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Sam Baster

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

10/22/78

Logged 10/26/78

Dear Clell,

Enclosed is a copy of an article we just submitted to the East African Medical Journal based on our baby nutritional status studies in Machakos District. I thought you would like a copy. We are submitting another article for publication which you will receive a copy of after typing. With best wishes —

Sincerely

Lani Stephenson

FORM NO. 75
(9–78)

THE WORLD BANK

ROUTING SLIP	DATE: Nov. 8

NAME	ROOM NO.
Mr. Basta	
File Kenya	

	APPROPRIATE DISPOSITION		NOTE AND RETURN
	APPROVAL		NOTE AND SEND ON
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REMARKS:

FROM:	ROOM NO.:	EXTENSION:
C. Harral	E535	72097

Preliminary Draft by A. Chesher
Sept 28, 1978

Comments on Technical Memorandum No.26: "The Relationship of Nutrition and Health to Worker Productivity in Kenya"

1. The use of 'Z-scores"

In the course of the Kenya nutrition study data was collected on task times for a variety of tasks. It was felt necessary to pool this data for the purpose of estimating a relationship between task times (T) and "weight for height" (WH) but the tasks took varying amounts of time to complete because they were of differing degrees of difficulty. Further the variability of task times differed from task to task. To allow pooling to proceed under these conditions each man's task time for each task was adjusted by subtracting from it the mean of all men's task times for the task under consideration and dividing the resulting difference by the standard deviation of task times for the task concerned. The result was called the "Z-score". One was obtained for each man for each task.

This procedure is only valid if the marginal effect of WH on T is the same for all the tasks considered and this should be borne in mind when interpreting the results. That these marginal effects are identical is questionable since tasks might require different degrees of strength and strength of different types. If the marginal effects are not similar, analysis using "Z-scores" can be regarded as producing an estimate of some "average" marginal effect of WH on T. Whether this average is useful depends on whether the proportion of time spent on the tasks during the period of observation is similar to the proportions of time spent in everyday working.

In any event, the "Z-score" procedure has been inefficiently applied. Any sensible statistical model leads one to reject dividing through by the standard deviations of task times. Instead one should divide through by the residual standard errors that arise from regressing, for each task separately, task time on weight for height. This is a very simple procedure which could be easily adopted at negligible cost. The separate regressions would, as a by-product, give information on the constancy of the marginal effects of WH on T over tasks. The currently used method almost certainly results in incorrect conclusions regarding the precision of the estimates of the regression coefficients.

Problems arise if the same individual appears more than once when the data is pooled - this would happen if any individual performed more than one task. In this case the data cannot be regarded as independent observations. Neglecting to allow for this would lead to overestimation of the precision of the estimates of the effect of WH on T.

2. Omission of variables from the fitted relationships

As I have remarked elsewhere, I believe it is unwise to rely too heavily on two variable analysis when alternatives are available. I doubt whether task time is affected by WH alone and the low correlations reported lend support to this view. Since other anthropometric data is available why not use it? In trailer loading for example it is possible that height (H) is an important determinant of task time particularly if the trailer is high sided. To the extent that H and WH are correlated, omission of H biases the estimation of the effect of WH on T.

3. Errors of measurement

The level of caloric intake (C) is almost certainly measured with error and the error may be quite large since intensive monitoring of home consumption was not possible. I am grateful to Mark Sharrock for raising this point. The effects of such error in what is an explanatory variable in the task time relationship can be considerable. One effect is to bias the estimators of the effect of C on T. I raised this in connection with the Brazil/Kenya highway study data where road roughness is measured with error and is used as an explanatory variable in, for example, tyre wear relationships. The same analysis applies here and I will not repeat it though I can expand on this point if requested. A common counter argument to this point is that all variables are measured with error to some extent and that one cannot cover every discrepancy of the data. However, the errors of measurement in C are likely to be of a different order of magnitude to those in say WH. Whereas the latter can be neglected the former cannot, unless they are indeed known to be small.

4. Alternative models for the effect of caloric intake on task time

It was suggested to me by Dr Harral that caloric intake might not affect task time if other restraints restricted task time. This leads me to reconsider the models used for the relationship between C and T. So far I have only been able to consider this very briefly but the following ideas may be useful.

I For certain individuals increasing C may not affect task time (at least to a first approximation) because they are already well fed. This leads me to consider a model of the form:

(1) $T = \alpha + \beta C + \gamma A + \varepsilon$ if $C < C^*$

(2) $T = \alpha + \gamma A + \varepsilon$ if $C \geq C^*$

Here: T is task time

A represents other anthropometric measurements (eg. WH)

C is caloric intake

ε is a random disturbance

α, β, γ are coefficients, β is the one on which interest is centred

C^* is a threshold level of caloric intake above which changes in C have no effect on T.

This model is not amenable to standard statistical analysis because

(a) there are two relationships for T which join at a point C^* which is unknown,

(b) C^* will vary from person to person,

(c) C^* will depend on A.

The model can be estimated without undue difficulty or expense though I suspect that one might need a range of observed values of C. The model currently estimated is

(3) $T = \alpha + \beta C + \varepsilon$

which is clearly a misspecification of (1), (2), omitting the variable(s) A and neglecting the threshold C*. Even if (1), (2) were not estimated the extended model may be useful in interpreting the results from estimating (3).

One might decide that the threshold, C*, could be neglected because of the resulting complication of the analysis. However, inclusion of A should be seriously considered.

II. The idea of competing constraints holding down task time is an interesting one. If we regard the relationship between T, C and A as a micro-economic production function what we may have is a production function in which C and A are substitutable to only a limited extent, rather like the production function in economic literature with fixed or semi-fixed input ratios. This would lead one to use in (1) above a functional form which allowed limited substitutability to be revealed. Clearly the linear formulation does not allow this for increasing A by ΔA produces the same effect as increasing C by $\Delta C = \frac{\gamma \Delta A}{\beta}$ regardless of the size of ΔA - C and A are infinitely and continuously substitutable in the linear formulation.

So what's [illegible] equation?

Andrew Chesher
University of Birmingham
England

28.9.78

~~Clell~~

September 26, 1978

Nutritional Status and Intestinal Parasites of Kenyan Preschool Children in Machakos District

by

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SUMMARY

Nutritional status and intestinal parasitic infections in 375 children aged 6-72 months in Mwatati and Kanzalu villages, Machakos District, were studied. Over half of the children showed anthropometric and clinical evidence of chronic or acute-on-chronic protein-calorie malnutrition, and one quarter showed clinical evidence of vitamin A deficiency, anaemia, or ariboflavinosis. One quarter were judged to have Ascaris infection; prevalence of other intestinal helminths was low. Increased availability of preventive and curative health/nutrition services is clearly needed in these villages.

INTRODUCTION

Malnutrition, particularly protein-calorie malnutrition, is a common cause of poor growth and mortality in Kenyan preschool children (1,2). Numerous available hospital statistics (3) and an excellent countrywide random sample nutrition survey (4) have usefully documented this fact.

In depth nutrition studies of populations of villages, although they cover small geographical areas, are also helpful in understanding the causation of malnutrition and in assisting local officials to plan nutrition and health intervention programmes aimed at prevention of PCM (5,6). This is particularly true if nutrition related variables (such as socio-economic status and health beliefs and practices) are studied in addition to the standard anthropometric and clinical variables commonly considered (5), and if longitudinal data, which show changes with time, can be collected.

The results reported here are the first or baseline measurements taken in a four year longitudinal study of growth of preschool and primary school-aged children in 2 villages in Machakos District. It is hoped that this information will be useful to local health workers concerned with childhood malnutrition in Machakos in particular and in Kenya in general. These preschool children also participated in a study of the effects of Ascaris infection on growth (7,8). Attempts are now being made to control Ascaris infection in these villages by administering a broad spectrum anthelminthic drug (levamisole) to all pre- and primary school-aged children three times a year for 3 years. The present paper relates only to preschool children.

MATERIALS AND METHODS

The survey was performed in early December 1975 in Kanzalu and Mwatati villages in Kambusu Sublocation, Machakos District. The staff of the Medical Research Centre (M.R.C.) in Nairobi have been conducting a large interdisciplinary project in Machakos District (9) and generously supplied background socioeconomic data collected in 1974-75 on the households.

All mothers were invited to bring their preschool children aged 6 to 72 months in December 1975 to the local primary schools, where examinations were conducted.

Procedures included anthropometric, clinical, and stool examinations for parasite ova and cysts. Anthropometric measurements done were: (nude) weight, length, mid upper arm circumference, triceps skinfold thickness, and head and chest circumferences. All measurements were carried out using techniques described by Jelliffe (10) and were converted to percent standard values using tables given by Jelliffe (10) and derived by Stuart and Stevenson; O'Brien, Girshik, and Hunt; Hammond; Tanner and Whitehouse; and Watson and Lowrey. The examination for 80 clinical signs of nutrient deficiency or other disease was performed by an experienced physician-nutritionist.

Stool samples were collected by two procedures. Most children provided samples at the schools and the samples were fixed immediately in Schaudinn's fluid reinforced with polyvinyl alcohol (11). With some children, however, it was necessary to issue the mother with a plastic pot for later use. Pots were retrieved by field workers from the child's home within 2 days. These stool samples were then fixed in the manner described above. Stool samples were examined in the

laboratory at Cambridge University for the presence of parasites after the use of a standard concentration technique involving ether extraction.

Each mother was asked a number of questions about her child's past and present health, breastfeeding history, food taken by her child that morning, and medicines her child presently is receiving.

RESULTS

Background information

Three hundred and seventy-five children, or approximately 80% of the resident preschool population of the two villages, and 219 mothers were seen. Age distribution of children is shown in table 1 and indicates that each age group was well represented except for 6-11 month olds. Half or 191 of the children were male (51%) and half were female (184, 49%). Forty-six percent (171) lived in Kanzalu, and 54% (204) lived in Mwatati.

The socioeconomic survey conducted by MRC staff indicated that 97% of children had mothers who were not employed outside the home, and 60% had fathers who were not employed in any regularly paid job. The majority had small farms. The mothers of 18% of the children had never been to school, those of 77% had had some primary education, and those of 5% had had some secondary education. Twelve percent of children came from households without a latrine, but the vast majority (88%) had access to a latrine of some type. All families obtained their water from a well, spring, or from rain water.

Coffee was the major cash crop grown, but 43% of children's families had earned less than 340 Kenya shillings from the sale of coffee in the season previous to the economic survey (1973-74); and

63% had harvested 4 or fewer bags of maize, the other major crop. Forty-seven percent of children's families owned no cattle, and 24% owned only 1 or 2 cows.

Anthropometry

A summary of means of the anthropometric measurements for the whole sample is shown in table 2. The high prevalence of poor physical growth is clear: the mean percent weight for age was 79%, mean percent length for age was 92%, and the mean percent weight for length was 91% of the standard.

The breakdown of percent weight for age by age group shown in table 3 illustrates the classic picture of an increase in prevalence and severity of low weight for age with increase in age. While 19% of children 1 year of age were above 90% weight for age, this was true only for 9% of children 4 years of age. Marked increases in the percent of children below 90% weight for age were especially notable comparing children under 1 year of age with those in the 1 and 2 year age groups. The fact that no 3 year olds with a weight for age below 60% were seen probably indicates that the severely malnourished 1 and 2 year olds in that age cohort either improved or died before reaching 3 years of age. Mean percent weight for age decreased significantly in older age groups, using one way analysis of variance ($p < .0005$).

Weight for age provides an indication of whether or not a child is or has been malnourished, but may tell little about the duration of PCM and may not tell whether the child is presently underweight for his body size. One can much better determine the child's present nutritional status by simultaneously considering his weight for age, height or length for age, and weight for height/length. Using these 3 parameters,

it is possible to classify children as being (1) essentially normal in body size, or (2) presently acutely malnourished, or (3) chronically malnourished in the past but presently of normal weight for height, or (4) suffering from present acute PCM on top of past chronic PCM (12,13). The potential for weight gain is likely to be greater in presently malnourished compared with previously malnourished children.

These three categories of malnutrition can be explained more fully as follows:

(a) Current acute short duration malnutrition. This category includes children with low weight for age, normal height for age, and low weight for height. Because height is normal but the weight is low, the child has evidently had a recent short duration deficiency of calories and/or protein, but no evidence of long term deficiencies.

(b) Past chronic malnutrition. This category includes children with low weight for age, low height for age, but normal weight for height. The child presents evidence of a presently adequate dietary intake of calories, but has the stigma of past long duration deficiencies of calories or proteins or both. Recovered children and so-called nutritional dwarfs would also fit into this category.

(c) Current long duration malnutrition (acute-on-chronic). This category includes children with low weight for age, low height for age, and low weight for height. The child has evidence of both a past and present deficiency of protein and/or calories.

The children in the "other" category are children whose weight for age is slightly below "normal" but whose weight for height and height for age are "normal". Thus, they are close to being normal in body size and clearly have a better nutritional status than do the

children in the 3 malnourished categories.

Results of applying this classification to the whole sample are shown in table 4. The most common types of PCM were past chronic PCM (32% of children) and present acute on past chronic PCM (36%). These two types of PCM together accounted for 2/3 of the children in the sample. This suggests that factors such as chronic poor diets and frequent infections during the weaning and post weaning periods cause a retardation of growth, and that frequently there is no catch-up of linear growth. Some children remain both thin and short for their age (acute on chronic PCM) while others gain weight and, though stunted, are not thin (chronic PCM).

Type of PCM varied between the sexes. Males were likely to be better nourished than females (19 vs 10% showed no anthropometric evidence of malnutrition). More females than males suffered from acute and acute on chronic PCM (14 vs 8%, 38 vs 33%). This bias in favor of males has been found by others in Kenya (4) and by workers in a number of traditional African cultures (10).

Clinical history and examinations

Clinical examinations revealed a high prevalence of signs associated with PCM, vitamin A deficiency (xerophthalmia), anaemia, and ariboflavinosis. The most common deficiency signs were of PCM, with 68% of children showing at least one clinical sign (excluding hair changes). Eight children (2.1%) were diagnosed as having nutritional marasmus (weight for age below 60% without edoema), and 8 (2.1%) had kwashiorkor (weight for age 60-80% with edoema). Clinical signs of vitamin A deficiency, anaemia, and ariboflavinosis were also common, with approximately one quarter of the subjects showing at least one sign of each condition.

Signs of goitre, pellagra, scurvy, rickets, and obesity were either not seen or were very rare in both villages. Only 8% of children had evidence of past or present dental caries. No child had filled teeth.

Results for prevalence of the most common clinical signs are shown in table 5. The most common signs of PCM seen were hair changes (7-50% of subjects), mosaic or crazy pavement skin (34%), muscle wasting (15%), potbelly (54%), lack of subcutaneous fat (27%), and apathy (20%). Several of these signs are not satisfactory used alone for diagnosis of PCM but do support the anthropometric evidence.

Signs of xerophthalmia were also relatively common, considering the seriousness of advanced stages of this disease. Conjunctival xerosis was present in 6% of cases, conjunctival wrinkling (not a distinct sign of xerophthalmia) was found in 18%, and Bitot's spots were present in 3.5% of cases. One child had a corneal scar probably resulting from xerophthalmia. According to a recent WHO Expert Committee report (14), presence of Bitot's spots with xerosis in over 2.0% of the population at risk indicates that xerophthalmia is a public health problem in a given community. On the other hand, no corneal xerosis or serious active lesions of xerophthalmia were seen. Follicular hyperkeratosis was seen in 11% of children. All this suggests that vitamin A deficiency may be a problem which requires confirmation using serum retinol determinations, and good dietary intake data. Since availability of mangoes and paw paws (papayas) is seasonal, prevalence of signs of vitamin A deficiency may be seasonal as well.

Signs of anaemia were uniformly common, with pallor of the conjunctivae of the lower eyelid, tongue, and nail beds present in 19%, 18%, and 21% of the children respectively. It was not possible to

take blood for haematological investigation. The commonest signs of diseases of non-nutritional origin were splenomegaly (23%), and umbilical hernia (10%). Other conditions found in significant numbers were ear and eye infections and a variety of skin lesions. The history indicated that respiratory and gastrointestinal infections were common.

Mothers were asked whether each child had any present health problems. Most children had at least one complaint, the common complaints being cough (55%), a head cold or "fever" (meaning mucus in nose or throat) (59%), "malaria" (meaning raised body temperature) (17%), diarrhea (23%), and other abdominal complaints, excluding diarrhea (33%).

Relatively few children were presently receiving medications at home. The most common medications given by the mothers agreed with health complaints given: aspirin compounds (9%), cough medicine (4%), antimalarial drugs (3%), and stomach preparations (3%).

The provision of treatment to children at the survey site was an important service which probably assisted in ensuring study participation. Eighty-seven percent of subjects were given one or more medicines. The most common preparations prescribed were multivitamins (31%), cough mixture (17%), iron tablets (19%), and chloroquin tablets (14%).

Stool examinations for parasites

Ova of Ascaris lumbricoides were observed in 27% of the stool samples. Protozoan cysts, which were identified on morphological grounds as being those of Entamoeba spp. were seen in 14% of the samples. Evidence of the presence of other parasites were detected less frequently, but it appeared that hookworm was present in 6.7% of the children, Trichuris trichiura in 1.8%, Schistosoma mansoni in 0.3% and Enterobius vermicularis in 0.3%. Almost a third (31%) of the children showed

evidence of having at least one parasitic infection, while 8.8% had 2 infections and 0.5% had 3 infections.

The detection of Ascaris eggs in stool samples was similar, irrespective of the sex of the child. Twenty-five percent of the males were considered to be infected as were 29% of the females. Prevalence of Ascaris infection increased with age, with 4% of children under one year of age infected, 18% of those one year of age infected, and 29-34% of those over 2 years of age infected.

Breastfeeding history

Results of questions on breastfeeding showed that prolonged breastfeeding is still the common practice in Kanzalu and Mwatati. Only 1.7% of children whose breastfeeding history was known were not breastfed at all. Most of the children (73%) had already ceased breastfeeding. The mean length of time that children were breastfed was 14.7 ± 6.8 months (range 0-36 months), and children on the average were reported to receive most of their nourishment from the breast for 5.6 ± 3.1 months (range 0-24 months).

Early morning feeding

Mothers were asked what food each child had received in the morning before coming to the survey. These food frequency data showed that 5 children (1.5%) had no food containing protein or calories in the early morning, e.g., plain tea. Of the remaining children, 57% had uji (thin maize meal porridge) to which milk, sugar, lemon juice and/or salt had been added; 17% had ugali (a common maize dish eaten by adults) with vegetables, beans, and/or milk; 17% had tea with sugar and/or milk; 7% had cow's milk to drink; 8% had bread or scones; 6% had whole maize with beans or milk; and 2% had breast milk. Some children consumed

more than one food item, e.g., tea with milk and uji with milk.

DISCUSSION AND CONCLUSIONS

The anthropometric and clinical results presented here show that poor growth and mild physical signs of PCM were common. Eighty-five percent of the preschool children seen in Kanzalu and Mwatati villages had a weight for age below 90% of the standard. This is the cut-off point for malnutrition using the Gomez classification widely accepted in Latin America (15). Bohdal's study of nutritional status in healthy African and European children 4-5 years old in an elite Nairobi kindergarten concluded that "the various (anthropometric) measurements do not differ in comparisons of African and European children" (16). The use of this cut-off point and the growth standards used (10) therefore seems justified.

The mean percent weight for age seen in these 1 to 4 year old children was 78-80%, which is a little lower than the mean of 83% found in the random sample survey conducted in Machakos District in early 1977 by the Central Bureau of Statistics team (4). However, this difference may reflect seasonal or yearly changes.

The high prevalence of acute (11% of sample) or acute-on-chronic PCM (36%), with low weight for height, is genuine cause for concern. Since these children can be rehabilitated by increasing food intake and preventing infections, action is called for. The chronically malnourished children (32% of sample), however, have low weight for age but normal weight for height. Catch up growth which would completely return these children to their standard height for age is unlikely to occur. As they now have a normal weight for height, too rigorous an attempt at rehabilitation may produce obesity.

Of these children with PCM, only 2.1% had nutritional marasmus and 2.1% had kwashiorkor.

The clinical signs of vitamin A deficiency and anaemia seen in one quarter of the children examined are also causes for concern although laboratory confirmation of these diagnoses is desirable. This should be supported by studies of their dietary intakes.

Dental caries was uncommon, and the teeth of these children are much better than those of children in most western countries. Goitre, which has been reported in several areas of Kenya, was seen in only one case in the children examined in this area. Similarly, even though the staple food consists of maize, evidence of pellagra was seen in only one case (0.3%). The preferred local food is isyo, containing maize and beans, which together with other foods, provides both niacin and tryptophan.

The almost universal practice of breast feeding probably contributes to the low rate of PCM in the very young children. Prolonged breast feeding contributes valuable nutrients often into the second year of life but when unsupplemented may contribute to poor growth and development.

The obviously close mother-infant and mother-child interaction and the genuine interest of mothers in the health and welfare of their children suggests that intentional child neglect is not the main cause of malnutrition except in a very few instances where obvious social problems exist.

In conclusion, it is clear that childhood malnutrition is widespread even in this relatively fertile coffee growing area of Machakos District. Future studies will hopefully determine whether the causes

are primarily due to inadequate food production and distribution, scarcity of paid employment, infant weaning practices, and/or to chronic infections of various kinds. In the meantime, increased availability of preventive and curative health services is highly recommended for children of preschool age.

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Note

Address correspondence to L. S. Stephenson at Cornell University (see above for complete address).

The work was carried out at the Medical Research Centre, Nairobi, Cornell University, USA, and Cambridge University, U.K.

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Table 1. Ages of Children

Age at Visit I, mo.[1]	No.	%
6.0 - 11.9	23	6.
12.0 - 23.9	85	23.
24.0 - 35.9	64	17.
36.0 - 47.9	73	20.
48.0 - 59.9	68	18.
60.0 - 72.0	62	16.

[1] Verification of child's birth month and year are from previous Medical Research Centre records and from the respondent in this survey (92% of cases) and from immunization card records (8% of cases).

Table 2. Anthropometric Measurements: Percent of Standard

Parameter	Mean ± SD	Range
weight for age, %	79.3 ± 10.6	53.4 - 125.0
length for age, %	92.3 ± 4.8	75.0 - 107.2
weight for length, %	91.0 ± 7.0	72.2 - 116.0
arm circumference for age, %	88.8 ± 6.4	70.9 - 112.0
triceps skinfold for age, %	97.7 ± 21.6	49.3 - 166.7
head circumference for age, %[1]	98.0 ± 3.2	90.5 - 109.8
chest circumference for age, %[1]	97.4 ± 4.9	83.4 - 111.2
chest/head ratio	1.04 ± 0.06	0.86 - 1.20

[1] Computed only for children 6-60 months of age, n = 315.

Table 3. Percent Weight for Age by Age Group

wt/age, %	Age at Visit I, yr < 1 yr	1+	2+	3+	4+	5+	All ages
90.0 + , col %	56.	19.	16.	12.	9.	2.	15.
80.0-89.9, col %	22.	33.	28.	36.	35.	26.	31.
70.0-79.9, col %	13.	38.	30.	38.	37.	36.	34.
60.0-69.9, col %	9.	7.	25.	14.	16.	32.	17.
< 60.0, col %	0	4.	2.	0	3.	5.	2.
Total column n	23	85	64	73	68	62	375
Total column %	100.	101.	101.	100.	100.	101.	99.
$\bar{X}$*	92.6	80.6	78.2	80.1	78.2	73.7	79.3
(SD)	15.2	9.9	10.0	8.9	9.3	8.8	10.6

* Statistically significant differences between age groups using one way analysis of variance, $p < .0005$. Further differential analysis between individual age groups was not performed.

Table 4. Type of PCM According to Percents Weight for Age, Length for Age, and Weight for Length

Type of PCM[1]	All children n	All children %	Males* col %	Females col %
normal	55	15.	19.	10.
acute	41	11.	8.	14.
chronic	120	32.	34.	30.
acute on chronic	133	36.	33.	38.
other	25	7.	6.	8.
Total column n	374		190	184
Total column %		101.	100.	100.

[1] Definitions of low and normal used in this study are:

	normal	low
weight for age	$\geq$ 90%	< 90%
height/length for age	$\geq$ 95%	< 95%
weight for height/length	$\geq$ 90%	< 90%

* Significant association between type of PCM and sex using Chi-square test, $p < .05$.

Table 5. Clinical Examination

Disease/Sign	Children No. positive	% positive
Protein Calorie Malnutrition		
*lack of luster of hair	78	23.4
*hair dispigmentation/color change	69	20.7
*hair texture change	77	23.1
*hair thinness, sparseness	165	49.5
*hair easy pluckability	23	6.9
moonface	8	2.1
parotid enlargement	3	0.8
gynecomastia	8	2.1
flaky paint dermatosis	0	0
mosaic or crazy pavement skin	128	34.1
muscle wasting, grade 1 or 2	56	15.0
potbelly, grade 1 or 2	204	54.4
edoema, grade 1	8	2.1
lack of subcutaneous fat, grade 1 or 2	100	26.7
apathy	74	19.7
misery	50	13.3
irritability	44	11.7
obvious muscle weakness	1	0.3
hepatomegaly: 1 finger breadth	30	8.0
2 finger breadths	2	0.5
Xerophthalmia		
xerosis	23	6.1
conjunctival wrinkling	68	18.1
Bitot's spots	13	3.5
conjunctival pigmentation	28	7.5
nightblindness	2	0.5
corneal scarring	1	0.3
follicular hyperkeratosis	42	11.2
Anaemia		
pallor of conjunctivae of lower lid	70	18.7
pallor of tongue	66	17.6
pallor of nail beds	79	21.1
Ariboflavinosis		
angular stomatitis	11	2.9
angular scars	3	0.8
cheilosis of lips	78	20.8
conjunctival vascularization	5	1.3

cont.

Table 5 (continued)

Disease/Sign	Children No. positive	Children % positive
Less Common Nutritional Diseases/Signs		
**mottling of tooth enamel (fluorosis) grade 1 or 2	56	15.5
DMF index (no. decayed + missing + filled teeth)*		
0	333	92.0
1-2	17	4.7
3-4	9	2.5
> 4	3	0.9

* N = 333; 42 children had shaved heads
** N = 362; 13 children had few teeth
*** No child had filled teeth

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HUMAN ECOLOGY AND AGRICULTURE AND LIFE SCIENCES
Statutory Colleges of the State University of New York

10/22/78

Dear Samir,

Enclosed is a copy of the article just submitted to the East African Medical Journal based on our early nutr. status studies in Kenya - thought you would like a copy.

I'm also sending a copy to Cecil. I hope everything's going well at the Bank -

Lani

Sapper

September 26, 1978 File

Kenya

Nutritional Status and Intestinal Parasites of Kenyan Preschool Children in Machakos District

by

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SUMMARY

Nutritional status and intestinal parasitic infections in 375 children aged 6-72 months in Mwatati and Kanzalu villages, Machakos District, were studied. Over half of the children showed anthropometric and clinical evidence of chronic or acute-on-chronic protein-calorie malnutrition, and one quarter showed clinical evidence of vitamin A deficiency, anaemia, or ariboflavinosis. One quarter were judged to have Ascaris infection; prevalence of other intestinal helminths was low. Increased availability of preventive and curative health/nutrition services is clearly needed in these villages.

INTRODUCTION

Malnutrition, particularly protein-calorie malnutrition, is a common cause of poor growth and mortality in Kenyan preschool children (1,2). Numerous available hospital statistics (3) and an excellent countrywide random sample nutrition survey (4) have usefully documented this fact.

In depth nutrition studies of populations of villages, although they cover small geographical areas, are also helpful in understanding the causation of malnutrition and in assisting local officials to plan nutrition and health intervention programmes aimed at prevention of PCM (5,6). This is particularly true if nutrition related variables (such as socio-economic status and health beliefs and practices) are studied in addition to the standard anthropometric and clinical variables commonly considered (5), and if longitudinal data, which show changes with time, can be collected.

The results reported here are the first or baseline measurements taken in a four year longitudinal study of growth of preschool and primary school-aged children in 2 villages in Machakos District. It is hoped that this information will be useful to local health workers concerned with childhood malnutrition in Machakos in particular and in Kenya in general. These preschool children also participated in a study of the effects of Ascaris infection on growth (7,8). Attempts are now being made to control Ascaris infection in these villages by administering a broad spectrum anthelminthic drug (levamisole) to all pre- and primary school-aged children three times a year for 3 years. The present paper relates only to preschool children.

MATERIALS AND METHODS

The survey was performed in early December 1975 in Kanzalu and Mwatati villages in Kambusu Sublocation, Machakos District. The staff of the Medical Research Centre (M.R.C.) in Nairobi have been conducting a large interdisciplinary project in Machakos District (9) and generously supplied background socioeconomic data collected in 1974-75 on the households.

All mothers were invited to bring their preschool children aged 6 to 72 months in December 1975 to the local primary schools, where examinations were conducted.

Procedures included anthropometric, clinical, and stool examinations for parasite ova and cysts. Anthropometric measurements done were: (nude) weight, length, mid upper arm circumference, triceps skinfold thickness, and head and chest circumferences. All measurements were carried out using techniques described by Jelliffe (10) and were converted to percent standard values using tables given by Jelliffe (10) and derived by Stuart and Stevenson; O'Brien, Girshik, and Hunt; Hammond; Tanner and Whitehouse; and Watson and Lowrey. The examination for 80 clinical signs of nutrient deficiency or other disease was performed by an experienced physician-nutritionist.

Stool samples were collected by two procedures. Most children provided samples at the schools and the samples were fixed immediately in Schaudinn's fluid reinforced with polyvinyl alcohol (11). With some children, however, it was necessary to issue the mother with a plastic pot for later use. Pots were retrieved by field workers from the child's home within 2 days. These stool samples were then fixed in the manner described above. Stool samples were examined in the

laboratory at Cambridge University for the presence of parasites after the use of a standard concentration technique involving ether extraction.

Each mother was asked a number of questions about her child's past and present health, breastfeeding history, food taken by her child that morning, and medicines her child presently is receiving.

RESULTS

Background information

Three hundred and seventy-five children, or approximately 80% of the resident preschool population of the two villages, and 219 mothers were seen. Age distribution of children is shown in table 1 and indicates that each age group was well represented except for 6-11 month olds. Half or 191 of the children were male (51%) and half were female (184, 49%). Forty-six percent (171) lived in Kanzalu, and 54% (204) lived in Mwatati.

The socioeconomic survey conducted by MRC staff indicated that 97% of children had mothers who were not employed outside the home and 60% had fathers who were not employed in any regularly paid job. The majority had small farms. The mothers of 18% of the children had never been to school, those of 77% had had some primary education, and those of 5% had had some secondary education. Twelve percent of children came from households without a latrine, but the vast majority (88%) had access to a latrine of some type. All families obtained their water from a well, spring, or from rain water.

Coffee was the major cash crop grown, but 43% of children's families had earned less than 340 Kenya shillings from the sale of coffee in the season previous to the economic survey (1973-74); and

63% had harvested 4 or fewer bags of maize, the other major crop. Forty-seven percent of children's families owned no cattle, and 24% owned only 1 or 2 cows.

Anthropometry

A summary of means of the anthropometric measurements for the whole sample is shown in table 2. The high prevalence of poor physical growth is clear: the mean percent weight for age was 79%, mean percent length for age was 92%, and the mean percent weight for length was 91% of the standard.

The breakdown of percent weight for age by age group shown in table 3 illustrates the classic picture of an increase in prevalence and severity of low weight for age with increase in age. While 19% of children 1 year of age were above 90% weight for age, this was true only for 9% of children 4 years of age. Marked increases in the percent of children below 90% weight for age were especially notable comparing children under 1 year of age with those in the 1 and 2 year age groups. The fact that no 3 year olds with a weight for age below 60% were seen probably indicates that the severely malnourished 1 and 2 year olds in that age cohort either improved or died before reaching 3 years of age. Mean percent weight for age decreased significantly in older age groups, using one way analysis of variance ($p < .0005$).

Weight for age provides an indication of whether or not a child is or has been malnourished, but may tell little about the duration of PCM and may not tell whether the child is presently underweight for his body size. One can much better determine the child's present nutritional status by simultaneously considering his weight for age, height or length for age, and weight for height/length. Using these 3 parameters,

it is possible to classify children as being (1) essentially normal in body size, or (2) presently acutely malnourished, or (3) chronically malnourished in the past but presently of normal weight for height, or (4) suffering from present acute PCM on top of past chronic PCM (12,13). The potential for weight gain is likely to be greater in presently malnourished compared with previously malnourished children.

These three categories of malnutrition can be explained more fully as follows:

(a) Current acute short duration malnutrition. This category includes children with low weight for age, normal height for age, and low weight for height. Because height is normal but the weight is low, the child has evidently had a recent short duration deficiency of calories and/or protein, but no evidence of long term deficiencies.

(b) Past chronic malnutrition. This category includes children with low weight for age, low height for age, but normal weight for height. The child presents evidence of a presently adequate dietary intake of calories, but has the stigma of past long duration deficiencies of calories or proteins or both. Recovered children and so-called nutritional dwarfs would also fit into this category.

(c) Current long duration malnutrition (acute-on-chronic). This category includes children with low weight for age, low height for age, and low weight for height. The child has evidence of both a past and present deficiency of protein and/or calories.

The children in the "other" category are children whose weight for age is slightly below "normal" but whose weight for height and height for age are "normal". Thus, they are close to being normal in body size and clearly have a better nutritional status than do the

children in the 3 malnourished categories.

Results of applying this classification to the whole sample are shown in table 4. The most common types of PCM were past chronic PCM (32% of children) and present acute on past chronic PCM (36%). These two types of PCM together accounted for 2/3 of the children in the sample. This suggests that factors such as chronic poor diets and frequent infections during the weaning and post weaning periods cause a retardation of growth, and that frequently there is no catch-up of linear growth. Some children remain both thin and short for their age (acute on chronic PCM) while others gain weight and, though stunted, are not thin (chronic PCM).

Type of PCM varied between the sexes. Males were likely to be better nourished than females (19 vs 10% showed no anthropometric evidence of malnutrition). More females than males suffered from acute and acute on chronic PCM (14 vs 8%, 38 vs 33%). This bias in favor of males has been found by others in Kenya (4) and by workers in a number of traditional African cultures (10).

Clinical history and examinations

Clinical examinations revealed a high prevalence of signs associated with PCM, vitamin A deficiency (xerophthalmia), anaemia, and ariboflavinosis. The most common deficiency signs were of PCM, with 68% of children showing at least one clinical sign (excluding hair changes). Eight children (2.1%) were diagnosed as having nutritional marasmus (weight for age below 60% without edoema), and 8 (2.1%) had kwashiorkor (weight for age 60-80% with edoema). Clinical signs of vitamin A deficiency, anaemia, and aribоflavinosis were also common, with approximately one quarter of the subjects showing at least one sign of each condition.

Signs of goitre, pellagra, scurvy, rickets, and obesity were either not seen or were very rare in both villages. Only 8% of children had evidence of past or present dental caries. No child had filled teeth.

Results for prevalence of the most common clinical signs are shown in table 5. The most common signs of PCM seen were hair changes (7-50% of subjects), mosaic or crazy pavement skin (34%), muscle wasting (15%), potbelly (54%), lack of subcutaneous fat (27%), and apathy (20%). Several of these signs are not satisfactory used alone for diagnosis of PCM but do support the anthropometric evidence.

Signs of xerophthalmia were also relatively common, considering the seriousness of advanced stages of this disease. Conjunctival xerosis was present in 6% of cases, conjunctival wrinkling (not a distinct sign of xerophthalmia) was found in 18%, and Bitot's spots were present in 3.5% of cases. One child had a corneal scar probably resulting from xerophthalmia. According to a recent WHO Expert Committee report (14), presence of Bitot's spots with xerosis in over 2.0% of the population at risk indicates that xerophthalmia is a public health problem in a given community. On the other hand, no corneal xerosis or serious active lesions of xerophthalmia were seen. Follicular hyperkeratosis was seen in 11% of children. All this suggests that vitamin A deficiency may be a problem which requires confirmation using serum retinol determinations, and good dietary intake data. Since availability of mangoes and paw paws (papayas) is seasonal, prevalence of signs of vitamin A deficiency may be seasonal as well.

Signs of anaemia were uniformly common, with pallor of the conjunctivae of the lower eyelid, tongue, and nail beds present in 19%, 18%, and 21% of the children respectively. It was not possible to

take blood for haematological investigation. The commonest signs of diseases of non-nutritional origin were splenomegaly (23%), and umbilical hernia (10%). Other conditions found in significant numbers were ear and eye infections and a variety of skin lesions. The history indicated that respiratory and gastrointestinal infections were common.

Mothers were asked whether each child had any present health problems. Most children had at least one complaint, the common complaints being cough (55%), a head cold or "fever" (meaning mucus in nose or throat) (59%), "malaria" (meaning raised body temperature) (17%), diarrhea (23%), and other abdominal complaints, excluding diarrhea (33%).

Relatively few children were presently receiving medications at home. The most common medications given by the mothers agreed with health complaints given: aspirin compounds (9%), cough medicine (4%), antimalarial drugs (3%), and stomach preparations (3%).

The provision of treatment to children at the survey site was an important service which probably assisted in ensuring study participation. Eighty-seven percent of subjects were given one or more medicines. The most common preparations prescribed were multivitamins (31%), cough mixture (17%), iron tablets (19%), and chloroquin tablets (14%).

Stool examinations for parasites

Ova of Ascaris lumbricoides were observed in 27% of the stool samples. Protozoan cysts, which were identified on morphological grounds as being those of Entamoeba spp. were seen in 14% of the samples. Evidence of the presence of other parasites were detected less frequently, but it appeared that hookworm was present in 6.7% of the children, Trichuris trichiura in 1.8%, Schistosoma mansoni in 0.3% and Enterobius vermicularis in 0.3%. Almost a third (31%) of the children showed

evidence of having at least one parasitic infection, while 8.8% had 2 infections and 0.5% had 3 infections.

The detection of Ascaris eggs in stool samples was similar, irrespective of the sex of the child. Twenty-five percent of the males were considered to be infected as were 29% of the females. Prevalence of Ascaris infection increased with age, with 4% of children under one year of age infected, 18% of those one year of age infected, and 29-34% of those over 2 years of age infected.

Breastfeeding history

Results of questions on breastfeeding showed that prolonged breastfeeding is still the common practice in Kanzalu and Mwatati. Only 1.7% of children whose breastfeeding history was known were not breastfed at all. Most of the children (73%) had already ceased breastfeeding. The mean length of time that children were breastfed was 14.7 ± 6.8 months (range 0-36 months), and children on the average were reported to receive most of their nourishment from the breast for 5.6 ± 3.1 months (range 0-24 months).

Early morning feeding

Mothers were asked what food each child had received in the morning before coming to the survey. These food frequency data showed that 5 children (1.5%) had no food containing protein or calories in the early morning, e.g., plain tea. Of the remaining children, 57% had uji (thin maize meal porridge) to which milk, sugar, lemon juice and/or salt had been added; 17% had ugali (a common maize dish eaten by adults) with vegetables, beans, and/or milk; 17% had tea with sugar and/or milk; 7% had cow's milk to drink; 8% had bread or scones; 6% had whole maize with beans or milk; and 2% had breast milk. Some children consumed

more than one food item, e.g., tea with milk and uji with milk.

DISCUSSION AND CONCLUSIONS

The anthropometric and clinical results presented here show that poor growth and mild physical signs of PCM were common. Eighty-five percent of the preschool children seen in Kanzalu and Mwatati villages had a weight for age below 90% of the standard. This is the cut-off point for malnutrition using the Gomez classification widely accepted in Latin America (15). Bohdal's study of nutritional status in healthy African and European children 4-5 years old in an elite Nairobi kindergarten concluded that "the various (anthropometric) measurements do not differ in comparisons of African and European children" (16). The use of this cut-off point and the growth standards used (10) therefore seems justified.

The mean percent weight for age seen in these 1 to 4 year old children was 78-80%, which is a little lower than the mean of 83% found in the random sample survey conducted in Machakos District in early 1977 by the Central Bureau of Statistics team (4). However, this difference may reflect seasonal or yearly changes.

The high prevalence of acute (11% of sample) or acute-on-chronic PCM (36%), with low weight for height, is genuine cause for concern. Since these children can be rehabilitated by increasing food intake and preventing infections, action is called for. The chronically malnourished children (32% of sample), however, have low weight for age but normal weight for height. Catch up growth which would completely return these children to their standard height for age is unlikely to occur. As they now have a normal weight for height, too rigorous an attempt at rehabilitation may produce obesity.

Of these children with PCM, only 2.1% had nutritional marasmus and 2.1% had kwashiorkor.

The clinical signs of vitamin A deficiency and anaemia seen in one quarter of the children examined are also causes for concern although laboratory confirmation of these diagnoses is desirable. This should be supported by studies of their dietary intakes.

Dental caries was uncommon, and the teeth of these children are much better than those of children in most western countries. Goitre, which has been reported in several areas of Kenya, was seen in only one case in the children examined in this area. Similarly, even though the staple food consists of maize, evidence of pellagra was seen in only one case (0.3%). The preferred local food is isyo, containing maize and beans, which together with other foods, provides both niacin and tryptophan.

The almost universal practice of breast feeding probably contributes to the low rate of PCM in the very young children. Prolonged breast feeding contributes valuable nutrients often into the second year of life but when unsupplemented may contribute to poor growth and development.

The obviously close mother-infant and mother-child interaction and the genuine interest of mothers in the health and welfare of their children suggests that intentional child neglect is not the main cause of malnutrition except in a very few instances where obvious social problems exist.

In conclusion, it is clear that childhood malnutrition is widespread even in this relatively fertile coffee growing area of Machakos District. Future studies will hopefully determine whether the causes

are primarily due to inadequate food production and distribution, scarcity of paid employment, infant weaning practices, and/or to chronic infections of various kinds. In the meantime, increased availability of preventive and curative health services is highly recommended for children of preschool age.

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The kindness and cooperation shown by the mothers and preschool children in Kanzalu and Mwatati cannot be over-emphasized.

Note

Address correspondence to L. S. Stephenson at Cornell University (see above for complete address).

The work was carried out at the Medical Research Centre, Nairobi, Cornell University, USA, and Cambridge University, U.K.

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Table 1. Ages of Children

Age at Visit I, mo.[1]	No.	%
6.0 - 11.9	23	6.
12.0 - 23.9	85	23.
24.0 - 35.9	64	17.
36.0 - 47.9	73	20.
48.0 - 59.9	68	18.
60.0 - 72.0	62	16.

[1] Verification of child's birth month and year are from previous Medical Research Centre records and from the respondent in this survey (92% of cases) and from immunization card records (8% of cases).

Table 2. Anthropometric Measurements: Percent of Standard

Parameter	Mean ± SD	Range
weight for age, %	79.3 ± 10.6	53.4 - 125.0
length for age, %	92.3 ± 4.8	75.0 - 107.2
weight for length, %	91.0 ± 7.0	72.2 - 116.0
arm circumference for age, %	88.8 ± 6.4	70.9 - 112.0
triceps skinfold for age, %	97.7 ± 21.6	49.3 - 166.7
head circumference for age, %[1]	98.0 ± 3.2	90.5 - 109.8
chest circumference for age, %[1]	97.4 ± 4.9	83.4 - 111.2
chest/head ratio	1.04 ± 0.06	0.86 - 1.20

[1] Computed only for children 6-60 months of age, n = 315.

Table 3. Percent Weight for Age by Age Group

wt/age, %	Age at Visit I, yr < 1 yr	1+	2+	3+	4+	5+	All ages
90.0 + , col %	56.	19.	16.	12.	9.	2.	15.
80.0-89.9, col %	22.	33.	28.	36.	35.	26.	31.
70.0-79.9, col %	13.	38.	30.	38.	37.	36.	34.
60.0-69.9, col %	9.	7.	25.	14.	16.	32.	17.
< 60.0, col %	0	4.	2.	0	3.	5.	2.
Total column n	23	85	64	73	68	62	375
Total column %	100.	101.	101.	100.	100.	101.	99.
$\bar{X}$*	92.6	80.6	78.2	80.1	78.2	73.7	79.3
(SD)	15.2	9.9	10.0	8.9	9.3	8.8	10.6

* Statistically significant differences between age groups using one way analysis of variance, $p < .0005$. Further differential analysis between individual age groups was not performed.

Table 4. Type of PCM According to Percents Weight for Age, Length for Age, and Weight for Length

Type of PCM[1]	All children n	All children %	Males* col %	Females col %
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[1] Definitions of low and normal used in this study are:

	normal	low
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height/length for age	≥ 95%	< 95%
weight for height/length	≥ 90%	< 90%

* Significant association between type of PCM and sex using Chi-square test, $p < .05$.

Table 5. Clinical Examination

Disease/Sign	Children No. positive	Children % positive
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gynecomastia	8	2.1
flaky paint dermatosis	0	0
mosaic or crazy pavement skin	128	34.1
muscle wasting, grade 1 or 2	56	15.0
potbelly, grade 1 or 2	204	54.4
edoema, grade 1	8	2.1
lack of subcutaneous fat, grade 1 or 2	100	26.7
apathy	74	19.7
misery	50	13.3
irritability	44	11.7
obvious muscle weakness	1	0.3
hepatomegaly: 1 finger breadth	30	8.0
2 finger breadths	2	0.5
Xerophthalmia		
xerosis	23	6.1
conjunctival wrinkling	68	18.1
Bitot's spots	13	3.5
conjunctival pigmentation	28	7.5
nightblindness	2	0.5
corneal scarring	1	0.3
follicular hyperkeratosis	42	11.2
Anaemia		
pallor of conjunctivae of lower lid	70	18.7
pallor of tongue	66	17.6
pallor of nail beds	79	21.1
Ariboflavinosis		
angular stomatitis	11	2.9
angular scars	3	0.8
cheilosis of lips	78	20.8
conjunctival vascularization	5	1.3

cont.

Table 5 (continued)

Disease/Sign	Children No. positive	Children % positive
Less Common Nutritional Diseases/Signs		
**mottling of tooth enamel (fluorosis) grade 1 or 2	56	15.5
DMF index (no. decayed + missing + filled teeth)*		
0	333	92.0
1-2	17	4.7
3-4	9	2.5
> 4	3	0.9

* N = 333; 42 children had shaved heads
** N = 362; 13 children had few teeth
*** No child had filled teeth

The World Bank / 1818 H Street, N.W., Washington, D.C. 20433, U.S.A. • Telephone: (202) 477-1234 • Cables: INTBAFRAD

October 19, 1978

Dr. Michael C. Latham
Professor of International Nutrition
Cornell University
Division of Nutritional Sciences
Savage Hall
Ithaca, New York 14853

Dear Michael:

Thank you very much for sending the September 30 Inception Report on the Kenya research project. It is concise and well written. I have, however, a few technical questions which I am hurriedly sending to you.

1. Ages

Is it possible to include ages where you give weight for height data in the productivity studies? As you know, during our very short visit to Nyeri, we were struck by the fact that a significant number of the (male) workers were either very young or very old. I think breakdown by age is therefore important, not only to determine and adjust caloric status requirements, etc., but also to indicate the populations characteristics and how representative the population is. The same is true for the studies on anemia.

2. Current Food Intakes, Occupations, Income, Family Size, etc.

I was very surprised to find nothing on this in your report. I was given to understand that June was collecting and quantifying such data.

3. Cost of Experimental Diets in Kwale

On page 16 you state the very important fact that workers were willing to pay 15 or even 30 Kenya cents/day for the food. However, on page 21 and table 7 (page 36) cost of diets are given as 98 and 60 cents. Why the discrepancy?

4. Hemoglobin Levels

(a) The distribution of hemoglobin levels in roads 7 and 12 (Nyeri district) (page 11) are interestingly enough similar to what one would find, I believe, in the USA. I think that fact should be brought out - "not highly prevalent" would not tell the general reader very much. It is interesting also to note the tremendous increase in anemia on the coast.

(b) On page 20, and later in the tables, you take 14g%Hb as the cut-off point for anemia in males. The WHO cutoff is 13g%, and I think for both the sake of continuity with our previous studies, and in order to conform to the international "standard", we should stick to 13g%.

5. Deworming of Kwale Workers

I'm not sure whether from an experimental view it is wise to undertake deworming of those workers that are to receive the different diets. How will we separate out the effects of deworming from that of the diets?

6. Ascaris Study in Children

On page 26, you indicate the overall decrease in prevalence after deworming. I personally find the decrease very small after one year and would have expected much more children to be worm free either as a result of the three drug doses given or because reinfection would take longer (or both). Perhaps I'm being too idealistic. Does Lani have any comments on this? It is also tremendously important because I'd like to recommend 'targets' for decreasing ascariasis in some of our projects.

As regards Peter Hopcraft, we have had no reply to either the cable or the formal letter of appointment that we sent out last week. I expect we'll get a reply in the next few days. If it is positive, I am anxious that he should start working with June on point (2) above as soon as possible. He should also have some "recommendations" on paper for you when you arrive in January 1979. Anyway, Clell or I will contact you as soon as we hear from him, and we'll then discuss with you how best and how soon to allocate his "inputs". I favor his immediate intervention prior to your arrival.

Still no formal reply as of March 79

Clell may have other points to discuss, but I'm sending this off post-haste on account of the usual travel and schedule and.....

Much regards.

Sincerely,

Samir

Samir S. Basta
Nutrition Expert
Nutrition Division
Agriculture and Rural
Development Department

PS: Sorry I could not personally reply to Lani's last letter. I hope she received the copies of the ascaris report and, of course give Juneau my address and tell him to write whenever he wishes. I was very pleased he remembered me.

cc: Mr. Clell Harral, TRP
Mr. Emmerich Schebeck, AGRNU

File Kenya

October 16, 1978

Professor Michael C. Latham
Cornell University
Division of Nutritional Sciences
Savage Hall
Ithaca, New York 14853

Dear Michael:

Just subsequent to my letter of October 4, we received the attached letter from Phil Green. Phil has been the director of the Bank sponsored Scott Wilson research group on labor-intensive methods of construction for the past several years and senior adviser to ODM on the British financed component of the Kenya RARP; thus he speaks on the basis of detailed and expert knowledge and I value his counsel highly.

Phil raises again, as I did earlier, the problem of maintaining a stable worker population for an intervention as long as six months' duration. However, surely if you are satisfied that an intervention of three to four months' duration would be sufficient to detect the effect of calorie improvements, then we will consider that issue settled.

Another aspect has me more concerned, however, and that is the size of the sample necessary to measure the magnitude of the caloric effect on productivity, as distinct from the easier but much less important question as to whether there is any statistically significant effect at all. I really wonder if it would be worthwhile to repeat the experiments in Kwale or elsewhere unless we feel we have a reasonable probability of successfully establishing a statistical estimate relating the increase in work output to the increase in caloric consumption, for, say, at least two or three levels of caloric supplementation. I am asking Andrew Chesher to give some judgment about the sample sizes that would be required based on what we know so far about the variance of productivities and the effect of other factors. If the maximum feasible work force size we can reasonably expect in another RARP unit would give us, say, less than a one in five chance of establishing an estimate of the change in work output with respect to a change in calories consumed within $\pm$ 25 percent of the true value with 90 percent confidence, then possibly we would all agree to abandon the experiment. I don't intend by this example to prescribe any particular criterion for decision making, rather just to illustrate my thinking about the kind of analyses that might help you reach your decision.

Phil Green raised another point of potentially great importance. Chad, with its recurrent and severe famines, might have been a better place to have chosen to do these particular experiments. Surely to the layman's

naked eye the problem of caloric deficiencies and the critical need for attention would appear to be far greater than in Kenya. Basil Coukis as well as Phil Green are familiar with conditions there from their pilot scale labor-intensive demonstration in construction of irrigation canals in the Sategui-Deressia project. However, followup to the labor-intensive demonstration project at Sategui Deressia is probably going to be delayed by a year or so, and I would imagine it is not feasible to think of so drastic a redirection of your research project to Francophone West Africa -- although if it were feasible we would certainly not rule it out. If it is of interest, you might wish to explore with Samir Basta what prospects there would be for more action-oriented nutrition programs in West Africa and elsewhere. In any case the World Food Program has been contacted and I am hopeful that food relief on a large scale will nót be delayed in the Sategui-Deressia (as in the whole Sahellian region) quite aside from any research concerns.

Sincerely yours,

Clell G. Harral
Highway Design & Maintenance Adviser
Transportation Department

CGHarral:phm

Cleared with & cc: Messrs. S. Basta & B. Coukis

cc: Messrs. P. Green/M. Sharrock, A. Chesher

Consulting Engineers and Transportation Planners

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Clell G. Harral Esq.
The World Bank
1818 H Street NW
Washington DC 20433
U.S.A.

Logged 10/4/78

Your ref

Our ref PAG/PDG/78126

26th September, 1978

cc. Dr. R. Latham

Dear Clell

KENYA: HEALTH/NUTRITION STUDY

Further to Mark's letter of 15th September, I noticed that he did not mention one important problem. As you know the current work may be partly abortive because of the "instability" of the labour force, and you have suggested repeating the work in Kwale. Unfortunately unless the RARP are prepared to change their methods specially for the health/nutrition study, there is little likelihood of keeping the same labourers for more than 3-4 months. This arises because the basic road is built at the rate of 2-3 km per month and the work quickly progresses beyond the range of individual villages. The only solution is to either (i) slow up the work by having less men at work on any one road, or (ii) provide camps so that the labour force will be stable for a minimum of 6 months. Neither solution is likely to be acceptable to the RARP. The first alternative, to employ less labour, is also counter to the existing statistical requirement for increased sample size.

For these reasons and in view of the nature of the work, Mark is not very confident that a satisfactory "before" and "after" situation can be achieved in the context of the RARP. The alternative is to find a program which is more static - for example, the Sategui-Deressia project in Chad would have been better than the RARP. Do such projects exist in Kenya? If so, would they be willing to cooperate with the study?

A final point I would mention is that the experience of obtaining the present 'baseline' data has shown that if a repeat study were to be conducted it would be essential to have at least two technical assistants for the data collection process. These should be equivalent technically to the Indian Border Roads Grade I personnel, and might be recruited from, for example, Peace Corps or V.S.O.

Yours sincerely

File my kenya file

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

October 16, 1978

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

Dear Clell:

As mentioned in my letter of October 12, I expect that June Wolgemuth will very soon let Mark Sharrock have details of the anthropometric measurements on the workers on which he has productivity data. As indicated in the Inception Report it is disappointing that Mark Sharrock was not able (a) to get productivity on more of the workers and (b) that he obtained less than 3 days output data on 28 workers, and yet over 10 days on others (clearly 5-7 days productivity on everyone would have been better).

I am disappointed to hear that the $6000.00 suggested by Samir is not actually available. I will re-assess the financial situation in the next few months and let you know what is feasible with regard to a study at a new location. In the meantime could you let me know if your funds allow for Mark Sharrock to go to Kenya on two or possibly three further occasions which may be necessary if we do a productivity study at a new site. I currently have Terry Elliott (stationed in Kwale) looking at possible alternatives.

With regard to the Range Rover it is being used full time now, and I expect it will be until about June 1979 at the earliest. In fact we could not conduct our research in two different parts of Kenya without the Range Rover. Transport is absolutely vital at each location and the Ministry of Works has only been able to provide us with one Land Rover. The Range Rover though invaluable is taking a large bite out of our budget because it guzzles gas and now requires over $1200.00 in repairs and replacements (the load leveller, muffler and tires). Is there any chance that the World Bank could pick up some of these costs in that the vehicle is Bank owned? With regard to insurance we were told by Mr. Nilsson after discussions with Mr. Hutchby (IBRD Administrator, Nairobi) that the World Bank would continue with its usual mode of insurance, and that we did not need to do anything about this. I realize that IBRD staff in Nairobi would like to have use of the Range Rover. I would not mind them using it at times if they could for those periods provide an alternative vehicle for us, and if they were then responsible for upkeep, repairs and replacements. At the present time Mr. Andrew Hall and Ms. June Wolgemuth have responsibility for the Range Rover. Andrew is knowledgeable about vehicles and takes excellent care of it, and June is a responsible and senior person. Before going to Kenya she was on the faculty of the State University in Blacksburg, Virginia, and worked for A.I.D. in the Philippines, she is over 30 years old, and has Masters degrees from Cornell and Johns Hopkins. The fact that she chose to go back to Cornell to do a Ph.D. rather than for example take a position with an international agency does not suddenly make her or my other Research Assistants in Kenya lose their sense of responsibility. I hope that the label "graduate student" does not immediately connote lack of responsibility in the eyes of IBRD staff in Kenya.

From about January 5 until mid March, and again from early May for a couple of months, I will be in Kenya and will then have control of the Range Rover, and will need it for the work that Dr. Crompton, Dr. Stephenson and I will then be doing in different parts of Kenya. The Range Rover was handed over to us on about July 10, 1978.

Please do let me know when Peter Hopcraft accepts the terms of the contract offered to him.

Sincerely yours,

Michael

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

cc: Dr. S. Basta

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

cc Mr Baum
[illegible]

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

October 12, 1978

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

Dear Clell:

I am grateful to you for your letter of October 5, 1978 enclosing the letter to you from Mark Sharrock.

I was extremely surprised to hear that June Wolgemuth had expressed some unwillingness to give the details of our anthropometric findings to Mark Sharrock. I can only believe that there was some misunderstanding. Of course he must have these data and I am asking June to send them to him immediately. All of the data will be shared. This is a joint project, and as Principal Investigator I am adamant that this is how the project will be run. I do wish that Mark had let me know his apparent difficulty immediately. It could then have been sorted out two months ago.

I also want to make it clear that we will greatly value the collaboration of Andrew Chesher with Mark Sharrock, and with us on the analysis and interpretation of these data. I indicated this clearly at the beginning of the project and have in no way changed my mind. I was most impressed with Andrew Chesher, and look forward very much to his collaboration, and I know that his expertise and input will be of the greatest value.

I have not received the actual productivity data from Mark Sharrock and would like to receive this. I had recently written to him about this, but it may save time if you can send me a copy of what was sent to you.

I will reply very soon to the other points that you made in your letter.

I hope that you have received the Inception Report.

In haste.

Sincerely yours,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd
cc: Mark Sharrock
Andrew Chesher
June Wolgemuth

FILE
KENYA

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

October 11, 1978

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

Dear Clell:

I attach to this a copy of the Inception Report for the Kenya project. I am sorry that it got delayed.

In haste.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. S. Basta

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

October 11, 1978

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

Dear Cleli:

I attach to this a copy of the Inception Report for the Kenya project. I am sorry that it got delayed.

In haste.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. S. Basta

Sept. 30, 1978

Inception Report
for
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433

KENYA: HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDIES

Prepared by:

Dr. Michael C. Latham
Professor of International Nutrition and Principal Investigator

and

Dr. Lani Stephenson
Postdoctoral Research Associate and Co-Investigator

from

Division of Nutritional Sciences
Cornell University
Ithaca, New York 14853 U.S.A.

Introduction

This is the inception report on the World Bank Research Project No. 671-73 entitled "Kenya: Health, Nutrition and Worker Productivity Studies". The present project designed to last three years grew out of work conducted in Kenya from 1975 to 1977. The overall project is receiving major financial support also from the British Overseas Development Ministry, from Cornell University and from Cambridge University. Imperial Chemical Industries in Britain have provided the anthelminthic Levamisole free, and have given some support to Dr. David Crompton's laboratory in Cambridge.

It should be noted that although the project was to start on January 1, 1978 the written letter of appointment for this project was dated April 7, 1978, and so the first funds were not available until mid April 1978. Agreement with the British Overseas Development Ministry (ODM) was reached earlier in the year but the first instalment of funds was not received by Cornell until March 1978 (A £1000.00 advance in January 1978 had been received.). ODM is providing support for Study No. 1 and the World Bank for Studies 2, 3 and 4.

The previous work in Kenya had consisted of two parts, namely (a) a study of nutrition and worker productivity, and (b) an investigation of the effects of roundworm infection on nutrition and health of children. In the first study an investigation was made of health and nutritional status of workers involved in the Kenya Rural Access Roads Program of the Ministry of Works. Poor nutritional status due to low calorie intakes and anemia due to poor diets and parasitic diseases were associated with low productivity. The studies were conducted in Nyeri and Kwale Districts. The second study in Machakos District was conducted in collaboration with

the Medical Research Centre based in Nairobi. It involved the examination of children in two villages, and a detailed determination of the effects of roundworm infection on growth, health and nutritional status. These two studies will be referred to later, and reports on them have been issued as IBRD Technical Memorandum No. 26 (1977) and Working Paper No. 271 (Sept. 1977), respectively.

The detailed proposals for the present three year project are contained in "Kenya: Health, Nutrition and Worker Productivity Studies," Proposal to the World Bank Research Committee, November 16, 1977.

Staff Involved

Investigators

Principal Investigator - Dr. Michael C. Latham, Professor of International Nutrition, Cornell University

Co-Investigator - Dr. David Crompton, Senior Lecturer in Parasitology, Cambridge University, and Adjunct Associate Professor, Cornell University

Co-Investigator - Dr. Lani Stephenson (Latham), Postdoctoral Research Associate, Cornell University

Co-Investigator (Ascaris Study only) - Dr. A. A. Jansen, Director, Nutrition Section of Medical Research Centre, Nairobi

Graduate Research Assistants

Ms. June Wolgemuth - Nutritionist from Cornell University

Mr. Andrew Hall - Parasitologist, Cambridge University

Mr. Terry Elliott - Nutritionist, Cornell University

Field Workers

Mr. Mutinda Munyao

Mr. Kiio Mwilu

Mr. Josephat Wambua	Mr. Juma Mwakuzimu
Ms. Esther Ndunda	Ms. Mwanasiti Bakari
Ms. Rose Nzuki	Ms. Terry Githua
Mr. George Matheka	Mr. Naftari Kibunya
Ms. Ruth Musau	Mr. Pius Waweru
Mr. Samuel Mulinge	Mr. Dunia Nyembere
Mr. Isaac Muena	Mr. Omari Bakari
Mr. Charles Kaboi	Ms. Jennifer Wambua

Consultants

Mr. Mark Sharrock - Work Study Engineer

Mr. Andrew Chesher - Statistician (Birmingham University)

Dr. Peter Hopcraft - Economist (Institute for Development Studies, University of Nairobi)

IBRD Staff

Mr. Clell Harral - Transportation

Dr. Samir Basta - Nutrition

Nutrition and Worker Productivity Study

Introduction

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. 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.

(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.

A report of this work is available as IBRD Technical Memorandum No. 26, May 1977 entitled "The relationship of nutrition and health to worker productivity in Kenya" under the general heading "World Bank Study on the Substitution of Labor and Equipment in Civil Construction".

On the basis of the findings in this short preliminary study it was decided that further investigations were desirable. These, it was proposed, should consist of three parts as follows:

Study No. 1 An evaluation of health/nutrition effects on the productivity of casual laborers in rural civil works. In this study the effects of an intervention with calories on work output will be determined.

Study No. 2 An evaluation of practical interventions to improve health and worker productivity. In a series of sub-studies an evaluation will be undertaken of alternative methods for feeding workers; of the routine provision of iron and calorie rich foods to road workers; of the provision of medicinal iron; and of the feasibility of controlling certain parasitic infections. In all these studies the prevalence of parasitic diseases and their relation to anemia will be studied.

Study No. 3 A study of health and nutritional status in two new ecological areas where rural access roads are being constructed.

Study No. 4 A study to evaluate the feasibility and effectiveness of controlling ascariasis, and a longitudinal study of child growth and nutritional status in children in two Kenyan villages.

Drs. Latham and Stephenson were in Kenya for about 8 weeks beginning from early June. In July, Dr. Samir Basta from IBRD visited project sites in both the highland area and at the coast. Full discussions were held about the progress of the projects, and many helpful suggestions were received. Dr. Basta's experience in this kind of activity, including his studies in Indonesia, makes him a very useful staff member to assist with various phases of this project.

Study No. 1 - Nutrition and Worker Productivity Study

The objectives of this study are (1) to ascertain whether a relationship exists between nutritional status and work output or productivity, (2) to evaluate whether about 800 extra calories provided as food at work will improve or increase work output compared with a control group receiving less than 300 calories, (3) to describe other benefits that might result from supplementation (for example improved nutritional status), and (4) to ascertain whether extra food supplied at work substantially reduces the amount of food normally consumed at home.

Road sites within a reasonable distance of the Rural Access Road Camp at Karatina were selected. Highland districts were believed to be most suitable because the work in Kenya in 1976 suggested that many workers in these areas had evidence of undernutrition, and yet heavy parasitic infections and severe anemia were uncommon. The work in Nyeri district in 1976 showed that 38% of 102 road workers had a weight for height below 85% of the standard, and yet anemia and parasitic infections were uncommon. In contrast, work in 1976 in Kwale showed that 41% of 179 men had a weight

for height below 85% of the standard, 34% had hemoglobins below 13.0 grams/100 ml., and parasitic infections were very prevalent, and often were heavy. Sixty-six percent of men had hookworm, 45% had Trichuris and 23% had Ascaris.

The Principal Investigator and members of his team had meetings in January 1978 with Mr. John Simpson (in charge Rural Access Roads), Mr. B. Nilsson (IBRD, Nairobi) and Mr. Michael Knowles (Engineer in charge of the Rural Access Roads supervised from Karatina).

The Investigators had decided that it was desirable to select first a "preliminary" road site. On this site the methodology to be used would be thoroughly tested, field workers would be trained, and a feasibility study would be undertaken. A second road site would then be selected for the definitive study. At a meeting with Mr. Knowles in the Karatina Rural Access Roads headquarters camp, alternative sites were discussed. A decision was reached that Road No. 55 at Igoka (near Makurweini) in Nyeri District would be used as the preliminary road site. A road site where work was planned to begin in April/May 1978 in Muranga District was chosen for the definitive study. (This subsequently had to be changed due to difficulties of obtaining adequate numbers of workers at this site.)

In February 1978 a 10 foot by 10 foot corrugated iron hut was set up at Igoka for use by us as a clinic and field study examination room. A landrover was provided by the Ministry of Works for the project. Two field workers were recruited from among some 20 applicants.

Examinations of all workers at the Igoka road site were then conducted over a period of 3 weeks. Clinical, medical and nutritional status examinations were conducted by Dr. Latham, anthropometric examinations were performed by Ms. Wolgemuth who also obtained relevant social information

on each worker, and stools were collected from each worker by Mr. Hall for later examination by him at the International Laboratory for Research on Animal Diseases in Nairobi or the Veterinary Laboratory in Karatina.

The weight for height findings in the 43 road workers who had clinical examinations are shown in Table 1. From this it can be seen that 73.5% of men were below 85% and 57.5% were below 80% of standard weight for height. Eighty-five percent was the cut off point used in the previous study. Persons below this were considered to have below optimum calorie reserves, or to have an indication of undernutrition. These data suggest that undernutrition is a problem in a substantial percentage of men at the preliminary road site at Igoka.

At the Igoka site stools were collected from the men on whom clinical examinations had been conducted, as well as new male recruits, and also for female road workers. The results are shown in Table 2. These stool examinations were conducted by Mr. Andrew Hall. Although Ascaris and hookworm infections were commonly reported in both males and females he reported that infections were usually very light. The striking difference between these findings and those in the 1976 study probably are due to the fact that in 1976 a commercial laboratory performed the stool examinations, and a thorough search was not made for parasites. In contrast, in 1978 a concentration technique was used, and a very time consuming and extensive search was made for ova in every stool specimen. Therefore even very light infections were not missed. Both hookworm and roundworm infections were more prevalent in males than in females. In contrast, although uncommon, only males were found to have Strongyloides, Taenia or S. mansoni infections.

The extent of multiple infections is shown in Table 3. Cysts were

found in 25.9% of males and 55.3% of females but their significance is unknown.

At the Igoka site two different feeding regimes were tested. For a period of time one group of workers received a lemon flavored sugar drink providing 700 calories and a second group a lemon flavored saccharin sweetened drink with virtually no calories. The workers complained that the sugar drink was unacceptably sweet, and trial and error suggested that acceptance was only common when it was reduced to provide 412 calories. Possibly the situation would have been different if a more dilute solution had been tried but this would require a rather large volume of intake. The saccharin drink, because of its flavor, was also not popular. Small amounts of sugar added helped in making it more acceptable.

For a period of about 4 weeks an alternative feeding regime was tried. This consisted of the provision of a gruel (uchuru or uji) made of maize meal, with added sugar and whole milk to provide 700 calories per day to one group. A "control group" received a low calorie gruel sweetened with saccharin and without added milk. These maize based gruels proved to be highly acceptable. Regular weighings were done on workers.

Twenty-four hour dietary recalls were performed prior to the introduction of the supplements, and again during the period when feeding was being undertaken. In a sub-sample of workers home visits were made and food consumption was determined using the food weighing method. The results have yet to be fully analyzed.

Throughout the study simple medical treatment was provided to workers, and more serious illnesses were referred to hospital.

This preliminary study at Igoka revealed (1) that labor substitution was common, (2) that both males and females were now commonly in the labor

force in this part of Kenya (even though this is uncommon in other districts), (3) that the workers were willing to be medically examined and to cooperate in the study, and (4) that acceptable supplements could be found.

Definitive Study Roads 7 and 12

The new road to be constructed in Muranga District which had been suggested by Mr. Knowles proved not to be feasible. Local leaders failed to recruit sufficient labor, and so the plans to construct this road were abandoned. These labor difficulties in 1978 are believed to be due to higher coffee prices, leading to higher wages for casual labor employed both in coffee and tea picking. The Rural Access Roads Project are paying Shillings 7.80 per day, and the pay for coffee picking was often as high as Shillings 15.00 per day.

After investigating possible road sites in several highland districts as well as in other provinces it was decided that the study would be conducted on Roads 7 (near Kibirigwi) and 12 (near Sagana) in Kirinyaga and Muranga Districts, respectively. These roads which were begun in mid 1978 would offer between them a labor force of over 160 persons, each would take at least 6 months to construct, and Mr. Sharrock believed that adequate measurable task work was available. Mr. Sharrock, Ms. Wolgemuth, Mr. Hall, and the local engineer helped in making this choice.

In June and July 1978 the Principal Investigator conducted clinical and nutritional status examinations and took blood, Ms. Wolgemuth did anthropometric measurements, and Mr. Hall took stools from all available workers on Roads 7 and 12. On Road 7, 79 men and 28 women were examined and on Road 12, 44 men and 51 women were examined.

During the same period Mr. Mark Sharrock, with the help of field

staff, did work productivity measurements on as many workers as possible. A summary of the numbers of workers and days of productivity measurements obtained is shown in Table 4. Up to the present we have not received details of work performed by these subjects. Productivity measurements were obtained from 60 subjects on Road 7 and 64 on Road 12. The number of days of observation varied from 1 to 14 days.

Considerable difficulties were encountered in getting these data. Adverse weather hindered this activity. There were major problems in finding adequate task work. Supervision of workers was not always good, and productivity measurements could only be made when supervision was adequate. Headmen considered that certain road workers were not suitable to undertake task work.

The results of stool examinations for Road 7 and Road 12 are shown in Table 5. These indicate a lower prevalence of Ascaris and hookworm than at Igoka. Hookworm was found to be more than twice as prevalent on Road 7 at Kibirigwi than at Road 12 near Sagana. 55.4% of subjects at Road 7 and 68.5% of subjects at Road 12 were apparently free of intestinal parasites. Once again parasitic infections were nearly all extremely light.

A summary of the hemoglobin findings for Road 7 and 12 are shown in Table 6. Hemoglobin levels below 12 g/% were present in 2.5% men and 10.7% of women on Road 7, and in 11.4% of men and 13.8% of women on Road 12. The mean hemoglobin levels for males were 14.85 g/% on Road 7 and 14.25 g/% on Road 12. In women the mean hemoglobin levels were 13.1 g/% on Road 7 and 13.4 g/% on Road 12. Anemia, although not highly prevalent, was found to be more of a problem than on roads in Nyeri district in 1976.

Yellow almost U.S.A standard picture

Twenty-four hour recalls were conducted by field workers under the supervision of Ms. Wolgemuth on all subjects in June, July or early August 1978. No analyses of the dietary findings or clinical examination data have been completed.

In August 1978 subjects were matched according to weight for height categories, age, and sex. Assignments were then made to high and low calorie supplementation groups. All subjects are receiving each day at work either the high or low calorie supplement according to which group they have been assigned to. They will continue to receive these supplements until December (or possibly late November) when repeat measurements will be conducted on work output by Mr. Mark Sharrock.

The supplement being used is a modification of that used and found feasible and acceptable at Igoka. The high calorie supplement provides approximately 830 calories, and the low calorie one about 150 calories. The base is a maize gruel or porridge. The difference in intake between study and control groups is between 650 and 700 calories per day.

After the initial clinical examination subjects were given 3 tablets of Levamisole, a broad spectrum anthelminthic especially effective against ascariasis, and partially effective against hookworm. Those found to be infected with hookworm were later given Alcopar, one of the most potent drugs against this parasite. Other diseases were, where possible, treated. Simple medicines and first aid are provided as required throughout the period of the study.

Study No. 1 is not without important problems. These are (1) productivity measurements were not conducted on all the workers, and on 27 out of 124 less than 3 days of productivity data have been obtained, (2) both males and females are now included in the study, (3) already study

losses due to persons leaving the job are quite substantial, and (4) a moderate degree of absenteeism is being encountered.

Serious consideration is being given to undertaking a further productivity study using a similar design at some other location in Kenya where labor might be more steady.

Ms. June Wolgemuth is now in charge of the field aspects of Study No. 1 and Mr. Andrew Hall is responsible for the stool examinations, for hematological studies and other aspects of this study.

Study No. 2

Study No. 2 is designed to evaluate the feasibility and effectiveness of several different practical interventions to improve health, nutrition and worker productivity. Study No. 2 consists of several different components, namely:

(a) An evaluation of different types of mid-work-day feeding;

(b) A study of practical means to control anemia by the provision of iron;

(c) A determination of the prevalence of certain parasitic diseases and their role as causes of anemia, ill health and absenteeism;

(d) An evaluation of the feasibility and effectiveness of routine parasitic treatment and prophylaxis aimed especially at hookworm, schistosomiasis and malaria.

At the present time Studies 2a and 2b are at various stages of completion, and 2d has not yet been initiated (work on these studies will begin early in 1979). Study 2c will include a compilation of parasitic findings from Studies 1, 2 and 3. Analysis has not yet begun but considerable amounts of data have been collected. These will be reported under each study, and not separately in this report.

Details are given here then of Studies 2a and 2b only. Both studies are being conducted on Rural Access Road sites in Kwale District, south of Mombasa in Coast Province. Work in 1976 had shown that men employed for road work at two sites in Kwale had (a) a high prevalence of signs of undernutrition, (b) considerable anemia believed to be of the iron deficient type, and (c) frequent parasitic infections including especially intestinal hookworms and urinary schistosomiasis (S. hematobium). These two conditions and malaria, as well as iron deficiency, were believed to be contributing to the anemia. Low hemoglobin levels were significantly associated with low worker productivity.

Study 2a. An evaluation of different types of mid-work-day feeding

This study was conducted by Dr. Lani Stephenson (Project Co-Investigator) with the assistance of two Kenyan field workers. Dr. Latham did preliminary medical examinations and provided treatment for the road workers.

The purpose of Study 2a was to decide on different types of nutritious meals that workers could consume at the road sites, to feed these meals to workers, and to evaluate their feasibility and acceptability. Two different meals were chosen, one hot meal and one cold meal. Each was fed to workers for 4 days, then the preferences of the workers and their willingness to pay for the meals was determined.

The strict criteria set up for selection of the meals narrowed the choices of foods down considerably. Each meal had to be:

(1) made from easily obtainable, relatively non-seasonal local foods, (preferably staple foods which would be well liked)

(2) acceptable to the vast majority of workers

(3) nutritious

(4) inexpensive (an arbitrary cost of Shillings one (U.S. 12 cents)

per worker per day or less was set, which is about 12% of the daily wage rate).

In addition one meal was to be cooked at the road site while the other was to consist of foods that needed no cooking at the site. The meals were specified to be isocaloric and of equal protein content, but one was to be high in iron content and the other low, so that these 2 meals or modifications could be used, after testing, in Study 2b.

The study was conducted on Road 35 in Kwale District, and a small market and a few shops were ready suppliers of food. The locally available foods were rated for availability in quantity, seasonality, nutrient content, and cost, and after consultations with local inhabitants on acceptability of various items, the 2 diets shown in Table 7 were chosen for trial. One consisted of bread, margarine, and groundnuts. The other consisted of stiff maize meal porridge (ugali) with amaranth leaves (similar to spinach) and pigeon peas (mchicha na kunde). Two local field workers were hired, 1 male and 1 female, they were consulted about preparation of acceptable local foods, and recipes were designed and tested.

The workers were informed about the purposes of the study at a meeting and heartily agreed to participate. The workers then had their height and weight taken, were asked about their age, tribe, and health complaints and received simple medical treatment free of charge.

All 42 workers on Road 35 participated in the study; cooperation was excellent. Thirty-nine were men and 3 were women employed to carry water for the men to drink. The mean age was 25.7 yr (range 17-46 yr). The mean weight for height for the 39 males was 85.3%; for the 3 females, 98.0%. Forty-five percent of all workers were below 80% weight for age and only 5.0% (2 workers) were above 100% weight for height. Thus most of the workers were clearly in need of extra calories.

Results of the meals taken by the workers (Table 8) show that both meals were readily accepted. Over 90-100% of workers took both the bread and groundnuts offered on all 4 days. All the workers present accepted the maize meal-spinach-pigeon pea meal (a commonly consumed local dish) on all 4 days. Regarding consumption, 85% of workers on day 1 and 100% on day 3 reported consuming both the bread and groundnuts at work. Only one worker neither liked or ate both the bread and groundnuts. Workers showed a preference for dietary bulk, since 92% reported preferring 5 slices of bread and slightly fewer nuts to 4 slices of bread with more nuts. All the workers but one (97%) stated that they were willing to pay 15 Kenya cents to receive the bread and groundnuts meal at work each day (See Table 9).

The maize meal-spinach-pigeon pea trial was even more enthusiastically received (Tables 8,10). All of the workers consumed the entire meal at work on day 1, 97.4% reported liking it, and 62% volunteered (without prompting) that they wanted a larger serving. All of the workers asked were willing to pay 15 cents or even 30 Kenya cents to receive maize meal, spinach and pigeon pea snack at work.

Regarding preferences between the 2 meals, 40% of workers liked both types equally, 54% preferred the maize meal staple, and 7% preferred the more novel and prestigious bread and groundnuts meal. Over half (56%) felt that eating the meals at work did not interfere with their normal food consumption at home after work.

These results show that mid-day worker feeding in Kwale district is technically feasible, highly popular, and can be nutritious and relatively inexpensive. It is probably best to feed local staples which are likely to be readily available, highly acceptable, and inexpensive

throughout the year. The cost calculated here for the maize meal-spinach-pigeon pea staple was less than that for bread, margarine, and groundnuts (60 and 98 cents respectively) but neither computation includes labor costs (which are low at local rates) or equipment costs (which are negligible for the bread-groundnuts meal and greater but generally non-recurrent for the cooked maize meal dish). In addition, workers were willing to pay something towards the cost of the meal. However, it may be unwise to charge workers more than 5% of their daily wage for the meal or to deduct costs of the meal from their wages. This is because a high proportion of these men were already undernourished, and are likely to have families in a similar condition. Any decrease in total take home pay could negatively effect food purchases and nutrient availability for the more nutritionally vulnerable preschool children and pregnant and lactating mothers at home.

The results of this feasibility study on Road 35 were used to design a long feeding trial as a part of Study 2b. The two alternative "meals" are currently being fed each to a different group of men for several weeks (see below). The acceptability and feasibility of these regimes are being studied. The effect of the feeding on nutritional status and on hemoglobin and hematocrit levels is being studied.

Study 2b. Evaluation of practical means to control anemia by the provision of iron

Because no Rural Access Road sites in Kwale District had more than about 65 workers it was necessary to select 3 sites for this study beginning in July 1978, and a fourth site was added in September. A continuing problem for us is that the labor force on each site is smaller than in 1976, and workers are also often employed for periods of less

than 5 months. These difficulties mean that modest changes had to be made in the design of these studies, but the research still remains feasible. Studies in many countries show that interventions may have measurable effects on hemoglobin levels even after only 4-6 weeks.

Study 2b was designed to investigate the effects on hemoglobin and hematocrit levels first of the regular provision of medicinal iron and secondly by the provision of a snack at work. A substudy involved an attempt to see if added ascorbic acid (vitamin C) would be beneficial.

In July 1978, 3 sites were selected. These were the Quarry Site and Road No. 3 where medicinal iron is provided, and Road No. 7 where long term feeding is being evaluated.

Mr. Terry Elliott, a Research Assistant from Cornell, has taken charge of the field operations of these studies, is based in Kwale District for the full duration of the studies, and he visits the sites each day. One Kenyan field worker is employed at each of the sites, with the exception of Road No. 7 where 2 workers are employed to assist with the feeding.

In July 1978 Dr. Latham did a full range of medical, clinical and nutritional status assessment examinations on all workers at the three sites. He and Mr. Elliott took blood. Mr. Elliott conducted anthropometric measurements on all workers, and Mr. Andrew Hall collected stools and urine for examination. A fresh stool smear was examined microscopically for parasites, and a duplicate piece of the stool specimen was put in a preservative for later examination in the laboratory using a concentration method. A blood slide was also prepared so that the presence or absence of malaria parasites could be determined. Urine was examined for the presence of the ova of Schistosoma hematobium. The blood samples

collected were taken on the same day (usually within 2-4 hours) to the laboratory at the Coast General Hospital. There Mr. Elliott did the hematocrit and hemoglobin (on a Coulter Counter) determinations.

The following numbers of workers were examined:

Murram site	63 workers
Road No. 3	56 workers
Road No. 7	69 workers
	188

Preliminary results of the urine examinations showed that 19 subjects (30%) at the Murram site and 18 subjects (32%) at Road No. 3 had Schistosoma hematobium in their urine. The screening of stools by wet examination at the site revealed a moderately high prevalence of hookworm infections. The detailed stool examinations have not yet been reported, nor are results available on the blood slides, and on any of the stool or urine examinations for Road 7. All workers found to have Schistosomiasis at the Murram site and Road No. 3 were treated by Dr. Latham with an injection of an appropriate dose level of Etrenol. Those with Schistosomiasis on Road No. 7, and the few missed from the other sites, received a course of treatment using the drug Ambilhar. Subjects found to have hookworm received Alcopar in all cases. Other workers received Levamisole (Ketrax) tablets to rid them of Ascaris and other intestinal parasites. Treatment for diseases found was provided at the site, and certain men requiring surgery or specialized treatment were referred to local hospitals.

The examinations described above were designed to provide the base line data on these subjects. The preliminary findings were examined and these were used to assist with allocation of subjects to different groups. Dietary information was collected using the 24 hour recall technique. The tabulation and analysis of these data are not yet completed.

A distribution of hemoglobin findings from the Murram site and Road No. 3 are shown in Table 11. This shows that 49% of men at the Murram site and 67% at Road No. 3 had some degree of anemia with hemoglobin levels below 14 g/100 ml. The preliminary data for hematocrits were quite similar to those for hemoglobins.

The approximately 100 road workers at the Murram site and on Road No. 7 were ranked by hemoglobin level, and then divided randomly into three groups. These were:

(a) Those to receive 600 mg ferrous sulphate each day,

(b) Those to receive 600 mg ferrous sulphate plus medicinal ascorbic acid each day,

(c) Those to receive placebos capsules containing a very few grams of lactose each day.

Prevalence rates for hookworm and S. hematobium are similar in all 3 groups.

The tablets and capsules are provided each day to the men at work by a trained field worker under the supervision of Mr. Elliott. The tablets and capsules are consumed in the presence of the field worker who then records that the medicine has been consumed. These interventions will run for 8-12 weeks, and then blood will be taken again for hemoglobin and hematocrit determinations.

This simple system of delivery of iron to road workers is being evaluated for its effectiveness, and the possible added benefits of ascorbic acid in combination with iron will be determined under the conditions of the study. Ascorbic acid has been found to enhance iron utilization.

On Road No. 7 a feeding trial was begun in July 1978 and is continuing. The objectives are twofold: (a) to see if either of two feeding regimes has any effects on hemoglobin levels and to see if responses are different

in the two regimes, and (b) to investigate acceptability, feasibility and cost of two alternate worker feeding schemes.

The workers on this road, after preliminary examination to obtain base-line data (medical; health, anthropometric, hematological, stool and urine), were divided into two groups. Again workers were allocated to groups after ranking them by hemoglobin and to ensure that almost equal numbers with hookworm and S. hematobium infections were included in each group. As on the other road sites treatment for parasitic infections including Schistosomiasis was provided.

Group 1 workers for the feeding study are receiving, each work day, a cold mid-work day snack or meal consisting of bread, margarine and groundnuts to provide 626 calories, 17.6 grams of protein, 1.5 mg. of iron and 0 mg. of vitamin C per day. The cost of the food is approximately 98 Kenya cents per day (about 12 U.S. cents) per worker.

Group 2 workers for the feeding study are receiving each working day a hot mid-work day snack or meal consisting of maize based ugali (like a stiff porridge) with pigeon peas and cooked amaranth leaves (a spinach like vegetable locally known as mchicha). This snack or meal provides approximately 625 calories, 17.7 grams of protein, 5.7 mg. of iron and 42 mg. of vitamin C. The cost of the food is about 60 Kenya cents per day (about 8 U.S. cents).

The meals or snacks are prepared in the project shed at the road site, and are supplied to men at their place of work during the work day. Field workers under the supervision of Mr. Elliott make certain that each worker gets the meal he should receive, and records each day whether or not it is consumed.

Group 1 and Group 2 are receiving from their meals very similar

amounts of calories and protein. The two meals deliberately provide differing amounts of iron and ascorbic acid. Group 1 receive a low iron and zero ascorbic acid meal, and Group 2 receive a moderately high iron and high ascorbic acid meal.

Details of the two different diets are provided in the description of Study 2a above.

Problems arising in Study No. 2 have been (a) an earlier than predicted completion of work at the Murram site, (b) the fact that Ramadhan may influence food intake. (However Muslim workers were willing and happy to eat food and take medicines during the day even during Ramadhan.)

In order to increase the numbers, and because the Murram site closed early a new group of men have been enrolled at a new quarry site. They will be divided into three groups, as on the other sites, where medicinal iron is being provided. A proportion of the men from the old Murram site have moved to the new site and they remain as study subjects.

Ascaris Study (Study No. 4)

Background

The present project to control roundworm infection (Ascariasis) in Kanzalu and Mwatati villages in Machakos District in Kenya, are a logical extension of an earlier project supported by the World Bank. The previous study conducted in Kenya in 1975 and 1976 was undertaken by the same investigators as the present project. The principal objective was to determine whether common roundworm infections adversely affected the growth of young children and by so doing contributed to malnutrition which is very prevalent in Kenya, as in most poor countries. The work was extended by Dr. Stephenson (Ms. Lani Stephenson Latham) to an evaluation of the economic implications of roundworm infection and its control in Kenya.

A detailed report of this earlier study on roundworm infection has been issued as "The Nutritional and Economic Implications of Ascaris Infection in Kenya" (by L. Latham, M. Latham and S. Basta) in September 1977. A further, more detailed analysis and discussion of the methodology, the locale, the findings and the conclusions for that study are available as the Ph.D. dissertation of Dr. Lani Stephenson (Latham) entitled "Nutritional and Economic Implications of Ascaris Infection in Kenya: Studies in Experimental Animals and Preschool Children".

This original project, for the first time in a well controlled field study, demonstrated that roundworm infection was significantly associated with a retardation of growth in children, and was therefore contributing to protein-calorie malnutrition in preschool age children. The cost of the disease to Kenya, and to individual families, was found to be high, and it was suggested from the data that the cost of control was relatively low.

On the basis of these findings, and the experience of the investigators (Prof. Latham, Dr. Crompton and Dr. Stephenson) in Kenya it was felt that a project should be instituted to attempt to control roundworm infection in these two Kenyan villages, and to evaluate the effect and effectiveness of a low cost practical control program.

Present Ascaris Control Project

The Ascaris project in Kenya is an attempt to lower the prevalence of Ascaris (Roundworm) infection in 2 rural villages by giving 1 dose of Roundworm medicine (levamisole) to all preschool and primary school children 3 times a year for 3 years, and to evaluate this.

The project began in January 1977. At that time, Dr. Latham, Dr. Crompton and Dr. Stephenson spent 6 weeks in Kenya. Anthropometric, stool

and clinical examinations were performed, and a dose of levamisole was given to all available preschool and primary school age children. This entire procedure, including all examinations performed by the investigators, will be repeated each January in 1978 (already completed), 1979, and 1980. The second 2 doses of the drug for 1977 were given by a locally hired field worker during visits to homes and schools in May and September of 1977 as follows:

Schedule for delivery of levamisole

Dose	Time	Status
1	January 1977	completed
2	May 1977	completed
3	September 1977	completed
4	January 1978	completed
5	May 1978	completed
6	September 1978	in process
7	January 1979	to be given
8-9	May-September 1979	to be given
10	January 1980	to be given

In January 1978 the 3 investigators plus Ms. June Wolgemuth, a nutritionist from Cornell University, and Mr. Andrew Hall, a parasitologist from Cambridge University, repeated the anthropometric, stool and clinical examinations and gave 1 dose of levamisole. In April 1978, 4 locally hired field workers, under the guidance of Mr. Hall and Dr. Ad Jansen, delivered the second yearly dose to preschool and some primary school children at home visits. In May 1978 the field workers and Mr. Hall visited the 2 local primary schools and gave levamisole to 524 primary school children.

Results of examinations and visits to date

a. 1977

In January 1977 over 750 children were seen and examined by the principal investigators. Dr. D. W. T. Crompton and his staff completed the very thorough stool examinations on all 752 stool specimens in fall 1977. Prevalence of Ascaris in preschool children was 21%, while prevalences of hookworms and Trichuris (whipworm) were 5% and 2%, respectively. For school children, these figures were: Ascaris, 14%; hookworms, 13%; Trichuris, 3%. (See table 4 of the Preliminary Inception Report of May 26, 1978)

An additional estimated 200 children who did not attend the January survey were also given dose 1 of levamisole in February 1977 by a field worker (Mr. Mutinda Munyao). An estimated 800 children received doses 2 and 3 of levamisole from a field worker in May and September of 1977. The target group is estimated to be about 1200 children, but precise figures await computer analysis.

b. 1978

In January 1978 over 800 stools were again collected for examination and anthropometric and clinical exams performed. Over 1100 children received dose 4 of levamisole in January and February. Dr. Crompton and co-workers completed the stool examinations in August 1978. A total of 810 stool samples were analyzed. A preliminary tally just completed indicates that the prevalence of Ascaris in all children (preschool and school age combined) in January 1978 was 17.6%, the prevalence of hookworms was 11%, and the prevalence of Trichuris was 2%.

To determine, on a preliminary basis only, whether the 3 doses of levamisole given between January 1977 and January 1978 were having an

effect on the prevalence of Ascaris infection, results of stool examinations on 516 children seen both in January 1977 and January 1978 were chosen. The overall prevalence of Ascaris had decreased by one-fifth or 21%, comparing January 1977 (19% infected) with January 1978 (15% infected). Small!

The 516 pairs of stools were also divided into 4 groups, those that were new cases of Ascaris (negative Jan. '77, positive Jan. '78), those that remained negative for both examinations, those that lost the infection (positive Jan. '77, negative Jan. '78), and those that had been reinfected or were positive for both Jan. '77 and Jan. '78. There were 36 new cases (7% of 516) of Ascaris infection between Jan. '77 and Jan. '78. Of the 480 remaining cases, 381 were negative both times, 57 cases (12% of 480) lost the infection, being positive in Jan. '77 and negative in Jan. '78, and 42 cases (9% of 480) were positive both times.

If the prevalence of Ascaris continues to decrease by 4 percentage points per year through January 1979 and 1980, then the prevalence in January 1980 will be only 7%. Since the efficiency of the delivery system for levamisole has improved since 1977, we expect this or even a larger degree of improvement may be possible.

Dose 5 has been given to 480 children at home visits and 524 school children at the primary schools. Mr. Hall and Dr. Jansen continue to supervise the activities of the field workers, particularly regarding accuracy of record keeping.

In June-July, Dr. Stephenson spent one week in the villages to check the progress of the 2 field workers and to hire and train a new field worker to replace those that had gone on to finish secondary school in late May. The 3 project field workers now are: Mrs. Esther Ndunda, Ms. Rose Nzuki, and Ms. Jennifer Wambua.

Dr. Stephenson also conferred with Mr. Hall and Dr. Jansen about the Dose 5 visits and arranged the schedule for Dose 6 (September-October 1978) to take place. In addition, Dr. Stephenson discussed the project with the headmasters at the primary schools. Both were very pleased with the project's progress, and neither had complaints or suggestions.

A health education component will be added to the project in January 1979 and will consist of lecture-discussions involving Dr. Crompton, Dr. Latham, Dr. Stephenson, and the school teachers of both primary schools. Topics covered will include how one contracts different parasites (Ascaris, hookworm, malaria, Schistosomiasis), what their health effects and treatment are, and a progress report on the project. Various visual aids are being collected for this purpose.

Computer analysis of stool examination results will provide useful information on reinfection rates and will help determine whether or not the same children get continually reinfected with Ascaris. It will also be important to determine whether levamisole, which is partially effective in treating hookworm infection, can lower prevalence of hookworm in school children. This type of long term study, with 4 yearly stool examinations on the same children, is extremely difficult and time consuming, and is rarely attempted on sample sizes this large.

The anthropometric and clinical data will allow the authors to monitor nutritional status of children for 4 years and will also provide valuable longitudinal growth data on preschool and primary school Kenyan children. Growth of siblings and nutritional status of mothers and their children will be compared. The need in East Africa for longitudinal growth data on children living at home has been recognized. Most growth data in Kenya, and other countries in Africa, has been based on cross sectional studies.

Conclusions

Studies No. 1, 2a, 2b and 4 are all currently underway. June Wolgemuth and Andrew Hall are based at Karatina and Terry Elliott is based in Kwale District and are working full time on these projects. They are currently assisted by some 12 Kenyan field workers. June Wolgemuth is engaged in the overall supervision of Study No. 1, Terry Elliott with Study Nos. 2a and 2b, and Andrew Hall is doing parasitological and related work for all four studies (1, 2a, 2b and 4).

A decision will be made late in October concerning a possible new site for repeating some of what is now being done in Study No. 1. Kwale District is a likely location for this study. The objectives will be to get a larger number of subjects and to obtain better work productivity data.

In early January 1979 Dr. M. Latham, Dr. L. Stephenson and Dr. D. Crompton will return to Kenya. Drs. Latham and Stephenson will stay for 9-11 weeks, and Dr. Crompton for 4-7 weeks. In January examinations will be done on the 900 or so children in Study No. 4 (Ascaris study). For the remainder of the period the Principal Investigator and the Co-Investigators will work on the other studies mainly in Kwale District.

In February, 3 new road sites in Kwale will be selected and base-line data obtained prior to initiating three different intervention studies, (a) an investigation of the effects of Schistosomiasis treatment on anemia and health, (b) a study of the effects on anemia of regular malaria prophylaxis, and (c) a determination of the effects on hematological parameters of treatment of hookworm (and other intestinal parasites). June Wolgemuth and Andrew Hall will move their base of operations from Karatina to Kwale.

In March 1979 (or late February) examinations will be made at 2 RAR sites in a new ecological zone as described for Study No. 3. The location will be decided in consultation with the Ministry of Works. This will be a rapid cross sectional survey.

Mr. Mark Sharrock is expected to return to Kenya in November-December 1978 to do the final productivity measurements on Roads 7 and 12 near Karatina. He may at the same time, or later, do base-line productivity measurements on a new site if one is selected for an extension of Study No. 1.

Dr. Peter Hopcraft is expected to work as a consultant on certain economic and related issues involved in the whole project. However the World Bank has not yet informed the Principal Investigator whether a consultant agreement has been signed by Dr. Hopcraft.

Table 1

Weight for height findings for male road workers

at Igoka site (No. 55)

% weight for height	Number	%
Above 95	2	5
90 - 94	1	2.5
85 - 89	8	19
80 - 84	7	16
75 - 79	18	40
70 - 74	4	10
65 - 69	3	7.5
Total	43	100

Table 2

Intestinal parasitic infections from stool examinations

(Igoka road workers)

	Males (N = 54)		Females (N = 35)	
	No.	%	No.	%
Ascaris	19	35.2	22	62.8
Hookworm	20	37	16	45.7
Trichuris	2	3.7	2	5.7
Strongyloides	1	1.85	0	0
Taenia sp.	3	5.6	0	0
Schistosoma mansoni	2	3.7	0	0

Table 3

Multiple parasitic infections from stool examinations

(Igoka road site)

No. of different parasitic ova found	Males (N = 54)		Females (N = 35)	
	No.	%	No.	%
0	22	40.7	9	25.7
1	17	31.5	13	37.1
2	14	25.9	12	34.5
3	1	1.85	1	2.85

Table 4

Productivity observations

No. of days observations	Road 7 No. of subjects	Road 12 No. of subjects	Total
1	5	11	16
2	4	8	12
3	8	12	20
4	2	3	5
5	5	4	9
6	7	2	9
7	13	0	13
8	7	5	12
9	4	4	8
10	5	3	8
11	0	4	4
12	0	2	2
13	0	4	4
14	0	2	2
Total	60	64	124

Table 5

Results of stool examinations - Kenya highlands

Road 7 - Kibirigwi	Males N = 74 No.	%	Females N = 23 No.	%	Males and females N = 97
Hookworm	23	31.1	8	34.8	32%
Trichuris	8	10.8	5	21.7	13.4%
Ascaris	8	10.8	9	39.1	17.5%
S. mansoni	1	1.35	-	-	1.03%
Taenia sp.	-	-	1	4.3	1.03%
No infections	41	55.4	9	39.1	51.5%

Road 12 - Sagana	Males N = 44		Females N = 51		Males and females N = 95
Hookworm	4	9.1	9	17.6	13.7%
Trichuris	3	6.8	4	7.8	7.4%
Ascaris	1	2.3	7	13.7	8.4%
S. mansoni	4	9.1	10	19.6	14.7%
Taenia sp.	2	4.5	1	2.0	3.2%
Strongyloides	1	2.3	-	-	1.05%
Nil	30	68.2	30	58.8	63.2%

Table 6

Hemoglobin levels - Roads 7 and 12

	Road 7		Road 12	
Males	No.	%	No.	%
Hb. above 14 g/%	63	79.7	28	63.6
12 - 13.9 g/%	14	17.7	11	25
Below 12 g/%	2	2.5	5	11.4
	79		44	
Females				
Hb above 12 g/%	25	89.3	44	86.3
10 - 11.9 g/%	3	10.7	6	11.8
Below 10 g/%	0	0	1	2.0
	28		51	

Table 7

Kwale Feeding Study 2a

Nutrient content and cost of meals

Ingredient	Amount	Kcal	Protein g	Fe mg.	Vit. C mg.	Cost Kenya shillings
Bread, margarine, groundnuts						
A. fed July 6 & 7:						
groundnuts	33 g	192	8.6	0.7	0	-/42
white bread, 4 sl	100 g	269	8.7	0.7*	tr	-/29
margarine	20 g	144	0.1	0	0	-/27
Total		605	17.4	1.4	0	-/98
B. fed July 8 & 10:						
groundnuts	25 g	146	6.6	0.6	0	-/32
white bread, 5 sl	125 g	336	10.9	0.9	tr	-/38
margarine	20 g	144	0.1	0	0	-/27
Total		626	17.6	1.5	0	-/97
Maize meal, spinach and pigeon pea						
fed July 11-14:						
maize meal, dry	137 g	496	13.0	3.4	0	-/25
raw mchicha(spinach)	41 g	19	2.0	1.6	41**	-/14
pigeon peas, dry	14 g	45	2.7	0.7	negl.	-/04
onion	5.5 g	3	negl.	negl.	0.7	-/08
cooking fat	6.8 g	62	-	-	-	-/09
salt	tr	-	-	-	-	negl.
Total		625	17.7	5.7	42.	-/60

* Assumes bread is unenriched.
** Ascorbic acid content of raw mchicha before cooking.

Table 8

Kwale Feeding Study 2a

Meals taken by workers

Day of study	Day 1	Day 2	Day 3	Day 4
Response	%	%	%	%
A. Bread, margarine, and groundnuts				
refused both	0	2.4	0	2.7
took both	100.0	90.2	100.0	91.9
took bread only	0	4.9	0	2.7
took nuts only	0	2.4	0	2.7
Total subjects	42	41	41	37
B. Maize meal, "spinach" and pigeon peas				
refused	0	0	0	0
took	100.0	100.0	100.0	100.0
Total subjects	39	39	38	41

Table 9

Bread and Groundnuts Meals

Workers' consumption and preferences

Day of study	Day 1	Day 1	Day 2	Day 3
Question	Did you eat all the B & G at work?	Did you like it?	Do you want more today?	Did you eat all the B & G at work?
Response	%	%	%	%
no, neither item	2.4	2.4	2.4	0
yes, both items	85.4	78.0	90.2	100.0
yes, bread only	9.8	12.2	4.9	0
yes, nuts only	2.4	7.3	2.4	0
Total subjects	41	41	41	37

Question asked on Day 4: Did you prefer 4 slices of bread and more groundnuts or 5 slices of bread and fewer groundnuts?

Response	%
4 slices	8.3
5 slices	91.7
Total subjects	36

Question asked on Day 4: Would you be willing to pay -/15 (fifteen Kenya cents) per day to receive bread and groundnuts at work every day?

Response	%
yes	97.2
no	2.4
Total subjects	36

Table 10

Maize meal-Spinach-Pigeon Pea and Bread-Groundnuts Meals

Overall preferences

Question asked after the first day of maize meal-spinach: Did you eat all the food (at work)?

Response	%
no	0
yes	100.0
Total subjects	39

Question asked after the first day of maize meal-spinach: Did you like the food?

Response	%
prefer other food	2.6
liked it as served	35.9
liked it but want larger serving	61.5
Total subjects	39

Question asked on last day of study: Did you prefer the bread-groundnuts or maize meal-spinach meal?

Response	%
liked both equally	39.0
prefer maize meal-spinach	53.6
prefer bread-groundnuts	7.3
Total subjects	41

Question asked on last day of study: Did receiving food at work cause you to eat less when you got home?

Response	%
ate normally at home	56.1
ate less at home	41.5
ate normally after bread but ate less after maize meal	2.4
Total subjects	41

Question asked on last day of study: Are you willing to pay -/15 each day (fifteen Kenya cents) to receive the maize meal-spinach meal at work every day? How about -/30?

Response	-/15 %	-/30 %
no	0	0
yes	100.0	100.0
Total subjects	41	41

Table 11

Hemoglobin levels - Murram Site and Road 3 - Kwale District

Males	Murram Site No.	Murram Site %	Road No. 3 No.	Road No. 3 %
Above 14 g/%	25	51	18	33
12.0 - 13.9 g/%	20	41	27	50
Below 12.0 g/%	4	8	9	17
Total	49		54	

Note: At Murram site 3 females were examined, 2 had Hb between 12 and 14, and 1 had Hb of 11.95 g/%.

At Road site No. 3 one female was examined, she had a Hb of 10.9 g/%.

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

File Kenya

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

October 9, 1978

Mr. Mark Sharrock
Scott Wilson Kirkpatrick & Partners
Scott House
Basingstoke Hants
RG21 2JG

Dear Mark:

I was glad to hear from you and to get the list of those on whom you have productivity data, and the number of days for each worker. How soon do you think you could let me have the actual measurements of work performed by each of the workers? I would very much like to see these data.

As you have probably heard from June and Andrew there was at first some loss of workers, but following a baraza the situation has now improved. I do not have a figure on the exact numbers. It looks however as if we may have to do a second study on a new road site probably in Kwale district. I need to hear from Kwale what road possibilities exist and to hear from June about actual losses of workers before I can make a firm proposal. Clell Harral and Samir Basta have been kept informed about this, and as you may know extra funds will be made available.

There seem to be two possibilities but these depend on what I hear from Kenya. The most economical possibility would be for you to go to Kenya as planned in November to do the final productivity measurements only on those workers who had been measured by you before (this could be as few as 30 or as many as 80), and during the same Kenyan visit for you to do productivity measurements for the baseline on a new road, if a suitable site was located. The less economical second alternative would be for you to do the follow up studies on the two existing roads (No. 7 and 12) during a relatively short visit beginning in November, and for you to return to Kenya to do baseline productivity measurements in February 1979 on a new road site, and to make a fourth visit around June 1979 to get final productivity data. The extra expense in this alternative will be that you make 4 visits to Kenya instead of 3.

This letter then is just to alert you to my thinking, and for you to consider these possibilities. I hope that a decision can be made within a few weeks. Could you please send me a cable or telex if any of these possibilities are not feasible for you?

With all good wishes.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd
cc: C. Harral
S. Basta
J. Wolgemuth

The University of Birmingham

DEPARTMENT OF ECONOMICS
Faculty of Commerce and Social Science
The University of Birmingham, P.O. Box 363,
Birmingham,
B15 2TT
Telephone 021-472 1301

ADC/MM

9 October 1978

Dr C.G.Harral,
Highway Design & Maintenance Adviser,
Transportation Department,
The World Bank,
1818 H Street N.W.,
Washington D.C. 20433,
U.S.A.

Dear Clell,

On Friday, 6 October, I met with Mark Sharrock to discuss the Health and Nutrition Study underway in Kenya and the prospects for a future project. I will comment first on the current project.

I was able to inspect the productivity data on all the individuals included in the sample. Data on 64 people is available at one road site and on 60 people at another. This is by no means a large sample given the information that we wish to obtain and its content is less than is apparent for a number of reasons.

1) The two roads studied differ and the work carried out at them is of different types.

2) Approximately 40% of the workers are females whose reactions to intervention may differ from those of males. The relationships between anthropometric attributes and productivity may also differ. At worst two separate models will have to be estimated each based on only 60 or so observations.

3) Only a few days' data is available on a sizeable number of workers. This problem is particularly acute with the females in the sample. At one road there are more than 3 days' data on only 4 of the 31 females. Among the 124 workers observed there is more than 3 days' data on only 78.

4) There is apparently a possibility of a high dropout rate before the completion of the intervention. Without first hand knowledge of the sites it is impossible to be precise but a 50% dropout rate should be seriously considered. A high dropout rate would reduce the effectiveness of the caloric intake intervention study but need not seriously affect the determination of the relationships between anthropometric attributes and productivity if replacement workers are introduced into the sample at the final measurement stage.

/...

5) Since the tasks set are of varying degrees of difficulty, recorded task times are not very informative. Mark Sharrock's proposed use of productivities as the object of the analysis seems sensible and I would expect to improve on the earlier study by doing so. However, productivity has proved difficult to measure accurately and it remains to be seen whether the improvement will be obtained.

6) Wage rates are not high on the sites studied. One consequence is that workers do not generally work on site for extended periods. Another is that good workers are not attracted to the project and the sample of workers obtained is not representative of the general construction workforce.

7) Poor workers (e.g. the very old, young, infirm) are not given difficult tasks and their productivity is not recorded for the study. Thus the sample of workers observed may be unrepresentative.

8) Unmeasured in-site variation in soil type increases the variability of productivity making the effect of caloric intake and anthropometric attributes more difficult to assess. It seems likely that on at least one of the roads, soil type will have changed by the time post intervention measurements are obtained.

It may be that some of these problems are not severe - without seeing the sites it is difficult to tell. In any event, judicious use of deviations about mean task times may, as in the previous study, enable more to be said about the determinants of productivity than is at first apparent.

It is clear that the sample size is small. If there is a dropout rate of the order of 50% then the effect of intervention will be difficult to measure. In this eventuality, in order to "rescue" the project, the inclusion of extra workers at the post-intervention measurement stage and concentration on the relationship between productivity and anthropometric attributes deserves serious consideration.

Without the anthropometric data there is not much analysis to be done at this stage. However, some work to determine the heterogeneity of the sample would be worthwhile and I have left some ideas on this with Mark. Please let me know if you wish me to follow this up. I expect two days of my time to be sufficient at this stage.

Finally, some comments concerning the worth of a future project. Clearly, the problems discussed above should be avoided as far as possible. I believe that a much larger sample size is necessary (particularly prior to intervention given the probability of dropout) but two points concerning sample size should be borne in mind. Moving to productivity as the object of the analysis should make relationships easier to estimate. In this case the requirement for large samples will be lessened. The requirement can also be lessened if investment is made in the accurate measurement of productivity. If we consider the relationship between say productivity (P) and anthropometric attributes (A) and represent this by

$$P = \alpha + \beta A + \varepsilon$$

where ε is the random disturbance in the relationship, we can regard ε as being made up of a number of components, thus:

$$\varepsilon = u + v + w.$$

Here

u = error in measuring P

v = random variation due to unmeasured differences in workers

w = random variation due to variation in in-site conditions, e.g. climate, soil type.

Mark Sharrock's feeling is that some 20% of the variation in "ε" may be due to variation in "u" and that this could be reduced to a quarter of its value by moderately increased attention to productivity measurement. It may be worthwhile spending proportionately less on anthropometric measurement and more on productivity measurement. It is unlikely that variation in "v" can be reduced cheaply. Variation in "w" could be reduced if it were possible to measure the in-site changes in soil condition. However, Mark believes that intensive monitoring of soil type would be prohibitively expensive.

For any future study we require a site with a large static workforce who do arduous work under good incentives producing an easily measured output insensitive to in-site variations in conditions and to short-term climatic changes. Compromises have to be made to be sure but I would slacken off the later of these conditions before the earlier ones.

Best wishes.

Yours sincerely,

Andrew Chesher

cc. M.J.Sharrock, Scott Wilson Kirkpatrick & Partners.

File
Kenya

October 5, 1978

Professor Michael C. Latham
Cornell University
Division of Nutritional Sciences
Savage Hall
Ithaca, New York 14853

Dear Michael:

I was a bit surprised to receive the attached letter from Mark Sharrock; I was even more surprised to learn on checking with Samir Basta that Ms. Wolgomuth was reluctant to show him any of the data your team had collected. Samir and I, of course, have responsibilities to the Bank to scrutinize all aspects of the research, including examination of the raw data and statistical methodology, and generally to ensure that everything that can be done is being done to ensure the success of the research -- and we will most assuredly be held to account at the end for every aspect originally ventured in the study proposal. While I am always eager to encourage the use of the results of Bank sponsored research by dissertation writers (indeed, Samir's own dissertation is one example!), I hope Ms. Wolgomuth will understand that the Cornell team's contractual responsibilities to the research sponsors take priority. However, I think there is really no conflict, just a minor misunderstanding due to Ms. Wolgomuth's unfamiliarity with the Bank's normal mode of operation, which I trust you will explain to her at the next convenient opportunity.

On the matter of collaboration with Mark Sharrock and Andrew Chesher, I had anticipated that you would want to take full advantage of our offer to provide their support services, and still encourage you to do so because I feel they are virtually uniquely qualified from their experience in analysis of the productivity of labor-intensive construction operations in our earlier research. However, I will leave it to your judgment how far you want to carry this particular collaboration. Certainly if you feel you can obtain adequate expert statistical support at Cornell you are free to do so. In any case, we at the Bank will have to look rather more closely at the underlying data and statistical methodology than we did in the earlier study. You will recall that in the course of discussions in the Bank on your proposal, questions were raised on the aspect of statistical design and methodology and the project would not have been approved if we had not given assurances that expert statistical consultants would be retained. Do let me know what you wish to do in this regard, as we will have to contract with Sharrock and Chesher for whatever services you may desire from them.

After some administrative delays, we have now offered Peter Hopcraft a fixed sum contract to work under your direction according to terms of reference as amended per your suggestion. I am asking that a copy of his letter of appointment be sent to you; I trust our offer will be satisfactory to him.

Another administrative matter that I should like to clarify - the $6,000 in contingency funds mentioned in Samir's letter of August 18 and your letter to me of August 22. Alas, there are no additional funds; Samir rather was indicating the Bank's willingness to accept a reallocation of the present budget to this effect.

One last administrative matter. I would be grateful if you could confirm what date (at least approximately) our Range Rover was turned over to your team, who will have custody of it, whether you anticipate that you will require it full time and whether you are carrying insurance of any kind on it. If there are periods when no senior member of your team is present in Kenya or periods of more than a few days when the vehicle is not required for the research project, custody should revert to the Bank's Nairobi office.

Sincerely yours,

C.G.H.

Clell G. Harral
Highway Design & Maintenance Adviser
Transportation Department

CGHarral:phm

cc: Messrs. S. Basta, B. Coukis

(5-77) IMPORTANT (PLEASE READ INSTRUCTIONS BELOW BEFORE TYPING FORM.)

Class of Service: LT Date: OCTOBER 5, 1978

Telex No.: Originators Ext: 73597

12 10

0 START HERE TO PETER HOPCRAFT, INSTITUTE OF DEVELOPMENT STUDIES, UNIVERSITY OF

CITY/COUNTRY NAIROBI, NAIROBI, KENYA

MESSAGE NO.: LETTER OF APPOINTMENT AND TERMS OF REFERENCE FOR NUTRITION

4 PRODUCTIVITY STUDY BEING MAILED TO YOU THIS WEEK. I APOLOGIZE

5 SINCERELY FOR THIS DELAY IN COMMUNICATION WITH YOU. I HAD BEEN

6 ASSURED ALL THIS WAS ON ITS WAY TO YOU WHILE I WAS IN BRAZIL EARLY

7 SEPTEMBER. THE TERMS OF REFERENCE BEING SENT TO YOU HAVE BEEN

8 CLEARED AND PARTLY DRAFTED BY LATHAM AND HARRAL, AND WHILE STYLE

9 HAS TO BE NECESSARILY TERSE, WE ACCEPT CONSIDERABLE FLEXIBILITY AND

10 ADAPTATION TO YOUR OTHER COMMITMENTS. SINCERELY SAMIR BASTA,

11 INTBAFRAD

12

13

15

16

17

18

19

20

21 END OF

22 TEXT

NOT TO BE TRANSMITTED

SUBJECT: Kenya Research

DRAFTED BY: SSBasta:jm

CLEARANCES AND COPY DISTRIBUTION:
cc: Dr. Michael Latham
Mr. C. Harrall, TRP

AUTHORIZED BY (Name and Signature): Samir S. Basta

DEPARTMENT: Research #67173

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05 October, 1978	Letter	

Correspondents / Participants

To: Professor Peter Hopcraft

From: Mrs. Sheila C. Wilkerson

Subject / Title

Appointment Letter

Exception(s)

Personal Information

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Tonya Ceesay	15-Apr-15

October 3, 1978

Dr. Lani Stephenson
Research Associate
Cornell University
Division of Nutritional Sciences
Savage Hall
Ithaca, New York 14853

Dear Dr. Stephenson:

Mr. Basta wishes to thank you for your letter of September 28, 1978.

Enclosed is one copy of Staff Working Paper No. 175 on Iron Deficiency Anemia and the Productivity of Adult Males in Indonesia which you requested. Also, I am sending you, under separate cover, ten copies of Staff Working Paper No. 271 on the Nutritional and Economic Implications of Ascaris Infection in Kenya.

Mr. Basta sends his best wishes to you and Dr. Latham.

Sincerely yours,

Joy Morgan
Nutrition Division
Ag. & Rural Development Department

Enclosure

JMorgan

The University of Birmingham

DEPARTMENT OF ECONOMICS
Faculty of Commerce and Social Science
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Telephone 021-472 1301

ADC/MM

29 September 1978

Dr C.G.Harral,
Highway Design & Maintenance Adviser,
Transportation Department,
The World Bank,
1818 H Street, N.W.,
Washington D.C. 20433,
U.S.A.

Dear Clell,

I have now looked closely at Mark Brooks letter of May 9th and my comments on this and on some more general points concerning the Kenya Nutrition Study are enclosed. I have omitted the technical algebraic derivations underlying my comments but I am happy to provide these if you think they would be useful.

My general impression of the analysis is that it is unsophisticated and that insufficient information is provided concerning the dangers of reading too much into the reported results. However, to be fair, the study was perhaps regarded as preliminary to a longer study and it might have been felt unnecessary to go beyond the level of analysis used in Tech.Memo 26 in such an investigation.

I am meeting Mark Sharrock on October 6th and I will report on that meeting

Best wishes,

Yours sincerely,

Andrew Chesher

Comments on Technical Memorandum No.26:

"The Relationship of Nutrition and Health to Worker Productivity in Kenya"

1. The use of 'Z-scores"

In the course of the Kenya nutrition study data was collected on task times for a variety of tasks. It was felt necessary to pool this data for the purpose of estimating a relationship between task times (T) and "weight for height" (WH) but the tasks took varying amounts of time to complete because they were of differing degrees of difficulty. Further the variability of task times differed from task to task. To allow pooling to proceed under these conditions each man's task time for each task was adjusted by subtracting from it the mean of all men's task times for the task under consideration and dividing the resulting difference by the standard deviation of task times for the task concerned. The result was called the "Z-score". One was obtained for each man for each task.

This procedure is only valid if the marginal effect of WH on T is the same for all the tasks considered and this should be borne in mind when interpreting the results. That these marginal effects are identical is questionable since tasks might require different degrees of strength and strength of different types. If the marginal effects are not similar, analysis using "Z-scores" can be regarded as producing an estimate of some "average" marginal effect of WH on T. Whether this average is useful depends on whether the proportion of time spent on the tasks during the period of observation is similar to the proportions of time spent in everyday working.

In any event, the "Z-score" procedure has been inefficiently applied. ~~Any sensible statistical model leads one to reject~~ Normally one would prefer not to dividing through by the standard deviations of task times. Instead one should divide through by the residual standard errors that arise from regressing, for each task separately, task time on weight for height. This is a very simple procedure which could be easily adopted at negligible cost. The separate regressions would, as a by-product, give information on the constancy of the marginal effects of WH on T over tasks. The currently used method almost certainly results in incorrect conclusions regarding the precision of the estimates of the regression coefficients.

Problems arise if the same individual appears more than once when the data is pooled - this would happen if any individual performed more than one task. In this case the data cannot be regarded as independent observations. Neglecting to allow for this would lead to overestimation of the precision of the estimates of the effect of WH on T.

2. Omission of variables from the fitted relationships

As I have remarked elsewhere, I believe it is unwise to rely too heavily on two variable analysis when alternatives are available. I doubt whether task time is affected by WH alone and the low correlations reported lend support to this view. Since other anthropometric data is available why not use it? In trailer loading for example it is possible that height (H) is an important determinant of task time particularly if the trailer is high sided. To the extent that H and WH are correlated, omission of H biases the estimation of the effect of WH on T.

3. Errors of measurement

The level of caloric intake (C) is almost certainly measured with error and the error may be quite large since intensive monitoring of home consumption was not possible. I am grateful to Mark Sharrock for raising this point. The effects of such error in what is an explanatory variable in the task time relationship can be considerable. One effect is to bias the estimators of the effect of C on T. I raised this in connection with the Brazil/Kenya highway study data where road roughness is measured with error and is used as an explanatory variable in, for example, tyre wear relationships. The same analysis applies here and I will not repeat it though I can expand on this point if requested. A common counter argument to this point is that all variables are measured with error to some extent and that one cannot cover every discrepancy of the data. However, the errors of measurement in C are likely to be of a different order of magnitude to those in say WH. Whereas the latter can be neglected the former cannot, unless they are indeed known to be small.

4. Alternative models for the effect of caloric intake on task time

It was suggested to me by Dr Harral that caloric intake might not affect task time if other restraints restricted task time. This leads me to reconsider the models used for the relationship between C and T. So far I have only been able to consider this very briefly but the following ideas may be useful.

I For certain individuals increasing C may not affect task time (at least to a first approximation) because they are already well fed. This leads me to consider a model of the form:

(1) $T = \alpha + \beta C + \gamma A + \varepsilon$ if $C < C^*$

(2) $T = \alpha + \gamma A + \varepsilon$ if $C \geq C^*$

Here: T is task time

A represents other anthropometric measurements (eg. WH)

C is caloric intake

ε is a random disturbance

α, β, γ are coefficients, β is the one on which interest is centred

C^* is a threshold level of caloric intake above which changes in C have no effect on T.

This model is not amenable to standard statistical analysis because

(a) there are two relationships for T which join at a point C^* which is unknown,

(b) C^* will vary from person to person,

(c) C^* will depend on A.

The model can be estimated without undue difficulty or expense though I suspect that one might need a range of observed values of C. The model currently estimated is

(3) $T = \alpha + \beta C + \varepsilon$

which is clearly a misspecification of (1), (2), omitting the variable(s) A and neglecting the threshold C*. Even if (1), (2) were not estimated the extended model may be useful in interpreting the results from estimating (3).

One might decide that the threshold, C*, could be neglected because of the resulting complication of the analysis. However, inclusion of A should be seriously considered.

II. The idea of competing constraints holding down task time is an interesting one. If we regard the relationship between T, C and A as a micro-economic production function what we may have is a production function in which C and A are substitutable to only a limited extent, rather like the production function in economic literature with fixed or semi-fixed input ratios. This would lead one to use in (1) above a functional form which allowed limited substitutability to be revealed. Clearly the linear formulation does not allow this for increasing A by ΔA produces the same effect as increasing C by $\Delta C = \frac{\gamma \Delta A}{\beta}$ regardless of the size of ΔA - C and A are infinitely and continuously substitutable in the linear formulation.

Andrew Chesher
University of Birmingham
England

28.9.78

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

September 28, 1978

Dr. Samir Basta
Nutrition Division
The World Bank
1818 H Street N.W., Room D-836
Washington, D. C. 20433

Dear Samir:

It was so nice to see you in Brazil even if the time was short! I hope you've had time to rest up from the trip before going off on another one. You were right--Rio is truly delightful.

I have been asked to write a chapter for a pediatric textbook on nutritional and economic implications of intestinal parasites--certainly a novel chapter title, but it's about time that parasites were considered to be problems! I'd really like to have a copy of your World Bank report on the cost estimates of anemia in Indonesia, so that I could quote it. Can you spare one copy? Do you know of any other economic studies on hookworm? The chapter is due at the editor's by Oct. 15, which, unfortunately, is quite soon.

Also our yellow reports on Nutritional and Economic Implications of Ascaris Infection in Kenya are almost gone. Do you by any chance have 10 extra copies?

I got a letter from Michael's student, Terry Elliott, who's overseeing the anemia studies in Kwale and he said that Juma Mwakuzimu (my fieldworker that you met when you visited us in Kwale) wanted your address, so I'm sending it to him. Terry said that Juma had just gotten a job teaching school, which is quite fortunate.

Our progress report for the Kenya studies is in the works and things seem to be going smoothly. David Crompton is here for 2 weeks and we've discussed our visit to Kenya in Jan-Feb '79.

I hope your job is going well there--I don't envy the chain of command! Michael and I send our best regards to you and Marina and the little Bastas. Hope to see you again soon.

Sincerely,

Lani

Lani S. Stephenson, Ph.D.
Research Associate

LSS:dd

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

Copy of appointment letter - File Kenya please refile

OFFICE MEMORANDUM

TO: Mr. Peter Hopcraft, Economist DATE: September 27, 1978

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. You will be responsible to Dr. Michael Latham, but please copy all reports and substantive correspondence to me 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 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 provided by Dr. Latham 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 interpreting and commenting upon 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, for example, in both labor

abundant as well as labor constrained scenarios, and you should provide advice as necessary concerning the economic and policy implications of Study No. 4.

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.

SBasta/CHarral:phm

Cleared with & cc: Messrs. C. Harral
M. Latham

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Correspondents / Participants

To: Personnel Department (Consultants Section)

From: Clell G. Harral

Subject / Title

Request for Consultant

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.

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Mr Basta : retain in your files

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Your ref

Our ref MJS/CLW/78126

15th September 1978

cc. M. M. Latham

Clell. G. Harral,
Transportation Department,
The World Bank,
1818 'H' Street N. W.,
Washington D. C. 20433,
United States of America.

Dear Clell,

Kenya Health and Nutrition Study

I enclose a list of subjects with identification nos., names and number of days work measured on each, and the productivity data itself which I collected in Kenya during June and July.

I had anticipated that you would wish me to assist Andrew Chesher in carrying out some preliminary assessment of the data. I therefore spoke about this to Michael Latham's student June Wolgemuth before leaving Kenya. However she declined to give me any of the detailed information of anthropometric data on the grounds that it was the basis of her Phd work. She did offer me some grouped extracts from her data but I did not think this was good enough so did not take it.

I have now spoken to Andrew Chesher and he is able to do some work on the data, but he did confirm it would be best to have complete health data that may be available. Perhaps you could sort out with Michael Latham who is entitled to see the data. Andrew asked me to mention he would like an instruction from you before starting work should you require this.

Yours sincerely,

Mark Sharrock

Enc.

COPY OF LETTER FROM SCOTT WILSON KIRKPATRICK & PARTNERS

Mr Barton

MJS/PAT/78126

Dr. Michael C. Latham,
Cornell University,
Division of Nutritional Sciences,
Savage Hall,
Ithaca,
NEW YORK 14853,
U. S. A.

15th September 1978

Dear Michael,

Thank you for your letter of 21st. August. I am sorry for the delay in replying, but I have at last completed the reduction of the field measurements and can now give you some details.

I enclose a list of subjects with the identification number and actual names of each person together with number of days work measured on each.

Unfortunately, I have no complete record of which workers were female - although I imagine this could be determined from the names of the individuals if one were familiar with local usage for names!

Yours sincerely,

Encs.

c.c. Clell Harral. ✓

PRODUCTIVITY DATA

IDENTIFICATION NUMBERS, NAMES AND DAYS OF PRODUCTIVITY OBSERVATIONS.

ROAD 12

2	CHOMBA GATUA	9	63	EMILY WANJIRA	1
3	HELEN WAMBUI	3	64A	JACOB KIIRU	12
4	MARGRET WAMBUI	5	69	DUNCAN KAMAU	4
5A	JAMES KIRANGO	8	70	JANE WANJIRU	1
6	MUTHIGANI MATATHI	1	71	EUNICE WAMBUI	2
9	VERONICA MUTHONI	3	73A	GICHIRA WILLY	1
11	MWANGI GITAU	6	75	GRACE NJERI	2
13	LABAN MAINA	11	76	BERNARD MUNENE	14
15	RUIRU NDAHI	10	77	WAIRIMU WANJOHI	1
16	JANE WAITHIRA	1	78	REBECCAH WANJIRU	2
19	FLACIAH WANDIA	3	78A	NANCY NJERI	2
20	SICILIAH WANGIKU	2	79A	JOSEPH MWANGI	3
21	ANNAH MUTHONI	3	80	STEPHEN MWANGI	9
23	LUCIAH NJERI MWANGI	1	81	JANE WAMAITHA	1
25A	JOHN GITAU	11	83	JECINTA NJERI	2
26	LUCIAH NJERI MAINA	2	84	MARGRET WAMBUI	3
27A	JOHN MAINA	1	86	MAINA GITAU	4
29	AGNES WANGIKU	1	87A	KIBOTHI MUTURI	8
30	GATANGU MWANGI	5	89	GRACE NJERI MWANGI	3
33	JOYCE WANJIKU	1	90A	PETER MAINA	8
36	KANYINGI MUKURIA	12	92	ESTHER WANJIRU	3
39	MARY NJOKI	4	94	MUCHOKI GITAU	11
41	VIRGINIA WAIRIMU	3	95	KAMIRI KANGETHI	9
46	MWANGI MBUGURA	13	96A	PETER GATHIMBI	8
47	EUNICE WANJIRU	2	97	MWANGI KABUGUA	14
49	MWANGI KIRATU	13	98	SARABINAH NYAMBURA	3
50A	KAMAU MWANGI	13	99	SARABINAH WANJIKU	3
51	MWANGI KIBERU	8	105	MWANIKI MUTURI	5
52	KAMAU GITAU	11	106A	KARIUKU WILLY	9
53	FRANCIS KIARO	10	107	BENJAMIN MUTURI	10
54A	GEOFFREY GICHEHI	13	109	MARGRET WANJIKU	3
58	KIMANI KAMAU	5	110	MARGRET NJERI	6

N ≈ 64 individuals

ROAD 7

4	ANTONY MWANGI CIIRA	3	148	MWANGI MUCHIRI	3
7	BERNARD MBUCHUNA M.	2	149	KIRAGO KIBUCHI	7
19	KANGANGE MURAGE	3	150	KIRIMBI CHOMBA	5
21	LEONARD MAINA KIHOHIA	8	151	JOSEPH NJONGI	5
23	JOSEPH MAINA W.	9	154	JANE NJERI	6
26	MAINA KARANI	7	155	MUTHONI GWATHIGA	9
31	MAINA MURIITHI	10	158	JOYCE WAMUYU	5
34	WAMWEA WANYAMBO	4	160	EVALINE WARUKURI	7
38	MWANGI MBURATI	5	164	PETERSON MURAGURI	1
48	KABIRU NJAU	6	165	GLADYS WAKINI	3
54	MWEA GOCHO	7	167	PETER MURIITHI	9
76	KIAMA KAARA	3	168	NDAGURI NGARI	7
79	WAGOCHO MUGOIYO	6	171	MARY MUTHONI	8
85	JANE WANJIRU	7	173	SAMUEL KARIUKU	3
88	BEATRICE MICHERE	4	174	ESTON M. NJOGO	8
90	ELIUD MURIUKI	3	177	MWAI MIANO	10
95	NANCY WANJIRU	3	178	MBUTU MURIMI	1
96	JECINTA NJERI	1	183	JACOB MAINA	7
106	KANOGA NDITU	1	185	KIBUCHI MUTUGI	7
109	MUTHIGANI NJAMBURI	2	186	MWANGI TIMOTHY	6

N ≈ 60 individuals

113	JOSEPH KANGANGI	8	189A	CYRUS K. GEDEON	7
114	MARY KANINI	6	190	STANLEY M. KIAMA	6
119	NJERI MAINA	9	191	MWANGI WANGWARO	10
121A	LEONARD MAINA	1	192	GATHIRI NGURU	2
122	FAITH WANJIRA	7	193	RUTH WAMBUI	8
126	PETER MAINA MWANGI	10	194	JANE WAKINI	10
133	MAINA MWANGI	8	198	EUNICE WAIRIMU	7
135	SAMUEL GITHINJI	7	199	RUTH WANJIRA	6
137	KIAMA MUGIRO	7	202	JAMES M. NJERE	8
143	WARUI GACHUHI	5	205	JOSEPH MAINA	2

RD. NO.	ID	DATE	ACTIVITY D	DS	S	E	TIMES (HHMM) BEG.	FIN.	DIFF	NOMINAL CHAINAGE	LIN. M	CSA SQM	VOL. CUM	CUM/ M-HR	TASK FIN.
12	2	21	6		1		905	1535	630	360			1.0	.154	
12	2	22	6	1			630	1225	555	760	25.0		4.0	.676	1
12	2	30	6		1		831	1105	234	1605	7.0	.273	1.91	.745	1
12	2	3	7		1		700	1530	830	2315	11.0	.284	3.12	.368	1
12	2	4	7		1		719	1230	511	2545	11.0	.269	2.96	.571	1
12	2	5	7		1		715	1120	405	2842	11.0	.237	2.61	.638	1
12	2	6	7		1		700	1000	300	3160	11.0	.281	3.09	1.03	1
12	2	7	7		1		715	1045	330	3260	11.0	.230	2.53	.723	1
12	2	10	7		1		700	1130	430	3597	11.0	.207	2.28	.506	1
12	3	4	7		1		815	1125	310	2622	11.0	.210	2.31	.729	1
12	3	5	7		1		835	1115	240	2996	11.0	.196	2.16	.809	1
12	3	7	7		1		755	1155	400	3359	11.0	.149	1.64	.410	1
12	4	21	6		1		930	1535	605	697.4	4.2		1.3	.214	
12	4	4	7		1		845	1105	220	2788	11.0	.270	2.97	1.27	1
12	4	5	7		1		830	1000	130	2809	11.0	.203	2.23	1.49	1
12	4	7	7		1		815	1310	455	3403	11.0	.155	1.71	.347	1
12	4	8	7		1		830	1315	445	3535	11.0	.223	2.45	.516	1
12	5A	19	6	1			758	1540	742		15.8	.140	2.21	.287	
12	5	20	6		1		830	1600	730	354.3	14.0		2.0	.267	
12	5	21	6	1			910	1535	625		10.2		1.6	.249	
12	5	4	7		1		730	1120	350	2512	11.0	.213	2.34	.611	1
12	5	6	7		1		730	1135	405	3204	11.0	.206	2.27	.555	1
12	5	7	7		1		715	1000	245	3271	11.0	.194	2.13	.776	1
12	5	8	7		1		715	1314	559	3447	11.0	.176	1.94	.324	1
12	5	10	7		1		730	1100	330	3564	11.0	.166	1.83	.522	1
12	6	19	6	1			755	1525	730		30.2		5.0	.667	1
12	9	5	7			1	915	1220	305	3330	10.0		2.9	.941	1
12	9	6	7			1	915	1200	245	3467	8.0		1.7	.618	1
12	9	7	7		1		755	1120	325	3337	11.0	.152	1.67	.489	1
12	11	3	7		1		809	1230	421	2326	11.0	.222	2.44	.561	1
12	11	4	7		1		825	1120	355	2666	11.0	.200	2.20	.562	1
12	11	5	7		1		715	1040	325	2853	11.0	.222	2.44	.715	1
12	11	6	7		1		730	1120	350	3193	11.0	.191	2.10	.548	1
12	11	7	7		1		730	1100	330	3315	11.0	.167	1.84	.525	1
12	11	8	7		1		725	1120	355	3480	11.0	.160	1.76	.449	1
12	13	19	6	1			758	1540	742		31.0	.116	3.58	.465	
12	13	20	6		1		843	1600	717	405	22.0		4.0	.549	
12	13	21	6		1		905	1535	630	480	17.4		3.1	.477	
12	13	28	6		1		835	1230	355		11.0	.229	2.52	.643	1
12	13	29	6		1		810	1245	435	1441	11.0	.208	2.29	.499	1
12	13	30	6		1		833	1040	207	1617	11.0	.121	1.33	.629	1
12	13	3	7		1		810	1140	330	2359	11.0	.215	2.37	.676	1
12	13	4	7		1		810	1055	245	2600	11.0	.242	2.66	.968	1
12	13	5	7		1		840	1130	250	3029	11.0	.173	1.90	.672	1
12	13	8	7		1		815	1150	335		11.0	.181	1.99	.556	1
12	13	10	7		1		835	1505	630	3636.7	6.67	.61	4.07	.626	1
12	15	20	6	1			845	1600	715	443	12.7		2.0	.276	
12	15	21	6		1		923	1535	612	664.2	4.2		1.3	.210	1
12	15	22	6		1		820	1100	240	938.1	11.0		4.0	1.50	1
12	15	27	6		1		840	1230	350		11.0		3.3	.861	1
12	15	29	6		1		850	1310	420	1528	7.0	.233	1.63	.376	1
12	15	30	6		1		835	955	120	1639	11.0	.164	1.80	1.35	1

12	15	3	7	1		830	1100	230	2436	11.0	.168	1.85	.739	1	
12	15	4	7	1		825	1115	250	2688	11.0	.184	2.02	.714	1	
12	15	5	7	1		820	1010	150	2919	11.0	.224	2.46	1.34	1	
12	15	8	7	1		845	1150	305		11.0	.210	2.31	.749	1	
12	16	5	7		1	845	1450	605	3270	10.0		2.0	.329	1	
12	19	5	7		1	905	1255	350	3310	10.0		3.5	.913	1	
12	19	6	7		1	915	1255	340	3489	11.0		1.5	.409	1	
12	19	7	7	1		815	1405	550	3381	11.0	.189	2.08	.356	1	
12	20	21	6	1		936	1535	559	676.6	4.2		1.3	.217		
12	20	22	6	1		830	1300	430	989.1	11.0		3.3	.733	1	
12	21	5	7		1	940	1410	430	3390	10.0		2.5	.556	1	
12	21	6	7		1	915	1245	330	3482	7.0		1.7	.486	1	
12	21	7	7	1		815	1345	530	3370	11.0	.188	2.07	.376	1	
12	23	5	7		1	950	1405	415	3400	10.0		2.0	.471	1	
12	25A	20	6	1		835	1600	725	561.4	17.1		2.7	.364		
12	25	21	6		1	905	1505	600	476.6	20.0		3.6	.600	1	
12	25	30	6	1		825	1045	225	1572	11.0	.192	2.11	.874	1	
12	25	3	7	1		800	1105	305	2205	11.0	.212	2.33	.756	1	
12	25	4	7	1		715	1015	300	2523	11.0	.247	2.72	.906	1	
12	25	5	7	1		745	1015	230	2864	11.0	.204	2.24	.898	1	
12	25	6	7	1		730	1010	240	3182	11.0	.213	2.34	.879	1	
12	25	7	7	1		715	1015	300	3260	11.0	.207	2.28	.759	1	
12	25	8	7	1		715	9945	230	3436	11.0	.163	1.79	.717	1	
12	25	10	7	1		730	1000	230	3553	11.0	.159	1.75	.700	1	
12	25	11	7	1		700	1000	300	3653.1	3.1	.556	1.72	.575	1	
12	26	4	7	1		815	1125	310	2611	11.0	.203	2.23	.705	1	
12	26	5	7	1		845	1250	405	3062	11.0	.151	1.66	.407	1	
12	27A	3	7	1		845	1100	215	2458	11.0	.152	1.67	.743	1	
12	29	5	7		1	850	1350	500	3280	10.0		2.0	.400	1	
12	30	19	6	1		808	1540	732		20.2	.099	2.00	.266		
12	30	20	6	1		826	1600	734	347.5	14.5		2.3	.304		
12	30	21	6		1	915	1535	620	340.0	9.1		1.6	.253		
12	30	22	6	1		820	1450	630	782.0	11.0		4.0	.615	1	
12	30	23	6	1		735	1140	405	515.0	12.0		3.2	.784	1	
12	33	11	7	1		847	1235	348	3662.8	3.2	.65	2.08	.547	1	
12	36	20	6		1	825	1600	735	352.5	16.7		3.0	.396		
12	36	21	6		1	910	1535	625		20.0		3.2	.499	1	
12	36	22	6	1		830	1400	530	869	11.0		3.3	.600	1	
12	36	27	6	1		822	1330	508		11.0		3.3	.643	1	
12	36	28	6	1		830	1155	325	1223	11.0	.178	1.96	.573	1	
12	36	29	6	1		810	1150	340	1452	11.0	.213	2.34	.639	1	
12	36	30	6	1		820	1100	240	1561	11.0	.180	1.98	.742	1	
12	36	3	7	1		805	1110	305	2260	11.0	.141	1.55	.503	1	
12	36	4	7	1		850	1025	135	2799	11.0	.198	2.18	1.38	1	
12	36	5	7	1		755	1050	255	2875	11.0	.262	2.88	.988	1	
12	36	10	7	1		830	1320	450	3623.33	6.67	.59	3.94	.814	1	
12	36	11	7	1		755	1030	235	3678.2	3.3	.603	1.99	.770	1	
12	39	21	6	1		930	1535	605	705.8	4.2		.67	.110		
12	39	22	6	1		820	1315	455	785	11.0		3.3	.671	1	
12	39	5	7		1	900	1220	320	3300	10.0		2.5	.750	1	
12	39	11	7	1		848	1230	342	3666.0	3.2	.59	1.89	.510	1	
12	41	5	7		1	855	1220	325	3290	10.0		2.0	.585	1	
12	41	6	7		1	915	1313	358	3500	10.0		1.8	.454	1	
12	41	7	7		1	825	1235	410	3530	10.0		3.0	.720	1	
12	46	20	6		1	825	1420	555	327.5			4.5	.761	1	
12	46	21	6		1	905	1510	605	431	20.0		3.6	.592	1	
12	46	22	6		1	805	1155	350		13.0		2.1	.548		
12	46	27	6	1		820	1440	620		11.0		3.3	.521	1	
12	46	28	6	1		825	1205	350	1201	11.0	.230	2.53	.660	1	
12	46	29	6	1		815	1240	425	1474	11.0	.259	2.85	.645	1	
12	46	30	6	1		837	1140	303	1661	11.0	.251	2.76	.905	1	
12	46	3	7	1		820	1200	340	2370	11.0	.208	2.29	.624	1	
12	46	4	7	1		830	1125	255	2700	11.0	.238	2.62	.898	1	
12	46	5	7	1		825	1130	305	2930	11.0	.237	2.61	.846	1	
12	46	8	7	1		810	1100	250		11.0	.173	1.90	.672	1	
12	46	10	7	1		835	1440	605	3643.33	6.67	.61	4.07	.669	1	

12	46	11	7	1		835	1017	142	3688.1	3.3	.684	2.26	1.33		1	
12	47	5	7		1	935	1400	425	3380	10.0		2.5	.526		1	
12	47	7	7		1	930	1325	355	3552	18.0		3.0	.766		1	
12	49	19	6	1		755	1540	745		15.8	.117	1.84	.238			
12	49	20	6	1		837	1600	723	371	18.0		3.0	.406			
12	49	21	6		1	917	1535	618	624.4	15.6		2.5	.397			
12	49	22	6	1		825	1300	435	887.1	11.0		4.0	.873		1	
12	49	28	6	1		815	1225	410	1278	11.0	.276	3.04	.729		1	
12	49	29	6	1		801	1040	239	1398	7.0	.259	1.81	.684		1	
12	49	30	6	1		830	1150	320	1583	11.0	.230	2.53	.759		1	
12	49	3	7	1		807	1155	348	2282	11.0	.193	2.12	.559		1	
12	49	4	7	1		725	1100	335	2567	11.0	.264	2.90	.810		1	
12	49	5	7	1		800	1120	320	2886	11.0	.213	2.34	.703		1	
12	49	8	7	1		804	1130	326		11.0	.207	2.28	.663		1	
12	49	10	7	1		820	1228	408	3616.67	6.67	.61	4.07	.984		1	
12	49	11	7	1		720	1035	315	3656.2	3.3	.543	1.79	.551		1	
12	50A	19	6	1		756	1540	744		15.6	.155	2.42	.313			
12	50	20	6		1	900	1545	645	454.5	25.0		4.5	.667		1	
12	50	22	6	1		825	1300	435	909.1	11.0		4.0	.873		1	
12	50	27	6	1		825	1240	415		11.0		4.0	.941		1	
12	50	28	6	1		830	1115	245	1212	11.0	.170	1.87	.680		1	
12	50	29	6	1		805	1030	225	1412	7.0	.226	1.58	.655		1	
12	50	3	7	1		806	1155	349	2271	11.0	.218	2.40	.628		1	
12	50	4	7	1		817	1045	228	2633	11.0	.197	2.17	.879		1	
12	50	5	7	1		835	1050	215	2974	11.0	.219	2.41	1.07		1	
12	50	6	7	1		800	1025	225	3248	11.0	.210	2.31	.956		1	
12	50	7	7	1		730	1110	340	3293	11.0	.172	1.89	.516		1	
12	50	8	7	1		717	1020	303	3458	11.0	.216	2.38	.779			
12	50	11	7	1		835	1040	205	3650.0	3.2	.60	1.92	.922		1	
12	51	20	6	1		838	1600	722	372	8.0		1.3	.177			
12	51	21	6		1	913	1535	622	567.4	12.6		2.3	.361			
12	51	27	6	1		835	1450	625		9.0		2.7	.421			
12	51	28	6	1		815	1205	350	1298	11.0	.248	2.73	.712		1	
12	51	30	6	1		820	1100	240	1554	7.0	.152	1.06	.399		1	
12	51	4	7	1		800	1125	325	2589	11.0	.264	2.90	.850		1	
12	51	5	7	1		828	1150	322	2941	11.0	.249	2.74	.814		1	
12	51	8	7	1		840	1140	300		11.0	.247	2.72	.906		1	
12	52	19	6	1		755	1425	630		29.0		5.1	.785		1	
12	52	20	6		1	857	1600	703	475	15.3		2.0	.284			
12	52	21	6	1		918	1535	617		9.6		1.6	.255			
12	52	22	6	1		810	1420	610	829	11.0		3.3	.535		1	
12	52	27	6	1		840	1500	620		11.0		4.0	.632		1	
12	52	28	6	1		825	1300	435	1190	11.0	.260	2.86	.624		1	
12	52	29	6	1		830	1100	230	1507	7.0	.184	1.29	.515		1	
12	52	3	7	1		820	1200	340	2414	11.0	.196	2.16	.588		1	
12	52	4	7	1		717	1018	301	2534	11.0	.250	2.75	.912		1	
12	52	5	7	1		848	1140	252	3073	11.0	.154	1.69	.591		1	
12	52	8	7	1		850	1315	425	3546	11.0	.166	1.83	.413		1	
12	53	21	6	1		930	1535	605	693.2	4.2		1.3	.214			
12	53	22	6	1		815	1440	625	807	11.0		4.0	.623		1	
12	53	28	6	1		820	1155	335	1342	11.0	.229	2.52	.703		1	
12	53	30	6	1		825	1005	140	1547	7.0	.211	1.48	.886		1	
12	53	3	7	1		803	1110	307	2238	11.0	.158	1.74	.558		1	
12	53	4	7	1		728	1010	242	2578	11.0	.282	3.10	1.15		1	
12	53	5	7	1		810	1010	200	2897	11.0	.230	2.53	1.27		1	
12	53	6	7	1		740	955	215	3215	11.0	.260	2.86	1.27		1	
12	53	7	7	1		720	1000	240	3282	11.0	.173	1.90	.714		1	
12	53	8	7	1		720	50	230	3469	11.0	.164	1.80	.722		1	
12	54A	19	6	1		758	1540	742		19.9	.132	2.63	.341			
12	54	20	6	1		843	1600	717	556.7	16.9		2.7	.371			
12	54	21	6		1	913	1535	622	580	16.0		2.8	.440			
12	54	22	6		1	805	1250	445	500	20.0		3.2	.674		1	
12	54	27	6	1		817	1440	623	1035	11.0		3.3	.517		1	
12	54	28	6	1		815	1150	335	1335	11.0	.253	2.78	.777		1	
12	54	29	6	1		803	1500	657	1419	11.0	.209	2.30	.331		1	
12	54	3	7	1		804	1240	436	2249	11.0	.132	1.45	.316		1	

12	54	4	7	1		830	1005	135	2755	11.0	.273	3.00	1.90		1	
12	54	5	7	1		900	1245	345	3139	11.0	.236	2.60	.692		1	
12	54	8	7	1		803	1110	307		11.0	.244	2.68	.861		1	
12	54	10	7	1		830	1410	540	3616.67	6.67	.61	4.07	.718		1	
12	54	11	7	1		730	1045	315	3666	2.8	.568	1.59	.489		1	
12	58	19	6	1		750	1540	750		15.2	.165	2.50	.319			
12	58	3	7	1		830	1530	700	2425	11.0	.227	2.50	.357		1	
12	58	4	7	1		830	1100	230	2733	11.0	.226	2.49	.994		1	
12	58	5	7	1		855	1350	455	3095	11.0	.212	2.33	.474		1	
12	58	6	7	1		930	1330	400	3204	11.0	.220	2.42	.605		1	
12	63	5	7		1	840	1400	520	3260	10.0		4.5	.844		1	
12	64A	19	6	1		810	1540	730		21.2	.127	2.69	.358			
12	64	20	6		1	825	1600	735	329.3	19.6		3.5	.462			
12	64	21	6	1		925	1535	610	672.4	4.2		1.3	.211		1	
12	64	22	6	1		820	1100	240	938.1	11.0		4.0	1.50		1	
12	64	28	6	1		815	1115	300	1313	11.0	.326	3.59	1.20		1	
12	64	29	6	1		830	1100	230	1496	11.0	.211	2.32	.928		1	
12	64	3	7	1		840	1200	320	2293	11.0	.203	2.23	.670		1	
12	64	4	7	1		830	1045	215	2744	11.0	.226	2.49	1.11		1	
12	64	5	7	1		900	1225	325	3128	11.0	.302	3.32	.972		1	
12	64	8	7	1		830	1100	230		11.0	.200	2.20	.880		1	
12	64	10	7	1		900	1315	415	3630.0	6.67	.62	4.14	.973		1	
12	64	11	7	1		835	1038	203	3653.2	3.2	.52	1.66	.812		1	
12	69	19	6	1		815	1540	725				1.2	.162			
12	69	20	6	1		840	1600	720	508.5	14.2		2.8	.382			
12	69	21	6	1		910	1535	625		7.5		1.2	.187			
12	69	22	6	1		810	1155	345	753	7.0		2.1	.560			
12	70	5	7		1	1000	1415	415	3420	10.0		2.5	.588		1	
12	71	21	6	1		930	1535	605	701.6	4.2		.67	.110			
12	71	22	6	1		810	1415	605	960.1	11.0		3.3	.543		1	
12	73A	5	7	1		830	1250	420	2963	11.0	.206	2.27	.523		1	
12	75	21	6	1		930	1535	605	685	4.2		1.3	.214			
12	75	22	6	1		820	1455	635	793	11.0		4.0	.608			
12	76	19	6	1		750	1540	750				4.0	.511			
12	76	20	6		1	845	1600	715	450	11.8		1.2	.166			
12	76	22	6	1		820	1330	510	796	11.0		4.0	.774		1	
12	76	23	6		1	800	1130	330				4.5	1.29		1	
12	76	27	6	1		821	1330	509		11.0		3.3	.641		1	
12	76	28	6	1		815	1205	350	1287	11.0	.303	3.33	.870		1	
12	76	29	6	1		845	1215	330	1514	7.0	.181	1.27	.362		1	
12	76	30	6	1		836	1105	229	1650	11.0	.195	2.15	.864		1	
12	76	3	7	1		810	1225	415	2337	11.0	.212	2.33	.549		1	
12	76	4	7	1		721	1110	349	2556	11.0	.241	2.65	.695		1	
12	76	5	7	1		815	1015	200	2908	11.0	.239	2.63	1.32		1	
12	76	8	7	1		800	1100	300		11.0	.244	2.68	.895		1	
12	76	10	7	1		820	1115	255	3610	6.67	.60	4.00	1.37		1	
12	76	11	7	1		725	1025	300	3659.5	3.1	.608	1.89	.628		1	
12	77	5	7		1	955	1420	425	3410	10.0		2.5	.566		1	
12	78	21	6	1		930	1535	605	689.2	4.2		1.3	.214			
12	78	22	6	1		810	1440	630	815	11.0		3.3	.508		1	
12	78A	5	7		1	925	1400	435	3350	10.0		3.3	.720		1	
12	78	11	7	1		845	1245	400	3656.4	3.2	.52	1.66	.416		1	
12	79A	19	6	1		757	1540	743		15.4	.127	1.95	.253			
12	79	20	6	1		857	1600	703		17.8		3.0	.426			
12	79	21	6	1		924	1535	621	668.2	2.4		.77	.121			
12	80	22	6		1	830	1405	535		20.0		3.8	.681		1	
12	80	29	6	1		800	1105	305	1380	11.0	.157	1.73	.560		1	
12	80	3	7	1		705	1005	300	2216	11.0	.227	2.50	.832		1	
12	80	4	7	1		700	1020	320	2490	11.0	.197	2.17	.650		1	
12	80	5	7	1		715	1015	300	2831	11.0	.242	2.66	.887		1	
12	80	6	7	1		740	1040	300	3226	11.0	.249	2.74	.913		1	
12	80	7	7	1		750	1000	210	3326	11.0	.225	2.48	1.14		1	
12	80	8	7	1		800	1022	222	3513	11.0	.200	2.20	.930		1	
12	80	10	7	1		738	1110	332	3586	11.0	.245	2.70	.763		1	
12	81	5	7	1		835	1115	240	2985	11.0	.135	1.49	.557		1	
12	83	5	7		1	1010	1430	420	3440	10.0		2.0	.462		1	

12	83	7	7		1	930	1400	430	3570	23.0		3.0	.667		1
12	84	22	6	1		820	1355	535	771	11.0		3.3	.591		1
12	84	5	7		1	1005	1425	420	3430	10.0		2.5	.577		1
12	84	7	7		1	930	1400	430	3593	15.0		2.8	.622		1
12	86	3	7	1		825	1234	409	2381	11.0	.263	2.89	.697		1
12	86	5	7	1		900	1250	350	3106	11.0	.185	2.04	.531		1
12	86	10	7	1		835	1420	545	3630.0	6.67	.64	4.27	.742		1
12	86	11	7	1		745	1042	257	3675.0	3.2	.631	2.02	.684		1
12	87A	22	6	1		810	1420	610	818	11.0		4.6	.746		1
12	87	23	6	1		735	1135	400	527.5	12.0		3.2	.800		1
12	87	28	6	1		830	1400	530	1353	11.0	.223	2.45	.446		1
12	87	3	7	1		845	1150	305	2469	11.0	.236	2.60	.842		1
12	87	5	7	1		900	1250	350	3117	11.0	.148	1.63	.425		1
12	87	6	7	1		715	1013	258	3171	11.0	.225	2.48	.834		1
12	87	7	7	1		755	1145	350	3348	11.0	.154	1.69	.442		1
12	87	8	7	1		745	1055	310	3502	11.0	.196	2.16	.681		1
12	88	5	7		1	930	1225	255	3360	10.0		2.2	.754		1
12	88	6	7		1	915	1200	245	3475	7.0		1.8	.655		1
12	88	7	7		1	820	1200	340	3540	12.0		3.0	.818		1
12	90A	22	6	1		800	1215	415	660	4.2		1.3	.306		1
12	90	28	6	1		845	1240	355	1364	11.0	.268	2.95	.753		1
12	90	29	6	1		850	1315	425	1528	7.0	.185	1.30	.293		1
12	90	30	6	1		834	1030	156	1628	11.0	.120	1.32	.683		1
12	90	4	7	1		830	1145	315	2711	11.0	.220	2.42	.745		1
12	90	5	7	1		840	1125	245	3018	11.0	.143	1.57	.572		1
12	90	6	7	1		758	1145	347	3193	11.0	.234	2.57	.680		1
12	90	8	7	1		855	1315	420	3425	11.0	.234	2.57	.594		1
12	92	5	7		1	935	1320	345	3370	10.0		2.3	.613		1
12	92	6	7		1	830	1105	235	3460	7.0		1.7	.658		1
12	92	7	7	1		815	1300	445	3392	11.0	.161	1.77	.373		1
12	94	20	6	1		900	1545	645	460	24.4		4.0	.593		1
12	94	21	6		1	907	1535	628	540	15.0		2.4	.371		
12	94	22	6	1		825	1400	535	920	11.0		4.0	.716		1
12	94	27	6	1		840	1230	350		11.0		4.0	1.04		1
12	94	28	6	1		813	1200	347	1267	11.0	.224	2.46	.651		1
12	94	29	6	1		815	1500	645	1463	11.0	.166	1.83	.271		1
12	94	3	7	1		825	1155	330	2392	11.0	.207	2.28	.651		1
12	94	4	7	1		820	1140	320	2644	11.0	.238	2.62	.785		1
12	94	8	7	1		825	1015	150		11.0	.167	1.84	1.00		1
12	94	10	7	1		855	1310	415	3636.67	6.67	.55	3.67	.863		1
12	94	11	7	1		728	1056	328	3662.6	3.4	.518	1.76	.508		1
12	95	19	6	1		800	1540	740		9.6	.168	1.61	.210		
12	95	20	6	1		845	1600	715	593.3	18.4		2.9	.400		
12	95	21	6		1	900	1455	555	372	18.4		4.3	.727		1
12	95	22	6	1		815	1405	550	804	11.0		4.0	.686		1
12	95	28	6	1		815	1150	335	1324	11.0	.355	3.91	1.09		1
12	95	29	6	1		816	1245	429	1485	11.0	.259	2.85	.635		1
12	95	4	7	1		840	1030	150	2777	11.0	.274	3.01	1.64		1
12	95	5	7	1		830	1000	130	2820	11.0	.292	3.21	2.14		1
12	95	7	7	1		820	1230	410		11.0	.200	2.20	.528		1
12	96A	20	6		1	840	1600	720	375	17.7		2.8	.382		
12	96	21	6		1	907	1535	628	520	20.0		3.2	.495		1
12	96	23	6		1	720	1115	355	640	14.9		2.4	.613		
12	96	28	6	1		830	1200	330	1234	11.0	.176	1.94	.553		1
12	96	4	7	1		831	1003	132	2766	11.0	.204	2.24	1.46		1
12	96	8	7	1		835	1120	245		11.0	.176	1.94	.704		1
12	96	10	7	1		840	1235	355	3643.33	6.67	.60	4.00	1.02		1
12	96	11	7	1		835	1027	152	3684.8	3.3	.712	2.35	1.26		1
12	97	19	6	1		745	1540	755				2.9	.366		
12	97	20	6		1	840	1600	720	406	25.0		4.5	.614		1
12	97	21	6		1	900	1510	610	429.3	20.0		3.6	.584		1
12	97	22	6	1		825	1300	435	898.1	11.0		4.0	.873		1
12	97	27	6	1		830	1325	455		11.0		4.0	.814		1
12	97	28	6	1		815	1200	345	1256	11.0	.214	2.35	.628		1
12	97	29	6	1		805	1040	235	1405	7.0	.209	1.46	.566		1
12	97	30	6	1		825	1015	150	1540	7.0	.229	1.60	.874		1

12	97	3	7	1		810	1140	330	2348	11.0	.226	2.49	.710		1	
12	97	4	7	1		827	1110	243	2699	11.0	.246	2.71	.996		1	
12	97	5	7	1		840	1125	245	3040	11.0	.193	2.12	.772		1	
12	97	7	7	1		805	1100	255		11.0	.248	2.73	.935		1	
12	97	10	7	1		830	1200	330	3623.33	6.67	.6	4.00	1.14		1	
12	97	11	7	1		740	1025	235	3671.9	3.2	.699	2.24	.866		1	
12	98	22	6	1		810	1405	555	829	11.0		3.3	.558		1	
12	98	5	7		1	1025	1435	410	3450	10.0		2.0	.480		1	
12	98	11	7	1		845	1235	350	3659.6	3.2	.65	2.08	.543		1	
12	99	21	6	1		930	1535	605	680.8	4.2		1.3	.214			
12	99	22	6	1		810	1455	645	837	11.0		3.3	.489		1	
12	99	5	7		1	920	1400	440	3340	10.0		3.7	.793		1	
12	105	3	7	1		825	1250	425	2403	11.0	.177	1.95	.441		1	
12	105	4	7	1		825	1200	335	2677	11.0	.193	2.12	.592		1	
12	105	5	7	1		900	1335	435	3084	11.0	.223	2.45	.535		1	
12	105	6	7	1		755	1210	415	3182	11.0	.225	2.48	.584		1	
12	105	11	7	1		735	1050	315	3668.8	3.1	.621	1.93	.592		1	
12	106A	19	6	1		750	1540	750		12.8	.121	1.55	.198			
12	106	20	6	1		857	1600	703	547.7	14.0		2.2	.312			
12	106	21	6	1		917	1535	618		7.7		1.2	.191			
12	106	29	6	1		800	1345	545	1391	7.0	.110	.77	.134		1	
12	106	3	7	1		830	1140	310	2447	11.0	.170	1.87	.591		1	
12	106	4	7	1		830	1150	320	2722	11.0	.181	1.99	.597		1	
12	106	5	7	1		828	1200	332	2952	11.0	.194	2.13	.604		1	
12	106	8	7	1		805	1155	350		11.0	.163	1.79	.468		1	
12	106	11	7	1		835	1043	208	3691.4	3.2	.594	1.90	.891		1	
12	107	27	6	1		840	1305	425		11.0		3.3	.747		1	
12	107	28	6	1		813	1200	347	1245	11.0	.233	2.56	.677		1	
12	107	29	6	1		800	1340	540	1430	11.0	.213	2.34	.414		1	
12	107	4	7	1		822	1200	338	2655	11.0	.248	2.73	.751		1	
12	107	5	7	1		842	1200	318	3051	11.0	.211	2.32	.703		1	
12	107	6	7	1		743	1045	302	3237	11.0	.265	2.92	.961		1	
12	107	7	7	1		725	1105	340	3304	11.0	.164	1.80	.492		1	
12	107	8	7	1		730	1055	325	3491	11.0	.201	2.21	.647		1	
12	107	10	7	1		735	1100	325	3575	11.0	.191	2.10	.615		1	
12	107	11	7	1		715	1037	322	3650.0	3.1	.556	1.72	.512		1	
12	109	4	7	1		710	1210	500	2501	11.0	.189	2.08	.416		1	
12	109	5	7	1		838	1125	247	3007	11.0	.178	1.96	.703		1	
12	109	11	7	1		855	1250	355	3669.2	3.2	.65	2.08	.531		1	
12	110	5	7		1	910	1255	345	3320	10.0		3.5	.933		1	
12	110	6	7		1	915	1310	355	3510	11.0		3.8	.970		1	
12	110	7	7		1	820	1150	330	3521	9.0		3.2	.914		1	
12	110	8	7	1		830	1310	440	3524	11.0	.194	2.13	.457		1	
12	110	10	7	1		825	1505	640	3610.0	6.67	.61	4.07	.610		1	
12	110	11	7	1		800	1055	255	3681.5	3.3	.639	2.11	.723		1	
7	4	1	7	1		800	1115	315	4006	12.5	.18	2.25	.692		1	
7	4	3	7	1		840	1258	418	4226	12.5	.18	2.25	.523		1	
7	4	12	7		1	740	1300	520	4703.7	1.9	2.05	3.90	.730		1	
7	7	1	7	1		800	1115	315	4030	12.5	.15	1.88	.577		1	
7	7	12	7		1	740	1300	520	4710.15	2.1	1.8	3.78	.709		1	
7	19	29	6	1		730	1120	350	3840.6	12.5	.19	2.38	.621		1	
7	19	1	7		1	837	1107	230	4269.0	2.37	1.64	3.89	1.56		1	
7	19	3	7		1	820	1155	335	4391.8	1.59	2.40	3.82	1.07		1	
7	21	27	6		1	747	1100	313	4027.0	2.85	1.32	3.76	1.17		1	
7	21	28	6		1	828	1107	239	4117.6	2.25	1.48	3.33	1.26		1	
7	21	1	7		1	830	1120	250	4241.4	2.7	1.49	4.02	1.42		1	
7	21	3	7		1	850	1320	430	4416.6	1.60	2.76	4.42	.981		1	
7	21	4	7		1	750	1130	340	4427.9	1.96	2.10	4.12	1.12		1	
7	21	5	7		1	805	1135	330	4453.15	1.05	3.76	3.96	1.13		1	
7	21	6	7		1	755	1100	305	4476.05	1.25	3.31	4.14	1.34		1	
7	21	7	7		1	805	1225	420	4607.25	1.15	3.06	3.52	.812		1	
7	23	28	6		1	826	1020	154	4110.15	2.65	1.25	3.31	1.74		1	
7	23	29	6	1		730	1120	350	3878.1	12.5	.19	2.38	.620		1	
7	23	30	6		1	826	1120	254	4200.15	2.15	1.93	4.15	1.43		1	
7	23	3	7		1	820	1145	325	4390.15	1.59	2.33	3.70	1.08		1	
7	23	4	7		1	750	1130	340	442.9	2.01	2.20	4.42	1.21		1	

	7	23	5	7		1	805	1125	320	4458.55	1.20	3.17	3.80	1.14	1		
	7	23	6	7		1	755	1100	305	4478.55	1.25	3.18	3.98	1.29	1		
2	7	23	7	7		1	750	1114	324	4540.2	1.15	3.53	4.06	1.19	1		2
	7	23	8	7		1	800	1125	325	4558.75	.95	4.20	3.99	1.17	1		
4	7	26	1	7	1		805	1300	455	4094	12.5	.18	2.25	.458	1		4
	7	26	5	7		1	800	1215	415	4340			4.0	.941			
6	7	26	6	7		1	800	1115	315	4508.65	1.15	3.49	4.01	1.24	1		6
	7	26	7	7		1	810	1300	450	4590.2	1.25	3.08	3.85	.797	1		
8	7	26	8	7		1	800	1125	325	4556.85	.95	4.08	3.88	1.13	1		8
	7	26	10	7		1	740	1340	600	4620.25	1.20	3.29	3.95	.658	1		
10	7	26	11	7		1	750	1150	400	4694.4	1.90	1.70	3.23	.808	1		10
	7	31	27	6		1	747	1100	313	4024.4	2.5	1.43	3.58	1.11	1		
12	7	31	28	6		1	827	1020	153	4112.8	2.5	1.32	3.30	1.75	1		12
	7	31	29	6		1	740	1125	345	4158.8	2.15	1.68	3.61	.963	1		
14	7	31	1	7		1	830	1120	250	4238.5	2.6	1.59	4.13	1.46	1		14
	7	31	3	7		1	850	1320	430	4411.8	1.60	2.69	4.30	.956	1		
16	7	31	4	7		1	750	1106	316	4430.2	1.90	2.14	4.05	1.24	1		16
	7	31	5	7		1	805	1210	405	4464.0	1.20	3.30	3.96	.970	1		
18	7	31	6	7		1	755	1100	305	4474.85	1.25	3.39	4.24	1.37	1		18
	7	31	7	7		1	810	1225	415	4608.4	1.15	3.03	3.49	.820	1		
20	7	31	8	7		1	807	1330	523	4568.4	1.2	3.59	4.31	.800	1		20
	7	34	1	7	1		805	1330	525	4082.5	12.5	.17	2.13	.392	1		
22	7	34	3	7		1	815	1307	452	4360.15	3.82	1.01	3.86	.792	1		22
	7	34	4	7		1	820	1340	520	4442.4	1.0	4.03	4.03	.756	1		
24	7	34	12	7		1	740	1325	545	4707.7	2.15	1.80	3.87	.673	1		24
	7	38	27	6		1	750	1100	310	4030.15	2.75	1.30	3.58	1.13	1		
26	7	38	28	6	1		800	1230	430	3752.5	12.5	.19	2.38	.528	1		26
	7	38	29	6		1	740	1210	430	4147.4	2.45	1.59	3.90	.866	1		
28	7	38	30	6		1	825	1240	415	4188.2	1.65	2.31	3.81	.897	1		28
	7	38	3	7		1	810	1145	335	4335.5	1.96	2.01	3.95	1.10	1		
30	7	48	28	6	1		810	1315	505	3800.0	12.5	.19	2.38	.467	1		30
	7	48	29	6		1	815	1202	347	4176.95	1.5	2.24	3.36	.888	1		
32	7	48	30	6		1	825	1200	335	4197.7	2.0	2.03	4.06	1.13	1		32
	7	48	1	7		1	837	1300	423	4266.8	2.31	1.68	3.88	.885	1		
34	7	48	3	7		1	820	1300	440	4396.6	1.59	2.54	4.04	.867	1		34
	7	48	7	7		1	800	1245	445	4601.5	1.15	3.21	3.69	.777	1		
36	7	54	28	6	1		810	1315	505	3813	12.5	.19	2.38	.467	1		36
	7	54	29	6		1	815	1202	347	4171.85	1.8	1.87	3.37	.890	1		
38	7	54	30	6		1	830	1220	350	4210.15	2.45	1.52	3.72	.971	1		38
	7	54	3	7		1	850	1305	415	4418.2	1.60	2.66	4.26	1.00	1		
40	7	54	6	7		1	815	1320	505	4526.05	1.25	3.09	3.86	.760	1		40
	7	54	7	7		1	800	1346	546	4600.35	1.15	3.24	3.73	.646	1		
42	7	54	8	7		1	805	1340	535	4567.25	1.15	3.73	4.29	.768	1		42
	7	76	1	7	1		800	1115	315	4018.5	12.5	.14	1.75	.538	1		
44	7	76	3	7		1	840	1305	425	4405.0	1.60	2.67	4.26	.964	1		44
	7	76	12	7		1	740	1300	520	4714.3	1.90	1.97	3.74	.702	1		
46	7	79	27	6		1	800	1220	420	4040.15	2.4	1.48	.355	.820	1		46
	7	79	28	6	1		800	1300	500	3780.0	12.5	.19	2.38	.475	1		
48	7	79	29	6		1	740	1210	430	4150.15	2.25	1.60	3.60	.800	1		48
	7	79	4	7		1	740	1220	440	4235			4.0	.857			
50	7	79	5	7		1	820	1440	620	4471.35	1.15	3.53	4.06	.641	1		50
	7	79	6	7		1	815	1320	505	4524.85	1.2	3.13	3.76	.739	1		
52	7	85	29	6		1	805	1202	357	4170.1	1.75	1.78	3.12	.789	1		52
	7	85	1	7	1		805	1345	540	4106.5	12.5	.16	2.0	.353	1		
54	7	85	3	7		1	810	1430	620	4328.3	2.44		3.57	.564			54
	7	85	4	7		1	805	1415	610	4422.1	1.91	2.52	4.81	.780	1		
56	7	85	6	7		1	815	1335	520	4521.35	1.15	3.24	3.73	.699	1		56
	7	85	7	7		1	810	1500	650	4547.3	1.25		2.80	.410			
58	7	85	8	7		1	800	1435	635	4553.75	1.05	3.60	3.78	.574	1		58
	7	88	3	7		1	820	1305	445	4393.4	1.59	2.45	3.90	.820	1		
60	7	88	6	7		1	820	1400	540	4537.5	1.15	3.49	4.01	.708	1		60
	7	88	7	7		1	810	1500	650	4550.2	1.25		2.33	.340			
62	7	88	10	7		1	740	1411	631	4625.2	1.40	2.71	3.79	.582	1		62
	7	90	28	6		1	825	1020	155	4090.15	3.25	1.28	4.16	2.17	1		
64	7	90	29	6	1		730	1120	350	3838.1	12.5	.22	2.75	.717	1		64
	7	90	1	7		1	830	1120	250	4235.8	2.65	1.59	4.21	1.49	1		

7	95	6	7		1	810	1310	500	4517.3	1.25	3.37	4.21	.843	1	
7	95	7	7		1	810	1500	650	4551.45	1.25		2.40	.351		
7	95	10	7		1	740	1500	720	4621.45	1.20		1.90	.261		
7	96	30	6		1	825	1230	405	4192.0	1.75	2.21	3.87	.947	1	
7	106	27	6		1	747	1100	313	4020.15	2.0	1.70	3.40	1.06	1	
7	109	27	6		1	740	1215	435	3997.6	2.15	1.81	3.89	.849	1	
7	109	12	7		1	745	1315	530	4718.0	1.90	2.19	4.16	.757	1	
7	113	27	6		1	805	1125	320	4057.5	2.35	1.48	3.48	1.04	1	
7	113	28	6	1		810	1225	415	3788.0	12.5	.19	2.38	.559	1	
7	113	29	6		1	800	1210	410	4167.25	1.7	1.73	2.94	.706	1	
7	113	30	6		1	825	1220	355	4190.15	1.8	2.27	4.09	1.04	1	
7	113	3	7	1		840	1245	405	4213.5	12.5	.18	2.25	.551	1	
7	113	4	7		1	750	1106	316	4432.1	1.70	2.45	4.17	1.28	1	
7	113	7	7		1	757	1114	317	4542.5	1.15	3.51	4.04	1.23	1	
7	113	8	7		1	800	1125	325	4557.8	.95	4.14	3.93	1.15	1	
7	114	27	6		1	800	1220	420	4042.5	2.5	1.46	3.65	.842	1	
7	114	28	6		1	826	1118	252	4106.6	3.25	1.15	3.74	1.30	1	
7	114	29	6		1	755	1205	410	4163.75	1.75	1.72	3.01	.722	1	
7	114	6	7		1	820	1400	540	4536.35	1.15	3.44	3.96	.698	1	
7	114	7	7		1	812	1500	648	4618.65	1.1	3.37	3.71	.545	1	
7	114	8	7		1	805	1430	625	4561.1	.8		2.5	.390		
7	119	27	6		1	750	1150	400	4032.9	2.30	1.36	3.13	.782	1	
7	119	28	6		1	830	1200	330	4127.5	2.35	1.75	4.11	1.18	1	
7	119	29	6		1	755	1400	605	4165.5	1.75		2.71	.445		
7	119	1	7		1	845	1500	615	4280.15	2.80	1.32	3.69	.591	1	
7	119	3	7		1	820	1430	610	4401.8	1.60		1.58	.255		
7	119	5	7		1	810	1505	655	4456.3	1.1		3.51	.507		
7	119	6	7		1	810	1440	630	4516.05	1.25	3.41	4.26	.673	1	
7	119	7	7		1	805	1500	655	4603.8	1.15	3.18	3.66	.529	1	
7	119	8	7		1	805	1500	655	4562.7	.8	4.18	3.34	.483	1	
7	121A	30	6	1		826	1330	504		12.5	.18	2.25	.444	1	
7	122	27	6		1	805	1200	355	4060.15	2.35	1.50	3.53	.900	1	
7	122	1	7		1	845	1500	615	4285.3	1.87	1.88	3.51	.561	1	
7	122	4	7		1	820	1340	520	4445.35	.95	4.03	3.83	.718	1	
7	122	6	7		1	820	1430	610	4533.95	1.20	3.29	3.95	.640	1	
7	122	8	7		1	805	1350	545	4564.4	.90	4.04	3.64	.632	1	
7	122	10	7		1	740	1411	631	4626.6	1.50	2.48	3.72	.571	1	
7	122	11	7		1	750	1320	530	4696.3	1.80	1.81	3.26	.592	1	
7	126	27	6		1	745	1100	315	4012.1	1.95	1.78	3.47	1.07	1	
7	126	28	6		1	825	1027	202	4087.1	2.75	1.33	3.66	1.78	1	
7	126	29	6		1	740	1210	430	4154.4	2.2	1.63	3.59	.797	1	
7	126	30	6		1	830	1205	335	4212.6	2.4	1.57	3.77	1.05	1	
7	126	1	7		1	830	1120	250	4233.0	2.7	1.49	4.02	1.42	1	
7	126	3	7		1	850	1320	430	4413.4	1.60	2.72	4.35	.967	1	
7	126	5	7		1	805	1135	330	4452.15	1.0	3.81	3.81	1.09	1	
7	126	6	7		1	800	1115	315	4506.35	1.15	3.48	4.00	1.23	1	
7	126	7	7		1	805	1225	420	4606.1	1.15	3.10	3.57	.823	1	
7	126	8	7		1	800	1125	325	4555.85	1.00	3.98	3.98	1.17	1	
7	133	29	6		1	940	1205	225	4186.6	1.6	2.34	3.74	1.55	1	
7	133	30	6	1		826	1330	504		12.5	.19	2.38	.469	1	
7	133	1	7	1		800	1120	320		12.5	.18	2.25	.675	1	
7	133	3	7		1	820	1300	440	4398.2	1.59	2.59	4.12	.884	1	
7	133	4	7		1	810	1300	450	4438.6	1.15	3.82	4.39	.909	1	
7	133	5	7		1	805	1410	605	4461.5	1.25	3.13	3.91	.643	1	
7	133	6	7		1	810	1430	620	4512.5	1.15	3.47	3.99	.630	1	
7	133	7	7		1	810	1500	650	4548.55	1.25	3.32	4.15	.607	1	
7	135	27	6		1	805	1120	315	4050.15	2.55	1.39	3.55	1.09	1	
7	135	28	6	1		800	1215	415	3740.0	12.5	.22	2.75	.647	1	
7	135	30	6	1		815	1225	410		12.5	.20	2.5	.600	1	
7	135	1	7		1	837	1120	243	4260.15	2.31	1.68	3.88	1.43	1	
7	135	3	7	1		840	1245	405	4201	12.5	.24	3.0	.735	1	
7	135	6	7		1	815	1310	455	4520.2	1.15	3.28	3.77	.767	1	
7	135	7	7		1	810	1255	445	4611.45	1.25	3.12	3.90	.821	1	
7	137	27	6		1	805	1200	355	4055.1	2.4	1.43	3.43	.876	1	
7	137	28	6		1	830	1300	430	4137.3	2.55	1.61	4.11	.912	1	
7	137	29	6	1		758	1255	457	3865.6	12.5	.19	2.38	.480	1	

7	137	4	7		1	820	1325	505	4446.3	.95	4.02	3.82	.751	1
7	137	6	7		1	810	1430	620	4514.85	1.2	3.43	4.12	.650	1
7	137	7	7		1	800	1325	525	4591.45	1.25	3.10	3.88	.715	1
7	137	8	7		1	808	1340	532	4566.2	1.05	3.87	4.06	.734	1
7	143	27	6		1	805	1120	315	4052.7	2.4	1.40	3.36	1.03	1
7	143	28	6	1		800	1230	430	3765.0	12.5	.19	2.38	.528	1
7	143	29	6		1	740	1210	430	4156.6	2.2	1.66	3.65	.812	1
7	143	30	6		1	828	1200	332	4204.6	2.5	1.69	4.23	1.20	1
7	143	1	7		1	830	1145	315	4244.0	2.9	1.30	3.77	1.16	1
7	148	27	6		1	805	1230	425	4065.0	2.3	1.50	3.45	.781	1
7	148	5	7		1	810	1210	400	4454.2	1.05	3.67	3.85	.963	1
7	148	10	7		1	740	1355	615	4623.7	1.50	2.91	4.37	.698	1
7	149	27	6		1	740	1145	405	4000.15	2.0	1.84	3.68	.901	1
7	149	28	6		1	825	1127	302	4103.4	3.2	1.11	3.55	1.17	1
7	149	29	6	1		758	1300	502	3880.6	12.5	.19	2.38	.472	1
7	149	30	6		1	833	1240	407	4222.5	2.4	1.58	3.79	.921	1
7	149	1	7	1		800	1200	400	4067.5	12.5	.17	2.13	.531	1
7	149	6	7		1	800	1345	545	4501.45	1.25	3.39	4.24	.737	1
7	149	7	7		1	800	1240	440	4593.95	1.25	3.16	3.95	.846	1
7	150	27	6		1	750	1150	400	4035.2	2.3	1.43	3.29	.822	1
7	150	30	6	1		827	1400	533		12.5	.19	2.38	.428	1
7	150	3	7		1	840	1340	500	4406.6	1.60	2.66	4.24	.849	1
7	150	5	7		1	810	1450	640	4467.55	1.15	3.55	4.08	.612	1
7	150	6	7		1	815	1335	520	4522.5	1.15	3.21	3.69	.692	1
7	151	27	6		1	805	1300	455	4075.3	2.55	1.66	4.23	.861	1
7	151	30	6		1	833	1250	417	4224.9	2.4	1.49	3.58	.835	1
7	151	3	7		1	850	1430	540	4408.2	1.60		3.19	.563	
7	151	4	7		1	823	1250	427	4448.1	.8	3.99	3.19	.717	1
7	151	6	7		1	810	1540	730	4510.2	1.15	3.49	4.01	.535	1
7	154	1	7		1	845	1500	615	4283.0	2.26	1.54	3.48	.556	1
7	154	3	7		1	820	1430	610	44020.2	1.60		2.89	.468	
7	154	8	7		1	805	1500	655	4563.5	.9		2.4	.347	
7	154	10	7		1	740	1355	615	4622.65	1.05	3.06	3.21	.514	1
7	154	11	7		1	830	1345	515	4701.9	1.80		2.62	.499	
7	154	12	7		1	745	1345	600	4716.2	1.80	2.08	3.74	.624	1
7	155	27	6		1	740	1145	405	4004.0	2.05	1.84	3.77	.924	1
7	155	28	6		1	828	1125	257	4120.15	2.55	1.59	4.05	1.37	1
7	155	30	6		1	832	1245	413	4220.15	2.35	1.63	3.83	.908	1
7	155	1	7		1	835	1120	245	4253.9	3.7	1.16	4.29	1.56	1
7	155	3	7		1	820	1300	440	4395.0	1.59	2.50	3.98	.853	1
7	155	4	7		1	745	1220	435	4240			4.0	.873	1
7	155	5	7		1	805	1435	630	4450.2	.95	3.92	3.72	.573	1
7	155	6	7		1	800	1345	545	4500.2	1.25	3.35	4.19	.728	1
7	155	7	7		1	800	1245	445	4597.6	1.15	3.23	3.72	.782	1
7	158	6	7		1	820	1440	620	4535.15	1.2	3.38	4.06	.640	1
7	158	7	7		1	810	1500	650	4546.05	1.25		.286	.419	
7	158	8	7		1	800	1435	635	4552.7	1.05	3.45	3.62	.550	1
7	158	10	7		1	800	1315	515	4690.15	2.20	1.47	3.23	.616	1
7	158	11	7		1	830	1345	515	4700.15	1.75		2.05	.390	
7	160	3	7		1	810	1430	620	4325.8	2.43		3.60	.569	
7	160	4	7		1	809	1425	616	4435.2	1.20		3.65	.583	
7	160	6	7		1	815	1320	505	4527.3	1.25	3.06	3.83	.752	1
7	160	7	7		1	812	1500	648	4615.2	1.20		2.48	.365	
7	160	8	7		1	805	1430	625	4561.9	.80		3.10	.483	
7	160	10	7		1	740	1355	615	4628.1	1.60	2.26	3.62	.579	1
7	160	11	7		1	750	1345	555	4698.1	1.75	1.99	3.48	.589	1
7	164	29	6		1	815	1202	347	4175.35	1.6	2.15	3.44	.909	1
7	165	27	6		1	805	1320	515	4062.6	2.3	1.50	3.45	.657	1
7	165	28	6		1	830	1340	510	4142.6	2.4	1.59	3.82	.739	1
7	165	1	7		1	845	1500	615	4290.15	2.56	1.20	4.07	.651	1
7	167	27	6		1	743	1110	327	4007.9	2.0	1.78	3.56	1.03	1
7	167	28	6		1	829	1125	256	4125.1	2.4	1.73	4.15	1.42	1
7	167	29	6		1	740	1200	420	4160.2	1.8	1.70	3.06	.706	1
7	167	30	6		1	830	1205	335	4215.0	2.4	1.63	3.91	1.09	1
7	167	1	7		1	845	1120	235	4297.7	5.45	.68	3.73	1.44	1
7	167	4	7		1	805	1255	450	4424.0	1.91	2.35	4.49	.929	1

7	167	5	7		1	810	1215	405	4468.7	1.1	3.58	3.94	.964	1	
7	167	6	7		1	810	1310	500	4518.55	1.25	3.33	4.16	.833	1	
7	167	7	7		1	800	1245	445	4598.75	1.15	3.23	3.72	.782	1	
7	168	27	6		1	750	1115	325	4037.5	2.35	1.48	3.48	1.02	1	
7	168	29	6		1	740	1210	430	4162.0	1.75	1.71	2.99	.665	1	
7	168	1	7		1	837	1250	413	4262.4	2.31	1.70	3.93	.931	1	
7	168	4	7		1	810	1106	256	4433.8	1.4	2.86	4.00	1.37	1	
7	168	5	7		1	800	1310	510	4338			4.0	.774	1	
7	168	6	7		1	800	1345	545	4503.95	1.2	3.42	4.10	.714	1	
7	168	7	7		1	800	1240	440	4592.7	1.25	3.13	3.91	.838	1	
7	171	27	6		1	805	1320	515	4067.4	2.35	1.50	3.53	.671	1	
7	171	28	6		1	830	1340	510	4134.9	2.40	1.65	3.96	.766	1	
7	171	29	6		1	830	1400	530	4180.15	1.65		2.79	.508		
7	171	1	7		1	840	1500	620	4274.1	2.73	1.43	3.91	.617	1	
7	171	3	7		1	810	1410	600	4320.15	2.86	1.39	3.97	.661	1	
7	171	4	7		1	809	1425	616	4436.4	1.1		3.24	.517		
7	171	6	7		1	820	1420	600	4532.7	1.25	3.20	4.00	.667	1	
7	171	7	7		1	812	1500	648	4616.4	1.15		2.89	.426		
7	173	27	6		1	740	1215	435	3995.3	2.30	1.75	4.03	.879	1	
7	173	28	6		1	830	1145	315	4130.15	2.35	1.53	3.60	1.11	1	
7	173	12	7		1	740	1219	439	4712.25	2.05	1.87	3.83	.824	1	
7	174	27	6		1	805	1235	430	4047.3	2.6	1.40	3.64	.809	1	
7	174	28	6		1	840	1300	420	4145	2.4	1.58	3.79	.875	1	
7	174	30	6	1		827	1330	503		12.5	.23	2.88	.569	1	
7	174	3	7		1	850	1430	540	4410.2	1.60		4.07	.718		
7	174	4	7		1	820	1250	430	4447.25	.85	4.01	3.41	.757	1	
7	174	5	7		1	810	1450	640	4466.4	1.15	3.49	4.01	.602	1	
7	174	6	7		1	820	1430	610	4531.45	1.25	3.13	3.91	.634	1	
7	174	7	7		1	800	1215	415	4544.85	1.2	3.47	4.16	.980	1	
7	177	27	6		1	740	1215	435	3992.8	2.50	1.66	4.15	.905	1	
7	177	28	6		1	825	1052	227	4093.4	3.2	1.32	4.22	1.72	1	
7	177	29	6	1		730	1230	400	3853.1	12.5	.19	2.38	.594	1	
7	177	30	6		1	832	1200	328	4217.4	2.35	1.66	3.90	1.13	1	
7	177	1	7	1		800	1155	355	4070	12.5	.19	2.38	.606	1	
7	177	3	7		1	815	1307	452	4364.3	2.94	1.50	4.42	.907	1	
7	177	4	7		1	810	1250	440	4441.3	1.1	4.00	4.40	.943	1	
7	177	5	7		1	805	1410	605	4460.25	1.25	3.11	3.89	.639	1	
7	177	6	7		1	810	1430	620	4511.35	1.15	3.48	4.00	.632	1	
7	177	7	7		1	800	1215	415	4543.65	1.2	3.5	4.2	.988	1	
7	178	27	6		1	805	1320	515	4072.8	2.55	1.57	4.00	.763	1	
7	183	27	6		1	745	1100	315	4016.0	1.95	1.80	3.51	1.08	1	
7	183	28	6		1	825	1045	220	4100.15	3.25	1.12	3.64	1.56	1	
7	183	30	6		1	825	1200	335	4195.7	1.85	2.11	3.90	1.09	1	
7	183	1	7	1		1020	1200	140	4131.5	12.5	.19	2.38	1.43	1	
7	183	4	7		1	745	1220	435	4237.5			4.0	.873		
7	183	6	7		1	800	1115	315	4507.5	1.15	3.49	4.01	1.24	1	
7	183	7	7		1	755	1114	319	4541.35	1.15	3.53	4.06	1.22	1	
7	185	27	6		1	740	1145	405	4002.1	1.95	1.85	3.61	.883	1	
7	185	28	6		1	829	1125	256	4122.7	2.4	1.66	3.98	1.36	1	
7	185	29	6	1		758	1305	507	3883.1	12.5	.27	3.38	.660		
7	185	1	7	1		800	1152	352	4042.5	12.5	.16	2.0	.517	1	
7	185	5	7		1	805	1125	320	4457.4	1.15	3.28	3.77	1.13	1	
7	185	6	7		1	800	1345	545	4502.7	1.25	3.41	4.26	.741	1	
7	185	7	7		1	800	1240	440	4595.2	1.20	3.20	3.84	.823	1	
7	186	27	6		1	800	1230	430	4044.9	2.5	1.42	3.55	.789	1	
7	186	28	6	1		810	1310	500	3826.0	12.5	.19	2.38	.475	1	
7	186	29	6		1	815	1140	325	4178.45	1.55	2.30	3.57	1.04	1	
7	186	1	7		1	835	1107	232	4257.6	2.25	1.94	4.36	1.72	1	
7	186	3	7		1	810	1145	335	4337.5	2.31	2.12	4.89	1.37	1	
7	186	8	7		1	800	1335	535	4544.8	1.05	3.79	3.98	.713	1	
7	189A	27	6		1	745	1140	355	4010.15	2.0	1.78	3.56	.909	1	
7	189	28	6		1	825	1027	202	4082.4	2.2	1.65	3.63	1.79	1	
7	189	1	7		1	837	1250	413	4264.6	2.31	1.70	3.93	.933	1	
7	189	3	7	1		840	1325	445	4238.5	12.5	.17	2.13	.447	1	
7	189	4	7		1	730	1255	525	4418			4.0	.738	1	
7	189	5	7		1	800	1310	510	4320			4.0	.774	1	

7	189	6	7		1	800	1345	545	4505.15	1.2	3.46	4.15	.722		1
7	190	27	6		1	745	1110	325	4014.0	2.0	1.79	3.58	1.05		1
7	190	28	6		1	825	1027	202	4084.6	2.5	1.52	3.80	1.87		1
7	190	1	7	1		805	1300	455	4131.5	12.5	.17	2.13	.432		1
7	190	3	7	1		840	1325	445	4251	12.5	.20	2.50	.526		1
7	190	4	7		1	805	1415	610	4420.2	1.91		3.87	.627		
7	190	5	7		1	810	1410	600	4455.25	1.05	3.57	3.75	.625		1
7	191	27	6		1	743	1110	327	4006.0	1.95	1.80	3.51	1.02		1
7	191	28	6		1	825	1045	220	4096.6	3.25	1.23	4.00	1.71		1
7	191	29	6		1	740	1210	430	4152.3	2.2	1.61	3.54	.787		1
7	191	30	6		1	830	1200	330	4207.1	2.55	1.57	4.0	1.14		1
7	191	1	7		1	835	1130	255	4250.15	3.75	1.08	4.05	1.39		1
7	191	3	7		1	850	1320	430	4415.0	1.60	2.75	4.40	.978		1
7	191	4	7		1	740	1220	440	4230			4.0	.857		
7	191	5	7		1	805	1135	330	4451.2	.95	3.87	3.68	1.05		1
7	191	6	7		1	755	1100	305	4477.3	1.25	3.24	4.05	1.31		1
7	191	7	7		1	800	1240	440	4596.4	1.20	3.22	3.86	.828		1
7	192	27	6		1	805	1100	255	4017.9	2.0	1.79	3.58	1.23		1
7	192	28	6		1	830	1320	450	4140.15	2.45	1.60	3.92	.811		1
7	193	27	6		1	805	1320	515	4070.15	2.7	1.51	4.08	.777		1
7	193	28	6		1	830	1314	444	4132.5	2.4	1.71	4.10	.867		1
7	193	29	6		1	830	1400	530	4183.4	1.6		3.09	.562		
7	193	1	7		1	837	1500	623	4271.5	2.63	1.57	4.13	.647		1
7	193	3	7		1	810	1430	620	4323.1	2.58		3.76	.594		
7	193	4	7		1	810	1425	615	4437.5	1.1		3.20	.512		
7	193	6	7		1	815	1330	515	4528.55	1.25	3.04	3.80	.724		1
7	193	7	7		1	812	1500	648	4617.55	1.1		2.12	.311		
7	194	27	6		1	747	1100	313	4022.2	2.15	1.60	3.44	1.07		1
7	194	28	6		1	827	1113	246	4115.3	2.30	1.40	3.22	1.16		1
7	194	29	6		1	815	1202	347	4173.65	1.7	2.0	3.4	.899		1
7	194	30	6		1	825	1230	405	4193.8	1.75	2.16	3.78	.926		1
7	194	1	7		1	845	1445	600	4292.8	4.74	.91	4.31	.718		1
7	194	3	7		1	810	1430	620	4333.4	2.06		3.73	.590		
7	194	4	7		1	820	1340	520	4444.4	.95	4.04	3.84	.720		1
7	194	5	7		1	805	1505	700	4462.75	1.25	3.20	4.00	.571		1
7	194	6	7		1	810	1430	620	4513.65	1.2	3.45	4.14	.654		1
7	194	7	7		1	810	1500	650	4612.7	1.25		3.28	.480		
7	198	27	6		1	827	1130	303	4077.6	2.35	1.72	4.04	1.33		1
7	198	1	7		1	845	1500	615	4287.2	2.29	2.18	4.99	.798		1
7	198	3	7		1	810	1430	620	4331.1	2.26		4.00	.632		
7	198	4	7		1	820	1340	520	4443.4	1.0	4.04	4.04	.758		1
7	198	6	7		1	835	1440	605	4538.65	1.15	3.52	4.05	.665		1
7	198	7	7		1	805	1500	655	4604.95	1.15		3.08	.445		
7	198	8	7		1	807	1350	543	4565.3	.9	3.96	3.56	.623		1
7	199	27	6		1	830	1300	430	4080.15	2.25	1.72	3.87	.860		1
7	199	29	6		1	835	1400	525	4185.0	1.6		.308	.355		
7	199	1	7		1	840	1500	620	4276.8	2.98	1.32	3.94	.622		1
7	199	3	7		1	820	1430	610	4403.4	1.60		2.20	.357		
7	199	6	7		1	815	1530	715	4530.2	1.25	3.08	3.85	.531		1
7	199	7	7		1	812	1500	648	4613.95	1.25		3.37	.495		
7	202	29	6		1	830	1205	335	4181.8	1.6	2.37	3.79	1.05		1
7	202	30	6		1	826	1120	254	4202.3	2.3	1.82	4.19	1.44		1
7	202	3	7		1	815	1307	452	4367.5	2.16	1.81	3.91	.804		1
7	202	4	7		1	750	1255	505	4448.9	.90	3.97	3.57	.703		1
7	202	5	7		1	810	1210	400	4465.2	1.20	3.42	4.10	1.03		1
7	202	6	7		1	815	1240	425	4523.65	1.20	3.17	3.80	.861		1
7	202	7	7		1	810	1300	450	4610.2	1.25	3.07	3.84	.794		1
7	202	8	7		1	805	1330	525	4560.2	.9	4.24	3.82	.704		1
7	205	5	7		1	850	1440	550	4472.5	1.15	3.50	4.03	.690		1
7	205	12	7		1	740	1150	410	4705.6	2.10	1.90	3.99	.958		1

COPY OF LETTER FROM SCOTT WILSON KIRKPATRICK & PARTNERS

NJS/PAT/70126

15th September 1973

Dr. Michael C. Latham,
Cornell University,
Division of Nutritional Sciences,
Savage Hall,
Ithaca,
NEW YORK 14853,
U. S. A.

Dear Michael,

Thank you for your letter of 21st. August. I am sorry for the delay in replying, but I have at last completed the reduction of the field measurements and can now give you some details.

I enclose a list of subjects with the identification number and actual names of each person together with number of days work measured on each.

Unfortunately, I have no complete record of which workers were female - although I imagine this could be determined from the names of the individuals if one were familiar with local usage for names!

Yours sincerely,

Encs.

c.c. Clell Harral. ✓

SSB.
Kenya: black books

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:

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SSBasta:ap

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

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File Title	Barcode No.
Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
18 August, 1978	Letter	

Correspondents / Participants

To: Dr. Michael Latham

From: Samir Basta

Subject / Title

Draft Terms of Reference

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
Tonya Ceesay	15-Apr-15

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.

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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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.

too low sample!

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).

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Yes

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.

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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.)

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Pl. send copies!

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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.

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(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.

Good idea - can be done primarily with supervision. Discuss with Economist Kenya Division

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.

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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

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File Title	Barcode No.
Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
18 August, 1978	Letter	

Correspondents / Participants

To: Dr. Michael Latham

From: Samir Basta

Subject / Title

Draft Terms of Reference

Exception(s)

Personal Information

Additional Comments

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Tonya Ceesay	15-Apr-15

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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.

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.

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Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
18 August, 1978	Letter	

Correspondents / Participants

To: Dr. Michael Latham

From: Samir Basta

Subject / Title

Draft Terms of Reference

Exception(s)

Personal Information

Additional Comments

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Withdrawn by	Date
Tonya Ceesay	15-Apr-15

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please file in my Kenya dir

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

August 22, 1978

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

Dear Clell:

Dr. Samir Basta's letter of August 18 has reached me a few hours before leaving for Brazil.

I wanted to let you know that I approve of the terms of reference for Peter Hopcraft. I suggest one addition to these, namely "That he provide advice as necessary concerning the economic and policy implications of Study No. 4".

My letter of August 21 to you summarizes my reactions to your verbal comments about the concerns that you, Samir and I share concerning Study No. 1.

As I indicate I do not believe that we should abandon Study 1 at the two sites near Nyeri now. I believe we should continue with it, at the same time realizing that the results may not meet our original objectives for this study. But a very great deal of effort on all our parts, and many thousands of dollars, have been invested in the study. It is now more than half over. It is almost certain that we will reap considerable dividends from this study even if it does not meet the original goals. We have clinical and other data on some 150 persons, and have base line productivity on about half of these. We cannot predict (or prevent) dropouts but should get final productivity data on a substantial number.

I do agree that it may well be necessary to do another productivity study, to increase the numbers. I agree fully with Samir that serious thought be used to finding another location not in the Nyeri-Karatina area. Kwale District would offer many advantages--cooperation seems good, the labor force is quite stable, only men are employed, and we know a lot about health and nutritional conditions. The disadvantage is that anemia and parasitic infections complicate the under-nutrition (but this could be controlled for).

The attractiveness of using estate agricultural workers is clear and I will suggest to our staff in Kenya and to Peter Hopcraft that possible sites be looked into soon. But this may be an impractical suggestion because of the time needed to organize such a new study, to learn about measurable tasks and to find work that was both measurable and similar to the tasks done by peasant farmers. In my view ditch digging on the roads is more similar to a peasant's agricultural work than is cutting sugar cane on an estate.

I do not feel that the Nyeri situation is totally unrepresentative of most of Kenya. Of course in a country with diverse ecologies and different tribes no

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I do not feel that the Nyeri situation is totally unrepresentative of most of Kenya. Of course in a country with diverse ecologies and different tribes no

one area is fully representative of another. But I should point out that the male workers we are seeing there are as, or more, undernourished (judged by weight for height etc.) than workers in Kwale, presumably because the poorest people in these highland districts are seeking road work, and the workers, because they are male and female, old and young, are perhaps more representative of agricultural peasant workers than are adult males employed by RAR in other districts.

I am grateful to the Bank's offer first to provide the further use of Mark Sharrock and secondly some $6000 in additional funding for an extension of Study 1.

I propose that (a) we continue with the present study, (b) we look into the feasibility and alternatives for an alternate site for a productivity study to add numbers, and reliability, and to help ensure meaningful results, and (c) that a decision be made about the locale, timing and design of the new study when we have heard from Mark Sharrock and June Wolgemuth in late September or early October.

If a new study is undertaken I would favor Mark Sharrock doing the base line productivity measures in November-December 1978 during the same visit as he does the final productivity studies on the Karatina Roads. The final productivity measurements would then be made somewhere between March 1 and June 30, 1979 depending on how long we could keep the workers. The budget implications of these changes will have to be reviewed with you.

I am indeed grateful to Samir Basta for his professional guidance and to you for your continued support of this project.

I do believe that useful results will be obtained.

Sincerely yours,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

cc: Dr. S. Basta ✓

File
Kenya
file

Sami Barta

Note para 11-12. Is there any point in continuing w/ the cold snack since it is more expensive, less nutritious & less well liked. Eliminate it & get on w/ some more serious alternatives.

CG

See para 11-12. Cable Basta

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.

There is no point in the cold snack continuing as ugali is both cheaper & more nutritious

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 team 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.

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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~~ this 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~~ consider, 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

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File Title	Barcode No.
Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
18 August, 1978	Letter	

Correspondents / Participants

To: Dr. Michael Latham

From: Samir Basta

Subject / Title

Draft Terms of Reference

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
Tonya Ceesay	15-Apr-15

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.

Bobby's.

BEACH
JARDINIA HOTEL
MOMBASA
82225
2021

BERTIL E. NILSSON

TEAM - LEADER

IBRD/MOW TECHNOLOGY UNIT

IBRD P.O. BOX 30577
MOW P.O. BOX 30260
NAIROBI, KENYA

TELEPHONE.
OFF. 26441 EXT 463
HOME 21460

Restaurant 1:30 Sunday, 9th
Alan Bobby's.

Nairobi July 4, 1978

Dear Dr Basta,

I trust you have received your proposed itinerary from Dr Latham and I'll just mention the transport arrangements:

1. Please ring Mrs Monteiro of the RMEA office tel. 24391 Wednesday morning and confirm that you want the train ticket for Mombasa Thursday night. The reservation is confirmed but the RMEA office will not pay the ticket until you have confirmed your trip as train tickets are not refundable.

2. A MoW car will pick you up Thursday morning for the trip to Karatina. The driver will be instructed to ask for you at the reception desk of the Norfolk hotel at 8.15 A.M.

I hope you will have a pleasant stay in Kenya

Yours sincerely

Bertil E. Nilsson

c.c. Mr Osano, executive off. RARP

Haile Sail 10 letter.

Study 1 - June's Spring 1978

HEALTH AND NUTRITION QUESTIONNAIRE

ame:_____ ID#: Road Site# - Personal#

Address:_____ __ __ __ __ __ __

Village:_____ Date of Survey:_____

Age:_____** Does not know:_____ Birth Date:_____ Does not kn__

Sex: M / F **Age estimated___; Significant event associated with birth:_____

1. How long does it take you to walk to the road site each day?

a. <1/2 hr.___ d. >2-3 hrs.___
b. >1/2 hr.___ e. other:_____
c. >1-2 hr.___ f. arrives by other means:_____

2. What is the distance from your home to the road site?

a. <1/2 mile/km.___ d. >2-3 miles/km.___
b. >1/2 mile/km.___ e. >3-4 miles/km.___
c. >1-2 mile/km.___ f. >4-5 miles/km.___
g.) other:_____

3. When did you start to work on the road site?_____

a. eeks worked on the road site:_____

b. Does not know when she/he started:_____

4. What was your employment before you started to work on the road

a. Farmer:___ e. Carpenter:___
b. Factory Worker:___ f. Student:___
c. Driver:___ g. Unemployed:___
d. Hired laborer:___ h. Other:_____

5. What work do you do when you return to you home each day after completing your task on this road?

a. Cultivates the shambe:___ d. Relaxes:___
b. Cooks or carries water:___ e. Other:_____
c. Grazes the cattle:___

If she/he works on the shamba, ask,

6. Who owns the shamba on which you work?

a. Respondent:___ e. Grandparent:___
b. Father:___ f. Uncle:___
c. Husband:___ g. Employer:___
d. Mother:___ h. Other:_____

7. How large is the shamba that you work on?

a. <0.5 acres/ha:___ e.>3-4 acres/ha:___ i.> 7-8 acres/ha:___
f.>4-5 acres/ha:___ j.>8-9 acres/ha:___
b. >0.5-1 acres/ha:___ g.>5-6 acres/ha:___ k.>9-10acres/ha:___
c. >1-2 acres/ha:___ h.>6-7 acres/ha:___ l. >10 acres/ha:___
d. >2-3 acres/ha:___ # _____

8. Do you work for wages on any other job? Yes / No

If yes, what do you do?_____

How much do you earn? _____

9. How many people live in your household this month?_____

What is their relationship tp you?

a. wife(s):___ d. father:___ g. grandparent(s):___
b. Children:___ e.sister(s):___ h. uncle:___ i. aunt:___
c. mother:___ f. brother(s):___ i. other:_____

10. Do you grow or do you purchase most of the food that you eat?
    a. Purchases:___ b. Grows:___

11. What foods does your family grow? What nonfood crops does your family grow?

    1._____ 1._____
    2._____ 2._____
    3._____ 3._____
    4._____ 4._____
    5._____ 5._____

12. What foods does your family purchase? 1._____ 2._____
    3._____ 4. _____ 5. ._____

13. Have you been able to buy any foods or beverages that you did not eat or drink before you started working on the road site? Yes / No; If yes, What foods and beverages are you now buying?

    1._____ 3._____
    2._____ 4._____
    5._____

14. Have you been eating more or less food since you started to work on the road site? More / Less; If more, what do you eat more of? 1._____ 2._____ 3._____
    4._____ 5._____

15. Do any other members of your family work on the road site? Yes / No; If yes, please name them.

	Relationship to respondent
1._____	_____
2._____	_____
3._____	_____
4._____	_____
5._____	_____

To be asked of the women:

16. How many children have you had during your lifetime?_____

17. How many of your children died before they reached the age of 5 years? _____

18. How many of your children live with you now? _____

19. How old is your youngest child? _____

If applicable, ask

20. Are you breasting a child? Yes/ No

21. Are you heavy (pregnant)? Yes / No Trimester: 1 2 3

22. When did you have your last menses? _____
    Does not remember:_____ Does not reply:_____

23. Have your taken any worm medicine in the last year? Yes / No

MEDICAL HISTORY

1. Present complaints: _____

_____

_____

2. Illnesses in the past 12 months: _____

_____

_____

3. Serious illnesses in the past: _____

_____

_____

Clinical Examination

Code: Negative = "0"; Positive = "+".

1. EYES — ALL NEG. ___
   a. xerosis conjunctivae ___
   b. conjunctival wrinkling ___
   c. conjunctival pigmentation ___
   d. Bitot's spots ___
   e. advanced xerophthalmia ___
   f. corneal scarring ___
   g. conjunctivitis ___
   h. signs of trachoma ___
   i. cataract ___
   j. pallor of lower lid conjunctivae ___
   k. other (specify): _____

2. EARS — ALL NEG. ___
   a. discharge ___
   b. external inflamation ___
   c. other (specify): _____

3. MOUTH — ALL NEG. ___
   a. angular stomatitis ___
   b. angular scars ___
   c. cheilosis of the lips ___
   d. spongy bleeding gums ___
   e. number of teeth decayed ___
   f. number of teeth missing ___
   g. number of teeth filled ___
   h. mottling of teeth ___
   i. gingivitis ___
   j. pallor of tongue ___
   k. other(specify): _____

4. GLANDS — ALL NEG. ___
   a. thyroid (goitre) - Grade: 0 1 2 3
   b. parotid enlargement ___
   c. gynecomastia ___
   d. other (specify): _____

5. SKIN — ALL NEG. ___
   a. pellagrous ___
   b. follicular hyperkeratosis ___
   c. crazy pavement or mosaic ___
   d. scabies ___
   e. petechial or subcutaneous hemorrhage ___
   f. fungal infection ___

g. scars
h. tribal scars
i. rash
j. other (specify):_____

_____

6. NAILS ALL NEG. ____
a. pallor of bed ____
b. koilonychia ____
c. other:_____

_____

7. CVS ALL NEG. ____
a. heart murmur ____
b. dyspnea ____
c. cardiac enlargement ____
d. edema ____
e. arythmia ____
f. other(specify):_____

_____

8. LUNGS NEG. ____
a. abnormalities:_____

_____

_____

9. ABDOMEN ALL NEG. ____
a. splenomegaly ____
b. hepatomegaly ____
c. hernias ____
d. ascites ____
e. other (specify):_____

_____

10. SKELETON ALL NEG. ____
a. knock knees ____
b. bow legs ____
c. other deformities:_____

_____

11. BLOOD PRESSURE

systolic: _____mmHg

diastolic:_____mmHg

12. ANY OTHER CONDITIONS:_____

_____

_____

13. TREATMENTS:_____

_____

_____

LABORATORY RESULTS

Blood:	1	2	3
Date			
Hb(g/100ml)			
PCV(%)			
MCHC			
STOOLS:			
Date			
Sm			

	1	2	3
Date			
Malaria:			
S			
A			
H			
E			
Tr			
T			

ANTHROPOMETRIC MEASUREMENTS ID# _____ (P/L)

I

Clothing: Date: _____

Trousers	___	Dress	___
Shirt	___	Skirt	___
Shorts	___	Blouse	___
Sweater	___	Jumper	___
Belt(L/C)	___	Other	___

		% Standard
WEIGHT:	_____kg.	_____
HEIGHT:	_____cm	_____
ARM CIRCUM:	_____mm	_____
TRICEPS SNFD:	_____CM	_____

CHEST CIRCUMFERENCE:

inspir._____cm
exspir._____cm

II

Clothing: Date: _____

Trousers	___	Dress	___
Shirt	___	Skirt	___
Shorts	___	Blouse	___
Sweater	___	Jumper	___
Belt(L/C)	___	Other	___

		% Standard
Weight:	_____kg	
Height:	_____cm	_____
Arm Circum:	_____cm	_____
Triceps SNFD:	_____mm	_____

Chest Circumference:

inspir._____cm
exspir._____cm

III

Clothing: Date: _____

Trousers	___	Dress	___
Shirt	___	Skirt	___
Shorts	___	Blouse	___
Sweater	___	Jumper	___
Belt(H/C)	___	Other	___

		% Standard
Weight:	_____KG.	_____
Height:	_____cm	
Arm Circum:	_____cm	_____
Triceps SNFD:	_____mm	_____

Chest Circumference:

inspir._____cm
exspir._____cm

IV

Clothing: Date: _____

Trousers	___	Dress	___
Shirt	___	Skirt	___
Shorts	___	Blouse	___
Sweater	___	Jumper	___
Belt(L/C)	___	Other	___

		% Stand.
Weight:	_____kg	_____
Height:	_____cm	
Arm Circum:	_____cm	_____
Triceps SNFD:	_____mm	_____

Chest Circumference:

inspir._____cm
exspir._____cm

DATA COLLECTED:

24-Hour Recall: #1___, 2___, 3____
Home Weighing: 1___, 2___, 3____
Stool Samples: 1___, 2___, 3____
Blood Samples: 1___, 2___, 3____
Work Productivity: 1___, 2___, 3___

Worker Feeding Study - Kwale Summer 1978

No._____ Name_____ Date_____

birthdate_____ age_____ comments_____

roadsite_____ village_____

tribe_____ religion_____

ANTHROPOMETRY (date)

weight, kg ( )_____ ( )_____ ( )_____

arm c, cm ( )_____ ( )_____ ( )_____

skinfl, mm ( )_____ ( )_____ ( )_____

height, cm ( )_____ chest, cm expir _____insp._____

MEDICAL HISTORY

Present complaints_____

_____

_____

Illnesses in last 12 months_____

_____

_____

Serious illnesses in past_____

_____

_____

Surgical operations_____

_____

CLINICAL EXAM

EYES xerosis conjunctivae + - corneal scars + -

conjunctival wrinkling + - conjunctivitis + -

Bitot's spots + - signs of trachoma + -

advanced xerophthalmia + - cataract + -

pallor of conjunctivae of lower eye lid + -

other_____

EARS discharging + - external inflamation + -

other_____

 no._____ name_____

MOUTH angular stomatitis + - pallor of tongue + -

angular scars + - no. teeth decayed _____

cheilosis of lips + - no. teeth missing _____

spongy bleeding gums + - no. teeth filled _____

gingivitis + - DMF index _____

mottling of teeth 0 1 2 3

other_____

GLANDS

thyroid goitre 0 1 2 3 parotid enlargement + - gynecomastia + -

other_____

SKIN Pellagrous dermatosis + - petech./subcut. hemor. + -

follicular hyperkeratos. + - fungal infections + -

crazy pavement/mosaic + - scars + -

scabies + - rash + -

other_____

NAILS pallor of bed + - koilonychia + - other_____

CVS heart murmurs + - cardiac enlargement + -

dyspnea + - edema + -

LUNGS abnormalities_____

ABDOMEN splenomegaly 0 1 2 3 hernias + -

hepatomegaly 0 1 2 3 ascites + -

other_____

SKELETON knock knees + - bowed legs + -

other deformities_____

BLOOD PRESSURE (systolic/diastolic) _____

ANY OTHER CONDITIONS_____

_____

_____

TREATMENT_____

_____

_____

_____

BLOOD (date)

hemoglobin, g%	(___)_____	(___)_____	(___)_____
hematocrit, %	(___)_____	(___)_____	(___)_____
malaria slide	(___)_____	(___)_____	(___)_____

URINE (date)

S. hematobium	(___)_____	(___)_____	(___)_____
other	(___)_____	(___)_____	(___)_____

STOOLS (date)	(____)	(____)	(____)
hookworms	_____	_____	_____
T. trichiura	_____	_____	_____
A. lumbricoides	_____	_____	_____
Entamoeba spp.	_____	_____	_____
other(specify)	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

8 July 1977

PRESENT STATUS OF KENYA PROJECT

KARATINA AREA (Highlands)

IGOKA ROAD This was a trial road for testing methodology, training field workers, and for a trial of different feeding regimes for the proposed worker productivity - feeding study. Clinical, anthropometric, dietary and parasitological examinations done in Feb 1978 for base-line by Dr. Latham and team. Andrew Hall and June Wolgemuth then followed the ~~50~~ approximately 50 workers & until June 1978. Two different feeding regimes tried. Work completed in June 1978.

Roads 12 and 7

These 2 roads are for definitive study on effects of calorie supplement on worker productivity. Mark Sharrock began doing base-line work productivity measurements first on

road 12 and then road 7 in early June and plans to complete this by July 15. Dr. Latham, June Wolgemuth and Andrew Hall did clinical, anthroponetic, parasitological & hematological examinations on about 120 road workers (male + female) on these two roads between June 12 and July 2 1978. Mark Sharrock appears to be able to get productivity data on 70 of these subjects each for approximately 8 days of work. Ditching and sloping is the only task he believes at present is quantifiable and there is a limited amount of this task work, his time is short, and the job is slow. Therefore some 50 or more workers will not be measured for productivity.

Feeding of workers on these roads will begin on about July 20 after base line dietary information is collected. On each road about half the workers will be the study group receiving ~~about 700 Cals~~ 500 - 700 calories more than the control group.

a bonus (incentive) of Shs 100/= has been offered to each worker who completes the study and who misses less than 5 days of work and feeding. Final productivity measurements will be undertaken by Mark Sharrock beginning about early November 1978.

KUALE STUDIES (ANAEMIA + FEEDING)

ROAD 35. This road is being used for a short (2-3 week) feeding trial. Modified medical examinations ~~of~~ (not including stools or haematology) were carried out in early July. Lane Latham is responsible for the feeding trial. A cold (not requiring cooking) mash or meal is being fed for ~~the~~ a short period (peanuts, bread and margarine) and then a hot meal (ugali (maize), mchicha (green leafy vegetable) and beans for a short period. Each person meal will cost less than Kenyan Shs. 1/= and the hot meal

may be as cheap as 60 kenyan cents. There are about 45 men participating. Lane is assisted by 2 kenyan field workers. The acceptability of these feeding ~~The~~ regimes is being assessed. On the basis of the findings a decision will be made for the long term feeding on Road 7

Quarry Site and Road 3

These two sites will be used to test the effectiveness of providing $FeSO_4$. The total number of men will be about 110. Clinical, hematological, parasitological and urinary examinations for the base line began on July 5 1978 and will be completed by July 15. Hb and haematocrits are being determined by Terry Elliott at the Coast General Hospital. Andrew Hall is examining stools (direct smear) and urines (for Schistosomiasis) on site. Duplicate stools ~~and~~ are collected for detailed qualitative examination in Kwale.

Starting about July 22 the 110 workers will be divided into 2 groups each with similar Haematological findings. One group will receive $FeSO_4$ 600 mg. daily and the second group will receive a placebo daily for 10-12 weeks. A sub-study on $FeSO_4$ + Ascorbic acid will be conducted. ~~The effect~~ At the end of the period Hb and Ht. will be determined to see the effect of the two treatment. Dietary information will be collected.

Road No 3

This road will be used to determine (a) the feasibility of long term feeding and (b) the effectiveness of an iron rich food supplement in comparison with an iron poor (or neutral) supplement on Hb and Ht. The clinical and other examinations identical to the Quarry site and Road 3 will be done as the base-line. Clinical exams will be completed by

July 20 1978. The feeding will be delayed until after Ramadhan which begins in ~~the~~ the first week of August. The foods selected will be based on the findings from the preliminary study on Road 35.

Personnel.

~~From~~ after the departure of Dr. M. Latham and Dr. R. Latham on July 23 the ~~following responsi~~ responsibility will be divided as follows:

June Wolgemuth will remain at Karatina until January 1979 and be responsible for the ~~studies~~ feeding studies on Roads 7 and 12.

Terry Elliott will remain in Kwale until January 1979 and will take responsibility for the anemia studies on Roads 3, ~~the~~ Quarry site, and Road 7 in Kwale District.

Andrew Hall will take all responsibility for parasitological work at both Karatina and Kwale

and hematological work at Kwale.

Mark Shamsuk is expected back in November 1978 & do the final productivity measurements & take responsibility for these.

FUTURE PLANS.

Dr. M. Latham, Dr. L. Latham and Dr. D. Crompton will come to Kenya on or about Jan 3 1979. The Lathams will remain for 10-12 weeks.

In January examinations will be done on the 900 or so children in Study 4 (Ascaris project)

In February on three new road sites in Kwale three different intervention studies will begin as follows (a) An investigation of the effects of Schistosomiasis treatment on anaemia (b) An investigation of the effects on anaemia of malaria prophylaxis and (c) An investigation of the effect of deworming and hookworm elimination on anaemia.

June Wolgemuth and Andrew

'ull will move ther residence from Karatina to Kwale, + will follow up ther studies. The Latham's will return in May - June 1979 for final examinations on these sites.

In March 1979 cross sectional examinations will be made at 2 RAR sites in a new ecological zone (probably Western +/or Nyanza Provice) and in June 1979 at in a second ecological zone (two arid districts).

OTHER INFORMATION

TRANSPORT. This is a continual problem. The MOW has made available a landrover for use by the project in Karatina, but sometimes it is also required for MOW use. ~~They to~~ The MOW has not been able to provide transport for the team in Kwale now for Mr. Sharrock. As a result unanticipated and very high expenditures have been made for the hire of vehicles. The situation will be partly, but not completely resolved when the project receives the World Bank Range Rover on July 10 1978.

LABS. Detailed parasitology exams are carried out by Andrew Hale at the Veterinary Research Labs at Karatina and in Nairobi (Kabete) at the International Laboratory for Research on Animal Diseases (ILRAD). Direct examination of specimens is carried out in the field in Kwale. Hematology is done at the Karatina Lab, and for Kwale Jerry Elliott

uses the Pathology Lab at the Coast General Hospital (the Government Hospital for Coast Province).

BUDGET. At this stage it is difficult to determine whether the funding allocated will be adequate, but there is concern about the high unanticipated costs for transport (over $2000.00 so far without the separate cost of Mark Sharrock). The costs of feeding more workers than we have productivity data on, is also an unanticipated cost. At the suggestion of Mark Sharrock and June Wolgemuth we have offered a monetary bonus of Sh. 100/= to each subject who completes the study period and misses fewer than 5 days of work or feeding. The cost of this is unknown + depends on absenteeism. This expenditure was not foreseen, and may be the subject of a separate letter to Mr. Hamal. The MOH would not themselves pay this cost but authorised us to use this incentive.

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An Alliance Hotel associated with
Brunners Hotel Nairobi
Castle Hotel Mombasa
Jacaranda Hotel Nairobi
Naro Moru River Lodge

10th July, 1978

TO WHOM IT MAY CONCERN

This is to certify that Mr. Basta stayed as a guest at Jadini Beach Hotel although he had made a reservation at Serena Beach Hotel.

Efforts were made to cancel the reservation at Serena Beach Hotel but the telephones at Serena were apparently out of order.

Therefore, Mr. Basta should not be held responsible for failure to cancel the reservation in time.

Thanking you.

Yours faithfully,

D M Kivuvani
ASSISTANT AND PERSONNEL MANAGER

DMK/pw

May 26, 1978

Preliminary Draft

Inception Report
for
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433

KENYA: HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDIES

Prepared by:

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Professor of International Nutrition and Principal Investigator

and

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Postdoctoral Research Associate and Co-Investigator

from

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Introduction

This is a preliminary inception report on the World Bank Research Project No. 671-73 entitled "Kenya: Health, Nutrition and Worker Productivity Studies". The present project designed to last three years grew out of work conducted in Kenya from 1975 to 1977. The overall project is receiving major financial support also from the British Overseas Development Ministry, from Cornell University and from Cambridge University. Imperial Chemical Industries in Britain have provided the anthelminthic Levamisole free, and have given some support to Dr. David Crompton's laboratory in Cambridge.

It should be noted that although the project was to start on January 1, 1978 the written letter of appointment for this project was dated April 7, 1978, and so the first funds were not available until mid April 1978, less than two months prior to the writing of this report. Agreement with the British Overseas Development Ministry (ODM) was reached earlier in the year but the first instalment of funds was not received by Cornell until March 1978 (A £1000.00 advance in January 1978 had been received.). ODM is providing support for Study No. 1 and the World Bank for Studies 2, 3 and 4.

The previous work in Kenya had consisted of two parts, namely (a) a study of nutrition and worker productivity, and (b) an investigation of the effects of roundworm infection on nutrition and health of children. In the first study an investigation was made of health and nutritional status of workers involved in the Kenya Rural Access Roads Program of the Ministry of Works. Poor nutritional status due to low calorie intakes and anemia due to poor diets and parasitic diseases were associated with low productivity. The studies were conducted in Nyeri and Kwale Districts.

The second study in Machakos District was conducted in collaboration with the Medical Research Centre based in Nairobi. It involved the examination of children in two villages, and a detailed determination of the effects of roundworm infection on growth, health and nutritional status. These two studies will be referred to later, and reports on them have been issued as IBRD Technical Memorandum No. 26 (1977) and Working Paper No. 271 (Sept. 1977) respectively.

The detailed proposals for the present three year project are contained in "Kenya: Health, Nutrition and Worker Productivity Studies", Proposal to the World Bank Research Committee November 16, 1977.

Staff Involved

Investigators

Principal Investigator - Dr. Michael C. Latham, Professor of International Nutrition, Cornell University

Co-Investigator - Dr. David Crompton, Senior Lecturer in Parasitology, Cambridge University, and Adjunct Associate Professor, Cornell University

Co-Investigator - Dr. Lani Stephenson (Latham), Postdoctoral Research Associate, Cornell University

Co-Investigator (Ascaris Study only) - Dr. A. A. Jansen, Director Nutrition Section of Medical Research Centre, Nairobi

Graduate Research Assistants

Ms. June Wolgemuth - Nutritionist from Cornell University

Mr. Andrew Hall - Parasitologist, Cambridge University

Mr. Terry Elliott - Nutritionist, Cornell University

Field Workers

Mr. Mutinda Munyao

Mr. Kiio Mwilu

Mr. Josephat Wambua

Ms. Esther Ndunda

Ms. Rose Nzuki

Mr. George Matheka

Ms. Ruth Musau

Mr. Samuel Mulinge

Mr. Isaac Muena

Mr. Charles Kaboi

Consultants

Mr. Mark Sharrock - Work Study Engineer

Mr. Andrew Chesher - Statistician (Birmingham University)

Dr. Peter Hopcraft - Economist (Institute for Development Studies, University of Nairobi)

IBRD Staff

Mr. Clell Harral - Transportation

Dr. Samir Basta - Nutrition

Nutrition and Worker Productivity Study

Introduction

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. 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.

(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.

A report of this work is available as IBRD Technical Memorandum No. 26, May 1977 entitled "The relationship of nutrition and health to worker productivity in Kenya" under the general heading "World Bank Study on the Substitution of Labor and Equipment in Civil Construction".

On the basis of the findings in this short preliminary study it was decided that further investigations were desirable. These, it was proposed, should consist of three parts as follows:

Study No. 1 An evaluation of health/nutrition effects on the productivity of casual laborers in rural civil works. In this study the effects of an intervention with calories on work output will be determined.

Study No. 2 An evaluation of practical interventions to improve health and worker productivity. In a series of sub-studies an evaluation will be undertaken of alternative methods for feeding workers; of the routine provision of iron and calorie rich foods to road workers; of the provision of medicinal iron; and of the feasibility of controlling certain parasitic infections. In all these studies the prevalence of parasitic diseases and their relation to anemia will be studied.

Study No. 3 A study of health and nutritional status in two new ecological areas where rural access roads are being constructed.

(Note - Study No. 4 is the roundworm study described later.)

Present Status of Nutrition and Worker Productivity Study

The proposed time table for work in Kenya calls for Study No. 1 and Study No. 4 to be initiated in January 1978. A part of Study No. 2 will be begun in June-July 1978, and the remainder of Study No. 2 and all of Study No. 3 will be initiated in early 1979.

This part of the report therefore deals only with Study No. 1. The main objective of this study is to determine the effects on worker output or productivity of providing extra calories to workers at a site where undernutrition appears to be prevalent, and where parasitic infections and anemia are less prevalent or can be easily controlled. The work in 1976 in Kenya suggested that Nyeri met these criteria. On two road sites (Ndunyu and Kihuyu) 38% of 102 road workers had a weight for height below 85% of the standard; anemia and parasitic infections were uncommon. In Kwale District, of 179 men examined, a rather similar percentage (41%) had low weight for height but in contrast to Nyeri anemia was common (34% had hemoglobin below 13.0 grams/100 ml.) and parasitic infections very common (66% had hookworm, 45% Trichuris, and 23% Ascaris).

It was therefore decided that a highland area such as Nyeri District would be most suitable for Study No. 1.

Meetings with Mr. John Simpson (in charge of Rural Access Roads) and Mr. B. Nilsson (IBRD in Nairobi) were held in January 1978. Agreement was reached that Nyeri or Muranga Districts would be suitable for Study No. 1. A decision was to be left to the Investigators in consultation with Mr. Michael Knowles, Engineer in Charge of Rural Access Roads for these districts.

The Investigators had decided that it was desirable to select first

a "preliminary" road site. On this site the methodology to be used would be thoroughly tested, field workers would be trained, and a feasibility study would be undertaken. A second road site would then be selected for the definitive study. At a meeting with Mr. Knowles in the Karatina Rural Access Roads headquarters camp, alternative sites were discussed. A decision was reached that Road No. 55 at Igoka (near Makurweini) in Nyeri District would be used as the preliminary road site. A road site where work was planned to begin in April/May 1978 in Muranga District was chosen for the definitive study. (This has now had to be changed due to difficulties of obtaining adequate numbers of workers at this site.)

In February 1978 a 10 foot by 10 foot corrugated iron hut was set up at Igoka for use by us as a clinic and field study examination room. A landrover was provided by the Ministry of Works for the project. Two field workers were recruited from among some 20 applicants.

Examinations of all workers at the Igoka road site were then conducted over a period of 3 weeks. Clinical, medical and nutritional status examinations were conducted by Dr. Latham, anthropometric examinations were performed by Ms. Wolgemuth who also obtained relevant social information on each worker, and stools were collected from each worker by Mr. Hall for later examination by him at the International Laboratory for Research on Animal Diseases in Nairobi.

The results of these examinations have only partly been analyzed. Table 1 shows the findings in terms of the weight for height of these workers. From this it can be seen that 73.5% of men were below 85% and 57.5% were below 80% of standard weight for height. 85% is the cut off point used in the previous study. Persons below this were considered

Table 1

Weight for height findings for male road workers at Igoka site (No. 55)

% weight for height	Number	%
Above 95	2	5
90 - 94	1	2.5
85 - 89	8	19
80 - 84	7	16
75 - 79	18	40
70 - 74	4	10
65 - 69	3	7.5
Total	43	100

to have below optimum calorie reserves, or to have an indication of undernutrition. These data indicate that undernutrition is a problem in a substantial percentage of men (and women). If similar findings occur in the definitive road site this would more than satisfy one of the needed criteria for an intervention study.

The clinical examination showed a picture of a population who have relatively little access to medical treatment and who suffer from a variety of illnesses notably skin infections, respiratory conditions, hypertension, hernias and so on. The final report will provide details of these. Simple treatment was provided to all those requiring it and some were referred to hospital for further treatment.

The results of the stool examinations are shown in Table 2. This indicates that intestinal parasites are fairly prevalent. The rates of infection are higher than was found in 1976, almost certainly because in 1976 a commercial laboratory was used, and a less thorough and precise examination of the stools was performed. Most of these parasitic infections are quite easy to treat. Appropriate anthelminthic drugs were supplied, and a re-examination of the stools performed to make certain that the workers had been freed of parasites. Results of the second stool examination are not available.

As a result of the preliminary examination of the men, Dr. Latham made the following recommendations to the Engineer in charge concerning conditions for the definitive road site:

(a) Men should be recruited, not women, because a mixed group would create problems for the study (women may be or become pregnant which would effect weight, continuation of work, and calorie needs. Also if both men and women are used then two separate groups would have to be used in the analysis).

Table 2

Infections with intestinal parasites from stool examinations (Igoka road workers)

	Number	Ascaris	Hookworm	Cysts	Taenia	Trichuris	Strongyloides
Males	39	12 (31%)	13 (33%)	8 (20%)	3 (8%)	1 (3%)	1 (3%)
Females	20	14 (70%)	9 (45%)	11 (55%)	0	0	0
Total	59	26 (44%)	22 (37%)	19 (32%)	3 (5%)	1 (1.5%)	1 (1.5%)

Interesting difference! (Women do more "dirty" work?!)

Number of workers with 0 infection = 19 (32%)

Number of workers with 1 infection = 16 (27%)

Number of workers with 2 infection = 16 (27%)

Number of workers with 3 infection = 8 (13.5%)

(b) Workers should be 18 years of age or older. Some workers at Igoka were well below this age. Because they are still growing this effects their nutrient needs and their weight.

(c) No substitution of one worker for another should be allowed. At Igoka it was found that on occasions a male worker unable to work for a day or two might send his wife, son or some other relative to substitute for him. This substitution would obviously create problems in a calorie supplementation program.

In the period March to May 1978 Ms. Wolgemuth and Mr. Hall (having taken up residence in Karatina) worked full time on Study 1 (with the exception of a short period when Mr. Hall went to Machakos District to assist with Study 4).

During this period the following activities have been undertaken:

(a) New workers have been enrolled and all examinations except the clinical examination performed on them.

(b) Dietary information on each worker was obtained using a 24 hour recall. Results?

(c) On a sub-sample of workers dietary information was collected using the weighing method in the household. Results?

(d) Different methods of providing approximately 700 extra calories per day to a "study" group than to a control group have been tried. The feasibility of each method is being carefully assessed, the acceptance by the workers assessed, and the costs determined.

(e) Weights of men are determined prior to and after each period of dietary intervention.

The preliminary results of these activities will be reviewed by Dr. Latham with the staff in June 1978. On the basis of the findings

and this review a decision will be made about the protocol to be followed at the definitive road site.

In May 1978 Mr. Mark Sharrock, the work study engineer, will arrive in Kenya. He will immediately begin his task of developing suitable work output measures first at the Igoka or some other road site. He will also train one or more field workers. In June 1978 Dr. Latham and Dr. Stephenson (Latham) will arrive in Kenya to work on the project. They will be accompanied by Mr. Terry Elliott who will be involved mainly with the anemia studies proposed for Kwale District.

In June or July, at the definitive road site Dr. Latham will conduct physical, clinical and nutritional examinations of the new men, Ms. Wolgemuth will get social information and do anthropometric measurements, and Mr. Hall will do stool and haematological examinations. Over a period of time Mr. Sharrock will do work output studies on each man.

When these data have been obtained (probably in July 1978) the calorie intervention will begin. Advice from Mr. Chesher will be used to assist with the assignment of men to the "study" and "control" groups. Any men having serious medical problems, or other conditions which might markedly effect work output, will be eliminated from the study. Men with parasites will be treated, and stools re-examined. Men will receive treatment when appropriate and needed.

In June or July work will start probably in Kwale District on Study No. 2. Dr. Latham, Dr. Stephenson, Mr. Hall and Mr. Elliott will all be involved in this. Ms. Wolgemuth and Mr. Sharrock will remain in Nyeri District involved in Study No. 1. In Kwale District, Dr. Stephenson will play a major role in the evaluation of different types of mid-work day snacks and of appropriate delivery systems. Mr. Elliott will be involved

mainly on the study of the routine provision of iron to workers, and the effects of this on anemia. Mr. Hall will do parasitic examinations on stool and urine, and will do haematological examinations. Dr. Latham will do clinical, medical and nutritional status examinations on all road workers enrolled in these studies.

Ascaris Study (Study No. 4)

Background

The present project to control roundworm infection (Ascariasis) in Kanzalu and Mwatati villages in Machakos District in Kenya, are a logical extension of an earlier project supported by the World Bank. The previous study conducted in Kenya in 1975 and 1976 was conducted by the same investigators as the present project. The principal objective was to determine whether common roundworm infections adversely affected the growth of young children and by so doing contributed to malnutrition which is very prevalent in Kenya, as in most poor countries. The work was extended by Dr. Stephenson (Ms. Lani Stephenson Latham) to an evaluation of the economic implications of roundworm infection and its control in Kenya.

A detailed report of this earlier study on roundworm infection has been issued as 'The Nutritional and Economic Implications of Ascaris Infection in Kenya" (by L. Latham, M. Latham and S. Basta) in September 1977. A further, more detailed analysis and discussion of the methodology, the locale, the findings and the conclusions for that study are available as the Ph.D. dissertation of Dr. Lani Stephenson (Latham) entitled "Nutritional and Economic Implications of Ascaris Infection in Kenya: Studies in Experimental Animals and Preschool Children".

This original project, for the first time in a well controlled field study, demonstrated that roundworm infection was significantly associated with a retardation of growth in children, and was therefore contributing to protein-calorie malnutrition in preschool age children. The cost of the disease to Kenya, and to individual families, was found to be high, and it was suggested from the data that the cost of control was relatively low.

On the basis of these findings, and the experience of the investigators (Prof. Latham, Dr. Crompton and Dr. Stephenson) in Kenya it was felt that a project should be instituted to attempt to control roundworm infection in these two Kenyan villages, and to evaluate the effect and effectiveness of a low cost practical control program.

Present Ascaris Control Project

The Ascaris project in Kenya is an attempt to lower the prevalence of Ascaris (Roundworm) infection in 2 rural villages by giving 1 dose of Roundworm medicine (levamisole) to all preschool and primary school children 3 times a year for 3 years, and to evaluate this.

The project began in January 1977. At that time, Dr. Latham, Dr. Crompton and Dr. Stephenson spent 6 weeks in Kenya. Anthropometric, stool and clinical examinations were performed, and a dose of levamisole was given to all available preschool and primary school age children. This entire procedure, including all examinations performed by the investigators, will be repeated each January in 1978 (already completed), 1979, and 1980 The second 2 doses of the drug for 1977 were given by a locally hired field worker during visits to homes and schools in May and September of 1977. (See Table 3)

In January 1978, the 3 investigators plus Ms. June Wolgemuth, a nutritionist from Cornell University, and Mr. Andrew Hall, a parasitologist from Cambridge University, repeated the anthropometric, stool and clinical examinations and gave 1 dose of levamisole. In April 1978, 4 locally hired field workers, under the guidance of Mr. Hall and Dr. Ad Jansen, delivered the second yearly dose to preschool and some primary school children at home visits. In May 1978, the field workers will visit the 2 local primary schools to give levamisole to the primary school children.

Table 3

Schedule for delivery of Levamisole

Dose	Time	Status
1	January 1977	completed
2	May 1977	completed
3	September 1977	completed
4	January 1978	completed
5	May 1978	partially completed
6	September 1978	to be given
7	January 1979	to be given
8-9	May-September 1979	to be given
10	January 1980	to be given

Results of examinations and visits to date

a. 1977

In January 1977, over 750 children were seen and examined by the principal investigators. Dr. D. W. T. Crompton and his staff completed the very thorough stool examinations on all 752 stool specimens in fall 1977. Prevalence of Ascaris in preschool children was 21%, while prevalences of hookworms and Trichuris (whipworm) were 5% and 2%, respectively. For school children, these figures were: Ascaris, 14%; hookworms, 13%; Trichuris, 3%. (See Table 4)

An additional estimated 200 children who did not attend the January survey were also given dose 1 of levamisole in February 1977 by a field worker (Mr. Mutinda Munyao). An estimated 800 children received doses 2 and 3 of levamisole from a field worker in May and September of 1977. The target group is estimated to be about 1200 children, but precise figures await computer analysis.

b. 1978

In January 1978, over 700 stools were again collected for examination and anthropometric and clinical exams performed. Over 1100 children received dose 4 of levamisole in January and February. Dr. Crompton and co-workers are presently examining the stool samples and expect to complete the examinations by fall 1978. A subsample of examinations completed now suggests that the prevalence of Ascaris has decreased since January 1977, but no firm conclusions can be drawn until all examinations are completed and the results analyzed by computer.

Dose 5 has been given to 480 preschool and younger primary school children in April 1978 at home visits by the 4 field workers. Dose 5 is being given to the remaining primary school children in May 1978 at

Table 4

Stool examinations for parasite ova.

Kanzalu and Mwatati. January 1977.

Group	Total n	% Ascaris	% hookworm	% Trichuris
Preschool				
Kanzalu	121	12	4	2
Mwatati	187	28	5	1
Both villages	308	21	5	2
Primary School				
Kanzalu standard				
1	33	15	3	0
2	53	19	2	4
3	52	15	4	0
4	43	5	12	0
5	22	23	4	4
6	26	19	31	0
7	15	7	33	0
all standards	244	12	9	1
Mwatati standard				
1	34	32	15	6
2	42	14	12	5
3	35	11	14	3
4	34	18	18	3
5	23	17	17	4
6	19	10	37	5
7	13	8	31	8
all standards	200	17	18	5
Both schools	444	14	13	3

All stools collected by Dr. D. W. T. Crompton in Kenya and analyzed by Dr. Crompton and his staff at the Molteno Institute, Cambridge University, England.

visits to the 2 local primary schools. Mr. Hall and Dr. Jansen are supervising the activities of the field workers (Mr. Josphat Wambua, Mr. Kiio Mwilu, Mrs. Esther Ndunda, and Ms. Rose Nzuki).

Computer analysis of stool examination results will provide useful information on reinfection rates and will help determine whether or not the same children get continually reinfected with Ascaris. It will also be important to determine whether levamisole, which is partially effective in treating hookworm infection, can lower prevalence of hookworm in school children. This type of long term study, with 4 yearly stool examinations on the same children, is extremely difficult and time consuming, and is rarely attempted on sample sizes this large.

The anthropometric and clinical data will allow the authors to monitor nutritional status of children for 4 years and will also provide valuable longitudinal growth data on preschool and primary school Kenyan children. Growth of siblings and nutritional status of mothers and their children will be compared. The need in East Africa for longitudinal growth data on children living at home has been recognized. Most growth data in Kenya, and other countries in Africa, has been based on cross sectional studies.

Conclusion

This is the Preliminary Draft of the Inception Report. The final draft is due on August 31, 1978.

NORFOLK HOTEL
College Road
P. O. Box 40064
Nairobi, Kenya
Tel. 335-422

Bank Office:
MR. J. D. North Director, Miss H. Goris Deputy Director.
Regional Mission in Eastern
Africa
Resident Representative, Kenya Tels: Office: 24391
Extelcoms House home: 61697
Haile Selassie Avenue
Nairobi, Kenya

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TELEX 22022
INTBAFRAD

Emmerich M. Schebeck

(Home) 703/768-2057
(Work) 202/477-3651

Clell G. Harral

(Work) 202/477-2097

cc. Mr. Basta

UNIVERSITY OF NAIROBI

INSTITUTE FOR DEVELOPMENT STUDIES

TELEGRAMS: "VARSITY" NAIROBI
TELEPHONE: NAIROBI 334244
22036

P.O. BOX 30197
NAIROBI, KENYA.

Dr Clell Harral
Dr Samir Basta
IBRD

Gentlemen:

Herewith a personal history for & attached C.V.

This relates to the Nutrition & Women Productivity study of Michael Latham et. al.

Please confirm with me that we have an arrangement & what it is. Once that is resolved I shall be happy to be involved in the substance of the study. On the basis of my initial discussion with Mark Sharrock Michael Latham and others I can foresee some rather severe problems with it, but I hope these can be sorted out.

Very sincerely

F. M. Stark

Record Removal Notice

The World Bank Group Archives & Records Management

File Title	Barcode No.
Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
01 June, 1978	CV / Resumé	

Correspondents / Participants
Peter Hopcraft

Subject / Title
Curriculum Vitae

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
Tonya Ceesay	15-Apr-15

FORM NO. 27-OCR (5-77)

WORLD BANK OUTGOING MESSAGE FORM (Telegram, Cable, Telex)

IMPORTANT (PLEASE READ INSTRUCTIONS BELOW BEFORE TYPING FORM.)

Class of Service: CABLE

Date: JUNE 26, 1978

Telex No.:

Originators Ext: 7-3597

START HERE

TO: MEDICAL RESEARCH CENTER CARE OF DR. JANSEN, P.O. BOX 20752

CITY/COUNTRY: NAIROBI, KENYA

MESSAGE NO.:

FOR MICHAEL LATHAM THANKS FOR CABLE STOP AGREE TO ALL PARTS OF ITINERARY EXCEPT FOURTEEN HOUR TRAIN TRIP FROM NAIROBI TO MOMBASA. RECOMMEND INSTEAD THAT I TAKE KENYA AIRLINES 483 FROM NAIROBI TO ARRIVE MOMBASA AT 18:30 ON JULY SIX. TENTATIVE RESERVATIONS HAVE BEEN MADE FOR SERENA BEACH HOTEL THAT NIGHT. RECOMMEND THAT YOU MEET WIFE AND ME AT MOMBASA AIRPORT OR HOTEL THAT EVENING. IF POSSIBLE TRY TO CALL ME AT NORFOLK HOTEL ON JULY FIFTH TO CONFIRM THESE ARRANGEMENTS ALSO PLEASE TRY SET UP APPOINTMENT WITH ECONOMIST PETER NOPCRAFT. REGARDS

SAMIR BASTA

END OF TEXT

NOT TO BE TRANSMITTED

SUBJECT: RESEARCH PROJECT 67173

DRAFTED BY: SSBasta:ap

CLEARANCES AND COPY DISTRIBUTION: cc: Mr. Nilssen, Nairobi

AUTHORIZED BY (Name and Signature): Samir S. Basta

DEPARTMENT: Agriculture & Rural Development

SECTION BELOW FOR USE OF CABLE SECTION

CHECKED FOR DISPATCH

DISTRIBUTION: WHITE — File Copy WHITE — Transmittal Copy CANARY — Bill Copy BLUE — Originator to Keep

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

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

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

Mr. Basta

JUNE 20, 1978
EXT. 72097

File
Kenya

BOOK OF TWO (SEE ATTACHED TEXT)

1) MEDICAL RESEARCH CENTER, FOR DR. MICHAEL LATHAM, C/O DR. JANSEN, P. O. BOX 20752, NAIROBI, KENYA

2) FOR MESSRS. NILSSON AND SHARROCK, C/O MR. J. NORTH, INTBAFRAD, NAIROBI, KENYA, TELEX 22022

JUNE 20, 1978
72097

0 START
1 TO
TY/COUNTRY
MESSAGE NO.
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21 END
22

WITH REGARDS SUPERVISION KENYA NUTRITION PRODUCTIVITY STUDY SAMIR BASTA WILL ARRIVE IN NAIROBI VIA CAIRO ON WEDNESDAY FIFTH JULY BY KQ215 FOR PERIOD OF ONE WEEK. PLEASE CONTACT HIM AT NORFOLK HOTEL OR CABLE INSTRUCTIONS ON WHERE HE SHOULD REACH YOU AND COMPLETE ITINERARY. REGARDS HARRAL, INTBAFRAD

671-73

MR. SAMIR S. BASTA

SSBASTA:JM

CGHARRAL:CW

TRANSPORTATION

June 26, 1978 · From: Nairobi

INCOMING TELEX

Distribution:
Transportation
Mr. Low

FOR HARRAL

WELCOME BASTA VISIT BEGINNING JULY 5 BUT BECAUSE EXPECTED JULY 12 COMMITMENTS KWALE JULY 5 SO CANNOT MEET NAIROBI. HAVE PLANNED ITINERARY AS FOLLOWS: JULY 6 WITH SHARROCK ON NYERI PRODUCTIVITY ROAD SITES. LEAVE 6:30 P.M. THAT NIGHT BY TRAIN FOR MOMBASA WHERE EYE WILL MEET TRAIN 8. 00 A. M. JULY 7 AND 8 OBSERVE KWALE STUDIES. LEAVE MOMBASA BY TRAIN WITH ME JULY 9 TO VIEW NYERI HEALTH STUDY ACTIVITIES TOGETHER JULY 10.

EWG REGARDS LATHAM7,3 26,

CABLE

JUNE 26, 1978
7-3597

START HERE

TO

MEDICAL RESEARCH CENTER CARE OF DR. JANSEN, P.O. BOX 20752

CITY/COUNTRY

NAIROBI, KENYA

MESSAGE NO.:

FOR MICHAEL LATHAM THANKS FOR CABLE STOP AGREE TO ALL PARTS OF ITINERARY EXCEPT FOURTEEN HOUR TRAIN TRIP FROM NAIROBI TO MOMBASA. RECOMMEND INSTEAD THAT I TAKE KENYA AIRLINES 483 FROM NAIROBI TO ARRIVE MOMBASA AT 18:30 ON JULY SIX. TENTATIVE RESERVATIONS HAVE BEEN MADE FOR SERENA BEACH HOTEL THAT NIGHT. RECOMMEND THAT YOU MEET WIFE AND ME AT MOMBASA AIRPORT OR HOTEL THAT EVENING. IF POSSIBLE TRY TO CALL ME AT NORFOLK HOTEL ON JULY FIFTH TO CONFIRM THESE ARRANGEMENTS ALSO PLEASE TRY SET UP APPOINTMENT WITH ECONOMIST PETER NOPCRAFT. REGARDS

SAMIR BASTA

END OF TEXT

RESEARCH PROJECT 67173

cc: Mr. Nilssen, Nairobi

SSBasta:ap

Samir S. Basta
Agriculture & Rural Development

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

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

OFFICE MEMORANDUM

File Kenya Files

TO: See Distribution

DATE: June 7, 1978

FROM: Armeane M. Choksi, VPD

SUBJECT: Missing Abstracts

Listed below are those abstracts for which we have not yet received a draft. To keep on schedule we would appreciate your sending these drafts by c.o.b. Monday, June 15, 1978. Thursday?

No.	Title	Supervisor
670-26	Substitution of Labor and Equipment in Civil Construction	B. Coukis (TRP)
670-27	Highway Design Study: Phase II	C. Harral (TRP)
670-45	Labor Force Participation, Income, and Unemployment	D. Mazumdar (DED)
670-70	Urban Public Finance and Admin.	J. Linn (DED)
670-67	Standards of Reliability of Urban Electricity Supply	M. Munasinghe (EWT)
670-76	Pricing and Investment in Telecommunications	J. Warford (EWT)
670-78	Project Evaluation Methodology: Education Attainments	C. Gilpin (EDC)
670-93	Evaluation of the Lilongwe Development Program	U. Lele (EAN)
671-07	Council for Asian Manpower Studies	L. Westphal (DED)
671-15	Effects of Health and Nutrition Standards on Worker Productivity	S. Basta/B. Coukis (TRP)
671-18	Pricing and Financing of Urban Public Services: Water Supply and Sewage Disposal	J. Linn (DED)
671-22	Raising the Productivity of Small Farms	A. Egbert (AGR)
671-28	Linkage of Commodity and Country Models	A. Schwartz (EPD)

No.	Title	Supervisor
671-30	Structure of Rural Employment, Income and Labor Markets	I.J. Singh (DED)
671-31	A Comparative Analysis of Rural-Urban Labor Market Interactions	R. Sabot (DED)
671-44	Agricultural Innovation and Rural Development	G. Donaldson (AGR)
671-48	Urban Labor Markets in Latin America	M. Leiserson (DED)
671-54	Economics of Educational Radio	S. Futagami (EDC)
671-59	Small-Scale Enterprise Development	D. Anderson (DED)
671-64	Food Deficits of Target Groups	G. Donaldson (AGR)
671-66	Research Support for the World Development Report	S. Gupta (EPD)
671-67	Effects of Increased Imports of Manufactured Goods from Developing Countries	S. Singh (EPD)
671-68	Key Institutions and Expansion of Manufactured Exports	D. Keesing (DED)
671-73	Kenya - Health, Nutrition and Worker Productivity Studies	C. Harral (TRP)

Distribution: Messrs. Coukis, Harral, Mazumdar, Linn, Munasinghe, Warford, Gilpin, Reutlinger, Westphal, Basta, Egbert, Schwartz, I.J. Singh, Sabot, Donaldson, Leiserson, Gutagami, Anderson, S. Singh, Keesing
Ms. A. Guys (VPD), U. Lele

AGuys:lt

File Kenya file please.

June 5, 1978

Mr. Andrew Chesher
The University of Birmingham
Department of Econometrics
P.O. Box 363
Birmingham B15 2TT, England

Dear Andrew:

Thanks for your letter of May 24. We are processing your fee payment.

At your convenience it would be worthwhile to look into Mark Brooks' letter, particularly as a critical analysis of the earlier work is likely to be instructive to Michael Latham for the future work. I presume a total of about a day would be adequate for the purpose. Please write directly to him w/copy to Latham, and Basta and myself at the Bank.

Regards,

Clell G. Harral
Highway Design & Maintenance Adviser
Transportation Department

CGHarral:cw

cc: Basta

Record Removal Notice

The World Bank Group Archives & Records Management

File Title	Barcode No.
Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
31 May, 1978	Letter	

Correspondents / Participants

To: Dr. Malden Nesheim

From: Samir Sanad Basta

Subject / Title

Appointment of Dr. L. Stephenson Latham as Research Associate

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
Tonya Ceesay	15-Apr-15

Logged
May 30, 78

File

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 Basta: Please circulate this to members of the advisory panel, also Messrs Sharrock & Nilsson in Nairobi, pointing out that this is an early draft & their comments are invited. Keep me informed of the feedback. CGLM.

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

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,

Michael C. Latham

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. Samir Basta

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

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Statutory Colleges of the State University of New York

May 24, 1978

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Transportation Department
The World Bank
1818 H Street N.W.
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Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. Samir Basta ✓

May 26, 1978

Preliminary Draft

Inception Report
for
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433

KENYA: HEALTH, NUTRITION AND WORKER PRODUCTIVITY STUDIES

Prepared by:

Dr. Michael C. Latham
Professor of International Nutrition and Principal Investigator

and

Dr. Lani Stephenson
Postdoctoral Research Associate and Co-Investigator

from

Division of Nutritional Sciences
Cornell University
Ithaca, New York 14853 U.S.A.

Introduction

This is a preliminary inception report on the World Bank Research Project No. 671-73 entitled "Kenya: Health, Nutrition and Worker Productivity Studies". The present project designed to last three years grew out of work conducted in Kenya from 1975 to 1977. The overall project is receiving major financial support also from the British Overseas Development Ministry, from Cornell University and from Cambridge University. Imperial Chemical Industries in Britain have provided the anthelminthic Levamisole free, and have given some support to Dr. David Crompton's laboratory in Cambridge.

It should be noted that although the project was to start on January 1, 1978 the written letter of appointment for this project was dated April 7, 1978, and so the first funds were not available until mid April 1978, less than two months prior to the writing of this report. Agreement with the British Overseas Development Ministry (ODM) was reached earlier in the year but the first instalment of funds was not received by Cornell until March 1978 (A £1000.00 advance in January 1978 had been received.). ODM is providing support for Study No. 1 and the World Bank for Studies 2, 3 and 4.

The previous work in Kenya had consisted of two parts, namely (a) a study of nutrition and worker productivity, and (b) an investigation of the effects of roundworm infection on nutrition and health of children. In the first study an investigation was made of health and nutritional status of workers involved in the Kenya Rural Access Roads Program of the Ministry of Works. Poor nutritional status due to low calorie intakes and anemia due to poor diets and parasitic diseases were associated with low productivity. The studies were conducted in Nyeri and Kwale Districts.

The second study in Machakos District was conducted in collaboration with the Medical Research Centre based in Nairobi. It involved the examination of children in two villages, and a detailed determination of the effects of roundworm infection on growth, health and nutritional status. These two studies will be referred to later, and reports on them have been issued as IBRD Technical Memorandum No. 26 (1977) and Working Paper No. 271 (Sept. 1977) respectively.

The detailed proposals for the present three year project are contained in "Kenya: Health, Nutrition and Worker Productivity Studies", Proposal to the World Bank Research Committee November 16, 1977.

Staff Involved

Investigators

Principal Investigator - Dr. Michael C. Latham, Professor of International Nutrition, Cornell University

Co-Investigator - Dr. David Crompton, Senior Lecturer in Parasitology, Cambridge University, and Adjunct Associate Professor, Cornell University

Co-Investigator - Dr. Lani Stephenson (Latham), Postdoctoral Research Associate, Cornell University

Co-Investigator (Ascaris Study only) - Dr. A. A. Jansen, Director Nutrition Section of Medical Research Centre, Nairobi

Graduate Research Assistants

Ms. June Wolgemuth - Nutritionist from Cornell University

Mr. Andrew Hall - Parasitologist, Cambridge University

Mr. Terry Elliott - Nutritionist, Cornell University

Field Workers

Mr. Mutinda Munyao

Mr. Kiio Mwilu

Mr. Josephat Wambua

Ms. Esther Ndunda

Ms. Rose Nzuki

Mr. George Matheka

Ms. Ruth Musau

Mr. Samuel Mulinge

Mr. Isaac Muena

Mr. Charles Kaboi

Consultants

Mr. Mark Sharrock - Work Study Engineer

Mr. Andrew Chesher - Statistician (Birmingham University)

Dr. Peter Hopcraft - Economist (Institute for Development Studies, University of Nairobi) 48643

IBRD Staff

Mr. Clell Harral - Transportation

Dr. Samir Basta - Nutrition

Call Dr. Ray Schaffer
48224
Senior lecturer dept. of community health
Univ. of Nairobi
- Resettlement classic.

Nutrition and Worker Productivity Study

Introduction

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. 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.

(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.

A report of this work is available as IBRD Technical Memorandum No. 26, May 1977 entitled "The relationship of nutrition and health to worker productivity in Kenya" under the general heading "World Bank Study on the Substitution of Labor and Equipment in Civil Construction".

On the basis of the findings in this short preliminary study it was decided that further investigations were desirable. These, it was proposed, should consist of three parts as follows:

Study No. 1 An evaluation of health/nutrition effects on the productivity of casual laborers in rural civil works. In this study the effects of an intervention with calories on work output will be determined.

Study No. 2 An evaluation of practical interventions to improve health and worker productivity. In a series of sub-studies an evaluation will be undertaken of alternative methods for feeding workers; of the routine provision of iron and calorie rich foods to road workers; of the provision of medicinal iron; and of the feasibility of controlling certain parasitic infections. In all these studies the prevalence of parasitic diseases and their relation to anemia will be studied.

Study No. 3 A study of health and nutritional status in two new ecological areas where rural access roads are being constructed.

(Note - Study No. 4 is the roundworm study described later.)

Present Status of Nutrition and Worker Productivity Study

The proposed time table for work in Kenya calls for Study No. 1 and Study No. 4 to be initiated in January 1978. A part of Study No. 2 will be begun in June-July 1978, and the remainder of Study No. 2 and all of Study No. 3 will be initiated in early 1979.

This part of the report therefore deals only with Study No. 1. The main objective of this study is to determine the effects on worker output or productivity of providing extra calories to workers at a site where undernutrition appears to be prevalent, and where parasitic infections and anemia are less prevalent or can be easily controlled. The work in 1976 in Kenya suggested that Nyeri met these criteria. On two road sites (Ndunyu and Kihuyu) 38% of 102 road workers had a weight for height below 85% of the standard; anemia and parasitic infections were uncommon. In Kwale District, of 179 men examined, a rather similar percentage (41%) had low weight for height but in contrast to Nyeri anemia was common (34% had hemoglobin below 13.0 grams/100 ml.) and parasitic infections very common (66% had hookworm, 45% Trichuris, and 23% Ascaris).

It was therefore decided that a highland area such as Nyeri District would be most suitable for Study No. 1.

Meetings with Mr. John Simpson (in charge of Rural Access Roads) and Mr. B. Nilsson (IBRD in Nairobi) were held in January 1978. Agreement was reached that Nyeri or Muranga Districts would be suitable for Study No. 1. A decision was to be left to the Investigators in consultation with Mr. Michael Knowles, Engineer in Charge of Rural Access Roads for those districts.

The Investigators had decided that it was desirable to select first

a "preliminary" road site. On this site the methodology to be used would be thoroughly tested, field workers would be trained, and a feasibility study would be undertaken. A second road site would then be selected for the definitive study. At a meeting with Mr. Knowles in the Karatina Rural Access Roads headquarters camp, alternative sites were discussed. A decision was reached that Road No. 55 at Igoka (near Makurweini) in Nyeri District would be used as the preliminary road site. A road site where work was planned to begin in April/May 1978 in Muranga District was chosen for the definitive study. (This has now had to be changed due to difficulties of obtaining adequate numbers of workers at this site.) What's the new site??

In February 1978 a 10 foot by 10 foot corrugated iron hut was set up at Igoka for use by us as a clinic and field study examination room. A landrover was provided by the Ministry of Works for the project. (via IBRD ?D) Two field workers were recruited from among some 20 applicants.

Examinations of all workers at the Igoka road site were then conducted over a period of 3 weeks. Clinical, medical and nutritional status examinations were conducted by Dr. Latham, anthropometric examinations were performed by Ms. Wolgemuth who also obtained relevant social information (what exactly?) on each worker, and stools were collected from each worker by Mr. Hall for later examination by him at the International Laboratory for Research on Animal Diseases in Nairobi.

The results of these examinations have only partly been analyzed. Table 1 shows the findings in terms of the weight for height of these workers. From this it can be seen that 73.5% of men were below 85% and 57.5% were below 80% of standard weight for height. 85% is the cut off point used in the previous study. Persons below this were considered

Table 1

Weight for height findings for male road workers

at Igoka site (No. 55)

% weight for height	Number	%
Above 95	2	5
90 - 94	1	2.5
85 - 89	8	19
80 - 84	7	16
75 - 79	18	40
70 - 74	4	10
65 - 69	3	7.5
Total	43	100

to have below optimum calorie reserves, or to have an indication of undernutrition. These data indicate that undernutrition is a problem in a substantial percentage of men (and women). If similar findings occur in the definitive road site this would more than satisfy one of the needed criteria for an intervention study.

The clinical examination showed a picture of a population who have relatively little access to medical treatment and who suffer from a variety of illnesses notably skin infections, respiratory conditions, hypertension, hernias and so on. The final report will provide details of these. Simple treatment was provided to all those requiring it and some were referred to hospital for further treatment.

The results of the stool examinations are shown in Table 2. This indicates that intestinal parasites are fairly prevalent. The rates of infection are higher than was found in 1976, almost certainly because in 1976 a commercial laboratory was used, and a less thorough and precise examination of the stools was performed. Most of these parasitic infections are quite easy to treat. Appropriate anthelminthic drugs were supplied, and a re-examination of the stools performed to make certain that the workers had been freed of parasites. Results of the second stool examination are not available.

(1) What parasites?
(2) Previous report said that parasites were not a problem in highlands

As a result of the preliminary examination of the men, Dr. Latham made the following recommendations to the Engineer in charge concerning conditions for the definitive road site:

(a) Men should be recruited, not women, because a mixed group would create problems for the study (women may be or become pregnant which would effect weight, continuation of work, and calorie needs. Also if both men and women are used then two separate groups would have to be used in the analysis).

Table 2

Infections with intestinal parasites from stool examinations (Igoka road workers)

	Number	Ascaris	Hookworm	Cysts	Taenia	Trichuris	Strongyloides
Males	39	12 (31%)	13 (33%)	8 (20%)	3 (8%)	1 (3%)	1 (3%)
Females	20	14 (70%)	9 (45%)	11 (55%)	0	0	0
Total	59	26 (44%)	22 (37%)	19 (32%)	3 (5%)	1 (1.5%)	1 (1.5%)

Men eat more meat?

interesting difference! (Women do more "dirty" work ?!!)

Number of workers with 0 infection = 19 (32%)

Number of workers with 1 infection = 16 (27%)

Number of workers with 2 infection = 16 (27%)

Number of workers with 3 infection = 8 (13.5%)

(b) Workers should be 18 years of age or older. Some workers at Igoka were well below this age. Because they are still growing this effects their nutrient needs and their weight.

(c) No substitution of one worker for another should be allowed. At Igoka it was found that on occasions a male worker unable to work for a day or two might send his wife, son or some other relative to substitute for him. This substitution would obviously create problems in a calorie supplementation program.

In the period March to May 1978 Ms. Wolgemuth and Mr. Hall (having taken up residence in Karatina) worked full time on Study 1 (with the exception of a short period when Mr. Hall went to Machakos District to assist with Study 4).

During this period the following activities have been undertaken:

(a) New workers have been enrolled and all examinations except the clinical examination performed on them.

(b) Dietary information on each worker was obtained using a 24 hour recall. Results?

(c) On a sub-sample of workers dietary information was collected using the weighing method in the household. Results?

(d) Different methods of providing approximately 700 extra calories per day to a "study" group than to a control group have been tried. The feasibility of each method is being carefully assessed, the acceptance by the workers assessed, and the costs determined.

(e) Weights of men are determined prior to and after each period of dietary intervention.

The preliminary results of these activities will be reviewed by Dr. Latham with the staff in June 1978. On the basis of the findings

and this review a decision will be made about the protocol to be followed at the definitive road site.

In May 1978 Mr. Mark Sharrock, the work study engineer, will arrive in Kenya. He will immediately begin his task of developing suitable work output measures first at the Igoka or some other road site. He will also train one or more field workers. In June 1978 Dr. Latham and Dr. Stephenson (Latham) will arrive in Kenya to work on the project. They will be accompanied by Mr. Terry Elliott who will be involved mainly with the anemia studies proposed for Kwale District.

In June or July, at the definitive road site Dr. Latham will conduct physical, clinical and nutritional examinations of the new men, Ms. Wolgemuth will get social information and do anthropometric measurements, and Mr. Hall will do stool and haematological examinations. Over a period of time Mr. Sharrock will do work output studies on each man.

When these data have been obtained (probably in July 1978) the calorie intervention will begin. Advice from Mr. Chesher will be used to assist with the assignment of men to the "study" and "control" groups. Any men having serious medical problems, or other conditions which might markedly effect work output, will be eliminated from the study. Men with parasites will be treated, and stools re-examined. Men will receive treatment when appropriate and needed.

In June or July work will start probably in Kwale District on Study No. 2. Dr. Latham, Dr. Stephenson, Mr. Hall and Mr. Elliott will all be involved in this. Ms. Wolgemuth and Mr. Sharrock will remain in Nyeri District involved in Study No. 1. In Kwale District, Dr. Stephenson will play a major role in the evaluation of different types of mid-work day snacks and of appropriate delivery systems. Mr. Elliott will be involved

mainly on the study of the routine provision of iron to workers, and the effects of this on anemia. Mr. Hall will do parasitic examinations on stool and urine, and will do haematological examinations. Dr. Latham will do clinical, medical and nutritional status examinations on all road workers enrolled in these studies.

Ascaris Study (Study No. 4)

Background

The present project to control roundworm infection (Ascariasis) in Kanzalu and Mwatati villages in Machakos District in Kenya, are a logical extension of an earlier project supported by the World Bank. The previous study conducted in Kenya in 1975 and 1976 was conducted by the same investigators as the present project. The principal objective was to determine whether common roundworm infections adversely affected the growth of young children and by so doing contributed to malnutrition which is very prevalent in Kenya, as in most poor countries. The work was extended by Dr. Stephenson (Ms. Lani Stephenson Latham) to an evaluation of the economic implications of roundworm infection and its control in Kenya.

A detailed report of this earlier study on roundworm infection has been issued as "The Nutritional and Economic Implications of Ascaris Infection in Kenya" (by L. Latham, M. Latham and S. Basta) in September 1977. A further, more detailed analysis and discussion of the methodology, the locale, the findings and the conclusions for that study are available as the Ph.D. dissertation of Dr. Lani Stephenson (Latham) entitled "Nutritional and Economic Implications of Ascaris Infection in Kenya: Studies in Experimental Animals and Preschool Children".

This original project, for the first time in a well controlled field study, demonstrated that roundworm infection was significantly associated with a retardation of growth in children, and was therefore contributing to protein-calorie malnutrition in preschool age children. The cost of the disease to Kenya, and to individual families, was found to be high, and it was suggested from the data that the cost of control was relatively low.

On the basis of these findings, and the experience of the investigators (Prof. Latham, Dr. Crompton and Dr. Stephenson) in Kenya it was felt that a project should be instituted to attempt to control roundworm infection in these two Kenyan villages, and to evaluate the effect and effectiveness of a low cost practical control program.

Present Ascaris Control Project

The Ascaris project in Kenya is an attempt to lower the prevalence of Ascaris (Roundworm) infection in 2 rural villages by giving 1 dose of Roundworm medicine (levamisole) to all preschool and primary school children 3 times a year for 3 years, and to evaluate this.

The project began in January 1977. At that time, Dr. Latham, Dr. Crompton and Dr. Stephenson spent 6 weeks in Kenya. Anthropometric, stool and clinical examinations were performed, and a dose of levamisole was given to all available preschool and primary school age children. This entire procedure, including all examinations performed by the investigators, will be repeated each January in 1978 (already completed), 1979, and 1980. The second 2 doses of the drug for 1977 were given by a locally hired field worker during visits to homes and schools in May and September of 1977. (See Table 3)

In January 1978, the 3 investigators plus Ms. June Wolgemuth, a nutritionist from Cornell University, and Mr. Andrew Hall, a parasitologist from Cambridge University, repeated the anthropometric, stool and clinical examinations and gave 1 dose of levamisole. In April 1978, 4 locally hired field workers, under the guidance of Mr. Hall and Dr. Ad Jansen, delivered the second yearly dose to preschool and some primary school children at home visits. In May 1978, the field workers will visit the 2 local primary schools to give levamisole to the primary school children.

Table 3

Schedule for delivery of levamisole

Dose	Time	Status
1	January 1977	completed
2	May 1977	completed
3	September 1977	completed
4	January 1978	completed
5	May 1978	partially completed
6	September 1978	to be given
7	January 1979	to be given
8-9	May-September 1979	to be given
10	January 1980	to be given

Results of examinations and visits to date

a. 1977

In January 1977, over 750 children were seen and examined by the principal investigators. Dr. D. W. T. Crompton and his staff completed the very thorough stool examinations on all 752 stool specimens in fall 1977. Prevalence of Ascaris in preschool children was 21%, while prevalences of hookworms and Trichuris (whipworm) were 5% and 2%, respectively. For school children, these figures were: Ascaris, 14%; hookworms, 13%; Trichuris, 3%. (See Table 4)

An additional estimated 200 children who did not attend the January survey were also given dose 1 of levamisole in February 1977 by a field worker (Mr. Mutinda Munyao). An estimated 800 children received doses 2 and 3 of levamisole from a field worker in May and September of 1977. The target group is estimated to be about 1200 children, but precise figures await computer analysis.

b. 1978

In January 1978, over 700 stools were again collected for examination and anthropometric and clinical exams performed. Over 1100 children received dose 4 of levamisole in January and February. Dr. Crompton and co-workers are presently examining the stool samples and expect to complete the examinations by fall 1978. A subsample of examinations completed now suggests that the prevalence of Ascaris has decreased since January 1977, but no firm conclusions can be drawn until all examinations are completed and the results analyzed by computer.

Dose 5 has been given to 480 preschool and younger primary school children in April 1978 at home visits by the 4 field workers. Dose 5 is being given to the remaining primary school children in May 1978 at

Table 4

Stool examinations for parasite ova.

Kanzalu and Mwatati. January 1977.

Group	Total n	% Ascaris	% hookworm	% Trichuris
Preschool				
Kanzalu	121	12	4	2
Mwatati	187	28	5	1
Both villages	308	21	5	2
Primary School				
Kanzalu standard				
1	33	15	3	0
2	53	19	2	4
3	52	15	4	0
4	43	5	12	0
5	22	23	4	4
6	26	19	31	0
7	15	7	33	0
all standards	244	12	9	1
Mwatati standard				
1	34	32	15	6
2	42	14	12	5
3	35	11	14	3
4	34	18	18	3
5	23	17	17	4
6	19	10	37	5
7	13	8	31	8
all standards	200	17	18	5
Both schools	444	14	13	3

All stools collected by Dr. D. W. T. Crompton in Kenya and analyzed by Dr. Crompton and his staff at the Molteno Institute, Cambridge University, England.

visits to the 2 local primary schools. Mr. Hall and Dr. Jansen are supervising the activities of the field workers (Mr. Josphat Wambua, Mr. Kiio Mwilu, Mrs. Esther Ndunda, and Ms. Rose Nzuki).

Computer analysis of stool examination results will provide useful information on reinfection rates and will help determine whether or not the same children get continually reinfected with Ascaris. It will also be important to determine whether levamisole, which is partially effective in treating hookworm infection, can lower prevalence of hookworm in school children. This type of long term study, with 4 yearly stool examinations on the same children, is extremely difficult and time consuming, and is rarely attempted on sample sizes this large.

The anthropometric and clinical data will allow the authors to monitor nutritional status of children for 4 years and will also provide valuable longitudinal growth data on preschool and primary school Kenyan children. Growth of siblings and nutritional status of mothers and their children will be compared. The need in East Africa for longitudinal growth data on children living at home has been recognized. Most growth data in Kenya, and other countries in Africa, has been based on cross sectional studies.

Conclusion

This is the Preliminary Draft of the Inception Report. The final draft is due on August 31, 1978.

File Kenya
File Joy - type up
second page on
bank stationary
& let me sign it —

Logged
May 26, '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

May 23, 1978

→ Sami Barta
① This is OK w/ me
② It would probably appear more sensible to Dr. Nesheim if you signed it rather than the Highways Adviser!

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

Dear Clell:

As you may know Lani has recently finished her Ph.D. and is now officially Dr. Lani Stephenson Latham. From June 1 she will become the paid Research Associate for the Kenya project rather than an unpaid assistant working very hard for it.

It would be helpful if you could write a letter something like the attached to Dr. Nesheim so that she can officially be appointed a Cornell Research Associate. This will get round complications such as having to advertise the position etc., and it will give Lani a position with status here and health benefits etc. It also seems better if such a letter comes from you rather than from her husband.

I have kept Mal Nesheim fully appraised about the project, and I think he understands why it is not being funded through Cornell. He is very supportive of our work, and is a close personal friend of mine.

I hope that this is agreeable to you.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

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File Title	Barcode No.
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31 May, 1978	Letter	

Correspondents / Participants

To: Dr. Malden Nesheim

From: Samir Sanad Basta

Subject / Title

Appointment of Dr. L. Stephenson Latham as Research Associate (Draft)

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
Tonya Ceesay	15-Apr-15

TELEX
858805

MAY 17, 1978

Please file in Kenya Res. file.

START HERE

PONTIFACT

BASINGSTOKE, HANTS, ENGLAND

FOR MARK SHARROCK

NILSSON EXPECTS RETURN NAIROBI BY MAY TWENTYTHREE AND WILL SERVE AS YOUR LIAISON WITH MOW. HE EXPECTS HE WILL BE ABLE OBTAIN MOW VEHICLE AND SOME SUPPORT STAFF FOR YOU. LATHAM DOES NOT EXPECT ARRIVE KENYA BEFORE MID JUNE PER ORIGINAL PLAN REGARDS HARRAL

END OF TEXT

CGHARRAL:PHM

CLELL HARRAL

TRANSPORTATION

cc: Messrs. S. Basta
B. Nilsson

EM/S More comments on cfB aspects.

March 30, 1978

Dr. Lincoln C. Chen
Scientific Director
Cholera Research Laboratory, Dacca
c/o Department of State
Washington, D.C. 20520

Dear Lincoln,

Thank you very much for your March 1st letter. I apologize for the delay in answering but I have been extremely tied up with supervision work on the Brazil National Nutrition project.

Your comments about the ascaris study are very kind. Your query about skinfold differences and growth in treated and non-treated children should best be answered by Lani Latham who is primary investigator. However, since that very question also disturbed me, I did give some thought to it. My only conclusion (Lani could have a better one), is that evidence from England (St. Mary's in London), Jamaica (Picou), etc.) indicates that during certain infective processes, or in severe malnutrition, or in kidney disease, there is a compensatory mechanism at work which among other things, leads to re-utilization of a number of nitrogenous by-products and a recycling of amino acids from muscle protein breakdown back towards protein synthesis. This "adaptive shunt" may take some time to wind down to normal after the infection has been eradicated, and hence a relative rapid growth spurt may occur in that period just after eradication when both the agent is removed and the compensatory shunt is still operating. Perhaps this process may explain in a little more detail parts of the "catch-up" growth phenomenon. Conversely, it may be that maximum gene expression (i.e. protein synthesis) for certain processes may decline during the infective process, and once the agent is removed, transcription, replication, etc. speeds up first quickly and then gradually to satisfy a certain pre-determined fixed point.

Certainly, we should include an untreated ascaris group in the next study (which has just been funded) and I think if it is relatively isolated from the others and treated at the study's termination, the ethical problems could be reduced. Thank you for suggesting it.

I hope you keep in touch with us. I have many "suggestions" for future studies, being desk and airplane bound these last few years! Let's talk when you are next in Washington. In the meantime think

about studying something regarding "compensatory mechanisms". It is a subject which is both fascinating and extremely relevant (e.g. for work related to calorie/protein requirements for different (infective/non-infective?) populations).

Best regards,

Samir Sanad Basta
Nutrition Scientist
Nutrition Division
Agriculture and Rural Development Department

P.S. I enclose the four copies of the ascaris studies and the two on anemia in Indonesia that you asked for.

Enclosure

cc: Messrs. Latham (Cornell U.)
Berg
Schebeck
Greene
Wilkie
Harral

SSBasta:lcm

কলেরা রিসার্চ ল্যাবরেটরী
Cholera Research Laboratory

March 1, 1978

Samir S. Basta
Nutrition Division
Agriculture and Rural Development
Department
The World Bank
1818 H Street NW
Washington D.C. 20433

Dear Samir:

My receipt of your study "The Nutritional and Economic Implications of Ascaris Infection in Kenya" was most timely, as it arrived just as I and some colleagues were in the process of discussing the possibility of a field project on this topic.

The study is excellent in design, execution and analysis. The results are about as convincing as one can get on this complex subject. Would you please send me another four copies of this report, as well as two copies of your earlier study on iron deficiency and worker productivity in Indonesia.

One aspect of the study puzzles me. Let us focus on tricep skinfold which is the most critical variable. Assuming that ascariasis retards growth by causing nutrient wastage, one should have observed at visit I a cross-sectional difference between the ascaris and control groups. One, of course, could argue that the infection-normal-reinfection cycle occurs among all children and that a cross-section would only pick-up those currently infected. A difference would not then be expected. If ascariasis affects nutrition, one should observe slower growth between visits I and II in the ascaris group; this was observed. Between visits II and III, however, the growth rates of the two groups should be identical, since their only difference (ascaris infection) had been eliminated. The results instead show a decline in the control and an increase in the treated group. Is the large increase in the ascaris group due to "catch-up" growth?

This problem could have been reduced by including an untreated ascaris group in addition to the other two groups. There may be ethical problems here but a third

group could have been treated at the study's termination at visit III. In addition, it would have been useful to compare growth within the ascaris group according to worm burden.

The cost/benefit analysis is less convincing than the nutrition study, in my opinion. Clearly, the "cost" side of the equation is overwhelmingly based on dubious "malabsorption" data. The resulting recommendation for mass ascariasis chemoprophylaxis seems to me insufficiently focused. The prevalence data upon which it is based is not strong and I suspect that a more targeted focus on preschool children during their critical growth period, say 1-3 years, has been discarded without sufficient justification.

All of these comments are not intended to detract from an excellent study. The study's quality, in fact, is giving us second thoughts about another study of this nature in Bangladesh. If you or the Lathems have any suggestions about the need or nature of such potential future studies, I would very much appreciate hearing from you.

Best regards.

Sincerely,

Lincoln

Lincoln C. Chen
Scientific Director

c.c. M. Lathem, L. Lathem

Dr. Samir Basta

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

March 28, 1978

Dr. Lincoln C. Chen
Scientific Director
Cholera Research Laboratory
Dacca, Bangladesh

Dear Lincoln:

I was very pleased to receive your letter and your comments on the Ascaris report. I'll respond to the comments point by point.

a) Regarding absence of cross sectional differences between Ascaris and control groups at the start of the study, I think it's likely, as you suggested, that we picked one point in time when certain children happened to be infected and others did not. At another point in time some of the controls would have been infected, etc. It's also possible that only certain children tend to contract Ascaris infection but that they do so on a seasonal basis and that our first measurement was taken before the worms had caused a measurable change in skinfold thickness. Our three year deworming program in the same villages with stools examined once a year should help determine who gets reinfected in this particular community.

b) I was interested in your comment that the Ascaris infected children after deworming should not have grown better than the controls, but rather should have grown at the same rate. I personally don't find this surprising but both Michael and Jean-Pierre Habicht felt, as you did, that this finding ran contrary to standard theory.

As confirming evidence, two other groups of workers have found that Ascaris-infected children grew faster after deworming than did controls.

1) Michael received a letter last week from a Walter Willett at Harvard Medical School. He said that their department in Dar es Salaam had just "conducted a randomized trial of 3-monthly levamisole given to pre-school children, and like you, observed the treated group to grow faster." (The abstract will be presented at the American Federation for Clinical Research in May.)

2) A study in India (Lancet, Gupta et al., July 16, 1977), also using 3 monthly administration of an anthelmintic for a year to preschool children, reported that a higher proportion of children infected with Ascaris at the beginning of the year gained at least one percentage point in wt/age during the year than occurred in "control" uninfected children. This study does not appear to be particularly well controlled but their evidence and Willett's and ours do point in the same direction.

3) I have a feeling that we simply don't know enough about recovery from intestinal helminthiasis to be able to predict what should happen in the long term. The only field studies I'm aware of on growth of Ascaris-infected

children after deworming that include a control group are the three mentioned here. It's likely in field studies that the children studied (both Ascaris infected and "controls") have many more diseases other than Ascaris which influence their growth. I think it's also likely that there may be synergism or occasionally antagonism between diseases, so that getting rid of one disease causes a greater effect on growth than one might expect.

I do think that what we saw was catch-up growth of some sort, but I can't come up with an airtight physiological explanation for it.

c) It did occur to us to have a control group that didn't receive treatment, but we didn't think it was completely necessary or justifiable under the circumstances. In retrospect, the worm burdens were generally so low that it probably wouldn't have made much medical difference to most of the children, but having read of enough cases of intestinal obstruction and aspiration of worms, I didn't want to take chances and neither did Michael.

d) I did look at worm burden in relation to growth rates and found nothing. There are 2 possible reasons for this. First, children were lightly infected (mean number of worms was 7±9 worms) so most children had between 1 and 14 worms. I don't think there was enough variation in worm load to show a significant effect on growth rate. I would definitely expect a fairly linear relationship with a mean of say 50 and a range of 1-100 worms. My studies at Cornell with Ascaris infected malnourished pigs showed a clear linear relationship between number of worms harbored and degree of hypertrophy of the tunica muscularis of the small intestine of infected animals.

The factor that complicates effects of worm burdens in the field is migration of larvae through the tissues, which we were unable to detect. We have no idea whether children in our area ingest a few ova each week or whether they tend to get most heavily infected during a rainy season but not during dry seasons. It is clear that ingestion of large numbers of ova can cause a serious pneumonitis, which probably effects growth much more per unit time than a few adult ascarids do.

At any rate I heartily encourage you to carry out work with Ascaris, especially in preschool children, in Bangladesh, to try to choose areas where you expect high worm burdens, and to try if possible, to get the mothers to collect the worms after deworming, so that someone can shed light on the worm burden question. We found the mothers curious to see the worms "come out" and perfectly willing to collect them. I think the majority are passed within 24 or at most 36 hr. after a dose of levamisole.

e) Regarding the economic study, I don't really expect that any of us rather "hard" scientists will ever be completely satisfied with cost-benefit type methodologies. But then, there hasn't been much, if any, attention given to economic costs of ascariasis in the past, so we did the best we could with the available data. I do think that improper absorption of food in Ascaris infection is an issue which deserves more controlled study. I did find the beginnings of a decrease in villus height and an increase in crypt depth in the jejunal mucosa of Ascaris infected malnourished pigs. This was obviously done under controlled conditions and the animals had had adult ascarids for only 8 weeks, so I think there is something to the findings by Tripathy et al of malabsorption type lesions in the mucosa of Ascaris infected children.

f) I agree that a targeted approach aimed at deworming children 1-3 years of age is perhaps more sensible than deworming of entire populations. On the other hand, we don't know (and can't really find out by asking) how much environmental contamination is caused by older children and adults through inadequate latrine use. No matter where the ova come from, it is still the preschool children who will be most likely to pick them up and to suffer from the resulting infections. This is one reason that I would recommend treatment of school children and adults, though much less frequently than the treatment for preschool children.

The other reasons for recommending treatment of all available people are two. First, if you contact preschool children and their mothers through the primary schools, as we are trying to do in Kenya, the school children are already a captive audience, and so are the mothers who bring their preschoolers to the primary school to receive medication. The broad spectrum anthelmintic we are using (levamisole) has reasonable activity against both human hookworms, which school children and mothers are more likely to have than are young children. It also removes part of a burden of Strongyloides and Trichuris. I think in places where medical care is pretty scarce, it's sensible to use the same drug and delivery system to reach everybody. The particular approach, target group, and drug have to be adapted to the individual community or area of a country. But the mass treatment approach at least does have a large element of systematic prevention in it (through killing of ova producing worms).

I hope you do conduct further studies with Ascaris in Bangladesh. I get the impression that cross sectional studies probably won't yield much and that a longitudinal approach is, unfortunately, necessary. Please do keep me posted about your decisions.

Again, thank you very much for your helpful comments. Michael is now in Indonesia for 10 days on an AID consultancy dealing with nutrition surveillance. I am almost finished with my Ph.D. dissertation, at long last, and will take a post-doc here to continue the Ascaris projects in Kenya.

With all good wishes.

Sincerely,

Lani

Lani Stephenson Latham

LSL:dd

cc. Dr Samir Basta
Dr Michael Latham

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

March 17, 1978

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

Dear Clell:

I attach herewith an abstract which has been sent to the Federation of the American Societies of Experimental Biology (FASEB) of which the American Institute of Nutrition is a member. The abstract has been accepted for the April 1978 meeting. As a result Mark Brooks will make a 10 minute presentation at the annual FASEB meeting in Atlantic City in mid April.

We wanted you and the Bank to have a copy of this.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. Samir Basta ✓

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

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Professor of International Nutrition

MCL:dd

Enc.

cc: Dr. Samir Basta

Cornell University
DIVISION OF NUTRITIONAL SCIENCES
Martha Van Rensselaer 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

Mar 17

Dear Samir,

Enclosed is a copy of the abstract that I'm submitting to the XI International Nutrition Congress in Rio. It's similar to the data I'm presenting at Federation Meetings in April 78 but the audience in Rio will obviously be more international & more interested in applied nutrition, not to mention more familiar with Arcaris.

Will you be going to Rio? It sounds like a fascinating city but apparently the conference hall for the Nutrition Congress doesn't have walls

Yet so we're anticipating a bit of disorganization! Michael's off for a few days to help set up a nutrition surveillance system in Indonesia & sends his warmest regards. He's also planning to present the worker productivity data in Rio & will be sending you a copy of his abstract.

I plan to take my B exam on May 3 so am up to my ears in thesis writing. It will be so nice to FINISH!

Best wishes to you & Marina and the little Bastas + please don't drown in the paper work -

Jan

P.S. I also sent the abstract to Claire

P.S. I wish I spoke French better - could you start a worm project in a Spanish or English speaking country!

Record Removal Notice

The World Bank Group Archives & Records Management

File Title	Barcode No.
Sectoral Analysis and Linkages - Kenya Health and Worker Productivity Studies - Kenya Research - Correspondence - Volume 1	30253108

Document Date	Document Type	
17 March, 1978	Letter	

Correspondents / Participants

To: Mr. Clell Harall

From: Dr. Michael C. Latham

Subject / Title

Breakdown by year of funds expected from the World Bank for the Kenya Project

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
Tonya Ceesay	15-Apr-15

File Kenya

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College Road
P. O. Box 40064
Nairobi, Kenya
Tel. 335-422

Bank Office:

Mr. J. D. North Director
Miss. H. Goris Deputy Director

Regional Mission in Eastern
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Resident Representative, Kenya
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Haile Selassie Avenue
Nairobi, Kenya

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home: 61697

Mailing Address:

P. O. Box 30577
Nairobi, Kenya

Cable Address:

TELEX 22022
INTBAFRAD

Emmerich M. Schebeck

(Home) 703/768-2057
(Work) 202/477-3651

Clell G. Harral

(Work) 202/477-2097

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

SB
Pl. Hamelle
Ellis

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

কলেরা রিসার্চ লাবরেটরী
Cholera Research Laboratory

March 1, 1978

Samir S. Basta
Nutrition Division
Agriculture and Rural Development
Department
The World Bank
1818 H Street NW
Washington D.C. 20433

Dear Samir:

My receipt of your study "The Nutritional and Economic Implications of Ascaris Infection in Kenya" was most timely, as it arrived just as I and some colleagues were in the process of discussing the possibility of a field project on this topic.

The study is excellent in design, execution and analysis. The results are about as convincing as one can get on this complex subject. Would you please send me another four copies of this report, as well as two copies of your earlier study on iron deficiency and worker productivity in Indonesia.

One aspect of the study puzzles me. Let us focus on tricep skinfold which is the most critical variable. Assuming that ascariasis retards growth by causing nutrient wastage, one should have observed at visit I a cross-sectional difference between the ascaris and control groups. One, of course, could argue that the infection-normal-reinfection cycle occurs among all children and that a cross-section would only pick-up those currently infected. A difference would not then be expected. If ascariasis affects nutrition, one should observe slower growth between visits I and II in the ascaris group; this was observed. Between visits II and III, however, the growth rates of the two groups should be identical, since their only difference (ascaris infection) had been eliminated. The results instead show a decline in the control and an increase in the treated group. Is the large increase in the ascaris group due to "catch-up" growth?

This problem could have been reduced by including an untreated ascaris group in addition to the other two groups. There may be ethical problems here but a third

group could have been treated at the study's termination at visit III. In addition, it would have been useful to compare growth within the ascaris group according to worm burden.

The cost/benefit analysis is less convincing than the nutrition study, in my opinion. Clearly, the "cost" side of the equation is overwhelmingly based on dubious "malabsorption" data. The resulting recommendation for mass ascariasis chemoprophylaxis seems to me insufficiently focused. The prevalence data upon which it is based is not strong and I suspect that a more targeted focus on preschool children during their critical growth period, say 1-3 years, has been discarded without sufficient justification.

All of these comments are not intended to detract from an excellent study. The study's quality, in fact, is giving us second thoughts about another study of this nature in Bangladesh. If you or the Lathems have any suggestions about the need or nature of such potential future studies, I would very much appreciate hearing from you.

Best regards.

Sincerely,

Lincoln

Lincoln C. Chen
Scientific Director

c.c. M. Lathem, L. Lathem

INCOMING TELEX

Loggeds, Feb 24, 78

COMTEL FOR

MR CHESHER-DEPT OF ECONOMICS

UNIVERSITY OF BIRMINGHAM

BIRMINGHAM ENG

DISTRIBUTION

Mr. Harral
Mr. Willoughby
Mr. Loh

Mr Barta

PLACE OF ORIGIN UNKNOWN

INTERNATIONAL BANK OF RECONSTRUCTION

WASHINGTON DC

WORLD BANK WASHINGTON

ATTN DR C G HARRALL

FOLLOWING ARE CALCULATIONS ON KENYA STUDY ONE SAMPLE SIZES

STOP SUPPOSE TASK TIME IS LINEALLY RELATED TO CALORI

INTAKE AND LET ALPHA DENOTE THE COEFFICIENT ON CALORI INTAKE

IN THIS EQUATION STOP PROPOSED SAMPLE SIZE OF ONEHUNDRED

AND TWENTY MEN LIKELY TO PRODUCE A NINETYFIVE PERCENT

CONFIDENCE INTERVAL FOR ALPHA WHO'S WIDTH IS BETWEEN

SEVENTY AND ONEHUNDREDANDFORTY PERCENT OF VALUE OF ALPHAS

STOP TO REDUCE WIDTH TO BETWEEN TWENTY AND FORTY PERCENT

OF VALUE OF ALPHA WOULD REQUIRE APPROXIMATELY FIFTENHUNDRED

MEN STOP DETAILS FOLLOW BY MAIL WITH FULL REPORT POSTED UK

TODAY

REGARDS CHESHIRE

NNNN

INTBAFRAD WSH

OFFICE MEMORANDUM

TO: Mr. C. Willoughby, TRPDR DATE: February 23, 1978

FROM: I. M. D. Little, VPD

SUBJECT: 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.

£ 36,600

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

FORM NO. 75
(7–73)

WORLD BANK GROUP

ROUTING SLIP	DATE Feb. 22

NAME	ROOM NO.
Samia	

	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
Clell	E535	72097

440098 WORLDBANK

ITT1/22 FEB

INCOMING CABLE

ZCZC AWA298 VIA ITT CIC903 HMA973

UIWA ML GCBM 185

BIRMINGHAM 200/185 21 1251

Distribution:

Mr. Harral

Mr. Willoughby

Feb. 21 78

LT

DR C G HARRAL

INTBAFRAD

WASHINGTONDC

Mr Barta

Your comments, pls.

Lotte 2/23/78

FOLLOWING ARE BRIEF COMMENTS ON KENYA STUDY STOP DETAILS FOLLOW BY MAIL GENERALLY STUDY DESIGN IS ADEQUATE STOP CONTROL GROUP IS ESSENTIAL IN STUDY ONE STOP LATHAM ACCEPTS THIS STOP SENSIBLE ALLOCATION OF WORKERS TO TREATMENT AND CONTROL GROUPS WILL HELP REDUCE PROBLEMS AT ANNALYSIS STAGE

MAJOR PROBLEM CONCERNS SAMPLE SIZES STOP RELATIONSHIPS BETWEEN PRODUCTIVITY AND ENVIRONMENTAL VARIABLES HAVE BEEN FOUND TO BE DIFFICULT TO ESTIMATE IN LABSUB BECAUSE OF HIGH VARIABILITY OF PRODUCTIVITY STOP SAMPLE SIZES TO BE EMPLOYED HERE ARE PROBABLY LARGE ENOUGH TO DETECT AN EFFECT ASSOCIATED WITH DIETARY INTERVENTION BUT MEASUREMENT OF THE MAGNITUDE OF THIS EFFECT IS LIKELY TO BE INACCURATE STOP PROBLEM WILL BE GREATER IF HIGH DROPOUT RATE IS EXPERIENCED STOP THESE COMMENTS ARE SPECULATIVE BECAUSE OF LACK OF INFORMATION ON VARIABILITY OF PRODUCTIVITY DATA

we shall attempt to enlarge sample size.

NO CONTROL GROUP IS PROPOSED IN STUDY TWO STOP HENCE UNAMBIGUOUS ASSOCIATION OF TREATMENTS WITH EFFECTS WILL NOT BE POSSIBLE STOP LATHAM ACKNOWLEDGES THIS ?

Can we add a control group? No need.

IN STUDY THREE TREATMENT WILL BE GIVEN WHEN SUBJECTS ARE EXAMINED STOP SICK INDIVIDUALS MAY THEREFORE BE DISPROPORTIONATELY REPRESENTED STOP REGARDS

How to correct? This is a survey

CHESHER

C

Mr. Basta

TELEX 22022 FEBRUARY 9, 1978 72097

START HERE TO

INTBAFRAD, NAIROBI, KENYA

ITY/COUNTRY

PROF. MICHAEL LATHAM CARE OF BERTIL NILSSON OR DR. A. JANSEN

MESSAGE NO.:

MEDICAL RESEARCH CENTER NAIROBI. AAA YRLTR JANUARY 24 JUST

RECEIVED. WE ARE DESPATCHING REPORTS REQUESTED CARE BERTIL NILSSON.

BBB PLEASED TO ADVISE THAT REVIEW PANEL HAS RECOMMENDED BANK

RESEARCH COMMITTEE FUND YOUR PROJECT SUBJECT TO RESOLUTION CERTAIN

QUESTIONS, AND FORMAL ACTION BY RESEARCH COMMITTEE IS EXPECTED

FEBRUARY SEVENTEEN. WE WILL REQUIRE THAT YOU VISIT WASHINGTON

FOR ONE DAY IN LATE FEBRUARY OR EARLY MARCH TO MEET WITH REVIEW

PANEL TO RESOLVE OUTSTANDING QUESTIONS AND AGREE CONTRACTUAL

ARRANGEMENTS. CCC ONE COMMENT BY REVIEW PANEL IS QUOTE THAT

RELEVANCE OF YOUR PROJECT TO CURRENT OR PLANNED PUBLIC PROGRAMS AND

POLICIES IN KENYA IS NOT CLEAR. THIS IS PARTICULARLY TRUE FOR

STUDY FOUR, WHERE 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 UNQUOTE WHILE THE BANK ITSELF WILL BE PURSUING THIS

ISSUE WITH THE GOVERNMENT IT WOULD BE USEFUL BEFORE YOU DEPART

/c

END OF TEXT

START HERE

TO

CITY/COUNTRY

MESSAGE NO.:

NAIROBI IF YOU COULD MEET WITH HARRIS MULE DEPUTY PERMANENT SECRETARY MINISTRY OF FINANCE TO REPORT THE CURRENT STATUS YOUR WORK AND INQUIRE WHAT FOLLOWUP HE MAY FORESEE AND THROUGH WHAT AGENCIES. DDD ANOTHER PANEL SUGGESTION IS THAT IT WOULD BE USEFUL TO PROVIDE FOR AT LEAST MODEST INPUT OF AN ECONOMIST ESPECIALLY WITH RESPECT STUDY TWO. WE SUGGEST YOU CONTACT PETER HOPCRAFT OF IDS NAIROBI UNIVERSITY TO EXPLORE HIS SUGGESTIONS AND POSSIBLE INTEREST IN ADVISORY ROLE. EEE ANOTHER QUESTION WAS DIRECTED AT STATISTICAL DESIGN AND ANALYSIS. REVIEW PANEL WILL WISH TO DISCUSS ANDREW CHESHERS COMMENTS ON PROPOSAL AFTER HIS MEETING WITH YOU SO PLEASE TAKE SOME CARE TO BRIEF CHESHER AS WELL AS SHARROCK FULLY. FFF FULL COMMENTS OF REVIEW PANEL ARE BEING MAILED YOU CARE NILSSON AND ALSO CHESHER. GGG PLEASE INDICATE BY RETURN CABLE ANY PARTICULAR DATES YOU MAY PREFER FOR WASHINGTON MEETING BETWEEN FEBRUARY 23 AND MARCH 8.

REGARDS HARRAL INTBAFRAD

END OF

Research: Nutrition

CGHarral:ks

C.G. Harral

cc: Messrs. Basta
Coukis

TRP

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

M. Basta.

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 inportantly 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

Form No. 1168
(4/77)

WORLD BANK RESEARCH PROGRAM

Project Proposal

Date of Submission

November 16, 1977 (Revised 2.9.78)

PART I. PROJECT IDENTIFICATION

1. Title: KENYA: Health, Nutrition and Worker Productivity Studies

2. Department(s) Responsible: Transportation	3. Staff Participation a. Principal Supervisor: Clell G. Harral b. Others Responsible: S. Basta
4. No. of Contracts: 1	5. Estimated Total Cost: $168,~~500~~ 150 (less $71,500 co-financed)

6. Estimated Total Staff Time Required (weeks):

Professional: 6 Assistant:

PART II. COORDINATION AND APPROVAL

1 Interdepartmental Coordination:

Department	Name and Signature	Support Project	No Objection	Do not Support Project-Comments Submitted
a. Nutrition Division Agr. & Rural Dev.		X		
b. East Africa Programs		X		
c. East Africa Projects		X		
d. DPS Population and Human Resources		X		

2. Departmental Approval:

Division Chief (signature)

Department Director (signature)

PART III. IMPLEMENTATION

1. Date Work to Start: 1/78 2. Date First Draft Expected: 12.30.79

3. Date Final Report Expected: 12.1.80

4. Implementation Method: Names:

a. Bank Staff..... / _____

b. Individual Consultants..... /XX/ _____

c. Developing Country Contractor/Institute.. / _____

d. Developed Country Contractor/Institute... / _____

e. Conference or Seminar..... / _____

5. Proposed Liaison with Operating Departments:

Informal advisory group and discussion of progress reports

6. Reports Expected in the First Year:

PART IV. FINANCIAL AND STAFF RESOURCES

1. Dollar Costs (Estimated Disbursements by Fiscal Year):

	FY 78	FY 79	FY 80	After FY	Total
a. Consultant Fees	22,000	22,000	(34,500)		44,000
b. Travel (Bank staff)	3,750	7,500	(7,500)		11,250
c. Data Processing					
d. Other Contractual Services					
e. Contingencies					
Total	25,750	29,500	(42,000)		55,250

2. Staff Requirements (Estimated staff-weeks by Fiscal Year):

	FY 78	FY 79	FY 80	After FY	Total
a. Professional	4	4	(4)		8
b. Assistant					
Total	4	4	(4)		8

Mr Baxter
I am drafting a cable reply.

P.S. Could you please share this with Basil Conkie

C/O DR. A. JANSEN
MEDICAL RESEARCH CENTRE
BOX 20752
NAIROBI

28

Logged 8/7/78

Mr. Clell Harral,
World Bank
Washington, D.C.

24 JANUARY 1978

Copy made for Mr. C. ① cc also to Knowles
Prav: ② Have you or Helen sent the reports [illegible] p.s.? If not please do ASAP!
③ file: Nutrition Research

Dear Clell,

This is just to let you know that we have been busy in Kenya for 3 weeks, and that things are going well. The five of us (Dr. David Crompton and Andrew Hall from Cambridge Univ.; June Wolgemuth, Lani and I from Cornell) have been mainly involved with the roundworm study in Machakos. But we ~~do~~ have had discussions with Mr. Nilsson and Mr. Simpson on 3 occasions in Nairobi, and have spent time in Nyeri with Mr. Knowles. We have selected a road site in Nyeri for a preliminary study, and a second one near this in Murangaa District for the definitive study (Study No. 1) on nutrition and worker productivity. It has been agreed that this 14 km. stretch of road will be geared especially for our study. That is very satisfactory. Up to now co-operation has been very good. Very soon we will be hard at work in Nyeri.

We still have some financial problems. Apparently O.D.M. do not provide money in advance, but they repay for expenditures already incurred. This is not the way that

, or Cornell are used to working. I am therefore having, rather desperately by correspondence to get Cornell to advance $6000.00 to cover our rather heavy expenditures incurred while the five of us are here, and when the project is beginning.

I would be most grateful if you could send me a cable when and if the World Bank Research committee meets and makes a decision on the funding for Studies 2, 3 & 4 of our project provided that is before Feb 18 when I leave Kenya.

I have arranged to meet with Mark Shorrock and Andrew Chesher in London on Monday 20th. February, on my way back to the United States. At that time firm arrangements can be made for their participation, and a date set for Mark Sharrocks visit to Kenya in the spring or early summer.

There are a number of persons in Kenya who are very interested to read the Staff Working Paper No. 271 on Roundworm infections in Kenya. Could you please send 10 copies of this, and perhaps also 10 copies of Technical Memorandum No. 26 which is the report on Nutrition and Work productivity, by pouch to me in Nairobi? Could you also if possible send a copy of our research proposal to Dr. DAVID CROMPTON MOLTENO INSTITUTE, CAMBRIDGE UNIVERSITY, DOWNING ST., CAMBRIDGE., ENGLAND?

Done

Lani sends her best wishes

Sincerely,

Michael Latham

Latham will be in Kenya 15 June + 6 wks.

The World Bank

Meeting on March 2, 1978

A panel consisting of: Berg, Beanstalk, Greene, Howal, Carranza, Schobelk, + Barta
student in Field + Parasit. from Cambridge.

study 1
question 4 King memo: 5, 6.
Only study in which W Produc. is being looked at. - 700 Cals. - Mark Sharokk will measure productivity at baseline. - Food to be used not necessarily that which will be used as an acceptable food - Pure research. (because of placebo)
drink or gruel to be used (soy.)
study 2a will provide the real food + delivery system. No work output studies here. Assumption is if 700 cals for study 1 O.K., then 700 cals in study 2a given in another food will be OK.
Absenteeism + other records will be looked at.

How is the 700 cal foods going to be chosen?

1 - What is being eaten
2 - Foods in region
3. Vehicle
4 - Sales, subsidy, giveaway,
5. requirements of Consumption, acceptability, etc

7, 8:

Harris Mulley, Perm. Secretary, Min of Plan, Kenya, particu-interested in study 2a and parasite control study - Wants to include parasite control program + nutrition in 5 yr. plan.

Worms:

It is not a drug trial, in the sense that the effect of the drug is known already. What is not known is reinfection rates etc in a village situation. — also no data exists in Kenya, or elsewhere, of Longitudinal growth of children. — Relevance to other Bank projects eg NE Brazil.

Random sample of adults will also be taken to determine prevalence

10. Economics:

Get names from Lalita for IDS guy and Cornell guy.

Mr. Basta

The University of Birmingham

DEPARTMENT OF ECONOMICS
Faculty of Commerce and Social Science
The University of Birmingham, P.O. Box 363,
Birmingham,
B15 2TT
Telephone 021-472 1301

ADC/MM

23 February 1978

Dr C.G.Harral,
Highway Design & Maintenance Adviser,
Transportation Department,
The World Bank,
1818 H Street N.W.,
Washington D.C. 20433,
U.S.A.

Dear Clell,

I enclose my comments on the Kenya Health, Nutrition and Worker Productivity Study. These expand the comments in my Telex of 22 February. Dr Latham, after reading the minutes of your meeting of 31 January, particularly paragraph 9, asked me to write a note on the statistical analysis of the data and the presentation of results - this is also enclosed. I have sent copies of these to Dr Latham and to SWKP.

Having read Dr Latham's proposal and Technical Memorandum No.26 I think you may be right to have a few worries over statistical analysis. Regarding Technical Memo 26 the presentation of results is incomplete (for instance where are the actual estimated regression equations?) and some curious manipulations are carried out with the data. For example, in one equation all task times are regressed on weight as a % of weight for height but these are times to perform different tasks - the meaning of this equation is not clear to me. Regarding Dr Latham's proposal, the eschewing of multivariate statistical techniques (Appendix, p.5) may not be sensible. The analysis in Technical Memo 26 might have benefitted from multiple regression analysis relating task time to weight as % of weight for height and other clinical and anthropometric attributes simultaneously.

Let me know if my comments require clarification.

Best wishes.

Yours sincerely,

Andrew Chesher

OFFICE MEMORANDUM

c/o Asher in London + c/o Nilsson in Kenya
N. Cheeher
Sharrock
J. Greene
B Conkin

TO: Mr. Armeane M. Choksi

DATE: January 31, 1978

FROM: Benjamin B. King

SUBJECT: Kenya - Health, Nutrition and Worker Productivity Studies

Dr. Casazza

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

OF ICE MEMORANDU" C/o Chokshi in London + c/o Nelson in Kenya — A. Choksi, Sherrock

.r. Armeane M. Choksi DATE: January 31, 1978

.M: Benjamin B. King

File — Mr. Greene

..JECT: Kenya - Health, Nutrition and Worker Productivity Studies

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700 Kcal supplement 0-3-6 x Section

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accept./feas/cost/delivery

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

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

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

cc: Messrs. Basta, Harral

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

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

Selective memo re seminar to be sent to:

B.S. Minhas
Selowsky
Reutlinger
Tim King
Avramovic
Gulhati
Perlin
Kanagaratnam
Baldwin
Messenger
Jim Lee
Goladay
Chener
Yudelman
Schebeck
Jim Green
Basta
Turnham
Chernichovsky
van der Tak
Baum
Ms. Tager
whoever is chief of Indian Region
Ranganathan
Beenstock
Koch-Weser (with note: You may wish to show this to Mr. McNamara).

SB

Copies of Staff Working Paper #271 were sent to UN agencies and individuals indicated on list - per Berg's request.

Jan 1/24

LIST OF PARTICIPANTS TO THE 2nd ACC SUB-COMMITTEE ON NUTRITION

UNITED NATIONS

Department of Economic and Social Affairs (ESA)

Mr. H.J.A. MORSINK
Social Affairs Officer
Division of Social Affairs
United Nations Office at Geneva

Office for Inter-Agency Affairs and Co-ordination (OIACC)

Mr. Theodore S. ZOYPANOS *
External Relations and
Inter-Agency Affairs Officer

UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION

Dr. E. HOOKHAM
Programme Specialist, Nutrition
Division of Science and Technology
UNESCO, Paris

WORLD HEALTH ORGANIZATION

Dr. M. BEHAR
Chief, Nutrition Unit, WHO, Geneva

WORLD BANK

Mr. Alan BERG
Senior Nutrition Advisor
Agriculture and Rural Development Department
World Bank, Washington

UNITED NATIONS CHILDREN'S FUND

Mr. E.J.R. HEYWARD
Senior Deputy Executive Director
UNICEF
New York

Dr. L. J. TEPLY
Senior Nutritionist
UNICEF, New York

UNITED NATIONS DEVELOPMENT PROGRAMME

Dr. Robert MUSCAT
Director
Programme Policy Division
UNDP, New York

WORLD FOOD PROGRAMME

Mr. J. MOSCARELLA
Economic Adviser to the WFP
Rome

UNITED NATIONS UNIVERSITY

Dr. Nevin S. SCRIMSHAW (Chairman)
Senior Adviser, World Hunger Programme
UNU, Cambridge, Mass, USA

UNITED NATIONS ENVIRONMENT PROGRAMME

Mr. Dario SANVINCENTI
UNEP, Nairobi

* partial participation, owing to other official commitments.

WORLD FOOD COUNCIL

FOOD AND AGRICULTURE ORGANIZATION

Dr. U. KRACHT
Senior Economist (Nutrition)
WFC, Rome

Mr. G.O. KERMODE
Officer-in-Charge
Food Policy and Nutrition Division

Dr. P. LUNVEN
Chief Food and Nutrition Assessment Serv
Food Policy and Nutrition Division

Dr. M.A. TAGLE (Secretary)
Acting Secretary
ACC Sub-Committee on Nutrition

Mr. S.C. GUPTA
Policy Analysis Division

Mr. K.B. KOLDING
Senior Liaison Officer
FAO/UNICEF

Mr Burke

Mr. B.B. King, VPD

January 17, 1978

E. Bevan Waide, ASNVP

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. Chokai

Could you, briefly, let us have your views on this comment as soon as possible? ~~BB~~

INCOMING CABLE 1b

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Logged 1/10/78

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Jan 9, 1978

Barta — FYI

DIST. - MR. C. HARRAL

LT

C G HARRAL TRANSPORTATION DEP

INTBAFRAD

WASHINGTONDC

SHARROCK OF SWKP AND I ARE MEETING FRIDAY JANUARY 20TH TI DISCUSS DESIGN OF KENYA HEALTH AND NUTRITION STUDIES STOP WI WILL BE ABLE TO HAVE REPORT ON DESIGN WITH YOU BY FEBRUARY 1ST STOP IF YOU WISH FOR REPORT SOONER PLEASE INFORM STOP PAGES 13/16 OF LATHAMS DRAFT PROPOSAL SUGGEST FURTHER INFORMATION ON DESIGN IS STILL TO COME STOP SHOULD I WAIT FOR THIS BEFORE REPORTING ? REGARDS

ANDREW CHESHER

COL SWKP 20TH 1ST 15/16

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

place: G. Chesham
S. Barton
file: Nutrition Res

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

January 4, 1978

Mr. Mark Sharrock
Scott Wilson Kirkpatrick
Scott House
Basingstoke
Hants., England

Dear Mr. Sharrock:

I understand that Clell Harral of the World Bank in Washington has been in touch with you concerning the possibility of getting your assistance for our project in Kenya. I believe that you have been sent a copy of the proposal. I look forward very much to working with you.

My colleagues and I from Cornell and Cambridge Universities will be going to Kenya in early January in order to undertake the next stage of the research project on roundworm infection in children, but also to begin work on the worker productivity study. I plan to stop in London for a day or two on my way back. I believe that it would be very useful if we could get together for a couple of hours then. The best day for me would be Monday, February 20, in London.

I expect to be staying at the Royal Commonwealth Society, 18 Northumberland Avenue, London WC2. Could we meet there at say 11 a.m. that day, or somewhere else if that is more convenient for you.

Could you let me know if this arrangement is satisfactory. A second possibility would be Tuesday, February 21. Please write to me c/o Dr. A. Jansen, Medical Research Centre, P. O. Box 20752, Nairobi, Kenya.

I expect that Clell Harral has let you know that it is my view that the most useful time for you to be in Kenya would be beginning in late May or early June 1978. I will have a much better idea about this when I see you in London in February.

I am delighted that we will have the advantage of your expertise in this next stage of our project.

Sincerely,

Dr. Michael C. Latham
Professor of International Nutrition

MCL:dd
cc: Mr. Clell Harral ✓

22951 WUICBL G
263907 ODMLDN G

OUTWARD

Misc
SECTION
(1) cc to Barta
(2) file: Nutrition Research

263908
LT CORNELL UNIVERSITY SAVAGE HALL ITHACA NEW YORK

TO CORNELL UNIV NEW YORK MISC 357 AIRMAIL WORLD BANK WASHINGTON
DR HARRAL
FOR PROF LATHAM
WORLD BANK TELEGRAM TODAY REPORTED GOVT OF KENYA APPROVAL FOR YR NUTRITION STUDY.
2. ODM RESEARCH GRANT OF £36,600 CAN ISSUE ON RECEIPT OF CONFIRMATION FROM CORNELL THAT UNIVERSITY WILL ADMINISTER FUNDS. DETAILED ACCOUNTING ARRANGEMENTS CAN THEN BE AGREED WITH MINISTRY'S ACCOUNTS DEPT.
3. PLEASE STATE WHETHER YOU REQUIRE ADVANCE OF FUNDS EQUAL TO COSTS FOR FIRST THREE MONTHS OF BUDGET

MINISTRANT
PERF 1010Z 20 DEC MF

22951 WUICBL G
263907 ODMLDN G

Messrs Schebeck / Basta

The World Bank / 1818 H Street, N.W., Washington, D.C. 20433, U.S.A. • Telephone: (202) 393-6360 • Cables: INTBAFRAD

September 30, 1977

Professor Michael C. Latham
Cornell University
Division of Nutritional Sciences
Savage Hall
Ithaca, New York 14853

Dear Michael:

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 look forward to hearing your presentation here in the Bank on October 11, when we hope also to finalize any outstanding details in your proposal.

We have agreed that the proposed continuation of your work on health and nutrition in Kenya be regarded as one package composed of four 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) Brief survey of Health and Nutritional Factors in Two New Ecological Areas.

(iv) Evaluation of the Feasibility and Effectiveness of a Parasite Control Program.

We understnad 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; it would facilitate matters greatly if you can have revisions in the proposal to take account of the points

made below in advance of the seminar. Immediately following the seminar we would hope to incorporate responses to any other issues which may be raised.

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 advance of the fieldwork. (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. Various persons have indicated that they did not understand the relationship of study 3 to the previous and proposed work, nor the costs thereof. The description of study 3 and its costs should be clarified.

(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 amoutn of iron administered (elemental and salt) must be specified. It should be based on a hemoglobin 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 Mule, has given approval in principle to the continuation of the health/nutrition work. Mr. Mule has asked for a copy of your report on "The Relationship of Nutrition and Health to Worker Productivity in Kenya" which we are now printing as a (draft) Technical Memorandum. (I hope to be able to post a copy to you later today.) 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 for the final version.

The Ministry of Works, through the Permanent 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

FORM NO. 75
(7–73)

WORLD BANK GROUP

ROUTING SLIP	DATE

NAME	ROOM NO.
Messrs: ~~Christoffersen~~	D-839
~~Venkitaramanan~~	
~~Sekhebeck~~	
~~Greene~~.	

	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

I enclose for your interest the summary results of the Nutrition/Productivity study that we financed in Kenya last year.

The complete report will be issued in a month or so by Urban Projects/Transportation Projects Depts.

FROM	ROOM NO.	EXTENSION
Samir Basta	D626	

Dietary intakes of calories, protein, minerals and vitamins were found to be fairly similar in Nyeri and Kwale.

IV. Conclusions

The study has shown that undernutrition is common in road workers both in Nyeri and Kwale. Using low weight for height as evidence of undernutrition, it was shown that this is significantly related to lower worker productivity. Workers on the road sites are on the average losing weight which indicates that their calorie intakes are lower than their caloric expenditure. Clearly if this process went on for many months the workers would become very thin and weak, or they would reduce their work output.

An intervention with calories reversed this trend. It led to some gain in weight, in arm circumference and in skinfold thickness. The intervention therefore is having a positive impact on nutritional status of the workers, because of time constraints but showed no effect on increased worker productivity.

Anemia was common in Kwale but not in Nyeri. It is often 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 resulted in a rise in hemoglobin and in hematocrit levels, and an increase in worker productivity.

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.

In Kwale District, and in other 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. An investigation is needed to determine the relative contribution to anemia of dietary and parasitic factors. It should be stressed that 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.

OFFICE MEMORANDUM

TO: Mr. S. C. Hardy, Standards & Procurement Adviser DATE: September 19, 1977
Transportation Department

FROM: Basil P. Coukis BPC

SUBJECT: Coordination with the Overseas Development Ministry of the United Kingdom on the Proposed Health/Productivity Studies in Kenya
Back-to-Office and Full Report

1. I summarize below my discussions with Messrs. Jordan and Chard on August 10 and 31 about the proposed health/productivity studies in Kenya.

2. After the completion of his report (currently under publication in our Technical Memoranda series) on the health/nutrition research he carried out during 1976 in Kenya, Professor Latham prepared a proposal for the "Evaluation of Health/Nutrition Interventions on the Productivity of Casual Laborers in Rural Civil Works" to be carried out in Kenya, starting in January 1978. This comprises the following four interrelated, but separate, studies:

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

(b) Evaluation of Practical Interventions to Improve Health and Worker Productivity.

(c) Study of Health and Nutritional factors in Two New Ecological zones.

(d) Evaluation of the Feasibility and Effectiveness of a Parasite Control Program.

3. A copy of the proposal was addressed to, and discussed by Professor Latham with, the Overseas Development Ministry. The Ministry had expressed interest in funding work that would follow up on Professor Latham's research within the Kenyan Rural Access Roads Program.

4. During my August 10 meeting with ODM, it was proposed that the four studies be regarded as a package to be jointly financed and administered by the Bank and ODM. ODM would undertake to finance Study 1, which they regard as "non-regional specific research", while the Bank would finance the remaining three. ODM expected to get internal clearance for Study 1 by the end of August and we agreed we should meet again on my way back to Washington from Kenya.

5. I reported on the above in a telex to the Bank and after communicating with Mr. Harral while I was in Kenya, I did the following:

(a) Secured approval for the "package" by Mr. Harris Mule, Deputy Permanent Secretary in the Ministry of Finance and Planning, on behalf of the Kenya Government.

(b) Secured permission from Mr. Simon Mbugua, Permanent Secretary in the Ministry of Works, that the Rural Access Roads Program continue to be used as the vehicle for the health/nutrition research.

(c) Discussed with staff members of the IBRD Technology Unit in the Ministry of Works the requirements for a Work Study Engineer who would collaborate with Professor Latham in the rigorous measurement of worker productivity.

6. During my August 31 meeting with the ODM, I was told that internal clearance for the health/nutrition research had not yet been secured but that it was a virtual certainty it would be forthcoming shortly. I mentioned that Bank procedures will probably prevent the Bank's portion from being approved before December. The question therefore arose as to whether ODM financing could be forthcoming quickly enough for Professor Latham to start his work sometime in January without waiting for Bank funding approval. The answer given me was that, although in the absence of internal approval no commitments could be made, all indication pointed to a contract being signed with Professor Latham during September/October.

7. I told ODM that, following the exchange of communications between Mr. Harral and myself, the Bank will provide a qualified Work Study Engineer to assist Professor Latham in the productivity measurements for both the ODM and the Bank-sponsored protions of the package. ODM was appreciative of the offer and are awaiting its formal confirmation.

cc: Messrs. Willoughby, Harral (TRP)
S.S. Basta (AGR)
Mrs. S. Boskey (IRD)

BPCoukis:sf

TELEX

JUNE 27, 1978
74925

INTBAFRAD

NAIROBI, KENYA

FOR NORTH. RE YOUR 1418. BURA EAST TERMS OF REFERENCE WILL BE HANDCARRIED TO YOU BY MR. BASTA ARRIVING NAIROBI JULY 5.

REGARDS, WALDEN.

KENYA BURA EAST

FMPatorni/il

M. J. Walden, Chief
EAPCA

c.c. Mr. S. Basta

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

Discuss file dr

TO: Mr. Clell G. Harral

DATE: May 9, 1977

FROM: Basil P. Coukis BPC

ES We may discuss. Can we make the continuation of this work a Bank Research Project?

SUBJECT: SOL/KENYA - Health and Nutrition Studies: Current Status and Prospects

1. Mr. Latham has submitted the draft final report on "The Relationship of Nutrition and Health to Worker Productivity in Kenya" 1/. Mr. Basta and I have agreed that it is a very interesting piece of work and that it deserves rapid, and wide, distribution before it is finalized. We have agreed to issue it as a Technical Memorandum and Mr. Basta is in the process of editing it.

2. When comments have been received, and Mr. Latham has had the opportunity to complete the analyses mentioned in the fourth paragraph of his letter, we feel that the report might be issued as a Bank Staff Working Paper. This can be done sometime in late summer, early fall.

3. The report reveals a number of issues specific to two construction units of the RAR Program (in Nyeri and Kwale):

(a) Clear evidence of undernutrition: the majority of the men consume far too few calories;

(b) Clear evidence of significant anemia problems in Kwale; in addition, the majority of subjects had more than one parasitic infection;

(c) Low weight for height was strongly associated with a lower work productivity over time, and anemia was also correlated with reduced work output, as in the previous Indonesian studies;

(d) The two interventions (provision of 700 extra calories and of 600 mg. of ferrous sulphate) led to physiological improvements. Iron treatment led to an increase in work output, but caloric supplementation did not, probably because the time period was too short;

(e) Weight loss of workers seems to be common, and to result from an inadequate calorie intake.

4. The health and nutrition status of the labor force are critical parameters in a construction program that relies on the efficient use of casual workers. It is stressed in the report, that treatment is only a temporary control measure. In the long run, appropriate public health measures in the community are needed to control these diseases. (e.g. better nutrition and control of parasite infestations).

1/ Attached with covering letter.

5. In September 1976, the Overseas Development Ministry of the United Kingdom expressed interest in a possible intervention program that might result from the Study recommendations. A draft proposal ("An Evaluation of Practical Interventions Designed to Improve Health, Nutrition and Worker Productivity in Kenya") was prepared by Mr. Latham and I discussed this document with Messrs. Jordan and Chard, and with Professor Waterlow when I visited the ODM in October 13, 1976. The draft proposal recommends that different treatment/feeding programs be attempted and evaluated on a large, applied scale.

6. At the end of that meeting, the following conclusions emerged:

(a) ODM was very interested in the follow-up phase;

(b) Before committing any resources, they would like to review the final report.

7. On May 5, 1977, I met with Miss Mason and Messrs. Reid and Kennedy of EAP, briefed them on the above, and asked for their reactions to a possible program of intervention (over a 3-year period and costing about $100,000, as in Mr. Latham's September 1976 proposal). The EAPHW, which is responsible for the Bank's participation in the RAR Program, is prepared to collaborate with Mr. Basta who, if the intervention program gets underway, would supervise its technical aspects. I have given Miss Mason a copy of the draft final Report and we have agreed to meet again sometime next week and discuss with Mr. Basta the next steps.

8. It seems to me that the Bank (through departmental, research or other funds) ought to continue its involvement in health/nutrition work in Kenya. The ODM assistance ought to be welcomed but, I believe, ultimate control and responsibility ought to remain with the Bank.

9. Perhaps you could discuss the matter with Mr. Reid sometime during the week of May 7. Professor Latham will be stopping in London on May 30 and he will be visiting the ODM, to whom I have sent a copy of his draft final report. It would help if he had an idea of the extent of the Bank's involvement so that he could discuss with greater precision the possible role of the ODM.

BPCoukis:sf

cc: TRP
Messrs. Willoughby
Hardy
Carnemark
EAPHW
Messrs. Reid
Kennedy
Bjelogric
Miss Mason
URB
Messrs. Basta
Churchill
VPD
Mr. Grimes
EA1
Miss Sato
NDP
Mr. Venkitaramanan

Mr. Venkitaramanan

INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION

OFFICE MEMORANDUM

TO: Mr. C.G. Harral, Chief, Transport Research Division DATE: March 22, 1976

FROM: S.S. Basta, Urban Division 11A

SUBJECT: KENYA: Nutrition/Productivity Road Construction Workers and Roundworm Study (RP0315) - Back-to-Office Report

1. Following my terms of reference dated January 7, 1976, I arrived in Nairobi from Jakarta on February 21, 1976 and met with Dr. Michael Latham and the rest of his study team. On February 22, I proceeded up-country to the Nyeri Valley in order to examine at first hand the productivity and clinical measurements of the road construction workers. On February 23, I spent the day at Kenyatta General Hospital, Nairobi, discussing with Mrs. Lani Latham details of the roundworm/growth study on young children and examined the conditions of several of these infants. The productivity study will cost US$28,000 and the Hospital study US$7,000.

2. The Productivity study, modelled in the lines of our research in Java and India on adult laborers, can be divided into three parts. The first part deals with representative work output measurements on 48 quarry workers and 40 road construction workers (rural access roads program) in the hills of the Nyeri Valley and is proceeding on schedule. The second part deals with the supplementation of half these workers (paired controls) with a 600 to 800 caloric drink for six to eight weeks and a repeat of the work output measurements, and the third part deals with similar work output measurements and caloric/iron supplementation in road laborers working in the lowlands around the Mombasa coastal region. This last study will aim at assessing the difference between highlanders and lowlanders in order to obtain results that are representative, since clinical differences (i.e. worm infestations and dietary intakes) differ among geographical regions. The coastal region studies are due to begin around the middle of April and the sample will be of the order of around 100 laborers.

3. In more detail, the productivity measurements on the quarry workers in Nyeri is proceeding as follows: each worker is given a clinical, dietary and anthropometric examination and then paired with a fellow worker. Each is given a "karai" which is a local implement shaped like a large hollowed out dish and is held on the back by two hands, and a numbered tee-shirt. He is then told to fill the karai with the loose gravel and small rocks in the quarry (supervised by foremen) and proceed 50 to 60 metres to an open trailer where he dumps the rocks. When he finishes fifty "karais", he is allowed to go home. Two field workers (senior high school students) record the time it takes for each worker to complete his cycles. The lead on each karai is about 30 kg and the foremen and field workers ensure that each is full. Five open trailers are used so it is possible to record several workers simultaneously. Three day measurements are recorded for each worker.

Anthropometric measurements are taken before the study and before and after supplementation.

4. In the road construction work, 40 individuals are divided into two groups, such that each worker in the first group is paired with a worker of nearly identical weight for height in the second group. These pairs work together on a stretch of the road to be built. The work entails the removal of a standard amount of earth which has been previously demarcated by the site engineers. The amount of earth to be removed is the same for each worker, and all the workers use the same type of tools, namely a type of hoe to loosen the earth, and a shovel to dig it out and dump it over the road parapet or edge (such that a road 'shoulder' is made). The amount of earth to be removed per day per worker is around six cubic metres. After each worker finishes this amount he is allowed to go home. The time taken per worker to finish ranges from three to six hours - a remarkable variation considering the standardization of the task.

5. To summarise so far, there are therefore two parameters of "productivity" which are being measured. The first is time taken to finish a standard task in both quarry and road workers, and the second is weight for height as well as arm and chest circumference and skinfold thickness. If the work task is expending more calories than are being ingested, then there will be a steady decline in these anthropometric measurements during a two month period. During caloric supplementation of the control groups, this decline should be arrested or reversed and work time should also, theoretically, decrease.

6. The procedure for supplementation or intervention is based on the current practice that around mid-morning each worker purchases a porridge like drink from a female vendor present on site. This porridge made from cornmeal millet and sugar is termed "oojie", and costs around 40 Kenyan cents per cupful (around 5 US cents), which is 5% of their daily salary. For intervention (caloric supplementation) it is proposed and I agreed that half the workers will get a fortified oojie containing an extra 600-800 calories obtained by adding more sugar and a little fat, while the other half will continue to receive the "unfortified" oojie. Both types of drinks will be provided free and only one cupful will be provided free and only one cupful will be allowed per worker (as is the case now, but here, price is the constraint). The female vendor will continue to make up the unfortified "oojie" and will be paid accordingly, while the fortified oojie will be made up by Dr. Latham's student, Mark Brooks, and then given to the vendor for distribution under strict observation. This intervention period will run for six weeks in Nyeri, and at the end of that time anthropometric measurements will be taken (e.g. weight for height), to see if the supplemental workers have maintained (or increased) their body weight relative to controls, and if work output has differed among both groups. A similar six week design will be followed in the site near Mombasa. It should be noted that the "oojie" these workers drink represents both "breakfast" and "lunch".

7. In regards iron deficiency anemia, the results of the hemoglobin and hematocrit (blood iron) determinations have revealed that no anemia exists in the male worker population at Nyeri, even if one adjusts for the effect of altitude and the resulting polycythemia. In fact, compared to the previous population studies by us in Java we can say that in regards hemoglobin we are dealing with a non-iron deficient population. Dietary and stool tests will be undertaken to determine the reason. The relatively high altitude in Nyeri and the cold temperature will make it unlikely that hookworm will exist. However, in the coastal lowland population that will be studied near Mombasa, hookworm will probably be present, and the likelihood of finding anemia is much stronger.

8. In any case, in order to examine the effect of hemoglobin values upon work output, a sample of ten workers divided into high (above 16g%) hemoglobin and "lower" hemoglobin (13g% to 15.9%) have been assigned in to groups to do ditch digging. The ditches lengths are 30 metres each, and they measure 40cm x 40 cm. Both groups will be treated with iron supplements during intervention, in order to see if blood iron levels will rise even higher, and whether this will have a beneficial effect upon workput.

The Hospital (Roundworm) Study

9. The objectives of the hospital study which we are financing for US$7,000 are to examine the effect of roundworm infestations and their removal upon the metabolism and growth of young children. Given that this subject has been very poorly researched in the past, and that some 70% of the low income populations in developing (and some "developed"!) countries suffer from this problem, it is of some importance to assess to what measure roundworm infestation contributes to malnutrition both directly and indirectly.

10. Accordingly, as part of a much larger study financed by the Royal Tropical Research Institute of the Netherlands which will also examine socio-economic characteristics and the growth patterns of 400 children from two semi-urban villages in terms of their ability to contract roundworms (ascariasis), the Bank's portion of the study will only concentrate on the metabolic aspects of 20 hospitalized malnourished children regarding their ability to absorb and metabolise protein and carbohydrates (nitrogen balance and D-xylose tests) while undergoing treatment for both malnutrition and roundworms. It should be noted that infestation by worms other than ascaris had shown to be almost non-existent in these populations.

11. In more detail, children suffering from malnutrition (kwashiorkor) are selected visually from the pediatric waiting rooms and wards of Kenyatta General Hospital. Their mother's consent is obtained and both mother and child are transferred to a lying-in ward for a period of 2-1/2 weeks. The children are divided into those with ascariasis and those without, on the basis of stool tests. They are initially put on a ward diet for two to four days, then on the "balance" or "metabolic" diet (high calorie, high protein) formulated on the basis of 150 calories/kg body weight and 3.4 gm. protein per kg. body weight for

four days, then dewormed using the product "Ketrax", which is well tolerated and made by Imperial Chemical Industries Ltd. of the U.K. The "deworming" period lasts another four days, and the children are then put on the balance diet for another four days. During all this time, the children's growth is carefully recorded, and blood, urine, and faeces collected. 'Absorption' is recorded by means of measuring the end product of protein metabolism (nitrogen) in both urine and faeces and relating this to the amount ingested. The other absorption test used is one in which a non-metabolizable carbohydrate (D-xylose) is ingested and its subsequent appearance in the urine measured.

12. The theory behind these studies is that if roundworms interfere with absorption (either by metabolising some of the food, producing a toxin, or causing some physical alteration in the gut's structure or motility) then this will be reflected in changes in nitrogen or D-xylose absorption, relative to children without worms, or relative to deworming.

13. The cycle, absorption - nutrition - infection - absorption will thus be examined. The results of this study, which will be supplemented by some of the socio-economic and seasonal data obtained from the Dutch study will be analyzed by computer in Cornell University, USA, starting September, 1976. The report will be sent to us by the end of February 1977, and will also include an economic study on the cost benefit of treatment on a large scale.

14. In regards the nutrition/productivity study on the road construction workers, the report will be sent to the Bank by November 1976. Dr. Latham and Mrs. Latham agreed that no outside publication will be sought unless the Bank has first examined any and all manuscripts, and cleared these for outside publication.

15. On February 24, 1976, I departed for Washington via Cairo (annual leave).

SSBasta:mrd

cc: Messrs. van der Tak (2), Carmignani, Ray, Raizen, Lee, Golladay, Koch-Weser, Ms. Leone (Office of the VP/Projects Advisory Staff); King (Development Policy); Jaycox, Churchill, Dunkerley, Hardy, Nanjundiah, Strombom, Venkateswaran, Carnemark, Ms. Mitchell, Coukis, Sud, Ms. Tager, Stone, Cook, Rathnam, Ahmad, Ms. Haldane (Trans. & Urban Projects); Please, Barry, Adler, Hendry, Hablutzel, Loh, O'Brien, Ahmad (East Africa Region); Keare (2), King (Development Economics); Christofferson, Berg, Venkitaramanan (Agri. and Rural Dev.); Miller, Jones (EDI); Casazza (Population Projects).

possible that the planktonics were outcompeted by the nonplanktonics.

Evidence presented here supports the hypothesis that larval ecology has an effect on evolutionary rates. Along continental shelves, nonplanktonic, low dispersal species are easily isolated by local barriers during periods of regression. The subsequent increase in rates of extinction and speciation decreases average species longevity. Planktonic, high-dispersal species are less frequently isolated and tend towards long species duration. In any group of organisms, however, evolutionary rates will be influenced by a number of factors. Within the ecologically and morphologically uniform group of Lower Tertiary volutids, species longevities are primarily controlled by a combination of two factors, dispersal and environmental tolerance. Whether these factors control mollusks in general or even other families of gastropods is yet unknown, because many other ecologic controls must be taken into account.

THOR A. HANSEN

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10. Jackson (4) and Scheltema (7) presented a model for the effect of larval dispersal on biogeography and evolutionary rates of transoceanic species. Species with long-lived planktonic larvae easily maintain gene flow between populations, which suppresses geographic isolation. Moreover, local environmental disturbances have little effect on the entire species population because of its wide distribution, hence extinction rates are lower. The result is that long-lived planktonic species have high longevity but low speciation rates. On the other hand, species with short-lived planktonic larvae may occasionally traverse a barrier such as an ocean basin, but are generally unable to maintain genetic communication. Thus, populations diverge and geographic speciation may result. Local environmental disturbances are likely to affect the entire species, giving rise to high extinction rates. In this case, short-lived planktonic species have high extinction rates and high speciation rates (low longevity).
11. Shuto's (9) criteria are size of embryonic whorl and shape and ornamentation of protoconch whorls. Primarily, a small and pointed apex indicates a planktonic larval stage while a large and blunt apex is characteristic of nonplanktonic forms.
12. The volutid nomenclature of Palmer and Brann (*14*) was adopted. Only species that passed the following criteria were used: (i) a part of their range must include Alabama, Mississippi, Louisiana, or Texas, (ii) only fully named species were used (for example, not *Athleta* sp.), (iii) species based on a single unique specimen or species poorly described and in which the sole type has been lost were disqualified, and (iv) all subspecies were included under the specific name.
13. Published reports on nannofossils and planktonic foraminifera allow correlation of Gulf Coast Paleocene-Eocene stratigraphy with the new Paleocene time scale of J. Hardenbol and W. A. Berggren (*Bull. Am. Assoc. Pet. Geol.*, in press). For a similar scale, see W. A. Berggren, *Lethaia* **5**, 195 (1972).
14. Species occurrences were taken from K. V. W. Palmer and D. C. Brann [*Bull. Am. Paleontol.* **48** (1965-66)] and L. Toulmin (*Ala. Geol. Surv. Monogr. 13*, in press).
15. Maps were drawn from W. L. Fisher [*Trans. Gulf Coast Assoc. Geol. Soc.* **19**, 239 (1969)], C. J. Mann and W. A. Thomas (*ibid.* **18**, 187 (1968)], and data compiled by the author from county geological reports.
16. The single long-lived nonplanktonic-eurytopic species is a problematical form present in one formation in the Upper Paleocene and one formation in the Upper Middle Eocene. Whether it is truly a single species is questionable, but it passed all the criteria of (*12*) and so is included.
17. I thank R. Dodge, E. Kauffman, D. Rhoads, N. Sohl, V. Tunnicliffe, and K. Waage for comments and criticism. Thanks go to J. B. C. Jackson and R. Scheltema for discussion.

20 October 1977

Aeolanthus biformifolius De Wild.: A Hyperaccumulator of Copper from Zaïre

Abstract. Aeolanthus biformifolius *(Labiatae) from Shaba Province, Zaïre, has been shown to be a hyperaccumulator of copper. The copper content of the total plant during the rest period after the rainy season was 1.3 percent (dry weight basis) and is easily the highest copper concentration ever found in living material. This species should be classified as a "copper flower" because of its exclusive occurrence over mineralized ground.*

Numerous studies have been concerned with the vegetation associated with copper mineralization in south-central Africa, namely, Shaba Province, Zaïre (*1*, *2*), and the "Copper Belt" in Zambia (*3*, *4*) and Rhodesia (*5*–*7*). Several plants have been described as "copper flowers" and are of considerable interest for mineral exploration. Typical copper flowers include *Becium homblei* (De Wild.) Duvign. et Plancke in Zambia and Rhodesia (*3*, *6*, *7*), *Haumaniastrum katangense* in the vicinity of Lubumbashi, and *H. robertii* around Kolwezi in Shaba Province, Zaïre (*2*). More recently, the copper and cobalt contents of African

Table 1. Copper concentrations (in micrograms per gram, dry weight) in *Aeolanthus biformifolius* compared with values for other accumulator species in south-central Africa.

Species	Location	Organ	Mean copper concentration	Reference
Aeolanthus biformifolius	Shaba (Étoile)	Basal leaves (1/7/77)	2,600	*
A. biformifolius	Shaba (Étoile)	Basal leaves (2/2/77)	2,150	*
A. biformifolius	Shaba (Étoile)	Flower stems (1/7/77)	3,500	*
A. biformifolius	Shaba (Étoile)	Flower stems (2/2/77)	2,150	*
A. biformifolius	Shaba (Étoile)	Corms (1/7/77)	2,600	*
A. biformifolius	Shaba (Étoile)	Corms (2/2/77)	11,800	*
A. biformifolius	Shaba (Étoile)	Corms (3/24/77)	13,700	*
A. biformifolius	Shaba (Étoile)	Whole plant (2/2/77)	10,000	*
A. biformifolius	Shaba (Étoile)	Whole plant (3/24/77)	13,700	*
Ascolepis metallorum	Shaba (Dikuluwe)	Leaves	1,200	(2)
Becium aureoviride	Shaba (Niamumenda)	Leaves	210	(2)
B. homblei	Zambia	Leaves	324	(3)
Crotalaria cornetii	Shaba	Leaves	12	(9)
C. peschiana	Shaba	Leaves	268	(9)
C. prolongata	Zambia	Leaves	15	(9)
Eragrostis boehmii	Shaba (Tilwizembe)	Leaves	78	(2)
Fimbristylis exilis	Rhodesia (Copper King)	Leaves	420	(7)
Haumaniastrum homblei	Shaba	Leaves	74	(8)
H. katangense	Shaba	Leaves	75	(8)
H. robertii	Shaba	Leaves	662	(8)
H. robertii	Shaba (Mupine)	Leaves	1,960	(2)
Indigofera dyeri	Rhodesia (Copper King)	Leaves	890	(8)
Pandiaka metallorum	Shaba (Dikuluwe)	Leaves	740	(2)
Triumfetta dikuluwensis	Shaba (Dikuluwe)	Leaves	123	(2)

*This study.

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species of the genera *Haumaniastrum* (8) and *Crotalaria* (9) have been reviewed. Hyperaccumulators have been recently defined as plant species with a specified elemental content, which in the case of nickel is >1000 μg/g on a dry weight basis (10). Until now, the highest recorded copper concentration has been that of *...ertii* (2), although further research (8) has shown that it contains considerably more cobalt than copper.

A survey of the copper content of various plants collected from Shaba Province, Zaïre (Table 1), carried out by atomic absorption spectrophotometry, has revealed the existence of a new hyperaccumulator (using the same 1000 μg/g criterion as for nickel): *Aeolanthus biformifolius* De Wild. (Labiatae). This species, which was previously only known from the vicinity to the Luiswishi Mine, has a very marked ability to accumulate copper. We have, however, recently discovered this dwarf perennial growing at the old "Mine de l'Étoile" and at the Ruashi Mine, both in the vicinity of Lubumbashi. From its present known distribution, it must be considered as endemic to the southern part of the Shaban Copper Belt.

There is a seasonal variation in the copper content of individual plant organs of *A. biformifolius*. Concentrations are lowest at the beginning of the rainy season and then increase rapidly with the ...elopment of the new corm, which is ...ully mature by the end of the rainy season some 3 months later. *A. biformifolius* should be considered as a copper flower for the southern part of the Shaban Copper Belt, since it appears to be confined to substrates rich in copper.

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21 September 1977

Tree Branch Angle: Maximizing Effective Leaf Area

Abstract. *In a computer simulation of branc... pattern and leaf cluster in* Terminalia catappa, *right and left branch angles were varied, and the effective leaf surface areas were calculated. Theoretical branch angles that result in maximum effective leaf area are close to the values observed in nature.*

The shape or geometry of a living tree has been related to its adaptive strategy for light interception (*1*, *2*). The woody framework of branches presents the photosynthetic surface, the leaves, to sunlight in a manner that is primarily, but not totally, related to the photosynthetic efficiency of the leaf and the distribution of light in the environment of the tree. Horn (*1*), on theoretical grounds, has established two basic types of leaf distribution: the monolayer with leaves densely packed in a single layer, and the multilayer with leaves densely scattered among many layers. Understory trees and forest floor species tend to be monolayered; canopy tree and pioneer species tend to be multilayered. Among crop plants, the shape of the leaf canopy (as determined by branch and leaf arrangement) directly affects light interception and, hence, productivity (*3*). In the simpler system of an individual leaf, the biophysical and adaptive significance of shape and orientation have been studied (*4*). Although the bifurcation ratio (a measure of the degree of branching) was shown to be greater in evergreen broadleaved trees than in deciduous ones (*5*), there are no published studies that quantitatively relate the parameters of tree branching to the interception of light by the leaf surface. The greatest obstacle to investigations of the adaptive function of branching pattern has been the three-dimensional complexity of tree branches and the varying orientation of the leaves borne by them. We present the finding that, in at least one tree species, the natural limits placed on branching and the asymmetry of branch angles observed in nature are, in fact, very close to theoretical values which maximize the effective leaf surface area (the horizontal projection of the leaf area), a feature with obvious adaptive value.

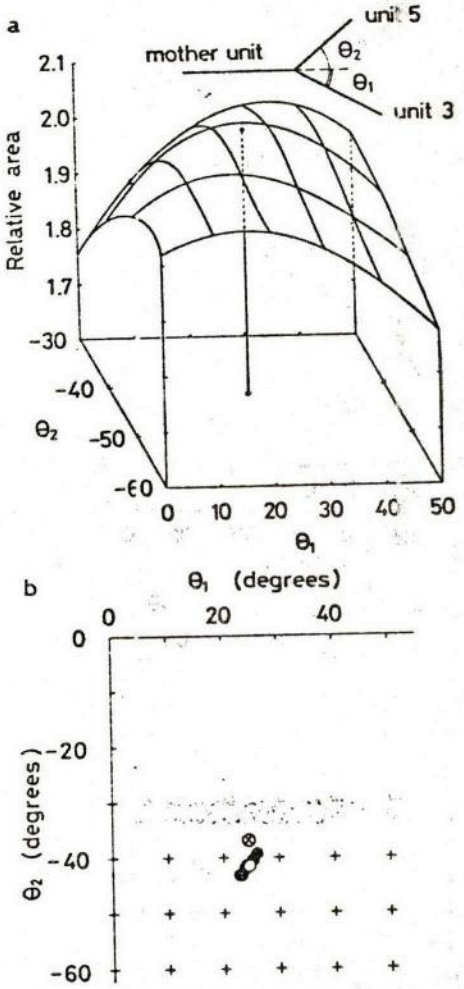

Fig. 1. (a) The effective leaf area versus θ_1 and θ_2. Conditions of the simulations are the same as Fig. 2. The maximum effective leaf area is shown by a vertical line indicating the optimal θ_1 and θ_2. Inset: explanation of branch angles θ_1 and θ_2. (b) Comparison of the actual θ_1 and θ_2 (⊗) with the optimal values derived from simulation in Fig. 2c. The conditions of the simulation are the same as Fig. 2. Results obtained with the six different values for the leaf disk radius between 0.7 and 0.9 (●), instead of 0.8 (○), are shown.

The tropical tree *Terminalia catappa* L. (Combretaceae) has certain architectural features that make it ideal for quantitative studies of branch pattern and leaf surface area. Its distinctive pattern of growth and development, *Terminalia*-branching, is widespread among tropical dicotyledonous trees (*6*). The tree, basically, consists of an erect leader axis with tiers of three to five lateral branches that result from periodic outgrowth of axillary buds and form a characteristic pagoda shape to the crown. The older lateral branches are horizontal and dorsoventrally flattened. Each lateral branch complex is composed of a repeating series of branch units, and each of these bears a cluster of horizontal leaves at its distal end (*7*). Therefore, most of the leaf surface of the tree is presented as a series of flattened layers, each one equivalent to a monolayer; these are well spaced along the trunk. Branching in *Terminalia* has already been studied quantitatively, and average values of different morphological parameters have been calculated (*8*). These ac-

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