

Full Length Research Paper

Quality of human capital for agricultural production in rural areas of Morogoro and Iringa regions, Tanzania

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The quality of labour force is very important for agricultural productivity and attainment of food self sufficiency in Tanzania. This study was carried out to determine the nutritional status of rural agricultural workers in two selected villages in Tanzania, with the aim of assessing the quality of agricultural labour force. Adult household members from 117 randomly selected households in the two areas participated in the study. Anthropometric, biochemical methods and clinical examination were used to assess the nutritional status of household members. A structured questionnaire was used to collect socio-economic-demographic information. The prevalence of underweight was 47% and 22% among males and females, respectively. The prevalence of anaemia was higher (60%) among males than among females (54%). About 66% of males and 60% of females had iodine deficiency; malaria parasites were present in 71% of adults' blood smears. Worm infestation and bilharzias were also observed to be afflicting quite a number of people in the surveyed villages. The quality of labour force in the surveyed areas is sub-optimal and this has implications for work capacity, productivity and economic growth. Strikingly, the prevalence of under nutrition was much higher among males than in females. Development of area specific nutrition and health interventions to improve quality of labour force is recommended.

Key words: Human capital, productivity, health, nutritional status, rural, quality, Tanzania.

INTRODUCTION

In most less developed countries of the world, mechanization in agriculture is minimal. Therefore, most activities performed in the rural areas in Tanzania and elsewhere in Africa and Asia involve human labour, which still provides much of the power needed for economic productivity. Thus, factors, which affect human power, such as high incidence of Protein Energy Malnutrition (PEM) and micronutrient malnutrition as well as diseases will tend to affect labour productivity and have a bearing on economic development. Improved health and nutrition, as related to labour productivity or better production

organization can increase household income, contribute to economic growth, and thus results in improved livelihoods. However, Government policies related to agricultural production have been emphasizing improved technologies in order to stimulate production of various agricultural commodities. Such technologies among others include, use of fertilizers, better seeds and a number of good agricultural practices. However, no emphasis has been directed to labour productivity with regard to nutrition and wellbeing of human resources that are used to engage other factors of production, that is, land and capital to stimulate agricultural production. It is high time that human resource's health and nutrition are given the necessary attention in order to engage efficiently in the production process.

Studies carried out in Iringa have shown that there is

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limited awareness among local people about the links that modern science has established between nutrition, health and productivity (Kinabo et al., 2003). Furthermore, peoples' knowledge about nutrition and food preparation does not correspond with the science-based knowledge in this important area. In addition, it has also been observed that local knowledge, perceptions and attitudes concerning food are usually linked to social norms and other socio-cultural dynamics that surround food and most of these have negative nutritional implications. Diseases including those associated with HIV and AIDS as well as malaria have an impact on labour productivity and therefore household food production. Frequent diseases or illnesses make farmers too weak to work therefore unable to produce enough food. In addition, the presence of a sick member in a household normally draws other household members from production and income generating activities in order to take care of a sick member. A study done on the impact of HIV and AIDS including related diseases and labour productivity in Kenya revealed that, HIV positive workers plucked significantly less tea leaves in the 18 months preceding death and used significantly more paid leave in three years preceding death showing that HIV and AIDS and related diseases have a significant negative impact on productivity (Fox et al., 2003).

In addition, valuable resources, savings and income are diverted to treatment, which results in low food accessibility thus reduced food intake and utilization. Good nutrition increases resistance to infections and diseases, improves energy level, and makes a person generally stronger and more productive. It also complements and reinforces the effectiveness of medication for people on medication. The aim of this study was to assess nutritional and health status of the farmers as proxies of the quality of labour force in the participating villages and use the information to develop appropriate nutrition interventions to improve the situation.

MATERIALS AND METHODS

In this survey, four different types of data were collected. These included socio-economic demographic data, which were collected through interviews using a structured questionnaire; anthropometric data involved measurement of the physical dimensions of the body, that is weight and height of all adults in the participating households; biochemical data involved measurements of haemoglobin concentration in blood and iodine levels in urine samples, and parasitological data involved measurements of the presence of worms in faeces and malaria parasites in the blood. The survey was carried-out during the months of April and May 2009.

Study population and sampling design

The study population included all male and female adult members aged 18 years and above in the selected households. A two-stage stratified sampling procedure was employed to obtain the sample

population. In stage one, districts, divisions and villages were randomly selected. All the districts in Tanzania mainland were listed and assigned numbers. Epi info computer software was run to obtain the two districts where the study was carried out. The same procedure was used to select the divisions and villages in the two districts. The entire village was used as a sampling frame.

In stage two, the total number of households from each hamlet was selected in a systematic random sampling on the basis of the probability proportional to size (PPS). The study aimed at reaching 30% of the households in the village. The list of households was obtained from the village register whereby a total of 117 households were selected. All selected households were informed about the study by the village government leaders and consented to participate. Once the household was selected from the village register, all adults (age 18 years and above) were measured for nutritional status assessment. As a result of mobilisation and interest to know about their nutritional status, all members in each of the selected households were available during the survey and measurements. Therefore there was no refusal or second visit.

Interviews

Face to face interviews involving the head of household and/or partner were conducted at the respondent's household. Interviews were carried out using a semi-structured questionnaire to obtain socioeconomic profile of the families. The questionnaire was tested and validated in a non-participating village in Morogoro rural district.

Anthropometric measurements

Weight and height measurements

Weight was measured using SECA electronic bathroom scale (SECA, GmbH & Co. Germany) and recorded to the nearest 0.1 kg. Subjects were requested to wear very light clothes. Height measurements were recorded to the nearest 0.1 cm using a stadiometer (Harpندن, Holtain Ltd, UK). The measurement was recorded while the subject was standing without shoes, on a horizontal flat plate attached to the base of the stadiometer with the heels together; and stretched upwards to a full extent and the head in the Frankfurt plane. The subject was closely observed to ensure that the heels remained on the flat base of the stadiometer and that the head was in upright position during the measurement. Weight and height values were used to calculate Body Mass Index (BMI) for adults.

Body mass index (BMI)

BMI compares the relationship between weight and height and is a measure of body fatness or thinness. BMI was derived from the measurement of weight and height by dividing weight in kilogram by the square of height in metres (W/H^2) and expressed in kg/m^2 . Results were then used to classify subjects into different BMI categories namely, underweight, normal, overweight and obese.

Biochemical measurements

Haemoglobin concentration

Haemoglobin was measured using the Haemocue photometric method (Vanzetti, 1966). Moreover, this method is based on the principle that sodium deoxycholate haemolyses the erythrocytes and haemoglobin is released. Sodium nitrite converts haemoglobin to met-haemoglobin, which together with sodium azide gives

Table 1. Physical and biochemical characteristics of adults.

Characteristics	Males		Females	
	N	Mean \pm SD	N	Mean \pm SD
Age (years)	89	41.7 \pm 14	114	36.3 \pm 12.6
Weight (kg)	79	53.4 \pm 7.8	112	52.8 \pm 9.1
Height (cm)	79	161.6 \pm 6.7	112	153.5 \pm 6.4
BMI (kg/m ²)	79	20.4 \pm 2.6	112	22.4 \pm 3.3
Hb (g/dl)	80	12.8 \pm 2.2	112	11.8 \pm 1.7
Urinary iodine (μ g/L)	69	42.3 \pm 30.5	93	44.1 \pm 31.9

azidemethaemoglobin. This compound's absorbance was then measured at two wavelengths 570 and 880 nm, using it to compensate for turbidity in the sample. The precision of the Haemocue was ± 0.3 g/dl, and was checked daily with control cuvette.

The puncture site on the ring finger or middle finger was disinfected using methylated spirit and using very gentle pressure, the finger was pricked using a disposable lancet prick. The first drop was discarded and the second drop was filled in the micro-cuvette continuously by capillary action to avoid introduction of bubbles. The filled cuvette was then inserted on the Haemocue photometer and the reading was displayed after 15 to 30 s and recorded as g/dl of whole blood. Haemoglobin concentration of < 13 g/dl for males and < 12 g/dl for females was used to categorize those with anaemia.

Determination of iodine concentration in urine

Iodine concentration in urine was determined using a micro assay which is based on the catalytic Sandell and Kolthoff reaction, as described by Pino et al. (1996). In this assay, the catalytic activity of iodide on the oxidation of arsenic (III) by cerium (IV) was measured by monitoring the reduction of the yellow ceric ions. The urine samples were analysed in duplicates to check precision and inter assay coefficient of variation (CV) was $< 5\%$. Iodine concentration in urine of < 100 μ g/L was used to categorize those with iodine deficiency.

Parasitological measurements

Malaria parasitemia

A finger prick blood sample obtained by disposable sterile lancets was used to prepare a thick blood smear on a glass slide. The blood smears were stained with Giemsa buffered staining solution and left to dry under room conditions for 30 min (Lema et al., 1999). The slides were then washed and allowed to dry and examined for the presence of malaria parasites under a light microscope ($\times 100$) (Wild-Heerbrug, Switzerland). Malaria parasite counts were expressed per 200 white blood cells.

Worm infestation

Faecal samples were collected from all participants and preserved using formaldehyde. Faecal examination to determine worm infestation was done according to Kato-Katz technique (Katz, 1972) and then examined under a light microscope ($\times 10$). The results were recorded as number of eggs counted $\times 18.5$ and expressed as number of eggs (ova) per gram of faeces.

Schistosomiasis

A sedimentation method was used to determine the number of eggs in urine. 10 ml of urine were placed in a centrifuge tube and centrifuged for 5 min at 1500 rpm. After centrifugation, the supernatant was decanted and the sediment was used for further investigation. A small sample of the sediment was placed on a clean slide and covered by a cover slip and examined under a microscope at $\times 10$ for general impression and at $\times 40$ for confirming the schistosoma species ova.

Data analysis

Data for weight, height, haemoglobin and iodine concentration, malaria parasitemia and worm infestation were entered and analysed using the Statistical Package for Social Sciences (SPSS version 12 for Windows, Chicago Inc.IL). Descriptive statistics using measures of central tendency and frequencies were performed. Student's t-test was used to test for significant differences among the variables at 95% confidence level unless otherwise stated.

RESULTS

Characteristics of households

A total of 132 males and 270 females were involved in the survey. Average household size of the participating farmers at the time of the survey was 5.3 individuals per household. The proportion of households with able-bodied individuals between 1 to 3 individuals in the surveyed areas was 90.6% and the dependency ratio was 1:8. Female headed households accounted for about 25% of the households.

Physical and biochemical characteristics

Physical and biochemical characteristics of farmers are presented in Table 1. The mean age of males and females was 41 ± 13.9 years and 36.3 ± 12.6 years, respectively. The mean age of males was significantly higher than that of females ($p=0.001$). The mean weight of males and females was 53.4 ± 7.8 kg and 52.8 ± 9.1 kg, respectively. The mean weight of males was significantly higher than that of females ($p= 0.0001$).

Generally, males were taller than females ($p=0.0001$),

Table 2. Nutritional status of adults of 18 years of age and above (N=190).

Status	BMI cut-off points	Males		Females		Total	
		n	%	n	%	n	%
Underweight	< 18.49	37	46.8	25	22.4	62	32.6
Normal	18.5 – 24.99	34	43.6	61	54.5	95	50.0
Overweight	25 – 29.9	6	7.7	21	18.8	27	14.2
Obese	>30	1	1.3	5	4.5	6	3.2
Total		78	100.0	112	100.0	190	100

Table 3. Prevalence of anaemia in adults of age above 18 years.

Haemoglobin concentration (g/dl)	Anaemia classification	Males		Females		Total	
		n	%	n	%	n	%
< 6.9	Severe anaemia	1	1.2	1	0.9	2	1.0
7.0 – 9.9	Moderate anaemia	47	58.8	59	52.7	106	55.2
>11.0	Normal	32	33.8	52	46.4	84	43.8
Total		80	100.0	112	100.0	192	100

with the mean height of 161.6 ± 6.7 cm and 153.5 ± 6.4 cm respectively. The mean BMI was 20.4 and 22.4 kg/m² for males and females, respectively. The BMI of females was significantly higher than that of males. Males recorded a higher ($p=0.008$) haemoglobin concentration (12.8 ± 2.2 g/dl) than females (11.8 ± 1.7 g/dl). The overall urinary iodine concentration for both males and females was low, with a mean of 43 µg/L, which indicates a severe to moderate iodine deficiency. The mean concentration of iodine in the urine of males was 42.3 ± 30.5 µg/L and 44.1 ± 31.9 µg/L in females.

Nutritional status of adults

Nutritional status categories of adults above 18 years of age are presented in Table 2. About 47% of males and 22% of females were underweight (severe, moderate and mild) having a BMI below 18.5 kg/m². The prevalence of overweight and obesity was 9% in males and 23.3% among females.

Prevalence of anaemia

The prevalence of anaemia (Hb below 11.0 g/dl) among males was 60%, and in females it was 54%, (Table 3). Severe anaemia was only observed in 1% among males and 0.5% among females.

Intestinal worms and urinary bilharziasis

The health status of adults was assessed by examining stool for intestinal worms. The overall prevalence of worm infestation was 6.6%. Males had a prevalence of about

7% and females 6% (Table 4). Males had a slightly higher prevalence compared to females. Urinary bilharzia was observed to be a problem among adult farmers in the study areas. The overall prevalence of urinary bilharzia was 8.8%. As shown in Table 4, about 11% of the adult males and 7% of adult females tested positive for bilharziasis, and were considered to be suffering from bilharzias. Results indicate that males were more affected than females.

Urinary iodine excretion

Urinary iodine is the favoured marker for iodine nutrition status. Urinary iodine concentration of less than 20 to 99 µg/L corroborate with a severe to mild iodine deficiency. In the present study, the overall prevalence of iodine deficiency was 63% among adult males and females, but it was slightly higher in males (66%) than in females (60%) (Table 4).

Malaria parasites

Results for malaria parasites in the blood are presented in Table 4. About 71% of the adults had malaria parasites in their blood ranging between 1 to 40 parasites per 200 white blood cells (WBC). About 5% of the adults had more than 40 parasites per 200 WBC. There was no significant difference between males and females with regards to presence of malaria parasites in the blood.

DISCUSSION

Data on nutritional and health status of adults especially

Table 4. Common diseases in adults.

Type of infestation/disease	Males		Females		Total	
	n	%	n	%	n	%
Worm infection						
Positive	5	5.1	8	6.1	13	5.6
Urinary bilharziasis						
Positive	7	7.1	4	3.0	11	0.04
Urinary Iodine excretion						
Deficient	44	44.4	56	42.4	100	43.2
Malaria						
Positive	43	43.4	64	48.5	107	46.3
Total	99	100	132	100	231	100

males in Tanzania is scanty. This study attempted to assess the nutritional status of adults (males and females) with a view to assessing quality of human capital for agricultural productivity. It must be recognized that Africa and Tanzania in particular will continue to rely on human capital in agriculture production for the foreseeable future. Therefore, human capital is crucial for agricultural productivity in Tanzania. However, what is the quality of this capital? In the present study, it was observed that nearly 50% of the males and 25% of the females in the study population were undernourished. This was mainly attributed to low food intake due low feeding frequency, and excessive alcohol consumption among males. Other reasons include high physical work intensity, none adherence to meal patterns and negative attitude towards consumption of vegetables and fruits. Their weight was low in relation to their height as indicated by BMI. Underweight is basically caused by a deficiency of protein and energy in foods consumed relative to body requirements. As an adaptive mechanism to the reduced weight, the individual will reduce work output and therefore labour productivity decreases.

It has been observed that household energy consumption is a positive and significant determinant of farm output (Strauss, 1994). In a study carried out in Kenya, it was observed that better nourished women (as measured by BMI) were able to spend more time in work-related activities including home production activities (Sahn and Alderman, 1988). Therefore, a good BMI and height appear to increase capacity to carry out intensive work. In addition, underweight makes an individual highly susceptible to diseases and has implications on productivity. Recently, much attention has been focused on the links between human nutrition and labour productivity. Improved nutrient intake in nutritionally compromised individuals reverses the effects of deficiencies, e.g. of iron and vitamin A increasing work output and gains in productivity and reduced morbidity

(Enwonwu, 1990). Therefore, the improvement of human nutrition can be seen as a key component of increasing agricultural productivity in Tanzania where labour is still a major input into crop and livestock production.

The prevalence of anaemia was also high and therefore it is considered a public health problem in the participating communities. Anaemia arises due to reduced concentration of haemoglobin in the blood. It is caused by inadequate intake of iron rich foods and or diseases such as malaria and worm infestation including schistosomiasis. The major effect of anaemia is that it reduces the availability of oxygen to the tissues, as well as reducing the efficiency of oxygen exchange in the muscle and myoglobin. Consequently, the muscles cannot perform their functions efficiently. The individual becomes weak, tires easily and becomes unable to work for long hours. It is not surprising therefore that the level of production in many communities of Tanzania is low (IFPRI, 2002). This could be linked to anaemia, which has been shown to hinder people from working to their full capacity. Correcting for iron deficiency has been shown to lead to increased productivity and income (Basta et al., 1979; Vijayalakshmi et al., 1987; Nokes, 1998; Hunt, 2002).

Diseases have devastating effects on household food security and nutrition (Basta et al., 1979; Hall et al., 2001; Persson et al., 2000). In the present study, it was observed that more than 60% of the participating individuals had malaria parasites in the blood. These ranged from 1 to 40 parasites per 200 white blood cells (WBC). About 5% of the farmers had more than 40 parasites per 200 WBC. Malaria has been found to be the leading cause of death (37% of the cases) in Iringa in 2003 (URT, 2003). There is an indication that malaria is endemic in these areas. High presence of malaria parasites is one of the contributing factors to frequent episodes of fever. Frequent ill health could have an impact on productivity due to its effects at individual and

community level. To an individual, malaria fever reduces food intake and causes anaemia because parasites destroy the red blood cells, consequently the individual becomes weak and fails to participate in agricultural production effectively (Nokes, 1998; Hall et al., 2001; Persson et al., 2000). Frequent diseases/fevers in a household means increased cash expenditure on health care services and decreased time allocated for production, as family members are drawn from production and income generation activities to care for sick relatives/children. Thus, food production and income drops dramatically as the household becomes affected. This perpetuates the vicious cycle of food insecurity in many households (URT, 2003). Severe malaria can lead to death and this has some implications to the community, because it tends to draw the community from production to attend funerals.

Ability to adopt new knowledge and technologies depends on the intellectual capabilities of the recipients, in this case farmers. Attainment of good intellectual and cognitive function depends on the nutritional status of the individual as well as the environment in which he lives. Some of the important nutrients for proper cognitive and intellectual development are iodine and iron (Graham-McGregor and Ani, 2001). In the present survey, it was observed that nearly 70% of the participating farmers had low levels of iodine in the urine, which is an evidence of iodine deficiency. Iodine is essential for synthesis of thyroid hormones, which are crucial for regulating the general pace of metabolism including oxygen consumption. Low thyroid hormone production leads to sluggishness and low learning ability. In iodine deficient areas, many children may fail to reach their intellectual potential because of impaired school performance and lower intelligence quotient than in children who have good iodine status. These children may later, as adults, fail to make great contributions to society and national development. Iodine deficiency might also affect the way farmers respond to new information, knowledge and technologies. Sluggishness associated with iodine deficiency is mainly due to reduced level of oxygen consumption and poor delivery of oxygen to the brain which may lower the ability of farmers to respond appropriately to new knowledge and technology (Goh, 2002).

Conclusion

The results indicate that the prevalence of malnutrition and diseases in the participating villages was high. These have negative effects on the quality of labour force and have implications for work capacity, productivity and economic growth. It is recommended that appropriate nutrition and health interventions be developed and implemented to improve quality of labour force. Further studies should be conducted to establish the link between

diseases or rather quality of labour force and economic well being of the household members. The most striking observation was the higher prevalence of under nutrition among males compared to females, contrary to what has been the contention that females are more undernourished than males.

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