THE IMPACT OF HOME GARDENS ON DIETARY DIVERSITY, NUTRIENT INTAKE AND NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN IN A HOME GARDEN PROJECT IN EATONSIDE, THE VAAL TRIANGLE, JOHANNESBURG, SOUTH AFRICA

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ABSTRACT

Urban agriculture is a strategy poor urban, informal settlement residents adopt to reduce poverty and improve food security and child nutrition. It is widely asserted in the literature and development circles that household vegetable gardens can provide a significant percentage of recommended dietary allowances of macro- and micro-nutrients in the diets of pre-school children. These children are vulnerable in terms of food access and nutrition. The first five years of a child's life are crucial to psychological well-being. This study set out to determine the impact of home gardens on access to food, dietary diversity and nutrient intake of pre-school children in an informal settlement in Eatonside, in the Vaal Region, Johannesburg, South Africa.

The home gardening project was undertaken in five phases, namely the planning phase; a baseline survey (including quantitative food intake frequencies, 24-hour recall, individual dietary diversity questionnaires and anthropometric measurements); a training programme on home gardens; planting and tending the gardens and evaluating the impact of home gardens on access to food, dietary diversity and nutrient intake of pre-school children.

Children aged two to five years (n=40) were selected to participate in the study. The sample population consisted of 22 boys and 18 girls. The children were categorised into three groups at the start of the project: children of 24-35 months (four boys and one girl), 36-47 months (four boys and five girls) and 48-60 months (14 boys and 12 girls). All but 10 per cent of the children's consumption of foods in the food groups increased. At the start of the project, low consumption rates were observed for white tubers and roots, vitamin A-rich fruit, other fruit and fish. After the gardening project, the number of children consuming vegetables increased considerably. There was an increase in the intake of food groups over the period of the project. The number of children consuming vitamin A-rich increased the most, with all children (45 per cent improvement) consuming vitamin A-rich vegetables at the end of the project, compared with just over half at the start of the project. The consumption of vegetables increased with 78 per cent of the children consuming beans and 33 per cent beetroot. Most children (95 per cent) consumed cabbage, carrots and spinach post-home gardening. Seventy eight percent of children consumed beans by the end of the project, but only a third of the children had consumed beetroot during the post-project survey period.

Intakes of all nutrients considered in the study improved by the end of the project, except for energy and calcium, which dropped marginally, but both remained at around 50 per cent below requirements.

Twenty five percent of boys (24-35 months) were underweight and below the 50th percentile at the pre- and post-project stages. The same boys were severely stunted (on average -4.41 standard deviations below the third percentile). Of the boys aged 36-47 months, 25 per cent were stunted pre-project, but by the end of the project, this number had decreased to 50 per cent. Twenty one per cent of the older boys (48-60 months) were within their normal height for age.

Twenty five per cent of girls were underweight (36-47 months). A slight change was observed in the 36-47 month group, where the mean changed from -0.14 standard deviations (below 50th percentile) pre-project to -0.5 (below 50th percentile) post-project. All girls aged 24-35 months were below -2 standard deviations pre-project. After the home gardening project, the figure dropped to 50 per cent. For girls aged 36-47 months, 25 per cent were below -3 standard deviations after the project, compared with 20 per cent pre-project. Height-for-age for girls aged 36-47 months dropped by 10 per cent below -2 standard deviation post-home gardening. Girls from 24 to 35 months were severely stunted [-3.02 (below 3rd percentile) pre- and -2.31 (below 5th percentile) post-project]. Stunting was observed in 36-47 months girls who had means of -2.39 (below 3rd percentile) and 1.86 (below 25th percentile) both pre-and post-gardening respectively and were at risk of malnutrition. The older girls were well nourished with means of height-for-age at -0.88 (below 50th percentile) pre-project and -0.92 (below 50th percentile) post-project.

Home-gardening improved food access, dietary diversity, energy, protein, carbohydrate, fat, fibre, vitamin A and iron intakes, but did not make a significant impact on the malnutrition of the children in the project or ensure adequate intakes. Home gardens had a positive impact on height-for-age scores; but had no significant impact on mean weight-for-age and height-for-weight z-scores of the pre-school children. Increases in carbohydrate and fat intakes were shown to have the only significant impact on the children's nutritional status and only with regard to improving height-for-age scores. The results show that the gardens did not have the expected impact on children's nutrition, but confirm that increases in incomes from gardening are likely to have a greater impact through savings from consuming

produce grown and selling produce to buy energy-dense foods for the children. This needs to be considered in nutrition interventions.

DECLARATION

I, Bolyn Mosa Selepe, declare that:

- The research reported in this thesis, except where otherwise indicated, is my original research.
- This thesis has not been submitted for any degree or examination at any other university.
- This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from those persons.
- This thesis does not contain other authors' writing, unless specifically acknowledged as being sourced from them. Where other written sources have been quoted, then:
    - their words have been paraphrased but the general information attributed to them has been referenced;
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- This thesis does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the references sections.

Signed: …… Date ……

As Research Supervisor, I agree to submission of this dissertation/thesis for examination.

Signed: …… Date 24 Nov 2010

Prof Sheryl Hendriks

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DEDICATION

This work is dedicated to my father (Mr. Piet Nono) and my mother (Mrs. Mary Nono). You have been tirelessly supportive throughout my years of study. You are my pillars of strength and I thank you!

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LIST OF ABBREVIATIONS

ACC/SCN	Administrative Committee on Coordination/ Standing Committee on Nutrition
ACFCGN	Australian City Farms and Community Gardens Network
AI	Adequate intake
BMI	Body mass index
DRIs	Dietary Reference Intakes
EAR	Estimated average requirement
FAO	Food and Agricultural Organisation of the United Nations
FFQ	Food frequency questionnaire
HAZ	Height for age Z-Score
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IDD	Iodine deficiency disorder
IFPRI	International Food Policy Research Institution
NCHS	National Centre for Health Statistics
NDHS	Nigerian Demographic and Health Survey
NFCS	National Food Consumption Survey
NICUS	Nutrition Information Centre University of Stellenbosch
PPP	Purchasing power parity
QFFQ	Qualitative food frequency questionnaire
RDAs	Recommended Dietary Allowances
RE	Retinol equivalents
SAVACG	South African Vitamin A Consultation Group
SD	Standard Deviation
SDQ	Socio-demographic Questionnaire
SPSS	Statistical Package for Social Sciences
UL	Tolerable upper intake level
UNDP	United Nations Development Programme
UNICEF	United Nation Children's Fund
VAD	Vitamin A deficiency
VIC	Vitamin Information Centre
WAZ	Weight for age Z-Score
WHO	World Health Organisation

CHAPTER 1: RESEARCH PROBLEM AND SETTING

1.1 Importance of the study

Poverty is concentrated in urban informal settlements in South Africa (Martin et al., 2000). Food insecurity and under-nutrition are common in such low-income areas (van Averbeke, 2007). Urban agriculture is a strategy poor urban or informal settlement residents can adopt to reduce poverty and improve food security (Rogerson, 1993, 1996) if land and other necessary resources are available (Burgess et al., 1998). Interventions seeking to improve household and individual nutrition in rural and urban areas seek to increase the production, availability and access to food to increase and diversify consumption to overcome, prevent or mitigate dietary deficiencies (Faber, 2002). Food gardening is not only a source of food, but also provides income to buy food, further enhancing household food security (van Averbeke and Khosa, 2007).

Webb (2000) postulates that the link between food gardens and nutrition seems obvious and is often the rationale for the promotion of vegetable gardening. Yet, despite considerable and global focus on home gardens as the panacea for food insecurity and malnutrition, very little evidence exists on the impact of such projects on nutrition (Webb, 2000). To date, no comprehensive study has been published on the impact of home gardening on child malnutrition in informal settlements, especially those in South Africa. Webb (2000) has called for greater depth and rigour of research to demonstrate that home gardens are indeed a solution to malnutrition. This study sets out to establish the impact of a home garden project in an informal settlement in South Africa on children's nutrition through a comprehensive investigation of changes in food consumption and its influence on dietary diversity, nutrient intakes and anthropometric measurements.

1.2 Research problem

This study set out to evaluate the impact of home gardens on dietary diversity, nutrient intakes and the nutritional status of pre-school children in a home garden project in Eatonside in the Vaal Triangle, Johannesburg, South Africa.

1.3 Research sub-problems

To determine the impact of home gardening on sampled children in the Eatonside informal settlement, four sub-problems were investigated:

Sub-problem 1: Does home gardening improve the socio-economic status of caregivers of pre-school children?

Sub-problem 2: Does home gardening improve perceived access to food and dietary diversity of pre-school children in the Eatonside informal settlement?

Sub-problem 3: Does home gardening improve nutrient intakes of pre-school children in the Eatonside informal settlement?

Sub-problem 4: Does home gardening improve the nutritional status of pre-school children in the Eatonside informal settlement?

1.4 Study limits

The study was confined to participants in a home garden project at Eatonside in the Vaal Triangle. The study included only children of participants in the home garden project in a pre- and post-test assessment. Households, with children between two and five years at the start of the study, were invited to participate in the study. Biochemical analysis was not conducted due to financial constraints and ethical considerations. Therefore, the results cannot be generalised to other informal settlements in South Africa.

1.5 Assumptions

The study was based on a fundamental assumption that the participating caregivers were interested in home gardening. It was assumed that the information provided by the children's caregivers was a true reflection of the households' demographic and socio-economic profiles and what the children consumed. It was also assumed that the information provided by the pre-school teachers was accurate. Finally, it was assumed that the nutritional benefits derived by the children over the period of the project were a direct outcome of the home gardens.

1.6 Outline of the thesis

Chapter 1 introduced the study, its importance and the research problem, study limits and assumptions. Chapter 2 presents a review of the relevant literature in which the relationship between home gardening and food security is reviewed and the benefits of home gardens discussed. Discussion on the background of the main project of which this study forms part will be presented in Chapter 3. Chapters 4 and 5 outline the methodology and fieldwork applied in this study, respectively. Chapters 6, 7, 8, and 9 address the research sub-problems. Chapter 10 discusses the association between the sub problems. The conclusions are drawn and recommendations presented in Chapter 11.

CHAPTER 2: REVIEW OF THE LITERATURE

2.1 Introduction

The purpose of this study was to determine the impact of home gardening on access to food, nutrient intakes and nutritional status of pre-school children in an informal settlement. This chapter presents a literature review covering the prevalence of hunger and malnutrition, benefits and challenges of and approaches to home gardening, home gardening as an intervention strategy to alleviate hunger and malnutrition, and monitoring and evaluation tools for child nutrition.

As malnutrition was unacceptably high and universal, the United Nations (UN) collectively adopted the Millennium Declaration in September 2000 that sets out development goals and targets for the new millennium. Many of the Millennium Development Goals (MDGs) were first drafted at international conferences and summits held in the 1990s. These MDGs were later compiled into what became known as the international development goals to reduce poverty in all its forms and are presented below:

- Eradicate extreme poverty and hunger, reducing by half the proportion of people living on less than a $1 (about R8.00) per person per day;
- Achieve universal primary education, ensuring that all boys and girls complete a full course of primary schooling;
- Promote gender equality and empower women, eliminating gender disparity in primary and secondary education by 2005, and at all levels by 2015;
- Reduce child mortality by two-thirds among children under five;
- Improve maternal health, reducing by three-quarters the maternal mortality ratio;
- Combat HIV/Aids, malaria and other diseases;
- Ensure environmental sustainability, reducing by half the proportion of people without sustainable access to safe drinking water, and achieving significant improvement in the lives of at least a 100 million slum dwellers by 2020 and,

- Develop a global partnership for development (FAO, 2007).

Halving hunger and extreme poverty by 2015 is the first Millennium Development Goal (MDG) (FAO, 2007). Persistent hunger is prevalent worldwide, slowing development towards other Millennium Development Goals, particularly in sub-Saharan Africa (FAO, 2007). Gardening plays an important role in promoting human wellbeing and sustainable development, but has been insufficiently emphasised, if not overlooked. In the light of poverty and hunger, home gardens could be a key tool to address poverty and malnutrition in developing countries (FAO, 2002). In developing countries, the most immediately apparent function of gardening is to provide food for millions of people who are hungry and living in poverty (FAO, 2002 and 2007).

The early years of a child's life are crucial to her/his physiological and psychological well-being. Therefore, good nutrition in a sound socio-economic environment is the foundation of health and well-being of a child's life (Rothwell, 1994). Malnutrition increases vulnerability to infections, which can result in death. Malnutrition has negative social and economic impacts and affects cognitive development, reduces resources and lowers the earning capacity of households (Rothwell, 1994). It is essential to identify the causes of malnutrition in order to solve it (Figure 2.1) in different communities and ensure that interventions are applicable and relevant to a particular local setting. The causes of malnutrition are multifactoral. The conceptual framework presented in Figure 2.1 on the causes of child malnutrition was developed in 1997 as part of the UNICEF nutrition strategy. The framework shows the causes of malnutrition being multicultural, embracing food, health and caring practices. These causes are also classified as immediate, underlying and basic, whereby factors at one level influence other levels. The framework can be used at national, district and local levels to help plan effective actions to improve nutrition. It serves as a guide in assessing and analysing the causes of the nutrition problem and helps in identifying the most appropriate mixture of actions (UNICEF, 1997).

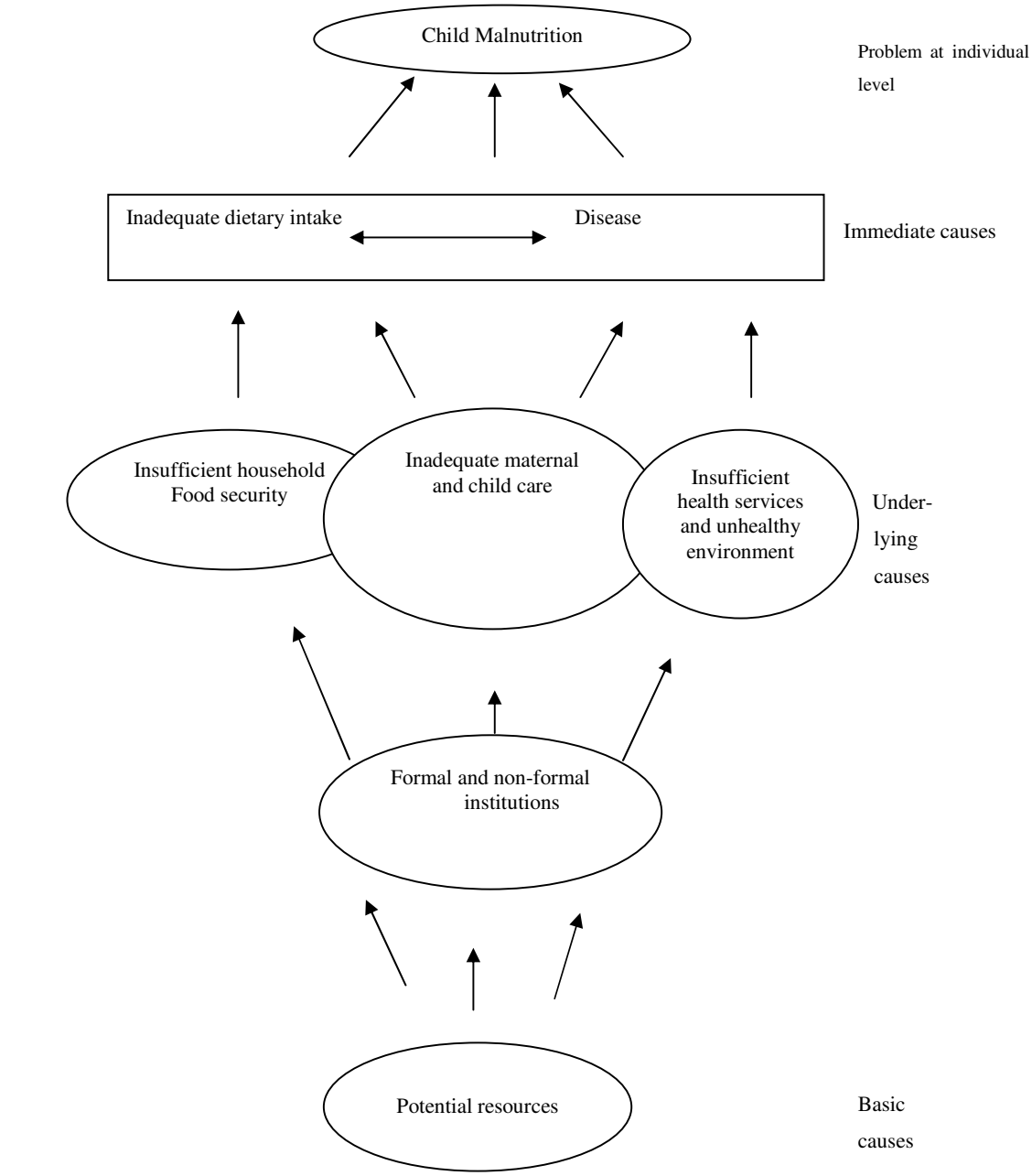

Figure 2.1 Immediate, underlying and basic causes of malnutrition (UNICEF, 1998, p4).

The UNICEF (1998) reported that the principle underlying cause of malnutrition and infection is inadequate dietary intakes, which lead to low nutritional reserves and manifest as weight loss or growth failure in children. These factors themselves worsen malnutrition, leading to further damage to defence mechanisms. At the same time, many diseases are associated with a loss of appetite. While other relationships play a part, these are some of the most important and account for much of the high morbidity and mortality under circumstances of high exposure to infectious disease and inadequate diet, typical in many poor communities (Gillespie and Mason, 1991).

The Opportunity for Micro Nutrient Interventions organisation (OMNI, 1996) and the Food and Agriculture Organisation of the United Nations (FAO, 2005) have indicated that malnutrition is a risk factor that increases vulnerability to and severity of infection. Dietary deficiency-related diseases reduce the body's resistance to infections and adversely affect the immune system in the sense that the body has reduced ability to defend itself against infections.

2.2 Hunger and malnutrition

Hunger and malnutrition are still major problems throughout the world today. High rates of micronutrient malnutrition persist, despite commitments made globally to reduce the malnutrition status of the world's population (Venter, 2007). Muller (2007) reported that malnutrition is one of the tragedies of our time, but data show that, regrettably, it is deteriorating over time and remains the underlying cause of many childhood diseases in the world. Presently, what causes existence of malnutrition in children in low-income households has not been adequately investigated. In order to understand the full impact of this problem in the world, it is important to investigate the range of factors related to malnutrition. As a result, eradicating malnutrition would cut child mortality by more than 50 percent, and reduce by 20 percent the burden of diseases in developing countries.

Although the problems of malnutrition are not the same across the world, they are still problems in both rich and poor countries (FAO, 2004). The Food and Agriculture Organization (FAO, 2004) estimated that, in 2000-2002, 852 million people worldwide were malnourished, which is a situation that develops when a person's body does not get the correct quantity of the micro- and macro-nutrients it needs to maintain healthy tissues and organ function (Fyke, 2005).

2.2.1 Global prevalence of hunger and malnutrition

Malnutrition is a global problem, with figures reflecting its wide-ranging occurrence in all parts of the world (FAO, 2004). Of the 852 million people who were deemed malnourished in the timeframe 2000-2002, 815 million people were in developing countries, 28 million in countries in transition, and 9 million in industrialised countries (FAO, 2006). Therefore, it means that over 800 million people suffer from malnutrition in developing countries and that over 20 per cent of their populations are hungry (Rutengwe et al., 2001). Of the 126,5 million underweight children globally, 89,2 million are in Asia, 34,5 million in Africa and 2.8 million in Latin America and the Caribbean (FAO, 2006). Overall, the World Health Organization (WHO) estimates that more than 3.7 million deaths in 2000 can be attributed to underweight (FAO, 2006).

Globally, malnutrition includes a spectrum of nutrient-related disorders and deficiencies. In young children, the consequences of malnutrition are growth retardation, increased risk of infection, high risk of death, blindness and anaemia (World Health Organisation (WHO), 1992). Grigsby (2003) reported that approximately 150 million children are malnourished (26.7% children younger than 5 years) in developing countries. These estimates are based on their low weight in relation to their age. Sanminiatelli (2005) reported that hunger and malnutrition kill nearly six million children a year, and more people are malnourished in Sub-Saharan Africa in the current decade than in the 1990s. Many of these children die of diseases that are treatable, including diarrhea, pneumonia, malaria and measles. Sub-Saharan Africa is among the worst hit regions. The UNICEF (2001) reports (Table 2.1) that South Asia (78%) has the highest incidence of malnourished children, followed by Sub-Saharan Africa (32%), with the lowest incidences in the Baltic States (2%).

Table 2.1: Malnourished children in developing countries (UNICEF, 2001)

Region	Percentage of population
South Asia	78
Sub-Saharan Africa	32
East Asia Pacific	27
Middle east	7
North Africa	7
Latin America /Caribbean	4
Baltic States	2

At least 10 million children die every year from malnutrition, most of who are from poor countries (Black et al., 2003). Malnutrition not only causes serious health problems, including higher incidence and severity of infectious disease, mental retardation and blindness, it is also responsible for loss of human capital and worker productivity (FAO, 2000). Therefore, an improvement in nutrition will lead to improved health status, well-being and development opportunities.

The prevailing global diet-related disorder is protein energy malnutrition, while disorders linked directly to lack of vitamins and minerals are common (Welch and Graham, 1999). Kennedy et al. (2003) reported that micronutrient deficiencies (hidden hunger) have become a serious global problem, particularly in areas where there is lack of dietary diversity. Approximately 40 minerals and vitamins are considered essential for mental and physical growth, healthy immune systems and sound metabolic processes (Flyman and Afolayan, 2006). More especially, widespread micronutrient deficiencies have been attributed to deficiencies of iron, iodine and vitamin A. Zinc and folate deficiencies are thought to be considerable, but their prevalence has not yet been established (Kennedy, 2003).

2.2.2 Prevalence of hunger and malnutrition in Africa

Africa has the highest statistics of malnutrition, with one out of every three children being underweight with the highest prevalence among black (25%) children. Black rural children are the most affected group (UNICEF, 1998; Vorster et al., 1997). The Nigerian Demographic and Health Survey (NDHS) conducted in 1999 indicated that the incidence of wasting had increased, while underweight and stunting decreased, compared with the 1990 NDHS data (Adelekan, 2001). In Nigeria, two main types of malnutrition were identified in children, namely micronutrient and protein-energy-malnutrition.

The United Nations Children's Fund (UNICEF, 2005) reported that in Sub-Saharan Africa, the number of people affected by malnutrition has risen from 170.4 million to 203.5 million since 1995. More and more of the world's children are suffering extreme deprivations, poverty, war and HIV/AIDS - conditions that deny children a healthy childhood and delay the development of nations. The UNICEF (2005) reported that more than one billion children are deprived of a

healthy and protected upbringing, despite the awareness created by the 1989 Convention on the Rights of the Child, constraining progress towards achieving human rights and economic advancement.

2.2.3 Prevalence of hunger and malnutrition in South Africa

The South African Constitution (1994) recognises the right of everyone to have access to sufficient food and the right of children to basic nutrition. Yet, it is estimated that about 2.5 million South Africans are malnourished. The problem is particularly acute with regard to previously disadvantaged and vulnerable groups (women, children and the aged). Bellamy (1998) reported rates of malnutrition in South Africa for under-five-year-old children as follows: 10 per cent were moderately and severely underweight; three per cent were suffering from moderate to severe wasting and 23 per cent from moderate and severe stunting.

Micronutrient deficiency diseases are still major causes of concern in South Africa (Labadarios and Steyn, 2001; Veneman, 2007). At the national level in 1994 and 1999, 33.3 per cent of pre-school children were vitamin A deficient, 21.4 per cent were anaemic and five per cent suffered from iron deficiency anaemia (Faber and Wenhold, 2007). The National Food Consumption Survey of South Africa that was conducted in 1999 showed that, on average, children's intakes of energy, calcium, iron, zinc, selenium, vitamins A, D, C and E, riboflavin and niacin were below two-thirds of the Recommended Dietary Allowances (RDA) (Labadarios et al, 1999). Between a quarter and a third of households were unable to purchase foods that would provide the dietary requirements of children (Doak et al, 2000). It follows that low household income would constrain food supply and intakes.

The South African Vitamin A Consultative Group (SAVACG) was the first national nutrition study (conducted in 1994) to look at the anthropometric profile of pre-school children (Vitamin Information Centre (VIC), 2001). The study reported that 24 per cent of South African children were stunted and nine per cent were underweight. The SAVACG study reported a 21.4 per cent prevalence of anaemia, 10 per cent prevalence of iron deficiency, a five per cent prevalence of iron deficiency anaemia, and that one in three pre-school children presents serum retinal concentrations below 20µg/dl which indicate VAD. The Eastern Cape had the highest levels of

malnutrition. Vitamin A deficiency (VAD) and anaemia were observed in one third and 20 per cent of all sampled children respectively (Labadarios et al., 1995). The most disadvantaged children are those aged 12 to 71 months, who live in informal settlements and whose mothers are mostly uneducated.

The National Food Consumption Survey (NFCS) was conducted in 1999 to determine the nutritional status of children aged 1-9 years (Labadarios, 1999). This survey showed that the majority of the children appeared to consume a diet low in energy, poor in protein quality and low in micronutrient density. Only one out of four households appeared to be food secure. Half the children aged 12 to 108 months consumed less than half the recommended intakes for vitamin A, vitamin C, riboflavin, niacin, vitamin B_6, folate, calcium, iron and zinc. Iron deficiency anaemia was a common problem among the children in rural communities. Although anaemia could result from malaria and parasite infestations, dietary deficiency of iron could be a major problem of concern (Labadarios et al., 2000). Under-nutrition is still considered a major problem worldwide, as well as in South Africa. In South Africa under-nutrition is said to be common mostly among Black, Coloured and Asian children, especially in the lower socio-economic communities (Krige and Senekal, 1997).

2.3 Home gardening as an intervention strategy for the eradication of hunger and malnutrition

Home gardening is an affordable, sustainable long-term strategy to complement supplementation and food fortification programmes and nutrition education (Chadha and Olouch, 2003; Faber, 2007). Home gardening produces crops for household consumption to improve the quality, diversity and nutrient content of diets. The vegetables provide immediately accessible sources of micronutrients as they can be cultivated throughout the year, providing vitamins, trace elements and other bioactive compounds (Chadha and Olouch, 2003). Vegetables are a vital dietary component, not just as a side dish to add flavour to meals, but they release and make available bound micronutrients in some staple crops for effective absorption and utilisation (Chadha and Olouch, 2003). Seasonal malnutrition accentuates already existing malnutrition. Gardens can help overcome the seasonal fluctuations in the availability of nutrients by staggering the planting of a mixture of early, average and late-maturing varieties. Garden projects need to be

complemented with other interventions such as nutrition education and promotion and other development initiatives and basic hygiene (Sikhakhane, 2007).

Home gardens can create income and improve food availability for the poor, but only if participants are fit enough to farm. The surplus harvest can be sold for income to purchase other foods to supply multiple nutrients (Faber, 2007) and enable households to direct the savings towards other needs, such as health care, education and housing (Binns and Lynch, 1998). Prain and Piniero (1999) showed that home gardening raises income among those with low income by 50 per cent in rural and informal settlements in Southern Phillipines. The impact of increased income on household consumption is important in estimating the benefits of increased income on consumption (Hendriks, 2003).

Anthropologists from different countries, including South Africa, have documented the struggle of poor families to obtain money for medicine and medical care due to unemployment (Tonia et al., 2004). Home gardens empower households to take ultimate responsibility for the nutritional quality of their diets by growing their own nutrient-rich food and making informed consumption choices (Faber, 2007). Home gardening assists in lifting people out of poverty (Foeken and Owuor, 2000; Rogerson, 2003) by improving their health and nutrition. The process of households producing their own food empowers households and makes them self-reliant (Ruel and Levin, 2000). Tonstisirin et al. (2002) recommend home garden interventions as they are are independent of external financial support and, therefore, more sustainable.

However, Webb (2000, p67), following a review of three case studies (see below) from Southern Africa states that: "However unpalatable the idea, this paper has questioned claims linking cultivation to the improved nutritional status of cultivators in general". These claims are found in both the general literature and in a few case studies. Promotional material might be excused for extravagant claims; case studies need to be taken far more seriously. Of the three case studies under consideration, two suggest that the links in question cannot be established. The positive claims made by one of them have been shown to be problematical. The fact that links between cultivation and nutrition have not been established does not mean that they do not exist or that they should not be sought. Given the exigencies of the urban and rural poor, it seems logical to view cultivation as an important element of household welfare of which nutrition is a key factor.

Whether cultivation does indeed play a role needs to be clearly established by means of rigorous investigations".

Table 2.2 highlights some of the scant literature on the effectiveness of home gardens in improving nutrition outcomes from studies around the globe. Overall, home gardens improved nutrition outcomes (dietary intake and anthropometric indicators) of participants although some exceptions are observed (Berti et al., 2004). The studies did not use comprehensive approaches in the investigations and study designs did not always provide the opportunity to evaluate nutritional changes among participants.

Webb (2000) reviews three case studies of home gardens in Southern Africa. These include Chiapa and King's (1998 cited by Webb, 2000) study that found a significant correlation between urban agriculture and household nutrition among urban farmers in Zimbabwe; secondly, Webb's (1996 cited by Webb, 2000) own study that shows a tenuous link between food gardens and nutrition in the Eastern Cape, South Africa; and thirdly, Webb reviews Schmidt and Vorster's (1995) investigation of the benefits of home gardens in Slough, North West Province, South Africa (see below for details) that reinforces Webb's (1996) tenuous findings for the Eastern Cape.

Evidence from rural South African studies suggests that agricultural growth drives food consumption demand in and can lead to beneficial dietary changes when production goes beyond subsistence requirements (Hendriks, 2003; Kirsten et al., 1998; Kirsten et al., 2007). Mjonono et al. (2009) investigated the food security coping strategies of households belonging to a farmers' organisation and a representative sample of control households in Embo, KwaZulu-Natal, South Africa. They showed that households with lower involvement in agriculture (home and community gardens), engaged in more erosive coping strategies than farming households engaged in regular smallholder commercial production. Adopting erosive coping strategies undermines future resilience. Mjonono et al. (2009) found that production and sale of food improved household food security. However, the evidence showed that vulnerability to consumption shocks reduced only as per capita crop income increased.

Table 2.2 The effectiveness of home gardens in improving nutrition outcomes from global studies (Berti et al., 2004)

Country	Type of study	Dietary intake indicator s	Anthropometric indicators
North Bangladesh	Pre-post with control group	Vegetables intake increased in households and especially in infants and children	Improvement in stunting and underweight
Vietnam (study 1)	Intervention vs. control, some pre-post comparisons	Fifty per cent higher intake of vegetables, fruit, energy, protein, vitamin A and iron	Stunting decreased from 50 to 42 per cent
Bangladesh	Pre-post with control	Ten to 20 per cent increased intake of vitamin A-rich vegetables (also in control) and other veg.	No data
Kenya	Intervention vs. Control	Vitamin A intake improved to almost adequate	No data
Tanzania, rural	Intervention vs. Control	Vitamin A - 50 per cent greater than control	No data
Vietnam (study 2)	Pre-post assessment	Increase in intake of energy, protein, fat and vegetables	No data
Philippines	Pre-post, with control	Increased vegetable consumption, vitamin A intake increased 12 per cent, control decreased by 48 per cent	No data

Hendriks and Msaki (2009) explored the impact of commercial organic production of traditional root crops at Embo, KwaZulu-Natal, South Africa on dietary diversity, energy consumption, micronutrient intakes and food expenditure patterns. Comparisons between these groups showed that fully certified organic producers selling to a formal supply chain enjoyed greater dietary diversity and better nutrition than non-members and members just starting to produce for this market. While higher farm incomes associated with fully certified organic production appeared to improve food diversity and nutrition in grower households, these growers had very small farms, which severely constrained their farm incomes and the potential benefits to nutrition.

2.4 Constraints and challenges of home gardening

Although home gardens have many benefits, there are also challenges, including the paucity of data on outputs and outcomes, and low esteem and stigmas associated with food gardens that hold that such gardens are only for the poor or those infected with TB, HIV and AIDS (Faber, 2007). Often a limited variety of crops are grown, often only the 'common' crops: spinach, cabbage, carrots and beetroot. Identifying or developing a market for extra produce is often problematic for communities (Fader, 2007). Getting the community to participate in and sustain their participation in gardens has proved to be one of the biggest challenges in promoting home and community gardens (Labadarios and Steyn, 2001).

It is essential to target areas where the natural resources can support to crop production (Kirsten et al., 2003). Small-scale food production may not be possible where water is scarce (van Averbeke and Khosa, 2007). Urban poverty and the proportion of the poor who are inhabiting the cities are rising, partly because of poor job prospects in rural areas (Nugent, 2000). These trends have serious implications for food security. Even after a more stable macroeconomic environment is restored, urban gardening can remain an important source of food for many urban food-insecure populations (Tevera, 1996).

2.5 Elements of and recommendations for design of nutrition programmes

Home gardens can produce a variety of foods including staple crops, vegetables, fruits, herbs and livestock for generating income or home consumption (FAO, 1999b). Musiimenta (2002) reported that home gardening has been expanding in many parts of the developing countries since the late 1970s, due to urbanisation. More advanced home gardening is found in Asian cities, which accept and promote food production as a critical urban function. In New York City, gardens grow where urban wastelands existed before, while apartment blocks of St. Petersburg (Russia) are countering the collapse of food systems by growing vegetables on rooftop gardens (Musiimenta, 2002). Currently some families in Western cities have gardens mainly for vegetable production and some for poultry and small ruminants (World Commission on Environment and Development, 2000). Table 2.3 details initiatives and nutrition programmes that are currently operating in South Africa to mitigate poverty and malnutrition.

Table 2.3 The different national departments in South Africa involved in initiatives to mitigate poverty and malnutrition (Sikhakhane, 2007; Kallman, 2004; Bonti-Ankomah, 2001)

Implementing Department	Programme implemented	Purpose of the programme
Department of Health	Home gardens	Improving nutritional status and some income generation for intended beneficiaries
	Communal or clinic gardens	On-site feeding, nutrition education, take-home rations (supplement home meals) and form of supplementary income
	School gardens	Mainly driven through Health Promotion to encourage consumption of vegetables and linked to the school feeding programme (Sikhakhane, 2007).
	Integrated Nutrition Programme	Provides nutrition interventions at hospitals and clinics to manage and prevent child malnutrition (Kallman, 2004)
	Community-based Nutrition Programme (Gauteng)	Target early childhood and crèches (Kallman, 2004)
	The National School Nutrition Programme	This provides funding to primary schools for school feeding programmes (Kallman, 2004)
	Primary School Nutrition Programme (PSNP) was established in 1994, lead by the President under the Reconstruction and Development Strategy Framework	Its objectives were to improve the primary school learner's active learning capacity, alleviate temporary hunger, educate learners about nutrition and improve micronutrient intake (Bonti-Ankomah, 2001)
	Food fortification was recommended in 1996 during a national work	The purpose was to fortify basic food products such as bread, flour and maize meal (Bonti-Ankomah, 2001)
	Vitamin A Supplementation	Provide vitamin A supplementation to pregnant women and children up to the age of five years in order to alleviate vitamin A deficiency (Bonti-Ankomah, 2001)

Implementing Department	Programme implemented	Purpose of the programme
	Breast-feeding and the National Breast-feeding Policy	Promote exclusive breast-feeding up to the of 4-6 months and establish breast-feeding friendly hospitals (Bonti-Ankomah, 2001)
Department of Agriculture	Supplying Agricultural Starter Pack Programme	Enable recipients to plant some vegetables
	Comprehensive Farmer Support Package	Train land reform beneficiaries
	Land Care Programme	Provides funds for community-based projects such as community gardens that can increase access to food and create jobs (Kallman, 2004).
Department of Social Development	The Social Assistance Programme	Provides grants for people who are not able to provide for themselves
	The Poverty Relief Programme	Supplies funds for the establishment of food production clusters in communities, focusing more on households affected by HIV/AIDS (Kallman, 2004)
	National Nutrition and Social Development Programme (NNSDP) which was established in 1990 to serve as a safety net for people considered likely to be affected by the proposed value added tax (VAT) on basic foodstuffs	The contribution of this programme in reducing malnutrition is in doubt as it has a narrow focus on food relief, poor targeting and administrative incapacity and, as a result, it reaches few beneficiaries (Bonti-Ankomah, 2001)
Department of Land Affairs	Land Distribution for Agricultural Development Programme	Provides grants to previously disadvantaged South Africans to access land for agricultural purposes, such as household crop production and production for markets (Kallman, 2004)

There are ways to make sure that the households always have garden produce for sustainability. One can use different methods to increase diversity and make sure that there is supply throughout the year. Faber and Wenhold (2007) reported that the availability of various nutritious foods at community and household level could be increased through the following methods:

- Mixed cropping – to increase the variety in the diet across and within food groups is recommended globally, and dietary diversity is recommended as an objective of every country's food-based dietary guideline. Therefore, encouraging mixed cropping can increase the accessibility of various nutritional foods, extend the harvesting period and help improve seasonal food shortages. It is also associated with potential yield improvements and reduced peril of crop failure (FAO, 1997).
- Introduction of new crops with the potential to improve the nutrition of designated populations are considerations in the selection of crops. The potential nutritional attributes of the crops need to be evaluated by a team of nutritionists, breeders and agronomists (FAO, 2001). Chakravarty (2000) reported that the crops selected should be easy to grow and cook, be palatable and suit consumer preferences in terms of colour, texture and flavour.
- Indigenous foods are easy to manage and require minimum production input. They grow on soil of limited fertility, can tolerate drought and often do not need pesticides or fertilisers (Shiundu, 2002; Shiundu et al., 2007).
- Home gardens can include production of both fruits and vegetables as a way of supplementing the cereal-based diet of the low socio-economic households. The main aim of home gardens is to produce the produce for household consumption (Mabusela, 1999) rather than increase household income (Ruel, 2001). Many home garden projects concentrate on the production of crops that are rich in vitamin A to alleviate vitamin A deficiency (Faber and Wenhold, 2007).

Home grown produce can be an essential supply of protective foods containing vitamins and minerals to form a balanced diet. One can easily start a vegetable garden by making use of available land. The Food Gardens Foundation has a special method of growing vegetables, which is very useful if there is a shortage of land, water and money, as in the informal settlements (NuFarmer and African Entrepreneur, 2000).

The method involves digging a trench, which is then half-filled with organic waste and topped up with the dugout soil. Seeds or seedlings are planted immediately on top of this "compost heap". The garden can be watered using a watering can or a tin with small holes, or a plastic bag with holes. It is advisable to water the gardens daily for the first ten days and thereafter, as required. The garden can be protected from chickens, rodents and domestic animals by putting a fence around the bed (NuFarmer and African Entrepreneur, 2000).

Home gardening is a water-intensive activity (Wenhold et al., 2007). Agriculture uses 70 per cent of the universal fresh water and can be as high as 90 per cent of usage in developing countries (Gerbens-Leenes and Nonhebel, 2006). Water is the main limiting resource in crop production and limits food production in dry regions, where the prevalence of under-nutrition is often alarming (Laker, 2004).

Home gardens may be as small as the size of a door. To ensure continuous fresh vegetables all year, one needs to plant at least four trench beds for the average family. The second bed should be planted four weeks after the first one was planted, similarly with the third and the fourth. This is called succession planting. Some vegetables produce seeds when matured and these seeds should be preserved for another round of planting. Crop rotation is recommended to preserve soil quality and break pest and disease cycles. All the organic kitchen waste can be used as compost (Nu Farmer and African Entrepreneur, 2000).

2.6 Evaluation and monitoring of child nutrition

The nutrient intake, dietary adequacy, anthropometric measurements and dietary diversity are the commonly used tools of evaluating and monitoring the nutritional status of children. A dietary diversity questionnaire is used to determine if a child has eaten all the recommended food groups in adequate quantities in a day. Anthropometric measurements are taken to ensure that a child is growing within the normal range as set out by the World Health Organisation. Biochemical indicators affirm the intake of nutrients within normal ranges (not part of the study due to financial constraints). These tools are discussed in detail in the following sections.

2.6.1 Dietary diversity

Dietary diversity refers to the number of food groups consumed over a given period and has been recognised by nutritionists as the key element of high value diets, increasing a variety of foods across and within food groups as recommended by dietary guidelines (Maunder et al., 2001), ensuring sufficient intakes of fundamental nutrients and promoting good health (Ruel, 2002). Dietary diversification has been shown to be the most sustainable and affordable strategy to improve nutrition for the majority of the population - particularly the poor.

Diversity is the important principle underlying the construction of sustainable agricultural and food systems. Home garden produce was found to improve the diet of participants by increasing the variety of vegetables and fruit consumed in Philippines (Miura et al., 2003). However, in the same study it was discovered that, with the abundance of vegetables and fruit, the consumption of protein-rich food was reduced. Home gardening itself did not increase the variety of vegetable consumption in the Philippines' study, but frequent consumption of a variety of foods did (Miura et al., 2003). Therefore, home garden products diversified the carbohydrate-rich foods and diversification of foods lead to nutritional improvement, as reported by World Health Organisation (WHO, 1998).

Faber et al. (2002a) reported that the diets of many children in developing countries consist principally of plant-based foods with little variety. Macintyre and Labadarios (1999) using a quantitative food frequency questionnaire, found that the diets of sampled children nationally consisted mainly of refined maize, white rice and potatoes. Maunder and Labadarios (2002) identified the most commonly consumed foods in the NFCS study as maize, sugar, tea, whole milk and brown bread. Bolaane (2006) reported that dietary diversity must be promoted to help increase energy and nutrients intake. Onyango (2003), Hatloy et al. (2000) and Onyango et al. (1998) investigated links between food variety, improved health and nutritional status and showed that improved intakes of fruit and vegetables improved the intakes of minerals and vitamins.

According to FAO (2002), adding nutrient rich foods to the diet through home gardening could reduce micronutrient deficiencies. South Africa's food-based dietary guidelines (FBDGs) recommend an increase in variety of foods in the diet across and within food groups

(Maunder et al., 2001). The dietary guidelines, which were established to improve the diets of South Africans, are presented below:

- Enjoy a variety of foods
- Be active
- Make starchy foods the basis of most meals
- Eat plenty of fruit and vegetables
- Eat dry beans, peas, lentils and soya often
- Meat, fish, chicken, milk and eggs can be eaten every day
- Eat fats sparingly
- Use salt sparingly
- Drink lots of clean, safe water, and
- If you drink alcohol, drink sensibly (Vorster et al., 2001; Love and Sayed 2001).

Labadarios et al. (2000) found that many South African households, particularly those with low incomes, have low dietary variety. Poverty disrupts the achievement of dietary diversity, and affordability and availability have been identified as major constraints when it comes to fruit and vegetable consumption (Love et al., 2001). Labadarios and Steyn (2001) suggested the promotion of indigenous vegetables and fruits as they are culturally acceptable and affordable and help achieve the FBDGs. Indigenous plants occur naturally and can adapt to harsh environments and do not need complex technologies and inputs to grow (van der Walt et al., 2005). Indigenous crops are usually referred to as *morogo* in South Africa, meaning a collection of green leafy vegetables (spinach, beetroot leaves, pumpkin leaves and sweet potato leaves among others), and are eaten as vegetables (Faber et al., 2002; Nesamvuni et al., 2001; Faber et al., 2007).

2.6.2 Anthropometric measurements

There are three different classifications of malnutrition, namely the WHO classification of malnutrition, the Gomez, and the Waterlow classifications. The three classifications are differentiated in Table 2.4. The Waterlow and Gomez classifications do not consider oedema and do not differentiate between marasmus and kwashiorkor. The Gomez classification also does not differentiate between wasting and stunting as only height is taken into account (WHO, 2006).

Table 2.4 Comparison of methods of classification of malnutrition (Seetharaman, 2008)

Grade of malnutrition	Gomez	Waterlow		WHO (1995)		
	Weight-for-age (underweight) (%)	Weight-for-height (wasting) (%)	Weight or height-for-age (underweight or stunting respectively) (%)	Weight-for-height (%)	Height-for-age (%)	Oedema
Normal	90-110	90-110	>95			
Mild	75-89	80-89	90-95			
Moderate	60-75	70-79	85-89	-3 ≤ SD	-3 ≤ SD	No
Severe	<60	<70	<85	SD score < -3 = severe stunting	SD score < -3 = severe wasting	Yes

Changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry is used to assess and predict performance, health and survival of individuals and reflects the economic and social wellbeing of populations. Anthropometry is a widely used, inexpensive and non-invasive measure of the general nutritional status of an individual or a population group. Recent studies have demonstrated the applications of anthropometry to include the prediction of who will benefit from interventions, identifying social and economic inequity and evaluating responses to interventions (Cogill, 2003). According to WHO (1995), growth charts are most commonly used tools for determining and assessing the nutritional and health status of infants and children and the wellbeing of the community. The growth charts are also used to find out the degree to which physiological needs for growth and development are being met during the periods of foetal development and childhood.

There are three most used anthropometric indices for children. These indices are derived by comparing height and weight measurements with reference curves, namely weight for height, height for age and weight for age. These indices are related and each has a specific meaning in terms of growth impairment (South African Department of Agriculture, 2002). The ranges in deficit physical status are based on each index and vary significantly across populations. Deficits in one or more of the anthropometric indices are often regarded as evidence of "malnutrition". Abnormal anthropometric measurements, including low weight and height

gain as well as excess weight gain, have significant short- and long-term health outcomes (WHO, 1995). Growth assessment is a cheaper and more valuable tool to measure nutritional assessment that can guide researchers and communities in making decisions regarding implementation and assessment of appropriate nutritional interventions.

The WHO (1995) reported that the nutritional status of children has been widely and successfully assessed by anthropometric measures. Height and weight have been the most commonly used parameters because they are quick, inexpensive and easy to use. This will need the child's correct height and weight measurements together with age. Then, the child's growth and general nutritional status can be assessed by using a standardised age- and specific growth reference to calculate the z-scores (WHO, 2007).

The z-score classification system is used to assess the prevalence of underweight, stunting and wasting in children (Table 2.4). The use of z-score expresses the anthropometric value as a number of standard deviations or z-score below or above the reference mean or median value according to National Centre for Health Statistics (WHO, 2006). When used for population, z-scores can be subjected to summary statistics such as the mean and standard deviations.

2.6.3 Nutrient intake and nutrient adequacy

Children are often the most at risk of developing malnutrition, and their nutrient needs are high compared with adults, as they are still growing (FAO, 1998). They need proper care and feeding to develop normally. Children in low-income families are likely to be hungry and malnourished (Whitney and Rolfes, 2005). When hunger worsens and becomes chronic, children become malnourished and suffer growth retardation. Children's dietary intakes need to be measured by means of the dietary reference intakes (DRIs). The DRIs were firstly used as recommended dietary allowances (RDA) that provide a standard for good nutrition (Nutrition Information Centre University of Stellenbosch (NICUS), 2003). However, RDAs focused only on the prevention of clinical deficiencies, while DRIs represent a paradigm shift from avoiding deficiencies to maximising health and providing quality of life. The DRI refers to a set of four nutrient-based reference values namely:

- Estimated average requirements (EARs), which define the risk of inadequate intake as 50 per cent of individuals in specified gender group at the given life stage. As a result,

the EAR is a dietary intake value that is used for adjustment for the bioavailability of the respective nutrient.

- Recommended dietary allowance (RDAs), is defined as the intake that meets the nutrient needs of almost all (98%) individuals in that gender group at the given life stage. The RDA can only be used in individuals not groups.
- Adequate intakes (AI) that define the nutrient intake at which the risk of inadequate intake is negligible. The AI is used instead of RDA as it based on experimental intake levels of a group of healthy people who have normal growth, biochemical indicators and other functional indicators of health.
- Tolerable upper intake levels (ULs) are defined as maximum nutrient intakes for an individual. It is unlikely to present the risks of unfavourable health effects in almost all (98%) of individuals in a specified group (NICUS, 2003).

A single criterion cannot be used to evaluate the nutritional status of individuals or groups, but a combination of tools is required. For example:

- EARs are used to measure inadequate intakes for individuals or groups
- RDAs are used to assess the nutrient insufficiency for individuals, and
- ULs are used as guidelines to measure over-consumption of a nutrient and the associated risks (NICUS, 2003).

An intake that is constantly below the RDA would need evaluation as shown in Table 2.5 and Figure 2. 2.

Table 2.5 Applications of the DRIs (adapted from NICUS, 2003)

Type of use	For the individual	For a group
Assessment	EAR: used to examine the probability of inadequate of usual intake RDA: usual intakes at or above this level have a low probability of being inadequate AI: intakes at or above this level have a low probability of in- adequate intakes UL: an intake above this level may increase the risk of adverse impacts	EAR: used to estimate the prevalence of inadequate intakes within a group RDA: not used to assess intakes of groups AI: mean intake at this level implies a low prevalence of inadequate intakes UL: used to estimate the percentage of a population that may be at risk of adverse effects
Planning	RDA: establishes standard for minimum intake EAR: establishes standard for minimum intake AI: Aim for adequate intake for individuals according the biochemical analysis UL: used as a guide to limit intakes - chronic intake of higher amounts may increase the risk of adverse effects	RDA: used for planning for group whose nutrient intake is adequate EAR: used for planning for a group whose nutrient intake is adequate AI: used to plan mean nutrient intake of a respective group UL: used to plan nutrient intake of a group with a low prevalence of potential risk which may pose adverse effects

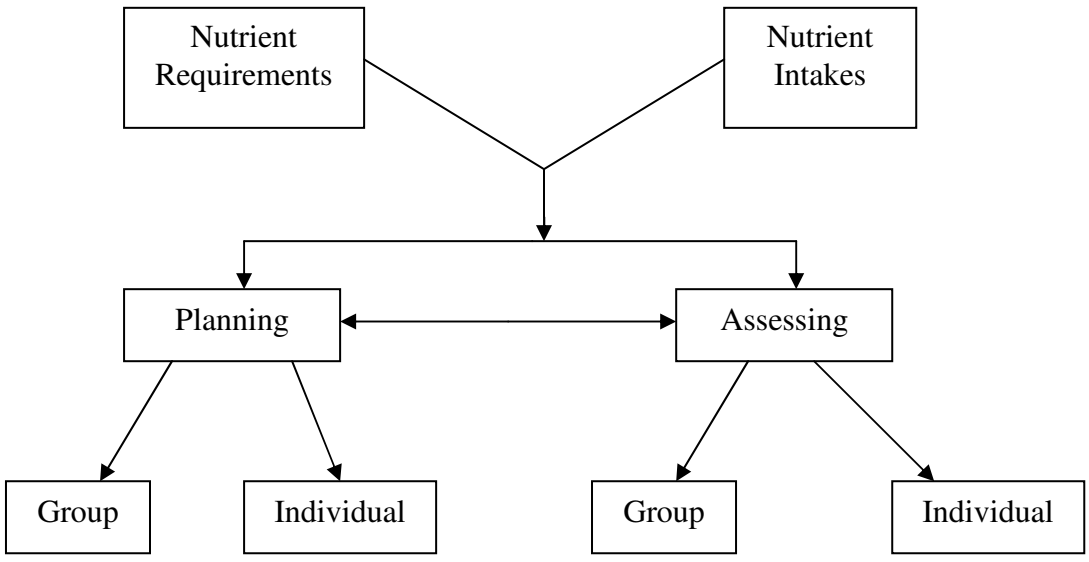

Figure 2.2 Uses of dietary reference intakes (NICUS, 2003, 10).

2.7 Summary

The review of the literature shows that agriculture is a vehicle to fight malnutrition in Southern Africa and those vegetable gardens may contribute to food security and poverty reduction at rural, urban and national levels. Small mixed-vegetable gardens may provide a significant percentage of the recommended dietary allowance for macro- and micro-nutrients. Home garden interventions proved to be effective when combined with promotional and educational interventions, such as providing information, communication and education, combined with community mobilisation and provision of agricultural inputs. Growing vegetables in urban areas may improve food access and child nutrition for lower-income groups.

CHAPTER 3: THE LARGER PROJECT

3. 1 Introduction

In this chapter, which is the larger project, the description of the study area and population is discussed. The outcomes of the larger project discussed in this chapter, includes the socio-demographic profile, food procurement and preparation patterns, dietary intake and anthropometric profiles of the children. Therefore, the researcher's project forms part of the larger project.

The Vaal Triangle Integrated Nutrition Research Project (larger project) was conducted in an informal settlement in the Gauteng Province, South Africa and set out to influence the food consumption, nutrition and health of informal settlement dwellers. The project was implemented by the Department of Hospitality, Tourism and Public Relations Management at the Vaal University of Technology's Faculty of Human Sciences in partnership with the Institute of Livelihoods and the Medical Technology Laboratory. The project team collaborated with local Departments of Health, Community Development, Agriculture, Education, Social Welfare, the Planning Commission, Treasury, Statistics, Water and Environmental Sanitation, community leaders and informal settlement dwellers, the North West University and the University of Westminster from the United Kingdom. The principal investigator was Prof Oldewage-Theron, and Dr Rutengwe was the Project Advisor. The researchers were Dr Napier, Dr Dicks, Ms Selepe, Mrs Duvenage and Dr Kearney.

This study was funded by the South African National Research Foundation (NFR) and the Central Research Council (CRC) of the Vaal University of Technology between April 2002 and December 2005, and was conducted in the urban informal settlement of Eatonside, in the Vaal Triangle. The Vaal Triangle is an industrial area situated approximately 70 km south of Johannesburg with a population of about 1.5 million. Approximately 42 per cent of the households live in poverty (Oldewage-Theron et al., 2003). Eatonside has a population of ± 6000 people. The settlement was randomly selected for the baseline survey on the basis that it reflected - in size (n = 1260 households) and geographical positioning - a typical informal settlement in Gauteng (Oldewage-Theron and Rutengwe, 2002). A sample of households (n=315) was purposively selected. An extra 45 households were added to cover for attrition.

Households were identified with the help of local councillors and the use of a township map obtained from the local municipality. Introductory visits were made to observe the general living conditions, availability and accessibility of basic services and waste management. The observers in the project included the project implementation team, comprised of local leadership and the researchers from Vaal University of Technology.

Eatonside (ward 39 of the Sedibeng District Council) is one of the poorest and oldest informal settlements in the Gauteng Province, South Africa. It is located in the north east of Vereeniging, with Vlakfontein in the east, Ironsyde in the north, Evaton Township in the west and Waterdal agricultural holdings to the south of Vereeniging. Eatonside was originally known as Evaton Estate with a settlement of ± 300 white residents. Evaton Estate was established in 1904 - the same year as Evaton Township, next to the freehold farm in the Wildebeestfontein district, Potchefstroom. Figure 3.1 shows the map of Eatonside and its neighbouring townships in the Vaal Triangle.

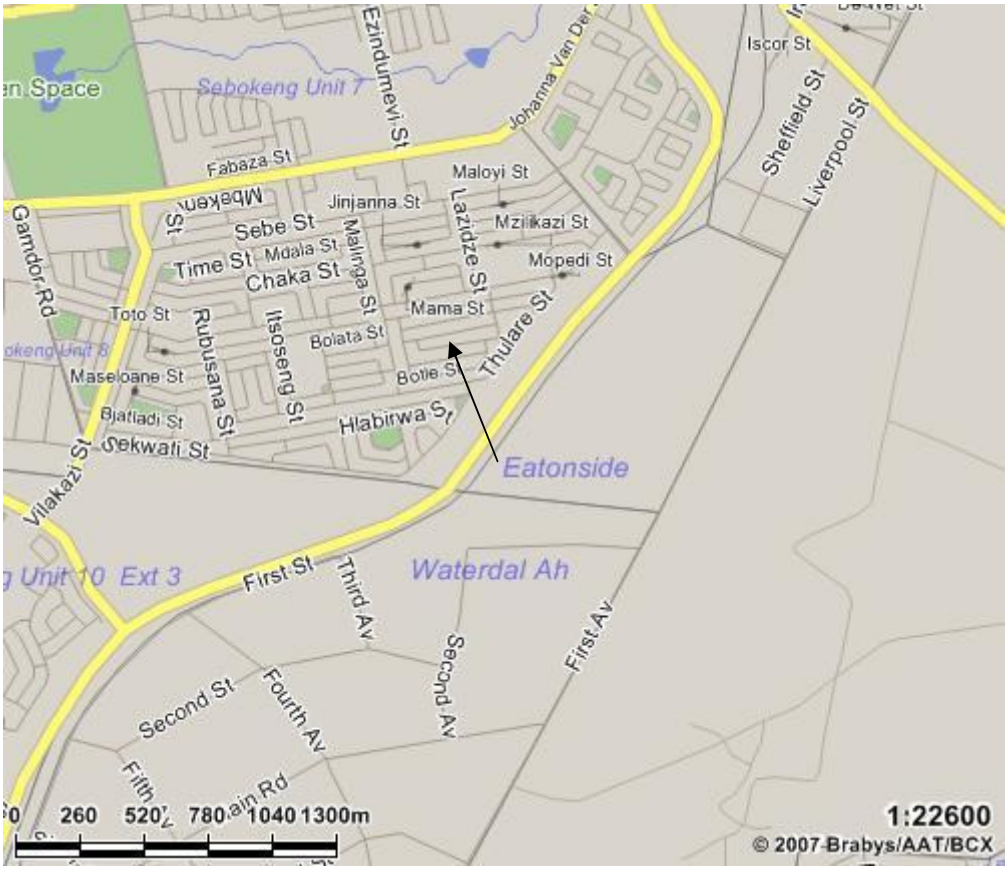

Figure 3.1 Map of Eatonside and neighbouring townships (Wikipedia, 2005).

In 1960, in accordance with the Group Areas Act, approximately 200 black families were settled in Eatonside. Housing consisted of corrugated tin shacks. About 94.2 per cent of the dwellers are currently unemployed and those who are employed work within the Vaal Triangle area.

A community workshop was held by the project team at which participants were divided into smaller groups to discuss different interventions identified as important from the baseline survey done in Eatonside and related to improving nutrition, food security and income generation. The following was discussed for each possible intervention:

- The major activities to be focussed on
- The sectors to be involved,
- How these activities would build the research activities at the Vaal University of Technology
- What data were needed?

3.2 The broader project objectives

The main goals of the larger project to which this thesis study contributes are:

- To improve the livelihoods of the informal settlement dwellers within three years of the project implementation, and
- To reduce poverty, fight diseases, raise literacy levels and accelerate development in the designated sample population.

The objectives of the larger project are:

- To determine the prevalence, magnitude and underlying causes of malnutrition problems of the informal settlement dwellers in the Vaal Triangle
- To plan and develop appropriate community-based projects to improve food, nutrition and health.
- To undertake community-based research projects to improve food, nutrition and health.
- To evaluate the outcomes and impact of the projects.

3.3 Larger Project Methodology

A community meeting was held to inform the community members about the objectives of the project and seek consent for participation in the in-depth survey. A pre-tested, structured demographic questionnaire was used to elicit data. Eight fieldworkers were recruited. A training manual was developed and an intensive participatory workshop was held for the fieldworkers to ensure a high standard of research.

Community involvement, participation and empowerment, in the light of their indispensable roles in the sustainability of community-based projects, were encouraged. As described in the project logical framework matrix (Appendix A), the study community and stakeholders were involved at each stage of the project. Representatives from the study community, especially community leaders, were key participants in project decision-making and ensuring that the project was successful by motivating community participation. The Department of Health was contacted and consulted on the research methods to be employed for data collection. Community health and nutrition education was given free of charge to the study participants.

The first quarterly meeting formed part of a two-day planning workshop to explain and receive feedback on the objectives and themes of the project and to ensure the project focus areas covered were of relevance to the community. Appropriate tools for project monitoring and ongoing evaluation were designed.

All field data were captured onto the Statistical Package for Social Sciences (SPSS) ® version 14.1. A well-trained and committed data processor was assigned to capture the data. A qualified statistician was consulted for the statistical analysis. A model of the prevailing problems in Eatonside was established. The results of the baseline survey provided information regarding the demographic and health profile of the informal settlement dwellers. These results were used for planning community-based intervention studies and promoting public health nutrition in the Vaal Triangle.

3.4 Description of sample for the larger project

All households in the community had access to running water and toilet facilities, located outside the homes in their yards. Ninety-eight per cent of households had flush toilets and

sewage removal facilities, while two per cent of households had pit toilets. Only six per cent of the households had access to regular waste removal facilities. Twelve per cent of households were located on tarred roads, while the other households were situated on gravel roads.

The sample population comprised nine pensioners, 266 adult females, 75 adult males and seven children (0 – 16 years of age) (Table 3.1). Most people from the sample population were between the ages of 21 to 60 years.

The number of children per household ranged from zero to five. Approximately a quarter of households did not have children present, and another 21 per cent had one child. More than 88 per cent of the households were permanent residents of the area and had lived there more than 5 years.

The majority of respondents were female (76%) and Sotho-speaking (68% see Table 3.2) with low levels of education (28% see Table 3.3). In terms of education, 23 per cent were illiterate with no formal school education, while 49 per cent of caregivers had completed primary school education.

The unemployment rate of the sample population was 94.2 per cent. Fifty-nine per cent of respondents indicated that they had been without a job for more than three years. Due to high

Table 3.1 Ages of the sample population, Eatonside, 2002

Age of respondents	N = 357	Percentage of population
‹ 21 years	7	2.0
21-30 years	79	22.1
31-40 years	92	25.8
41-50 years	83	23.2
51-60 years	60	16.8
61-70 years	27	7.6
›70 years	9	2.5

Table 3.2 Home language of the sample population, Eatonside, 2002

Home language	N = 357	Percentage of population
Sotho	242	67.8
Zulu	50	14.0
Xhosa	34	9.5
Afrikaans	21	5.9
Other	10	2.8

Table 3.3 Education levels of the sample population, Eatonside, 2002

Education level	N = 357	Percentage of population
None	83	23.2
Primary school	173	48.5
Secondary school	98	27.4
Tertiary	3	0.8

unemployment, 36 per cent of households had one employed person and 28 per cent have two or more people contributing to household income.

Mothers (68%) were typically responsible for household expenditure, while 84 per cent of mothers were responsible for food procurement decisions and 80 per cent were responsible for feeding children. A mother, grandmother or aunt was typically responsible for household expenditure, food procurement decisions, food preparation and feeding the children. In cases where the mother, grandmother or aunt was absent, the father, grandfather, uncle or siblings were responsible for household expenditure, food procurement decisions, food preparation and feeding the children (Oldewage-Theron et al., 2006).

Fifty-eight per cent of sample households for the larger study had an income of between R500 and R1000 per month, indicating poverty as discussed below (Table 3.4). Forty-three per cent of households had incomes of approximately R500 per month (the national social grant value at the time of the survey). The poverty gap index for the households in Eatonside was determined as 0.56, implying that households had a shortfall of 56 per cent of income below the poverty lines on average (Oldewage-Theron et al., 2006). Rampant food insecurity was reported as half the households spent less than R100 on food per week (Table 3.5). This means that an average household size of five people spent R2.90 per person per day on food (Oldewage-Theron et al., 2006). This amount is far less than the international one dollar a day per person poverty line, which is the absolute minimum (Kakwani, 2007). The World Bank (1990) defines a poor household as one where

Table 3.4 Total household income, Eatonside, 2002

Total household income per month	Number (N = 357)	Percentage of population
‹R500	152	42.6
R501-R1000	56	15.7
R1001-R1500	6	1.7
R1501-R2000	5	1.4
R2001-R2500	1	0.3
›R2500	1	0.3
Do not know	136	38.1

Table 3.5 Weekly food expenditure, Eatonside, 2002

Weekly food expenditure	N = 357	Percentage of households
R0-R50	136	38.1
R51-R100	72	20.2
›R100	47	13.4
Do not know	101	28.3

Table 3.6 Frequency of shopping for food, Eatonside, 2002

Frequency of food shopping	N = 357	Percentage of households
Every day	27	7.6
Once a week	63	17.6
Once a month	220	61.6
When money is available	14	3.9
Never	11	3.1
Donations	22	6.2

Table 3.7 Frequency of shopping for food, Eatonside, 2002

Where food is bought most of the time?	N = 357	Percentage of households
Spaza shop	198	55.5
Street vendor	2	0.6
Supermarket	62	17.4
Spaza shop, street vendor and supermarket	27	7.6
Spaza shop and street vendor	33	9.2
Spaza shop and supermarket	10	2.8
Street vendor and supermarket	2	0.6
Other	23	6.5

the combined income of all its members is less than the household subsistence level for that specific household. According to Oldewage-Theron et al. (2006), using the Household Subsistence Level, 44 per cent of the Eatonside households lived in poverty.

The highest proportion of households shopped for food once a month (Table 3.6). More than half the households shopped frequently at spaza (community) shops (Table 3.7).

Seventeen per cent of households consumed one meal per day, 56 per cent consumed two meals, 23 per cent had three meals a day and four per cent ate more than three meals per day. Eighty-seven per cent of households consumed food at home, while 13 per cent consumed food with neighbours or relatives (how often was not investigated).

Analysis of the quantitative food frequency questionnaire and 24-hour recall data indicated that energy and micronutrients intakes of the total sample population were compromised, except for thiamine and vitamin E. The dietary intakes of caregivers are presented in Table 3.8.

The most frequently consumed protein sources (Table 3.9) were soya beans and chicken stew (Oldewage-Theron et al., 2006).

Table 3.8 Dietary intake of caregivers, Eatonside, (n=357) 2002 (Oldewage-Theron et al., 2003)

Nutrient	Mean intake per caregiver	Standard deviation	RDA*/DRI#
Energy (kJ)	4557.8	1984.1	10 093#
Total protein (g)	29.7	16.1	56*
Total fat (g)	21.0	20.8	Not available
Carbohydrates (g)	182.6	77.4	130*
Calcium (mg)	150.1	176.8	700#
Iron (mg)	3.79	0.52	14.8#
Vitamin A (RE) (mcg)	176.3	618	1000/600#
Thiamine (mg)	0.72	0.32	0.4/4200#
Riboflavin (mg)	0.34	0.34	1.4*/1.1#
Niacin (mg)	4.94	4.08	6.6/4200#
Folate (mcg)	81.9	103.6	100*/200#
Vitamin B_{12} (mcg)	1.19	3.17	1.6*/1.5#
Vitamin C	14.4	14.9	45*/10-40#
Vitamin E	4.6	7.3	3#

*RDA – recommended daily allowance

DRI- dietary recommended intake

The anthropometrics of children aged 9-13 years were measured in this project for a study conducted by Napier (2006) as part of the larger Eatonside project (Tables 3.10 and 3.11). The body mass index-for-age indicated that 56 per cent of boys and 62 per cent of girls were at risk of malnutrition. Twelve per cent of boys and eight per cent of girls were severely malnourished. Thirty-one per cent of boys and 30 per cent of girls were stunted and 31 per cent of boys and 23 per cent of girls showed wasting. These statistics indicated the prevalence of food shortages.

Table 3.9 Twenty most frequently consumed food items by sample population, Eatonside, (n= 357) 2002 (Oldewage-Theron et al., 2003)

Rank	Food item	Average portion size
1	Stiff maize meal porridge	649 g
2	Tea, brewed	288 ml
3	Soft maize meal porridge	379 g
4	Full cream milk	243 ml
5	Brown bread	166 g
6	Rooibos tea, brewed	274 ml
7	White sugar	22 g
8	Stewed spinach	63 g
9	Beef stew with cabbage	132 g
10	Fried cabbage	61 g
11	Boiled cabbage	78 g
12	Stewed cabbage	86 g
13	Coffee, brewed	254 ml
14	Tomato and onion stew	35 g
15	Boiled potatoes	100 g
16	White bread	123 g
17	Boiled chicken	75 g
18	Boerewors (sausage)	102 g
19	Cold drink	304 ml
20	Maltabella (sorghum porridge)	208 g

The study reported in this thesis was initiated in consultation with the community to determine the impact of home gardening on nutrient intake and access to food of pre-school children in the informal settlement (Eatonside), achieving one of the objectives of the larger project.

Table 3.10 Weight-for-age distribution (9-13 years), Eatonside, 2002 (Napier, 2006)

	Males		Females	
	N	**%**	**N**	**%**
Below 5% percentile	14	21.21	6	7.23
On 5% percentile	3	4.55	3	3.61
Between 5 and 50 per cent percentile	32	48.48	47	56.63
On 50 per cent percentile	1	1.52	4	4.82
Between 50 per cent and 95 per cent percentile	16	24.24	21	25.3
On 95 per cent percentile	-	-	-	-
Above 95 per cent percentile	-	-	2	2.41
TOTAL	**66**	**100**	**83**	**100**

Table 3.11 Height-for-age distribution (9-13 years) Eatonside, 2002 (Napier, 2006)

	Males		Females	
	N	**per cent**	**N**	**per cent**
Below 5 per cent percentile	12	18.18	12	14.46
On 5 per cent percentile	1	1.52	1	1.52
Between 5 per cent and 50 per cent percentile	32	48.48	44	53.01
On 50 per cent percentile	-	-	2	2.41
Between 50 per cent and 95 per cent percentile	17	25.76	20	24.1
On 95 per cent percentile	-	-	-	-
Above 95 per cent percentile	4	6.06	3	3.61
TOTAL	**66**	**100**	**83**	**100**

CHAPTER 4: STUDY METHODOLOGY

4.1 Introduction

This study set out to determine the impact of home gardens on access to food and nutrient intake of pre-school children in an informal settlement (Eatonside). The methodology and details of methods used in this study are described in this chapter. Several variables, indicative of the nutritional status of two to five year old pre-school children living in Eatonside, were analysed at the beginning and end of the study by means of:

- Anthropometric measurements
- Food access measured in terms of dietary diversity
- Dietary intakes.

4.2 Research design

A variety of research tools were designed and applied. All research tools were compiled in English. A pilot test was carried out with a representative sample of ten households who completed the questionnaires four times, in order to assure quality control (reproducibility, reliability and validity) and standardisation before administration to the study population.

Eight enumerators were recruited as field workers. Training manual was compiled (Appendix B) and an intensive training workshop was conducted for data enumerators, to ensure a high standard of data. Various participatory teaching methods were used in the training, including: case studies, role-plays, brainstorming, animation process and communication skills.

Children aged two to five years were selected as the sample, which was comparable with the National Food Consumption Survey (Labadarios et al., 1999) and South African Vitamin A Consultative Group (SAVACG, 1996) studies, that also indicated that pre-school children were the most vulnerable group in terms of nutritional status and accessibility to food at household level. The first five years of a child's life are crucial to his/her psychological wellbeing (Napier, 2003).

The home gardening study was undertaken in five phases namely planning meetings, a baseline survey, and training of households on home gardening, planting of seeds, and evaluating the impact of home gardens.

4.3 Meetings

In June 2004, coordinators of the project held another meeting with residents of Eatonside in order to inform them about the action plans (Appendix C) of the home gardening project (Figure 4.1). During this first meeting, the procedure for the inclusion of participants was explained. The selection criteria included the following:

- Households with children aged between two and five years
- Participants had to be residents of Eatonside
- At least one literate person within the household
- Ample space for home gardening.

Figure 4.1 The meeting with the community to explain the home garden study, Eatonside, 2004.

In August 2004, another meeting was held with the participants at the stadium. The 100 participating households gave consent to take part by completing the questionnaire in Appendix D. The representatives were chosen from the participants to help the researcher communicate with participants. These representatives formed part of the field worker team. In the meeting, the following points were discussed:

- Purpose of the home gardening project
- Administering of questionnaires
- Anthropometric measurements procedure
- Identification of areas for the gardens.

4.4 Training for home gardening

After consultation with the community and representatives, it was decided that training should be conducted at a local school (Setlabotsha Primary School) because there was space for a demonstration garden. The school principal was consulted and the objectives of the study were explained. The school principal was happy with the objectives of the study, granted permission for the establishment of the demonstration garden, and asked if the school teachers responsible for environmental health could also be trained in gardening.

The researcher, schoolteachers and the fieldworkers were the first group to be trained so they could, in turn, train the community participants. The training participants were divided into three groups to ensure that everyone was involved in the activities. A training manual provided systematic information on how to plant vegetables (Appendix E).

Training was conducted over two days for each group. There were four groups, each approximately 20 participants. On day one of training, the trainers provided theory on gardening and on day two, this was put into practice (Figure 4.2). Training was conducted on the following dates: 8 and 9, 15 and 16, 22 and 23 and 29 and 30 October 2004.

Figure 4.2 The researcher, the trainers and group one on the first day of training at the school, Eatonside, 2004.

4.5 Planting of vegetables

After the second day of each training session, the participants were provided with packages of seeds to start planting in their yards as soon as possible. In consultation with the community and Departments of Agriculture and Health, it was decided that **cabbage, spinach (Swiss chard), carrots, green beans and beetroot** were the vegetables of choice and would provide different micronutrients. The packages also included a tape measure, a piece of string and two types of fertiliser. The seeds provided could last the participants for two seasons per year over a period of three years, if used economically. Gardening tools were also supplied to households. Summer and winter seeds were purchased to ensure that there was an all year supply of vegetables. Winter seeds were planted in April. See Figure 4.3 for a photograph of the participants planting the seeds during a training session.

The nutrient composition of the vegetable seeds provided is presented in Table 4.1. Nel and Steyn (2002), recommend three servings per day of 132g portion size.

Table 4.1 Food composition of planted vegetables per 100 g of cooked vegetables (Langhoven et al., 1991)

	RDAs	Beans	Beetroot	Cabbage	Carrot	Spinach
Protein (g)	16	1.9	1.1	1.0	1.1	3.0
Energy (kJ)	6354	147	131	90	188	95
Fat (g)	35	0.3	0.1	0.32	0.2	0.3
Carbohydrate (g)	130	5.9	5.0	2.0	7.3	1.6
Fibre (g)	22	2.0	1.7	2.8	3.2	2.2
Calcium (mg)	22	46	11	33	31	136
Iron (mg)	8	1.3	0.6	0.4	0.6	3.6
Vitamin A (µg)	350	67	5.0	9	2455	819

After the initial training, participants were visited once a week for the first four weeks and thereafter, once a month until the vegetables were harvested.

Figure 4.3 Planting of vegetables on day two at the school, Eatonside 2004.

CHAPTER 5: FIELD WORK AND DATA ANALYSIS

5.1 Introduction

The study instruments were adapted from the larger project and compiled in English, pre-tested and revised before the fieldwork. Six enumerators from the University's Hospitality Department were trained in study procedures, qualitative methods and interviewing skills to strengthen the field operations.

5.2 Questionnaires

Two experienced farmers were appointed to help with training the participants and the development of a training programme. A meeting to familiarise trainers was held, and the information to be included in the training programme was discussed. The training programme was developed and translated into Sesotho by a qualified language expert. The training programme was pre-tested on the enumerators, representatives of the Eatonside community, pre-school teachers and teachers from the local school (involved with environmental studies) to ensure reproducibility and validity.

The study instruments included the following questionnaires:

- The socio-demographic questionnaire captured information on factors relevant to the household regarding the environment in which the child lived (Appendix F)
- The 24-Hour recall questionnaire captured information on the current diet and eating pattern of the child (Appendix G)
- The individual dietary questionnaire tool measured the number of different food groups eaten in the previous 24 hours by individuals or households, reflecting food access and quality of the diet. The tool was based on the 24-hour recall questionnaire (Appendix H)
- The quantitative food frequency questionnaire captured information on the eating patterns and intakes of the children over the previous six months so that seasonality effects could be observed (Appendix I).

The described questionnaires collected information on the socio-economic profile of the caregivers and determined the food consumption patterns and nutrient intakes of the children. To assist the fieldworkers in quantifying the portion sizes of foods eaten by the children, a specially designed kit with food models was used for quantification of food during the fieldwork. This kit included wax and polystyrene models of commonly eaten food items, household utensils, dry food (e.g. beans) as well as empty containers of food and drinks. Each field worker was trained to complete the questionnaires and had a manual with detailed information regarding the completion of all the questionnaires used in the study to collect data.

5.3 Anthropometric measurements

The anthropometric data were collected by measuring and weighing the participant before and at the end of study. A scale was placed on an even, uncarpeted area with the spirit level indication in the middle. The scale was switched on and the enumerator waited until the zero indication (0.0). The participants were weighed in light clothes, without shoes, after emptying their bladders. The participants stood on the scale, upright in the middle of the platform, facing the fieldworker and looking straight ahead. Their feet were placed flat and slightly apart. Then the measurements were recorded in the space provided on the station card. The participants stepped on the scale and waited for the zero reading to appear on the digital display. Figure 5.1 depicts the weighing of a child using a calibrated electronic scale. The procedure was repeated twice and the readings had to be within 100g of each (Mahan and Escott-Stump, 2004).

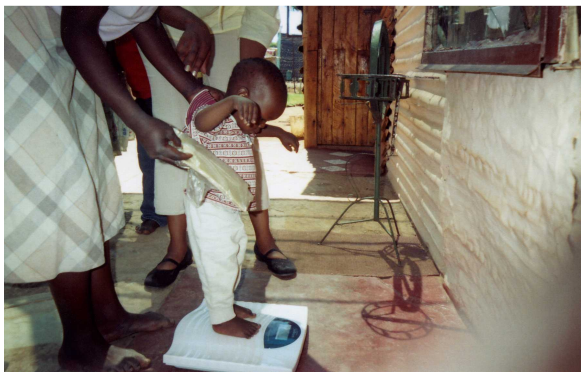

Figure 5.1 Weighing of children with an electronic scale at the pre-school, 2004.

To record the children's heights, participants took off their shoes and faced the fieldworker, shoulders relaxed with shoulder blades, buttocks and heels touching the measuring board, arms relaxed at the sides, legs straight, feet flat and knees together. The participants looked straight ahead before the headpiece was slid down onto the crown of the child's head (Figure 5.2). The fieldworker recorded the reading in millimetres on the anthropometric measurement space provided on the socio-demographic questionnaire. The procedure was repeated twice and the two readings were not to vary by more than 5mm (Mahan and Escott-Stump, 2004).

A fieldwork administration form was developed (Appendix J). The purpose of the form (also called the station check form) was to ensure that the participants completed all the activities at each recording session. The activities at different stations were:

Figure 5.2 Measuring of children using the measuring board at the pre-school, 2004.

Figure 5.3 Completion of questionnaires at the preschool, 2004.

Figure 5.4 Issuing of meals, juice and packets of seeds at the preschool, 2004.

Station 1: Registration of participants

Station 2: Anthropometric measurements

Station 3: Completion of the different questionnaires (Figure 5.3)

Station 4: Handing out of snacks as a token of appreciation (Figure 5.4)

Station 5: Issuing of seeds, and then back to station one to hand in the completed forms.

In February 2005, the socio-demographic questionnaire, QFFQ, 24-hour recall and anthropometric measurements were repeated. These results are discussed in Chapters 7, 8, and 9. Most gardens yielded good quality vegetables. Some participants had good yields in one to four vegetable crops (Lekotoko, 2008).

A socio-demographic questionnaire was applied to determine the social and demographic profile of the sample population. Pre- and post-measurements were taken to determine differences at the two phases of the study.

5.4 Data analysis

After completion of the fieldwork, questionnaires were sorted and checked for completeness, accuracy and reusability. Seventy-nine socio-demographic questionnaires, 40 individual dietary diversity (IDD) questionnaires and 40 each of the quantitative food frequency questionnaire and 24 hour-recall questionnaires were usable.

To investigate sub-problem one, a socio-demographic questionnaire was developed. The socio-demographic data were analysed for descriptive statistics of caregivers. For sub-problem two, an individual dietary diversity questionnaire, adapted from FAO's (2007) simple tools for measuring household access to food and dietary diversity, together with the 24-hour recall, were used. Fifteen food groups were used to determine dietary diversity, as recommended by FAO and to comply with the South African dietary guidelines as presented in Chapter 2. Paired sample t-tests were used to determine the significance between pre- and post-gardens.

The data on the completed questionnaires were captured and cleaned by the researcher on MS Excel 2000® computer programme and analysed by Statistical Package for Social Science (SPSS)® version 15.0. A double entry system was used to minimise data entry errors, and all discrepancies were corrected by referring to the survey instruments.

The QFFQ was used to evaluate sub-problem three. The data were analysed on the computer packages Dietary Manager® developed by Oscar Scharf to establish the nutrient intake and food consumed (Scharf, 1994). The statistical analysis determined the adequacy of the nutrient intakes and compared these to RDAs. From the dietary analysis, a table of the 20 most frequently consumed foods was drawn up. Paired sample t-tests were carried out to determine the significance of pre- and post-project data.

To answer sub-problem four, anthropometric measurements (weight and height) were plotted on Road to Health Charts. The weight and height measurements were classified according to percentiles used by National Centre for Health Statistic (NCHS, 1977). Height-for-weight, height-for-age and weight-for-age z scores were estimated to determine wasting, stunting and underweight pre- and post-home gardens. The body mass index (BMI) was not used because the children were still growing and BMI indicates malnutrition over a period, while height-for-age indicates recent malnutrition.

Finally, simple linear regression was used to explore relationships between dietary diversity, nutrient intakes and anthropometric measurements. The significant model was refined using step-wise linear regression.

CHAPTER 6: SOCIO-DEMOGRAPHIC PROFILE OF THE CAREGIVERS OF THE PRE-SCHOOL CHILDREN

The caregivers or parents of children that took part in the project were asked to complete the socio-demographic questionnaire assisted by the fieldworkers. The results of the socio-demographic questionnaire prior to and post-implementation of home gardens are presented in the tables below.

Twenty-nine per cent of caregivers were single and forty-two per cent were married, indicating that more of these children stayed with both their parents. Nine per cent of caregivers were males while 91 per cent were females, indicating that women were the principal caregivers. One per cent of the caregivers did not know their education level, 35.4 per cent studied until primary level, 32.9 per cent had junior secondary education, 17.5 per cent high school education and 2.5 per cent had tertiary qualifications. This indicates that the levels of education in this community were low.

Of the 79 households, 78.45 per cent of the caregivers were self-employed and only 7.7 per cent were retired (grandparents). In terms of money spent weekly on food (Table 6.1), 53.2 per cent of the sample (a sub-set of the whole sample reported in the previous chapter) spent R64.00 (US$8). The rate of unemployment was high. Most households (53 per cent) spent less than eight Rand (R8.00) per week on food, indicating that they lived on or just below the

Table 6.1 Money spent on food per week, Eatonside, 2004

Money spent on food per week (Rands)	Number	Percent of population
<8	42	53.2
8-175	18	22.8
17-24	11	13.9
25-32	4	5.1
33-40	4	5.1
Total	79	100

Table 6.2 Household income per month, Eatonside, 2004

Household income per month (Rands)	Number	Percent (%)
None	3	3.8
17-83	38	48.1
84-177	19	24.1
178-500	12	15.2
Don't know	7	8.9
Total	79	100

poverty line, by the definition of the World Development Report 1990 (World Bank, 1990) (see expenditure in Table 6.2). The World Development Report chose $1.08 a day as the poverty line because it was the most typical poverty line among the low-income countries. This poverty line is regarded as the absolute minimum standard of living, which by no means meets the basic needs of living. Forty-eight per cent of the household had a monthly income of between R136 and R664 (US$17 and 83) and 15.2 per cent had an income of between R1416 and R4000 (US$177 and 500) per month. The usual income of the households confirmed a high rate of poverty that may lead to malnutrition.

Forty-two percent of the households had three to four people sharing one sleeping room, and 19 per cent of the households had more than four people sharing one sleeping room, which characterises a typical informal settlement. Figure 6.1 shows a caregiver in her home garden. The next chapter discusses the food access and dietary diversity by pre-school children in the informal settlement.

Figure 6.1 A participant in her garden, Eatonside, 2004.

CHAPTER 7: ACCESS TO FOOD AND DIETARY DIVERSITY

Accessibility to food depends on a sufficient, steady and food supply. Access to food is influenced by many interacting factors, including access to land, a safe accessible water supply, stable climatic conditions, access to shops, presence of alternative food supplies and cash to buy food (Steyn et al., 1993). Access to food, poverty and economic growth are closely related. The poor often do not have sufficient means to gain access to sufficient food (Lado, 2001). Lack of access to food contributes to malnutrition, which negatively affects lives.

Ruel (2002) and Matla (2008) refer to dietary diversity as the number of individual foods or number of food groups consumed over a given period, usually ranging from a day to several days (not more than seven days). Faber et al. (2002a) report that the diets of many children in developing countries principally consist of plant-based food, with little variety. Macintyre and Labadarios (1999), using a QFFQ, found those South African children's diets consisted mainly of maize, white rice and potatoes, supporting Maunder and Labadarios's (1999) NFCS findings.

Bolaane (2006) proposed that dietary diversity be promoted to help increase children's energy and nutrients intake. According to the FAO (2002), adding nutrient-rich foods to diets through home gardening to increase dietary diversity could reduce micronutrient deficiencies. The FAO (2002) encourages home gardening because it increases household food supplies. Home gardening can provide households with direct access to food that can be harvested, prepared and consumed by the household members on a daily basis. Moreover, Tonstisirin et al. (2002) have stated that strategies that promote household production are more sustainable because they are independent of external financial support.

The study collected information on children's food consumption pre- and post-project implementation. The aim of the surveys was to determine whether home gardens contributed to the access and diversity of food of sampled children, using 24 hour and dietary diversity questionnaires as indicators of access to food and dietary diversity. The dietary diversity questionnaire collected information on consumption of food from 16 food groups: cereals, vitamin A-rich vegetables, white tubers and roots, dark green leafy vegetables, other

vegetables, vitamin A rich fruits, other fruit, organ meat, flesh meat, eggs, fish, seeds, nuts and legumes, milk and milk products, oils, sweets, coffee and tea.

Table 7.1 shows an increase in the intake of food groups over the period of the project. The number of children consuming vitamin A-rich vegetables increased the most, with all children (45 % improvement) consuming vitamin A-rich vegetables at the end of the project, compared with just over half at the start of the project. One child had a consumption of two vitamin A rich vegetables within 24 hours during the period covered in the post-assessment survey. The number of children consuming seeds, nuts and legumes doubled. Thirty and 25 per cent more children ate other vegetables and dark green leafy vegetables by the end of the project. Other noteworthy improvements were in the number of children consuming fish and eggs (25 and 20% more children) at the end of the project. This may be attributed to savings effected through gardening that freed up funds for purchasing other beneficial foods. All the children consumed cereals and fats/oils daily pre- and post-project.

Table 7.1 Food groups consumed by children Eatonside, 2004

Food groups	Number of children pre-project	Number of children post-project	Per cent change for the sample
Vitamin A rich vegetable	22	40	45
Seeds, nuts and legumes	17	34	44.5
Other vegetables	26	38	30
Dark green vegetables	28	38	25
Fish	9	19	25
Eggs	19	27	20
Flesh meat	29	35	14.5
White tubers and roots	7	11	10
Organ meats	34	38	10
Vitamin A- rich fruits	11	14	7.5
Milk	34	36	5
Sweets	39	40	2.5
Cereals	40	40	0
Other fruits	10	10	0
Fats/oils	40	40	0
Coffee/Tea	35	35	0

Paired sample t-tests were used to compare the average food consumption frequencies before and after the project (Table 7.2). Statistically significant ($p \leq 0{,}01$) changes were seen in the consumption of vitamin A-rich vegetables; other vegetables; seeds, nuts and legumes; cereals; dark green leafy vegetables; eggs; meat; organ meats and milk (in decreasing order – refer to Table 7.2).

Table 7.2 Summary statistics for paired sample t-test of food groups for pre- and post-project implementation, Eatonside, 2004 (n=40)

Food group	Mean daily consumption frequency	t- value	df	Sig. (2-tailed)
Vitamin A-rich vegetables	-0.45000	-5.152	39	0.000*
Other vegetables	-0.30000	-3.365	39	0.002*
Seeds, nuts and legumes	-0.30000	-3.365	39	0.002*
Cereal	-0.47500	-3.219	39	0.003**
Dark green leafy vegetables	-0.22500	-2.683	39	0.011**
Eggs	-0.17500	-2.479	39	0.018**
Meat	-0.20000	-2.449	39	0.019**
Organ meats	-0.10000	-2.082	39	0.044**
Milk	-0.25000	-2.037	39	0.048**
Fish	-0.17500	-1.862	39	0.070
Fats and oils	0.15000	1.233	39	0.225
Vitamin A-rich fruits	0.07500	0.771	39	0.446
White tubers	-0.05000	-0.703	39	0.486
Other fruits	-0.02500	-0.374	39	0.711
Sweets	-0.02500	-0.274	39	0.785

Note: * denotes statistically significant at 99 per cent level and ** denotes significant at the 95 per cent level.

The change in frequency of consumption of foods from the food groups is presented in Table 7.3. The mean and frequency of consumption of the vegetables from the garden are presented in Table 7.4. Most children (95%) consumed cabbage, carrots and spinach post-home gardening. Seventy-eight percent of children consumed beans by the end of the project, but only a third of the children had consumed beetroot during the post-project survey period. This may be attributed to the undesirable colour of beetroot.

Table 7.3 The change in frequency of consumption of foods from food groups, (n=40) Eatonside, 2004

Food group	Change in frequency of consumption (number of days over one month)
Vitamin A rich vegetables	0.450
Legumes and nuts	0.425
Other vegetables	0.300
Dark green leafy vegetables	0.250
Fish	0.250
Eggs	0.200
Flesh meat	0.128
White tuber	0.100
Organ meat	0.100
Vitamin A rich fruit	0.075
Milk	0.050
Sweets	0.025
Cereal	0.000
Other fruit	0.000
Fats and oils	0.000
Coffee/tea	0.000

Table 7.4 Mean and frequency of consumption of produce from the garden, Eatonside, 2004

Produce grown in the home gardens	Did the child consume these vegetables before the project?		Did the child consume these vegetables after the project?	
	No	Yes	No	Yes
Beans	9	31	22.0	75.6
Beetroot	27	13	65.9	31.7
Cabbage	2	38	4.9	92.7
Carrots	2	38	4.9	92.7
Swiss chard	2	38	4.9	92.7

All but 10 per cent of the children's consumption of foods in the food groups increased. For 25 and 23 per cent of the children, foods from one and two food groups, respectively were added to the diets post-project implementation. Fewer households (7 and 5%) added five and six food groups to their consumption diversity (Table 7.5).

Table 7.5 Improvement in dietary diversity through home garden implementation, Eatonside, 2004

Food groups added to consumption	Number of children post-project	Per cent of sample
0.00	4	9.8
1.00	10	24.4
2.00	9	22.0
3.00	6	14.6
4.00	5	12.2
5.00	3	7.3
6.00	2	4.9

The increase in dietary diversity was highly statistically significant ($t = -8.949$, $df = 38$ and sig. (2 tailed) $p = 0.000$), showing a direct positive impact of the home gardens on dietary diversity among the children. Therefore, access to food improved, with the consumption of produce from the garden having a direct impact on the consumption of foods by the children, particularly the nutrient-rich foods grown in the gardens. Dietary diversity and the frequency of consumption of nutritious foods increased with the implementation of the gardens.

CHAPTER 8: NUTRIENT INTAKES

This chapter answers research sub-problem three i.e. does home gardening improve the nutrient intakes of pre-school children in the Eatonside informal settlement. The mean intakes of energy, total protein, total fat, carbohydrates, total dietary fibre, calcium, iron and vitamin A are discussed.

Data on the nutrient intakes of sampled pre-school children in the garden project were gathered using the Quantitative Food Frequency Questionnaire (QFFQ). Caregivers were asked to complete the QFFQ on the children's nutrient intakes with the help of trained fieldworkers. The minimum, mean and maximum intakes of pre-school children were analysed and compared to requirements and recommendations for their age. From the data, a list of the foods most frequently consumed was drawn up. The nutrient intakes and their adequacies are discussed in the following sections.

At the start of the home garden project, the foods most often consumed by the children were tea, maize meal and milk, with animal protein 14th on the list of the 20 most frequently consumed foods (Table 8.1). The children used milk in tea and coffee. The only fruits that appeared on the list (Table 8.1) were oranges, apples, bananas and peaches (there were peach trees at the homesteads). Tomato and onion stew was the only source of vegetables on the list. The dietary intakes changed after implementation of the gardening project. The food items in italics in Table 8.1 are those produced from the seeds supplied for the home gardens.

Table 8.1 Most frequently consumed foods by mass (n=40) before and after implementation of home gardens, Eatonside, 2004

	Pre-home gardens			Post-home gardens		
Frequency Rank	**Number of children consuming this food**	**Food**	**Average intake per day**	**Number of children consuming this food**	**Food**	**Average intake per day**
1	23	Tea, brewed	208 ml	7	Apple, average	10 g
2	18	Maize meal, stiff	14 g	4	Atchar, mango	5 g
3	24	Full cream milk	80 g	7	Banana	10 g
4	19	Maize meal, soft	20 g	15	Beef (mince)	18 g
5	17	Mabella (sorghum)	20 g	23	*Beetroot*	5 g
6	15	Orange	10 g	12	Bread, brown	30 g
7	20	Apple	10 g	2	Bread, white	30 g
8	23	Bread, brown	12 g	4	*Cabbage (fried)*	10 g
9	14	Fruit juice	50 ml	3	*Carrot (boiled)*	12 g
10	17	Rice, white	55 g	23	Chicken (fried)	30 g
11	17	Cold drink, carbonated	60mℓ	16	Coffee	125 ml
12	38	Banana	15 g	1	Cold drink, squash	200 ml
13	15	Maize meal crumbly	20 g	18	*Swiss chard* (with tomato, onion and fat)	15 g
14	32	Chicken, boiled	15 g	32	Tomato onion stew	8 g
15	17	Peach, raw	10 g	1	Drinking yoghurt	125 ml
16	8	Coffee	150 g	12	Maas	60 ml
17	8	Mango	20 g	8	*Beans*	12 g
18	8	Tomato, onion stew	25 g	34	Offal	35 g
19	20	Oats, cooked	15 g	20	*Pumpkin* (candied with margarine)	7 g
20	14	Drinking yoghurt	50 ml	17	Liver	20 g

The adequacy of intakes before and after the implementation of gardens is presented in Table 8.2. Ninety-eight percent of the sampled children increased their intakes of vitamin A and iron by the end of the project, showing that the vegetables grown in the gardens (*Swiss chard,*

beans, carrots, cabbage and beetroot) had a positive impact on the children's nutrient intakes. Encouraging increases were seen in the intake of macro- and micronutrients for the majority of children, except for calcium (only 53% of children increased this intake, which was less than half the requirement for the age of the children) and carbohydrates (where 65% of children increased their intakes).

Table 8.2 Number of children increasing and decreasing nutrient intakes, Eatonside, 2004 (n=40)

Nutrients	Number of children who increased and decreased intake of nutrients (figures in brackets indicate the number of children as a percentage of the sample)							
	Energy	**Protein**	**CHO**	**Fat**	**Fibre**	**Calcium**	**Iron**	**Vitamin A**
Increased intake	27 (68%)	28 (70%)	26 (65%)	28 (70%)	30 (75%)	21 (53%)	39 (98%)	39 (98%)
Decreased intake	13 (32%)	12 (30%)	14 (35%)	12 (30%)	10 (25%)	19 (47%)	1 (2%)	1 (2%)

At the start of the project, average intakes for all nutrients were below requirements and recommendations for sound nutrition (Table 8.3), except for protein that was almost double (almost 90% above) the RDA and Vitamin A (that was close to 46 % above the RDA for the age of the children). Energy, fibre and calcium intakes were almost half the daily reference and adequate intakes. Carbohydrate intakes were, on average, just over 12 per cent below the RDA for the age of the children. These data indicate that the children were malnourished to start with, consuming considerably low energy diets with a surprisingly considerable high protein intake. Significant intake of protein may be from legumes, nuts and seeds; fish; eggs and flesh (red) meat, which were consumed (Chapter 7).

Intakes of all nutrients improved by the end of the project, except for energy and calcium, which dropped marginally, but both remained at around 50 per cent below requirements. The average protein intake increased by only one per cent after implementation of the home gardens, but was still high, and above requirements. The most significant contribution of the gardens to the nutrition of the pre-schoolers was the marked increase in intakes of carbohydrates, fibre and iron. The increased intakes were respectively equivalent to approximately 21, 27 and 28 per cent of the recommended intakes, increasing the average intake for carbohydrates and iron above the RDA. Fibre intake remained below adequate

intakes but improved by close to 6g on average. Vitamin A intake increased, although this was above the RDA before the project.

Table 8.3 Comparison of mean nutrient intakes and required and/or recommended intakes, 2004

	Energy kJ/day (per cent of DRI)	Protein g/day (per cent of RDA)	Fat g/day (per cent of RDA)	CHO g/day (per cent of RDA)	Fiber g/day (per cent of AI)	Ca mg/day (per cent of AI)	Fe mg/day (per cent of RDA)	Vitamin A µg/day (per cent of RDA)
RDA/DRI/AI*	6354.00	16.00	35.00	130.00	22.00	480.00	8.00	350.00
Mean intake pre-project	3427.72 (-46.05)	30.39 (+89.94)	22.67 (-35.23)	113.63 (-12.59)	9.36 (-57.45)	219.89 (-54.19)	6.46 (-19.25)	509.76 (+45.65)
Mean intake post-project	3150.85 (-50.41)	31.5 (+96.88)	25.7 (-26.57)	140.56 (+8.12)	15.35 (-30.23)	219.77 (-54.21)	8.60 (+7.5)	550.22 (-57.21)
Mean change	-276.87	1.11	3.03	26.93	5.99	-0.12	2.14	40.46

Note: Indicates an intake below that required or recommended. Indicates an intake above that required or recommended

Note too: RDA = Recommended Daily Intake, DRI = Dietary Reference Intake and AI = Adequate intake.

The only significant differences in intakes, before and after the project with regard to nutrients, were for vitamin A and iron (Table 8.4). These findings confirm Faber and Benadé's (2002) study of home-gardens in two rural areas of KwaZulu-Natal, where the mean serum retinol concentration of children in the experimental village significantly improved compared with a baseline and a control group. However, Faber *et al.* (2002a, b) also found that home gardens significantly improved the vitamin A status, indicating the prevalence of low serum retinol concentrations (‹ 20µg/dℓ) decreasing from 58 per cent at baseline to 58 per cent after implementation. Keiss *et al.* (1998) also found, from a cross sectional survey in Bangladesh, that home gardening had a positive effect on the mean serum retinol concentration of those children. The results suggest that access to home gardens

improved the intake and concentration of the serum retinol. However, vitamin A intakes were above RDAs at the start of the current project, so, although intakes increased, the increase was not necessary in this case. The high intakes of vitamin A may be attributed to cereal-based diets (bread and maize meal that are fortified in South Africa).

Table 8.4 Summary statistics for paired sample t-tests of nutrients for pre- and post-project implementation, Eatonside, 2004 (n=40)

Nutrient	Mean	t- value	Df	Sig. (2-tailed)
Iron	-0.18225	-6.756	39	0.000*
Vitamin A	-0.38400	-8.325	39	0.000*
Protein	-1.83750	-0.647	39	0.522
Carbohydrates	-5.79875	-.0565	39	0.575
Fibre	-0.33800	-0.488	39	0.628
Fats and oils	-0.81875	-0.292	39	0.772
Calcium	-5.97150	-0.265	39	0.792
Energy	5.58725	0.025	39	0.980

Note: * denotes significant at the 99 per cent level of statistical significance.

No significant changes in the consumption of macronutrients and fibre were found (Table 8.4). As was seen in the previous chapter, the gardens improved access to food (nutritious vegetables in particular, that were not frequently consumed by the majority of children before the project), which increased the consumption of beneficial foods and improved dietary diversity. Encouraging and positive changes were evident in the consumption patterns and consequently in improved intakes of most nutrients; statistically significant changes in intakes of macronutrients were not found. It is concerning that the intake of carbohydrates did not improve significantly or enough to satisfy even half the energy requirements of the children, despite significant changes in the consumption patterns and frequency of consumption of cereals. Intakes of energy, fat, fibre and calcium remained inadequate by the end of the study. These dietary components are crucial for growth and health.

CHAPTER 9: NUTRITIONAL STATUS

This chapter answers sub-problem four: does home gardening improve the nutritional status of pre-school children in the Eatonside informal settlement? Growth monitoring reflects children's nutritional status through anthropometric measures. These variables include height, weight and head circumferences for children from birth to two years of age (Napier, 2006). Anthropometric measures determine current and past nutrition and health status. They help in planning interventions and implementing strategies for at-risk individuals (Ojo, Deane and Amuna, 2000). The United Nations High Commission for Refugees, the World Food Programme (WFP) and the World Health Organisation (WHO) strongly advocate the use of weight-for-age (WFH) and height-for-age (HFA) as indicators of wasting and stunting respectively (Ojo, Deane and Amuna, 2000). The UNICEF also recommends weight-for-age (WFA) as an indicator of underweight (FAO, 1998). Weight-for-height is an indicator of recent malnutrition (MacFarlane, 1995). Anthropometric measurements were assessed using a growth chart. The measurements included body mass index-for-age, height-for-age and weight-for-age against the –2, -3, 1 and 2 standard deviations (SDs) from the National Centre for Health Statistics (NCHS) median (WHO, 2006).

The nutritional status of the 40 pre-school children participating in this study was categorised according to the standard deviations, as stipulated by the NCHS growth charts of 1977 and the WHO (1995) indicators. The Figures 9.1 and 9.2 show the weights and heights respectively of children before and after the implementation of the home gardening project. The results indicated that malnutrition existed among both girls and boys of all age groups prior to the implementation of home gardens project. Stunting was a problem among this sample, especially in younger children (24 - 35 months), indicating a persistent shortage of food.

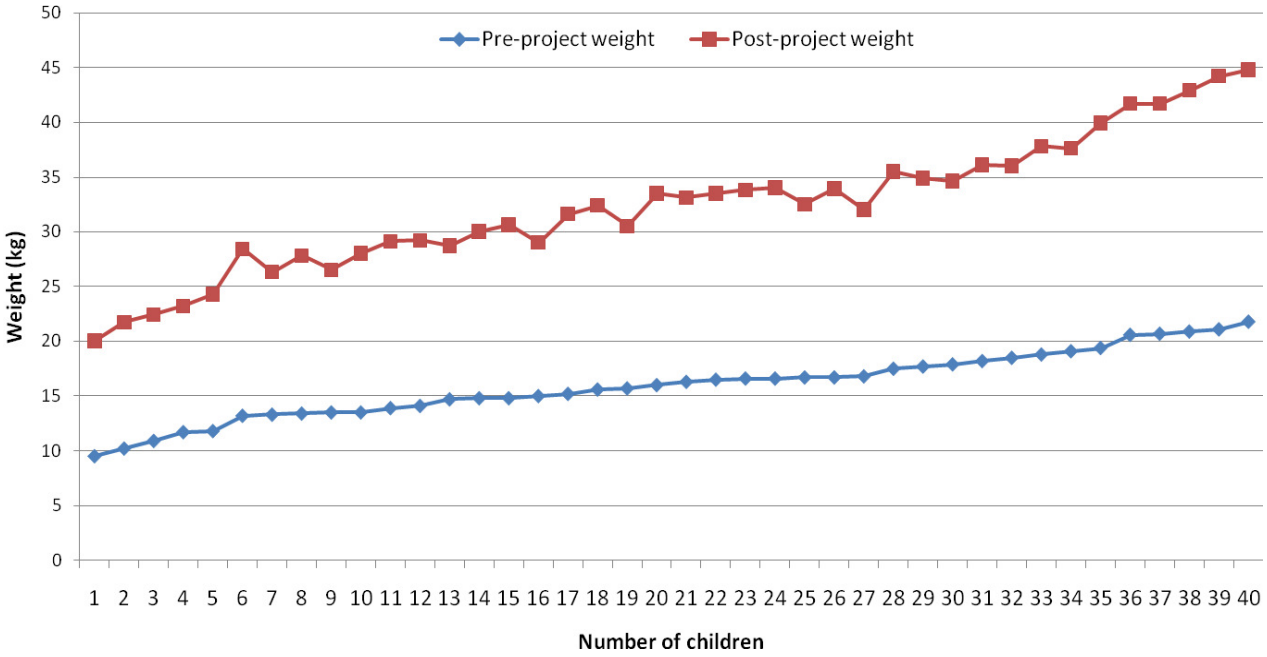

Figure 9.1 Weights of children pre- and post-project, Eatonside, 2004.

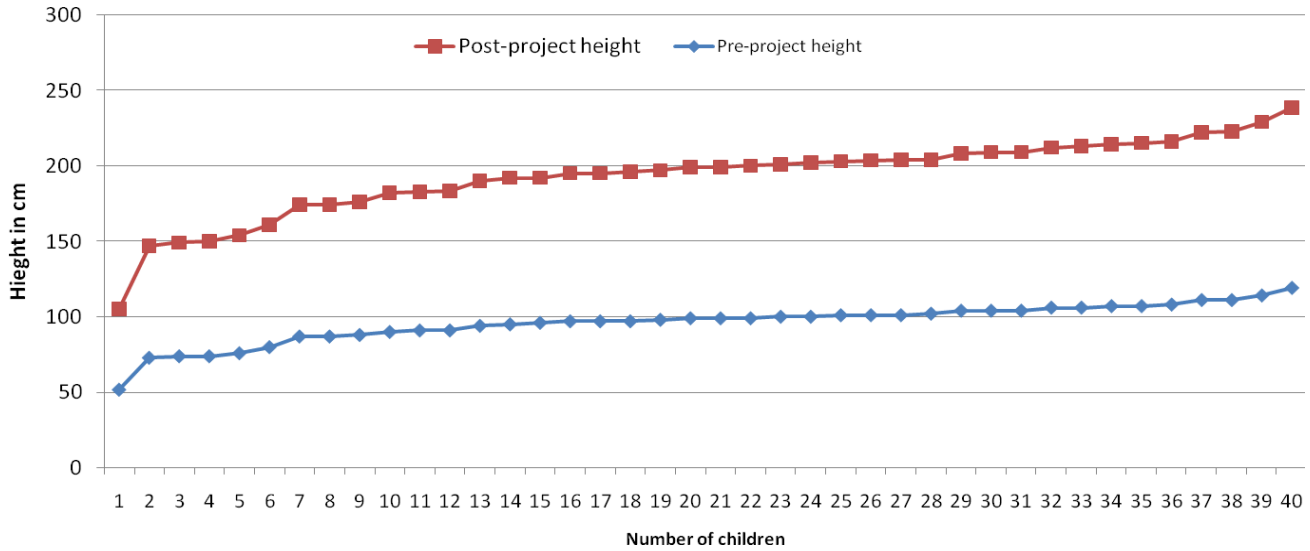

Figure 9.2 Heights of children pre- and post-project, Eatonside, 2004.

The z-score means and standard deviations (SDs) of the three nutritional indicators [height-for-age (HAZ); weight-for-age (WAZ) and height-for-weight z-scores (HWZ)] were

calculated and analysed. All data were analysed with the WHO AnthroPlus software 1.0.2, using the cut-offs set out in the 2006 WHO standard. Data were excluded if a child's HAZ was below -6 or above +6, WAZ was below -6 or above +5, or HWZ was below-5 or above +5.

Table 9.1 shows the z-score means and SDs. The analysis indicates that boys aged 24 to 35 months were severely stunted, with a mean height-for-weight z-score of -4.41 (below the third percentile). The mean increased slightly after implementation of the project to -4.97 (but still below the third percentile). For boys aged 36 to 47 months, 25 per cent were stunted at the start of the project and 50 per cent by the end of the project, showing deterioration in nutritional status. Twenty-one percent of the older boys (48 - 60 months) were within their normal height-for-age range pre- and post-project.

Table 9.1 Height-for-age, 24-60 months boys and girls, Eatonside, 2004

Age in months	Number of children	Mean for height-for-age		Standard Deviations (SD) for height-for-age	
		Pre	Post	Pre	Post
Boys					
24-35 (n=4)	4 (18%)	-4.41	-4.97	0.18	0.30
36-47 (n=4)	4 (18%)	-1.10	-1.76	1.30	1.28
48-60 (n=14)	14 (64%)	-0.75	-1.22	1.42	1.18
Girls					
24-35 (n=1)	1(6%)	-3.02	-2.31	0.00	1.80
36-47 (n=5)	5 (28%)	-1.86	-2.39	1.46	1.70
48-60 (n=12)	12 (64%)	-0.88	-0.92	1.05	0.88

These findings show that boys between 24 and 35 months benefited marginally from the garden project, but the nutritional status of boys between 36 and 47 months deteriorated over the project period. This is of great concern and was not anticipated, given the encouraging improvement in diets following implementation of the project (reported in the previous chapter). Many children were undernourished at the start of the project, and the low intake of carbohydrate at both the start and end of the project is worrying. The paired sample t-tests did not detect any statistically significant differences between the means of the pre- and post-project height-for-age z-scores for the whole sample, but did detect a significant difference pre and post-project for boys (Table 9.2). The sample size was too small to further sub-

divide into age categories, but the mean difference in z-score changes was observed among the youngest children and not the group (36 and 47 months) that seemed most malnourished and to have benefited least from the project.

Table 9.2 Paired sample t-test statistics for nutrition indicators for the pre- and post-project, Eatonside 2004

Z-score	t-value	Df	Sig. (2-tailed)
Whole sample			
Height-for-age	1.279	39	0.208
Height-for-weight	-1.137	39	0.262
Weight-for-age	-0.269	39	0.790
Boys			
Height-for-age	2.446	16	0.026**
Height-for-weight	0.205	16	0.840
Weight-for-age	-0.722	16	0.481
Girls			
Height-for-age	0.326	22	0.747
Height-for-weight	-1.568	22	0.131
Weight-for-age	0.059	22	0.954

Note: * denotes statistically significant at the 99 per cent level and ** at the 95 per cent level.

All girls aged 24 to 35 months were below -2SDs for height-for-age at the start of the project. At the end of the project, only 50 per cent of the same girls were stunted (Table 9.2), showing an encouraging benefit from the project. However, for girls aged 36 to 47 months, 25 per cent were -3SDs below the height-for-age norms at the end of the project, compared with 20 per cent pre-project implementation, showing a worrying deterioration in their nutritional status, as with the boys of the same age group. Although girls between 24 and 35 months showed an improvement in terms of height-for-weight ratios, they were on average severely stunted, with a mean height-for age z-score of -3.02 (below the third percentile) pre- and -2.31 SDs (below the fifth percentile) post-project. On average, girls between 36 and 47 months were also stunted pre-project (-2.39 which is below the third percentile) but only at risk of stunting (-1.86 and below the 25th percentile) at the end of the project. The sample of older girls were better nourished, with a mean for height-for age of (-0.88 SDs, below the 50th percentile) pre-project and -0.92 SDs (below the 50th percentile) post-project. Changes in height-for-age ratios were not statistically significant for girls.

The z-score means for height-for-age were generally lower among girls than boys, indicating that the girls were better nourished than the boys. There were slight changes in the z-score means and standard deviations for height-for-age post-project implementation, but changes in height-for-age rations were not statistically significant for the whole sample or for the sub-sample of girls. However, the paired sample t-tests showed that there was a significant difference in the mean z-scores for the pre- and post-project data. The data set was too small to split the data further into gender and age groups.

Twenty-five percent of boys aged 24 - 35 months and seven per cent of boys aged 48-60 months fell below -2SDs (third percentile) in terms of weight-for-age, indicating they were underweight (Table 9.3). Boys aged 24 - 35 months had mean weight-for-age z-scores of -0.24 and -0.43 (below the 50th percentile) pre- and post-project respectively. The weight-for-age means for boys aged 36 - 47 months changed slightly from -0.15 to -0.47 below the 50th percentile and -0.07 to -0.28 below the 50th percentile for boys aged 48 - 60 months, showing deterioration in their status over the duration of the project. On average, boys' weight-for-age ratios deteriorated over the project period. However, these differences were not found to be statistically significant.

Table 9.3 Weight-for-age, 24-60 months boys and girls, Eatonside, 2004

Age in months	Number of children (percentage of sample)	Mean weight-for-age z-score		Mean SDs for weight-for-age	
		Pre-project	Post-project	Pre-project	Post-project
Boys					
24-35 (n = 4)	4 (18%)	-0.24	-0.43	2.09	1.77
36-47 (n=4)	4 (18%)	-0.15	-0.47	0.19	1.11
48-60 (n=14)	14 (64%)	-0.07	-0.28	1.15	1.31
Girls					
24-35 (n=1)	1(6%)	-0.97	-0.02	0.00	1.10
36-47 (n=5)	5 (28%)	-0.14	-0.50	0.98	1.20
48-60 (n=12)	12 (64%)	-0.04	-0.18	0.79	0.84

Twenty-five per cent of girls between the ages of 36 and 27 months fell below -2SDs for weight-for-height, indicating they were underweight (Table 9.3). A slight change was observed in weight-for-age ratios among girls between 36 and 47 months, where the weight-

for-age means changed from -0.14 (below the 50th percentile) pre-project to -0.5 (still below the 50th percentile) post-project, again indicating a deterioration of nutritional status, with a worrying number of underweight girls both pre and post project implementation. However, these changes were not statistically significant.

Table 9.4 shows the z-score means and SDs for weight-for-height. Most boys were adequately nourished in terms of weight-for-height, except for a concerning 25 per cent of boys aged 24 to 35 months who had z-scores below -3SD for height-for weight, and were considered wasted. All girls were adequately nourished, as indicated by the weight-for-height z-score analysis, but the height-for-weight z-scores deteriorated over the period of the project, except for girls aged 36 – 47 and 48 – 60 months (whose ratios improved) showing that this indicator of current nutritional status did not improve through the garden project. This finding supports the results above, although the differences pre-and post-project were not statistically significant.

Table 9.4 Height-for-weight, 24-60 months boys and girls, Eatonside, 2004

Age in months	Number of children (percentage of sample)	Mean height-for-weight		SD height-for weight	
		Post-project	Post-project	Pre-project	Post-project
Boys					
24-35 (n = 4)	4 (18%)	1.65	2.44	0.71	0.53
36-47 (n=4)	4 (18%)	0.83	1.06	0.46	0.74
48-60 (n=14)	14 (64%)	0.64	0.87	1.17	0.98
Girls					
24-35 (n=1)	1(6%)	1.35	2.09	0.00	0.16
36-47 (n=5)	5 (28%)	1.92	1.57	0.86	0.39
48-60 (n=12)	12 (64%)	0.72	0.57	0.83	0.67

The results described in this chapter highlight that malnutrition is problematic among children of all age groups in this sample. Home gardens had no statistically significant impact on anthropometric measurements of the children. A concerning, negative statistical difference was found between pre- and post-project height-for-age z-scores for boys, showing significant deterioration of nutritional status among boys.

CHAPTER 10: ASSOCIATION BETWEEN NUTRITIONAL STATUS, DIETARY DIVERSITY AND CHANGES IN NUTRIENT INTAKES OF THE PRE-SCHOOL CHILDREN

Children are susceptible to malnutrition, owing to their high nutrient requirements for growth and their vulnerability to communicable diseases, such as diarrhea and respiratory infections, which can hinder nutrient absorption and reduce the desire for food. If other associated factors affecting child nutrition are controlled, children with lower nutrient intakes should logically have lower nutritional status. Similarly, children with low dietary diversity probably have inadequate nutrient intakes. This chapter explores the relationships between nutritional status and dietary diversity, and changes in intake of macro- and key micronutrients among children in the Eatonside home garden project.

As explained in Chapters 7 and 8, home gardens increased the availability of vegetables and improved dietary diversity and intakes of some key nutrients among the sampled children. Increases in consumption were observed as statistically significant increases in consumption of beneficial vegetables over the period of the project. As a result, a strong statistically significant improvement in intakes of iron and vitamin A was observed. Dietary diversity increased, with ten children adding one vegetable; nine children adding two; six children adding three, five children adding four, three children adding five and two children adding six vegetables to their diets over the period of the project. However, significant changes in the children's nutritional status had no statistical significance and did not render the impact that was hoped for by the project implementers. Linear regression analysis was applied to investigate whether there was any relationship between dietary diversity, nutrient intakes and nutritional status.

The change in height-for-age, weight-for-age and height-for-weight z-scores and the dietary diversity scores over the period of the project were each modelled against the change in intake of energy, protein, carbohydrate, fat and fibre. The only statistically significant relationship between macronutrient intakes and the anthropometric indicators was for the height-for-age model, with a R^2 value of 0.418 and adjusted R^2 of 0.333 (Table 10.1).

Table 10.1 Regression analysis to determine the relationship of changes in height-for-age and changes in macro nutrient intakes, Eatonside, 2004 (n = 40)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7826.678	5	1565.336	4.887	.002
	Residual	10891.297	34	320.332		
	Total	18717.975	39			

This regression model was refined and improved through stepwise regression to identify the best fitting model, using the most influential variables. The best fitting model included only changes (in this case an increase) in consumption of two macronutrients - fats and oils and carbohydrates (Table 10.2). Models were then run for the micronutrients. No statistically significant models could be found for increases in intakes of vitamin A, iron and calcium, indicating no significant relationship between the nutritional status and dietary diversity indicators and improved intakes of these micronutrients. These findings confirm the results of studies by Hendriks and Msaki (2009); Kirsten et al. (1998) and Mjonono et al. (2009) that illustrate that, only when household food production exceeds household requirements and the surpluses sold, does children's nutrition improve. Household gardening may improve food access, dietary diversity and nutrient intakes to some extent, but not enough to make significant difference to nutritional status.

Table 10.2 Stepwise linear regression analysis to determine the relationship of changes in height-for-age and changes in macro nutrient intakes, Eatonside, 2004 (n = 40)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4246.677	1	4246.677	11.151	.002(a)
	Residual	14471.298	38	380.824		
	Total	18717.975	39			
2	Regression	7088.760	2	3544.380	11.277	.000(b)
	Residual	11629.215	37	314.303		
	Total	18717.975	39			

a Predictors: (Constant), change in fat and oil consumption
b Predictors: (Constant), change in fat and oil and carbohydrate consumption
c Dependent Variable: difference in height for age z-score

CHAPTER 11: CONCLUSIONS AND RECOMMENDATIONS

Malnutrition is a concern across the world. Poverty, household food insecurity and malnutrition are common causes of death among children in Africa. Malnutrition is both a cause and a consequence of poverty. Sound and adequate nutrition is a pre-condition for human and economic development. Malnutrition constrains this by increasing vulnerability to illness, increasing mortality and reducing labour productivity. Malnutrition may lead to death, increased health costs, decreased mental capacity and it lowers future productivity.

Malnutrition is also a concern in South Africa, where child malnutrition is still unacceptably high. There is considerable focus on home gardens globally and, in South Africa, with numerous governmental, non-governmental and community projects promoting home gardens to improve nutrition and food security. However, very little empirical data and no comprehensive evidence exists to show that home gardens do, in fact, have a significant, positive impact on children's nutrition. Often home garden projects are set up in ways that do not enable pre/post empirical testing of the impact on beneficiary nutritional status.

This study set out to fill this gap through an in-depth and comprehensive empirical analysis of the benefits of a home garden project on children in an informal settlement in South Africa. The objective of this study was to determine the impact of home gardens on dietary diversity, nutrient intakes and the nutritional status of pre-school children in a home garden project in Eatonside in the Vaal Triangle. The study was motivated by the prevalence of household food insecurity and malnutrition, identified in this informal settlement through the larger project to which this study contributes. Children aged two to five years were selected as the sample. Several variables, indicative of the nutritional status of two to five year old pre-school children living in Eatonside, were measured at the beginning and end of the study.

11.1 Conclusions

The gardens improved access to food (nutritious vegetables in particular, that were not frequently consumed by the majority of children before the project), which increased the consumption of beneficial foods and improved dietary diversity. Consumption of produce from the garden had a direct impact on the consumption of foods by the children, particularly

of the nutrient-rich foods grown in the gardens. Dietary diversity and the frequency of consumption of nutritious foods increased with the implementation of the vegetable gardens project. The increase in dietary diversity was highly statistically significant ($t = -8.949$, $df = 38$ and sig. (2 tailed) $p = 0.000$), showing a direct positive impact of the home gardens on dietary diversity among the children.

Encouraging and positive changes were evident in the consumption patterns and, consequently, in improved intakes of most nutrients, but statistically significant changes in intakes of macronutrients were not found. It is concerning that the intake of carbohydrates did not improve significantly and enough to satisfy even half the energy requirements of the children, despite significant changes in the consumption patterns and frequency of consumption of cereals. Intakes of energy, fat, fibre and calcium remained inadequate by the end of the study.

The results indicate that malnutrition is problematic among children of all age groups in the sample. Home gardens had no statistically significant impact on the anthropometric measurements of the children. A concerning negative statistical difference was found between pre- and post-project height-for-age z-scores for boys, showing a significant deterioration of nutritional status among boys.

The only statistically significant relationship between macronutrient intakes and the anthropometric indicators was for height-for-age. The best fitting model included only changes (in this case an increase) in consumption of two macronutrients - fats and oils and carbohydrates. Statistically significant models for changes in micronutrient intakes were not found, indicating no significant relationship between improved nutrient intakes, nutritional status and dietary diversity indicators for this sample, confirming other studies in South and Southern Africa that indicate a tenuous impact of home garden projects on children's nutrition. Statistically confirmed impacts of the home gardens included increased dietary diversity and increased intakes of vitamin A and iron. Trends observed but not able to be confirmed empirically were that access to vegetables increased, children consumed vegetables they rarely consumed prior to establishment of the gardens, and the intake of some macro- and micronutrients increased. Statistically significant increases in anthropometric measurements were not found and, in fact, some anthropometric indicators worsened over the duration of the garden project. Carbohydrates and fats were the only macronutrients found to

significantly improve height-for-weight z-scores among the children. Given the alarming prevalence of malnutrition among the children at the start and end of the project, this result is not surprising. The children's carbohydrate intakes remained approximately half of RDAs and their fat intake was inadequate, despite consuming more than the RDA for protein and achieving significant increases in vitamin A and iron intakes. Carbohydrate and fat intakes are not likely to increase through home gardening, as the plots are too small to grow staple cereal and root crops. Other means are required to ensure supplementation of the children's diets to ensure that they have sufficient food to meet these crucial, energy-dense foods required for growth and development.

Until the impact of home gardens on children's nutrition can be empirically established, caution should be exercised in promoting home gardens as the ultimate solution to food insecurity and malnutrition.

11.2 Recommendations

Existing evidence is confirmed through this study, suggesting that where vitamin A deficiencies are identified, home gardens can improve intakes of this micronutrient. However, national food fortification of key staples and public health initiatives may be more cost effective, scalable and wide reaching than home gardens. However, home gardens have been shown to improve dietary diversity, and home gardening should be widely promoted to improve dietary diversity in contexts where land, water, labour and inputs are available and accessible. Dietary diversification improves health in general.

It seems presumptuous to promote home gardens as a panacea for child malnutrition. Therefore, governments and agencies should be cautious in how such programmes are promoted, designed, targeted and managed. Feeding schemes, subsidies and social protection that are targeted at pre-school children may be more effective than home gardens. Growth monitoring is essential to identify nutritionally at-risk and affected children and for effective targeting of interventions. Nutrition education helps in attitude changes towards food and healthy living habits and should be widely implemented and targeted at caregivers.

Home gardens alone will not improve the overall nutritional status of children and increase family income, especially among the vulnerable communities, such as informal settlement

dwellers. Therefore, it needs to be coupled with nutrition education so that behavior modification can also take place. Nutrition education may include the relationship between different vegetables and health, the identification of which vegetable provides which nutrient, preparation methods that preserve the nutritional value of the vegetables e.g. cooking with little water or oven steaming the vegetables. Those vegetables can be mashed for small children instead of buying bottled food. The addition of a little bit of fat to the vegetables will increase the nutrient value. The importance of a home garden as a source of nutrients should also be emphasised. In addition, the caregivers should also be provided with knowledge on how to harvest in such a way that they can preserve the seeds for future use without having to buy seeds every season.

11.3 Recommendations for further research

Further research to investigate the impact of home gardens on access to food, nutrient intakes and nutritional status of pre-school children is needed in different contexts, countries and situations (rural and urban) and in comprehensive ways to guide policy and programme design and implementation and ensure efficient investment of resources for all stakeholders. Further panel research could be conducted in Eatonside to monitor the progress and productivity of the gardens and their impact on the children, providing long-term data and evidence.

11.4 Recommendations for improvement of the study

Initially, the project sample included 62 children, but, due to attrition and the unwillingness of some participants to engage in the post-project survey, the sample size dropped to 40 children. More regular monitoring and surveys of respondents could have reduced the attrition rate and provided more data for analysis, including seasonal data on intakes. Biochemical measurements would have provided the opportunity for sub-clinical investigation of nutritional status, but this was not possible due to financial and ethical constraints. Understanding the relationship between the caregiver and the child may also have rendered interesting information regarding feeding practices and intra-household allocation rights.

The researcher did not monitor health. Therefore, it is not known if any of the children were sick during the study and how this may have affected their growth. There was no data on how much produce was produced or sold by the caregivers. This information may have helped quantify the proportion of produce that the child was fed.

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APPENDIX A PROJECT LOG FRAMEWORK

Project component	Objectives	Activities	Personnel	Inputs	Outputs	Outcomes	Means of verification
1. Planning session (Phase I)	To invite key stakeholders in order to make decisions, avoid conflicts, get authorisation and agree on project goal and purpose.	Correspond with key stakeholders Convene a planning workshop. Draw up roles, norms, ethics and research variables.	Researchers Coordinator Experts Researchers Coordinator	Allowances Stationeries Hall charges Transport	1. Planning workshop held. Interdisciplinary project protocol developed.	Community leaders involved. Research project understood and accepted by community. Community based initiatives established.	Letters Workshop report Working document
2. Baseline survey (Phase II).	To determine the prevalence, magnitude and underlying causes of malnutrition problems of the informal settlements dwellers in the	Prepare research tools Collect a wide-ranging baseline data including physical, anthropometrical,	Facilitator Researchers Data processor Coordinator	Allowances Stationeries Hall charges Transport	Research tools developed. A wide-ranging data collected. Benchmarks established.	Established food, nutrition and health situation analysis. A well-defined and area specific problem statement	Questionnaires Extensive data set stored in the retrieval system.

Project component	Objectives	Activities	Personnel	Inputs	Outputs	Outcomes	Means of verification
	Vaal Triangle area.	dietary and biochemical. Data entry, process, interpret and report results. Integrate results and refine project goal.				Research skills mastered.	
3. Evaluation, planning and development community based research projects (Phase III).	To evaluate a baseline survey report. To plan and develop appropriate community-based projects.	Conduct project planning and management meeting. Examine baseline data and findings. Identify appropriate interventions, design and develop	Experts Researchers Coordinator	Allowances Stationeries Hall charges Transport	1 meeting conducted. Research project protocols 3 research projects designed. B-Tech project reports.	Appraised research projects established. Identified tasks and assignments. Research skills mastered. 4 parts of qualification s	Plan of action.

Project component	Objectives	Activities	Personnel	Inputs	Outputs	Outcomes	Means of verification
		community-based studies (projects). Assign tasks and carry out assignments.				obtained.	
4. Implementation and coordination of projects (Phase IV).	To undertake community based research projects to improve food, nutrition and health situations.	Implement community based intervention projects. Conduct on-going project evaluations and record outcomes of the projects. Coordinate community based projects.	Researchers Coordinator	Allowances Stationery Transport	3 parts of B-Tech qualifications obtained. Three B-Tech project reports.	Appropriate interventions put in place. 3 research projects implemented. Established accessible project services. Research skills mastered.	Project progress reports. 3 parts of B-Tech qualifications obtained.

Project component	Objectives	Activities	Personnel	Inputs	Outputs	Outcomes	Means of verification
		Write reports (Three B-Tech project reports).					
5. Evaluation, interpretation and report writing (Phase V).	To evaluate the outcomes and impact of the projects.	Conduct evaluation exercise. Interpret the results. Write reports (one B-Tech Education three M-Tech FSM and one Post Doctoral Public food and nutrition).	Researchers Experts Facilitator	Allowances Stationery Transport	Progress report One B-Tech project report, three M-Tech dissertations and one Post Doctoral thesis.	Research skills mastered. 1 evaluation mission conducted. 1 part of B-Tech and 3 parts of M-Tech qualifications obtained.	Data set
6. Feedback sessions (Phase VI).	To report the findings to the study community.	Conduct three feedback sessions at community level.	Researchers Experts Transport	Allowances Stationeries Hall charges Transport	4 community meetings held. 3 conferences	Increased community awareness, participation and	Three community reports. One district report.

Project component	Objectives	Activities	Personnel	Inputs	Outputs	Outcomes	Means of verification
		Conduct feedback seminar at district level. Attend conferences and publish papers in national and international peer reviewed journals.			attended. 4 theses and three dissertations 3 scientific articles published.	empowerment at grassroots and district levels. Contributed new scientific knowledge to the body of international knowledge.	Articles published and conference proceedings

APPENDIX B: INSTRUCTION MANUAL

IMPORTANT: DO NOT START SAMPLING BEFORE YOU HAVE READ AND UNDERSTOOD THE FOLLOWING INSTRUCTIONS

INDEX

1. IMPORTANT INFORMATION

The team leader of this project is Ms M Selepe. In order to ensure accurate and reliable data, the team leaders will supervise the data collection process and crosscheck some of the information that you as field worker have obtained. If differences are found, you will be asked to repeat the observations in the presence of one of the team leaders in order to find the reasons for the differences.

All questions must be asked in the same way by all the field workers. Should questions be translated, please ensure that the meaning of the question is not changed by the way the question is rephrased. The team leaders will be available for assistance at all times during the trial.

2. EQUIPMENT PER TEAM

The following equipment must be prepared and be available for the week that measurements will be done.

2.1 Station 1

- All the subject files
- Demography questionnaires
- Consent forms
- Check lists
- 10 X Pens

2.2 Station 2

- 2 X Measuring tapes
- 2 X Scales
- 2 X Pens
- Calculator

2.3 Station 3

- 24-hour Recall, IDD, QFFQ questionnaires
- 10 X Pens
- 2 X Tape recorders,
- 16 X tapes,
- 4 X Exam pads

2.4 Station 4

- 100 X 250 ml Fruit juice, assorted
- 10 Loaves Bread, sliced
- 1 Marmite, 1 Peanut butter (800 g), 1 Jam (410 g), 500 g butter
- 10 Knives
- 100 Paper plates
- 100 Paper serviettes
- Pen

2.5 Station 5

- Pens
- Seeds

3. Instructions to fieldworkers

3.1 Station 1

At the beginning:

- Explain the routine for the day
- Register the subject on the attendance register as being present
- Complete the demography form
- Ensure that the consent form is in the file and completed

At the end:

- Check that the station form is complete (authorized signature at each station)
- Collect the completed file from the subject
- Sign the subject out on the register

3.2 Station 2

Weight measurement: As described in the methodology chapter

Height measurement: As described in the methodology chapter

3.3 Station 3

- Complete all the questionnaires

3.4 Station 4

- Check that the subject has completed all the steps in stations one to three by checking the station card.
- Hand out a sandwich with a 250mℓ fruit juice to each subject and sign the station card.

3.5 Station 5

- Check that the subject has completed all the steps in stations one to four by checking the station card
- Check the code on the subject file and issue the seeds
- Sign the station card

4. Field work dates: Are discussed in the fieldwork chapter

APPENDIX C: PROJECT ACTION PLAN

Project activity	Start date	Finish date	Responsible	Remarks
Phase I				
i) Correspond with key stakeholders.	1 Mar 2002	20 Mar 2002	Principal investigator and co-ordinator	Monitored by project advisor and overall project promoter
ii) Convene a planning workshop.	1 Apr 2002	15 Apr 2002		
iii) Draw up roles, norms, ethics and research variables.	15 Apr 2002	30 Apr 2002		
Phase II				
iv) Prepare research tools.	1 May 2002	31 May 2002	Principal investigator B Tech and M tech students	Monitored by project advisor and overall project promoter, as well as PST
v) Collect a wide-ranging baseline data.	1 June 2002	30 June 2002	Data enumerators	
vi) Data entry, process, interpret and report results.	1 Aug 2002	15 Aug 2002	Research assistant	
vii) Integrate results and refine project goal.	16 Aug 2002	15 Sep 2002	Principal investigator and statistician	
Phase III			Principal investigator	Monitored by project advisor and

Project activity	Start date	Finish date	Responsible	Remarks
viii) Conduct project planning and management meeting.	15 Sep 2002	28 Sep 2002	and co-ordinator	overall project promoter, as well as PIT, local government departments and project community committees
ix) Examine baseline data and findings.	1 Oct 2002	31 Jab 2003	Principal investigator Prof S Sumar	
x) Identify appropriate interventional community based studies (projects).	1 Oct 2002	31 Jan 2003	Principal investigator Prof Sam Sumar	
xi) Assign tasks and implement assignments.	1 Oct 2002	31 Jan 2003	Principal investigator Prof Sam Sumar	
xii) Write reports (Three B-Tech FN).	1 Oct 2002	15 Nov 2002	B Tech students	
Phase IV				
xiii) Conduct on-going project evaluations and record outcomes of the projects.	15 Jan 2003	31 Jan 2003	Principal investigator and co-ordinator Prof Sam Sumar	Monitored by project advisor and overall project promoter, as well as PIT, local government departments and project community committees
xiv) Coordinate CB-projects.	30 Nov 2003	30 Nov 2003	Principal investigator	
xv) Write reports (Three B-Tech project reports).	1 Sep 2003	15 Oct 2003	B Tech students	
Phase V				
xvi) Conduct evaluation exercise.	15 Jan 2004	14 Mar 2004	Principal investigator and co-ordinator	Monitored by project advisor and overall project promoter

Project activity	Start date	Finish date	Responsible	Remarks
xvii) Interpret the results. xviii) Write reports (one B-Tech Education three M-Tech FSM and one Post Doctoral Public food and nutrition).	15 Mar 2004 15 Apr 2004	14 Apr 2004 30 June 2004		
Phase VI xix) Conduct three feedback sessions at community level. xx) Conduct feedback seminar at district level. xxi) Attend conferences and publish papers in national and international peer reviewed journals.	1 July 2004 1 Aug 2004 1 Sep 2004	31 July 2004 31 Aug 2004 30 Nov 2004	Principal investigator and co-ordinator	Monitored by project advisor and overall project promoter, as well as PIT, local government departments and project community committees

APPENDIX D: PROJECT INFORMATION AND INFORMED CONSENT

Good day

My name is Mosa Selepe and I am working at the Vaal University of Technology. I am doing a project to determine the impact of home gardens on access of food and nutritional status of 2-5 year old children in Eatonside and need your assistance in getting the information for this project. I will explain the project to you so that you will understand exactly what will be done, the reasons and what will be expected of you so that you can decide if you want to participate in this project. Participation is voluntary and should you decide to participate, you may withdraw at any stage during this project.

WHAT IS THIS PROJECT?

The purpose of the research project is:

- The purpose of the research project is to collect information on what types of foods children in the ages 2-5 years in Eatonside eat.
- The information collected will be used to determine the intake of various nutrients especially vitamin A and iron and to decide whether food gardens should be introduced in the whole of Eatonside so that children would get more nutrients from the home gardens.

WHY IS THIS PROJECT IMPORTANT?

This project is a relevant and worthwhile undertaking due to the need of promoting urban agriculture, in particular home gardening in South Africa. Evidence exists that adequate nutrition is an underlying factor contributing for public health problems and social challenges in the world today (Vorster et al. 1999). Therefore, a better understanding of the determinants and changes in dietary patterns and nutrient intakes during the demographic transition in developing countries and how these changes or the nutrition transition influences health outcome, could lead to more appropriate and relevant policies, strategies and

intervention programs to protect and promote health, and to prevent and control diseases (Vorster et al., 1999).

PROCEDURE

The project will take place over a period of four weeks. The parent/caregiver will be requested to complete questionnaires on behalf of the children with the assistance of the field workers. We will measure the height and weight of the caregivers and the children and will also undertake other anthropometrics measurements. One blood sample will be drawn from your child. You will be supplied with the exact dates when will this take place.

WHAT ARE THE BENEFITS FOR YOU?

- Healthy and nutritional status indicators of your child will be measured. You will receive feedback during which a member of the investigation team will explain your child's health risk to you.
- The information collected will be analysed and the results will be made available to the participant on request, will be used for publication in scientific journals and will also be presented in scientific conferences. No results will be published in magazines or local newspapers.

WHAT DO WE EXPECT FROM YOU?

- Please bring your ID, your child's birth certificate or child road to health clinic card
- We will appreciate it if you will report fasting on the day of your participation. It means that for 10-12 hours before your blood sample is taken, you must not eat or drink anything but pure water.
- You will be asked to sign a consent form giving consent on behalf of your child to participate in the project.
- We will ask you a number of questions regarding your health, age, income, family, smoking and drinking habits
- Then you will receive a reference number for the project.
- Your child will be weighed and measured

- The temperature of your child will be taken orally three times during the study, once at the beginning and then again at the end of the study.
- Three teaspoons of blood will be taken from your child's arm once at the beginning and at the end of the study by a registered nursing sister. The child may experience a little pain at the prick of the needle, but this will not be long lived. The blood samples will be analysed to determine the nutrient content in your child's blood. This will provide information to the researchers in order to give you advice on your eating habits and dietary intake. NO AIDS TESTING will be done.

If you have any questions about the project, please do not hesitate to ask any one of the field workers at any time.

Thank you,

Mosa Selepe (Ms)

Project Leader

Tel: 016 950 9279

Fax:016 950 9788

INFORMED CONSENT

I, the undersigned,……

[ID……..] participant OR in my capacity as…… of the child in the project [ID……]
of……(address).

I have read the details of the project, or have listened to the oral explanation thereof, and declare that I understand it. I have had the opportunity to discuss relevant aspects with the researcher and declare that I voluntarily participate in the project. I hereby give consent to participate in the project and that blood samples may be taken from me.

I hereby indemnify the Vaal University of Technology (VUT), or any employee of the VUT, against any liability that may originate during my participation in this research project. I further undertake that I will not claim against the VUT or any VUT employee for damage or personal disadvantages that my child may suffer as a result of this research.

Signature of parent/guardian……..

Signed at ……on……

Witnesses

Name…….Name ……

Signature ……Signature…….

Signed at……..Signed at……

Address of the parent/guardian……..…….....
…….....
.....

Contact telephone number……..

APPENDIX E: HOME GARDENING TRAINING PROGRAMME

PREPARATIONS FOR INDIVIDUAL CROP

Mark out your complete garden (3m long and 4m wide) dig it over with a garden fork to the depth of the fork's teeth.
Start from the one side and prepare a bed for beetroot. (See Stark Ayres Booklet)

BEET (Crimson globe)

Beetroot is a cool-seasoned crop that liked to be planted in full sun, well-drained soil that is rich in organic matter. (pH of 6.0 -7.0.)

BED PREPARATION

Mark out beetroot bed. (3 m long and 60 cm wide =1.8m2 =110g or one fifth of the packet).
Draw a narrow furrow 2 cm deep along each row with a wooden peg.
Plant 2 seeds directly in the furrow, 2 cm deep, 7 cm between plants in rows that is 20cm from each other.
In our area, which is defined as moderate warm Highveld, it is best to sow them during October.
Sow at monthly intervals but give more water during November, to February to keep cool.
Keep soil damp until seeds have germinated.
Never let the soil dry out but water in such a manner that young seedlings are not damaged.
Thin out the seedlings when they are 4 cm high and draw up a little soil against the remaining plants to support them. The area in between plants should be 7 cm.
If the plants are too close together when they are 7 cm high, a second thinning out can be done.
Very important – Do not plant in a bed where fresh manure was worked into the soil. The best results are obtained when planted in a bed where a good amount of manure was incorporated the previous season.

HARVESTING

It will take about 90 days before you must harvest your beetroot.
Pull them out without damaging the beetroot and twist of the leaves 5 cm from the beet to prevent bleeding.
The leafs can be used as a spinach and the swollen roots for a salad after being cooked

PESTS AND DISEASES

Cutworms often feed on the young seedlings and cutworm bait from Kombat can be applied during late afternoon.
Protect seedlings from birds and other animals.
A fungal disease, leaf, spot, is common on beets particularly during wet weather with medium temperature's. Crop rotation and the use of clean seed are the basis for long-term control. Cabbage or unions must be planted in this area for the 2^{nd} season, beans the 3^{rd} season and

BEANS

Espada is a dwarf bean that like's a loose, friable soil with good drainage and pH of 6, 0 – 7,5 that was previously planted with heavy feeders such as cabbage, cauliflower or potatoes.
It is very important that growth must be quicker, so that pods are not hard or misshapen. Therefore it is important that you add your 2:3:2 fertilisers.

BED PREPARATION:

After you left a walkway of about 40 cm from the beetroot bed, mark out your beans bed. (3 m long and 0.9 m wide =2.7 m^2)
Rake the soil to an even bed and raise a ridge around the bed.
Sprinkle the 2:3:2 (22) fertilizer over the bed (60 g per m^2 = 162 g)
Draw a narrow furrow 4 cm deep with a wooden peg.
Plant 1 seed every 7 cm in the furrow. Make another furrow 50 cm away from the first and plant the same way.
The best time for sowing is between August and January.

Sow at monthly intervals but give more water during November to January to keep cool.
Keep soil damp until seeds have germinated.
Never let the soil dry out but water at such a manner that young seedlings are not damaged.
Cultivating once or twice will be enough to remove the weed. Draw a little soil up against the stem during first cultivation to prevent plant damage through wind.

HARVESTING

The pods will be ready in plus minus 55 days.
The pods should be removed while they are still young and tender and before swelling of the seeds occurs. Pick the beans twice a week. Be careful not to damage the plant when picking. The plant should be held with one hand while the pods are removed with the other.

PESTS AND DISEASES

Cutworms – use cutworm bait.
CMR beetles – feed on flowers – hand pick them early in the morning or if infestation is bad spray with BHC or Malathion.
Bean stem fly – small black fly that lower yields. Spray Malathion.

DISEASES

Only troublesome in warm overcast wet weather.
Examples are Anthracnose, Brown rust and Bacterial blight.

For crop rotation plant tomatoes, potatoes or Swiss chard during the 2nd season, carrots and beetroot the 3rd and cabbages, onion or cauliflower during the 4th season.

SWISS CHARD (Fordhook Giant)

Swiss chard is loosely called spinach but it is not true spinach. It is more productive, has a shorter picking season (4 month's) and are more tolerant to heat than spinach.

Swiss chard like to be planted in a full sun area with temperatures 10 – 30^0C AND pH of 6.0 – 7.0. It will not tolerate any soil acidity and a dressing of dolomitic lime should be applied on suspected soils.

Thorough soil preparation is necessary before any planting or sowing is to be done. Incorporate a lot of old manure or compost. A dressing of 60 – 90 g/m of 2:3:2 (22) prior to sowing will encourage rapid growth.

BED PREPARATION

After you left a walkway of 40 cm from the beans bed, you can mark out the bed for the Swiss chard (3 m long and 80 cm wide = 2.4 m^2).

Sprinkle old poultry - , cattle manure or compost in a thick layer (3cm) over the bed and dig it in to fork's teeth depth.

Rake to an even bed and raise a ridge around it.

Sprinkle 2:3:2 fertilizer over the bed (60 g/m2 = 144g).

Draw a narrow furrow 2 cm deep with the wooden peg.

Plant 2 seeds every 20 cm in the furrow. Make another furrow 40 cm away from the first and plant the same way.

The best time for sowing is between August and May. Sow with monthly intervals to ensure a constant supply.

Germination takes place about 8 – 10 days later.

Thinning out can be done from about 3 weeks later where the plants can be lifted out carefully and used to fill up gaps or plant our additional rows.

From the time that picking commence, monthly side dressings of LAN will maintain the vigorous growth as will liquid manure applications every 2 to 3 weeks.

HARVESTING

Start hand picking 2 to 3 leaves per plant from about 8 weeks.

When the leaves start spreading out to form a rosette, it is an indication that the picking season is ending.

PEST AND DISEASES

Caterpillars – spray with Malathion or Karbaspray.
Leaf spot occur sometimes in warm weather with high humidity.
Spray with Dithane m45 and again 5 – 10 days later.

CARROTS (Chantenay Karoo)

Carrots prefer cool growing conditions, but if adequate moisture is available they can be grown during most of the months (October to March). The ideal soil for carrots is a deeply worked sandy loam that has been improved with a lot of compost or manure for a previous crop of cabbages or cauliflowers. The best pH is 6,0 – 7,0.
Heavy soils do not allow roots to develop freely and make harvesting extremely difficult.
Do not incorporate fresh manure or other organic material, as this could cause forked roots, crooked growth and develop excessive numbers of coarse side roots.

BED PREPARATION

After a walkway of 40 cm from the Swiss Chart bed, you can mark out the bed for the carrots (3 m long and 60 cm wide = 1,8 m2).
Dig the soil over to a fork depth and remove all stones, hard objects and roots of grass. Break up all clods and rake the soil. Raise a ridge around the bed.
Sprinkle 2:3:2 (22) fertilizer over the bed (60g/m2 =108 g).
Draw a narrow furrow, 2 cm deep, in the middle of the bed. Put a quantity of seed n the palm of your one hand. Taking a pinch of it with the other hand and rubbing it between finger and thumb along the row.
Make two other rows left and right (10 cm of the center row) and plant the same way. Cover the seed with soil, firmed and water.
Weed control, watering and thinning are the three main chores to look after.
Give a shallow cultivation as soon as the rows can be seen. Hand weeds 5 cm on either side and in the rows. Do not disturb carrot roots.
When the third true leaves of the swelling develop, you can start thinning the extra seedlings so that there is a space of 8 cm between plants.
Earth up the rows a little after thinning and give a light soaking.
Always cover carrot shoulders with soil so as to prevent green shoulders. After thinning spread the fertilizer LAN at a rate of 60 g/m2. (One teaspoon for every 5 plants).

HARVESTING

It will take about 100 days before you can start harvesting your carrots.
Harvesting is best by removing the biggest carrots and so making room for the remainder to develop.

PESTS AND DISEASES

Aphids = a grey, mealy and waxy pest in large numbers at the base of the foliage especially during hot weather. Spray with Metasystox and if crop is more mature then Malathion is more suitable.

APPENDIX F: SOCIO-DEMOGRAPHIC QUESTIONNAIRE

This questionnaire covers certain aspects of your life and your child/children's life, including work and personal details, health and illness, anthropometrics information, lifestyle and social life that are relevant to health.

Personal information:

Education level of mother **(Tick one only)**	1	2	3	4	5	6
	None	Primary school	Std 6-8	Std 9-10	Tertiary education	Don't know
Mother's employ-ment status **(Tick one only)**	1	2	3	4	5	6
	Housewife by choice	Unemployed	Self-employed	Wage earner	Other, specify:	Don't know
Education level of caregiver **(Tick one only)**	1	2	3	4	5	6
	None	Primary school	Std 6-8	Std 9-10	Tertiary education	Don't know
Father's employ-ment status **(Tick one**	1	2	3	4	5	6
	Unemployed	Self-employed	Wage earner	Retired by choice	Other, specify:	Not applicable e.g. dead

Education level of mother **(Tick one only)**	1	2	3	4	5	6	
	None	Primary school	Std 6-8	Std 9-10	Tertiary education	Don't know	
only)	1 person 1 person	2 persons 2 persons	3-4 persons 3-4 persons	5-6 persons 5-6 persons	More than 6		
Household income per month (including wages, rent, sales of vegetables, etc, state grant) **(Tick one only)**	1	2	3	4	5	6	7
	None	R100-R500	R500-R1000	R1000-R3000	R3000-R5000	Over R5000	Don't know
Is this usual income of the household? **(Tick one only)**	1	2	If no, what other income is available, specify				
	Yes	No					
Is this	1	2					

Education level of mother **(Tick one only)**	1		2		3	4		5	6	
	None		Primary school		Std 6-8	Std 9-10		Tertiary education	Don't know	
more or less the income that you had over the past six months? **(Tick one only)**	Yes		No							
How much money does household on food spend weekly? **(Tick one only)**	1	2	3	4	5	6	7	8	9	10
	R0-R50	R50-R100	R100-R150	R150-R200	R200-R250	R250-R300	R300-R350	R350-R400	R400-R450	R450-R500

Marital status of the caregiver (tick one only)

1	2	3	4	5	6	7	8
Unmarried	Married	Divorced	Separated	Widowed	Living together	Traditional marriage	Other, specify

Now decide on the following (considering the household where this child lives):

Type of dwelling	1	2	3	4	5
	Brick, concrete	Plastic	Tin	Plank, wood	Other, specify:
Number of people sleeping in house for at least 4 nights per week?					
Number of rooms in house (excluding bathroom, toilet, kitchen, if separate)					
Number of people per living/sleeping room (tick one)	1	2	3		
	0-2 persons	3-4 persons	More than 4		

APPENDIX G: 24 HOUR RECALL

Subject ID number:_____ Interviewer:_____

Name:_____ Date:_____

Address:_____

Tick what day was yesterday:

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

Would you describe what you ate yesterday as your habitual food intake?

Yes = 1	No =2

If No,

why?_____

Would you please tell me all that you ate and drank yesterday since you woke up until you went to bed? Please tell me how much food and drink you consumed.

IN THE MORNING:

Time (approximately)	Description of food or drink	Preparation method	Amount	Amount in g for office use	Code(office use only)

AT PRE-SCHOOL:

Time (approximately)	Description of food or drink	Preparation method	Amount	Amount in g for office use	Code(office use only)

AFTERNOON AT HOME:

Time (approximately)	Description of food or drink	Preparation method	Amount	Amount in g for office use	Code(office use only)

IN THE EVENNING:

Time (approximately)	Description of food or drink	Preparation method	Amount	Amount in g for office use	Code(office use only)

APPENDIX H: INDIVIDUAL DIETARY DIVERSITY QUESTIONNAIRE

Question number	Food group	Examples	YES=1	NO=0
1	CEREALS	bread, noodles, biscuits, cookies or any other foods made from millet, sorghum, maize, rice, wheat + insert local foods e.g. ugali, nshima, porridge or pastes or other locally available grains		
2	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrots, squash, or sweet potatoes that are yellow or orange inside + other locally available vitamin-A rich vegetables		
3	WHITE TUBERS AND ROOTS	white potatoes, white yams, cassava, or foods made from roots.		
4	DARK GREEN LEAFY VEGETABLES	sweet pepper, dark green/leafy vegetables, including wild ones + locally available vitamin-A rich leaves such as cassava leaves etc.		
5	OTHER VEGETABLES	other vegetables, including wild vegetables		
6	VITAMIN A RICH FRUITS	ripe mangoes, papayas + other locally available vitamin A-rich fruits		
7	OTHER FRUITS	other fruits, including wild fruits		
8	ORGAN MEAT (IRON-RICH)	liver, kidney, heart or other organ meats or blood-based foods		
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, wild game, chicken, duck, or other birds		
10	EGGS			
11	FISH	fresh or dried fish or shellfish		
12	LEGUMES, NUTS AND SEEDS	beans, peas, lentils, nuts, seeds or foods made from these		
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products		
14	OILS AND FATS	oil, fats or butter added to food or used for cooking		
15	SWEETS	sugar, honey, sweetened soda or sugary foods such as chocolates, sweets or candies		
16	COFFEE/TEA	tea (black, green, herbal) or coffee		
17.	Did you eat anything (meal or snack) outside of the home yesterday?			
Total				

APPENDIX I: QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE

Subject number:…… **Interviewer:**

INTRODUCTION

Greeting
Thank you for giving up your time to participate in this study. Here we want to find out what children who live in this area eat and drink. This information is important to know, as it will tell us if people are eating enough and if they are healthy.

Please think carefully about the food and drink you have consumed during the past four weeks. I will go through a list of foods and drinks with you and I would like you to tell me:

If you eat the food
How the food is prepared
How much of the food you eat at a time
How many times a day you eat it every day, how many times a week or a month you eat it.

To help you to describe the amount you eat, I will show you samples of different amounts of food. Please say which sample is the closest to the amount you eat or if it is smaller, between sizes or bigger than the samples.

THERE ARE NO RIGHT OR WRONG ANSWERS.

EVERYTHING YOU TELL ME IS CONFIDENTIAL.

IS THERE ANYTHING YOU WANT TO ASK NOW?

ARE YOU WILLING TO CONTINUE?

INSTRUCTION

Circle the subject's answer. Fill in the amount and time eaten in the appropriate columns.

I shall now ask you about the type and the amount of food you have been eating in the last few months. Please tell if you eat the food, how much you eat and how often you eat it.

We shall start with maize meal porridge.

Do you eat maize porridge? 1 2

YES	NO

Where do you get your maize-meal? (May answer more than one)

Shop	1	
Employer	2	
Harvest and grind self	3	
Other – specify	4	
Don't know	5	

FOOD	**DESCRIPTION**	**AMOUNT**	**TIME EATEN**				**CODE AMOUNT/DAY**	
			Per Day	**Per Week**	**Per Month**	**Seldom /Never**		
Maize-meal Porridge	Stiff (pap)						e4225 4250	
Maize-meal Porridge	Soft (slappap)						e4225 4250	
Maize-meal Porridge	Crumbly (phutu)						e4225 4250	
Ting								
Mabella Coarse Finé Rice	Stiff						4082	
Mabella	Soft						4083	
Oats							4032	
Breakfast cereals	Brand names of cereals at home now (5) Don't know						4032	

Do you pour milk on your porridge or cereal?

1 2

YES	NO

If YES, what type of milk (whole fresh, sour, 1 per cent fat free milk blend _____

INSTRUCTION: Show subject examples

If YES, how much milk?							

Do you pour sugar on your cereal/porridge/mabella? 1 2

YES	NO

If YES, how much sugar?							9012	
Samp	Bought Self ground						4077 4073	
Samp and Beans							A014	

Are the amounts of samp and beans the same as in the picture?

YES	NO

If NO, do you use more beans than in the picture or less?

MORE	LESS

Samp and Peanuts							A013	

Are the amounts of samp and beans the same as in the picture?

YES	NO

If NO, do you use more peanuts than in the picture or less?

MORE	LESS

Rice	White Brouwn Maize rice						4040	
Pastas	Macaroni Spaghetti Other						4062	

You are being very helpful. Can I now ask you about meat?

7 CHICKEN, MEAT, FISH.

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN				CODE	AMOUNT/ DAY
			Per Day	Per Week	Per Month	Seldom/ Never		
Chicken	Boiled						1521	
	Fried in batter/crumbs Not coated						1634	
	Roasted/Grilled						1520	

Do you eat chicken skin?

1 2 3

ALWAYS	SOMETIMES	NEVER

			Per Day	Per Week	Per Month	Seldom/ Never		
Chicken bones stew							A003	
Chicken feet							A083	
Chicken offal							1650	
Red meat:	How do you like meat? With fat Fat trimmed							
Red meat	Fried							
	Stewed						A001	
	Mince with tomato and onion						1585	
Beef Offal	Intestines boiled nothing added						1616	
	Stewed with vegetables							
	Liver						1515	
	Kidney						1518	
	Other specify							

What vegetables are usually put into meat stews?

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN				CODE	AMOUNT/ DAY
			Per Day	Per Week	Per Month	Seldom/ Never		
Wors / Sausage	Fried						1526	
Canned meat	Bully Beef						1537	
Pilchard in Tomato sauce							2557	
Fried Fish	With batter/ crumbs						2509	
	Without/ batter Crumbs						2523	
Eggs	Boiled						1001	
	Scrambled						1025	
	Fried						1003	

We now come to vegetables

FOOD	AMOUNT	TIMES EATEN				CODE	AMOUNT/ DAY
		Per Day	Per Week	Per Month	Seldom/ Never		
Cabbage							
						8066	
						A006	
						A007	
						A006	
Spinach/morogo/ other green leafy.	How do you cook spinach?						
	Boiled added, noting					8071	
	Boiled fat added					8209	
	Boiled with onion/tomato and fat					A011	
	- onion tomato and						

	potato						
	- with peanuts						
	Other Don't know						
Tomato and onion gravy	Home made - with fat - without fat					A012 A016	
	Canned					8221	
Pumpkin	How do you cook pumpkin?						
	Cooked in fat and sugar					A010	
	Boiled, little sugar and fat						
	Other Don't know						
Carrots	How do you cook carrots?						
	Boiled, sugar and fat					8129	
	With potato/onion					A008	
	Raw, salad					8015	
	Chakalaka						
	Other: Don't know						
Mealies/Sweet corn	How do you eat mealies?						
	On cob					8033	
	Off cob – creamed sweet corn - whole kernel					8034 8261	
Beetroot salad	Homemade Bought					8005	

Do you spread anything on the bread?

1 2 3

ALWAYS	SOMETIMES	NEVER

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN				CODE	AMOUNT/ DAY
			Per Day	Per Week	Per Month	Seldom/ Never		
Margarine/ Butter	What brand do you have at home now? …….. Do not know ……. Show examples							
Peanut butter							6509	
Jam/syrup/honey							9008	
							9501	
Fish/meat paste							1512	

Drinks

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN				CODE	AMOUNT/ DAY
			Per Day	Per Week	Per Month	Seldom/ Never		
Tea							9514	
Coffee							9513	
Sugar/cup tea or coffee							9012	
Milk, cup tea or coffee	What type of milk do you use in tea and coffee?							
	Fresh/long whole						0006	
	Fresh/long 2%						0069	
	Fresh/long fat free						0072	
	Whole milk powder Brand						0009	
	Skimmed milk powder Brand						0008	

	Milk blend Brand						0068	
	Whitener Brand						0039	
	Condensed milk						0002	
	Evaporated milk						0003	
	None							
Milk as such	What type of milk do you drink as such?							
	Fresh/long life whole						0006	
	Sour/Maas						0006	

Sauces/Gravies/Condiments

FOOD	**DESCRIPTION**	**AMOUNT**	**TIMES EATEN**				**CODE**	**AMOUNT/ DAY**
			Per Day	**Per Week**	**Per Month**	**Seldom/ Never**		
Tomato Sauce Worcester sauce							9505	
Chutney							9524	
Pickles							8176	
Packet soups							4069	
Others:								

Miscellaneous: Please mention any other food used more than once/two weeks, which we have not talked about.

FOOD	DESCRIPTION	AMOUNT	TIMES EATEN				CODE	AMOUNT / DAY
			Per Day	Per Week	Per Month	Seldom/ Never		

Salt use:

What type of salt do you use? _____

The next few questions are to find out if you use salt, where you use it and how much you use.

Do you add salt to food while it is being cooked?

1 2 3 4

ALWAYS	SOMETIMES	NEVER	DON'T KNOW

Do you add salt to your food after it has been cooked?

1 2 3

ALWAYS	SOMETIMES	NEVER

Do you like salty foods e.g. salted peanuts crisps?

1 2 3

VERY MUCH	LIKE	NOT AT ALL

Do you use any of the following?

	Name of product	Amount/day
Vitamins/vitamins and minerals		
Tonics		
Health foods		
Body building preparations		
Dietary, fibre supplements		
Other: Specify		

THANK YOU FOR YOUR COOPERATION AND PATIENCE

GOOD- BYE!

APPENDIX J: FIELDWORK CONTROL FORM

STATION 1	STATION 2	STATION 3	STATION 4	STATION 5
Registration	Completion of consent form and socio-demographic questionnaire	Weighing and measuring	Completion of other questionnaires. Issuing of snacks or meals.	Signing off and issuing of the seeds.