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**Title** The Impact of Mild Anaemia on the Productivity and Economic Welfare of Women Pickers on a Coffee Estate in Thyolo District, Malawi

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## SUMMARY

Two hundred and twenty non-pregnant female coffee-pickers on a commercial estate in Thyolo district, Malawi were enrolled in a prospective cohort study to estimate the magnitude of the association between anaemia and productivity in a mildly anaemic population. An association between anaemia and lower total yields over the 18 day study period was found though these findings did not reach statistical significance ( $P=0.11$ ). The decrease in productivity was due to fewer days at work ( $P=0.06$ ) rather than lower productivity on days worked.

Over the 18 day study period, the estimated change in earnings with each 1g/dl increase in haemoglobin (Hb) was MK7.70, amounting to a 3% wage increase for mildly anaemic women.

Qualitative data collected concurrently indicated that estate women and their families are one of the poorest groups in rural Malawian communities. Extra earnings due to improved haemoglobin levels would have a marked positive impact on their welfare, enabling them to incorporate essential food items such as fish or green vegetables into their diets and to ensure the purchase of household items such as soap and matches.

These results indicate that mild anaemia may affect the productivity and subsequent economic welfare of Malawian women, although more research is needed to substantiate this finding. The implication is that population-based programmes against anaemia may be justifiable even for populations with predominantly mild anaemia.

## INTRODUCTION

Anaemia is a highly prevalent disorder with over 2 billion people world-wide affected and high prevalence rates for women of reproductive age in developing countries (Koblinsky 1995). In Africa it has been estimated that two-thirds of pregnant and half of non-pregnant women may be anaemic (Winikoff 1988). The main causes reported in sub-Saharan Africa are iron deficiency (often exacerbated by hookworm infestation), folate deficiency, malaria, haemoglobinopathies and human immunodeficiency virus (HIV) infection (Fleming 1989, Hurrell 1997). Thus anaemia is largely preventable. Severe anaemia in pregnant women has been associated with multiple adverse effects including maternal death (Allen 1997, Hoestermann 1996, Danforth 1982, Hughes 1991, Zucker *et al* 1994), low birth weight (Brabin *et al* 1990, Dolan *et al* 1993, Rusia *et al* 1995, Singla *et al* 1997) and perinatal mortality (Bouvier *et al* 1997, Dasgupta *et al* 1997, Fleming, 1989, Garn *et al* 1981). A second cause for concern is the effect of anaemia on work performance and productivity, both in formal wage sectors and informal non-wage sectors of the economy, although published studies concentrate on the former.

Significant or severe anaemia related to iron deficiency reduces work performance (Yip 1994). The adverse effect of iron deficiency on work or energy output appears to be mediated through a combination of decreased oxygen-carrying capacity and reduced muscle function. In animal studies it has been shown that both aerobic and anaerobic functions are reduced (Dallman 1986, Davis *et al* 1984).

A relationship between severe anaemia and work output was demonstrated for female workers on tea plantations in Sri Lanka and Indonesia (Edgerton *et al* 1979, Husaini *et al* 1983), male rubber plantation workers in Indonesia (Basta *et al* 1979) and male road construction workers in Kenya and

the Philippines (Brooks *et al* 1979, Popkin 1978) Trials have shown that supplementation increases productive output (Edgerton *et al* 1979, Basta *et al* 1979) Relationships were found between mild anaemia and British schoolgirls' physical performance (Nelson *et al* 1994) and female Indonesian jute-factory workers' productivity (Scholz *et al* 1997) Intervention in moderate to mild anaemia improves intermediate clinical outcome measures, specifically the Harvard Step Test in Indian women (Dodd *et al* 1992) and energy expenditure for equivalent work in female cotton mill workers in China (Li *et al* 1994) In summary anaemia clearly affects productivity for both men and women, but the impact of mild anaemia (Hb 10-12g/dl for non-pregnant women) on economic welfare mediated through productivity, has not been studied

Lack of knowledge about the effects of mild anaemia has contributed to a general lack of consensus over the issue of the haemoglobin cut-off level at which anaemia should be recognised as a problem meriting action, either at the individual clinical level or through population-based programmes This study focused on the impact of anaemia on productivity, wage earnings and subsequent economic welfare in a population with predominantly mild anaemia The specific objectives were to

- 1 Quantify loss of productivity due to anaemia in a population with predominantly mild anaemia
- 2 Estimate the loss of wage income attributable to anaemia over 18 days (3 weeks of 6 working days)
- 3 Investigate the impact of estate wages on the economic welfare of women and their households

## **MATERIALS AND METHODS**

### **Study Setting**

Thyolo district, in the south of Malawi, covers an area of 1,715 sq km. Non-estate, usable land is 665.95 sq km total, with a population density of 647 persons per sq km (World Bank 1990). Thyolo district has been defined as “performing badly in terms of nutrition”, as 30.2% of children under 5 years are underweight, 42.5% have moderate stunting and 13.9% moderate wasting (Malawi Social Indicators Survey 1996).

The physical capacity to work on estates or farms is vital for the economic survival of a majority of the district. Over 93% of the population derive their livelihood from agriculture (national average is 80%) with the main subsistence food crops being local and hybrid maize (GOM/UNDP 1995). A recent survey of 420 households found that 40% obtained their main income from tea and coffee estates and 23% of women had worked on an estate during the past year (Williams *et al* 1997).

Women have traditionally been employed on the estates to pick coffee. The picking season runs from June to August, with a peak in July when the study took place. Women are paid only for the days they work and according to the number of kilograms they pick. In July 1997 the assigned task was 44kg each day which most women exceeded, there was a minimum daily wage of MK11 (USD=\$0.73, July 1997 exchange rates) and the estates gave MK1 for every additional 4 kilograms. Women began work by 6.30am and remained until the final weighing session. The working week was Monday to Saturday.

## **Methods**

A cohort study was chosen to minimise the potential selection bias of anaemic women dropping out from employment. The study period was limited to 18 working days to coincide with the peak in ripe coffee so that pickers' productivity would not be differentially constrained by crop supply. An

obtained sample of 198 women was calculated as having 80% power to detect a 10% difference in productivity between women with Hb<11 g/dl and women with Hb≥11 g/dl. Allowing an extra 20% for refusals, pregnancies and loss to follow-up meant that 238 women needed to be approached for entry into the study. The study sample was composed of all consenting non-pregnant women in one division enrolled for coffee picking on the first 3 days of the 18 day study period. Over the course of the study, information was obtained on the women's home location, key demographic variables, socio-economic status and other lifestyle factors hypothesised to influence the yield. Anthropometric measurements and reported illness and treatment episodes for the previous two weeks were obtained at the end of the study period. At this time haemoglobin levels were also measured using a HemoCue and a thick blood film stained with Field's Stain was examined for malaria parasites. The interviewers were nurse/midwives who were trained for one week in questionnaire administration, anthropometric measurements and HemoCue use.

Absences from work were noted on a daily register. When women returned to work the reason for their absence was ascertained. Any woman absent for three consecutive working days or more received a home visit. Data on picking yields during the study period was provided through worksheets filled in by the estate's clerks. Study interviewers were present in the picking fields and at weighing times throughout the study period.

### **Statistical Analysis**

The data were double-entered using the computer package Epi-Info. Analysis was performed using Epi-Info and Stata.

Three productivity variables were derived for the analysis.

- work attendance number of days worked out of the 18 working days of the study period
- average daily yield (kg of coffee berries picked) during weekdays present at work
- average daily yield (kg of coffee berries picked) over the 18 day study period

The explanatory variables were placed into 3 groups

- physiological variables e.g haemoglobin, malaria parasites, recent illness and treatment episodes, anthropometric measures (height, weight, body mass index, mid-upper arm circumference)
- demographic (age, parity, marital status, ethnic group) and socio-economic variables (alternative sources of income, reading ability, ownership of land, a radio and a bicycle)
- other lifestyle factors which may affect productivity (performance of housework, distance walked to work years of experience picking coffee, recent food intake children under and over 5 years at home)

Multiple regression was used to estimate the relationship between the explanatory variables and productivity. For each productivity variable the model was fitted in 3 main stages. First physiological variables were added then demographic & socio-economic variables and finally the other lifestyle factors which might affect productivity. At each of the 3 stages non-significant ( $P > 0.05$ ) variables were dropped from the model apart from the variable haemoglobin. A quadratic term for haemoglobin was also entered into the model to test for non-linearity.

To extrapolate the effect of anaemia on women's income over the 3 week (18 working days) study period, two assumptions were made. Firstly, the association found between haemoglobin and decreased productivity was assumed to be causal, i.e. the anaemic women picked less coffee

compared to non-anaemic women due to their lower haemoglobin levels. Secondly, if these women had physically been able to pick more they would not have been constrained by how much coffee there was. This assumption was valid during the peak picking season as there was marked excess demand for labour.

### **Qualitative Data**

Qualitative information on the impact of the estate wage on women and their household's economic welfare was collected over 5 weeks, concurrently with the quantitative data. Semi-structured interviews were conducted with study women currently picking and absent pickers who had returned to work. Women were selected for interview based on a systematic selection of study numbers of the women present on that day. Some of these women were particularly willing to give information and were reclassified as in-depth interviewees. Other key informants for in-depth interviews included estate managers and village chiefs or headsmen. The latter were helpful in identifying more informants: pickers who had recently left estate employment, women who chose not to pick and local men. Further snowballing techniques, whereby selected participants recommended other participants for inclusion in the study, were used to identify more interviewees from the community. Purposive sampling to include more women not working on the estate, was also employed by recruiting at local markets and shops. Group discussions were held in the villages within and surrounding the estate. Due to informal recruitment through snowballing and the public locations which allowed relatives and friends to join the dialogue, the participants were not unknown to one another and thus formed natural groups, i.e. groups that exist apart from the study within the natural context of the research setting (Coreil 1995). However to avoid male dominance, discussions for women and men were conducted in separate groups. On average each group consisted of 9 participants (range 6-11).

The methodologies employed are summarised in Table 1. The process of triangulation of sources and methods was used to cross-check the data collected for consistency and trustworthiness. Questions were modified daily in the light of recent insights and analysis. All interviews and discussions were conducted in the local language, Chichewa, by a local teacher trained in qualitative data collection methodologies. The group discussions and some in-depth interviews were recorded on audio cassette for later transcription and translation.

## RESULTS

The final sample size was 217 (98.6%) women of the original 220 that made up the cohort. Only 3 women were lost to follow-up. From the original 235 women who worked during the recruitment days, 8 women were excluded from the group due to pregnancy, 4 women left estate work before recruitment to the study and 3 with-held consent.

The mean age of the study population was 28.1 years and ranged from late teens to 60 years (65% < 30 years, 92% < 45 years). There was no relationship between age and haemoglobin or parity and haemoglobin in our data-set. Thirty nine per cent received treatment for illness during the study period and 20% had malaria parasitemia which was significantly related to haemoglobin group ( $\chi^2 = 6.89$ ,  $df = 2$ ,  $p = 0.031$ ). Only 18% of the study sample were married compared to the national average of 69% (NSO 1994). The rest were single (35%), separated (41%) or widowed (6%). Twenty seven per cent of the women could read. Sixty four per cent reported at least one alternative source of income. These included a husband that worked, selling crops for cash, trade in the last week and believing oneself to be a permanent employee (with guaranteed employment and entitlement to sick pay and holiday pay). The mean number of household duties performed before

work was 0.77 and after work 2.43. Fifty seven per cent of the women had at least one child over 5 years at home.

### **Association between anaemia and productivity**

The mean haemoglobin was 12.5g/dl (SD = 1.6). Thirty seven per cent of women (81/217) had haemoglobin levels below 12g/dl, the WHO definition of anaemia in non-pregnant women. Amongst these anaemic women, 85% (69/81) were mildly anaemic (Hb 10 - 12 g/dl) and 12 women were moderately anaemic (Hb < 10 g/dl).

Absenteeism was common for female estate workers, being particularly high on Saturdays and when the weather was cold and wet. The mean number of days worked per woman from the total of 18 days in the study period was 12.89 (SD = 3.94, range = 1-18 days), and 71% of possible working days were worked (2774/3906). Yields on days worked varied substantially between women. The average coffee yield per woman for weekdays worked was 80.61 kg (SD = 25.45).

A summary of the relationship between anaemia and productivity is shown in table 2. There was no evidence of curvature in the relationship between haemoglobin and the productivity variables and therefore linear relationships have been assumed. The evidence suggests that anaemia may be associated with a decrease in the number of days worked and the overall amount of coffee picked over the 18 day period though these findings did not reach statistical significance. There was no evidence that anaemia had an effect on average kilograms picked on days present.

In these models, productivity was significantly associated with having received treatment during the study period, malaria parasites, age, being married, reading ability, access to other sources of income,

the number of household tasks performed before work and having a child over 5 years at home (table 2) Productivity was not affected by anthropometric measurements (weight, height, body mass index and mid-upper arm circumference), parity, ethnic group, distance walked to work, some socio-economic proxies (ownership of a radio, bicycle or land), years of experience picking coffee and recent food intake

From table 2 the estimated change in overall yields for each 1g/dl increase in haemoglobin is 1.71 kg each day or 30.78 kg over the 18 day study period. Thus if a woman's haemoglobin rose by 1g/dl she would earn an additional MK7.70 overall or MK2.57 per week (95% confidence intervals -0.72, +5.86). This is equivalent to US\$0.17 and for a mildly anaemic woman (Hb 10-12g/dl) it amounts to a 3% wage increase.

### **Impact of Estate Employment and its Wages on Women and their Household's Welfare**

Current and former coffee pickers thought the most important factor affecting productivity in estate work was general nutritional status and also whether a picker had eaten the night before and that morning, a belief which was not supported by the quantitative data. A woman's strength was reported to be a key determinant with strength being affected by her diet and any illnesses she might have (e.g. malaria, body pains, pneumonia, diarrhoea, stomach ache, headache, dizziness and "less blood"). Current pickers also mentioned women's "speed in picking" (skill) and her attitude "some people put all their heart into what they're doing and so can get a lot of money, so her mood that day is important."

Women pickers were clear that only those lacking reliable alternative sources to maintain themselves and any dependants would undertake manual work on the estates. "At this time of year, we don't

have maize and are very poor Had it been that we're not very poor, we would not have come here to work The wage is very low "

A local headman concurred "Some of these women may have four kids and they do not have a husband They will always be thinking of what to give them to eat Now these women are afraid that their kids may die of hunger - that's why they go in the fields of coffee and work there They think of ways of getting money and the estate comes to them as a solution to their problems They have no choice " However during one discussion, local men said that some women choose estate work even whilst they are still with their husbands to gain extra money Realising their earning ability, they can become proud and tell their husbands to leave In other discussions and interviews with women, a differing view was purported in such a situation husbands choose to go as they are embarrassed that their wives are supporting the home

In all groups and interviews, manual employment on the estates was viewed unfavourably for women "it is a hard, bad job and most people go to the estates because of problems' The estate women are described by others in the community as "with problems", "having poverty or sickness at home , "uneducated", "otherwise helpless" and people "feel pity for them '

One local man stated that "the work which these women do is for men " Current and former pickers described the work as physically very demanding pickers are outside in all weather there is concern about the chemicals sprayed on the coffee trees, the hours are long with women getting up very early and returning after dark A few older community informants mentioned concerns about what might happen to women in the coffee fields

This qualitative evidence is supported by quantitative data. Women working on the estates were atypical for the area in their lack of economic support from other family members. The younger, unmarried pickers (35%) were often supporting elderly parents or younger, orphaned siblings. The few married pickers (18%) felt they had been forced into employment as their husbands were unsuccessful in meeting the minimum subsistence needs of their families. "how can I see my children go to bed hungry, have no soap to wash them with, for them not to go to school as they are too hungry to learn. I am forced to do something to help them." Many women (42%) were separated from their husbands and 37% of the women were household heads, compared to a district average of 8% (Williams 1997).

If they became ill and could no longer work, most women pickers stated that they would have no one to turn to for financial assistance. "Not even the orphans in our village are helped." So such a woman will "sleep without food and if she does not go to the estate to work, automatically there will be hunger at the house and the children will suffer. They will even fail to go to school as they've slept with empty stomachs." A minority of women pickers reported that they might demand reciprocity from those they had helped in the past, or attempt to gain help from parents or relatives, generally in the form of maize loans. Yet it was stressed that this assistance was of a one-off and short-term nature.

When not working on the estates, some women engage in *ganyu* (piecework) where payment is for a given task regardless of the time taken to achieve it. The piecework may be from a neighbour or friend and involves manual labour in return for cash or payment in kind. It brings in less money than estate work - estimates were around MK7 (US\$0.47) per day for a woman - and it is a very unreliable source of income. Village headmen and some local men talked about women being

forced into “whoring” (prostitution) by their circumstances, with the predominant currency being gifts of food

In Thyolo district, subsistence farming is an important source of income. However, although the society is predominantly matrilineal and inheritance is along the female line, less than a quarter of the female estate workers in the study had a plot of land of any size and only 18% sold some of their crop for cash. Complaints about plots were that yields were unreliable, plots were too small to support the households for a full year, soil was of poor quality and required expensive fertiliser. Some estate women were working to repay debts to the government or the agricultural marketing board (ADMARCK) incurred to buy fertiliser.

All groups and informants agreed that wage earnings were utilised mainly for food, especially the staple ingredient, maize eaten as *nsima*. “We just spend our wage for food, food, food!” The “relish” eaten with *nsima* is usually made from green leaves gathered by women themselves, perhaps adding tomatoes and/or onions. More luxury food items were salt and small local fish, *utaka* and *matemba*. Other items such as soap, matches and kerosene for lamps were also purchased from weekly wages.

“For you to buy enough food with the ticket [estate] money is difficult.” The coffee estates’ self-imposed minimum weekly wage was MK66 (US\$4.40) and the average weekly earnings for study women was MK89 (US\$5.92). Women pickers reported spending MK40-60 a week on maize, leaving little money for other purchases. The prices of other local food items for one meal serving 5 people were MK18 for beef, MK6 for fish, MK5 for cabbage or peas, MK3 for beans and MK2 for

tomatoes When earnings were low for that week, women said they would buy less food (and only maize flour) and forego soap or matches

Most pickers had current debt obligations either for items purchased on credit or to friends under the *chiperegano* system *Chiperegano* involves giving a friend a proportion of the week's wage (e.g. K50 = US\$3.33) in return for receiving an equivalent amount from that friend the following week With this extra money, larger items could be purchased such as a better value big bag of maize, a *chitenge* (material worn over a skirt), second-hand clothes or shoes for themselves or their children Women also use the *chiperegano* money to pay back debts Even if a woman's weekly earnings were very low, usually due to absence, she still gave it all to her friend as part of *chiperegano* and was thus driven into debt or going hungry Many women accounted for the existence of the *chiperegano* system by their inability to save cash - if they have money they just spend it

If they received more money, all the women pickers stated that they would purchase more food Other items that would be gained were clothes for themselves or their children Less commonly, women mentioned specific treats such as beans, fish, Coca-Cola, and lotion for their skin If they received substantially more money they would start a business pay children's school fees or build a [better] house Women who owned land said they would buy fertiliser or seed maize and/or employ a piece-worker

## **DISCUSSION**

### **Association between Anaemia and Productivity**

The prevalence of anaemia in the study population was low with only 37% of women classified as anaemic (Hb <12g/dl). This was similar to levels of anaemia found in men (36%, n=315) (Williams *et al* 1997) but the same population survey found a much higher prevalence in pregnant women (67%, n=210) and women who had delivered in the last 6 months (61%, n=210). Estate women are disproportionately separated and widowed and thus possibly have had fewer pregnancies recently which may contribute to their higher haemoglobin status.

This study provides some evidence that mild anaemia may be associated with decreased productivity in coffee-picking, measured as number of days worked and overall yields but not daily yields, although none of the findings reached statistical significance. However Scholz *et al* (1997) have shown a significant correlation between haemoglobin and work output in a mildly anaemic population.

Measurement errors may be present in the records of women's absences and their daily yields. A few women pickers alleged deliberate mis-recordings motivated by self-interest within lower management tiers at the estate. Attempts to minimize these errors were made by ensuring the presence of study personnel at weighing sessions.

Substantial random "noise" in the data and very little of the variation in productivity being explained by the explanatory variables is to be expected. Work output is likely to be influenced by many factors including women's inherent physical suitability for the work in question. Furthermore the attempts to capture different levels of motivation to work hard were crude measures of individuals' "work ethic" and determination. With only 11-16% of the variation in productivity explained by the

models it is unsurprising that the coefficients on haemoglobin levels do not reach statistical significance

With respect to demographic variables, productivity on days worked was increased by being younger and presumably stronger and more energetic. Being married was associated with increased absenteeism as husbands actively discourage their wives from engaging in such socially unrespectable employment and because husbands can sometimes provide alternative sources of income or the capital to engage in business for a few days.

The effect of lower motivation, proxied by enjoying alternative sources of income, was significantly associated with much lower total and daily yields (7 kg per day less for each additional source) perhaps because these women are not in such desperate need. However, access to other sources of income was not significantly associated with absenteeism. Reading ability was significantly associated with increased daily yields. This may be because the variable is also capturing some form of "work ethic" or "determination to survive" characteristic in individuals.

Obtaining traditional or allopathic treatment and the presence of malaria parasites were both associated with lower productivity, highlighting the need for estate management to ensure good health care if they want optimum productivity.

Somewhat surprisingly, performing household tasks before work was associated with greater daily yields. This may be because the explanatory variable captured the effects of some women being generally more energetic or productive with their day.

Having a child over five years old was associated with higher productivity in all three models. These children are available to look after younger children or old people and hence reduce absenteeism for women. On a daily basis they assist with household duties which might tire female pickers and reduce their productivity at work.

### **Likelihood of increased wages if productivity increased**

During the coffee picking season there is excess demand for labour: no adult women are turned away or laid off by the estate management, and there are insufficient pickers to complete the work. The estates' profits suffer as a substantial proportion of the coffee is not picked at the right time. This coffee is of diminished quality, receives a lower grade and sells for a lower price.

There is a self-imposed industry wage structure for manual labour to which all tea and coffee estates in Malawi conform. Without this collaboration it is feared that individual estates would attempt to poach labour from one another by offering progressively higher wage rates. Eventually wages would reach a level whereby all the estates would make an overall loss.

The existence of this wage agreement prevents the managers from adjusting the wage rates at short notice to try and encourage labour supply to rise in line with demand at peak picking times. However, labour supply is unresponsive to changes in the wage rate. Wages were raised by 22% a few months before the study took place, yet the estate management reported that labour supply showed no marked increase in response, although existing employees may have tried harder as they are paid per kilogram picked. Larger wage increases are simply not financially viable for the estate sector.

The explanation for labour supply being unresponsive to price changes is that estate work is not perceived as an attractive option and is taken only by desperate individuals, of which there are a finite and limited number. Thus the greater work capacity of the labour force from a reduction in anaemia would be translated into greater output and a wage increase of around 3% for anaemic coffee pickers in Thyolo district.

### **The Value of Estate Work**

A University of Malawi report states that “poverty is worse in the rural areas, especially in the South. The poorest group of all are female household-heads who are widowed, divorced or single, who have little or no education, and must support several small children” (UNIMA 1997). Female-headed households are also noted as poorer by many other surveys (UNIMA 1997, NSO 1994, Government of Malawi 1993). In Thyolo district, the poorest 8% of women gained their main source of income from estate employment. The other common sources of income for women in the area were full reliance on a husband (46%), a garden/*dimba* for subsistence farming and cash sales (16%), and petty trading (24%) (Williams 1997). Estate work offers a real safety net for one of the most vulnerable groups in rural Malawi. Those who choose to engage themselves in estate work are doing so despite the fact that the wage is low, there is considerable social stigma attached to the role and the work is physically very demanding. They disproportionately lack access to other reliable sources of income and have few other alternatives open to them.

An increase in wages from estate work would make a difference to women’s welfare and the welfare of their dependents. Higher wages would allow purchases of more maize and also facilitate the introduction of other food items (such as fish and green vegetables) into their diets. Increased weekly incomes would also help to ensure the purchase of household items such as soap and

matches Furthermore the perpetual cycle of debt women are currently trapped in, constantly paying elevated prices for items on credit, might be alleviated

## **CONCLUSION**

The results of this study on the effects of anaemia on productivity whilst picking coffee add to the findings of earlier publications Earlier work found that simple attention to anaemia alleviating measures such as improved nutrition, iron supplementation and treatment of underlying causes increases the productivity of road workers, tea pluckers, rubber plantation workers and mill workers This study suggests that even mild anaemia diminishes productive output on the estates More research is needed to substantiate this result However positive findings could be extrapolated to other productive activities both within and outside the formal wage economy

The productivity improvement in all facets of people's work that might be gained from the alleviation of mild anaemia would have a substantial impact on many people's lives This has implications for the clinical management of individual patients in developing countries it may be an effective use of resources to intervene at higher haemoglobin levels than is current practice The public health implications are that population-based programmes against anaemia may be justifiable even for populations with predominantly mild anaemia

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Table 1 Qualitative research methodologies employed

Type of Respondent	Semi-Structured Interviews	In-Depth Interviews	Group Discussions
women currently picking	15	7	3
absent women returned to work	11	2	-
women quit recently	-	4	-
non-estates work women	11	6	2
local men	4	2	2
estate management	-	3	-
chiefs/headmen	-	4	-
total	41	28	7

Table 2 Summary of relationship between haemoglobin and productivity

productivity variable	change for 1g increase in Hb	95% confidence intervals	p-value	significant (P<0.05) explanatory variables *
days worked (out of 18) adj R <sup>2</sup> =0.11	0.295	-0.013, 0.603,	0.060	treatment in previous 2 weeks (-) married (-) child >5 years (+)
Ave kg per day picked on weekdays present adj R <sup>2</sup> =0.14	0.062	-2.093, 2.216	0.955	In no parasites (-) age in years (-) reading ability (+) other income (-) tasks before work (+) child > 5 years (+)
Ave kg per day picked over 18 day period adj R <sup>2</sup> =0.16	1.710	-0.477, 3.898	0.125	treatment in previous 2 weeks (-) other income (-) reading ability (+) child > 5 years (+)

\* (-) indicates negative and (+) indicates positive association with productivity variable