analysis of the data. Multivariate statistical techniques for the analysis of the data will be used sparingly. The validity of these techniques is based on a set of assumptions about the data which may not be relevant. Analyses using these techniques are often difficult to interpret. Decisions about the effectiveness of an intervention with for example calories or iron supplements may be based upon fairly simple considerations such as whether or not an intervention has increased work output (or in this case decreased the time to complete a task), whether it has increased the hemoglobin levels of the subjects, whether it has increased the weight of workers, etc. The same principles apply to the analysis of data on, for example, the effectiveness of a treatment program such as an anthelminthic given for hookworm or an injection of Etranol for schistosomiasis.

Testing the significance of the differences between several classes with respect to a polychotomous random variable such as the prevalence of a clinical sign or of high or low hemoglobin levels will, when appropriate use the Chi-square test. In some situations it cannot be assumed that

the basic data follow the normal distribution. Those situations can be handled by means of non-parametric procedures which make no assumptions about the distribution of the data. The disadvantages of the non-parametric procedures is that they are generally less powerful than the ones based on say the Students' T-test, that is they are less likely to detect the effectiveness of an intervention as significant, when in fact the intervention has had a significant effect.

When testing the significance of differences between the means of two groups with respect to a continuous (normally distributed) random variable such as calorie or iron intakes and skinfold thickness or hemoglobin levels then the Students' T-test will often be used.

These are the guiding principles. In Study 1 comparisons will be of work output as the dependent variable, and selected independent variables. The latter will include weight for height, hemoglovin levels, and presence of parasites (especially hookworm and Schistosoma hematobium). Similar analyses will be repeated after the intervention.

Pearson correlation coefficients and linear regressions will be computed to detect linear relationships between variables such as weight for height and time taken to complete a task, or hemoglobin levels and work output.

III. ORGANIZATION

1. Timetable

For ease of description the work to be undertaken is shown as Studies (1), (2), (3) and (4). However Studies (1), (2) and (3) are not completely separate and all are connected with the Rural Access Roads Program. Some will be conducted on the same road sites, and on occasion will involve the same group of study subjects. All 4 studies will be conducted more or less concurrently and by the same senior scientific and medical staff.

The following provides a preliminary guide to the proposed timing for each of the 4 studies.

Study 1

January-March 1978

Preparation, selection of sites, preliminary clinical examinations, etc.

April-May 1978

Feasibility of intervention and pre-testing of productivity assessments.

June-December 1978

Intervention in the 2 Districts.

January-March 1979

Final clinical assessments and beginning of special studies.

April-September 1979

Completion of intervention study and special field studies in Kenya.

Data Analysis at Cornell

October-December 1979

Completion of data analysis at Cornell. Preparation of report and publications.

Study 2

January-May 1978

Evaluation of mid-work day snacks.
Prevalence study of parasitic diseases.

June-December 1978

Study of routine provision of iron.

January-May 1979

Evaluation of routine parasitic treatment and prophylaxis.

June-December 1979

Completion of intervention studies and data analysis at Cornell.

January-June 1980

Complete data analysis and prepare reports on intervention study.

Study 3

January-May 1979

Undertakes examinations and collect data in new ecological zones.

June-December 1979

Data analysis at Cornell.

January-June 1980

Complete data analysis and prepare reports.

Study 4

January 1977. Investigators visit Kenya and undertake detailed examination of preschool age and primary school children in Kanzalu and Mwatati. Provide anthelminthics.

February-December 1977. Field Assistant will follow subjects and provide anthelminthics in May-June and September-October.
Data coding at Cornell and preparations for January 1978 visit.
Stool examinations performed in Molteno Institute, Cambridge University
Note: These activities have been completed or are underway.

January-February 1978, 1979 and 1980

Investigators will repeat examination of preschool age and primary school children in Kanzaly and Mwatati and provide anthelminthics.

March-December 1978 and 1979

Field assistant will follow subjects and provide anthelminthics in May-June and September-October.

Data coding and analysis.

Stool examinations performed in Molteno Institute, Cambridge University on stools collected previous January-February.

March 1980-June 1980

Data analysis at Cornell and in Cambridge.

Completion of stool examinations at Cambridge.

July-December 1980

Final analysis, preparation of reports and publications.

2. Reports

1. Progress Report by December 1, 1978.

2. Second Progress Report by June 30, 1979.

3. Final report on Study 1 and on progress of Studies 2, 3 and 4 by December 30, 1979.

4. Final Report Studies 2, 3 and 4 by December 1, 1980.

3. Staff

(1) Principal Investigator--Dr. Michael C. Latham, O.B.E., Professor of International Nutrition, Cornell University, Ithaca, New York. He is a physician and nutritionist, trained in Public Health and Tropical Medicine, and with extensive work experience in East Africa including a knowledge of Swahili.

(2) Co-Investigator--Dr. David Crompton, Fellow, Sidney Sussex College and Senior Lecturer in Parasitology, Molteno Institute, Cambridge University, England, and Adjunct Associate Professor, Cornell University. Experienced in parasitology. Visited Kenya on two occasions in 1976 and undertook all parasitological examinations for previous study.

(3) Co-Investigator--Ms. Lani Stephenson Latham, Research Associate, Cornell University, holder of a National Institutes of Health Traineeship. Experienced nutritionist with training also in parasitology. Spent 1975-76 academic year in Kenya and directed the field study on the relationship of ascariasis to nutritional status. Expected Ph.D in 1978.

(4) Dr. A. A. Jansen, Co-Investigator of the Ascaris study in Machakos. Director of the Nutrition Section of the Medical Research Center. He is a physican and nutritionist with extensive international experience.

(5) Mutinda Munyao, Field Worker in Kenya. Recruited in 1976, he has worked with the Ascaris project, and is employed full time on the project.

(6) Graduate Research Assistants, These cannot be recruited until funding is assured. One Graduate Research Assistant is likely to be a Cornell nutritionist with experience in Zambia and the Philippines, and with training in Public Health. A second one will be a parasitology graduate student from Cambridge University.

(7) Field Assistants, These will be recruited in Kenya. For short term assignments medical and other university students will, where possible, be recruited.

(8) Consultants, A number of Kenyan professionals will serve as short term consultants. These will include physicans from the Medical School and faculty from the Institute for Development Studies of the University of Nairobi, etc.

(9) Work Study Engineer, Mark Sharrock will spend up to 6 months in Kenya in 1978 and 1979. He will take responsibility for designing and conducting measurements of work output for Study No. 1. He will be provided by Transportation Department of IBRD out of funds held by them.

(10) Statistician, Andrew Chesher, Statistician at Birmingham University, England will serve as a consultant in statistics. He will assist with statistical questions of study design and sampling, and will provide continuing advice on data analysis. His services will be provided by the Transportation Department of IBRD out of funds held by them.

Time and Effort of Principal Investigator and Staff

The estimates of time to be spent by the Principal Investigator, the Co-Investigators and other senior staff is illustrated in the attached bar graph. This reflects present intentions. Not included is the work time in Kenya of staff to be recruited there, of effort spent at Cambridge University by parasitology laboratory technicians and staff (estimated at 15 person months), and of time devoted by Cornell Graduate Research Assistants and other staff (estimated at 20 person months). These Cambridge

and Cornell assistants will not be paid for by the funds requested in this grant application.

Principal Investigator

If funded this project will be by far the major research undertaking of the Principal Investigator. The Principal Investigator will spend 6-8 weeks at the beginning of each year (1978, 1979 and 1980) and 8-9 weeks from mid-May in 1978 and 1979 in Kenya working full time on the project.

In general, the Principal Investigator will devote 20 percent of his time to the project while not in Kenya. This will of course vary, and in some months more, and at others less, time will be needed.

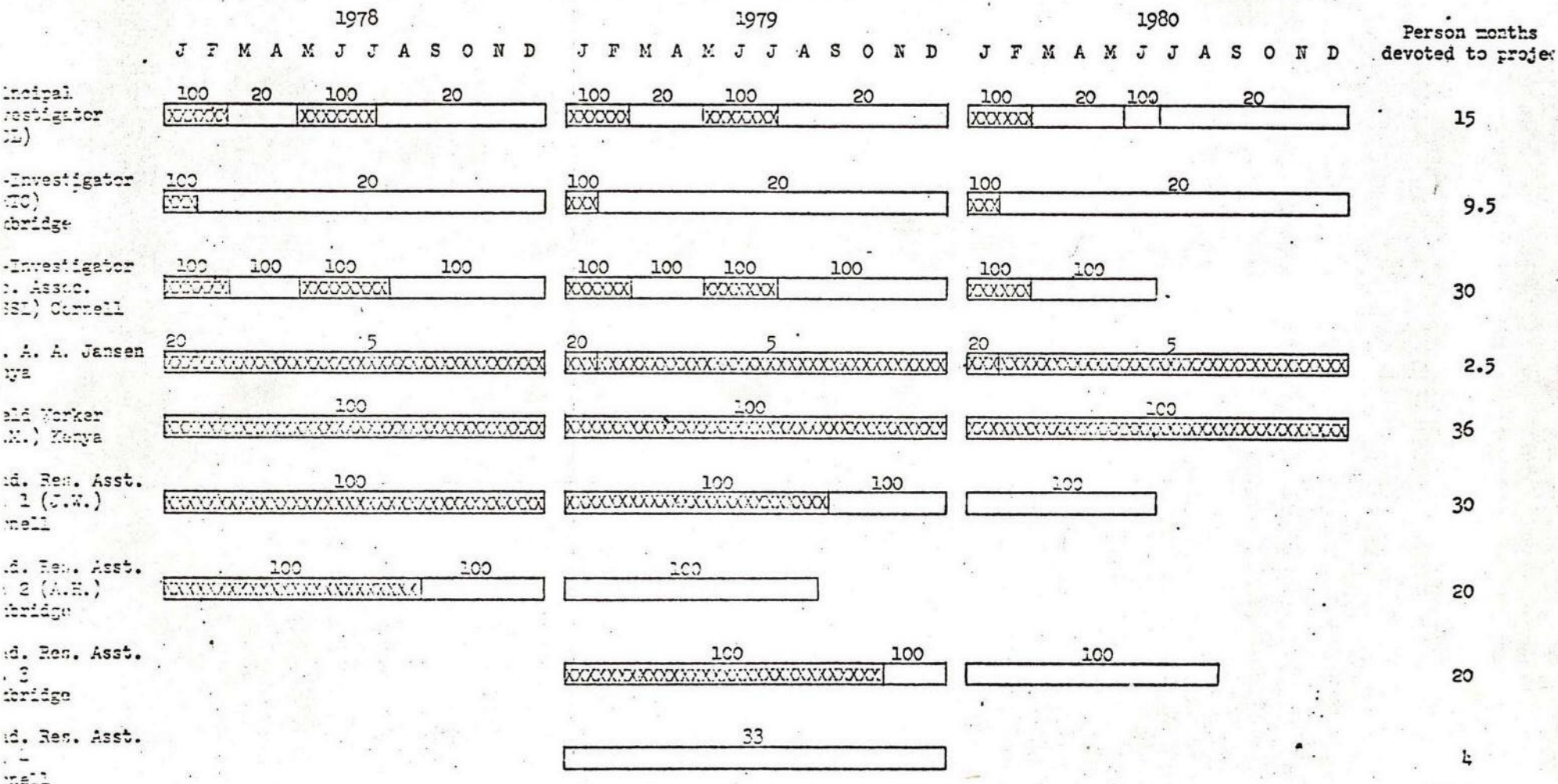
Time of Principal Investigator (M.C.L.) to be devoted to the project

In Kenya		Weeks
1978	Jan.6 -Feb. 24	7
	May-July	9
1979	Jan.-Feb.	6
	May-July	8
1980	Jan.-Feb.	8
	Total	38 weeks

In U.S.		% of time	Week equivalents of full time effort
1978	March-May	20	6
	Aug.-Dec.	20	
1979	March-May	20	6
	July-Dec.	20	
1980	March-May	20	
	June	100	12
	July-Dec.	100	
			24 weeks

Grand total for 3 years = 62 weeks

Proposed Staff Time Devoted to Project



Numbers above bars denote percent of time staff member expected to devote to project.

= Work in Kenya

= Work out of Kenya at Cornell or Cambridge

IV RESOURCE REQUIREMENTS

1. Budget

The total estimated cost of all four studies is $161,000 ($146,000 for study plus $15,000 Bank travel and supervising) over the January 1978-January 1981 period. For budgeting purposes, total costs are split into:

Phase I (Jan. 1978 - Dec. 1979)

$121,000

Phase II (Jan. 1980 - Dec. 1980)

$40,000

Out of the total of $121,000 for Phase I approximately $71,500 will be forthcoming through a grant from the U.K. Ministry of Overseas Development. IBRD Research Committee approval is hereby requested for the balance, amounting to $49,500 including $7,500 for Bank travel and subsistence.

Subject to satisfactory results from Phase I, approval for Phase II by the IBRD Research Committee will be requested in the middle of calendar year 1979.

Study Budget - Year 1

A. Personnel	U.S. $
(1) 1 Research Associate (6 months at $1000.00 p.m.)	$ 6,000
(2) 2 Graduate Research Assistants (1 for 12 months and 1 for 8 months). Stipend and Living expenses at $500.00 p.m. x 20 person months	10,000
(3) 8 Field Assistants (4 for 12 months and 4 for 6 months) 72 person months x $100.00 p.m.	7,200
(4) Daily paid workers in Kenya	2,000
(5) Consultants in Kenya etc.	2,000
B. Overseas Travel	
(1) Travel to and from Kenya for 2 Investigators and 1 Research Assistant from U.S. (Cornell)	5,000
(2) Travel to and from Kenya for 1 Investigator and 1 Research Assistant from England (Cambridge)	2,000

C. Transport and Local Travel	U.S.$
(1) Mileage and/or car hire and local transport	$ 3,500
(2) Per diem for investigators etc.	2,000
D. Equipment and Materials	
(1) Dietary supplements for snacks	
(2) Ferrous sulphate tablets	
(3) Other medical supplies	
(4) Laboratory materials for stool, urine and blood examinations	
(5) Reimbursement for lab determinations	
(6) Stool, urine and blood containers	
(7) Miscellaneous	4,000
E. General	
(1) Office expenses, typing, data analysis, computer expenses, stationery, clerical assistance, Xeroxing, postage, phone, etc.	3,000
F. Contingency	3,000
Total Year 1	$49,700

Study Budget - Year 2

A. Personnel	U.S.$
(1) Research Associate with doctorate (12 months at $1250.00 p.m.)	$15,000
(2) 2 Graduate Research Assistant in Kenya (10 months at $500.00 p.m.)	5,000
(3) 1 Graduate Research Assistant at Cornell (Stipend etc. for 12 months)	6,000
(4) 4 Kenyan Field Assistants (2 for 10 months and 4 for 3 months) 32 months at $125.00 p.m.	4,000

A. Personnel (cont.)	U.S. $
(5) Daily paid workers in Kenya	$ 1,500
(6) Consultants in Kenya etc.	1,500
B. Overseas Travel	
(1) Travel to and from Kenya for 2 Investigators and 1 Research Assistant from U.S.(Cornell)	5,000
(2) Travel to and from Kenya for 1 Investigator from England (Cambridge)	1,000
C. Transport and Local Travel	
(1) Mileage and/or car hire and local transport	3,000
(2) Per diem for investigators etc.	1,800
D. Equipment and Materials	
Items similar to year 1	2,500
E. General	
(1) Office expenses etc. (Items as in year 1)	1,000
(2) Data analysis, keypunching, computer analysis, etc.	2,500
(3) Publication costs	1,000
(4) Contingency	3,000
Total Year 2	$63,800

Study Budget - Year 3

A. Personnel	U.S.$
(1) Research Associate with doctorate (10 months at 1500.00 p.m.)	15,000
(2) 1 Kenyan Field Assistant (12 months at $125.00 p.m.)	1,500
(3) Daily paid workers in Kenya	1,000

	U.S. $
B. Overseas Travel	
(1) Travel to and from Kenya for 2 Investigators from U.S.	$ 3.500
(2) Travel to and from Kenya for 1 Investigator from England	1,000
C. Transport and Local Travel	
(1) Mileage and/or car hire and local transport	1,500
(2) Per diem for investigators etc.	1,200
D. Equipment and Materials	
Items similar to year 1	1,500
E. General	
(1) Office expenses (items as in year 1)	1,000
(2) Data analysis, keypunching, computer analysis, etc.	2,500
(3) Publication costs	1,000
(4) Contingency	1,800
Total Year 3	$32,500

Budget Total by Year

Year 1	$49,700.00	- Phase I
Year 2	63,800.00	
Year 3	32,500.00	- Phase II
Total (3 years)	$146,000.00	

Plus,

Phase I Bank Staff Supervision

2 round trips to Kenya per year = 2,500 x 2 = 5,000

2 m/w subsistance = 80 x 14 x 2 = 2,240

Total = 7,200

Total + Contengency = 7,500 approx.

Phase II Bank Staff Supervision

2 round trips to Kenya per year	= 2,500 x 2 = 5,000
2 m/w subsistance	= 80 x 14 x 2 = 2,240
Total	= 7,200
Total + Contengency	= 7,500 approx.

Phase I and Phase II Bank travel and subsistance = $15,000

Total Budget: $146,000 + 15,000 = $161,000

2. Proposed Payment Schedule

Phase I

(1) First payment of 75 percent of first year budget well prior to beginning of work on January 1, 1978 (to allow purchase of tickets, equipment etc. needed before work which begins in Kenya in January 1978).

(2) Second payment of 25 percent of first year budget on June 30, 1978.

(3) Third payment of 75 percent of second year budget on December 1, 1978.

(4) Fourth payment of 25 percent of second year budget on June 30, 1979.

Phase II

(5) Fifth payment of 75 percent of third year budget on December 1, 1979.

(6) Sixth and final payment of 25 percent of third year budget on June 30, 1980.

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WORLD BANK STUDY OF THE SUBSTITUTION OF LABOR AND EQUIPMENT IN CIVIL CONSTRUCTION

Technical Memorandum No. 26 *

The Relationship of Nutrition and Health To Worker Productivity in Kenya

May 1977

Undernutrition was shown to be common in 281 road workers surveyed in highland and coastal areas of Kenya. Using low weight for height as evidence of undernutrition, it was shown that this is significantly correlated with lower worker productivity. An intervention with 700 extra calories per day for 3 to 4 weeks (average 25 days) reversed this trend. It led to significant gains in weight, in arm circumference and in skinfold thickness. The intervention therefore had a positive impact on nutritional status of the workers, as compared to a sacharine placebo, but because of time constraints, showed no effect on increased worker productivity. Anemia was very common in the coastal areas. It was associated with parasitic infections particularly with hookworms in the intestinal tract, and with urinary schistosomiasis. Both of these parasites cause a loss of blood and therefore of iron. Worker productivity was significantly correlated with hemoglobin levels. An intervention with iron (600 mg. ferrous sulphate) resulted in a rise in hemoglobin and in hematocrit levels, and a small increase in worker productivity, as compared to groups given vitamin C tablets. The interventions to supply approximately 700 extra calories and to provide regular iron therapy were found to be acceptable and feasible.

Clearly the provision of food at work to the laborers working on the Rural Access Roads would be beneficial to them. It would be expected to improve their health and nutritional status, to reverse the weight loss that they are suffering, and it could be expected over time to increase worker productivity. There is a need for a trial of different foods and alternate delivery systems for worker feeding. Conversely, in areas of Kenya where anemia may be common, the regular use of iron tablets by workers is likely to have a beneficial effect on both health and worker productivity. Similarly the treatment of common parasitic diseases such as hookworm and schistosomiasis will improve health, reduce the prevalence of anemia, and probably increase productivity. However, treatment of these parasitic diseases is only a temporary control measure. In the long run appropriate public health measures in the community are needed to control these diseases.

Transportation Department
Agricultural Rural Development Department
Nutrition Division

*Available from Clell Harral

DRAFT

This paper is prepared for staff use.
The views are those of the authors
and not necessarily those of the Bank.

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

STAFF WORKING PAPER NO. 271*

THE NUTRITIONAL AND ECONOMIC IMPLICATIONS OF ASCARIS INFECTION IN KENYA

September 1977

Roundworms are believed to affect a quarter of the world's population. This study was undertaken to determine the effect this disease may have, as well as its treatment, both from a nutritional and an economic viewpoint. The study was carried out in Kenya by consultants from Cornell University, U.S.A. (L. Latham and M. C. Latham) and has been under the direction of Samir S. Basta, Agriculture and Rural Development Department. It was part of a much larger worker productivity study, sponsored by the Transportation Department under the direction of Clell Harral. Although the results presented here largely pertain to children, its implications are equally valid to the well-being and productivity of adults, as is discussed. Thus, from the foregoing research, children with light infections in Ascariasis absorb less nutrients, and this is translated into a food loss of an average of 3% of ingested calories. Heavy infections could lead up to non-utilization of 25% of ingested calories. This may have important repercussions for nutritional programs. The paper also calculates costs of medication, hospitalization, and loss of income from Ascariasis in the general population based on hospital statistics. Deworming undertaken on an average of twice a year could lead to a benefit cost ratio as high as 10:1. Additional studies will explore the feasibility and costs of large scale treatment.

Prepared by: L. Latham, M. Latham (Consultants)
S. S. Basta, Agriculture and Rural Development Department
(Nutrition Division)
Transportation Department

*Available from the Publications Unit

October 7, 1977

Supplementary Information

for

Project Proposal to World Bank

for

An Evaluation of Practical Interventions to Improve Health, Nutrition and Worker Productivity in Kenya

Principal Investigator:

Dr. Michael C. Latham
Professor of International Nutrition
Cornell University
Ithaca, New York 14853

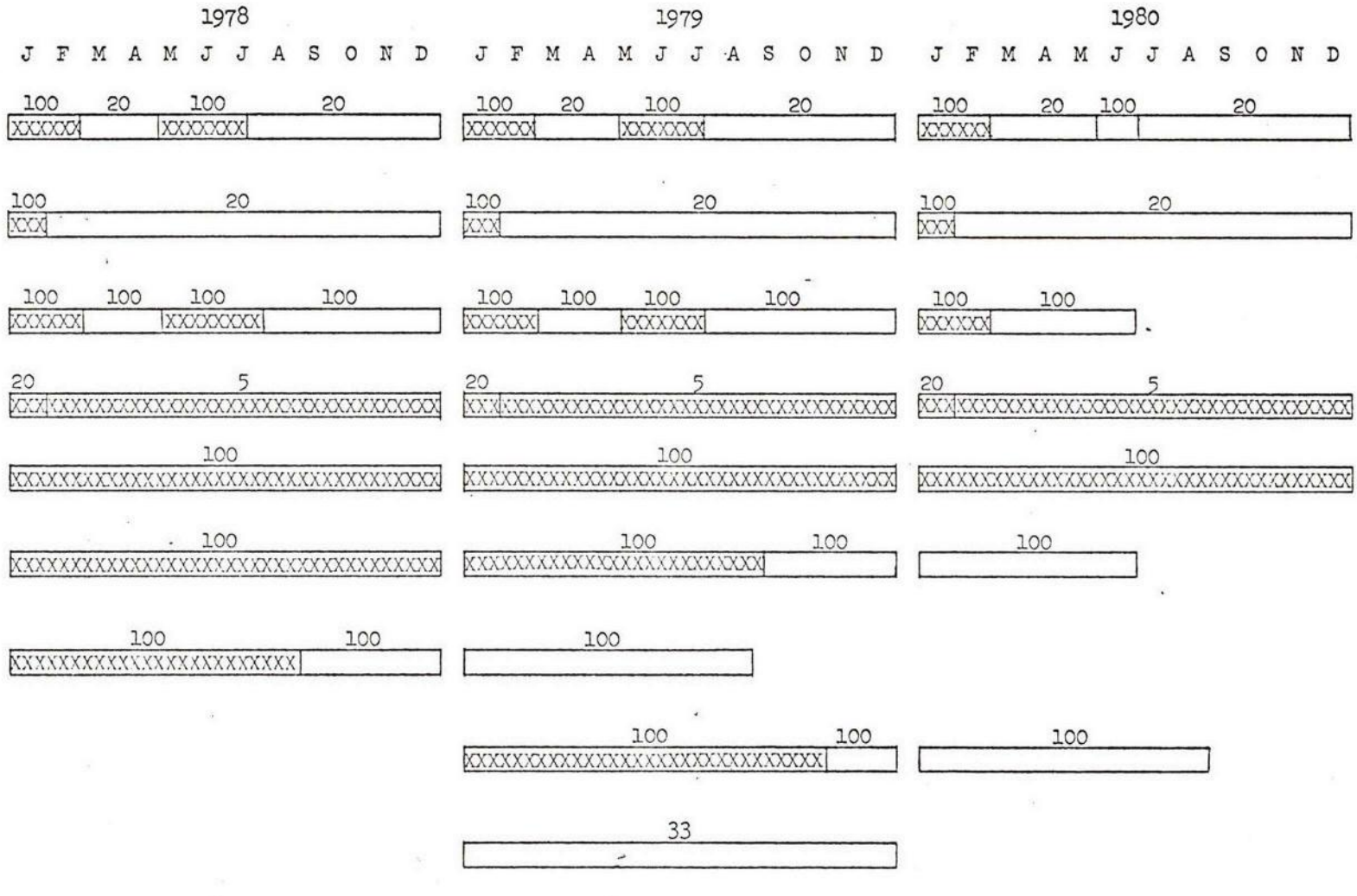
Time of Principal Investigator (M.C.L.) to be devoted to the project

In Kenya		Weeks
1978	Jan. 6 - Feb. 24	7
	May - July	9
1979	Jan. - Feb.	6
	May - July	8
1980	Jan. - Feb.	8
	Total	38 weeks

In U.S.		% of time	Week equivalents of full time effort
1978	March - May	20	6
	Aug. - Dec.	20	
1979	March - May	20	6
	July - Dec.	20	
1980	March - May	20	
	June	100	12
	July - Dec.	100	
			24 weeks

Grand total for 3 years = 62 weeks

Proposed Staff Time Devoted to Project



Note: Numbers above bars denote percent of time staff member expected to devote to project.

Total = 167 months

= Work in Kenya

= Work out of Kenya at Cornell or Cambridge

Time and Effort of Principal Investigator and Staff

The estimates of time to be spent by the Principal Investigator, the Co-Investigators and other senior staff is illustrated in the attached bar graph. ~~This reflects present intentions.~~ Not included is the work time in Kenya of staff to be recruited there, of effort spent at Cambridge University by parasitology laboratory technicians and staff (estimated at 15 person months), and of time devoted by Cornell Graduate Research Assistants and other staff (estimated at 20 person months). These Cambridge and Cornell assistants will not be paid for by the funds requested in this grant application.

Do overheads provide for these assistants?

Principal Investigator

If funded this project will be by far the major research undertaking of the Principal Investigator. The Principal Investigator will spend 6-8 weeks at the beginning of each year (1978, 1979 and 1980) and 8-9 weeks from mid-May in 1978 and 1979 in Kenya working full time on the project.

In general, the Principal Investigator will devote 20 percent of his time to the project while not in Kenya. This will of course vary, and in some months more, and at others less, time will be needed.

Justification for Study 3

Study of health and nutritional factors related to productivity in two new ecological zones

Study 3 will be the least time consuming and therefore the least costly of the four studies proposed. The research carried out in Kenya in 1976, and the studies proposed here, will lead to concrete recommendations to the Ministry of Works and to other branches of the government concerning action that might be taken to improve nutritional status, health and productivity of road workers, and others, in Kenya.

The 1976 study was carried out at two road sites in the highlands, both in Nyeri District, and two at the coast, both in Kwale District. The Investigators believe that Kwale may be representative of the coastal districts and that Nyeri may be representative of the highland districts (or parts of districts). However from these studies it is difficult to predict what the situation is likely to be in other ecological zones especially in relation to nutritional status, anemia and parasitic infections.

Study 3 is designed to provide clues, or answers, to assist in filling in these gaps in information. It will be a simple cross-sectional study, and will not involve time consuming work output studies. The point prevalence surveys to be conducted in these two new ecological zones will, it is estimated, consume less than 5 percent of the total budget, and less than 10 percent of total staff time (probably about 8 percent of the Principal Investigator's effort).

The objective of the study is to evaluate health and nutritional status of workers on Rural Access Roads in two areas in Western or

Nyanza provinces and in two areas in the arid ecological zone. Therefore a total of four Rural Access Road sites will be selected in consultation with the Ministry of Works. At each road site all road workers (if they number more than 60 and less than 120) will be examined on one occasion. If a road site has more than 120 road workers, then those to be examined will be chosen from the muster roll by using random numbers to yield 70-80 workers. From past experience a team of two examiners (one physician and one nutritionist) with two field assistants can examine 20-30 workers per day. Therefore the actual examinations at each road site can be conducted in one week or less provided that proper prior arrangements have been made. The examination will consist of a medical and health history, a routine medical clinical examination, evaluation of nutritional status using anthropometry (height, weight, arm circumference, triceps skinfold thickness, etc.), collection of stool and urine for parasitological examination, and finger prick blood collection for determination of hemoglobin and hematocrit. Appropriate treatment will be given at the time of examination, and those requiring it will be referred for treatment.

These examinations will not be repeated, nor will they be related to work performance. It is believed that a one day visit to each district and road site by the Principal Investigator will be necessary to get agreement for the arrangements. One of the Graduate Research Assistants, together with a Kenyan field worker, may then spend approximately one week at each site making the organizational arrangements and identifying those to be examined. The Principal Investigator together with the Research Assistants and two field workers will complete the examinations at each site in about one week.

The proposal to conduct studies in two new ecological zones may sound like a major undertaking that will spread the research team too thin, and which will therefore detract from the other studies. This is not the case. The studies in the new ecological zones will not be very time consuming in relation to the other projects. The examinations will be conducted at times set aside for this work. As currently planned this would be in February and in May 1979. For example, the Principal Investigator might devote 2 weeks of his time in Kenya in February 1979 and another 2 weeks in May 1979 to this part of the project. This then is 4 weeks out of 38 weeks spent in Kenya. The analysis and interpretation of the data collected from this cross-sectional study will also be easier than that for the other semi-longitudinal studies in which there are treatment groups, interventions, work studies, and hypotheses to be tested. The study in the new ecological zones will yield largely "descriptive" data and results.

The Principal Investigator believes rather strongly that this study in the two new ecological zones will be fully worth the investment of time. It is also believed that this will yield results of considerable interest to the Government of Kenya, and ones on which policy can be based. It would be a pity to complete 3 years of studies in Kenya, and not to know whether recommendations for action and intervention are likely to be applicable or suitable for important areas of the country. As stated in the Project Proposal it is important to know for example whether anemia is prevalent in these other zones and that the situation is similar to Kwale, or whether anemia is rare as was found in Nyeri.

Without this study in two other ecological zones the Principal Investigator will find it difficult to make recommendations to the Ministry of Works. It is also true that measures recommended to the Ministry of Works to improve health, nutritional status and productivity will almost certainly have relevance to farmers and others besides road workers. Therefore results from several ecological zones will be useful also for this purpose.

Iron supplementation and amount of iron

Study 1 is a difficult experiment which is designed to determine the effect on health, nutritional status, and especially work productivity of two interventions, one of which is the control of anemia. In this study a strictly controlled intervention seems essential, if success is to be realized.

Therefore for this study it is believed that the use of iron tablets, rather than iron in food, is the most desirable intervention where extra iron is called for. The difficulty of controlling iron intake from food is very real, and there are many factors which influence iron absorption and utilization from food. A controlled trial of this kind would become extremely complex.

In this intervention it is proposed therefore to administer tablets to provide 600 mg. ferrous sulphate (120 mg. elemental iron) per day to workers.

In Study 2b which is intended to evaluate methods of routine provision of iron to road workers it will be possible, and desirable, to investigate the use, and effectiveness, of iron containing foods as well as medicinal iron. The protocol for this study will therefore be amended as follows:

2(b) Study of routine provision of iron

A study will be undertaken of the feasibility, participation rate, costs and effects on hemoglobin levels of (i) the routine provision of iron (probably ferrous sulphate) tablets to road workers using foremen or field workers, and (ii) the daily provision of an iron rich dietary supplement.

Calorie supplements

The proposal states that the "intervention will include the provision of a nutritious dietary supplement at work to provide 500 to 1000 kilocalories per work day". We had believed that about 700 calories (the amount used in the 1976 study) was about the appropriate amount to aim at in the new studies. That remains the objective. The proposal can be amended accordingly. A wider range was included to allow flexibility and because with heavy work 700 calories provides only about 20 percent of the required daily calories. It is appreciated that higher levels of supplementary calories may be less cost-effective and possibly impractical for future implementation, compared with lower levels.

In the new studies it will be possible in Study (2)a to experiment with lower levels of calorie intakes, perhaps as low as 300 calories per day but certainly using 500 calories per day. However for the major study (Study 1) on worker productivity it is believed that the supplement should provide 700 calories per day, an amount that was previously shown to be effective in terms of weight gain, and which is consistent with previous intervention studies, and with theoretical considerations.

On two road sites base-line data will be obtained on a total of about 150 men. This will include determinations of hemoglobin and hematocrit levels. On one road site iron tablets (ferrous sulphate 300 mg. daily, containing 60 mg. of elemental iron) will be provided to each worker each working day. Records of consumption will be maintained. On the second road site a mid-work day snack will be provided which will be designed to increase iron consumption and iron absorption. The actual foods to be used will be decided in Kenya and will depend on which road site is selected, what local foods are consumed, and what local customs and preferences are. The foods chosen might include local dark green leafy vegetables (such as cassava leaves), chick peas or some similar legume, and possibly also a fortified product. It would also be desirable in the same snack to include a rich source of ascorbic acid such as guava or other fruit. Recent evidence makes it clear that ascorbic acid consumed at the same meal as iron containing foods will increase iron absorption.

On both road sites blood will be taken again approximately 12 weeks later, and hemoglobin and hematocrit determinations performed. Data will be collected to help evaluate the feasibility, the acceptance and the costs of these two different interventions. The effectiveness will be judged mainly in terms of the effect of the intervention on hemoglobin and hematocrit levels of those men judged to be anemic at the beginning of the study period.

This study of the routine provision of iron is designed especially to evaluate the practicality and costs of delivering more iron to road workers, and to discover the problems inherent in such delivery

systems. The study is based on the assumption that it is desirable to take practical steps to increase iron consumption, and to improve iron absorption in subjects where there is a high prevalence of iron deficiency anemia.

It should be quite clear that this rather small project will not be definitive research to determine iron nutritional status and to provide answers to questions of the optimum programs of fortification, supplementation, etc. to control iron deficiency anemia in Kenya. Such research would require a major separate project which should probably begin with studies of iron absorption using local diets and radioactively labeled iron products. Such research is beyond the scope of the project now proposed.

Statistical design and sampling procedures

The importance of statistical advice is fully recognized. Once funding is secured it is proposed first in the U.S. and then in Kenya to utilize the services of a statistician before any work begins. In Kenya Mr. Kenneth Williams, a British statistician in the National Bureau of Statistics, has been consulted in the past, and his advice will continue to be used. It is intended that he, or a Kenyan recommended by him, will serve as a statistics consultant to the project from the beginning and then during the various stages of the project. We regard this as being a vital part of the project. In Kenya, once the locations of the study have been decided upon, and some knowledge has been gained on the size of the work force on each road, then a very early activity and one of great importance will be to obtain real involvement of a competent statistician or biostatistician. This will be done in January 1978, at the time that detailed local plans are made and when the Kenyan staff are being recruited. The statistician will have the responsibility for providing essential inputs from the beginning in terms of local sampling design and problems, the evaluation system and subsequent analyses of the data.

For Study 4 Mr. V. Gemert, a statistician with the Dutch Medical Research Center, has been involved from the beginning in the design and analysis of the parasite study. He will continue to provide this service, and may also be consulted about Studies 1, 2 and 3.

It should be noted that the Research Assistants and Research Associate from Cornell will be persons who have considerable training in statistics, who have familiarity with computer data analysis, and who know how to handle data and to resolve ordinary design questions. All

will have had experience with similar field projects which generated data and required complex analysis including the use of SPSS.

Sampling procedures to be followed are in general quite straightforward and are relatively simple. The logic for selection of particular sample sizes is a much more difficult question, and is based on several considerations. These include practicality and feasibility, and on knowledge of the likely variability of measures used and the likely response which may result from the interventions (these are based on research of others and the research conducted by us in Kenya in 1976).

Of the three related studies on nutrition, health and worker productivity it is clear that Study 1 is the major and critical research study. It is the core of the "research" component whereas Studies 2 and 3, though of great importance, are evaluations, are more applied, and in the case of Study 3 are more descriptive. This is not a value judgment. In fact Studies 2 and 3 may be of more practical interest and importance for Kenya. Study 1 is an attempt to answer some questions of very broad international concern and interest.

The sampling procedures and statistical design though important for all studies, are more critical for Study 1. More consideration is given here, for the above reasons, to Study 1.

In Study No. 1 the two sites selected will not be randomly made. Sites will be purposively chosen which meet the special needs of the research. These are (a) to locate groups of workers where at least 30 percent have a "weight for height" of less than 85 percent of the standard, and where at least 30 percent have a "weight for height" of more than 90 percent of the standard, and (b) to locate groups of workers where hemoglobin levels below 13 gm/100 ml occur in at least 25 percent

of workers and where at least 30 percent of those with low hemoglobin levels have evidence of hookworm infections. The conditions required for (a) above were easily met at the road sites in Nyeri District and for (b) above were easily met by the road sites in Kwale District in the 1976 study.

In Study 1 the following sample sizes are proposed:

(i) Dietary intervention to determine effects on productivity etc. 120 men

(ii) Anemia intervention to determine effects on productivity of different means of controlling anemia 200 men

The 200 men are expected to be grouped as follows:

(a) 50 men who are hookworm free will receive iron supplementation alone

(b) 50 men with hookworm will receive anthelminthics and iron

(c) 50 men with hookworm will receive only anthelminthics

(d) 50 men to serve as controls receiving only placebos

Study 2

(a) Evaluation of mid-day feeding N = 150

(b) Study of routine provision of iron N = 150

(c) Prevalence of parasitic diseases and their role as causes of anemia, of lack of physical fitness and of absenteeism N = 200

(d) Evaluation of the feasibility and effectiveness of routine parasitic treatment and prophylaxis N = 200

Study 3. Health and nutritional factors related to productivity in two new ecological zones N = 300

Study 4. Evaluation of feasibility and effectiveness of a community parasite control program N = 950 children

Note: It should be noted that the N for each study is the number now proposed for the study. It is not an inflexible number and may be changed for a number of possible reasons. For example the fact that insufficient subjects are available in a particular area or satisfying a particular criterion to meet the total number proposed, may be a reason for reducing the sample size. In contrast if variation in a particular parameter being measured is smaller than expected, this may be a reason for increasing a particular sample size.

It should also be noted that the same subjects in one study might serve as subjects in a second study. Therefore the total N is not necessarily the sum of the N of each study. For example a group of men might serve as subjects for determination of prevalence of a parasitic infection, and also perhaps for an evaluation of the feasibility of routine parasitic treatment, or for the evaluation of mid-day feeding.

Wherever feasible and appropriate it is proposed to use fairly basic statistical procedures for the analysis of the data. Multivariate statistical techniques for the analysis of the data will be used sparingly. The validity of these techniques is based on a set of assumptions about the data which may not be relevant. Analyses using these techniques are often difficult to interpret. Decisions about the effectiveness of an intervention with for example calories or iron supplements may be based upon fairly simple considerations such as whether or not an intervention has increased work output (or in this case decreased the time to complete a task), whether it has increased the hemoglobin levels of the subjects, whether it has increased the weight of workers, etc. The same principles apply to the analysis of data on for example the effectiveness of a treatment program such as

an anthelminthic given for hookworm or an injection of Etranol for schistosomiasis.

Testing the significance of the differences between several classes with respect to a polychotomous random variable such as the prevalence of a clinical sign or of high or low hemoglobin levels will when appropriate use the Chi-square test. In some situations it cannot be assumed that the basic data follow the normal distribution. Those situations can be handled by means of non-parametric procedures which make no assumptions about the distribution of the data. The disadvantages of the non-parametric procedures is that they are generally less powerful than the ones based on say the Students' T-test, that is they are less likely to detect the effectiveness of an intervention as significant, when in fact the intervention has had a significant effect.

When testing the significance of differences between the means of two groups with respect to a continuous (normally distributed) random variable such as calorie or iron intakes and skinfold thickness or hemoglobin levels then the Students' T-test will often be used.

These then are the guiding principles under which it is proposed that we work. In Study 1 comparisons will be of work output as the dependent variable, and selected independent variables. The latter will include weight for height, hemoglobin levels, and presence of parasites (especially hookworm and Schistosoma hematobium). Similar analyses will be repeated after the intervention.

Pearson correlation coefficients and linear regressions will be computed to detect linear relationships between variables such as weight for height and time taken to complete a task, or hemoglobin levels and work output.

Proposed Payment Schedule

(1) First payment of 75 percent of first year budget well prior to beginning of work on January 1, 1978 (to allow purchase of tickets, equipment etc. needed before work which begins in Kenya in January 1978)

(2) Second payment of 25 percent of first year budget on June 30, 1978

(3) Third payment of 75 percent of second year budget on December 1, 1978

(4) Fourth payment of 25 percent of second year budget on June 30, 1979

(5) Fifth payment of 75 percent of third year budget on December 1, 1979

(6) Sixth and final payment of 25 percent of third year budget on June 30, 1980

FORM NO. 75
(7–73)

WORLD BANK GROUP

ROUTING SLIP	DATE Sept. 12

NAME	ROOM NO.
Mr. O Grimes	
New manila folder, pending proposals:	
Nutrition and Productivity (Latham)	

	APPROPRIATE DISPOSITION		NOTE AND RETURN
	APPROVAL		NOTE AND SEND ON
	COMMENT		PER OUR CONVERSATION
	FOR ACTION		PER YOUR REQUEST
✓	INFORMATION		PREPARE REPLY
	INITIAL		RECOMMENDATION
	NOTE AND FILE		SIGNATURE

REMARKS

FROM	ROOM NO.	EXTENSION
C. Harral	E535	2097

DRAFT
BCoukis/SBasta:phm
September 12, 1977

cc: Messrs. O. Grimes ✓
B. Coukis
S. Basta

Professor Michael C. Latham
Cornell University
Division of Nutritional Sciences
Savage Hall
Ithaca, New York 14853

Dear Professor Latham:

This letter recapitulates the main points touched upon during our recent telephone conversations and, more specifically, the issues discussed during the conference call among yourself and Messrs. Basta and Coukis on September 8.

We have agreed that the proposed continuation of your work on health and nutrition in Kenya be regarded as one package composed of our distinct studies which would be financed from different sources:

(i) Evaluation of Health/Nutrition Effects on the Productivity of casual laborers in Rural Civil Works.

(ii) Evaluation of Practical Interventions to Improve Health and Worker Productivity.

(iii) Study of Health and Nutritional factors in two new Ecological Areas.

(iv) Evaluation of the feasibility and Effectiveness of a Parasite Control Program.

We understand that Study 1 is virtually assured of financial support by the Overseas Development Ministry of the United Kingdom which will shortly enter with you into the necessary contractual arrangements. However, to ensure that productivity measurements, a crucial element in your proposed research, be carried out on the basis of the most rigorous scientific methodology, we shall undertake to provide the services of a qualified Work-Study Engineer.

In addition, we propose to submit Studies 2, 3 and 4 to the Bank's Research Committee for financing. I would, accordingly, be grateful if you could revise the proposal towards this end once you have signed a contract with ODM.

As Mr. Basta mentioned to you, we would appreciate if the revised proposal would pay particular attention to the following points:

(i) Statistical design and sampling procedures: we require that a rigorous statistical design for the experiments, sampling procedures and estimated sample sizes be provided in the proposal. (e.g. 20 man year subgroup on P.15 of the old proposal should be increased to 2 or 3 times that number to take account of dropouts.)

(ii) Number of Ecological Zones

To be specified in detail. (e.g. 2 zones for productivity studies and 2 zones for nutrition surveys.

(iii) Calorie Supplement

1000 calories is too high as a supplement in terms of cost effectiveness and for future implementation recommendations. Mr. Basta recommends 500 to 700 since the earlier studies showed that this was effective in weight gain. Lower amounts may also be tested if you think it is feasible.

(iv) Iron Supplementation

Local iron rich foods or fortified beverages or condiments should be explored as alternatives to ferrous sulphate pills, since they might be more cost-effective as longer

term solutions on the feeding of large numbers of workers. They may also be important in a natural nutrition program.

(v) Amount of Iron

The amount of iron administered (elemental and salt) must be specified. It should be based on a hemaglobin response, as in previous studies, occuring in 2 to 3 weeks.

The Kenya Government, through the Deputy Secretary to the Ministry of Finance and Planning, Mr. Harris Mole, has given approval in principle to the continuation of the health/nutrition work. Mr. Ole has asked for a copy of your report on "The Relationship of Nutrition and Health to Worker Productivity in Kenya" which we are preparing for printing as a Technical Memorandum. In this connection, it would be very helpful if you could have new drawings of Figures 1, 2 and 3 made, as suggested in your letter of August 30.

The Ministry of Works, through the Pavement Secretary, Mr. Simon Mbugua, has approved that the Rural Access Roads Program continues to be used as the research vehicle for your work on health and nutrition.

With respect to administrative matters, please clarify whether the contract would be made directly with you, Nairobi University, Cornell or some combination. Also, please clarify how much of your own time, as well as that of other staff, will be allocated and when; we would prefer this in the form of a simple bar-chart.

I trust that the cost estimates for Studies 2, 3 and 4 will represent marginal costs since many of the overheads will have to be covered by the ODM contract. Please also indicate a proposed payments schedule; if

the study is approved by the Research Committee, we could advance working capital as before.

With best regards.

Sincerely yours,

Clell G. Harral
Highway Design & Maintenance Adviser
Transportation Department

cc: Ms. Sato/Mr. Mutharika, EA1
Mr. Schebeck, AGP
Mr. Baba, AGP
Mr. D. Chernichovsky, ECD