

THE FEASIBILITY OF INCORPORATING MICRONUTRIENT
INFORMATION INTO ENGLISH LANGUAGE TEACHING
MATERIALS USED IN AFRICAN SCHOOLS, WITH
PARTICULAR REFERENCE TO TANZANIA

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Abbreviations used in this thesis:

CCM: Chama Cha Mapinduzi (political party)

FAO: Food and Agriculture Organisation

IMF: International Monetary Fund

MDG: Millennium Development Goal

NGO: Non-Governmental Organisation

UN: United Nations

UNICEF: United Nations International Children's Fund

WHO: World Health Organisation

Currency:

The currency used in Tanzania is the Tanzanian shilling. In the course of this research the exchange rate varied between 2000/- and 2450/- per £ sterling.

A Note on Statistics

“Economics” says former UK politician Denis Healey, discussing his five-year spell as Chancellor of the Exchequer, “has acquired a spurious respectability through the use of numbers, which appear to many people much more meaningful than mere adjectives or adverbs, because they appear to be precise and unambiguous. “Unfortunately, I soon discovered,” he says, “that the most important numbers were nearly always wrong” (Healey 1989 P379).

Having previously admitted to making up numbers himself during a wartime stint on Swindon railway station, Mr Healey was unsurprised.

Historian Eric Hobsbawm admits to acquiring his lifelong scepticism about rural statistics after being told by an administrator in North Africa: “When the government asks me for a livestock census, I make very casual enquiries, because the flocks would vanish into the hills otherwise. Then I look up what we said last time round, and put in a figure that looks plausible.” (Hobsbawm 2002 P 367).

Sub Saharan Africa can hardly be expected to have avoided global pitfalls identified here. In fact it is more than half a century since economics pioneer Dudley Seers suggested that attempts to develop international statistical comparisons between countries might well cause “a net reduction in human knowledge” (Jerven 2013 P36). Growing scepticism over ability to produce accurate statistics for the continent, chronicled by Morten Jerven, culminated in in Ghana’s 2010 announcement that it was revising its estimate of national income upwards by a very substantial 60% (Jerven 2013 P 81). Other countries are expected to follow suit.

As far as Tanzania is concerned, Jerven demonstrates the immensity of the problem by quoting the wildly differing estimates of per capita GDP from the world’s leading agencies: US\$ 190 (World Development Institute database maintained by the World Bank group), US\$ 535 (Angus Maddison datasets updated by Groningen Growth and Development Center, University of Groningen), and US\$ 817 (Penn World Tables, University of Pennsylvania). (But see Section 4.3 of this thesis for the emergence of Tanzania’s substantial informal economy, a complicating factor in any statistical analysis.) What is agreed, however, by all three agencies is that the country ranks as one of Africa’s eight poorest (Jerven 2013 P 16 - 18).

This thesis makes use of statistics, but suggests that they be treated with caution.

Tanzania 2012: Background Statistics

* Population -----	47.7million
* Annual births -----	1.89 million
* Urban population -----	27.2%
* Deaths under five per 1,000 live births -----	97
* Life expectancy at birth -----	60.9
* HIV Prevalence -----	5.1%
* Iodized salt consumption 2008-2012 -----	58.5%
* Gross National Income per capita 2012 -----	US\$ 570
* Mobile phones per 100 population -----	57.1

(www.unicef.org/infobycountry/tanzania_statistics.html &
<http://data.worldbank.org/indicator/SH.DYN.MORT>)

ABSTRACT

This thesis addresses the problem of micronutrient deficiency in Africa. It looks at the limited choice of foodstuffs available to many Africans, with special reference to Tanzania, and links this to specific common deficiencies including iron, iodine and vitamin A. It highlights the severe, sometimes fatal consequences of deficiency, including the deaths from scurvy of hundreds of thousands of sailors as a result of Vitamin C deficiency, and continuing child mortality from common diseases such as measles as a result of Vitamin A deficiency in developing countries. The thesis proposes a means by which young Africans might acquire information on both the significance of deficiency and the micronutrient content of common foodstuffs via the existing English Language curriculum used in Tanzania's schools, and making use of desktop technology to provide cheap teaching materials. A separate document – Appendix A – is designed to brief teachers, providing basic information on micronutrients in a flexible form, including pictures for use in the classroom. Appendix B offers samples of lesson modules for students' use. The aim is to enable young people to leave school equipped, as both producers and consumers, to ensure the maximum possible nutrient intake in a world becoming increasingly concerned about the future price and availability of food.

CONTENTS

CHAPTER 1: Introduction

1.1 Summary of this thesis	9
1.2 Defining nutritional deficiency	12
1.3 Micronutrient deficiency: why is it so important?	13
1.4 Distracting from the crucial issue	16

CHAPTER 2: Food Considerations

2.1: Food Production	20
2.2 Maize	20
2.3 Cassava	24
2.4 Millets	28
2.5 Sorghum	30
2.6 Rice	31
2.7 Vegetables	32
2.8 Improving micronutrient intake	34

CHAPTER 3: Food Production, Distribution and Preparation

3,1 Introduction: contributing to micronutrient malnutrition	39
3.2 Climate	40
3.3 Distributing Food	42
3.4 Cooking Fuel	45

CHAPTER 4 Tanzania

4.1 Introduction: Recent History	48
4,2 Health of the nation	57
4.3 Delivering school education	59
4.4 Delivering health education	65

CHAPTER 5: Fieldwork

5.1 Research considerations	68
5.2 Visits	70
5.3 The Curriculum	70
5.4 Curriculum Co-ordinators	73

5.5 School context	76
5.6 Module costings	79
5.7 Feedback	80
CHAPTER 6: Conclusion	83
Bibliography	85

Appendix 1: The Teachers' Handbook: sample pages

Appendix 2: Lesson Modules and display material

CHAPTER 1: INTRODUCTION

1.1 Summary of this thesis

This thesis examines the problem of providing adults and children in Tanzania with a nutritious diet, and considers one potential means of helping them to make informed decisions on what foods to grow and purchase to maintain health. The thesis starts out by establishing a distinction between life-threatening malnutrition popularly associated with famine and starvation and specific nutrition deficiency as a result of shortage of one or more micronutrients. It explains why the latter is such a serious problem and is therefore considered by the World Bank to be a major development issue (Chapter 1). Before suggesting solutions it is necessary to review existing studies to establish what people eat and why (Chapter 2), and to examine the difficulties they face in production, distribution and preparation of food in Africa in general (Chapter 3) and Tanzania in particular (Chapter 4).

The challenges encountered in providing Africans with a nutritious diet are familiar. Both colonial and post-colonial governments as well as a range of development partners have sought to change practices and behaviour affecting the production and consumption of food. It is possible to assess effectiveness of earlier interventions, and to consider the reasons some have failed in their aspiration. Several lessons stand out. Firstly, a nutritious diet is not achieved automatically as a by-product of improvement in cash income (World Bank 2006 P 49) although it is also accepted that separate research in North Tanzania and Dar es Salaam provides examples of women unable to put good knowledge of nutrition requirements into practice as a result of poverty. This points to the need for specific interventions to provide information on nutritional content of common and low-cost foodstuffs. A second critical issue is the failure of previous gender-oriented interventions which have often targeted women, and ended by burdening them with time-consuming demands to listen to advice when they continue to lack the means to put new information into practise.

Taking these two issues into consideration, this thesis proposes and tests an alternative strategy. Rather than focus education principally towards women, who are so often overburdened with responsibility for delivering the nation's health, it will argue that nutrition education can be practically and effectively incorporated into the school

curriculum, making use of the generous timetable allocation for English Language lessons. This approach has the advantage of reaching both boys and girls and of providing scope for students to examine their own nutritional intake, while presenting information they can later use in the decisions they will make both as producers and consumers of food. Delivery of such lessons is demonstrated through a pilot study carried out at two schools: Mlimani Primary in Mang'ula, a rural area of Tanzania and Jangwani Girls' Secondary in Dar es Salaam.

In devising this project the researcher has been influenced by personal experience of the desperate shortage of teaching materials in many parts of Africa, encountered during periods as an English language teacher in Gahini Secondary School, Rwanda (some text books, gifted by the British Ambassador) as a lecturer at a Guinea Bissau teacher training college (no text books) and as in-service teacher trainer at Mlimani Primary School, Tanzania (five text books for 60 pupils in one class). Given this situation, it seemed reasonable to assume that the offer of written material, in the form of lesson modules, to provide each pupil with a personal copy would be acceptable as a pilot project.

The first task in Tanzania was to engage with staff who design school curricula to ensure that the project was acceptable, to discuss the format in which lesson modules might be prepared and to explore the framework in which they themselves might develop and evaluate solutions. While the researcher was the major initiator of the project and took a leading role in gathering feedback, the underlying aim is that the format agreed can be repeated without external input in a range of schools, and with wide scope for adaption to different teaching requirements and local conditions. Chapter 5 describes the action research approach which guided fieldwork and the cycles of reflection carried out with a range of participants in the project: curriculum advisors, teachers and – though less opportunity here - students.

English language and domestic science are both timetabled into Tanzania's national curriculum. Teachers face ongoing problems in design and delivery of effective lessons, particularly when they lack books and other teaching materials. It was not considered practical to suggest introduction of a separate new subject into an already crowded curriculum. Rather, the pilot study was designed to improve the quality and usefulness English teaching by incorporating nutrition education into the existing

Language curriculum and existing timetables.

Key factors of the pilot study include:

* Selection of specific nutrients for detailed study, incorporating information on foods supplying them, and consequences of inadequate intake

* Demonstration of the means by which desktop publishing might be used to disseminate information on key nutritional facts in flexible low cost materials

* Separate material for teachers including suggestions for practical work both inside and outside the classroom, which might enable students to engage with family members and friends as well as teaching staff in the course of investigating cultivation, cost and preparation of particular foodstuffs

The thesis goes on to explain how this framework was tested in the course of the pilot study, how its effectiveness was evaluated and what findings suggest for future use and wider dissemination.

The thesis concludes with a short discussion of reception of the project and potential for its development.

1.2 Defining nutrition deficiency

This thesis relates to micronutrient deficiency, one of two separate conditions resulting from inadequate food intake:

MALNUTRITION (also known as multinutrient undernutrition) defined as:

A state in which the physical function of an individual is impaired to the point where she or he can no longer maintain adequate performance in such processes as growth, pregnancy, lactation, physical work, resisting or recovering from disease. Malnutrition impacts most seriously on infants and young children and is most commonly associated with protein deficiency. Marasmus (characterised by severe muscle and fat wasting) and kwashiorkor (oedema, accompanied by muscle wasting and frequently poor skin and hair condition) are the two clinical forms of protein energy malnutrition, and open the way to death from a range of infectious diseases. Adults are not normally affected, with the exception of pregnant and lactating women. Women in their 20s and 30s in developing countries are pregnant on average for five years and lactating for 10.

MICRONUTRIENT DEFICIENCY (also known as specific nutrient deficiency) defined as:

A state in which there is insufficient intake of one or more vitamins or minerals and leading to specific health conditions.

Micronutrient deficiency is widespread, affecting, in one deficiency or another, more than half the world's population in developed and particularly in developing countries. Though often invisible to the naked eye, micronutrient deficiencies are a significant source of disease, disability and death.

Examples include:

Vitamin A deficiency leading to xerophthalmia

Iodine deficiency leading to cretinism

Iron and folate deficiencies leading to anaemia

Vitamin C deficiency leading to scurvy

Thiamin deficiency leading to beri beri

Micronutrient deficiencies are found in all age groups.

(Lucas & Gilles 2003 P 261 – 264/ Young in Devereux & Maxwell 2001 P 232 – 233).

1.3 Micronutrient deficiency: why is it so important?

This thesis takes as its starting point the 2006 World Bank report “Repositioning nutrition as central to development”. The report followed a review of the Bank’s nutrition work by its Human Development Network. This argued that the financial support for nutrition – less than 0.5% of the Bank’s total lending – had been inconsistent with the Bank’s own analysis “that nutrition lending is one of the best economic investments, and critical towards the Millennium Development Goals” (Good work but not enough of it: a review of the World Bank’s experience in nutrition (World Bank 2006 P XI).

It is the Bank’s contention that malnutrition is the world’s most serious health problem, implicated in more than half of all child deaths. It is also a serious drain on the economic growth that the Bank seeks to promote. In particular, the report highlights the major problems caused by micronutrient deficiencies common throughout the developing – and sometimes the developed – world. The most significant of these are:

- * Vitamin A deficiency affecting 40% of under-fives in the developing world, resulting in reduced immunity and deaths of one million children a year from common diseases such as measles
- * Iodine deficiency leading to 18 million babies a year being born mentally impaired
- * Iron deficiency, affecting 40% of people in developing countries, and disproportionately affecting women of child-bearing age. Severe iron deficiency (anaemia) leads to 60,000 deaths a year in pregnancy and childbirth
- * Maternal folate deficiency leads to 250,000 severe birth defects a year

(World Bank 2006 P 22 – 23).

(The first three of the above are subjects of the teaching modules which make up Appendix 2 of this thesis.)

For both malnutrition and the commonly linked micronutrient malnutrition the biggest - irreversible – damage occurs in the womb and in the first two years of life. This is the limited “window of opportunity” that must be seized if the situation is to be improved. Failure will result in physical and intellectual problems which will blight an individual’s entire life. Low birth-weight can reduce IQ by five percentage points, stunting (failure to achieve the required height-for-age measurement) by between ten and 15 points, and even mild to moderate iodine deficiency by between ten and 15 points (World Bank 2006 P 25). Physically, the missed window results in increased susceptibility to disease in later life, including tendency to cardiovascular disease, adult-onset diabetes, osteoporosis, high blood pressure, high levels of blood cholesterol, obesity and some cancers (World Bank 2006 P 24).

But malnutrition is not simply, nor even necessarily, a problem of poverty. The reality is both more complicated and more challenging. Poor access to food is not the major causes of malnutrition, which can occur in regions and in households where food is plentiful (World Bank 2006 P 54). A major project in Iringa, Tanzania, the centre of a prosperous and fertile agricultural area, revealed a stunting rate of 66%. In addition, says the Bank, “as many as 60% of households with an underweight person also have an overweight person” (World Bank 2006 P 49). Throughout the planet numbers of overweight (1.1 billion) and obese (300 million) people are increasing, often in the same countries where undernutrition and associated micronutrient deficiency are concentrated (World Bank 2006 P 43).

These facts lead the Bank to conclude that non-poverty malnutrition is a real problem and can be attributed to the fact that many people do not know what feeding practices are best for themselves or their children, and, given that micronutrient deficiencies are not commonly visible to the naked eye, are unaware when their children are malnourished. Problems that can result in malnutrition in food-secure households include:

* Mothers having insufficient time to care for themselves or their children

- * Pregnant women suffering from overwork, untreated infections and poor food intake
- * Colostrum which should nourish the newborn for several days being discarded
- * Inappropriate weaning practices: solid food too early (before six months) or too late
- * Poor hygiene

(World Bank 2006 P 9)

Having set out its agenda, the Bank moves on to consider how reform might best be delivered. It discards strategies which it believes offer little prospect for improvement. School feeding programmes which target young people almost entirely outside the “window of opportunity” lack effectiveness. “The recent push in Africa for school feeding programs is yet another example of mistargeted resources” says the report (World Bank 2006 P 89). Instead “Nutrition education, iron supplements and deworming are usually better school nutrition investment than school feeding” (World Bank 2006 P 74).

A study of school initiatives, carried out six years previously, found that iron supplement distribution and deworming produced a detectable improvement in outcomes. Unsurprisingly, the Bank is not in favour of general food subsidies. And, while conceding that food supply is not irrelevant, the Bank is also concerned to focus spending on water supply, sanitation and health services.

Returning to its checklist of factors affecting malnutrition in food secure households, the Bank examines effective strategies for delivery of education in general, and maternal education in particular. It notes that most countries have chosen to invest more in improved food supply and health provision than in improving mothers’ knowledge of feeding and childcare. The problem, acknowledged by the report, is that any attempt to improve mothers’ knowledge places yet more responsibility squarely on the shoulders of women. “Many

development programmes,” the report warns, “expect women to ‘do more’ when they have no time available (World Bank 2006 P 137).

Here the Bank echoes findings of previous research. This dilemma had been identified 30 years previously with the warning: “Most of the preventive actions promoted by health educators --- will actually increase women’s workload. It is unrealistic to expect women to take action to improve health and nutrition unless we find ways of reducing their workload and --- give them time to follow our advice” (Hubley 1986 P 235). A study of a nutrition rehabilitation unit in North Tanzania (Howard and Millard 1997) detailed dissatisfactions articulated by its female clients, including resentment of both the time they were required to spend away from their children and of the apparently superficial analysis of the difficulties they faced in providing adequate nutrition.

Recognising this difficulty, the Bank offers examples of alleviation strategies to help women in their other activities: provision of wheelbarrows for example, improved cooking stoves, improved water supplies and food processing equipment to reduce time spent on tasks such as milling would free both time and energy to enable women to devote more time to nutrition (World Bank 2006 P 137). And this is necessary, maintains the Bank. Improved nutrition will not simply happen, as was once assumed, as a by-product of other poverty reduction strategies (World Bank 2006 P 57). Simply reducing income poverty or even improving food supply without changing the way young children are cared for will do little to improve nutrition.

1.4 Distracting from the crucial issue

The bank is not alone in its focus on micronutrient malnutrition. The Copenhagen Consensus – an international group of leading economists which comes together every four years to debate how development money might most effectively be spent - judged micronutrient deficiency its top priority for action in both 2008 and 2012. (www.copenhagenconsensus.com/Projects/cc12).

UNICEF points out “The visibly starving child has become the world-wide symbol of malnutrition. Yet it is a symbol that misrepresents the problem. Usually, visible

malnutrition is the result of extreme and unusual circumstances. The vast amount of malnutrition is invisible. It is this ordinary everyday malnutrition that affects almost a third of the developing world's children and prevents them from reaching the mental and physical potential with which they were born" (Malnutrition: the news UNICEF UK in association with Western Union. undated).

East Africa has had its visibly starving children in the past, and could still do so, were aid agencies and governments not nowadays skilled in organising emergency relief. Historian John Iliffe lists Tanganyikan famines so severe that they passed into folklore in the 1820s, 1830s and 1850s. The 1890s, marked by both rebellion and tsetse fly infestation and resulting agricultural disruption led to widespread deaths and a period of prolonged population decline. World War disruption and drought led to a new famine that reached its peak in 1919. It was then that observers recorded seeing children for sale in local markets: asking price one cow for a boy and, more commonly, two for a girl of marriageable age (O Grada 2009 P62). But this was the last serious loss of life. No famine between the wars rivalled past outbreaks (Iliffe 1979 P 315) though twice in 1948-50 and 1952-55 drought resulted in famine that would have killed large numbers of people had relief measures not been in place (Iliffe 1979 P471) while independence celebrations in 1961 coincided with rain failure and what would, without a major relief operation, have been the north's worst famine since the nineteenth century. The new government accepted that an adequate food supply could not be taken for granted and devised an early warning system. Its efforts have been assisted, says famine specialist Alex de Waal, by personal initiatives on the part of ordinary people, who have developed an extensive system of urban farming, linked to informal marketing structures which have enabled individuals to keep food coming in (de Waal 1997 P34).

Yet in the West famine continues one of Africa's most enduring images, crowding out badly needed debate on problems of micronutrient deficiency. Cormac O Grada, in his history of famine, highlights a change in relief care procedures which has led several African governments to hand over responsibility for feeding and health functions to NGOs. While these have successfully raised

Western awareness of poverty and malnutrition, the obligations relief organisations have taken on in the course of their transition from ad hoc philanthropy to permanent activity have their downside in the form of a burgeoning bureaucracy necessary to maintain these commitments. The need to ensure sufficient funds to keep going during the good times has led NGOs to overstate the danger or extent of famine when it does occur he suggests, making use of sophisticated publicity machines to feed international media in the ongoing competition for the public's cash. "They have used famines as a pretext for soliciting additional aid. Much of that aid has then subsequently been put to other uses" (O Gráda 2009 P 224). The efforts of the highly paid fund raisers at home do not always meet with the approbation of the professional development workers abroad. O Gráda quotes the text message "Starving child found in Malawi!" which circulated among cynical staff in the field while their employers at home were busily claiming 15 million victims across six southern African countries. FAO statistics in this particular case later revealed harvests lower than normal, but not excessively so (O Gráda 2009 P 222).

UK Labour politician Claire Short, while Secretary of State at the Department for International Development, criticised agencies for what she considered unnecessary fundraising which portrays developing countries as full of "constant suffering, failure and famine" and blamed an obsession with crisis for deflecting serious debate about development work (Franks 2013 P 153).

Anyone can set up an NGO, launch an appeal and try their hand at running an orphanage, a clinic, a feeding centre, says Alex de Waal, and when they do they are often aided and abetted by a media ever chasing the latest sensation. The result is "exaggerated dire predictions and stereotypes of pathetic dependency" (de Waal 1997 P 82). He quotes TV reporter George Alagiah who explains: "There's an unspoken understanding between us, a sort of code. We try not to ask the question too bluntly: 'Where will we find the most starving babies?' And they never answer explicitly. We get the pictures just the same" (de Waal 1997 P 83).

Also getting the picture, if not the pictures, have been food and pharmaceutical multinationals quick to grasp the profit potential in famine and nutrition aid programmes which have become increasingly big business, leading to the

emergence of a new raft of commercial products known as Ready to Use Therapeutic Foods (RUTF). Originally designed as energy-dense foods with added micronutrients for short-term management of severe malnutrition, the pressure group Global Health Watch suggests: “A huge market is being envisaged by the food industry”, citing the case of the commercial supplement Plumpy’nut, which enabled its producer, the French company Nutriset to boost profits from €16m in 2005 to €52m in 2009 following a tie-up with UNICEF. In 2009 the Indian government demanded that UNICEF take back a consignment of Plumpy’nut on the grounds that low-cost alternatives were already available in the country itself (Global Health Watch 2011 P 252). Global Health Watch maintains that there is evidence that similar results to the admittedly effective Plumpy’nut can be obtained with community-produced RUTFs. It concedes, however, that an undoubted strength of the Nutriset product is that it does not require dilution with (sometimes contaminated) water (Global Health Watch 2011 P251-3).

The suggestion that supplements such as Plumpy’nut might be used not simply to treat severe malnutrition but additionally as a precautionary measure to prevent the condition developing has already sounded alarm bells. “It is” suggests Global Health Watch, “part of a much larger design to mystify malnutrition and create spaces of profit-making opportunities for the food industry” – in the course of which it threatens to soak up government and NGO resources that might otherwise be used to address food production and distribution problems that have given rise to the need for supplements in the first place. The group quotes a team including economist Jeffrey Sachs as warning that such a solution would be “an absurdly high cost compared to the real solution of improved local agriculture, improved household dietary practices, and expanded access of the poor to basic health care” (cited in Global Health Watch 2011 P 255).

CHAPTER 2: FOOD CONSIDERATIONS

2.1 Food Production

This section of the thesis looks at the staple foodstuffs available in Africa and the micronutrients they supply. It is worth bearing in mind that, except in periods of crisis, no single staple is consumed to the exclusion of all other foods, and that no staple alone will supply a healthy and balanced diet. Even wheat, a cereal rich in nutrients (and unsuitable for growing in Africa's high temperatures) is currently being considered for a formal fortification recommendation by the World Health Organization (who.int/nutrition/micronutrients/wheat_maize_fort).

Tanzania's traditional diet is based on cereals, maize and/or tubers. The food is boiled to form a thick paste, and usually enhanced and enriched by one or more "relishes": sauces made from vegetables, pulses, meat or fish, depending on season, budget and time available. Micronutrient deficiency occurs both as a result of limited micronutrient content of food consumed, often as a result of lack of choice, or as the result of seasonal food shortages. Vitamin A which is most easily accessed from animal products, is particularly prone to deficiency before the new harvest brings in vegetables such as carrots. Research projects have highlighted Tanzania's low vegetable consumption, particularly among the poorest urban residents, who were found to consume just 154g per head per day, compared to the 317g consumed by the most prosperous. Even the latter figure falls short of the 400g per day fruit and vegetable consumption recommended by the World Health Organization. A third of participants in one survey had consumed no vegetables at all the previous day (Shackleton et al 2009 P 110 – 111).

2.2 Maize

When historian and food writer James McCann set out on an (imaginary) culinary expedition north from the Cape he was quickly able to assemble promises of a rich collection of local specialties he might encounter en route: *mealie pap* in South Africa, *mutuku* around the Limpopo, *sadza* in Zimbabwe, *xima* in

Mozambique, *nshima* in Zambia, *ugali* in Tanzania. But along the way, says McCann, the journey became marked by “a strange and growing sense of déjà vu”. For at each stage the dish that he was so hospitably and enthusiastically offered under yet another new name turned out to be the increasingly familiar bowl of roughly processed maize flour boiled with water into a stiff porridge (McCann 2010 P 137). While roasted maize, in season, is sold on the street as a snack, the crop is overwhelmingly consumed either as flour or after a period of boiling – a cooking method which reduces vitamins A and C. Alternative cooking methods are almost unknown. Even lavishly illustrated cookery books of the west (a genre in which African cuisines are sparsely represented) fail to identify any diversity in maize preparation.

What McCann seeks to illustrate is the extent to which maize, an import from the Americas, is now overwhelmingly the staple of Southern and East Africa. It has taken just 50 years for the plant, carrying all before it, to oust indigenous cereals millet and sorghum in many parts of the region (McCann 2010 P 137 – 139) to take up 41% of the total cereal growing area (McCann 2005 P 13). Of the 22 countries where maize constitutes the highest proportion of the national diet, 16 are in Africa, including Tanzania.

The advantages of maize over traditional foods are not hard to identify. For a start it is exceptionally prolific, providing a higher yield per unit of land and labour than any other grain. While wheat provides between four and six times the volume of grain per volume of seed sown, the equivalent figure for maize is between 100 and 200 times the volume of seed sown (Standage 2010 P 113). Africa’s yields fall well below average however: less than three tons per hectare, compared to an average of eight tons in industrialised countries.

Maize is easier to harvest than either sorghum or millet, easier and less time-consuming to prepare and cook than both these and than the staple root crop cassava, and producing, at the end of the process, as women were no doubt delighted to discover, a porridge capable of reaching “the stubborn thickness that they sought” (McCann 2010 P 140) with considerably less time and effort than

the staples they had previously used. All cultures have their chosen starches, comments McCann. African cultural preferences as to what constitutes “a proper and filling meal” are based more on the texture of a particular glutinous starch than on its taste (McCann 2010 P 33).

Another reason for the plant’s appeal is Africa’s extreme seasonal climate: the world’s most abrupt swings from wet to dry and back again. Once rain returns and the growing season gets underway maize matures quickly – between 100 and 120 days – providing an early season crop to mark a return to plenty.

The result of all this, says McCann, is that “by the first decade of the twenty first century a tidal wave of maize had engulfed Africa” (McCann 2005 P 7). As well as finding favour with farmers, the crop is increasingly common in cities, where it lends itself to sowing on narrow strips of land between houses and alongside roads (McCann 1999 P 7). A survey of six Tanzanian cities revealed that 68 per cent of citizens are engaged in urban farming (Shackleton et al 2009 P 37). Africa, says McCann, is unusual in that 95% of its maize crop is consumed by people, rather than used as animal feed or industrial raw material. In the USA, where 2012 maize prices hit an all-time high as a result of drought, a portion of the crop - currently 40% - is by law diverted into ethanol production (The Guardian 14.08.12 P 19).

Though most commonly ground into flour, technically maize is not a cereal: it’s a vegetable. Nutritionally, it provides vitamins A, C and E (three of a vegetable’s defining characteristics) though its vitamin A content is low, particularly in the case of African maize which is overwhelmingly white in colour, unlike the yellow maize familiar to most Westerners. But maize lacks the B vitamins that define a genuine grain such as millet or sorghum. It is high in carbohydrates but low in usable protein.

Most seriously, maize contains leucine, an amino acid that, when excessively consumed, blocks the body’s absorption of niacin. Niacin deficiency then leads in turn to protein deficiency, and diets high in maize are linked to outbreaks of

pellagra, a skin disease that causes digestive problems and eventual mental disorder, resulting, over the course of several years, in death from either infection or malnutrition. (“Diarrhoea, Dermatitis, Dementia, Death” in the words of medical students memorizing techniques of diagnosis.) Death from pellagra was a major problem in the South Eastern maize belt of the USA (where stewed maize is known as grits) in the early twentieth century, until solved by fortification of manufactured foodstuffs. In Italy adoption of maize as a basis for polenta led to outbreaks of sickness and death. In Southern Africa outbreaks of both pellagra and kwashiorkor have been observed to increase in direct proportion to the percentage of maize in the local diet (McCann 2005 P 119). Historically the disease has been a problem in the region’s mining communities, where owners sought to maximize profits by feeding workers at minimal cost on maize diets. To a lesser extent it also emerged in Eastern Africa as rural workers migrated to the new cash crop estates – in Tanzania’s case, sisal – where easy-to-grow, easy-to-transport, easy-to-prepare maize was the food favoured by authorities in workers’ canteens. (It’s worth noting that a diet high in groundnuts, an excellent source of niacin, can both reduce the risk of developing pellagra and treat the disease when it occurs.)

An additional nutrition hazard is the crop’s propensity during storage or transport to develop a fungus which produces the heat-resistant carcinogenic substance aflatoxin. Aflatoxin, also common in poorly stored groundnuts, is thought to be the cause of tropical Africa’s high rates of liver cancer. Individuals exposed to both aflatoxin and the Hepatitis B virus run a sixty times greater risk of developing this cancer.

And, most seriously of all, there is this drawback to maize. “The great fecundity of the maize plant in good weather conditions,” warns McCann “is as remarkable as its decline when the rains fail” (McCann 2005 P 16). Drought is a characteristic of the African climate, unalleviated in many countries, including Tanzania, by significant irrigation projects. The developing maize has little resilience. Even a few days of drought at the time of tasselling can drastically reduce yield. Extra heat may also become an increasing problem as global warming takes hold.

Maize crops in Southern Africa may be at risk (Conway 2009 P 15). Neither is the crop well suited to Africa's porous soils, which are low in the nitrogen and phosphorous critical to maize yields. Added to this, the crop is notorious for its soil depletion properties.

It is against this background that McCann concludes that by planting maize, both as a domestic and commercial crop, Africans "walk a slender tightrope of risk" (McCann 2005 P 7).

There is some evidence that he is not alone in this view. Ethiopian farmers adopted maize enthusiastically in the 1980s, only to revert to traditional crops such as teff which are better able to tolerate delayed and erratic rains (McCann 2005 P 20). Zambia's maize production rose by 137% when supported by subsidy. Once this support was reduced, leading to higher prices for fertilisers and hybrid seeds, some farmers opted to switch back to millet, sorghum, beans and groundnuts (McCann 2005 P 165 – 6). On the other hand, there is potential for an improved plant. McCann reports that Ghana is working on QPM – Quality Protein Maize – to add to its current staples of millet and sorghum in the north and cassava in the south "in what is likely to become a worldwide effort to promote the role of maize as humankind's principal food" (McCann 2005 P 52).

2.3 Cassava

Cassava (also known as manioc) like maize is a New World import to Africa. Primarily a root crop, it quickly became common on the West Coast where its ubiquity provided the Victorian traveller Mary Kingsley with a cassava experience to parallel Professor McCann's maize moment. "As you pass along" records Miss Kingsley, "you are perpetually meeting with a new-named food, *fou fou* on the Leeward, *kank* on the Windward, *m'vada* in Corisco, *agooma* in the Ogowe: but acquaintance with it demonstrates that it is all the same – manioc. If I ever meet a tribe that refers to buttered muffins I shall know what to expect and so not get too excited" (Kingsley 1897 Virago edition P 209). More than a century later cassava remains Africa's second most important staple after maize

in terms of calories consumed. Africa produces more cassava than the rest of the world together, with 70% of production taking place in just three countries: Nigeria, Congo and Tanzania (McCann 2010 P 51).

For the farmer cassava (in two varieties, labelled sweet or bitter) offers outstanding advantages. It is easy to propagate, tolerates poor soils and minimal rainfall, produces a high yield and can be harvested after six months or left in the ground for two years, thus providing year-round food. It can be harvested a plant at a time, a few leaves at a time, or even a piece of root at a time. In Tanzania the colonial government designated cassava a famine crop and thus a compulsory component for planting regimes in those parts of the country prone to famine. Its one disadvantage, both for commercial marketing and for famine relief is that historically the root's high water content renders it a poor traveller, remaining fit to process for little more than two days after harvest. (The recent appearance of the cassava root on the UK's streets and supermarket shelves suggest that this drawback has been overcome, by commercial growers at least.)

For the cook, cassava's strengths are constrained by another major and time-consuming weakness. Both strains, and particularly bitter cassava, contain cyanide. The poison can be neutralised, but only after lengthy and time consuming processing, including soaking in water for three or more days before drying in the sun and then peeling, grating and boiling. Failure to neutralise the poison effectively can result in paralysis.

As far as nutrition is concerned, the root presents a range of drawbacks. While high in carbohydrates and containing both vitamins B and C, its minimal protein content – just one or two per cent – is largely stored near the skin and easily lost in peeling. It is low in most minerals and in vitamin A, while B vitamins tend to be lost during processing. Mary Kingsley remarks: "The natives themselves say that a diet too exclusively maniocan produces dimness of vision, ending in blindness if the food is not varied" (Kingsley 1897 P 210).

Considerable problems then. But for Africa's poorest citizens one overwhelming advantage: cassava is cheap, the cheapest source of calories in every one of the six countries reviewed by the Ibadan-based Collaborative Study of Cassava in Africa (COSCA), which found it the principal calorie source for 40% of population surveyed and the second for another 23%. "In the Congo many families eat cassava for breakfast, lunch and dinner" COSCA reports (Nweke 2002 P 156).

Given this finding it proved a source of dismay to team members that their chosen crop is so often neglected by nutritionists and agronomists alike. Only two books have been published on cassava in Africa in the past 40 years, they observed, in the course of producing the third, the 2002-published "The Cassava Transformation". The team blames the neglect on both the stigma attached to cassava's designation as a famine crop and on the fact that its low protein content renders it an unsuitable food for children. But, says the team, "instead of being criticised cassava should be praised because it is the cheapest source of calories for the poor" (Nweke 2002 P 156). Despite their despondency the team notes with satisfaction – in part the fruit of their own enthusiastic promotion of the crop – a resurgence in cassava cultivation over the last three decades of the twentieth century. Significant technological advances have included the development of the new high-yielding disease-resistant TMS strains of cassava and availability of a mechanised grater to process the root. TMS can improve crop yield by as much as 40% without use of fertilizer, while development of a new mechanized grater eliminates the need for soaking by making it possible to squeeze the poison out of the grated root. Unfortunately, TMS strains do not lend themselves to mechanised grating as a result of uneven root surface.

Nutritionists have noted that cassava leaves, less common as a food than the root, have also enjoyed a resurgence of interest. It is the leaves which are of particular micronutrient value, though they also contain small amounts of cyanide, They can be dried and stored, and make a significant contribution to diet in some countries including Tanzania and Congo, while remaining unused in others. In Uganda the COSCA team was told that using the leaves was considered indication of low economic status. In the team's native Nigeria the leaves are normally

neglected although they possess the potential to fill the February – May harvest gap when child mortality is high. “Women in cassava-growing areas of West Africa are generally not aware that cassava leaves are edible and rich in protein, vitamins and minerals,” says COSCA. “The women do not know that their children can be saved from malnutrition and even death by feeding them cassava leaves in the dry months when other vegetables are in short supply” (Nweke 2002 P 125). The team concludes that: “A major challenge is to diffuse the best practices from one region to another within Africa” (Nweke 2002 P 115).

The cassava leaf is also the subject of analysis by Fatimah and Robert Jackson, whose study “The role of cassava in African famine prevention” offers the following favourable comparison between cassava leaves and spinach:

three times as much protein as spinach
three times as much calcium as spinach
nearly five times as much vitamin C as spinach

While cassava’s protein deficiency may account for its neglect, the Jacksons argue that nowhere do people live on a 100% cassava diet. The root is combined with other foodstuffs, usually fish or vegetables which are high in micronutrients. In times of famine cassava can provide bulk, supplemented with aid distribution of dried milk and other foodstuffs. The Jacksons contend: “We should improve the quality and quantity of the crops we already have. We should never dissuade people from consuming any food crop. Our aim should be to increase the diversity of the human diet rather than decrease dietary diversity” (Jackson in Huss-Ashmore & Katz 1991 P 214).

New strains of the plant are currently being identified as a means of combating Vitamin A deficiency. Nigerian Minister of Agriculture Akinwumi Adesina told an international conference in September 2012 that three vitamin A-rich cassava varieties have been released with 10,000 stems ready for distribution to farmers (www.tribune.com.ng/index.php/nres/48137 accessed 25.9.12).

2.4 Millets

Millets are Africa's principal indigenous staple, and admirably suited to the continent's extensive semi-arid areas. The genus sub divides into two main varieties: pearl millet and finger millet. In Tanzania millets remained the most important staple until their displacement by maize in the interwar years. The same trend occurred in other parts of the continent, with the result that both millets are included in the widely acclaimed 1996 work "The Lost Crops of Africa". Lost, say the authors, because even though pearl millet remains the world's sixth most important cereal, with production equally divided between India and Africa, the crop's untapped potential will remain vast for as long as it continues to be poorly supported by both science and politics. Grossly neglected, often considered appropriate only as an animal feed, finger millet is known to most westerners as a food for budgerigars. It might however, speculate the authors of Lost Crops, currently hover on the verge of newfound significance as both millets start to attract increasing attention from nutritionists and agronomists alike (National Academic Press 1996 P 77).

Nutritionally, millets offer high concentrations of calcium and iron, a relatively high protein content and range of amino-acids, with the result that the crop has recently been hailed as a "supergrain" in the western popular press. Pearl millet is "a superior foodstuff" in the words of the authors of Lost Crops who would like to re-establish its significance in Africa so that it can compete with maize in the drier parts of the continent. Research in India suggests that a diet based on pearl millet and pulses is nutritionally superior to both rice and wheat (National Research Council 1996 P 81-85). There are downsides, including uncertainty about the digestibility of pearl millet. The grain, normally used for porridge, can also be ground into flour and used for pancakes. There is growing interest in its potential as a wheat substitute in bread, a food becoming increasingly popular with Africa's urban populations.

Finally, and traditionally, in East Africa there is millet's popularity (along with bananas, potatoes, sorghum, maize and even bamboo) as a raw material in the

production of home-brewed alcohol: “an economic resource of extraordinary importance during the twentieth century” (Willis 2002 P 34). Beers made from millet have a high vitamin B content, which has led to their being defended on grounds of health. The other side of this equation is advanced by those who oppose the diversion of sometimes scarce foodstuffs into alcohol production. Banning home-brewed alcohol in times of famine has been a stock response of both the colonial and post colonial state says Willis: “a telling reflex which reveals the ingrained official belief in the irresponsibility of ordinary people”. Rather, he suggests, production of alcohol for sale has proved a successful survival strategy (Willis 2002 P 42). It is certainly true that home brewing can offer rural women a rare opportunity to participate in the cash economy, which may provide scope to vary family diets and to access otherwise unaffordable consumer goods.

For agronomists concerned with climate change, millets’ untapped potential is increasingly relevant as the world becomes hotter and drier. Yields, currently low, and only at the end of a long growing season, have potential for improvement with research. This has already been achieved in India, where public and private investment in new seed varieties has nearly doubled millet and sorghum yields in the past forty years (Juma 2011 P 150). Of all grains, pearl millet, the Sahel staple, is best able to tolerate extremes of heat and, thanks to its exceptionally long root, of drought. Pearl millet is the last crop before the Sahara starts. Farmers there know that if pearl millet fails, they have nothing.

For the cook, millet is a demanding foodstuff. Anthropologist Audrey Richards’ pioneering 1930s study of food preparation among the Bemba people of north east Zambia describes the day-long preparation of millet porridge, starting in the morning with use of heavy three-foot poles to separate the grains from the stalk. “The pounding is exhausting work” she reported. Sometimes two women work together, their bodies steaming in the heat. The grain must then be sifted from the chaff, pounded again and sifted again before being transferred to a grinding platform. The woman kneels in front of this, and on it she places a handful of grain which she grids beneath a small stone. “This task is reckoned very hard

work and the women sing to lighten their labour. The rhythmic to-and-fro of the grinding stone and the notes of the song, falling flatter and flatter are the most common sounds in a village in the late afternoon.” The coarse flour produced may be reground to produce a thin porridge to feed a baby. Otherwise it is tipped into boiling water to make a thicker mix – so thick that it requires a 2.5 foot high spoon, held with both hands and using the entire weight of the body, to stir (process quoted in McCann 2010 P 141 – 144). Perhaps surprisingly, says McCann, the Bemba were rather slow to adopt maize as their primary staple.

2.5 Sorghum

Sorghum, like millet, is one of the tiny number of grains indigenous to Africa. And like millet it is considered by agronomists to be unjustly neglected in favour of “up-to-the-minute” foreign cereals (National Academic Press 1996 P 1). Nevertheless, sorghum remains the staple diet of more than 500 million people in more than 30 countries and is, says the US Grains Council, the fifth most important cereal crop in the world. Used outside Africa and India as animal feed and biofuel, within it is both a basis for alcoholic drink and a foodstuff containing carbohydrate, slightly more protein than maize and some B vitamins, but less vitamin A. Sorghum is a rich source of minerals, supplying calcium, magnesium, potassium, zinc and iron. But its protein is difficult to digest and it is deficient in some amino acids, while the seed coat of brown sorghum contains tannin, which can reduce the body’s ability to absorb and use nutritional substances. It is also deficient in niacin, with the result that pellagra is a disease of sorghum areas. In Africa it remains largely a subsistence crop, consumed where it is grown.

For the cook, sorghum can be boiled like rice, used for porridge or ground for flour to make bread. Often it is eaten fermented to improve its digestibility. James McCann makes the point that all three of Africa’s indigenous grains, millet, sorghum and teff, are exceptionally nutritious because their tiny size means that the whole grain is consumed, unlike rice or wheat. The size also means that the

small space between grains allows little oxygen for insect pests or mould to survive and propagate, thus enhancing storage potential (McCann 2010 P 35).

For the farmer, sorghum is one of the quickest maturing crops: 75 days, making three crops a year a real possibility if climate permits. In a drought sorghum will survive longer than maize. And it possesses one other increasingly relevant strength – its ability to withstand high rainfall and even some waterlogging. (Even, according to research in Israel, some tolerance to saline water.) So if, as climate specialist Nicholas Stern maintains “The danger from climate change lies not only, or even primarily, in heat. Most of the damage is from water, or lack of it: storms, droughts, floods, rising sea levels” (Stern 2009 P 9), sorghum may anticipate a more distinguished future than its recent neglected past suggests. For the authors of *Lost Crops*: “As the world moves towards the time when its supplies of food will be insufficient for its supplies of people, this plant will increasingly contribute to the happiness of the human race” (National Academic Press 1996 P 129).

2.6 Rice

The rice widely consumed in East Africa, is not Africa’s indigenous rice of the continent’s west coast, but Indian rice first imported by the immigrant Asian community, and subsequently propagated as a local crop. In Tanzania imports to supplement domestic production were common until the 1930s depression led to its being overtaken as a food import by cheaper Kenyan maize. Rice remains a popular food on the coast, and in cities. The Dar es Salaam YWCA, a popular lunch venue for office workers, offers either rice or ugali (maize) as the basis for its cheapest 2,200/- lunch (around 90p in 2012) including beans and the occasional green vegetable. It attracts a steady stream of patrons. Rice is also popular in parts of the country where climate permits both commercial and domestic crop. This includes Mang’ula, where the rural research for this thesis was carried out. Here, the seasonal rain comes off the neighbouring scarp slopes of the Udzungwa mountain range with sufficient ferocity to enable rice

cultivation. Rice is the principal crop of Mlimani School's shamba. There is an allocation for teachers, though the bulk is used to provide food for pupils sitting national examinations. Following harvest, everyone's rice is laid out to dry over village roads on sheets of polythene, walked over, driven over by trucks and the occasional car. The deposits of grit and small stones thus acquired do nothing to enhance the dental health of residents.

Nutritionally rice – the staple food of more than half the world's population – contains good quantities of iron and folate and a reasonable amount of niacin. It has no A or C vitamins. Tanzanians do not normally eat the more nutritious brown rice. For the farmer, rice is labour-intensive, requiring nursery sowing, followed by planting out of seedlings some four weeks later. Germination to harvest is around 110 days. For the cook, rice offers obvious advantages: easy to store, quick to prepare, and increasingly popular in cities where many women are in paid employment.

2.7 Vegetables

Every year 2.7 million people throughout the world die as a direct result of insufficient vegetable consumption (Shackleton et al 2009 P 105). Poor consumption leads to micronutrient deficiencies – mainly iron and vitamin A - rather than protein or calorie deficiency. Fruit and vegetables are among the richest sources of micronutrients, as well as often being the most affordable. Among the most significant examples are those coloured yellow and orange, which are rich in vitamin A, and green leaves rich in folate, now known to protect the foetus from spina bifida when consumed in early pregnancy.

Growing focus on nutrition, and on the nutritive value of vegetables in particular, has led to growing interest in Africa's indigenous flora with the result that in the year 2000 a group of scientists came together to launch the Plant Resources of Tropical Africa network. Their aim is to collect and disseminate information on an estimated 7,000 potentially useful plants before they are lost for ever. This

initiative was converted in 2006 into the Indigeno Veg network, which has a specific interest in vegetable consumption in urban areas. Work centres on the Africa HQ of the World Vegetable Center, located in Arusha, Tanzania.

The network has identified a declining demand for indigenous vegetables, * which it attributes to:

- a growing taste for less bitter vegetables
- a need for vegetables which can be prepared more quickly and more easily
- an association of indigenous vegetables with famine food “such that it can be regarded as humiliating to eat them”

As a result of these trends consumption of indigenous vegetables has almost halved, from 20% by value of food eaten, to just 11% (Shackleton et al 2009 P 11). It is not just indigenous vegetables that are insufficiently consumed. Recommended vegetable consumption is estimated at an average 73 kilos per person per year. Africa’s per capita intake is less than half this. In countries - including Tanzania - where intake is classified as “exceptionally low” the result is high child and adult mortality. Fruit and vegetable consumption can help to address the double burden of micronutrient deficiency and chronic diseases such as diabetes, cancer and cardiovascular disease. “These conditions are intolerable” say Network members Ray-Yu Yang and Gudrun Keding (Shackleton et al 2009 P 105). An exception to this situation is the coastal areas of both Tanzania and Kenya, believed to use, proportionately, more indigenous vegetables than any other part of Africa (Shackleton et al 2009 P 77).

Inland East Africa , by contrast, is particularly affected by low vegetable consumption, though efforts are now being made to reverse this trend which appear to be bearing fruit. A breakthrough occurred in Nairobi in 2004 when the supermarket chain Nakumatt agreed to stock indigenous vegetables (Shackleton et al 2009 P 217).

Food availability in urban areas is an issue of increasing significance because Africa is currently experiencing the world's highest urban growth rates – 4.5% pa - with more than 50% of the population expected to live in towns and cities by 2030 (Shackleton et al 2009 P XXII, citing UN-Habitat 2007). A 1998 local government survey in Dar es Salaam noted that more residents were engaged in urban agriculture than in formal employment (Shackleton et al 2009 P 245) while a survey in Ubungo Darajani, a few kilometres from Jangwani Secondary School reported cultivation along roads, railways, factory boundaries and institutional premises as well as plots housing cows, pigs and poultry (Shackleton et al 2009 P 258).

* The Network distinguishes between “indigenous vegetables”, which are either native to Africa or, like cassava and sweet potato, have been cultivated there for a long period, and “exotic vegetables” which are relatively new imports such as brassicas. “One of the characteristic features of traditional African vegetables is that they often contain higher levels of essential minerals and micronutrients than exotic vegetables as well as being higher in protein” (Shackleton et al 2009 P 12). Exotic vegetables have sometimes been introduced into Africa for their export potential, but are now becoming increasingly common in urban agriculture.

2.8 Improving Micronutrient Intake

For those whose insufficient or insufficiently varied diet leads to micronutrient deficiency, there are three potential solutions:

- * supplements: extra micronutrients taken in the form of medicines, often distributed by NGOs as part of child health programmes
- * fortification: extra micronutrients added to common foods during manufacture often as a result of national legislation

* a change in diet

(Both supplements and fortification are explained in the Teachers' Handbook. Pupils of all ages will often have had personal experience of both, and fortified salt is dealt with in lesson modules.)

Supplements can be distributed or, in the case of western societies in particular, bought in supermarkets and shops. The World Health Organisation estimates that supplements have averted 1.25 million deaths in 40 countries since 1998 (www.who.int/nutrition/tropics/vad.en). The most common supplement in Africa is currently the Vitamin A pill distributed to young children. An estimated 60% of children up to age five receive this supplement in Tanzania. Vitamin A must be administered every six months, so it is expensive and time-consuming to distribute. Patients can slip through the net as a result of staff shortages, transport problems, isolation or civil disturbance. Their well-being is at the mercy of a system beyond their control. Additionally, supplementation carries the risk that patients may receive or self-administer a higher dose than they actually need, giving rise to other health problems. Supplements are required for high-risk groups, says the World Bank. But for the population at large, it believes that there are both technical and economic reasons to opt for fortification (World Bank 2006 P 203).

Fortification has a long and respectable history dating back to the 1920s when addition of iodine to salt in Michigan, USA, resulted in a reduction in reported goitre cases from 40% of the population to less than 10%, while Switzerland, adopting the same strategy, reported a dramatic drop in deaf mutism in newborns. Fortification of salt and other common foodstuffs with iodine remains the most common worldwide example of micronutrient deficiency control, with progress monitored by the International Council for the Control of Iodine Deficiency Disorders, which publishes regular updates on methods of fortification used by different countries. Iodine was followed with fortification of breakfast cereals to combat deficiency of B vitamins, fortification of margarine

with vitamin A in Denmark and of milk with vitamin D in the United States. The US also uses folic acid (folate) fortification to reduce birth defects, while countries in Central America have successfully experimented with vitamin A-fortified sugar (now being tested for use in Zambia). Some fortifications are declared mandatory by governments, while others are introduced by manufacturers as an added selling point. Fortified breakfast cereals are now the main source of iron for young children in the United States. Among recent initiatives in the UK has been a campaign launched by Scottish teenager Ryan McLaughlin calling for vitamin D fortification. This deficiency, caused by lack of sunshine, is now linked to the disease multiple sclerosis, common in northern latitudes. Ryan's mother has been diagnosed with MS (The Guardian 24.12.11).

Fortification is now credited with proving a major factor in the control of diseases. The advantages are spelled out in the WHO/FAO 2006 "Guidelines on food fortification with micronutrients". Above all, it "requires neither changes in existing food patterns – which are notoriously difficult to achieve, especially in the short term, nor individual compliance" (WHO/FAO 2006 P 29). Against this must be set the fact that micronutrient deficiency is often the result of either poverty or locality, and in either case individuals may have little access to food that has been fortified. An additional drawback may be ignorance of the need for micronutrients, a difficulty that might potentially be addressed by the school education programme proposed by this thesis. Tanzania's sole fortification programme to date is that of salt iodization. A joint Tanzania/UN report has warned of lack of general knowledge on the need for iodized salt, used in only 60% of households. As small producers continue to flood the market with non-iodized salt the report notes weak enforcement of regulation and limited access to nutrition information, and calls for campaigns to promote iodized salt and improve public education (United Republic of Tanzania/United Nations 2011 Accelerating Progress towards MDGs P 43). The need for education was highlighted at a meeting of international representatives of the iodine programme at UNICEF's Dar es Salaam offices in March 2010. According to the local press, the Tanzania Food and Nutrition Centre reported to the meeting that a plan to distribute iodine capsules had been abandoned following rumours that

they would cause infertility. Following this the World Bank announced that it was withholding \$2 million allocated to start a Tanzanian food fortification programme until the Tanzania Bureau of Standards finalized its fortification procedures (www,the citizen.co.tz).

Tanzania is not alone in making slow progress on fortification. But a more encouraging development has recently been reported from Kenya where frustration at lack of government action brought processors of vegetable oil together with a group of sympathetic civil servants in 2007 to set themselves a 100-day target to produce guidelines for sale of vitamin A-fortified cooking oil. The project, advised by the Canada-based Micronutrient Initiative, overran by 30 days, but ended with an announcement by the Ministry of Health that three brands of oil, used by 3.6 million consumers, had been given authority to use the newly-designed fortification logo. Further fortification initiatives are now underway (See picture of Kenyan fortified flour in the Teachers' Handbook.) A report on the project notes that after years of delay and apathy: "Leaders pay attention to concrete results that can be talked about, photographed and disseminated" (www.micronutrient.org). The report also notes that 57% of the population of Sub Saharan Africa have access to some form of processed foods, and that this percentage is expected to grow.

As far as promotion of specific micronutrients or specific foods is concerned, nutrition specialists point out that, while we have moved beyond the stage of the generalised "Eat more fruit and veg" or "Cut down on Fat" advice, we are dealing with a science that is still imperfectly understood. This includes the caution that we do not know whether a micronutrient additive can be relied upon to mimic the effect of the micronutrient food in the nutrition process. It is now recognised that micronutrient absorption differs when different combinations of food are eaten. Not only is iron in meat more likely to be absorbed than iron in plants, but it is thought that eating meat and vegetables together will actually increase absorption of the plant iron. But drinking tea at the same time will reduce iron absorption. The Indigeno Veg network warns that while both nutrition research and nutrition interventions currently focus strongly on single nutrients, less is

known about health outcomes from a combination of foods. “It is increasingly acknowledged that single nutrients alone are not the key to solving nutrition problems and to preventing chronic diseases; but whole foods or food groups in the right combinations, and thus a variety of vegetables and fruit as part of a plant-food based diet are desirable” the Network says (Shackleton et al 2009 P 136). It concludes that more varied food production and consumption are needed to ensure a range of micronutrients.

The WHO warns that fortification is not the whole solution. “Its limitations are also well known: food fortification alone cannot correct micronutrient deficiencies when large numbers of the target population, either because of poverty or locality, have little or no access to fortified food, when the level of micronutrient deficiency is too severe, or when the concurrent level of infections increases the metabolic demand for micronutrients” (WHO/FAO 2006 P XV). Instead the organization would like a focus on “enduring solutions” such as promotion of vitamin A-rich diets combined with fortification. “Cultivating the garden, both literally and figuratively, is the next phase necessary to achieve long-term results” it predicts (www.who.int/nutrition/topics/vad.en).

CHAPTER THREE: PRODUCING, DISTRIBUTING AND CONSUMING FOOD

3.1 Introduction: Contributing to micronutrient malnutrition

This section of the thesis considers other factors which result in Africa's high incidence of malnutrition: the climate problem which impacts adversely on production of food and produces a distinct "hungry season" when quality and sometimes quantity of diet deteriorates and vitamin A in particular may be hard to access, the transport and distribution problems which restrict choices of food for producer and consumer alike, and the problem of food preparation which affects both quality and availability of meals. Potential for food preservation as a result of processing – drying, tinning and freezing – is discussed in the Teachers' Handbook. Given the vastly differing facilities for accessing or applying these techniques, both on school premises, within the family, and between rural and urban areas, discussion and elaboration will be a matter for the discretion of the individual teacher.

Food for East Africa's domestic consumption has traditionally been produced by human labour (the continent lacks indigenous domesticable animals) with minimal technology.

This pattern of peasant agriculture, whether carried out in rural, or, as is increasingly the case, in urban areas remains the principal source of the domestic food crop. The latest report on Tanzania's MDG progress draws attention to:

- A production system still dominated by the hand hoe: the latest Household Survey of farm implements shows that 92% of farmers rely on this
- Failure to promote fertilizer use to increase output: Tanzania's average nine kilograms per hectare compares with a regional average of 16 kilograms per hectare – itself low by world standards
- Minimal irrigation: less than 1% of land is irrigated
(Accelerating Progress towards MDGs 2011 P 26)

The result of this, warns the report is the “increasing number of poor and hungry people in rural areas”.

Feminists such as Kenyan Nobel Peace Prize winner Wangari Maathai point to women’s responsibility for much of Africa’s domestic food production as a factor in the low priority and lack of interest accorded the sector. Many national agricultural policies have relied on buying ‘cheap food’ such as corn, wheat and white rice in international markets. “But such food is no longer particularly cheap and was never particularly healthy” (Maathai 2009 P 235).

3.2 Climate

It is now 20 years since food supply specialist Deborah Bryceson told a conference in Jinja, Uganda that fluctuations in Tanzania’s food market “could best be described as wild rather than wide” (Bryceson 1994 in Sahil ed *Inducing Food Insecurity* P 146). No continent, says James McCann, experiences a pattern of rainfall as harsh and unforgiving as Africa. In East Africa months of drought ending in December, mark an abrupt transformation. “Within two weeks brown and seemingly lifeless landscapes turn green as seeds germinate and chemical reactions within the soil make nutrients available to plants --- camels’ and cows’ milk become more plentiful” (McCann 2010 P 17-18).

Lack of nutritional variety imposed by the months of drought is reminiscent of the winter deprivation experienced in pre-industrial North Europe. But with this one significant variation: the wheat flour that sustained Europeans through the coldest months is rich in protein and contains iron, folate and calcium; the maize flour that sustains many Africans through dry seasons of varying severity contains little protein, little iron and little folate.

African rainfall is the result of a meteorological phenomenon known as the Intertropical Convergence Zone (ITCZ). Located over the Sahel, the zone migrates by as much as 40-45 degrees north or south in the course of a year. It is the movement of the ITCZ that triggers seasonal rains in an area of Africa stretching from Swaziland in the south to Liberia on the west coast (Toulmin 2009 P 36).

The result of the marked seasonal variation in much of East and Southern Africa is abnormally short growing seasons, restricting choice of food cultivated. This is

a major cause of the lack of variety in African diets that render individuals so prone to micronutrient deficiency. In the absence of irrigation, the months without rain lead directly to the “hungry season” (January–March in Central and East Africa) before the new crop is ready to harvest. It is now that food choices become ever more limited and deficiency of micronutrients that cannot be stored for long in the body, including vitamins A, Bs and C takes hold. The cities, with a regular water supply which can be used to irrigate urban agriculture, fare better in this respect than rural regions, and city children are found in surveys to be better nourished than their rural counterparts. Urban areas also benefit from much of the imported food that is increasingly necessary, and, in the view of urban populations, desirable. African countries now import on average 25% of their food needs including rice, meat, dairy and processed cereals such as pasta, while indigenous and cheaper millets and sorghum face lower levels of demand (Toulmin 2009 P 54).

Once in every estimated three to eight years the ITCZ migration south stops short of its usual limit. The result is poor harvests, food shortages and occasional famine. ITCZ migration is influenced by the planet’s principal source of year-on-year weather variation, the imperfectly understood Pacific-based El Nino Southern Oscillation – ENSO. “Research has shown that ENSO events and associated changes in eastern Pacific sea temperatures account for 60% of the variation in annual yields of maize in Zimbabwe” (Toulmin 2009 P 37).

It is the pattern of rain rather than the amount that falls that is so damaging to African food production. Rainfall concentrated into a few months and followed by drought often comes dangerously close to the minimum growing period for many food crops. Reference has been already been made to the appeal of maize as a result of its short growing season.

The impact of climate change on existing weather pattern remains speculative, though Toulmin tentatively observes an increase in frequency and intensity of ENSO events in recent years. Current predictions suggest that East Africa is expected to become wetter as climate change exacerbates. “Too much water, like too little water, plays havoc with municipal planning and service provision” she

observes, citing the 2000 Mozambique floods as an example (Toulmin 2009 P 38).

3.3 Distributing Food

Africa has the highest transport costs in the world. According to the UN “Transport costs are unaffordable for many African citizens” (UN Africa Review Report on Transport 2009 P 110). Poor transport, says the UK Commission for Africa, results in up to 50% of harvest being lost in many parts of the continent because farmers are unable to get their crop to market. This is double the average in other developing countries (Commission 2005 P 81).

In a last-minute postscript to her history of East Africa’s TAZARA railway project Professor Jamie Monson describes her shock on returning to Tanzania in 2010 to discover almost deserted stations and once bustling platforms standing empty (Monson 2011 P 155). TAZARA, like other African rail lines, was built to link mining and cash crop areas to the coast and export, in this case to link the Zambia copper belt to Dar es Salaam. Passing through Mang’ula, the largest interior base camp during construction, which has its own station, the railway quickly became the centre of new farm activity and a new trade in foodstuffs up and down the line. Local farmers – many having moved to the area for work on the Chinese-run project completed in 1975 – quickly seized the opportunity to grow and sell surplus produce once the railway opened. Monson records Mang’ula railway workers growing maize, bananas and fruit on their rest days (Monson 2011 P 66). Larger landowners flocked to ship their products to the markets and trading houses of Dar es Salaam, buying capacity on goods trains made up of wagons loaded with timber, rice, maize and even cattle. At the same time hundreds of small farmers and traders entrusted their modest parcels of surplus produce to goods wagons attached to passenger trains, to be shipped to another small station where a market had been identified. Parcels enabled maize to be shipped to rice-growing areas and vice versa, as well as carrying vegetables, beans, and groundnuts up and down the line (Monson 2011 P 95). For these farmers the railway presented a rare opportunity to produce and sell surplus

produce, offering potential to achieve a higher standard of living as well as profit to be invested back into the land. For the consumer, it often meant a better (and fresher and healthier) variety of foods in their local market.

The Government's failure to maintain the railway, leading to a decline in both rolling stock and track, has put an end to most of this. Through no fault of their own small entrepreneurs who had seized with both hands the opportunity offered have seen their businesses disappear. Tanzania's 4.800 km of track, a World Bank mission reported in 2004, are now characterised by "irregular services operating at low levels of safety and speed"

(United Republic of Tanzania – Transport Sector Snapshot Thum 2004 P 8).

In just five years from 1998 to 2002 the number of passengers using TAZARA fell from 1.5 million to 1 million, while freight tonnage fell from 273 tons to 163 (Thum 2004 P 14). The Mission's attempts to find out what had gone wrong was hampered by a lack of detailed information leading to large numbers of blanks in statistical tables which might have recorded the decline. The Mwanza line was closed completely for three years. It was due to reopen in December 2012.

But for most Africans a railway is an undreamed of luxury. 80% of African goods and 90% of passengers are transported by road. And it is an exceptionally dangerous means of transport, both for vehicle users and the many pedestrians who die in road traffic accidents. Of the world's 1.2 million annual road deaths, 225,000 occur in Africa (UN Africa Review Report on Transport: Summary 2009 P 2). African roads are also among the most expensive to use, with 2010 freight charges estimated to be 22% higher than elsewhere (World Bank, cited in Mills 2011 P 195). Limited competition (links between ruling elites and transport operators), high profit margins, road blocks, delays in customs clearance and payment of bribes are among reasons advanced by commentators. For passengers the system is seldom transparent, with formal tickets printed with a fixed fare rarely available.

In Tanzania, says the World Bank's 2004 Transport Snapshot – their most recent survey on the country's road network - virtually all 27,500 km of rural feeder

roads (out of a total network of 79,000 km) – were earth tracks or gravel roads in poor condition. Just 1% of the rural population owned a truck or car. The review concludes that poor roads are forcing a significant percentage of the rural population to live without access to markets and to essential economic and social services (Thum 2004 P 13). Poor roads result in limited incentives to produce extra food, limited opportunities for producers with a surplus to sell, and higher prices and less choice for consumers. Proximity to a road, Thum reports, results in a higher standard of living for rural people: an extra 33% income for those living within 100 metres of a gravel road that is passable 12 months a year and with its own bus service - a category that includes Mang'ula. They are in a minority. Only 38% of the rural population lives within two kilometres of an all-weather road. Remoteness is one of the key factors in explaining concentration of poverty in Tanzania as it limits access to markets. For most of the rural population, transport is limited to bicycle, animal-drawn carts or wheelbarrows to move agricultural inputs and outputs to and from their fields (Thum 2004 P 12).

Even those living within easy reach of a tarmac road find the system often fails when food is harvested, The combination of crops coming simultaneously to maturity and a serious shortage of storage facilities leaves farmers competing with one another to sell, and forcing prices down to the detriment of long-term agricultural investment, and so of improvements in national diet. Poor transport is matched by poor or non-existent processing facilities, so that many seasonal micronutrient-rich foods go to waste. Post-harvest losses are estimated at 30% for cereals, 70% for fruit and vegetables and 20% for fisheries (Tanzania: Country report on Millennium Development Goals 2011 P 20). Packaging, which would extend shelf life, is rare. Just 3% of UK perishable food is wasted pre-sale as it passes through the food chain, says the UK's Packaging Federation, compared with a 50% loss in India. A simple plastic film around a cucumber will extend shelf life by a week (Financial Times magazine 26/27-04-08). * The Indigeno Veg Network highlights waste in the marketing process. Farmers often carry produce on foot to public markets that are poorly adapted for food sales. Markets may not be cleaned. They may not be covered, thus reduced to a sea of

mud when it rains, vegetables may be displayed on an old piece of plastic sacking laid on the ground, or sold in heaps, baskets or buckets. There are seldom storage facilities, never cold rooms. The result is that market traders buy from farmers only the minimum amount they can be confident of selling. Anything unsold is usually dumped at the end of the day, says the Network. A paved market, with an electricity supply would contribute to public health and food safety as well as encouraging more traders into the market (Shackleton et al 2009 P 238 – 241).

* Even so, wastage is a significant problem in rich countries. 25% of all food on sale in the UK and US goes direct from the checkout to the rubbish bin, or is thrown away by shops and restaurants. (The Economist: special report on feeding the world 26.2.11 P 10).

3.4 Cooking Fuel

When researchers at Dar es Salaam university asked a sample of women delegates attending a church conference what cooking fuel they used, 70% reported preparing meals on a wood fire outside the home. Disappointingly for the team, working on a brief to investigate poor uptake of biogas, the second and third most common fuels were charcoal, then kerosene.

Use of fuels which increase greenhouse gases, exacerbate global warming and contribute to environmental degradation are common throughout Africa. – though only 2% of the women sampled reported that they still enjoy access to a good supply of wood. Choice of fuel -although given the limitations of the Tanzanian National Grid many would argue that there is little choice - impacts significantly on nutrition and also, as wood gathering becomes an increasingly time-consuming activity, on women's ability to meet other obligations including childcare. One study suggests that it takes longer now to prepare a family meal than it did more than half a century ago Then anthropologist Audrey Richards estimated the time required at three hours. A 1990 study of women farmers in the Morogoro district of Tanzania suggests 3.5 hours a day spent on collecting water, food preparation and cooking (Mbilinyi in Bryceson 2010 P 173). Piped

water was one of the great achievements of the Nyerere era, but still requires a visit to the nearest public tap (perhaps several for a large family) to fill buckets and jerry cans.

The growing problem was identified as far back as 1999 when Tanzania Prime Minister Frederick Sumaya told a conference in Dodoma “The time used for collecting firewood or the expenses for buying wood or charcoal keep on increasing, and therefore reduce the capacity of our people, especially the women, to engage in other productive activities” (Mshana & Ischeback 1999 P 21). An earlier report on the problems of preparing an African meal (Dankelman & Davidson 1988 P69) found deforestation led to women and girls walking increasing distances – up to ten km – and carrying heavier loads – up to 35 kg . Deforestation in Tanzania was estimated in 2009 by the Tanzania Forestry Working Group at 412,000 hectares a year, from a total remaining stock of 35 million hectares ([tnfr.org/files/E-INFO TFWG](http://tnfr.org/files/E-INFO_TFWG) accessed 1.10.12). The heavy weights women and children are obliged to carry damage the spine and can cause problems in child-bearing, while the smoke from a wood fire can have a detrimental effect on both eyes and lungs. Nutritionally, a shift away from foodstuffs such as beans, which can take up to four hours to soften and eliminate toxins, and hence require more wood, is a direct consequence of deforestation. Of all common foods, beans tend to be richest in both protein and in amount and variety of micronutrients. After women in the Sahel started to switch from millet to less nutritious rice in order to save fuel an attempt was made to sustain nutritional intake by encouraging consumption of soybeans - 40% protein, rich in iron and with the added advantages of both tolerating low rainfall and enriching the soil with nitrogen. This failed when women pointed out that soy takes longer to cook than (less nutritious) black-eyed beans (Dankelman & Davidson 1988 P 71). But a carefully structured scheme in neighbouring Togo inviting women to start growing just a few soy as an experiment, and incorporating cooking demonstrations showing how to use soy as a relish, and accompanied by simultaneous development of a high protein porridge for children identified as malnourished proved more successful (Dankelman & Davidson 1988 P 23). In other parts of the Sahel families reported switching from two to one cooked

meals a day. The number of cooked meals impacts directly on the health of the family and is particularly critical for young children who need to eat at least three small meals a day (Dankelman & Davidson 1988 P 71).

It is hard to see that any solution to this major nutrition problem is in prospect. Just two per cent of Tanzania's rural population is connected to the national grid (Tanzania National Panel Survey Report 2008–9 Household Survey). Charge for new connection, estimated at 10,000,000/- per kilometre to bring supply into a village is considered prohibitive. Few rural families can afford generators.

CHAPTER FOUR: TANZANIA

4.1 Introduction: Recent History

This section looks at Tanzania, its environment, its history and, in particular, the post-independence era of idealism and the determination to build a better future which soon disintegrated into years of near disaster, dominated by increasing poverty.

The chapter also looks at the country's education service, including past attempts at health and nutrition education – some more successful than others – in the light of lessons to be learned. It considers health services currently available.

The most significant possession that German Chancellor Otto von Bismarck bore triumphantly away from the 1884 Congress of Berlin remains one of Africa's largest countries. But there were reasons why this huge tract – 945 square kilometres – lying so close to one of the world's principal shipping lanes had remained neglected and unclaimed for so long. Tanzania was both one of the last parts of Africa to experience foreign colonization, and one of the last parts to experience human colonization of any kind. A mere 13 years earlier the explorer Henry Morton Stanley, en route to link up with David Livingstone at Ujiji, had complained bitterly of the country's hostile environment, and of the non-availability of pack animals, which had obliged him to spend seven months on what should have been a one-month journey from the coast. (Stanley 1895 P 463).

The country's pre-independence historian John Iliffe singles out four principal characteristics of Germany's new possession:

- * poverty of soils: except in rare volcanic areas these are shallow, deficient in humus and phosphates and constantly leached by heavy rains

- * scarcity of water: only 20% of the country can reliably expect 800 millilitres of rain per year, and this is further compromised by seasonality. Large areas of the country were unoccupied as a result of annual flooding,

while other parts were rendered uninhabitable by prolonged drought for several months each year

* large numbers of wild animals: still identified as a problem by workers struggling to build the new rail link with Zambia nearly a century later

* disease: including malaria-carrying mosquitoes and, in wooded areas, tsetse fly bringing sleeping sickness as well as the fatal cattle disease trypanosomes

(Iliffe 1979 P 11 – 12)

The Germans named their new colony Tanganyika and designated the port of Dar es Salaam its capital. With no evidence of valuable mineral deposits, the Government set about importing settlers and introducing cash crops, most noticeably cotton and sisal. They quickly grasped that railways were the key to development and profit in East Africa (Iliffe 1979 P 135). A northern line inland from the coast reached Moshi, close to the rich coffee growing area around Kilimanjaro in 1912, and a central line reached Kigoma on the shore of Lake Tanganyika in 1914. A start was made on a central line extension, but interrupted by the outbreak of war. A southern extension had been ruled out by the experience of the south-based Maji Maji rebellion.

These were not easy decades, either for the colonisers or for their African subjects. European arrival accelerated Tanganyika's incorporation into the world disease environment as well as its economy (Iliffe 1979 P 123). The last decade of the nineteenth century was marked by outbreaks of human and animal disease, locust infestation, drought and finally famine, which resulted in mass starvation in pastoral communities. The first decade of the twentieth century saw the Maji Maji rebellion over taxation policies enforced with a harshness that proved unacceptable. The second saw World War, with Tanganyika a significant field of military operations. Thousands on both sides, colonisers, colonised and enemy alike died as a small German force mounted a skilful and determined guerrilla campaign against almost a quarter of a million Allied troops. The end

only came with the reluctant surrender of the German commander Paul von Lettow-Vorbeck two weeks after the Armistice had come into operation.

With the 1919 Versailles Treaty Tanganyika became a British Mandate territory. But the country was at the very bottom of the imperial pecking order, with doubt over its long-term status deterring investment. Suggestions that the colony might be returned to Germany were part of an agenda put forward by proponents of appeasement. "I don't believe myself" wrote Neville Chamberlain, "that we could purchase peace and a lasting settlement by handing over Tanganyika to the Germans, but if I did I would not hesitate for a moment" (cited in Iliffe 1979 P 103). The postwar era brought little change in government policy. There was no spare money to invest, though spending on education rose from six to 14% of the budget between 1948 and 1955. But delays in expanding secondary school places and Tanganyikans' tiny representation among East Africans attending the regional higher education centre at Makerere, Kampala, caused bitter African criticism. An ill-conceived 1947 project to boost both agriculture and manufacturing by growing groundnuts on what turned out to be poorly selected, infertile and parched soils quickly entered economic history's hall of infamy. It was abandoned in 1950, but only after costing £36 million – the equivalent of the entire government budget between 1946 and 1950 (Iliffe 1979 P 441). Despite a late expansion in infrastructure investment, by 1958, with independence looming, manufacturing accounted for less than five per cent of GDP.

Independence in 1961 coincided with a new outbreak of famine as a result of rain failure. Nearly half a million people celebrated their newfound status while queueing for food aid. In his Independence Day message their new leader Julius Nyerere declared: "From now on we are fighting not man but nature" (Iliffe 1979 P 576). It was an unpromising beginning. But the new state was – is – possessed of two pieces of good fortune which mark it out from many of Africa's new nations. Nyerere himself, in a 1971 report on the first decade of independence, draws attention to the country's wide diversity of ethnic groups.

The 123, often small, groups and absence of even one large power-hungry

grouping has saved the country and its people from the problems which have threatened to overwhelm neighbours such as Kenya, Rwanda and Burundi. John Iliffe advises against even attempting an ethnic analysis of the country, observing: “Early nineteenth century Tanganyika was not inhabited by discrete, compact and identifiable tribes, each with a distinct territory, language, culture and political system. The need to describe makes use of collective names inescapable, but they distort and over simplify a vastly more complex reality. Normally one group merged imperceptibly into another” (Iliffe 1979 P 8). Of the nine largest ethnic groupings, six were scattered on the country’s borders, far removed from the centre of power. Of the most prosperous groups, such as the Chagga, based around the Kilimanjaro coffee plantations, none was large.

This pre-colonial situation was reinforced by extensive migration in the German period, bringing different groups into early and close proximity. Large areas of Tanganyika were so underpopulated that by the last decade of the nineteenth century recruiting parties were scouring the country in search of labour to build the new railways and work on the sisal plantations. This period was followed, suggests Iliffe, by a second phase of migration at the start of the new century as a result of attempts to avoid both famine and the government’s increasingly efficient system of tax collection. One 1910 survey of workers in a sisal estate settlement identified representatives of 52 different ethnic groups.

The migration led to the country’s second piece of good fortune in the form of a relatively recent development: Swahili. Swahili has given Tanzanians their own national language. While in almost every other African country the only common language is English, French or Portuguese, in Tanganyika Swahili was quickly establishing itself as a national language: a development of “inestimable value” in forging the unity of the new nation, said Nyerere. The language, familiar to most East Africans because it is basic Bantu with the addition of Arabic vocabulary, owes its origin to the literate Moslem culture of the East coast, emerging in written form (Arabic script) in the eighteenth century then spreading inland. By the 1850s the explorer and linguist Richard Burton reported that “almost every inland tribe has some vagrant man who can speak it” (Iliffe

1979 P 79). Both German and later British colonisers opted to enhance Swahili's status by designating it the language of government schools. For the Germans Swahili was also the language of district administration, a decision steadfastly defended against missionary enthusiasm for the vernacular and the German public's enthusiasm for anything that might enhance the status of their own national tongue. A 1971 estimate suggested that while only 10% of Tanzanians spoke Swahili as their native language, 90% were bilingual in their native language and Swahili. By then the country had acquired several hundred thousand new Swahili speakers. In 1964, following an uprising against Zanzibar's ruling Arab elite, Nyerere invited the island's new African-controlled government to form a union with Tanganyika. The resultant country was renamed Tanzania, and a new political party, Chama Cha Mapinduzi (translating as "Party of the Revolution") emerged, replacing Nyerere's Tanganyika African National Union. It remains in power to this day.

Nyerere was a socialist. One of only a tiny handful of Tanzanians who had studied abroad (Edinburgh) he was considered a leader of exceptional ability and integrity. A former school teacher, described by Africa specialist Margery Perham as "certainly the most poised, confident, extrovert and indeed radiant of all the African leaders I have met" (quoted in Meredith 2005 P 250), Nyerere rejected the pomp and personal wealth accumulation favoured by other African leaders. Instead, year after year, he crisscrossed the country, staying in old colonial rest houses, spending his evenings translating Shakespeare into Swahili and his days making speeches offering advice and encouragement, urging his compatriots (to take a random sample of nutritionally relevant examples) to:

Make chutney from surplus produce

Keep poultry so that children might eat eggs

Eat more beans

Eat at least one green vegetable a day

“A handful of nuts and a slice of pawpaw every day could protect many of our children from vitamin deficiency blindness” he accurately advised (Nyerere 1973 P 93).

Politically, the widely admired Arusha Declaration of 1967, urging self-reliance, prioritization of rural development and state control of means of production and exchange was followed by a radical and extensive rural resettlement programme. This was based on Nyerere’s 1967 paper “Socialism and Rural Development” which set out plans to concentrate the scattered rural population into a new network of self-sufficient *ujamaa* villages (translating literally as “villages for familyhood”) where people would work together in a new spirit of co-operation and shared enterprise to build a better society. The villages were intended to concentrate farmers into larger, more efficient units where they might be more easily provided with access to modern techniques and equipment, and to facilitate provision of schools, clinics and public utilities. It has been described as “the largest mass movement in Africa’s history” (Meredith 2005 P 255). Nyerere was initially at pains to emphasise the voluntary nature of the scheme, and uptake, accompanied by early inducements to move, such as access to a piped water supply, led to two million people – 15% of the rural population – coming forward for resettlement. But this was followed by a policy of compulsion that led to another 11 million people being moved between 1973 and 1977 into 8,000 villages on sites often selected by civil servants (Bryceson in Guyer ed 1987 P 183) where proximity to a road accessible to bureaucrats’ cars rather than to water or fertile soil was too often the main factor in selecting location. There were reports of homes burned and destroyed to prevent any attempt to return. The French writer Sylvain Urfer described millions of people camped out in huts thrown together from branches and foliage, stretching in untidy lines along roadsides. The country, he said, looked as if it were emerging from a national disaster. And the distinguished agronomist René Dumont wrote that: “the operation took place without any planning at all, with bureaucrats giving orders” (both Meredith 2005 P 256). At the same time the state, through its marketing boards and assisted by favourable exchange rates, was taking an increasing share of the world price achieved from farmers’ labour, a policy that acted as both a

disincentive to production and an incentive to smuggle abroad what was produced (Kelsall 2013 Business, Politics and the State in Africa). A later verdict judged that “State leaders seemingly devised their own agenda with little concern for accountability or popular compliance” (Tripp 1997 P 2).

With the onset of drought soon exacerbating both a massive fall in food production and a slump in supply as civil servants who had taken over responsibility for distribution from Asian trader networks failed to deliver, disaster became reality. Unlike the traders, civil servants collected their salaries whether the food reached market or not (Bryceson in Guyer 1987 P 185). A 1979 war to end Idi Amin’s nine-year rule in neighbouring Uganda (Amin had previously embarked on his own invasion of Tanzania) won international approbation by succeeding in its object, but added to financial problems, agricultural disruption and distribution difficulties when vehicles that might have been used to transport food to famine areas were requisitioned for military use. By 1981, with eight months to the next harvest, Tanzania was reported to have two months’ supply of grain available and aid agencies stepped in (Bryceson in Guyer 1987 P 188). The Government was finally obliged to resume ill-tempered negotiations with the IMF (it had walked away empty-handed from its previous 1974 application for assistance). Initial resistance to Fund conditions - devaluation, budget cuts, relaxation of economic controls - was facilitated by continuing tolerance from Tanzania’s people as the situation continued to deteriorate throughout the decade. Whereas one day’s official minimum wage would buy a 13 kg bag of maize flour in 1980, by 1990 it bought less than 2kg (quoted in Msuya 1998 P 24).

In the towns residents set about dealing with the crisis themselves as IMF negotiations dragged on. Faced with a catastrophic breakdown in food supply leaving them at risk of famine “the Tanzanian population learned alternative ways to supply themselves with food directly by barter between households, exchange with family members in the home village and other kinds of informal exchange” (Holm in Sahil 1994 P 104). Many people simply walked around until they identified an unused open space, then fetched a hoe. Technically, all land in

Tanzania is owned by the state and formal application is required for use. In practice administrative incompetence left individuals free to make their own de facto arrangements. Here, Tanzania became part of a worldwide trend. Only 20% of cultivation in city areas of developing countries takes place on land owned by the cultivator (Shackleton et al 2009 P 14). "In the end," says political scientist Aili Mari Tripp, "little was demanded of a state that had placed itself at the center of the nation's development agenda and established itself as the guarantor of society's welfare" (Tripp 1997 P 5). As real wages fell by 83% between 1974 and 1983 increasing numbers of people simply came together to establish a huge informal economy of their own, where waged workers opted to retain their formal employment but lived primarily off their sideline incomes. "Economic irrationalities were being challenged by popular non-compliance and resistance" (Tripp 1997 P 3).

At the end of the day the politicians accepted that their experiment had failed. New institutions that had mushroomed to meet the shortcomings of the socialist state (private schools, private security firms, traditional healers) were permitted to continue. Starting in 1982 formal price controls were gradually abandoned. But however appalling for those who lived through the turmoil – including a growing number of political prisoners – Nyerere's vision had brought concrete and lasting achievements. Average life expectancy rose from 41 to 51 years thanks to new health clinics in 30% of *ujamaa* villages and a supply of tap water in 40%. Primary education expanded from an estimated 25% attendance to a high of 95% before falling back in response to the economic crisis (Meredith 2005 P 259).

The experience has also left Tanzania with a lasting legacy of "occupational diversification" said to be the most pervasive feature of the country's labour force (Seppala in Bryceson ed 2010 P 256). For critics, the undertaking of additional economic activities alongside formal employment results in "compromised time allocation and resource borrowing --- undermining the functioning of formal organizations, diminishing their efficiency and creating informal organizational structures." But for others this is "a negative assessment that cannot go

unchallenged” (Seppala in Bryceson ed 2010 P 256). Diversification has produced new interactions and social networks that effectively blend conventional employment with new means of acquiring a living wage such as trading and agricultural activities. Without this “Tanzania would have no public schools or hospitals due to the deplorably low levels of official salaries for teaching and medical staff” (Seppala in Bryceson ed 2010 P 257).

An alternative verdict is more damning. As the economy sought to recover by abruptly changing tack, its lasting legacy is a situation where “cronyism in the Ministry of Education prevents schoolchildren receiving sufficient school books with which to learn; incompetence in the health service means that Tanzanians suffer chronically poor health; venality in the national roads agency means that Tanzania pays over the odds for its roads; corruption in the forestry service means that the nation’s natural resources are being plundered” while there have been major scandals in allocation of – to take one example – vitally needed power-generating projects (Kelsall 2013 P 58). And while post-Nyerere reconciliation with the Bretton Woods institutions restored economic growth, at the end of the day the *umajaa* upheaval has failed to deliver the hoped for take-off into prosperity in rural areas. While the 16-year period 1991-2007 saw a national 5% fall in poverty overall, most of this can be attributed to growing prosperity in Dar es Salaam, where high rise buildings (banks and upmarket apartment blocks) now proliferate. Overall, the gap between rich and poor has increased, with the poorest 10% of population experiencing falling consumption. Poverty in rural areas remains at 37.6% (Kelsall 1913 P 70).

Nyerere himself stepped down in 1985, continuing to exercise his role as respected elder statesman on both national and international stage until his death in 1999. He was widely mourned and is affectionately remembered. Power passed in an orderly transition to Zanzibar President Ali Hassan Mwinyi, who had a reputation as a liberaliser, sympathetic to foreign investment. He continued the steady dismantling of state controls and reached a new deal with the IMF. Restrictions on media were relaxed. *Ujamaa* was quietly abandoned and in 1991 key points of the Arusha Declaration were withdrawn by Mwinyi in what became known as the Zanzibar Declaration. The following year multi-party politics were

reintroduced, and elections have proceeded in an orderly manner ever since though, post Mwinyi, not without some nervousness in Zanzibar where the opposition Civic United Front runs high profile campaigns. The CCM has yet to come even close to losing power, despite the fact that Mwinyi's successor Benjamin Mpaka (a member of the UK 's 17-strong Commission for Africa) demonstrated that the era of Nyerere was well and truly over by spending £28 million on a US Gulfstream Presidential jet, delivered in 2004.

The country's fourth President, Jakaya Kikwete won his second five-year term in 2010 with 61% of votes cast – down from 80% in 2005. Fewer than half the country's 20-million strong electorate turned out to vote.

4.2 Health of the nation

Health provision has a direct bearing on this thesis. There is no doubt that Tanzania's health service faces serious problems. The country is currently part-way through a six-year strategy agreed with the World Health Organisation. The Organization has welcomed significant progress in decline of under-five and infant mortality. But it warns: "Malnutrition is estimated to be an underlying cause of 50% of under-five mortality --- 38% of Tanzanian children under five are still stunted, reflecting chronic malnutrition, while 72% are estimated to be anaemic, reflecting both the burden of malaria, worm-infestations and micronutrient deficiencies" (WHO Country Co-operation Strategy Second Edition 2010 – 15 P 4). Malaria remains the leading cause of death among under-fives (WHO 2010 P 5). The Organization identifies a number of weaknesses which present specific challenges. These include:

- * The fact that more than half the population lives below the poverty line of \$1 per person per day

- * An estimated 65% shortfall in the number of skilled staff in public health facilities

* Shortage of essential medicines. Medicine prices are often high, with both NGOs and private providers operating a 60% mark up

While Government spending on health care is increasing - up from 9% of mainland expenditure to 10.8% (the UK equivalent figure is 16%) - this is still significantly below the 15% Abuja target for East and Southern Africa agreed in 2001.

The Strategy review finds progress towards gender equality unsatisfactory. Tanzania's placing, 138 out of 177 countries, reflects inequalities in terms of literacy rates, school enrolment, access to health care and per capita GDP (WHO 2010 P 2). Mainland maternal mortality is estimated at 578 deaths per 100,000 population, reflecting both poor access to and poor quality of care. Fewer than half mainland deliveries take place with the attendance of a skilled professional (WHO 2010 P 4).

The December 2011 report Accelerating Progress towards MDGs (joint UN and Tanzanian Government) records a reduction in child malnutrition which may be attributable to improvements in the prevention and treatment of malaria. But overall it identifies a lack of comprehensive strategy to reduce malnutrition among at risk groups (children and women of childbearing age). "Due to resource constraints, Tanzania has been resorting to low-cost approaches such as vaccination and maternal education instead of measures like cash transfers" it reports. One result of this is micronutrient deficiency, notably anaemia (associated with a high prevalence of malaria and parasitic infections) and vitamin A and iodine deficiencies. Health factors such as fevers and diarrhoeal diseases have an adverse effect on good nutrition. Child malnutrition both fuels illness and undermines learning. The report finds that "Overall, urban children are more likely to enjoy better nutrition than rural children" (UN 2011 P 28 – 29). Latest figures give a 2011 infant mortality rate of 45 per thousand (considerably down from 97 per 1,000 in 1990) and an under-five mortality rate of 68 per thousand (www.unicef.org/infobycountry/tanzania_statistics).

Recommendations relevant to this thesis include:

* Fresh attempts to eradicate availability of non-iodized salt (10% of local salt is not iodized and only 60% of households are using iodized salt), combined with a new promotion on use of salt fortified with iodine

(for NGO work in African schools on this topic see Appendix 2, The sad story of Sami lesson module.)

* Opening the way to introduce other fortifications by completing national fortification guidelines and addressing current limited knowledge of fortified foods

* Promotion of nutritional education, production of manuals on nutrition and employment of more nutritionists

(UN 2011 P 43)

At the end of the day the World Health Organization is not confident. “Prospects for sustained economic growth which would offer prospect of improving the situation remain ‘highly fragile’ as a result of the country’s dependence of agricultural products which rely on rainfall” (WHO 2010 P 14).

4.3 DELIVERING SCHOOL EDUCATION

By independence Tanzania’s teachers and students had worked their way through more than half a century of differing and sometimes contradictory priorities and philosophies in the delivery of western-style education. Lene’ Buchert, whose history of the service covers the period 1919–1990 describes the basic dilemma as “whether education was used to follow or lead societal development, whether mass or elite education was to be the primary focus of investment, and whether education was to promote primarily social as opposed

to economic or even political goals". To this mix is added expectations of individual clients and client groups (Buchert 1994 P 2).

The earliest schools were attached to mosques, either on the coast or along the inland trade routes. Then came – usually Protestant – missionaries aiming to assimilate local populations to western Christian values, coupled with a healthy dose of western economics. The University Missions to Central Africa, to take one example, was set up “for the promotion of true religion, agriculture and commerce” (Hinzen & Hundsdorfer 1979 P 77). The schools preceded arrival of the German colonial government, which quickly moved to establish a framework of direct rule using former pupils as administrators and tax collectors. Starting in 1892 the government launched its own schools, favouring Swahili as the medium of instruction. The decision to switch Swahili itself from Arabic to Roman script in 1899 constituted a significant boost for African participation in the state system.

From 1919-39 a British administration pursued a policy known as *Education for Adaption*, which included, from 1933, an instruction that all schools should incorporate an agricultural bias. Practice fell short of theory. European teachers knew nothing of agriculture. African teachers knew a great deal, but aspired to a higher status than part-time peasant. As for students: “What Africans wanted, at this time and throughout the colonial period was literary, assimilative education in a European language, for this was seen as the route to higher wages, equality and power” (Iliffe 1979 P 340). An ambitious, though ultimately unsuccessful initiative was the establishment in 1933 of Nyakato Agricultural Training Centre, in the increasingly prosperous coffee growing area of Bukoba. With a brief to contribute to improved coffee cultivation and disease prevention, Nyakato also intensified debate over theoretical academic versus practical agricultural education. The Centre attracted widespread interest and a succession of visitors. But there were complaints that its original requisition of an existing school building had reduced secondary provision in the area, and that the Centre overemphasised manual work at the expense of academic study. (Students were allocated 10.5 hours per week practical agricultural activities, 2.5 hours agricultural theory and 10 hours for other academic subjects.) Critics also

pointed out that there was no capital input or formal career structure to secure the future of the Centre's graduates. Tensions were exacerbated by the – ongoing – debates on the merits of mixed cropping (coffee and bananas in this case) versus monoculture and the related question of how the extra cattle required for composting might impact on the fragile subsistence economy. By 1939, with other priorities looming, administrators had had enough and the Centre was closed (Buchert 1994 P 41).

European governments have been criticised for their failure to provide an education service that recognised the significance of agriculture on the continent. There were no trained teachers capable of delivering agricultural education and shamba work was too often seen as punishment rather than opportunity to teach new skills says Walter Rodney, who believed Nyakato part of a programme defining the 'correct attitudes' and 'natural place' which Europeans thought fit for the natives (Rodney 1972 P 271). Dr Rodney fails to draw attention to a point later raised by other critics: that specialist agricultural projects such as Nyakato excluded women, who are responsible for a significant proportion of African farm activity.

By the postwar period government priorities had changed again. The new policy, *Education for self-government*, focused on industrialisation and development of a modern urban sector in preparation for eventual independence. Education's share of government spending increased from five to 16% with a simultaneous shift to higher spending on older students (Buchert 1994 P 59). In spite of these efforts the new country celebrated independence with a shortage of skilled manpower extreme even by the standards of the continent, and its first government felt it had no choice but to designate secondary and post-secondary education its top priorities. The policy could hardly be expected to commend itself to Nyerere personally, and the tipping point came in 1967 when students at the recently established University of Dar es Salaam staged a protest, sparked by suggestions that they might like to repay at least some of the cost of their privileged education by undergoing a period of national service. They were briskly packed off home with an instruction to go work on the shambas. Nyerere

bowed to the inevitable and allowed them back the following year, but by then, with the policies of the Arusha Declaration in process of formulation, the government was moving to a new set of priorities under the banner *Education for Self Reliance*.

Nyerere recognised that though the country lacked both capital and skills, it did possess both abundant land and a population willing to work hard. While accepting the need for graduates, he aspired to ensure that everyone shared the fruits of independence. “It is in the rural areas that people live and work, so it is in the rural areas that life must be improved” he argued, adding “The most central thing about the education we are at present providing is that it is basically an elitist education designed to meet the interests and needs of a very small proportion of those who enter the school system ---- the prize they and their parents expect is higher wages, comfortable employment in towns and personal status in society.” Furthermore: “Although only about 13% of our primary school children will get a place in a secondary school, the basis of our primary education is preparation of our children for secondary school.” Such a system left the 87% who failed to progress further confronting a permanent sense of failure, he warned (Hinzen & Hunsdorfer eds 1979 P 22). Nyerere’s solution was a school system geared to the skills and values needed to enable the individual to thrive in a predominately rural society. Reorganisation of the service abolished the break between primary and middle school – each offering a four-year course – and replaced it with today’s seven-year primary syllabus starting in Standard I at the comparatively late age of seven and continuing up to Standard VII at 14, the age at which students were judged ready to move seamlessly into economic activity. Both business studies and agriculture were included in the new curriculum, and farm activities were expected to contribute 25% of school running costs – though in practice they seldom did – to help compensate for abolition of school fees in 1973. At secondary level, where fees had been abolished in 1964 in the hope of attracting a more representative mix of students, the same 25% target was set and again seldom achieved. 10% was more usual in both sectors (Buchert 1994 P 115).

To cater for the growing number of female students entering the system a new General Housecraft curriculum appeared in secondary classrooms in 1977, aimed at preparing girls for their future roles as wives and mothers. Seeking to initiate the rising generation into the affluence the new state confidently anticipated, its contents were often destined to remain more a matter of theory than of domestic reality. In Form 1 girls were to study use of egg beaters, cake tins and roasting pans. Picking up on Nyerere's very valid concern with nutrition and wasted foods, they were to progress to "the most practical ways of storing perishable foods: drying, bottling, canning, freezing, smoking and chemical methods" (Stambach 2000 P 53). Despite this tantalising promise of culinary bliss Stambach observes that growing numbers of Chagga girls who were the subject of her research project were forsaking rural domesticity, choosing instead to beat a path to one or other of Tanzania's rapidly growing towns, the precursors of a new breed of women quickly dubbed 'city sisters' by those left behind. And there were elements in the new advice that failed to find favour: its exhortation to eschew traditional home-brewed banana beer (high in alcohol, often even higher in bacterial contamination) in favour of American-style fizzy sodas for example. Fanta, as the wits were quick to point out, was an acronym for the phrase "Foolish Africans Never Take Alcohol" (Stambach 2000 P 70).

But the years of aspiration were moving inexorably into reverse. New *Ujamaa* schools, and abolition of school fees initially saw 98% primary enrolment (in ever larger classes, teachers noted with dismay) until the looming economic crisis led to parents pulling their children out to help with food production and income generating projects. Pupils formed a large portion of the informal army that sprang up as wages fell even below the level required to buy basic foodstuffs. Urban children were sent onto the streets to sell cigarettes, snacks and other items. Those who still presented at school sometimes found their teachers trying to sell items to them, or that they were dispatched to help with the school's own income-generating schemes, or to sell the teacher's own products on commission (Tripp 1997 169).

For those who did have money, educational opportunity might actually have taken a turn for the better. Nyerere had always insisted on a strict “no moonlighting” policy for state employees. Now, as teachers struggled to make ends meet, a new network of supplementary classes sprang up all over the country. Teachers could double, treble or even quadruple their salary by taking extra tutorials. One put the case thus: “In the past classes had 25 to 30 children and it was easy to teach them. Now with Universal Primary Education there are 100 students. We have no books or textbooks to use, my students have no desks or chairs. In an effort to cut back on costs the government laid off the school watchman and then all the desks and chairs were stolen.” This teacher had started taking private tutorials of up to 15 students. “Nice, because you can have peace and quiet and can teach them well,” she said (Tripp 1997 P 169). As life slowly returned to normal the Government made a not very effective attempt to crack down on this development. But many teachers felt the satisfactions and money obtained from teaching tutorials was some compensation for the low wages and other frustrations of their work (Tripp 1997 P 168). Three quarters of teachers in a 1990 survey reported that they engaged in sideline activities outside their government employment, with agriculture being the most popular. A third of secondary teachers ran private tutoring sessions and 18% combined teaching with petty trading. It is more than likely that employees in the Ministry of Education running the service engaged in similar practices. Only the most senior employees at the highest levels found it easy to live comfortably on salaries constantly eroded by inflation (Seppala in Bryceson 2010 P 254). While abolition of primary school fees in 2001 has brought pupils back into the classroom, research suggests that education continues to place a financial burden on families. Sending a child to school requires investment in uniform, books and other education supplies, exam fees and sometimes transport. Parents also reported being asked to contribute to pupils’ lunch of maize and beans. Four head teachers interviewed defended the policy on the grounds that it paid for text books and building improvements, and had led to better exam results. Researchers comment: “The difference between a fee and a contribution is murky at best” (Vavrus & Moshi 2009 International Critical Childhood Policy Studies 2009 2 [1]). At Mlimani Primary – one of the two schools co-operating in

this research – a parent reported that families wanting to take advantage of the introduction of maize porridge part-way through the school day are required to make periodic contributions of 2,500/- and a quarter tin of maize (five kilos). The result has been to divide pupils into the “haves” who receive a mug of porridge, and the “have-nots”.

4.4 DELIVERING HEALTH EDUCATION

Women are the principal deliverers of family health, and it has appeared logical that they should be the target of any health improvement programme aimed at family and particularly at child well-being. The assumption is not always borne out in practice. An early study of one such programme demonstrates pitfalls of what is increasingly considered a simplistic approach. In their book “Hunger and shame: child nutrition and poverty on Mt Kilimanjaro” Mary Howard and Ann Millard follow the progress of NARU, a nutrition rehabilitation unit opened in 1970 and attached to the Kilimanjaro Christian Medical Center. Though situated in one of the most prosperous and fertile areas of the country, a rapidly increasing population (up from 365,000 in 1975 to 849,000 in 1988 in the Center’s catchment area) was leading to growing pressure on land and growing poverty. Child health monitoring from 1964-88 established that 12% of under fives fell into the “severely malnourished” category. To combat this problem NARU decided that instead of treating affected children in clinics, a more effective long-term approach could be achieved through an intensive programme of maternal education. Mothers of affected children would be invited to spend between three and six weeks living at the Center, where they would receive instruction on infant feeding practices.

Problems quickly emerged. The main areas of contention were:

- The fact that NARU advertised itself as a Center to cure kwashiorkor. Despite its claims to cultural sensitivity, it had totally failed to recognise the stigma attached to the condition, sometimes attributed in indigenous cultures to perceived

personal failings such as the mother's failure to undergo circumcision or the father's failure to pay bridewealth

- The assumption that mothers did not understand how to provide a nutritious diet. Over the years NARU came to recognise that many mothers understood well enough what constituted appropriate feeding practices but – as increasing amounts of land were taken over for coffee and other cash crops – lacked the means to deliver them
- The requirement that women should live in at the Center, which led to neglect of food crops and could mean leaving very small children in the care of slightly older siblings. Neither did a stay at the Center offer even temporary relief from physically demanding lifestyles. Between instruction women were allocated domestic and agricultural duties in the buildings and on its farm

Over the years policies were modified or abandoned in an attempt to resolve problems: issue of “kwashiorkor certificates” to mark graduation from the unit was abandoned, a plan was drawn up to lease some of the Center's own land to families and seeds, chickens, rabbits and even cows were distributed. But at the end of the day the scheme was judged misguided and the Center closed in 1992 following a decision to continue the work in community-based schemes closer to women's homes.

An alternative approach, and one of particular relevance to this thesis since it involved delivery of health education as a by-product of the main agenda, was a government literacy scheme launched in 1968 when Tanzania joined a 12-country Experimental World Literacy Programme organised under the auspices of the UN. On the assumption that learners – both male and female - would be more motivated if they were also offered practical advice, the adult literacy primers prepared incorporated a heavy emphasis on growing staple food crops (Freyhold in Hinzen & Hundsdorfer 1979 P 162). A nutrition primer was also produced, explaining the need for vitamins and protein, though sadly without explaining how this might be achieved on a limited budget. A particularly successful primer was designed after one village asked for help combating

bilharzia. Local emphasis in the reading material supplied plus (unusually) a supplementary budget allocation contributed to the acknowledged success of this project. The scheme was followed by the hugely ambitious *Chakula ni Uhai* (Food is Life) project launched by Julius Nyerere in 1975. This set out to combat malnutrition through a countrywide network of specially established study groups and distribution of 1.5 million copies of a simple book illustrated with pictures and diagrams containing information on how to achieve a balanced diet and briefings on topics such as marasmus and kwashiorkor. The project was accompanied by weekly 15-minute radio programmes. Inevitably, given its scale and the poverty of the country, there were problems: poor distribution of written materials, groups lacking access to a radio, cuts in budgets for training group advisers. Even so, study groups planned for between eight and 15 members ended up with 30 or even 60 adults. Members of the previous literacy scheme arrived en masse. Some study groups didn't see their adviser from start to finish of the four-month programme, but persevered. And, records an account of the scheme "Many groups cleared land for gardens and started growing vegetables like lettuce, cabbage and tomatoes. In many places participants decided to undertake poultry-keeping projects in order to get eggs and meat" (Mahai et al in Hinzen & Hundsdorfer 1979 P 159).

CHAPTER 5. FIELDWORK

5.1 Research considerations

While this project was at least in part inspired by a desire to improve the working conditions of teaching staff – a profession which makes significant contributions to society in, for example, participation in public debate at both local and national levels – at its heart lies effective delivery of nutrition information. Given the Tanzanian context, it was also essential that materials should be produced cheaply.

There is some scepticism surrounding the potential of health education to influence human behaviour and plenty of evidence that it may not deliver, from the adolescent in school uniform lighting a cigarette at the bus stop to the growing incidence of obesity. Researcher Lucia Luzi, who studied links between education, child health and nutrition in Sub Saharan Africa counts herself among sceptics. (Though she notes that Kenya’s deworming programme boosted primary school attendance.) “The aim of health education targeted at children should be to create awareness and responsibility concerning diseases, for children and their families. However reality shows that the majority of health education activities for school-age children fall short of such ideals” (Luzi: Causal relation between basic education, child health and nutrition for children in Sub Saharan African countries: the case of Tanzania: Ca’Foscari University of Venice dissertation 2005-2010). However recent research findings suggest that young people are receptive to change in diet messages. A study carried out for the UK government suggests that children’s food choices start out conservative, with family a significant influence, but this is gradually overtaken by respect for peer group consensus - around the age of seven in UK culture (Stockley 2011 P 12). Classroom food education was found to be most effective if hands-on activities could be introduced – food highlighted should be available for inspection, example, and food preparation should be incorporated wherever possible. Involving parents also has a positive impact on learning (Stockley 2011 P60 – 61).

Work in African schools developed as part of HIV/AIDS education projects has found that variety is a significant factor in success: drama, comic books, games all worked well. "Learning theory suggests that people are more likely to learn when messages are presented in multiple formats using different communication strategies" (Peltzer in 'Cultivating health: cultural perspectives on promoting health education ed MacLachlan 2000 P 171 – 173). And messages need to be both simple and realistic.

This project aspired to enable teachers briefed with the help of the specially compiled handbook (see appendix 1) to disseminate information on micronutrients. The handbook (provided in the form of a display book for maximum flexibility and introduction of additional material) is designed to present information in a format and style accessible to both primary and secondary teachers. For teachers, particularly in rural areas, there is a constant problem of accessing accurate information on any relatively new topic.

Additionally, in the absence of textbooks, primary school lessons in particular start with a lengthy period when the teacher has his/her back to the class and is engaged in writing the material to be learned on the blackboard. This is then copied, with varying degrees of accuracy, into students' exercise books. It is not stimulating for anyone involved. For students, there is the difficulty of reading and copying from a poor quality blackboard in a crowded poorly lit classroom. The project sought to both address this problem and to reinforce learning by preparation and distribution of small booklets (modules) to each student. Modules begin with fictional presentation of the micronutrient theme under consideration, followed by conventional language work in line with Tanzania's English Language curriculum. Space is provided for drawing and puzzles for primary pupils. Each module is accompanied by teachers' notes detailing the section of curriculum covered, plus additional suggestions for oral work and activities.

A high priority was attached to preparation of modules, and it was hoped that these might become the property of pupils. While some students respond well to the prevalent vogue for predominately oral work, there are others who require the reassurance and reinforcement of the printed word, and find shortage of textbooks particularly challenging. The finding at Jangwani, where it was

observed that some previously poor class participants became more forthcoming when offered written material, are particularly interesting in this context (see feedback from Jangwani).

5.2 Visits

In the course of this research three visits were made to Tanzania:

24.10.10 – 30.10.10 : Liaison with the Ministry of Education, Dar es Salaam to explain and seek approval for the project. The Ministry then provided introductions to curriculum supervisors at the Tanzania Institute of Education for more detailed discussion.

09.03-12 – 02.05.12: Report on progress to Ministry liaison officer and negotiation on selection of schools: Jangwani Girls' Secondary, close to the centre of Dar es Salaam was selected by the Ministry, and Mlimani Primary some five hours from the capital, with the final hour along an unsurfaced road, suggested by the researcher. Three weeks was spent intermittently at each school, briefing staff, selecting micronutrient topics, working through details of combining topics with the requirements of the English Language syllabus, then writing and arranging printing of the modules

22.11.12 – 03.12.12: Liaison with and feedback from teachers

5.3 The curriculum:

Starting point for this research was the schools' curricula, the responsibility of the Tanzania Institute of Education. The Institute, confirmed by Parliamentary Act in 1975, is "charged with the responsibility of ensuring the quality of education at pre-school, primary, secondary and teacher training levels".

Situated in a high-tech complex on the edge of Dar es Salaam, the Institute is headed by a Director, who oversees work of a team of curriculum co-ordinators, one for each academic subject, and a team of administrators. The Institute maintains a website offering a variety of teaching aids. The English Language

section is extensive and detailed, and includes a 3,500 word English-Swahili dictionary available for download and guides to lesson planning, hints on effective teaching etc. For teachers and schools with access to the internet – it was not possible to establish how many – the website is a valuable resource. Many rural schools lack an electricity supply, and while internet cafés are becoming increasingly common (charging, around 800/- for half an hour) these are beyond the means of many teachers, particularly if bus fares are to be factored in. An internet café opened within walking distance of Mlimani between the researcher’s second and third visits.

The Primary English Curriculum: This is a detailed 170-page document published, in English, in 2005. Each school is supplied with a copy and staff are well acquainted with its requirements, which are taken very seriously. Its length can be attributed to the fact that it is designed to give maximum help and support to teachers by setting out examples of skills and grammar structures required and vocabulary lists for each series of lessons, advising on appropriate teaching strategies and suggesting resources the teacher might use – cards, pictures, real objects for example. A fixed number of lessons are allocated for each topic. The syllabus identifies Swahili, the official language of the primary sector, as “the symbol of national identity and pride and the medium of political, social and cultural communication for the majority”. English is defined as Tanzania’s second official language, the main medium of post primary education and training, and the agency of local and international commerce, industry and trade.

The syllabus sets out nine objectives for education in Tanzania, starting with “To guide and promote the development and improvement of the personalities of the citizens of Tanzania, their human resources, and effective utilization of those resources in bringing about effective individual and national development.” It stresses the need for students to understand their obligations under the country’s constitution. At primary level English Language is allocated seven periods a week, each lasting 30 minutes in Standards I and II and 40 minutes from then. Teachers are advised to introduce each topic orally then move to the written word. They are advised to assemble a small library of books for students to use.

Schools are advised to monitor progress with a variety of continuous assessment exercises, but warned against a teaching style based on “merely memorising some facts or concepts”. Examples of levels of competence required are set out: to take part in a simple conversation by the end of Standard II, for example, and to produce a simple text by Standard VII. At the end of Standard VII pupils sit the ‘O’ level national examination. The best performing students are then offered a place at a state secondary school.

The Secondary English Curriculum: Setting out learning requirements for forms 1-4, this is a 61-page document updated in 2010 and covering to 15–18 age group. English is the medium of instruction in secondary schools and the syllabus emphasises spoken language, and skills in using both spoken and written English for research and presentation. Students in Forms 1 and 2 are allocated seven 40-minute periods a week, which then drops to six. There are 174 teaching days and ten days for examination. The syllabus appears compatible with this research project in that it seeks to extract maximum educational value from language lessons by introducing a series of topics designed to extend students’ awareness of significant issues facing Tanzanian society, ranging from HIV/AIDS and road traffic accidents to drug abuse and child labour. It is a stimulating document which must offer considerable satisfaction to teachers and learners alike. Each topic is allocated a fixed number of lessons, a range of skills such as public speaking, debate and letter or short story writing. There are suggestions for class activities, teaching and learning strategies and materials the teacher might introduce into the classroom. While nutrition and its significance for health is not covered in detail, the teachers with whom the researcher worked were sufficiently familiar with the topic-based language format and with nutrition guidelines to immediately grasp the aspirations of this project and to offer constructive suggestions of means by which they might incorporate nutrition into their lessons and combine it with syllabus requirements to extend skills in both spoken and written English. Students sit a national examination at the end of the fourth year. The most talented are offered places at a small number of sixth form centres (including one at Jangwani).

5.4 Curriculum co-ordinators

Interviews were carried out with the co-ordinators at the Institute of Education responsible for nutrition education and for English Language teaching.

Home economics co-ordinator Zena Ameri is a former teacher and fabrics specialist, recently appointed and primarily occupied with drafting a new syllabus. In the course of a semi-structured interview with the researcher Ms Ameri accepted that her subject faces a number of problems, including

- allocation of time as home economics competes with traditional academic subjects
- shortage of qualified teachers, particularly in rural areas
- premises shortfall: many schools lack cookery or needlework rooms

“At primary level home economics is one of a number of subjects grouped together under the heading *Stadi za Kazi*, roughly translating as practical employment subjects” she explains. “It includes business studies, agriculture, fine arts and theatre. Schools allocate time amongst these, depending on what teachers and what facilities are available. Nutrition does not appear as a separate subject, though it does form a significant part of home economics. At secondary level where home economics is grouped with business studies, technical education and agriculture 85 schools offer home economics and five function as specialist home economics college.” Both ‘O’ and ‘A’ level have a strong nutrition element, says Ms Ameri, with an ‘O’ level focus on malnutrition. At ‘A’ level the small number of remaining students move to a detailed study of the Tanzanian diet and nutrition intake. In a second interview (November 2012) Ms Ameri stated that the new syllabus has now reached draft form. “It gives greater priority to the environment and closely related issues such as cooking fuel and, because by ‘A’ level almost all our students are girls, gender. There is also a strong emphasis on problem solving, linked to the whole idea of sustainable education to equip our students for today’s rapidly changing world”. Teacher shortage remains a problem – the 300 available work out at around two per school, but they are not distributed evenly around the country. Ms Ameri would like to see

more nutrition education: “Though I myself believe that micronutrient education is more suitable for ‘A’ level study, where vitamin preservation is already part of the syllabus” she says.

Since the preliminary interview conducted on the researcher’s first visit she has identified a new problem: the fact that fewer students are opting for home economics. “This means that some of the teachers I do have are being diverted to other subjects to ensure they have a full timetable. As a result, I’m trying hard to draft a new syllabus that will attract more students into this extremely important subject for all young people – boys as well as girls. Boys will be fathers one day, trying to feed a family on what will probably be a limited budget.” Ms Ameri is aware that television has opened up the whole subject of food preparation and related nutrition in many parts of the world. She would dearly love to capitalise on this by distributing material to schools via computer links. “It would be particularly useful for practical subjects like mine, if only I could manage to get some money from somewhere,” she says.

English Language co-ordinator Stomin Msaka sometimes wrestles with a different problem, first identified in his own teaching days. “There were times when younger students would ask me why they were obliged to spend so long learning English. ‘Why am I doing this?’ is not a question any teacher wants to hear,” he says. “But we must recognise that it isn’t totally stupid either. We are fortunate in Tanzania in having Swahili as a lingua franca. It’s very unusual in Africa. Unlike Kenya or Uganda we can communicate with other people in different parts of the country without the need for English.” The concern is not with students going on to secondary education, who understand their need for the generous timetable allocation for English, which they will almost certainly require in their future careers, and who will benefit from have achieved a level of competence required to handle the stimulating topic-based secondary syllabus. But there are millions of young people in rural Tanzania who may never be required to speak English from one end of the year to the other.

“We need,” says Mr Msaka, “to meet the needs of these young people. I am constantly conscious of this. We need to teach English, but I would like to think that every student takes away something permanently useful from the lessons.”

So a project that sets out to provide nutrition information along with English would be an interesting experiment. “It might also go some way towards solving our problems with shortage of teaching materials,” he says. But, Mr Msaka stresses, the syllabus is the top priority. Any material on micronutrients must be built around the detailed language syllabus, and materials must be approved before being used in schools.

This requirement had been anticipated. It would hardly be appropriate to walk into schools and commandeer English lessons for a separate agenda. Crucial to this project is the aspiration that it might make – a little – use of English language allocation without demanding massive syllabus upheaval which has caused such problems in UK schools. In order to meet Mr Msaka’s priority it was agreed that each lesson module should be linked to a section of the curriculum, with the relevant pages of syllabus requirement incorporated into the teacher’s copy of the lesson module.

Cycle of Reflection: Stomin Msaka’s emphasis on the curriculum prompted a rethink on module contents. Instead of a slightly vague commitment to English grammar structures and vocabulary groupings of particular interest to the researcher (responsible for module drafting) module exercises and class activities have been structured around the very specific curriculum requirements. In the case of the primary curriculum this proved no problem. At secondary level, where the curriculum incorporates heavy emphasis on written and oral presentation skills, (students are assumed, not always correctly, to have excellent command of grammar), identifying appropriate structures for study proved more of a problem, with less guidance offered by the curriculum. In fact feedback from teachers suggested that the small number of tentative grammar exercises (see appendix B) has been unduly timid. Unlike the UK, correct grammar remains a high priority in most African countries where students progress as a result of formal written examinations.

But for all students, whatever their future, the project must be judged on both Zena Ameri’s concept of sustainable education equipping young people with a permanently enhanced lifestyle and Stomin Msaka’s concern to satisfy the recalcitrant pupil’s demand “What use in English to me?” It would be nice to

think that a young mother working on her shamba or shopping in Mang'ula market some ten years hence will as a matter of course, albeit unconsciously, focus on vitamin A content of food she is providing.

5.5 School Context: Second Visit

The two schools exemplify the contrasts between rural and urban environment.

At Milimani, a short survey established that all teachers, and other residents encountered in the course of the research such as the local photographer, maintain a shamba to grow their own food. "Without it, you cannot live" says deputy head Elizabeth Nyamlikali. During the growing season agricultural requirements are likely to impact on other commitments for both teachers and students. The village is situated part way along a gravel road leading (three hours by bus) to the administrative centre at Ifakara. In the other direction it takes an hour to reach the market town of Ruaha (teachers' salaries, which start at 150,000/- per month, are paid into a bank here, and collected by a senior teacher once a month for distribution) and the tarmac road linking into the country's main transport system. Location so close to the road (used mainly by buses, lorries transporting bottled water and sodas to Ifakara and the occasional private car suggest, by rural standards, a degree of prosperity as identified in the World Bank Transport Snapshot. This is reinforced by the national park starting on the far side of the road, where the heavily wooded Udzungwa mountains rise steeply upwards. The park maintains a residential education centre visited by national and international researchers. Mang'ula started out a railway town, having been designated principal inland base camp by the Chinese planners, who constructed workshops and factories which formed the basis for a small industrial centre. Many of these units struggled on until the turn of the century, but today only the sawmill remains. There is a local health clinic and a good water supply. Two hotels and the national park provide a few employment opportunities. "But for most of our leavers, there is only agriculture," says school head Ally Msanda. Rice (average November to April rainfall 1,000 – 2,000 millilitres as a result of the Udzungwa mountain range) is both a domestic and commercial crop providing the basis for local diet as well as income from the school's own shamba, which is

then used to buy in food for pupils sitting the national examination. Long-term, rice may not be a sustainable crop. Kyoto University researcher Futoshi Kato suggests that increasing competition for limited land and conflict with pastoralists may reduce the area under cultivation (Kato 2007 P 17). Just a short walk along the roadside confirms that a large area under rice cultivation a few years ago is now sugar cane grown for biofuel. (The Swahili teacher at Mlimani is a substantial farmer who recently amazed colleagues by acquiring a car. "It's sugar that paid for it," he says cheerfully). The National Park impacts on farmers as the source of wild animal (primate and elephant) invasion of shambas. Elephants are considered particularly greedy and destructive. For women and children, restrictions and a recent outright ban on collection of park timber has impacted severely on time demands. The school is one of four primaries in the area. In the 2012 academic (coinciding with calendar) year there were 786 pupils on roll, including 112 in Standard VI (selected for module production) and 18 teachers including the head and deputy. There is a teachers' resource centre at a neighbouring school some 30 minutes walk away. This is largely used for private coaching. School costs are met by the Ministry of Education, which pays teachers' salaries directly. The school has a separate budget. It covers purchase of around 60 text books a year, says Mr Msanda. The main outgoing from the budget is the 40,000/- a month salary for the night watchman. A donor paid for a link to the National Grid several years ago and this provides a power point and electric light in the head's office and in the school's small library (also the result of a donation). The library point is much valued as a facility for recharging mobile phones. Few teachers have alternative access to electricity. A computer and printer were presented by Italian donors several years ago, but both are now said to be broken (not available for inspection) and there are no local facilities for repair.

Jangwani, situated in the Ilala district of Dar es Salaam, close to both the old colonial city and the new commercial centre, is a day and boarding school for 1,668 students aged 14-19. The majority will progress after Form 4 to vocational training in a range of subjects: nursing, primary school teaching, accounting skills for example. One text book per three students is quoted as typical. Fees are

20,000/- per year for day students and 70,000/- for boarders. The school, considered one of the best in the city, is situated on the corner of a busy road junction, surrounded by low rise offices, houses and self-build homes that are being gradually pushed out as the city expands. Anthropologist Brigit Obrist who studied women's lives in Ilala, categorises the district as "in the middle range of less privileged areas" (Obrist 2006 P 122). Arrival in the city presents new migrants with unforeseen expenses as they struggle to access goods they could have provided for themselves in a rural setting: food, water and housing. The result may be food economies. Water supplies are a constant problem. The Government has attempted to respond by drilling new wells and some residents have drilled wells of their own, but the water can be salty and contaminated by pit latrines, leading to outbreaks of cholera and dysentery (Obrist 2006 P 234). Rubbish collections ended in 1980, and women interviewed drew attention to problems with rats and cockroaches (Obrist 2006 P 236). In interviews with 100 women (8 with no formal education, 73 primary, 19 secondary) Obrist found an awareness of health and of the nutrition foundations of health – often expressed in slogans which, she suggests, may date back to the Nyerere era. Contrary to widely held stereotypes, the low-income women interviewed, like those attending the NARU project in Kilimanjaro, knew what they should do but lacked the means to do it: sufficient fuel to boil drinking water for example (Obrist 2006 P 316). And "for many women, having food, or being able to eat nutritious food or enough food, is not simply a matter of course" (Obrist 2006 P 123). Obrist echoes Aili Mari Tripp's finding of a culture of non-compliance with the well-meaning but ill-considered advice handed out by those in authority. "The women in our study as well as their husbands grew up and spent their young adulthood during a time of great hope, of political awakening, of building a new society based on the idea of *ujamaa* and of African socialism, and then experienced many disappointments and much hardship, both during the actual crisis and the rapid reform which followed ---- An absence of trust in the government and sometimes even a lack of hope are sentiments expressed by many" (Obrist 2006 P123). Even so, a thriving self-help culture is clearly on view in the proliferation of cultivated plots occupying even tiny areas of ground all over the city, though those alongside busy roads raise questions of contamination by heavy metals, which

are not destroyed in cooking (Shackleton et al 2009 P 56). A 1998 local government report noted that more people in the city were engaged in formal agriculture than in formal employment (Shackleton et al 2009 P 245). Some practise both. The researcher's Ministry liaison officer Paulina Mkoma grows food around her house as well as maintaining a shamba near the edge of the city.

In the course of setting up the research project the researcher allocated three weeks to each school. In both cases the project was explained to selected teachers – head and deputy at Mlimani, three teachers of English at Jangwani. Several days was then allowed for school discussion before the researcher returned. In both cases teachers were happy to proceed. Copies of the teachers' handbook were distributed and several briefing meetings held to talk through content, explain the basics of nutrition and micronutrients and touch upon the wider context of world food prices and supply. Teachers themselves selected micronutrients to be studied and sections of the syllabus to be addressed, and undertook to trial the modules as an action research experiment. At Jangwani all three teachers – two female, one male - selected topics of particular relevance to their female students. Two modules were planned for each school. (This was later revised to one at Mlimani after the head teacher was hospitalised in Ifakara following a motor cycle accident.)

5.6 Module costings:

Cheap production of teaching materials is a key feature of this project.

For Mlimani: printing from a laptop was charged at 500/- per page at the education centre attached to Udzungwa national park. (exchange rate £1 = 2,500/-)

Phopocopying: There is one commercial print shop in the larger village 30 minutes walk away, charging 100/- per page. (colour, 1,000/-, was beyond budget.) It was decided to print 100 copies for Elizabeth's Standard VI class and proved possible to negotiate a 20% discount as a result of the size of the order, bringing the cost down to 64,000/- or 640/- per student.

For Jangwani: in Dar es Salaam it was possible to access a shop charging 50/- per page (40/- was later spotted). As in the village it proved possible to negotiate a discount and the charge for 60 copies of the (slightly longer) Class 4 module was 15,000/-, unit cost 260/-.

(Jangwani modules were printed and Class 2 module photocopied free of charge thanks to a philanthropic printer. He has recently started his own nursery school in partnership with his wife, a trained teacher, and took a copy of the primary module to show her.)

5.7 Feedback:

This was gathered from both schools. At Mlimani it was possible to observe and participate in a lesson. At Jangwani two teachers were away from the school involved in in-service activities and Form 4 had just finished national examinations. However a detailed report on the project had been prepared beforehand.

Mlimani feedback: 83 pupils were present on the day of the research. Lesson modules had clearly been used, and spaces for pictures had been filled. Elizabeth Nyamlikali was certain that pupils had enjoyed the material, and thought that a number of pupils – girls in particular - had demonstrated improved confidence in learning, while she had enjoyed the extra teaching and interaction time permitted by less blackboard writing. Pupils had still been required to transfer their work into exercise books, however. The researcher's intention that modules should become property of the pupils was, predictably, considered an extravagant waste of a valuable resource. One disappointment was failure to make much use of art materials supplied for poster making. It was hoped that posters might be displayed around the school and the village. During class observation it became clear that the poster concept – eye-catching picture and snappy slogan – was not understood. Offered a series of slogans by the researcher, pupils produced new drawings and carefully wrote their chosen slogan on the back of the paper. One problem is the need to hoard any materials offered to the school. But it seems sensible that any revised module should place more emphasis on oral activities, perhaps involving music and dance: local

strengths enthusiastically and skilfully executed. At an informal meeting with school staff several volunteers suggested that they might be selected to teach the module in the new school year. Printing costs caused considerable surprise – being lower than expected. When invited to speculate, most teachers estimated the price at between (a fairly ruinous) 500/- and 1,000/- per copy.

Jangwani feedback. A great deal of thought had been put into this, most particularly by the male teacher Ayoub Msuya. The modules were judged a success, having provided interesting material and provoked lively debate. The story of Sami (iodine deficiency) which the researcher feared might appear too negative, had proved particularly stimulating. “Several of the girls started talking about children they had met, who, they now realised, could have been affected by this deficiency” said MrMsuya. It provoked personal stories and sympathetic discussions about such children. Given that a number of these exceptionally able girls were planning health-related careers, it is not surprising that health related material went down well. A small number of students wanted to know why they were learning about biology in an English lesson, countered by the reply “You are learning two things at once.” Zena Ameri had hoped to attend the feedback meeting at Jangwani, but was needed at the university where she is studying for a further qualification. She planned to visit later. Teachers at Jangwani often own their own laptops, but none has a printer and the school printer is reserved for administrative use. They now believe a school printer would represent value for money, especially if a budget for photocopying could be attached, and plan to use the modules to put this case to the administration. All three teachers had developed ideas for writing their own materials, buying internet time where necessary to gather information. They have also requested a new module from the researcher on the subject of folate deficiency. Like Elizabeth Nyamlikali, Mr Msuya believes that provision of written materials has been a particular stimulus to the confidence of some students – a particularly interesting finding given the emphasis on oral participation in UK language schools. “Every class has some girls who never say a word,” he says. “Often they are too frightened of getting it wrong”. Seeing the lesson in print, and having time to absorb it at their own pace, (Jangwani’s usual allocation is one text book shared between three girls) “gave

them the courage to speak out.“ It cannot be stressed too often that, even in a class of exceptionally able, there is no one teaching method that suits all pupils. As at Mlimani, there was no evidence of use of art materials supplied, although this could be because Mr Msuya’s class had now left the school. Certainly girls at Jangwani must understand the concept of a poster. The busy road outside the school is lined with large expensively-purchased backlit displays. On the downside, the modules were considered short on grammar exercises. Teachers had, as usual, devised some of their own, but blackboarding these eats into lesson time. Everyone – including the researcher – is still trying to compile a bumper nutrition crossword, but we have all run out of ideas for clever clues. An informal meeting was set up with a group of students, most of whom were studying economics. Out of 13, four girls has access internet at home. Five were from families growing food crops as a sideline.

CHAPTER 6: CONCLUSION

This thesis has sought to focus on recent developments in our knowledge of micronutrients and the effects on health of their deficiency, to examine these in an African context and to effect a small pilot project whereby useful knowledge might be usefully disseminated. (Page 3)

In the course of the research it became obvious that African food producers and consumers face formidable problems, not least in accessing information, or even knowing that it is out there. Examples of problems with text books have been offered in an early part of this thesis. Adult populations in western countries might reasonably expect to obtain information from newspapers. In Mang'ula there were none – though a pupil might sometimes be sent at a sharp trot to the nearest bookshop some 20 minutes away. And for many residents in many parts of Africa price may be prohibitive. Then there is the question of media content. In Tanzania there is no equivalent to constant stream of health news and health advice that is a common feature of English newspapers.

Africa is not alone. Development economists Jean Drèze and Amartya Sen in their latest work draw attention to not simply India's inadequate healthcare, but also the near-absence of discussion and public debate on the topic of health. Their analysis of India's leading English language dailies, carried out in 2012, found "overall coverage of health issues in editorial discussion remains miniscule – around 1% of the total editorial space." (Drèze & Sen 2013 P 143). Results of the lack of public information and debate have been low expenditure on health (1.2% of India's GDP compared with 2.9% in Sub Saharan Africa, 8.1% in the EU and a world average of 6.5%), serious micronutrient deficiencies and "a vicious circle of low awareness, low expectations, weak demand and lethargic implementation" (Drèze & Sen 2013 P 143-168). Their book, its authors maintain, has been written not to inform government, but with the aim of stimulating public debate in the hope of improving the situation (Drèze & Sen 2013 P 253).

In this context, it's possible to speculate that, as a result of the massive drive to contain HIV/AIDS, African populations and certainly African students are already receptive to health information messages. Spreading information on

micronutrient deficiency may well be a more challenging prospect in other parts of the world than in Africa. (Despite a preoccupation with vitamins the UK, for example, does not require micronutrient content to be given on tinned or packaged foods.) Certainly the Teachers' Handbook (Appendix 1 of this thesis) provoked comment and discussion. "I have started to put lemon in my tea after reading about Vitamin C" said Mlimani head Ally Msanda. (Lemons are common in Mang'ula. They are also, at 100/- per fruit, exceptionally cheap.) "The girls were very surprised how much Vitamin A there is in just one carrot" said Ayoub Msuya at Jangwani. "They wanted to know why NGOs don't tell people when they give out supplements."

A crucial element in this project is use of technology to produce cheap materials – and thus stimulate debate. Tanzanian schools do not have computers, do not have computers that work, had computers that have been stolen (as was the case at a primary near Mlimani) or, in the case of Jangwani, do not possess printers available to teachers. It is here that evidence gathered by the researcher proved revealing. Teachers at both schools were impressed that it cost so little to get a piece of written material onto every desk and made it clear they would be happy to see the scheme extended to increase the number of modules available.

Ultimately, material for schools is a matter for the Ministry of Education, where use of technology appears to lag behind developments in the private sector, where even Mlimani is within walking distance of a state of the art print shop and internet cafe. Contrast this with the Ministry of Education, where one very senior member of staff welcomed the researcher with "I haven't looked at my e-mails for around a week, or I would have answered yours", where regional and district offices, stacked floor to ceiling with paper, required personal visits in order to submit yet more paper to seek required permissions and where, in one district office, the officer in charge remarked "I'm in too much of a hurry to do the letter on the computer. I'll just write a note". Only the researcher's Ministry liaison Paulina Mkoma appeared to have totally embraced IT, reaching instantly for the keyboard at every meeting. And in Ifakara district office, among staff surrounded by paper, one lone officer explained "I've bought a laptop. I really need in my job, special education, so I can keep up with new developments".

If this research is to bear fruit, these are examples to treasure.

Sadly, for most of the classroom teachers who have made this thesis possible, scope is limited.

This has been a project about nutrition understanding. As such, it has not touched in any detail on income. Estimates of income in developing countries are in any case notoriously difficult, given the challenge of estimating value of food produced for personal consumption. However, in the course of one informal session the researcher invited Mlimani teachers to contribute (anonymous) written answers to the questions: “How many people are there in your family?” and “How much of your income do you spend on food?” Answers were as follows:

85% of salary for a family of 7

80% of salary for a family of 10

75% of salary for families of 7, 4 and 3

60% of salary for families of 9, 8, 5 and 4

55% of salary for families of 9 and 7

50% of salary for families of 2 and 3 *

Even if food were to become cheaper, there is little spare cash here for internet access and downloads, for books, for newspapers, for stationery to finance and develop the sort of projects that have enabled primary teachers in the UK to cover every inch of their classrooms with constantly changing materials to entertain, to stimulate and to inform their students.

* It's worth bearing in mind that some large families may have access to sufficient labour to produce a considerable quantity of the food they consume.

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Appendix 1: The Teachers' Handbook: sample pages and classroom display materials

**Micronutrient Education
Project**

Teachers' Handbook

"Our attitude to food is the result of ignorance, indifference and indolence.

Many of our people do not realise what they can do, or why it is important that they should, and they find it easier to carry on in the old-fashioned way than to make the effort to change the condition of their life.

We must spread knowledge, to show why and how improvements in diet can be made."

Julius Nyerere.

Speech in Dar es Salaam,

28 May 1969

"Investments in micronutrients have higher returns than those in trade liberalization, in malaria, or in water and sanitation.

No other technology offers as large an opportunity to improve lives at such a low cost and in such a short time."

The Copenhagen Consensus

2004

(The Copenhagen Consensus is a group of the world's top economists who meet every two years. They offer advice on how they think money should be spent to improve the lives of everyone on the planet.)

Why should we start teaching about food?

Two reasons. First because nutrition has been one of the great areas of scientific progress in recent decades. Starting with the discovery of iodine deficiency and its disastrous effect on intelligence less than 100 years ago, scientists have identified the vitamins and minerals in our food and their effect on health. If we pass this information on to our students they will be able to make better decisions about what food they should grow and buy to keep healthy .

Second, food is getting more expensive so it's important to spend the household budget as effectively as possible. There are several reasons why food prices are likely to keep going up:

1. World population is going up. It's already seven billion. By 2050 it will be nine billion. That's a lot more people to feed.
 2. Some countries and some parts of the world – China for example – are getting richer. When people get richer they often want more food and they want nicer food. That usually means meat. The only way to produce more meat is to use more crops such as maize to feed animals. So we end up needing more food for animals as well as more food for people.
 3. The other thing richer people want is more fuel , for electricity, and for the cars and plane trips they can afford. Oil and coal are expensive so scientists have worked out how to produce fuel from crops such as sugar cane and maize. These are known as biofuels. Producing them takes up land that used to be used to grow food.
-

4. Global warming. The world is getting warmer. At the moment no one is quite sure exactly what will happen. But it has been predicted that the climate in East Africa will rise 3.2 degrees C by the end of the century – too hot for some crops. The other problem with global warming is rain – not simply more of it, but more storms which can lead to floods like those in Mozambique in the year 2000. Not many crops grow in a flood.

DEFINITIONS:

This project is about micronutrients we obtain from food.

Nutrients are the parts of food that:

1. Supply energy so that we can move about and keep warm
2. Supply material so that we can grow, reproduce or repair our bodies after sickness or accidents
3. Control the way the body does this

Nutrients are divided into two categories:

MACRONUTRIENTS: so called because we need a lot of them. There are three macronutrients: carbohydrates and fats, that provide energy and protein that provides material for growth and repair.

MICRONUTRIENTS: so called because we need only a little of each. Micronutrients are vitamins and minerals.

Examples of micronutrients are vitamins A, B, C, D, E and K and minerals such as iron, iodine, calcium, zinc, potassium, phosphorous and magnesium.

Most food contains more than one nutrient. Most contain a complicated mix of carbohydrates, fats and protein as well as water and tiny amounts of some – but not all – micronutrients.

DEFICIENCY: is not getting enough of a nutrient.

Macronutrient Deficiency occurs when people simply do not get enough to eat. It is a serious condition visible to the naked eye, leading in extreme cases, such as famine to starvation and death.

Micronutrient Deficiency occurs when people do not eat a sufficient variety of food to get enough of one or more particular micronutrients. To give some idea how common it is, in the world's population of 7 billion, more than 2 billion suffer from one or more micronutrient deficiencies. The most serious micronutrient deficiencies are iodine, iron, and Vitamin A.

You cannot usually see micronutrient deficiency but it can have serious results, such as blindness as a result of vitamin A deficiency. Extreme micronutrient deficiency leads to inability to resist other diseases, and accounts, for example, for the high death rate from measles in developing countries.



Micronutrients: Results of the 2010 Tanzania Demographic and Health Survey

The 2010 Tanzania Demographic and Health Survey (TDHS) is the eighth in a series of national sample surveys conducted in Tanzania to measure levels, patterns, and trends in demographic and health indicators. The 2010 TDHS collected biomarkers to determine the current status of vitamin A, iron, and iodine in children and women. The specific objectives of the micronutrient component of the 2010 TDHS were to collect data on the following indicators:

- Prevalence of vitamin A deficiency (indicated by retinol binding protein – RBP) in children age 6-59 months and women age 15-49 years
- Prevalence of iron deficiency (indicated by serum transferrin receptor – sTfR) in children age 6-59 months and women age 15-49 years
- Prevalence of iodine deficiency (indicated by urinary iodine excretion) in women age 15-49 years
- Proportion of households consuming adequately iodised salt (indicated by rapid test kits, with one-third of samples retested at the laboratory).

The survey is based on a nationally representative sample. It provides estimates for rural and urban areas in the Mainland, for Zanzibar, for each of the seven zones, and, in most cases, for each of the 26 regions.

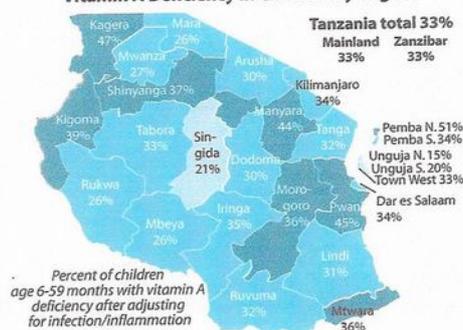
	Number Tested	Response Rate
Vitamin A testing		
Children age 6-59 months	6,384	89%
Women age 15-49	9,245	88%
Iron Status testing		
Children age 6-59 months	6,486	90%
Women age 15-49	9,469	90%
Iodine testing		
Household cooking salt (rapid test)	9,087	94%
Women age 15-49	9,921	94%

Vitamin A

Vitamin A is a micronutrient that is needed for a healthy immune system and to protect against nutritional blindness. Periodic vitamin A supplementation is important to ensure that children do not develop vitamin A deficiency. Sixty-one percent of children age 6-59 months received a vitamin A supplement in the six months before the survey.

One-third of children age 6-59 months are vitamin A deficient (after adjusting for infection). Vitamin A deficiency varies dramatically by region, from a low of 15% of children in Unguja North to a high of 51% of children in Pemba North.

Vitamin A Deficiency in Children by Region

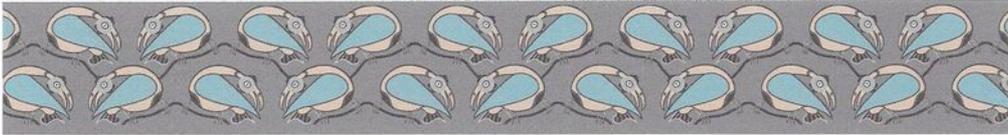


The 2010 TDHS found that 37% of women age 15-49 are vitamin A deficient (after adjusting for infection). Vitamin A deficiency varies dramatically by region, from 17% of women in Unguja North to 55% of women in Pemba North. Women living in urban areas are slightly more likely to be vitamin A deficient than women living in rural areas (40% and 36%, respectively). Vitamin A deficiency increases with women's level of education and household wealth.

The 2010 TDHS was implemented by the National Bureau of Statistics (NBS) and the Office of the Chief Government Statistician-Zanzibar in collaboration with the Ministry of Health and Social Welfare (MoHSW) and the Tanzania Food and Nutrition Centre (TFNC). TFNC participated in the planning of the survey and in formulating questions for the micronutrient biomarker component. TFNC was actively involved in the training of field staff and provided laboratory staff and services for the testing of blood, urine, and salt samples.

Funding for the survey was provided by the Tanzania government through the MoHSW, the Tanzania Food and Nutrition Centre (TFNC), the Department for International Development (DFID), the World Health Organisation (WHO)/Zanzibar, the United Nations Population Fund (UNFPA), the United Nations Children's Fund (UNICEF), the World Food Programme (WFP), the United Nations Development Programme (UNDP), and Irish Aid. ICF Macro provided technical assistance for the survey through the MEASURE DHS programme, with funding from the United States Agency for International Development (USAID) and UNICEF/Tanzania.





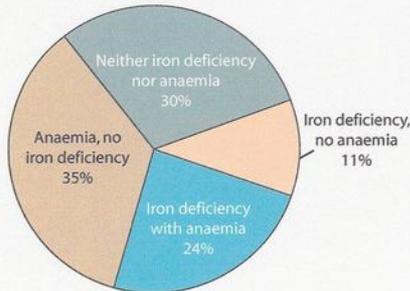
Anaemia and Iron Deficiency in Children

The 2010 TDHS tested haemoglobin levels of children age 6-59 months to determine anaemia prevalence. Nearly 6 in 10 Tanzanian children suffer from some degree of anaemia (haemoglobin <11.0 g/ dl). The majority of children have moderate anaemia (29%) or mild anaemia (27%), while 2% have severe anaemia. Children age 9-11 months are most likely to have anaemia (81%).

Iron is essential for cognitive development and low iron intake can contribute to anaemia. More than one third (35%) of all children age 6-59 months are iron deficient. Iron deficiency is more common in urban areas than rural areas (41% and 34%, respectively). There is no clear relationship between iron deficiency and mother's level of education or household wealth.

Anaemia in the developing world is usually attributed to lack of sufficient iron intake. In Tanzania, 24% of children have both iron deficiency and anaemia. Iron deficiency anaemia is highest in Arusha, Shinyanga, and Unguja North (39% each) and lowest in Iringa (10%). Forty-one percent of anaemia among young children can be attributed to iron deficiency; however, other causes of anaemia should be investigated since the 2010 TDHS found that 35% of children have anaemia that is not associated with poor iron status. Anaemia could also be due to other nutritional deficiencies, malaria, hookworm infestation, and chronic inflammatory disorders.

Iron Deficiency and Anaemia
Percent of children age 6-59 months



Anaemia and Iron Deficiency in Women

Four in ten Tanzanian women age 15-49 suffer from some degree of anaemia. The majority of women (39%) have mild or moderate anaemia, while 1% have severe anaemia. Pregnant women are more likely to be anaemic (53%) than women who are breastfeeding (39%) or women who are neither pregnant nor breastfeeding (39%).

The 2010 TDHS found that 3 in 10 Tanzanian women are iron deficient. There is no clear relationship between iron deficiency and level of education or household wealth.

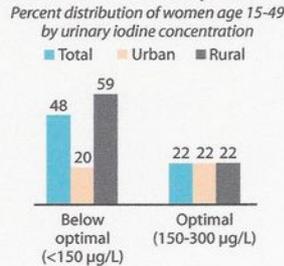
Fourteen percent of women have iron deficiency anaemia. Iron deficiency anaemia is highest in Tabora, Unguja North, and Shinyanga (28% each) and lowest in Mtwara (5%). Overall, 35% of anaemia among reproductive age women can be attributed to iron deficiency, which highlights the importance of investigating other causes of anaemia in women.

Iodine

Iodine deficiency has serious effects on physical growth and mental development. The 2010 TDHS tested salt used for cooking in households via two different methods—rapid test and laboratory test. Rapid test results show that 59% of households had adequate levels of iodine (15 or more ppm), while laboratory test results show that 47% of households had adequate levels of iodine. Both methods of testing found that the richest households are more than twice as likely than the poorest households to have adequately iodised salt.

The 2010 TDHS also tested women's urinary iodine concentration. Nearly half (48%) of women have a urinary iodine concentration below the optimal range. Urinary iodine concentration is higher among women living in urban areas, which is not surprising given that urban households are more likely than rural households to have access to adequately iodised salt for consumption.

Women's Iodine Status by Residence



The Micronutrients

A Note of Caution

The information in this section ranks micronutrients according to milligrams per 100 gram edible portion of raw food.

BUT please note that the exact amount will vary according to:

- * the particular variety of the fruit or vegetable. Some may have been genetically modified.
- * the soil in which they have been grown
- * the method of production (whether fertilisers are used, how much rainfall/irrigation has been available)
- * how long it has taken to transport the food from field to market
- * processing: eg food that has been dried, food that has been tinned, and size of the tin. (Large tins need more heat in processing, which may destroy micronutrients). Some processed food eg flour, cooking oil, breakfast cereals may be fortified during manufacture.
- * whether the food is cooked or eaten raw. If cooked, how soon it is eaten: food that is left for several hours may contain fewer micronutrients

VITAMIN A

KEY FACT

Vitamin A deficiency increases the risk of death from common illnesses such as measles and diarrhoea, which until a few years ago caused up to 2.5 million avoidable deaths of young children every year.

WHAT VITAMIN A DOES

- * Ensures that the immune system works effectively to achieve resistance to disease.
- * Protects against blindness. Deficiency is the main cause of child blindness.

NEED TO KNOW

- * A campaign to hand out cheap Vitamin A capsules to children has been one of the biggest health success stories of recent years. In some countries 80% of young children have been protected by supplements, saving hundreds of thousands of lives every year and reducing hospital admissions.
- * But vitamin A is also an example of a micronutrient that can actually be bad for your health if you have too much. People who eat liver once a week or more are advised not to take supplements or fish oil. (Vitamin A is stored in the liver.)
- * Too much Vitamin A during pregnancy can lead to birth defects. Pregnant women are advised not to take vitamin A supplements, including fish oil unless advised by a doctor. They are also advised not to eat liver.
- * However, Vitamin A deficiency in pregnancy can lead to death from malaria.
- * Many adults get all the vitamin A they need from their normal diet.
- * But the diet should include meat and eggs as well as fruit and vegetables. "For millions of families such a diet is unaffordable" says UNICEF, which warns that the capsule campaign only conceals the symptom of a more serious problem.
- * There is little Vitamin A in basic cereals such as rice, millet or maize.
- * Vitamin A may be reduced by cooking (see Hanging on to Micronutrients).

VITAMIN A: mg per 100g edible helping:

Palm oil, red, fresh	5,000
Carrot	1,088
Leaf vegetables (dark)	550
Sweet pepper (red)	458
Mango	400
Leaf vegetables (medium)	300
Sweet potato	300
Pumpkin	292
Sweet pepper (green)	290
Egg	200
Papaya	200
Orange	122
Avocado	88
Poultry	85
Tomato	74
Cabbage	64
Yellow maize/flour	54
Cow's milk (fresh)	52
Water melon	42
Fish (fresh)	28
Banana	20
Mung bean	19
Pineapple	15
Chick pea	11

(You will notice that cereals, including white maize and flour, millet, sorghum, wheat flour and pasta do not contain Vitamin A, or contain only very small amounts. Neither will you get much vitamin A from meat, apart from liver, or from yam, cassava, plantain or onion. These absences go a long way toward explaining why this deficiency is so widespread.)

B

Folate

KEY FACT

An adequate supply of folate is needed in pregnancy from the moment of conception to help prevent defects of the brain and spinal cord. These affect 300,000 babies every year.

WHAT IT DOES

- * Protects against damage to the spinal cord, which causes the condition spina bifida, leading to permanent handicaps, often including paralysis.
- * Helps prevent anaemia, miscarriage and stillbirth.

NEED TO KNOW

- * Ensuring that pregnant women get enough folate could prevent 75% of cases of spina bifida and brain damage every year.
- * Folate is one of a number of B vitamins. It occurs in many foods, but usually in small amounts. Most people get enough to cover their needs from their normal diet, but pregnant women need extra which is why deficiency is a problem for them.
- * Pregnant women need extra folate up to the twelfth week after conception. Because it's needed from the moment of conception, women planning to have a baby should seek medical advice to make sure that they have an adequate supply.
- * Folate is easily destroyed by cooking.
- * There is a manufactured artificial form of folate, called folic acid. This is available in pill form, and is often prescribed when a pregnancy is planned.
- * Folic acid is also used by some governments to fortify foodstuffs such as flour.
- * There is growing evidence that a diet rich in folate can help prevent some cancers and heart disease.
- * In recent months scientists have suggested that folate might also delay the effects of ageing on the brain. Research continues.

FOLATE: micrograms (μg) per 100g edible helping. $1 \mu\text{g} = 1/1000$ of a milligram.

Soyabean	439
Cowpea	210
Chickpea	180
Mung bean	120
Groundnut	110
Leaf vegetables (dark)	105
Pigeon pea	100
Sesame seeds	97
Leaf vegetables (light)	79
Cabbage	75
Sweet potato	52
Wheat flour	51
Orange	37
Pasta	34
Aubergine	29
Rice	29
Bread	28
Tomato	28
Fresh coconut	26
Egg	25
Fresh cassava	24
Avocado	22
Plantain	22
Banana	19

Animal meat (no fat)	15
Irish potato	14
Onion	14
Fresh fish	12
Pineapple	11
Mango	10
Lemon	10
Poultry	8

VITAMIN C

KEY FACT

The body cannot store Vitamin C. A Diet without Vitamin C will in a few weeks lead to symptoms like bleeding gums. A few more weeks leads to scurvy, and then death.

WHAT VITAMIN C DOES

- Holds tissue (soft bits of the body) together. Your teeth will soon drop out without it.
- It's an anti-oxidant, so it helps repair damage to the body by free radicals, which can cause cancer. There is evidence that a Vitamin C-rich diet protects against some cancers. Research continues.
- Helps wounds heal quickly.

NEED TO KNOW

Almost all our Vitamin C comes from fruit and vegetables. But there are large differences in the amount of Vitamin C different fruit and veg contain.

To make things even more complicated, the amount of Vitamin C in the same fruit/veg can differ depending on freshness and preparation. Problems include:

Time taken for transport and/or storage:

A 100g potato you have just dug up contains 21mg of Vitamin C. But if you – or the trader – store the same potato for three months there will only be 9mg left.

Time between preparation and eating:

Food will start to lose Vitamin C as soon as it's peeled or shredded.

Cooking:

Vitamin C is heat sensitive, so it is destroyed by cooking. The longer the cooking time, the less Vitamin C will be left.

Cooking Method:

Vitamin C is also water soluble, so if you boil vegetables you will lose Vitamin C this way as well. A 100g helping of cabbage contains 49mg of Vitamin C, but after boiling just 20mg is left. And the more water you use, the more Vitamin C disappears. One solution is to make sure the cooking water which has absorbed the Vitamin C is used by making soups, or using the water in sauce or relish.

Time between cooking and serving:

Even when cooked, vegetables continue to lose Vitamin C. Cooked cabbage loses 60% of its Vitamin C if kept warm for an hour.

**Vitamin C content of food
(mg per 100 g edible portion)**

	RAW	COOKED
Green pepper -----	120	69
Kiwi fruit -----	59	
Orange -----	54	
Cabbage -----	49	20
Cauliflower -----	43	27
Mango -----	37	
Grapefruit juice -----	31	
Cantaloupe melon -----	26	
Sweet potato -----	23	17
Courgette -----	21	11
Old potato, just dug up -----	21	
Tomato -----	17	12
Plantain -----	15	9
Banana -----	11	
Old carrot -----	6	2
Apple -----	6	

(Raw potato and plantain are not recommended, but included to show the effect cooking has on vitamin content. Vitamin C is water soluble, so vegetables in soups or stews where the liquid they're cooked in is part of the meal will improve vitamin intake. Chips and fried potatoes lose less vitamin C than boiled potatoes.)

VITAMIN D

KEY FACT

The main source of Vitamin D is sunshine – which is good news for Africans. (Unless you move to North America or North Europe, of course.)

WHAT IT DOES

- Helps strengthen bones by increasing absorption of calcium.

NEED TO KNOW:

Pregnant women and young children need more Vitamin D than other people.

Almost all Vitamin D in food comes from animal and dairy products, after animals have themselves obtained and stored Vitamin D in the same way as people – from the action of sunshine on skin.

Vitamin D is stored in the liver. Livers of different animals and fish are the best food sources of Vitamin D.

In North Europe and North America, where there are seasonal variations in the amount of Vitamin D available, several foods are fortified. Eg margarine in the UK, and supplements are sometimes prescribed for high risk groups.

White skins absorb more Vitamin D than black skins. Black people who live in northern latitudes are often at risk of Vitamin D deficiency.

In Africa itself the only high risk groups are people who don't go outside, or people whose clothes cover them completely when they do.

Too much Vitamin D is dangerous, so take care with supplements. And don't eat polar bear liver – it has so much Vitamin D that it can kill you!

VITAMIN D CONTENT OF FOOD: μg per 100g

Cod liver oil	210
Herring	16.1
Salmon tinned in brine	9.2
Sardine tinned in sauce	8.0
Soft margarine	7.8
Evaporated milk (fortified)	4.0
Tuna tinned in oil	3.0
Dried skimmed milk (fortified)	2.1
Egg	1.8
Butter	0.9
Stewed steak	0.6

NB: Not much Vitamin D in food, and you will notice that the milk is fortified as a result of the fortification programme in the UK. (check details in Tanzanian tins). Whole milk, as it comes out of the cow, contains no vitamin D at all.

Calcium

KEY FACT

Calcium, combined with Vitamin D, is essential for healthy bones and teeth. Deficiency leads to poor growth and the disease RICKETS (causing deformed legs) in young children and the disease OSTEOPOROSIS (causing broken bones) in old people.

WHAT IT DOES

- * Calcium is the commonest mineral in the body, with all but 1% used by bones and teeth
- * The remainder used in muscle contraction, including the heart muscle
- * It also helps with normal blood clotting

NEED TO KNOW

The main source of calcium for most people is milk and milk products such as cheese. There is also calcium in cereals and in the bones of canned sardines.

You can consume as much calcium as you like, but it will do you no good without Vitamin D, so read this section along with Vitamin D information.

Young children whose bones are still growing, and breast feeding women need more calcium than anyone else.

With an adequate diet, bones continue to get stronger until the age of around 30. After that they gradually become weaker, especially in post menopausal women. This can result in fractures to the wrist and hip, and curvature of the spine. As well as calcium and Vitamin D, getting enough exercise is also important in avoiding osteoporosis, and, it's thought, eating enough fruit and veg.

Calcium is considered important enough for food fortification in some countries. In the UK it's added to flour.

Calcium content of food: mg per 100g

Dried skimmed milk	1280
Cheddar Cheese	739
Sardines, canned in oil	500
White bread	177
Low fat yoghurt with fruit	140
Skimmed milk	122
Boiled Okra	120
Whole milk	118
Boiled Egg	57
Baked beans	53
Roasted peanuts	52
Oranges	47
Fried onions	47
Raisins	46
Boiled Cabbage	33
Boiled courgettes	19
Boiled White Rice	18
Stewed Beef	15
Boiled Potatoes	5
Apples	4

Iodine

KEY FACT

Iodine deficiency is extremely common, and is the single most preventable cause of mental retardation and brain damage, estimated by UNICEF to affect 40 million people.

WHAT IODINE DOES

- * Plays an essential part in growth of the child's brain, from 12 weeks after conception until the age of three. Brain damage caused by deficiency is irreversible
- * Most iodine is stored in the thyroid gland. When someone is iodine-deficient the gland swells up, causing goitre. Deficiency affects achievement and work output

NEED TO KNOW

Some studies suggest that the average IQ of whole populations in iodine-deficient areas can be lowered by as much as 13 points.

The best source of iodine is seafood, including edible seaweeds.

Populations with little or no access to seafood depend on iodine from the soil which is absorbed into food crops. But many soils are themselves iodine-deficient.

As a result, governments all over the world opt for iodine fortification schemes. Laws have been passed ordering that iodine should be added to various foods or drinks.

In Tanzania iodine must be added to salt before it is sold. Don't buy salt unless it says on the label that it contains iodine.

Progress in iodine fortification is monitored by the International Council for Control of Iodine Deficiency Disorders. It reports on iodine fortification schemes. Examples include salt fortification in countries such as Italy and Ukraine, and adding iodine to irrigation water in Inner Mongolia, which has increased the iodine content of local food crops.

In 2007 the Council carried out a special survey in Equatorial Guinea, which included work with schools. Students were asked to bring a sample of salt from home for testing. 350 samples were tested in the classroom, with students announcing their sample result to the rest of the class. 30% of samples contained no iodine, in spite of legislation.

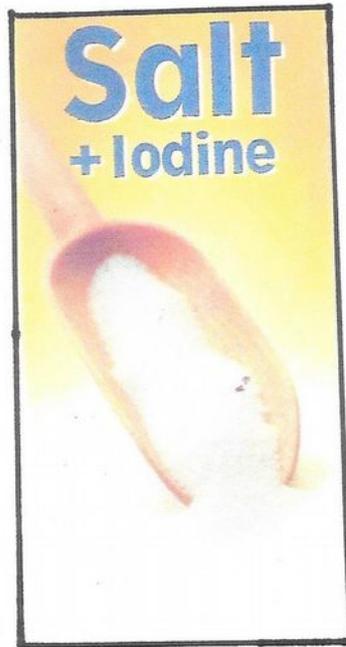
Some foods reduce the body's ability to absorb iodine. These include "bitter" cassava, cabbage and millet.

There is no list of foods containing iodine – because in most inland parts of the world there are either very few or even none. While we need only tiny amounts of iodine, often there is simply not enough in the soil to pass to plants and animals, and in turn to us. What iodine there was has been washed away into lakes and rivers, and from there into the sea.

So in many countries, the only people who for years were not at risk of iodine deficiency were those who lived near the sea and ate its products - fish and seaweed – or lived in places where transport is so good that they could easily eat these things.

Sea products are still a satisfactory means of avoiding iodine deficiency. For the many billions of people who can't access these, long term iodine deficiency is now being solved by adding iodine to other products - an example of fortification - particularly salt, which is the favoured method of iodine fortification in many countries including Tanzania.

Iodine was the first example of micronutrient fortification, starting in the 1920s in the Great Lakes area of North America and in Switzerland, both parts of the world where soils are particularly iodine deficient. The result of fortification was a dramatic fall in both adults visibly suffering from goitre and in babies born or growing up with irreversible brain damage.



Iron

KEY FACT

Iron deficiency – anaemia – is the world's most common nutrition problem, affecting women of childbearing age in particular. It is a leading cause of death in childbirth.

WHAT IT DOES:

- It forms haemoglobin – the red substance in blood that transports oxygen from the lungs around the body, so that it can be used by individual cells to maintain health and energy.

NEED TO KNOW:

Anaemia symptoms include tiredness, poor concentration and reduced productivity.

Women are particularly at risk because they lose iron every month as a result of menstruation. They need twice as much iron as men. An estimated 25% of UK women, but only 1% of UK men are iron deficient.

From the age of six months (when their birth supply of iron runs out) young children need nearly as much iron in their diet as adult men if they are not to become anaemic.

But both males and females are at risk from iron deficiency and anaemia as a result of hookworm infections and malaria.

Iron in food occurs in two different forms: haem iron and non-haem iron.

Haem iron occurs in meat, and is reasonably easy to absorb. Between 20 and 30% of haem iron which is eaten is absorbed.

Non-haem iron occurs in cereals, pulses, vegetables, fruit and dairy products, and is less easily absorbed. You will get more iron out of a plate filled with meat than out of the same plate filled with vegetables.

Absorption of non-haem iron is increased if it is eaten at the same time as meat and fish. It's thought that eating foods with a high amount of Vitamin C at the same time may also increase absorption of non-haem iron.

Absorption may be decreased by tea, and by some cereals and legumes.

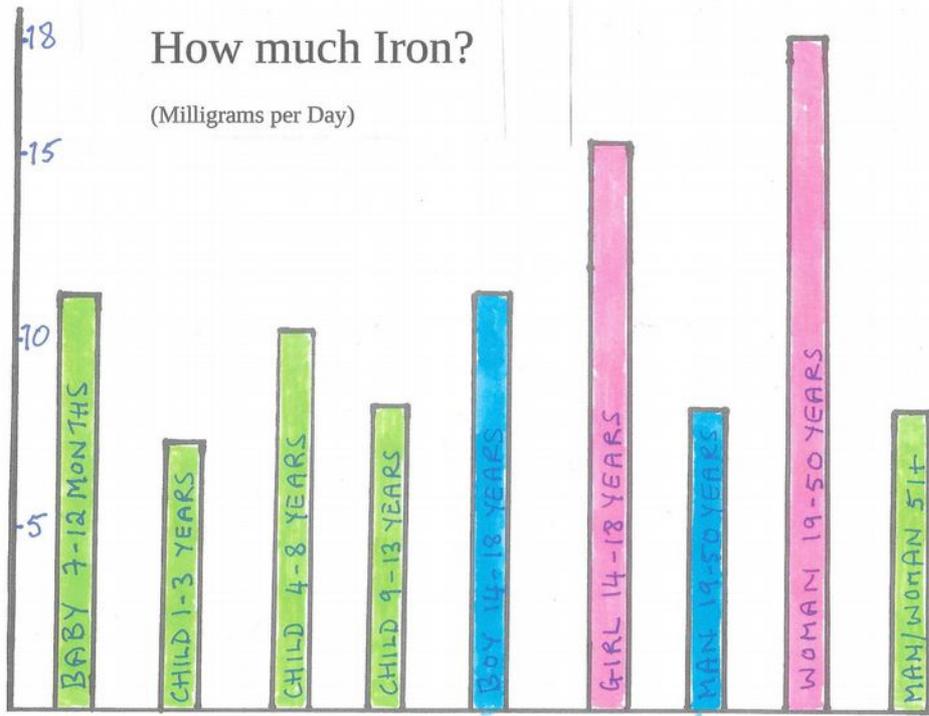
IRON: mg per 100g edible helping:

Mung bean	8.9
Dried fish	8.5
Sesame Seed	8.1
Sunflower seed	7.6
Melon seed	7.4
Leaf vegetables (dark)	7.2
Soyabean	6.1
Chickpea	5.5
Pigeon pea	5.0
Cowpea	5.0
Finger millet flour	5.0
Lean animal meat	4.6
Sorghum flour	4.5
Yellow maize and flour	4.2
Groundnut	3.8
White maize	3.6
White wheat flour	3.6
Cashew nuts	3.6
Bulrush millet flour	3.0
Pumpkin seed	2.8
Sweet pepper	2.6
White maize flour	2.5
Pasta	2.1
Egg	2.0
Sweet potato	2.0

Dried cassava	2.0
Plantain	2.0
Onion	1.9
White bread	1.7
Fresh fish	1.6
Pumpkin	1.4
Avocado	1.4
Banana	1.4

How much Iron?

(Milligrams per Day)



Micronutrients and Children

“A handful of nuts
and a slice of pawpaw
every day could
protect many of our
children from
vitamin deficiency
blindness.”

Julius Nyerere

Nyerere made a point of travelling the country so that he could meet and talk to as many people as possible. He often talked about nutrition, advising Tanzanians to:

- * Make chutney from surplus fruit and vegetables
- * Keep hens so that their children would have eggs
- * Eat more beans
- * Eat at least one green vegetable every day

"The visibly starving child has become the world-wide symbol of malnutrition. Yet it is a symbol that misrepresents the problem. Usually, visible malnutrition is the result of extreme and unusual circumstances.

The vast majority of malnutrition is invisible. It is this ordinary everyday malnutrition that affects almost a third of the developing world's children and prevents them from reaching the mental and physical potential with which they were born.

The overwhelming majority of the world's malnourished children live in homes where there is enough food to provide for the needs of a small child.

The danger period of malnutrition is not at pre-school or primary school stage, but from conception to age two."

UNICEF

**“Any deficiency is most devastating during
the period of most rapid growth.**

**By the age of three most of the growth of
brain and body is complete.**

There is no second chance.”

Little people, large needs

Mention child malnutrition, says UNICEF, and most people will think at once of the pictures they have seen of obviously starving children queueing in relief camps around the world.

But they couldn't be more wrong, says the organisation.

"The visibly starving child has become the world-wide symbol of malnutrition. Yet it is a symbol that misrepresents the problem."

Most child malnutrition does not occur in times of famine, which affects only a tiny portion of the world's children - a fraction of 1%.

Rather, says UNICEF, almost all malnourished children live in families where there is enough food.

It identifies the period from conception to two as the crucial danger period.

The organisation singles out three problems which can lead to malnutrition:

- * Early ending or part ending of breastfeeding. Apart from the fact that breastmilk is "the perfect food", substitute food and drink can introduce hygiene problems and disease
- * Childhood illness, resulting in loss of appetite and loss of nutrients as the result of vomiting and diarrhoea. "If illness strikes five or six times a year in the first two years of life then it is almost certain that the child will be cruelly pulled down from the precarious tight-rope of normal growth." It's vital that children should be fed even when they are sick, says UNICEF
- * The fact that small children have small stomachs and small appetites. The usual family structure of one or two big main meals a day just doesn't suit them. Instead little and often should be the rule - perhaps five meals a day to ensure enough nutrients for growth of body and brain.

CHILDREN

KEY FACT

This is rather surprising, but a small child can need almost as many micronutrients, and sometimes even more than a full grown adult

WHAT THEY DO

Ensure physical and intellectual development

NEED TO KNOW

The table shows micronutrients for which young people's need is particularly high

AGE	CALCIUM	IRON	VITAMIN A	FOLIC ACID
7 - 9 months	525 -----	7.8 -----	350 -----	50 -----
10-12months	525 -----	7.8 -----	350 -----	50 -----
1 - 3 years --	350 -----	6.9 -----	400 -----	70 -----
4 - 6 years --	450 -----	6.1 -----	500 -----	100 -----
7 - 10 years -	550 -----	8.7 -----	500 -----	150 -----
MALES				
11 - 14 years	1000 -----	11.3 -----	600 -----	200 -----
15 - 18 years	1000 -----	11.3 -----	700 -----	200 -----
19 - 50 years	700 -----	8.7 -----	700 -----	200 -----
50 + years ---	700 -----	8.7 -----	700 -----	200 -----
FEMALES				
11 - 14 years	800 -----	14.8 -----	600 -----	200 -----
15 - 18 years	800 -----	14.8 -----	600 -----	200 -----
19 - 50 years	700 -----	14.8 -----	600 -----	200 -----
50+ years ----	700 -----	8.7 -----	600 -----	200 -----

BREASTMILK

KEY FACT

It's the only food that contains every single micronutrient that the human body needs.

WHAT IT DOES

Provides 100% healthy hygienic diet for the first six months of life. Nothing else is needed. It provides up to a third of nutrients needed in the second year of life.

NEED TO KNOW

As well as providing all the micronutrients needed, breastmilk contributes to health by passing on to the baby the immunities to different infections that the mother has built up over her life. It 'immunises' babies against common life-threatening illnesses.

It also prevents infections from germs - which can cause fatal diarrhoea - in the water used to mix the milk powder.

For many years breastfeeding declined as women moved into the labour market, and multinational companies producing powdered baby milk tried to increase sales of their products. This decline has now been reversed as the result of action by governments and NGOs. The International Code of Marketing of Breastmilk Substitutes now prohibits advertising of milk powder.

But it is important that women who are breastfeeding eat a nutritious diet and get a good variety of different foods if their own health is not to suffer. Breastfeeding increases need for micro-nutrients, especially iron. Women should also ensure they use iodised salt.

HIV+ women need to take medical advice on whether to breastfeed.

Buying and Cooking Food

PROCESSING METHODS:

Drying: This takes out the water, so the nutrients left are more concentrated. Dried fish has five times as much iron as fresh fish of the same weight. But remember that dried food loses vitamin C and folate. Fresh cassava has nine times as much vitamin C as dried cassava.

Tinned food: Tinning requires heat, so again destroys some vitamin C and folate. Loss will depend on the time needed to destroy germs - bigger tins take longer.

Freezing: This has little effect on nutritional value as long as the food is frozen quickly after harvesting. If frozen vegetables can then be cooked in a microwave oven, this will produce an even better nutrition outcome, because microwaves can cook very fast, in very little water.

Removing the outer layer of cereals such as rice also removes important nutrients. But it also increases absorption of others, including iron.

PREPARING FOOD AT HOME:

Frequent washing of rice removes B vitamins. One or two washes is enough.

Allowing legumes to germinate so you get beansprouts increases vitamin C and also makes it easier to absorb iron and other minerals.

Allowing cereals to ferment increases absorption of iron and other minerals.

Peeling and cutting vegetables that are not to be eaten immediately reduces vitamin C. The same applies to cooking some time before you eat.

Cooking destroys vitamin C and folate. The longer you cook, the more you destroy, so keep cooking of vegetables to a minimum.

If you are boiling, vitamin C will escape into the water. Preserve as much as possible by either keeping water to a minimum or by using the water in soups or sauces.

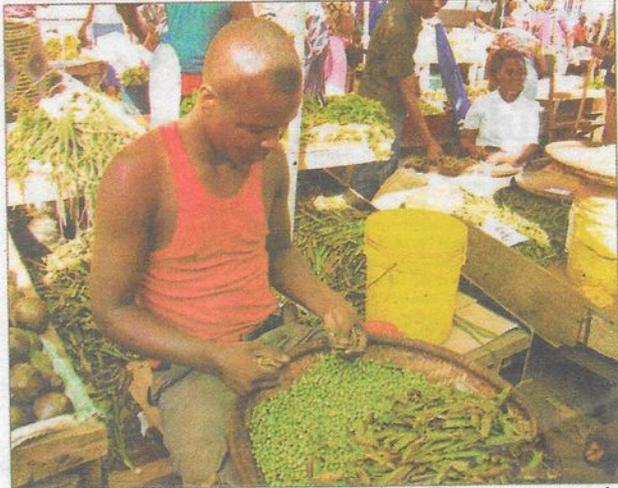
The larger the vegetable surface, the more vitamin C and folate will be lost. Leafy vegetables lose most.

Cooking when you leave food in contact with the air - eg no lid on the pan - will reduce vitamin A content.

Vitamin A can be preserved by drying foods such as tomato or mango at home. They need to be put in boiling water for two or three minutes to destroy enzymes that turn food bad. Dry in the shade to prevent vitamin A loss.

How not to sell peas!! This market trader no doubt thinks that by shelling the peas he's being helpful. He isn't! Fruit and vegetables start to lose their nutritive value the moment they're peeled, sliced, shelled or cut up. It will probably be several hours before the peas can be eaten. The shells would also have protected them from flies and other pollution.

BUSINESS TIMES • FRIDAY, NOV 30 - DEC 6, 2012



Preparing peas for sale at the Buguruni Open-air Market in Dar es Salaam is petty trader Hassani Jumanne. A kilogramme of the peas retails at Tsh4,000! (Picture by Peter Twite).

ADDITIVES & FORTIFICATION

In an ideal world we would all get all the micronutrients we need from the food we eat.

Unfortunately, it's not an ideal world.

The fact that there isn't enough iodine in the soil to enrich the vegetables many people eat is one example. They have no control over this.

People who live in North Europe and Canada have no control over lack of sunshine that can cause vitamin D deficiency. In Africa - and other places - vitamin A deficiency can arise when fruit and vegetables run short at the end of the dry season.

There are two solutions: additives and fortification, which are explained in the next two pages.

FORTIFICATION

WHAT IS IT?

Fortification is an increasingly common solution when a particular micronutrient deficiency is widespread. A foodstuff used by as many of the population as possible – salt or flour, for example – is chosen, and then fortified by adding supplies of the micronutrient during processing. In some cases one foodstuff is fortified with more than one micronutrient.

Once micronutrients had been identified by scientists, governments quickly realised that fortification of common foods is a cheap and effective way of boosting the health of entire populations.

The first priority was iodine deficiency, and in the 1920s and 1930s governments in Europe and North America led the way by adding iodine to salt.

Many governments have passed laws to make fortification of particular foodstuffs compulsory. In Tanzania iodine must be added to salt before it goes on sale. A trader who sells salt without iodine risks a prison sentence.

Iodised salt is one of the world's major examples of fortification, but wheat flour, rice, and vegetable oils are also regularly fortified in different parts of the world.

Micronutrients most commonly selected for fortification include Vitamins A and D, iron, and folate.

Quite often consumers do not realise they are eating fortified foods.

A printout of a UN Food and Agriculture Organisation list of fortified foodstuffs is attached. (Teachers who do not know their Fe for their K will need a copy of the Periodic Table to understand it.)

As well as government activity it's important to be aware that some food processors choose to fortify foodstuffs themselves. This can be a popular selling point, especially as increasingly health-conscious consumers become increasingly interested in what they eat and whether it's good for them.

A group of Kenyan businessmen concerned about Vitamin A deficiency recently decided to fortify their vegetable oil. An account of the project (they set themselves a deadline of 100 days to achieve the plan, and turned out their first bottle of fortified oil after 130) is included in the resource box. An uplifting tale!

Whole grain

InQars
whole and healthy

PURE AMARANTH FLOUR

(Tereere)

Kenya's first range of healthy flours

The whole family from wondrous recipes to our age old enjoy the benefits of delicious, nutritious InQars Amaranth. It's gluten free and contains fibre for easy digestion and essential nutrients for good health.

500g

Pure Amaranth Flour - Cooking Instructions (Suggested)

For bread: 1 cup Amaranth flour, 1 cup All Purpose Flour, 1/2 cup Yeast, 1/2 cup Sugar, 1/2 cup Oil, 1/2 cup Milk, 1/2 cup Water, 1/2 cup Salt. **For porridge:** 1 cup Amaranth flour, 1 cup Water, 1/2 cup Sugar, 1/2 cup Oil, 1/2 cup Milk, 1/2 cup Salt. **For porridge:** 1 cup Amaranth flour, 1 cup Water, 1/2 cup Sugar, 1/2 cup Oil, 1/2 cup Milk, 1/2 cup Salt.

Add whole portion and pure Amaranth to your family recipes to enjoy

Liquid: Fardige, Cleopatra, Parakee
Porridge: Gabe, Amaranth, Amaranth, Amaranth
Bread: Shaya, Amaranth



100% whole grain
100% natural
100% healthy

Nutritional information per 100g:

Energy	Protein 10g
Moisture 10.0g	Fat 1.0g
Carbohydrate 70.0g	Fiber 1.0g
Crude fiber 1.0g	Calcium 100mg
Crude protein 10.0g	Iron 1.0mg
Crude fat 1.0g	Phosphorus 100mg
Crude ash 1.0g	Sodium 100mg
Crude starch 50.0g	Zinc 1.0mg
Crude sugar 1.0g	Copper 1.0mg
Crude cellulose 1.0g	Manganese 1.0mg
Crude lignin 1.0g	Selenium 1.0mg
Crude pectin 1.0g	Vitamin B1 1.0mg
Crude gums 1.0g	Vitamin B2 1.0mg
Crude waxes 1.0g	Vitamin B3 1.0mg
Crude silica 1.0g	Vitamin B6 1.0mg
Crude ash 1.0g	Vitamin B12 1.0mg
Crude wax 1.0g	Vitamin E 1.0mg
Crude wax 1.0g	Vitamin K 1.0mg

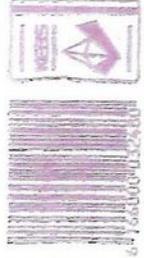
Ingredients: Pure Amaranth whole grain flour

Manufactured by: Kenya's first range of healthy flours

Product description: "Kenya's first range of healthy flours"

Kenya's first range of healthy flours

Manufactured by
Kenya's first range of healthy flours
P.O. Box 11100, Nairobi, Kenya
Tel: +254 (0) 20 477 7300
Fax: +254 (0) 20 484 7867



Top marks for information printed on this bag of flour bought in a Mombasa supermarket, which contains a range of different B vitamins, as well as Vitamins A and C.

Unlike most food labels, this one tells you exactly which micronutrients you're getting, and how much you get of each.

Kenyans are starting to take nutrition very seriously.

The same supermarket chain also sells bottles of cooking oil which have been specially fortified with Vitamin A.

A group of Nairobi businessmen took a lead in producing an East African brand of fortified oil after getting together with some civil servants and NGOs to do something to tackle Vitamin A deficiency.

The result was Kenya's first locally-fortified food - developed by a group of scientists and approved for sale in little more than three months.

**IN THE
CLASSROOM**

"Research shows that the human brain accepts new concepts largely through constant recall, while interacting socially."

"This suggests that good teaching must de-emphasise lecture and emphasise active problem solving"

The Economist. 19.09.11 P 32

LESSON MODULES

Each module is designed to highlight a single theme, usually one individual micronutrient. It will also focus on one or more grammar points from the Tanzania national curriculum, and introduce new vocabulary.

Modules are expected to occupy between 15 and 20 hours of teaching time, depending on age and ability level of students.

Each module starts with a short story, designed to provide an easy introduction to the selected micronutrient in an entertaining manner, while explaining its function in establishing and preserving health. The story will also make use of the grammar points in the curriculum and the new vocabulary.

It's followed by space for a Swahili-English vocabulary list, explanations of grammar, grammar practice exercises and translation work/comprehension subjects for student writing and research, all appropriate to age/ability levels of the class.

In order to reinforce the micronutrient message, teachers should try to provide illustrations, and preferably real life examples of foods containing the micronutrient being discussed eg a packet of iodine-fortified salt, or iron-rich green vegetables. Students should analyse their own diet for examples of the nutrient. Older students can weigh vegetables to estimate micronutrient content. All age groups can work together to devise and use questionnaires, then with the help of adults to:

- * identify local sources of the nutrient under discussion
- * conduct surveys on growing season and cultivation techniques
- * collect information on cookery methods, and perhaps produce a cookery book

Where possible they should be encouraged to write reports and to organise displays, both for their own pleasure and to publicise the work to as wide an audience as possible.

**“EVERY
PICTURE
WORTH
1,000
WORDS”**

Advertisers who pay out hundreds of thousands of shillings to buy space in newspapers or time on television don't use words to get their "Buy Me" message across.

They often use just a single sentence.

Instead, they rely on pictures : a line of beautiful white washing fluttering in the breeze, a delicious looking meal, a group of well-dressed successful young people enjoying themselves over a few bottles of Coke or Tusker.

Their experience - backed up by reports from psychologists - tells them that a picture will stick in the mind long after words have been forgotten.

Teachers can adopt the same technique. Sadly, we don't have a few hundred thousand shillings to commission art work. But we do have students - some of whom will turn out to possess impressive artistic talent once you give them the chance. And it's astonishing what difference a few brightly coloured posters and pictures can make to a classroom.

All that's needed is a modest budget for paper, paint, crayons and glue.

You may have to produce a couple of posters yourself to get things started, or at least to have a few examples ready to show students what can be done, and to suggest a theme - advertising food with Vitamin A, for example.

You can also use classroom walls to display students' written work, as well as setting aside a section for your own displays - a selection of new vocabulary, perhaps, or examples of the grammar being learned.

NB: If other teachers use the room you will need to explain to them what you are doing, and check whether they would like some space, and perhaps some materials, for their own work.

The Short Story

This is entirely up to you. You know your pupils. You know what they enjoy. And every teacher knows that learning is more effective when it's fun. And that fiction is, as a general rule, more fun than a string of facts.

The advantage of writing your own lessons is that your material can be local, and we all relate more to something happening in an area we know than something happening 100 or even ten miles away.

You will need to select your grammar point(s) before you start, so that they can be incorporated into the story. You also need to provide a separate vocabulary list.

You can introduce both either before or after the story, though you should actually start the module with the story, which is a bit more eye-catching and inviting than, say, a table explaining the present perfect tense.

Here are two stories written by trainee teachers in Bissau for work with secondary students learning English as a second foreign language after Portuguese.

"How malaria came to Geta Island" introduced a module on the subject of malaria for first and second year secondary students working on past tenses.

"The Drought" took clean water as its theme, and was used with older students practising modal verbs of obligation.

Five Minute Fillers

It's a good idea to have a few quick activities to fill any blank spot in the lesson, either at the beginning if you need to start by writing in the board, or at the end if you've finished your lesson.

At the beginning, it's best to keep students occupied by asking them to write something. Start a sentence for them to finish:

The best day of my entire life was when ----

The first time I saw the ghost -----

The student with the best sentence gets to start the game with their own sentence next time. Lists are always a good idea:

My 5 favourite foods are ----

The healthiest / unhealthiest things I eat are ----

Five foods with iron in them are ----

You could just ask them to write something on what is - for example - the most interesting thing they have learned this week / term / year

At the end of the lesson a simple GUESS WHAT WORD game is flexible. Think of a long (ish) word that they have recently learned - FORTIFICATION for example. Put a dash on the board for each letter:

13 letters. They have to suggest one letter at a time - which fills a gap if they're right - until someone guesses the word. If you have any time left, the winner can take over on the blackboard. If they fail to guess after 13 tries, you win.

The advantage of games like this is that you get to nominate students to speak - a mix of those you can depend on to be entertaining and clever and those you need to encourage to participate more.

The questionnaires are intended to provide an introduction to micronutrients by giving a quick picture of why they are so important.

Getting the answers wrong is not surprising, or even unusual. The whole point is to teach something that is probably new or unfamiliar.

Just for the record, members of the postgraduate forum at Birmingham University's Centre of West African Studies, including several lecturers, have already had a go. No one got all answers correct. Lowest mark was two.

What Symptom(s)

People who don't get enough vitamin A:

- 1 Keep getting broken bones
- 2 Are always cheerful and smiling
- 3 Never eat carrots or tomatoes
- 4 Are more likely to die from common diseases such as measles and malaria
- 5 Don't know

ANSWER _____

People who don't get enough vitamin C

- 1 Have poor eyesight
- 2 Don't eat fruit and vegetables
- 3 Bleed easily eg when cleaning their teeth
- 4 Are very good at school work
- 5 Don't know

ANSWER _____

People who don't get enough vitamin D

- 1 Hate going out in the sun
- 2 Have weak easily broken bones
- 3 Love eating cakes and sweets
- 4 Are very bad at school work
- 5 Don't know

ANSWER _____

People who don't get enough calcium

- 1 Are always forgetting things
- 2 Drink lots of tea with lemon
- 3 Often feel depressed
- 4 When old, may develop a disease called osteoporosis

ANSWER _____

People who don't get enough iodine:

- 1 Will suffer tooth decay
- 2 If female, will have babies who are less intelligent
- 3 Eat lots of fish and seaweed
- 4 Don't like food with salt
- 5 Don't know

ANSWER _____

People who don't get enough folate or folic acid

- 1 Behave badly at school
- 2 Get tired easily and don't like football or netball
- 3 Never eat green vegetables
- 4 If female, may give birth to handicapped babies
- 5 Don't know

ANSWER _____

People who don't get enough iron

- 1 Have very poor eyesight
- 2 Can sing very beautifully
- 3 Often feel tired and have no energy
- 4 Are vegetarian
- 5 Don't know

ANSWER _____

WHERE TO FIND MICRONUTRIENTS

VITAMIN A

Is found in:

- 1 Millet flour
- 2 Orange and yellow fruit and vegetables
- 3 Round potatoes
- 4 Rice
- 5 Don't know

CORRECT ANSWER _____

IODINE

Is found in:

- 1 Red palm oil
- 2 Fish from the sea
- 3 Papaya
- 4 Groundnuts
- 5 Don't know

CORRECT ANSWER _____

VITAMIN C

Is found in:

- 1 Garlic
- 2 Maize
- 3 Bread and chapatis
- 4 Fruit and vegetables especially citrus
- 5 Don't know

CORRECT ANSWER _____

FOLATE

Is found in:

- 1 Green leafy vegetables
- 2 Onions
- 3 Sugar
- 4 Poultry such as chicken
- 5 Don't know

CORRECT ANSWER _____

VITAMIN D

Is found in:

- 1 Sunshine on bare skin
- 2 Yams and cocoyams
- 3 Dried beans eg mung, cow peas, soya
- 4 Cassava and boiled cassava leaves
- 5 Don't know

CORRECT ANSWER _____

IRON

Is found in:

- 1 Juice from cashew apples
- 2 Red meat
- 3 Yellow sweet potatoes and pumpkin
- 4 Bananas and yellow plantains
- 5 Don't know

CORRECT ANSWER _____

Answers to questionnaires:

What Symptoms:

Vitamin A: 3 possible, 4 definite

Vitamin C: 2 possible, 3 definite

Vitamin D: 1 possible, 2 definite

Calcium: 4

Iodine: probable, 4 possible

Folate or folic acid: 3 possible, 4 possible

Iron: 3 probable, 4 possible

Where to find micronutrients:

Vitamin A: 2

Vitamin C: 4

Vitamin D: 1

Iodine: 2

Folate: 1

Iron: 2

Here are two passages for older students, which can be used for listening/comprehension activities. There is also a graph illustrating world population increase, though students should be able to make their own.

What is Global Warming and why is it important?

Global warming is a new discovery, only recognised in the past few years.

But to understand the cause, we need to go back more than 200 years, to the time when scientific discoveries led to the invention of engines and factory machines, powered by coal. Then, at the beginning of the twentieth century came cars and planes, powered by oil.

Coal and oil are both fossil fuels. They contain carbon, and using them pushes carbon dioxide out into the air and the sea. Carbon attracts heat, so the earth and sea get warmer.

Carbon dioxide is the most important of the "greenhouse gases" – so called because they are making the planet warm up in the same way that a greenhouse warms up. Other greenhouse gases include methane and nitrous oxide.

The amount of carbon dioxide produced by, for example, cooking a stew, or driving a car, is known as its "carbon footprint". Driving a car has a much bigger carbon footprint than cooking a meal. We can also talk about people having a carbon footprint and countries having a carbon footprint. The United States, as the world's richest country, has a very large carbon footprint. Tanzania's is much much smaller.

So far, it's estimated, global temperatures have risen by 0.5 degrees C in the past 50 years. This rate is expected to increase as world population rises and consumption increases, so that in the next 100 years temperatures are expected to rise by several degrees more.

Does it matter? 0.5 of a degree doesn't sound very much. But even a slight change in temperature can change the climate. More importantly, global warming will affect rainfall. Both North and South Africa are among parts of the world that may get less rainfall as a result. This may make it more difficult to grow food. Already there have been droughts in several parts of the world: Australia in 2008, Russia in 2010, the US in 2014, when more than 20% of the country's grain and maize harvest was lost.

There's also the question of sea levels. These are expected to rise, partly because water expands as it gets warmer, and partly because of melting ice at the poles. Bad news for people, such as large numbers of Bangladeshis for example, who live and grow food at sea level. London has built a flood barrier. New York is building one now.

No one knows exactly what will happen. The prediction for East Africa is that it will warmer and wetter. This is probably better than getting drier. But it could

get too wet, bringing new problems. Warm air attracts moisture. So when it rains, it can rain more heavily. There are already examples. Think of the Mozambique floods in 2000. Water rose as much as 8 metres, thousands of people had to be rescued from rooftops and trees, and schools and hospitals were destroyed. There was serious flooding in West Africa in 2007. In both these floods farmers lost their crops and animals.

All the signs are that global warming is going to affect food production. Countries getting less rainfall may need to keep more of their food for themselves, and buy more on the world market. Prices are likely to rise for everyone as a result, as people compete to buy food. For countries that need to import food – including many African countries – this isn't good news.

Books used for this piece:

Camilla Toulmin: Climate Change in Africa
Stephen Emmott: 10 Billion
plus Wikipedia website

World Population: growing ever faster

Ten thousand years ago the world's population is thought to have been one million: 1,000,000.

By the year 1800, thanks to improvements in food production – gradually learning which plants grew best and which animals could be eaten or used on farms or for transport – world population had risen to one billion: 1,000,000,000.

It took only 130 years to get to the next billion, helped by the growth of cities, new transport systems, factories for mass production of goods and medical progress.

Then, in spite of terrible wars and famines, it took just 30 years to reach three billion by 1960.

After that population growth just got faster and faster:

Four billion by 1980

Five billion by 1990

Six billion by 2000

There are now more than seven billion of us on this rather small planet. Scientists predict that we will continue to grow until nine billion by 2050. Some think

drives down prices, reduces profit and leaves them with less money to invest, then countries like Tanzania could grow a lot more.

The world-famous Kenyan agronomist and Nobel prize winner Wangari Maathai has argued that Africa made a mistake by starting to import cheap food such as wheat and rice from abroad instead of using the money to help its own (often female) farmers. "Such food is no longer cheap and was never particularly healthy" she said. Better to stick to Africa's own root crops, beans, fruit and vegetables.

A group of scientists from the World Vegetable Center have set up a base in Arusha to study African vegetables, which they say are often more nutritious than foreign varieties. They have also made a special study of urban farming in the Ubungo Darajani district of Dar es Salaam, where many city workers grow maize and vegetables on tiny plots. At the same time, Nigerian scientist Felix Nweke is busy developing better strains of cassava, which he says will make an important contribution to Africa's food supply.

* calorie: the way we measure the amount of energy that our food provides.

Books used for this piece:

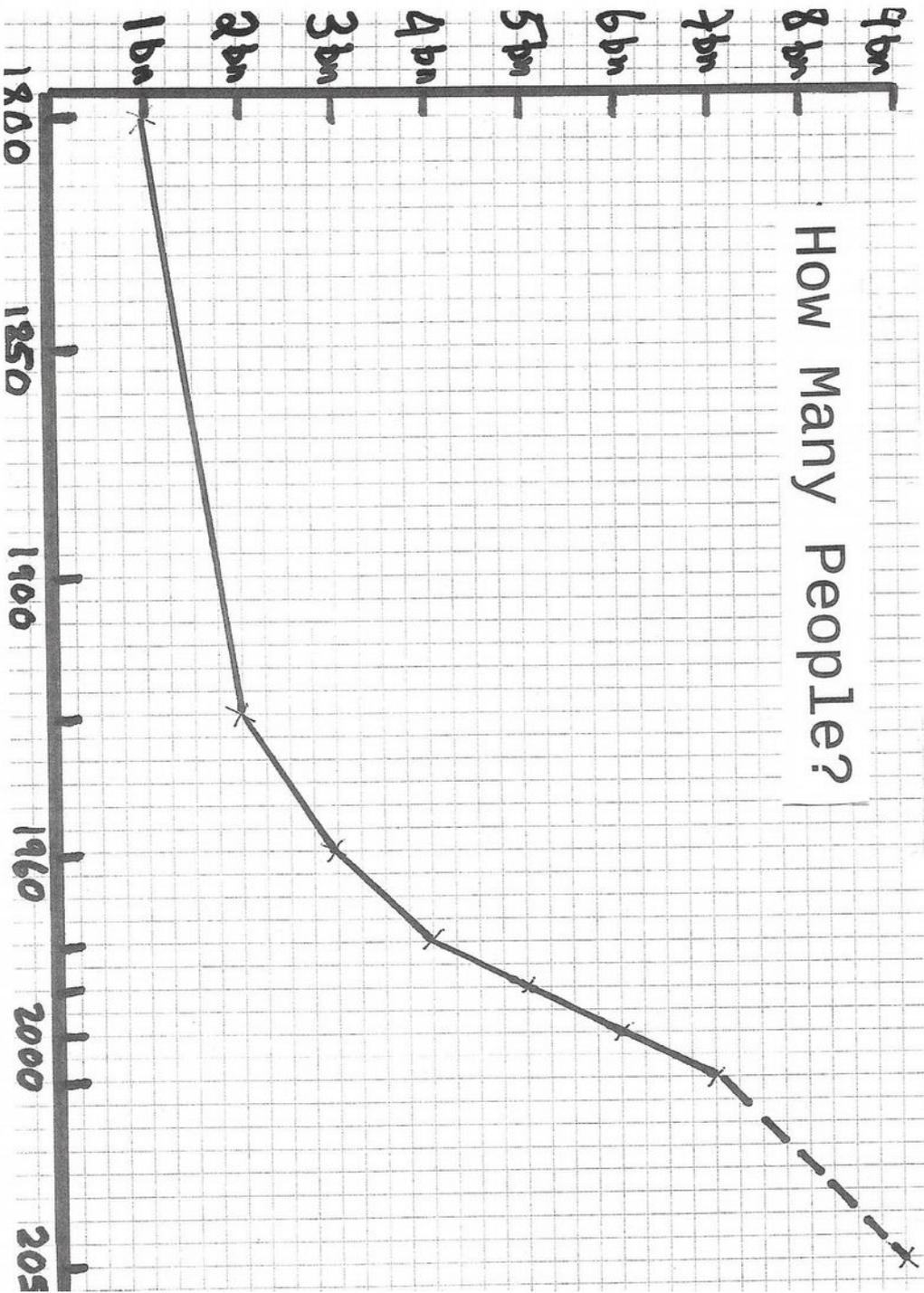
Wangari Maathi: The Challenge for Africa: A New Vision

Shackleton & others: African Indigenous Vegetables in Urban Agriculture

Nweke & others: The Cassava Transformation: Africa's Best-Kept Secret

Stephen Emmott: Ten Billion

How Many People?



Appendix 2

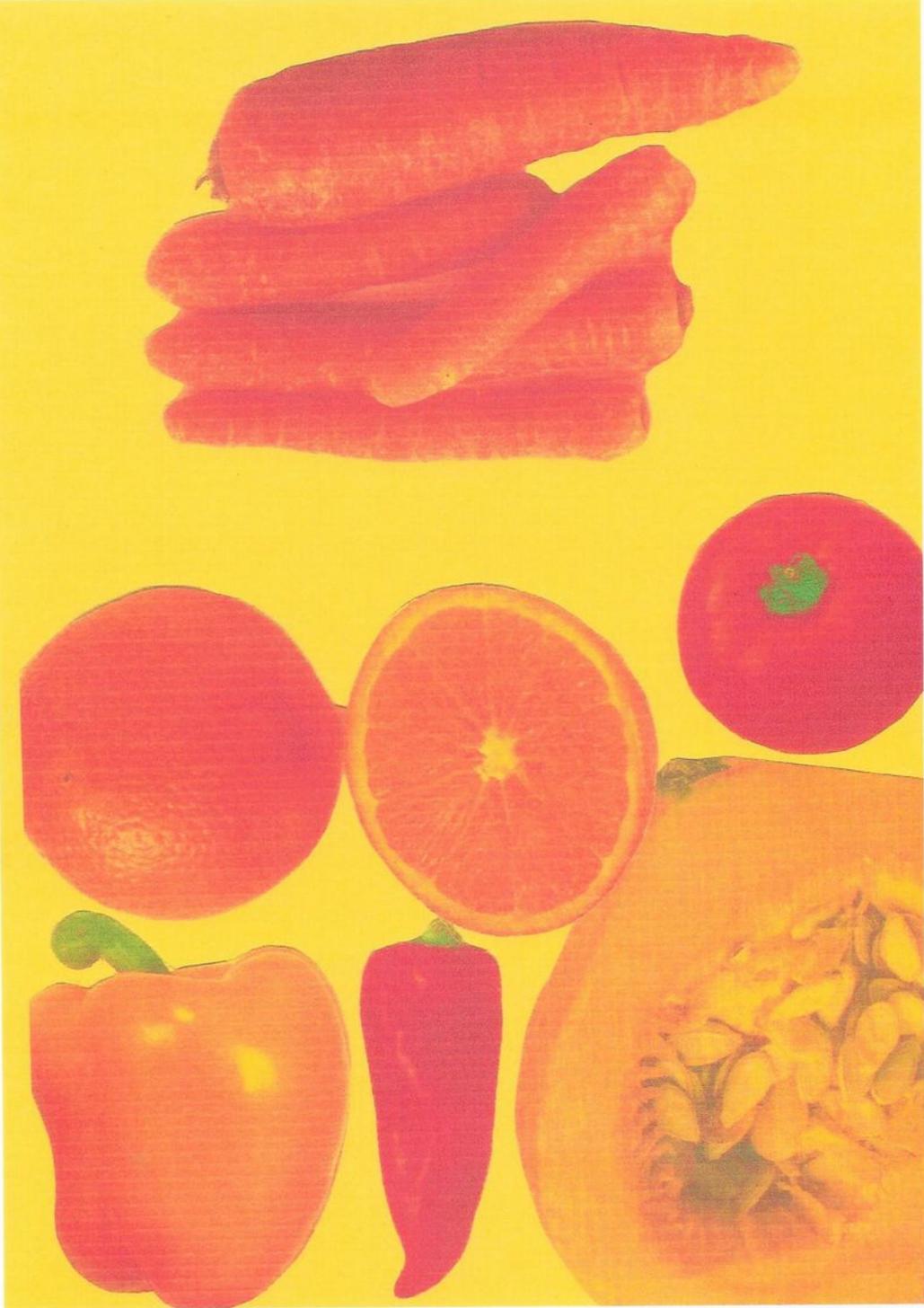
This appendix contains examples of laminated cards for teachers to use in the classroom, and of lesson modules prepared as part of the thesis.

The little girl was very ill
last time she got malaria

The nurse says she doesn't
eat enough food with
Vitamin A

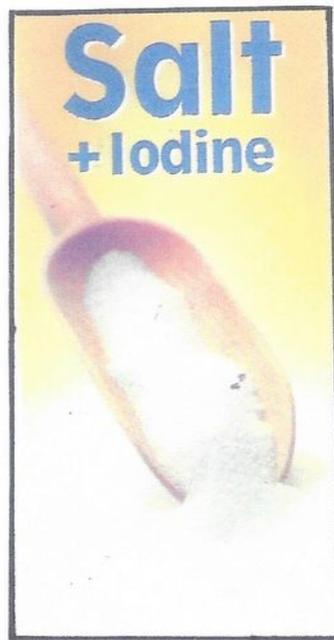
She needs to eat more

?????????



She wants to have a
baby very soon

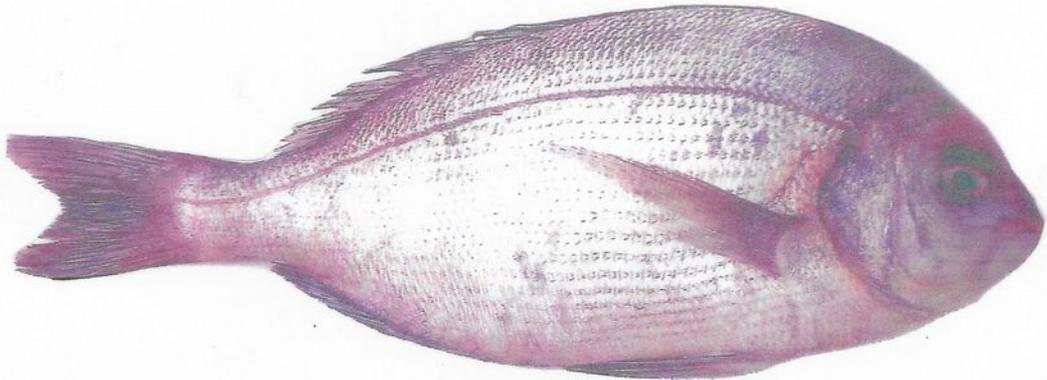
Well then,
she'd better
make sure she
uses this



And/Or

eats lots of

Fish

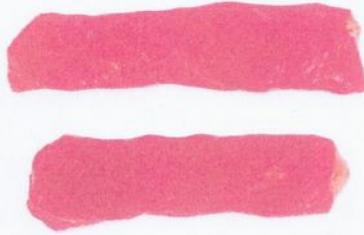


The man says his wife is
always tired

He went to the internet
café and read up on causes
of tiredness. He thinks she
isn't getting enough iron

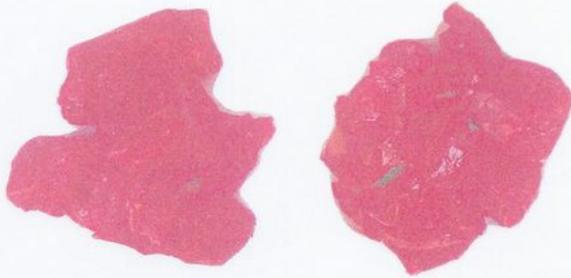
Now he's on his way to
buy her some

?????????



MEAT

has lots of



IRON

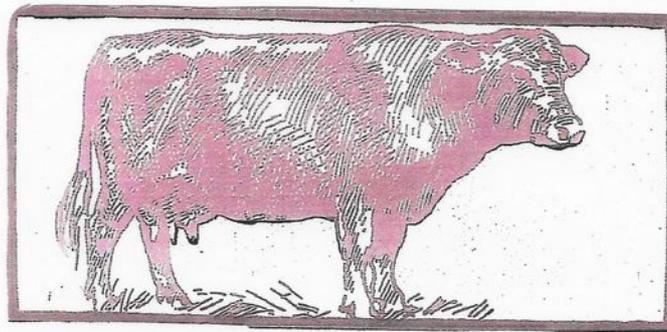
He can't play football
because he's broken his
leg.

Last year he broke his
arm.

I don't think he gets
enough

??????????

Calcium



JOKE

Joseph has two grandmothers: Grandmother Janet and Grandmother Judith.

Each of the old ladies wants to be Joseph's favourite grandmother.

So each tries to give Joseph everything he wants.

On Saturday Grandmother Janet visits. She brings Joseph

- One large chocolate cake cut into seven slices - one for every day of the week
- Seven bars of chocolate - one for every day of the week
- Seven packets of sweets - one for every day of the week
- Seven bottles of Coca Cola - one for every day of the week

On Sunday Grandmother Judith visits. And she brings Joseph

- One large coffee cake cut into seven slices - one for every day of the week
- Seven Kit Kat bars - one for every day of the week
- Seven packets of sweets - one for every day of the week
- Seven bottles of Fanta - one for every day of the week

Joseph is now 18 years old. He likes cakes, sweets and chocolate more than anything else.

Today is Wednesday. What does Joseph have?

DIABETES