Chapter 3 Methods used in the present study

3.1 Introduction

A preliminary study was conducted in Eatonside and Orange Farm to determine the household food security status of the two communities in 2004 and 2005, after which, interventions (school feeding) were planned in order to attempt to address the problem areas identified in the preliminary study. The methods as well as the products used as part of the school feeding projects in semi-urban areas in the Vaal Region for the preliminary study will be discussed in this chapter. These products were vetkoek, the existing PSNP, Sejo, CSB and fruit. The studies were conducted in a primary school in Eatonside and in three primary schools in Orange Farm. The programmes in the different schools were each managed by a different researcher. Figure 3.1 depicts the way in which data from the different studies contribute to this study.

The vetkoek was developed by the author of this document (as part of a Master's degree) and used in an intervention study by Napier (2006) to determine the nutritional impact of vetkoek, PSNP and fruit on children aged six to 13 years. The nutritional impact of Sejo was evaluated by Mbuli in 2007 and that of CSB by Nyathela in 2008, on children of the same age. The sustainability of CSB was tested in the Orange Farm school feeding programme by Chibe (2007:5). The researcher will evaluate the data from all the above-mentioned studies and compare the different products used for school feeding programmes in the Vaal Region in order to determine the most effective product and to formulate guidelines that will be made available to JAM, the DoH and DoE.

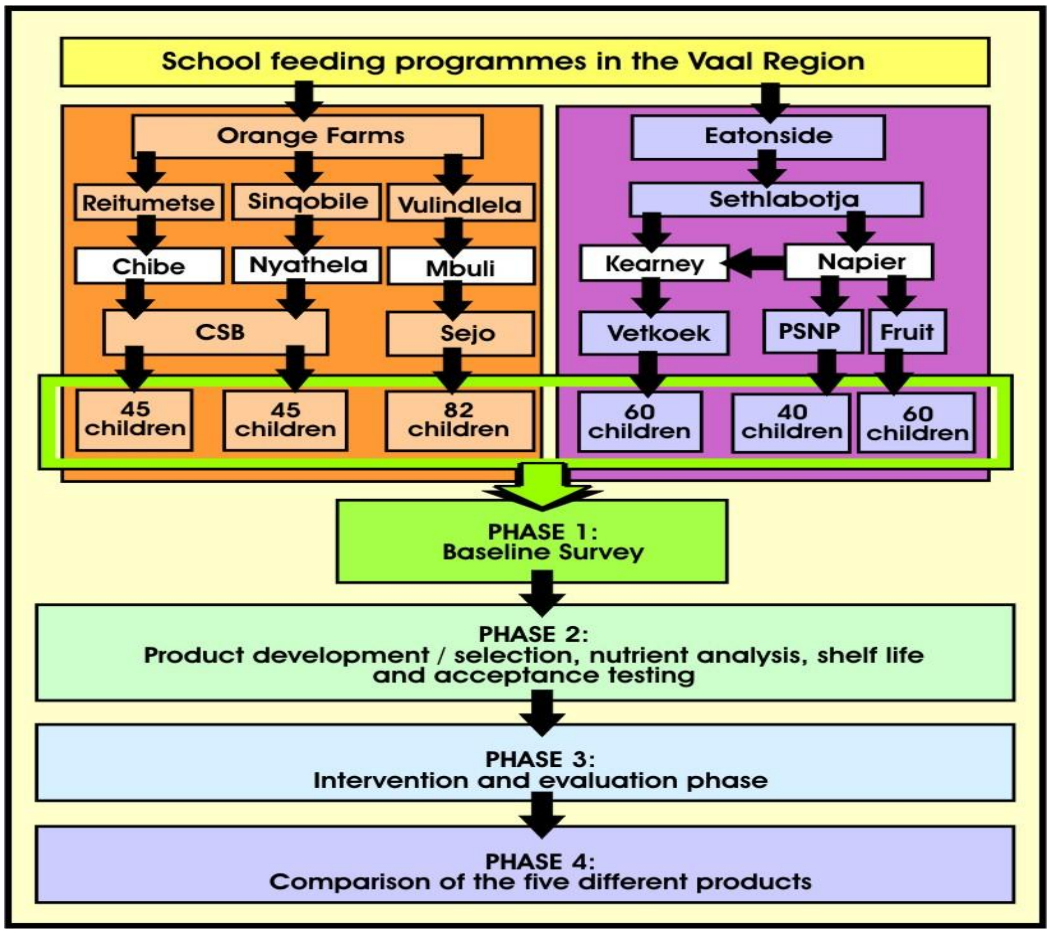

Figure 3.1 Premises, products, researchers and number of children involved in the study

3.1.1 Eatonside

Eatonside is a semi-urban informal settlement next to the Sebokeng township in the Vaal Region (McIlrath & Slabbert 2003), Figure 3.2 illustrates where the Eatonside area is situated. The school was identified when a strategic roundtable participatory planning workshop including all stakeholders was conducted. The stakeholders included councillors of the region and representatives from the DoH and DoE. The stakeholders identified Eatonside as a community perceived as being among the ‘’poorest of the poor’ (Napier 2006:102). The Sethlabotja Primary School was the only primary school in this area and was thus used in this study.

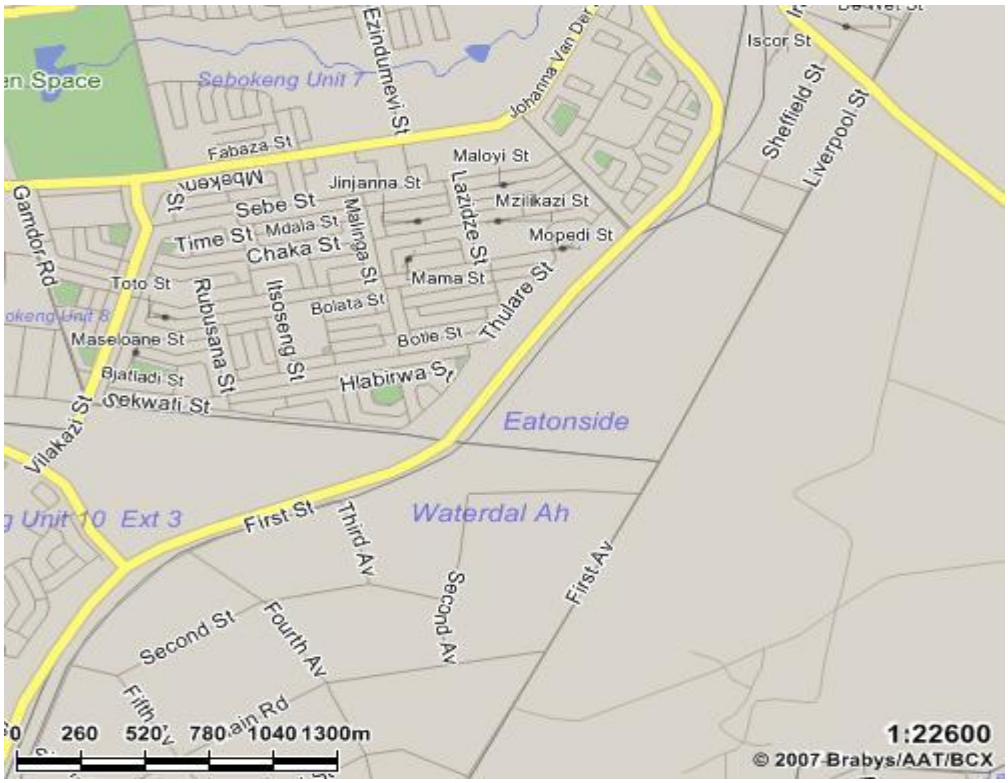

Figure 3.2 Eatonside area map.

3.1.2 Orange Farm

Orange Farm (Figure 3.3) is an urban informal settlement with a population of about 500 000 people; it is situated 45 km to the south of the Johannesburg central business district, between Lanseria and Evaton (Emfuleni Municipality) in the greater Johannesburg Metropolitan Municipality, in Gauteng Province, South Africa (Naidoo 2003:2). Orange Farm is recognised as one of the 'poorest of the poor' communities in the Gauteng province, with an unemployment rate close to 70 percent and a high HIV/AIDS infection rate (Hanes 2006).

Joint Aid Management requested that the councillors from the Orange Farm local municipality identify schools with a high level of poverty (Chibe 2007:37). In total, JAM provided meals to children in seven schools in Orange Farm. For this study, only three of the seven schools were randomly

chosen to take part in the study, namely, the Reitumetse and Sinqobile schools, where the participants received the Corn Soya Blend (CSB), and the Vulindlela Primary School, where the participants consumed Sejo. The participants receiving the CSB consisted of 45 randomly selected participants in each school, including boys and girls aged six to 14 already voluntarily participating in the JAM school feeding programme at that stage. The Sejo group consisted of 82 participants, of which 40 were boys and 42 were girls, aged 6-13 years.

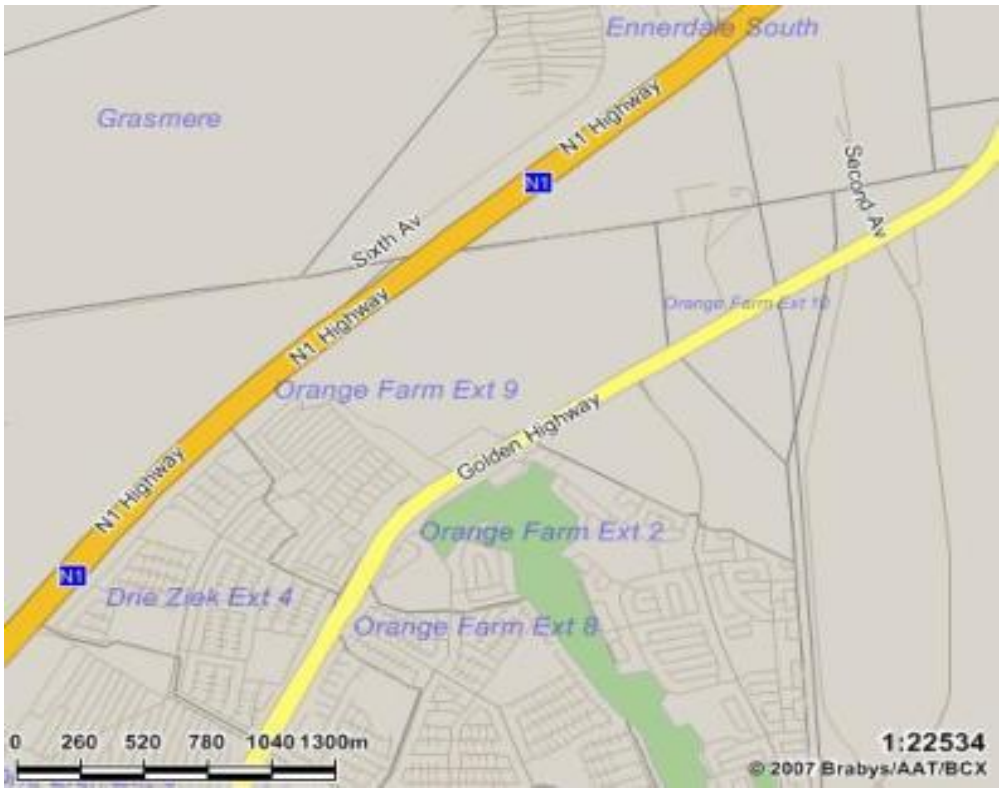

Figure 3.3 Orange Farm area map

3.2 Preliminary survey

In order to determine the situation in both these communities, a cross-sectional survey was conducted in 2004 in Eatonside (Oldewage-Theron, Dicks, Napier & Rutengwe 2005:14) and in 2005 in Orange Farm. Both the Eatonside and Orange Farm communities are informal settlements.

3.2.1 Planning of the survey

The female caregivers of households in the Eatonside and Orange Farm community were targeted to complete questionnaires. The caregivers were identified as the women responsible for looking after the children in the households, usually the mother, or, in the absence of the mother, a grandmother, stepmother, family member or guardian. Three hundred and forty households in the Eatonside community were randomly selected for the baseline survey. A total of 315 questionnaires had to be completed by the caregivers of the households in order to obtain a representative sample of 25 percent of the population in Eatonside, and an additional 25 households were selected to make provision for possible dropouts during the project. A total of 259 caregivers in the Orange Farm community gave consent to participate in the study. These caregivers formed the convenience sample in Orange Farm.

3.2.2 Consent from the communities

After the two communities were identified, as discussed in 3.1.1 and 3.1.2, a planning meeting was held in each of the two communities to obtain consent for the projects to be undertaken. In this meeting, the aims and objectives of the studies were clearly explained. The procedures were discussed and the community members present had the opportunity to ask questions. All participating members had to give written consent to participate in the studies.

3.2.3 Ethical considerations

The ethics committee of the Vaal University of Technology approved the study and the protocol was submitted in accordance with the existing policy for research in the institution.

3.2.4 Data enumerators

Eight data enumerators were recruited as fieldworkers. A training manual was developed and fieldworkers received intensive fieldworker training, which included various participatory methods such as case studies and role-playing. During the workshop, the communication skills of the fieldworkers were also developed.

3.2.5. Questionnaires

In the preliminary survey, the various questionnaires were used to investigate the following variables:

- A socio-demographic questionnaire (Annexure A) to determine demographic data such as the age, gender, home language and education levels of the household members;
- Physical and infrastructure data such as the residence setting, number of household members, number of rooms, number of rooms used for sleeping, water storage, fuel usage, household pests and perceptions regarding environmental services;
- Socioeconomic data such as health, food, food procurement, food processing and preparation, employment status, household assets and caring practices; and
- A quantitative food frequency questionnaire (QFFQ) (Annexure B) as well as a 24-hour recall questionnaire (Annexure C) to determine dietary intake and food consumption patterns.

A validated QFFQ (MacIntyre 1998:200) was used for the preliminary survey in order to obtain quantitative as well as descriptive information. Fieldworkers assisted the respondents when necessary, and used food models to determine portion sizes and to explain the different food items. A 24-hour

recall questionnaire, which was drawn up and then tested for reliability, served as reference measure for the QFFQ (Napier 2006:108).

3.2.6 Statistical analyses

Demographic, socioeconomic and health data were captured onto a spreadsheet by a trained data capturer. The data were analysed using the Statistical Package for Social Sciences (SPSS) and descriptive statistics (frequencies, means, standard deviations and confidence intervals) were obtained.

The dietary intake and food consumption data were captured and analysed using the Food Finder®, South African Medical Research Council's computer program version 3.0, with the assistance of a qualified dietician. Means and standard deviations were calculated for food and nutrient intake.

3.2.7 Preliminary results

Evidence from the preliminary survey indicated prevalence of poverty in both the Eatonside (Oldewage-Theron *et al.* 2005:14) and Orange Farm communities. The household income of the two samples indicated that in both communities a large percentage of the respondents earned less than one thousand rand a month. Although the majority of the households had two or more people who contributed to the monthly income, the unemployment rate in both areas was high, at 94.2 percent in Eatonside and 93.3 percent in Orange Farm.

Results showed that most households shopped for food monthly (61.6 percent in Eatonside and 54.2 percent Orange Farm), and mainly at spaza shops in the area (Eatonside 55.5 percent, Orange Farm 57.8 percent). The results further indicated that 38.1 percent of households in Eatonside and 40 percent of households in Orange Farm spent less than R50 per week on

food. This correlates with the low income in both communities, as mentioned earlier. In both areas, food preparation was mainly the responsibility of the mother (in Eatonside, 81.8 percent and in Orange Farm, 76.2 percent). The majority of the households in both communities consumed at least two meals per day (in Eatonside, 55.7 percent and in Orange Farm, 58.4 percent), and the meals were mainly consumed at home.

Results for dietary intake and nutritional status showed that the majority of the household members consumed a carbohydrate-based diet with insufficient consumption of all the other nutrients. In addition, the health status of the respondents was compromised.

3.2.8 Conclusion

After the preliminary study, the conclusion was drawn that the socioeconomic status of both communities was poor, household food security was a problem and health problems existed.

The results of the preliminary study formed the basis for the baseline study, after which the intervention, in the form of school feeding programmes, was planned and implemented.

JAM introduced school feeding products in all the schools in Orange Farm, and the author of this thesis developed and introduced a product called a vetkoek in a school in Eatonside. The purpose of the current study was to analyse all the school feeding products used as part of the above-mentioned school feeding programmes, including the PSNP and a fruit group which acted as a control group, as well as CSB and Sejo, which was used for the first time in Orange Farm schools. The objectives were to compare the nutritional status of the children participating in the programmes as well as to compare acceptance and shelf life of the different products. In order to

accomplish these objectives, a baseline study, which will be discussed in the next section, was conducted in both the communities. .

This project was undertaken in four phases, namely:

1. Baseline survey;
2. Product development / selection, nutritional analysis, acceptance and shelf life testing;
3. Intervention, analysis and evaluation phase; and
4. Comparison of the five different school feeding products evaluated.

Phase one, the baseline survey, will be discussed for all the groups, whereas phase two will be discussed for each individual product. The intervention segment of phase three will be discussed in Chapter 3, while the section dealing with the results, analysis and evaluation of phase three, as well as the comparison of all the products, will be discussed in Chapter 4.

3.3 Phase 1: Baseline survey

The nutritional status of a random sample from Eatonside of 80 male and female primary school children, aged six to 13 years, and 79 children of the Orange Farm community, was assessed. Both the communities are situated in semi-urban areas in Gauteng, South Africa and the participating schools are attended only by children from the informal settlements under investigation. As mentioned before, the schools in the two communities were identified when a strategic roundtable participatory planning workshop including all stakeholders was held. The following schools formed part of the investigation: Sethlabotja in Eatonside, and Reitumetse, Sinqobile and Vulindlela in Orange Farm.

3.3.1 Objectives

The main objective was to determine the nutritional status of the children before the implementation of the different school feeding programmes. The

measurements chosen included a QFFQ (Annexure B), 24-hour dietary recall (Annexure C), as well as anthropometric and biochemical measurements.

3.3.2 Planning of the baseline study

During a public meeting with parents, teachers, representatives of the Vaal University of Technology and JAM, permission was obtained from the DoE (Annexure D) the school principal, the parents and the school governing body to conduct the study in the Sethlabotja School in Eatonside, and from the principals of the three schools in Orange Farm. The researchers involved in the project were introduced to those who attended the meeting (Chibe 2007:36).

3.3.2.1 Letters of consent

Letters of consent containing all the requirements, expectations and details of the research projects were distributed to the parents at the meetings in Sethlabotja (Annexure E) and Orange Farm (Annexure F). All parents were asked to complete these letters in order to approve learners' participation in the studies and to provide consent. The whole process was conducted under the leadership and supervision of Prof. W. H. Oldewage-Theron.

3.3.2.2 Ethical considerations

Approval was obtained from the Medical Ethics Committee of the University of the Witwatersrand (WITS) for the two main studies, namely 'Evaluation of a feeding programme in addressing malnutrition in primary schools' (Annexure G) and 'Impact of a nutrition intervention programme on school children in Orange Farm' (Annexure H). All the children taking part in this study obtained written parental consent to participate in the various studies. It was indicated to the respondents in the letters of consent that the dissemination of information would take place in a responsible and

professional manner and that all findings would be treated with confidentiality and the necessary respect. Anonymity was assured with regard to personal and sensitive information, by providing participants with project numbers. The participation of all the children in this study was voluntary. The baseline data were collected in May 2003 in the Eatonside community and in March 2005 in the Orange Farm community. The researcher assisted with the collection of data in the Eatonside community.

3.3.2.3 Sample selection

The nutritional status of a random sample of primary school children in the schools mentioned was assessed. The first contact was made by a visit to the Department of Education to obtain permission to do studies in government schools.

The sample was stratified as follows:

- Children aged six to thirteen years;
- Boys and girls;
- Geographical area – residing in the informal settlement; and
- Children attending the primary school.

3.3.2.4 Sampling procedure

A random sample, representative of the community, was chosen. The selection criteria for the above included the following:

- Households with children in primary schools;
- Residents of the informal settlement of Eatonside or Orange Farm; and
- At least one literate person in the household.

The parents of all the children meeting the inclusion criteria in the school in the Eatonside area (n=519) were asked to participate, of whom 80 agreed. A total of 80 children was thus included in the sample population of the baseline study in the Eatonside area.

In Orange Farm, 760 respondents completed assessments over four individual data-gathering sessions. This was the total for all the socio-demographic, QFFQs and 24-hour recall questionnaires, as well as anthropometric and biochemical measurements completed during the baseline survey in Orange Farm as discussed in 4.1.2.

3.3.2.5 Fieldworker training

Ten third year students and BTech students of Food and Beverage Management were trained to act as fieldworkers by a registered dietician. These students were all Sotho-speaking women. Training for the initial implementation of the activities and refresher courses throughout the projects were included. Trained fieldworkers completed questionnaires in an interview situation, as seen in Figure 3.4 and Figure 3.5, and gathered information for the baseline study from the sample population. Fieldworkers were responsible for distributing and completing the questionnaires and for weighing and measuring the children. They received detailed instructions regarding anthropometric measurements and administering the quantitative food frequency questionnaire to the children. Emphasis was placed on ensuring that the fieldworkers were aware of the objectives and importance of the project.

Figure 3.4 Trained fieldworkers completing questionnaires in Eatonside

Figure 3.5 Trained fieldworkers completing questionnaires in Orange Farm

3.3.3 Questionnaires

Three different questionnaires were used in all the schools: a socio-demographic questionnaire (Annexure A), a quantitative food frequency

questionnaire (Annexure B) and a 24-hour recall questionnaire (Annexure C). The breakfast pattern questionnaire (Annexure I) was used only in Eatonside. The questionnaires used in the baseline survey were the same as used in the preliminary survey, with the exception of the breakfast pattern questionnaire. The parents/caregivers completed all the questionnaires with the assistance of the trained fieldworkers. One of the limitations of this study was that the QFFQ was completed in all the groups for pretesting; however, for post-testing it was completed only in the CSB and Sejo groups

3.3.3.1 Socio-demographic questionnaire

The socio-demographic questionnaire included questions to determine household density, number of children in the family, age of children, gender of the children, parents living at home, parents' education, parents' occupation, income level of the household, geographical area and money available for school snacks.

3.3.3.2 Quantitative food frequency questionnaire

The dietary intake and food consumption patterns were determined by a quantitative food frequency questionnaire (QFFQ) as test measurement and a 24-hour recall questionnaire as reference measurement. The validated QFFQ that was used in the Transition and Health during Urbanisation in South Africa (THUSA) study (MacIntyre 1998:200) was used in this study to obtain quantitative, descriptive information about usual food consumption patterns. The questionnaire consisted of two components, namely, a list of the foods and a set of frequency-of-use response categories. An extensive list of simply defined foods was included, with the aim of estimating total food intake, and thus dietary diversity. The QFFQ provides a retrospective review of intake frequency, that is, food per day, per week or per month. For ease of evaluation, the food frequency questionnaire organises food into groups that have common nutrients. All the QFFQs were completed for the subjects by

the fieldworkers during an interview situation with the mother or caregiver. Food models were used simultaneously to determine portion sizes and to explain the food items to subjects.

3.3.3.3 24-Hour recall

Nutrient intake data depends largely on the methods used to obtain information on dietary habits and intakes. The 24-hour recall method tends to measure lower intakes than do diet history and food frequency questionnaires (Vorster, Oosthuizen, Jerling, Veldman and Burger 1997:3). The 24-hour recall asks the person to list specific foods and the amount of foods consumed in the last 24 hours, for use by the information-processing professional. Problems that can be experienced in using this method include:

- Inability to recall accurately the kinds and amounts of food eaten;
- Over-reporting low food intake; and
- Under-reporting high food intakes.

Using a QFFQ and the 24-hour recall method in combination provides a more accurate estimation of food intake (Mahan & Escott-Stump 2004:366). The QFFQ was utilised for all the groups for pre-intervention testing; however, for post-intervention testing, only the CSB and Sejo groups completed the QFFQ.

3.3.3.4 Breakfast pattern questionnaire

The breakfast pattern questionnaire was designed to determine the breakfast consumption patterns of the schoolchildren in order to determine the actual number of children who consume breakfast before going to school, as well as the portion size and items consumed. The questionnaire included questions on breakfast foods as well as additional snacks, to determine the need for a lunch box snack/meal for children attending the primary school. From the

data, a list was compiled of the top 20 food items most frequently consumed as breakfast food. The breakfast pattern questionnaire was completed only in the Eatonside community. The results of the QFFQ, 24-hour recall and breakfast pattern questionnaires were used to determine the availability of food items in the households and this information was used in the development of the vetkoek.

3.3.3.5 Reproducibility

All the questionnaires, except the QFFQ and the 24-hour recall, which were already validated and their reproducibility confirmed, were tested for reproducibility on 10 randomly selected female caregiver volunteers from the informal settlements. Both the purpose and the contents of each of the questionnaires were explained by the fieldworkers and then completed by the caregivers. These selected caregivers completed the socio-demographic and breakfast pattern questionnaires each week for a period of four weeks. The answers were then compared and, based on the results, the questionnaires were accepted as reproducible since a high correlation was found ($r = 0.523$, $p \leq 0.05$). The caregivers were randomly assigned to the fieldworkers and were not necessarily interviewed by the same fieldworkers. This was done in order to eliminate observer bias. All of the completed questionnaires were statistically analysed to detect variation; however, no consistent pattern of variation was reported.

3.3.4 Measuring instruments

The study design used for the baseline survey was a cross-sectional, analytic design in which a number of variables were measured, as discussed in the following paragraphs.

3.3.4.1 Anthropometric measurements

Two of the fieldworkers were responsible for measuring weight and height and recording these results. Body weight, in light clothing with shoes removed, was determined to the nearest 0,1 kg by using a Phillips weight scale, and height measured to the nearest 0,5 cm using a vertical height scale.

The height measurements were conducted as follows:

- The subject had to remove his/her shoes.
- The subject was positioned as follows:
  - facing the fieldworker
  - shoulders relaxed, with shoulder blades, buttocks and heels touching the measuring board
  - arms relaxed at the sides
  - legs straight and knees together, feet flat and heels touching.
- The subject had to look straight ahead before the headpiece was slid down on the head. It just touched the crown of the head.
- The fieldworker recorded the reading in cm on the anthropometric measurement space provided on the demographic questionnaire.
- The procedure was repeated. The two readings had to be within 5 mm of each other.
- If the two readings varied by more than 5 mm, the procedure was repeated until the two readings were within 5 mm of each other.
- An average of the two readings within 5 mm was recorded (SAVACG 1995:103).

The weight measurements were conducted using a digital Phillips scale as follows:

- The scale was placed on an even, uncarpeted area with the spirit level indication in the middle.

- The scale was switched on and the fieldworker waited until the zero indicator (0.0) appeared, as well as the stable indicator (º in the top left-hand corner of the display panel).
- The subjects were weighed in light clothes, without shoes, after emptying their bladders (Figure 3.6).
- The subjects stepped on the scale. They had to stand upright in the middle of the platform, facing the fieldworker and looking straight ahead. Their feet had to be flat and slightly apart. They had to stand still until the measurement was recorded.
- The subject had to step down from the scale and wait for the zero reading to appear on the digital display.
- The procedure was then repeated. The readings had to be within 100 g of each other.
- If the two readings were not within 100 g of each other, the procedure was repeated until the two readings were within 100 g of each other.
- An average of the two measurements was recorded (SAVACG 1995:100-101).

Figure 3.6 One of the subjects being weighed

3.3.4.2 Biochemical measurements

The subjects were required to fast overnight (8-12 hours). Venous blood samples were taken by qualified nursing sisters from the *vena cephalica* of seated subjects, using a 21-guage scalp vein infusion set (Figure 3.7). All the blood samples were drawn with minimal stasis and between 07h00 and 10h00 to avoid effects of diurnal variation. Vacutainer blood collecting tubes were labelled in advance with each subject's trial number as well as the date. Body temperature was also measured by the same nursing sisters, using standardised techniques.

Figure 3.7 A registered nursing sister drawing blood from one of the subjects

Blood samples were drawn for the determination of serum vitamin A, haemoglobin, haematocrit (Hct), zinc, iron, ferritin, transferrin and total iron binding capacity. The following samples were collected from each subject:

- 5 ml blood in ethylene diamine tetra-acetic acid (EDTA) tubes (purple lid) for full blood counts, total protein, albumin, vitamin B12 and folate, as well as measurement of haematological markers: Hct, mean cell volume (MCV), red blood cell count (RBC), haemoglobin (Hb) and white blood cell count (WBC);

- 10 ml blood in silicone-coated tubes for preparation of serum for the analysis of serum retinol, iron, vitamin E, zinc, ferritin and transferrin. The tube was immediately protected against UV light (after collection), by being covered with aluminium foil.

All the blood samples were collected and handled by a haematologist under controlled, standardised conditions. The blood was separated within two hours of blood collection. One of the most important attributes of the project was the importance placed on the quality of the data. A monitoring haematologist visited the blood collection point to check and calibrate the equipment in use and to supervise the data collection. Detailed monitoring checklists were maintained to verify whether appropriate techniques were being employed for each point of the data collection. The laboratories involved in the analysis of the blood used standardised techniques according to existing routine procedures.

3.3.5 Data capturing

3.3.5.1 Demographic questionnaires

After completing the fieldwork, questionnaires were sorted and checked by the researcher for completeness, accuracy and usability. The data on the completed questionnaires was captured on Excel spreadsheets by the researcher. The demographic questionnaires were analysed for descriptive statistics, with the assistance of a statistician. Tables were drawn up with the percentages of the different variables included on the questionnaire. Standardised methods were used.

Data was presented in terms of frequencies and percentages for the following categories:

- age,

- gender,
- number of children per household,
- household income,
- household demographics;
- services available; and
- occupation of the breadwinner.

3.3.5.2 Dietary intake

As described in section 3.2.5, a 24-hour recall, a breakfast pattern questionnaire and QFFQ, previously validated in the THUSA study, were obtained from each child during personal interviews together with the parent / caregiver. Food models were used to assist in the quantification of portion sizes. Data was captured and analysed by a qualified dietician, using the Food Finder® version 3.0 computer software package. The QFFQs were analysed and the nutrient intake and foods consumed were established. The data from the QFFQs were captured and related in tables and graphs for interpretation. The statistical analysis was conducted by an independent statistical analyst to determine the adequacy of the nutrient intake and the prevalence of deficiencies that could be concluded from the QFFQs. The children's minimum, mean and maximum intakes with standard deviation were analysed and compared to the Estimated Average Requirement (EAR) (Institute of Medicine 2004). From the data, a list of top 20 foods most frequently consumed was drawn up.

3.3.5.3 Anthropometric measurements

The growth charts of the National Centre for Health Statistics (NCHS) were used to make a statistical comparison of the anthropometric indicators. As recommended by the WHO, the nutritional status of the children in the survey was compared with an international reference population defined by the

NCHS. Height and weight measurements were classified according to these percentiles, which are generally used as an international reference population. For this study, age was calculated in years from the date of birth to the actual date that each child participated in the survey (Flegal, Wei & Ogden 2002:761).

The anthropometric measurements were captured on an Excel spreadsheet and sent to a statistician for analysis. Scatter plots were drawn on the NCHS growth charts. The indices included the following: BMI-for-age, weight-for-age and height-for-age indicated on the 5^{th}, 50^{th} and 95^{th} percentile of the NCHS median (Flegal *et al.* 2002: 761).

3.3.5.4 Biochemical measurements

Blood was separated (centrifuged at 1500 g for 20 minutes) within 2 hours of collection by a haematologist. Separated serum was aliquoted in marked Eppendorf test tubes. Two qualified medical technologists continuously audited the separating procedure. Serum for the analysis of ferritin, total protein, albumin, vitamin B12 and folate was stored at -10 ºC until analysis in the laboratories of the Vaal University of Technology. Serum for retinol, vitamin E and zinc analysis was covered with aluminium foil and stored at -10 ºC until it was couriered to the Nutritional Intervention Research Unit of the Medical Research Council (MRC) in Cape Town. The EDTA tubes were directly placed on a sample tube mixer for immediate analysis. After analysis, the haematologist captured the data on an Excel spreadsheet, after which it was analysed for means and standard deviations (SDs), using the Statistical Programme for Social Sciences (SPSS) version 15.0.

All blood parameters were analysed according to standard protocol. The following analyses were performed; haematocrit (Hct) (numeric integration, Coulter counter ABX $MICROS_{CT}$); haemoglobin (Hb) (cyanomethaemoglobin colorimetric method, Coulter counter ABX $MICROS_{CT}$); red blood cell count

(RBC) (Coulter counter ABX MICROS$_{CT}$); serum glucose (colorimetric, Konelab^{TM}, GOD-POD); serum albumin (colorimetric, Konelab^{TM}, BCG); total protein (colorimetric, Konelab^{TM}); serum folate (immunoturbidity, TOSHO, AIA-PACK B12); vitamin B_{12} (immunoturbidity, TOSHO, AIA-PACK B12); retinol (high performance liquid chromatography, HPLC); iron (colorimetric, Roche Unimate 5 Iron); ferritin (immunoturbidometric method, Roche Unimate 3 FERR); zinc (non-diluted serum flame atomic absorption spectrophotometry); and total cholesterol and triglycerides (homogenous enzymatic colorimetric, Konelab^{TM}).

3.4 Phase 2: Product development and/or selection, acceptance and shelf life testing

The following five different products, as shown in Figure 3.8, formed part of this study: a vetkoek specifically designed by the researcher as part of a school feeding programme, the PSNP currently used in South Africa, a corn soya blend product (CSB), a sorghum product (Sejo), and fruit, which was given to a control group. JAM produces both the CSB and Sejo. The vetkoek, PSNP and fruit were administered to children in the Eatonside community and the CSB and Sejo to children in the Orange Farm community.

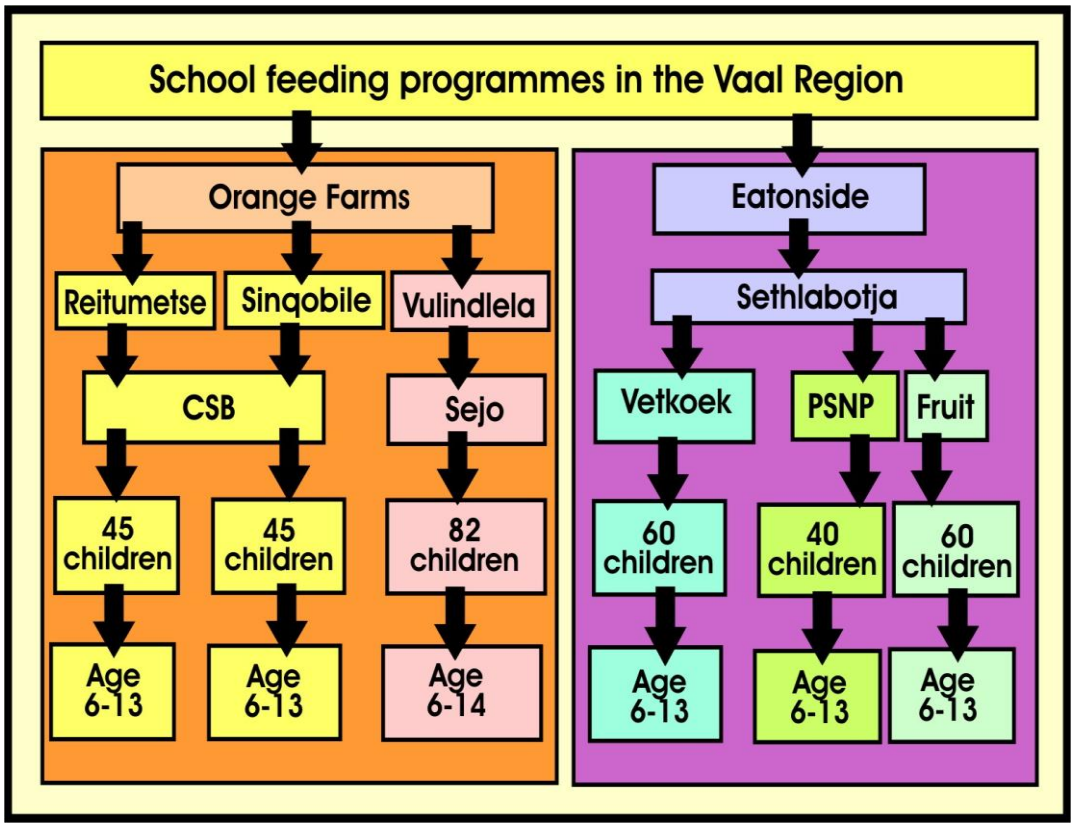

Figure 3.8 School feeding programmes evaluated in this study.

The first product that will be discussed is the vetkoek. It will be discussed in more detail than the other products as it was developed by the researcher as part of her Master's study.

3.4.1 Vetkoek

The main objective for the development of a novel food product, namely, vetkoek (Figure 3.9), was to meet the criteria required for a school feeding product, specifically, that it should be cost effective, culturally acceptable, easy to prepare and accepted by children. The aim was that this vetkoek should supply at least 25% of the RDA for children aged six to 13 for energy, iron, zinc, calcium and vitamin A, as prescribed by the DoH when the PSNP was initially implemented. The baseline study was conducted to determine the socio-demographic background, nutritional status, dietary intake and food

consumption patterns of the primary school children in Eatonside. The information gathered was used for the development of the vetkoek for school feeding, with the objective of addressing nutrient deficiencies identified in the baseline study, in order to improve the nutritional status of previously disadvantaged primary school children in the Vaal Triangle, who were not receiving breakfast.

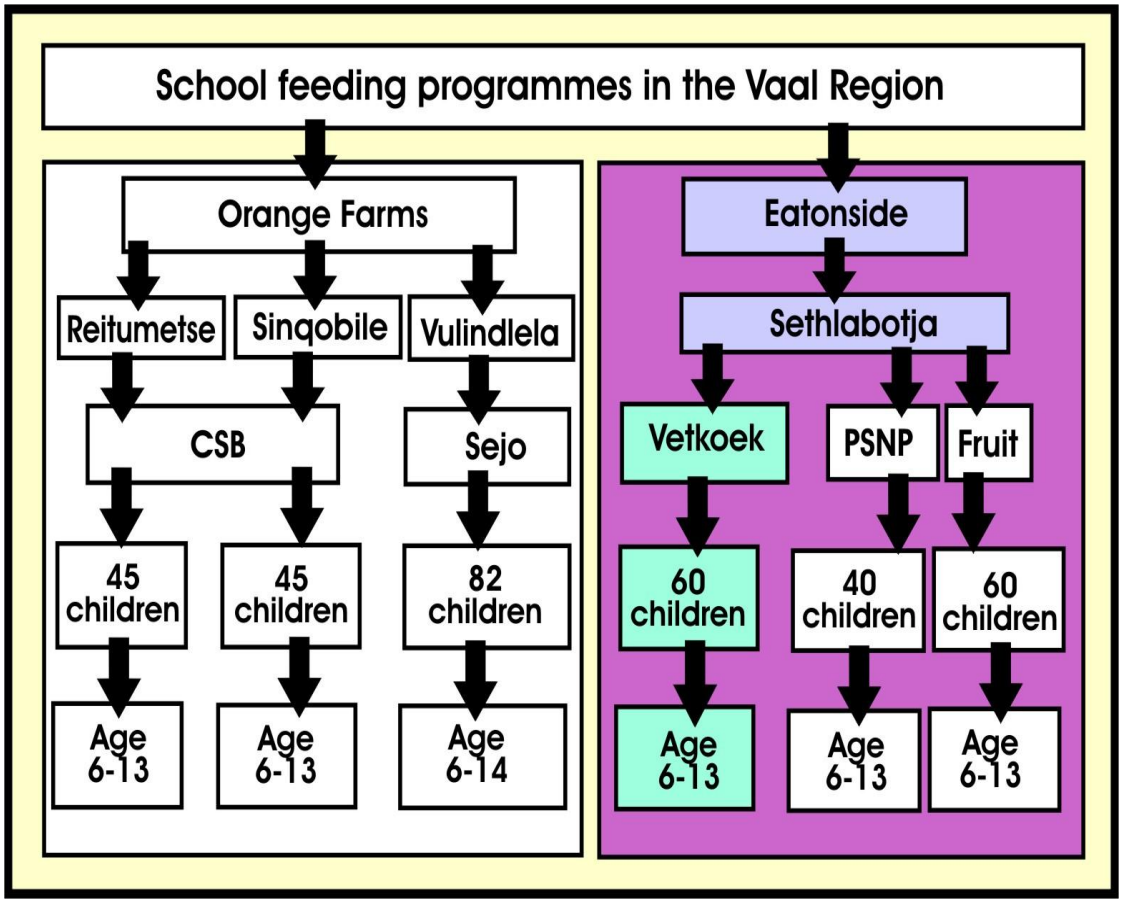

Figure 3.9 The vetkoek intervention

This project initiated the involvement of local communities and non-governmental organisations in the Vaal Triangle for the upliftment of the community, as described previously. A primary school, situated in Eatonside, was chosen for the intervention. Permission from the Department of Education, the School Governing Body, principal and parents had previously been obtained, as described earlier.

3.4.1.1 Criteria for the development of the product

The product that was developed was based on the following criteria: affordability, availability of widely consumed foods, sustainability and addressing under-nutrition. The main ingredients were based on the staple food items most commonly used in the community as indicated in a preliminary survey (Oldewage-Theron *et al.* 2005:23). Ingredients (Figure 3.10) used in the product were among the top 20 food items consumed. The product that was developed was a maize and wheat “vetkoek” (small deep-fried cake made from unsweetened dough, a typical South African snack).

The development of this novel nutritious food product was based on the following criteria:

- Balanced nutritional value, rich in energy, zinc and iron. (The vetkoek was developed to meet an average of 25 percent of DRIs for energy, iron, zinc and vitamin A for children six to 13 years of age). The NFCS indicated that the intake of the above-mentioned nutrients by South African children was below two-thirds of the RDA (Labadarios *et al*. 2005:540).
- Easy to prepare (18.9 percent of mothers were illiterate, only 17 percent of the households had access to electrical stoves, 8.8 percent had access to coal and 75.6 percent had access to paraffin stoves). Ingredients had to be those generally available in the households. Although the vetkoek was prepared at school, the intention was that the mothers should continue preparing these after the intervention.
- Acceptable to children (62 percent of children had bread and tea for breakfast; ingredients are among food items most commonly consumed, as indicated in Figure 3.10, and vetkoek is a product that is well known to children in the Eatonside area).
- Low cost (<R 2.00 per person per day).

Figure 3.10 Ingredients used in the product

3.4.1.2 Different recipes identified

A specific product suitable for children and easy to prepare with readily available ingredients was the ideal. Five different vetkoek recipes were initially identified as possible products. Basic vetkoek recipes were chosen since vetkoek is one of the top 20 food items consumed, as indicated in the breakfast survey. A cost analysis was performed on each recipe to determine the most cost effective recipes. Each recipe was prepared and nutritionally analysed using the Dietary Manager program, based on the South African food composition tables. All ingredients for the recipes were readily available; a stove was not necessarily required for preparing the product, as vetkoek can also be prepared on an open fire.

From the original five recipes, the three most suitable were chosen and three different types of maize meal and/or whole-wheat vetkoek were developed;

A - Maize vetkoek

B - Wholewheat vetkoek

C - Maize and wholewheat vetkoek

3.4.1.3 Formulation of the product (theoretical)

The Dietary Manager program, based on the South African food composition tables, was used to evaluate the five recipes for nutritional content. The nutritional content of each recipe was compared to the DRI for children aged between six and 13. Different ingredients from among the top 20 foods consumed (as indicated in the baseline survey and discussed in 3.3.3.4)..The different recipes were adjusted so that they were maize based (maize is a staple food) and different ingredients were added to contribute to the nutrient content. Sensory evaluations were conducted to determine acceptance and preference, as discussed in 3.4.1.5.

Three recipes were selected for nutritional value and cost for the empirical study. These recipes were those with nutritional values meeting the criteria closest to 25 percent of DRIs (for energy, iron, zinc, calcium and vitamin A) for children six to 13 years of age. The different recipes were prepared and a preference testing was conducted.

The results from the ARC indicated a shortfall in energy (429 kJ), calcium (156.4 mg) and vitamin A (40 µg RE). From the theoretical calculations on the Dietary Manager program, the shortages could be addressed by adding 20 g of full-cream milk powder. The final adjustments were made to reach an average of 25 percent of DRIs for energy, iron, zinc, calcium and vitamin A for children six to 13 years of age. The recipe was then finalised and the product was couriered to the ARC for a second nutritional analysis. Three nutritional analyses (Table 3.1) were conducted by the ARC, and an average of the three was used for the actual nutrient content of the final vetkoek.

Table 3.1 Average of the three nutritional analyses of the final vetkoek.

		Dietary Manager	**1st Analysis by ARC**	**2nd Analysis by ARC**	**3rd Analysis by ARC**	**Average**
Analysis	Unit					
Moisture	%		34.20	29.86	39.50	34.52
*Protein	%	12.64	7.29	10.32	8.96	8.86
Fat (ether extraction)	%	33.72	15.42	17.79	8.21	13.81
Folate	µg /100g	57	1002.52	540	820	787.51
Vit A	µg /100g	0.29 (retinol)	60	70	90	70
Vit B1	mg/100g	0.24	0.43	0.41	0.40	0.41
Vit B2	mg/100g	0.36	0.15	0.21	0.10	0.15
Vit B6	mg/100g	0.22	1.35	0.36	0.46	0.72
Vit B12	µg /100g	0.30	5.31	1.49	1.27	2.69
Vit C	mg/100g	2.00	0.81	0.42	1.27	0.83
Carbohydrates calculated	g/100g	34.15	40.66	39.82	41.45	40.64
Energy calculated	kJ/100g	2065	1386	1511	1161	1353
Calcium	mg/100g	198	140.49	156.03	117.23	137.92
Magnesium	mg/100g	85	73.42	72.13	72.24	72.59
Copper	mg/100g	0.24	0.08	0.17	0.14	0.13
Iron	mg/100g	3.09	0.98	0.69	0.40	0.69
Zinc	mg/100g	12.64 **	1.35	0.36	0.46	0.72

1 IU = 0.3 µg retinol

*For the conversion of nitrogen content to protein content, the factor 6.25 was used

** Estimated amounts were used for zinc, as there are no recommended amounts available

The final vetkoek (Figure 3.11) contained the following ingredients: maize meal, whole wheat, yeast, spinach, full cream milk powder, canned pilchard fish, egg, sugar and salt. The vetkoek was fried in vegetable oil. The different recipes were prepared and tested in the cooking laboratories of the Hospitality and Tourism department of the Vaal University of Technology. A cost analysis was performed for each recipe to determine whether the recipe met the cost criterion (< R2.00 per portion).

Figure 3.11 Vetkoek portion of 120 g

The recipe was then finalised. The product was prepared and a sensory analysis was conducted by the target group. The final product was couriered to the ARC for a final nutritional analysis

3.4.1.4 Chemical analyses

The prepared product was sent to the Agricultural Research Centre (ARC), an accredited food analysis laboratory in Pretoria, for actual chemical analysis for the following: ash, moisture, fat, protein, folate, vitamin (vit) A, carbohydrates, vit B1, vit B2, vit B6, vit B12, vit C, energy, calcium, magnesium, copper, iron and zinc.

3.4.1.5 Sensory evaluation: paired preference testing

In the first sensory evaluation, a paired preference test (Annexure J) was conducted to determine the most popular of the three products. The preference test forces a choice of one item over another. A sensory panel of 60 children, aged six to 13 years, was composed by random selection from the primary school in order to evaluate the three types of vetkoek presented to them, namely, sample A - Maize vetkoek, sample B – Whole wheat

vetkoek and sample C - Maize and whole wheat vetkoek. Two sessions were held in two different classrooms, with 30 children in each classroom. The sensory panel was seated in three rows of ten children each; the children were not allowed to communicate with one another during the sensory evaluation session. An example of the sensory evaluation form was drawn on the black board in the classroom and an explanation in the children's own language was given before the sensory evaluation took place. Sensory evaluation forms and pencils were handed out to all the children. For serving, each vetkoek was placed on a white paper plate and numbered A, B or C. The children evaluated sample A first, then sample C and finally, sample B; the sensory evaluation form indicated this order. A glass of water was given to the children between tastings to clear their taste buds and mouth before they tried the next sample. Personal assistance was offered to the children during evaluation.

3.4.1.6 Acceptance testing

In the second sensory evaluation, an acceptance test (Annexure K) was performed, the objective of which was to test the acceptability of the product. A hedonic scale was used, which is a suitable method for measuring children's responses to products. This test was relatively simple and the aim was to determine whether the children liked or disliked the vetkoek. The target group consisted of 30 children aged six to 13 years, currently attending the primary school in Eatonside. An example of the sensory evaluation form was drawn on the black board in the classroom and explained to the children in their own language as well as in English to make sure that they understood exactly what was expected from them. Sensory evaluation forms and pencils were handed out to all the children.

For serving, the vetkoek was placed on a white paper plate and a glass of water was given to the children after tasting. As a reward for helping with the

assessment, the children got fruit and a sweet and they were also allowed to keep the pencils.

3.4.1.7 Shelf life analysis of the vetkoek

The researcher had to contract out the shelf life studies, as this was not her field of expertise. Shelf life analysis was conducted under a range of controlled test conditions by the ARC, an accredited laboratory. Microbiological tests were conducted to evaluate the growth of harmful bacteria and microorganisms after specified time periods, to determine shelf life. During shelf life testing, the food was periodically examined for changes in appearance, aroma, texture and taste, until it became unacceptable. The sensory changes were initially subtle, but they eventually made the food unacceptable. High numbers of microorganisms are normal in certain foods, but indicate deterioration in other foods. The prepared vetkoek was couriered to the laboratory in a cool box without any cooling blocks, immediately after preparation for the shelf life testing. It was packed in a foil tray with a cardboard lid. One tray was kept at 4 ºC and the other tray at room temperature (± 25 ºC). The vetkoek was plated out on day 0 (day of arrival), day 2, 4 and day 7.

A 10 g sample was aseptically removed from the inside of the vetkoek. The sample was homogenised in a Stomacher 400 (DHK Pty Ltd., Norwalk USA) with 90 ml of diluted buffered peptone water. The sample was plated out for a total aerobic plate count on Tryptone soya agar and incubated at 25 ºC for 72 hours, and for yeast and moulds on Rose Bengal agar and incubated at 25 ºC for 72 hours.

3.4.1.8 Developing the recipe pamphlet

A recipe pamphlet (Annexure L), containing different vetkoek recipes, was developed and printed for illiterate people. The pamphlet was used to train the mothers and caregivers who were responsible for preparing the vetkoek for the schoolchildren. The recipe pamphlet contained the recipe for the vetkoek and another similar recipe that could be prepared with ingredients, which, according to the baseline study conducted, would be available in the households. The same recipe pamphlet will be used in future in basic training of caregivers in this and other communities.

The second product that will be discussed is the PSNP menu.

3.4.2 Primary school nutrition programme

The second item under investigation in this study, as indicated in Figure 3.12, included the products used as part of the PSNP. The food was prepared by women of the community with the occasional help of teachers when necessary. The PSNP group consisted of 40 children randomly selected from among the children who took part in the PSNP, whose parents had given permission to participate in the study and who had completed all the questionnaires and had had blood samples collected. Their names were listed on a register for attendance control. The children lined up in front of a classroom; the grade one to four group met at 09h30 and the grade five to seven group at 14h00 (Napier 2006:167).

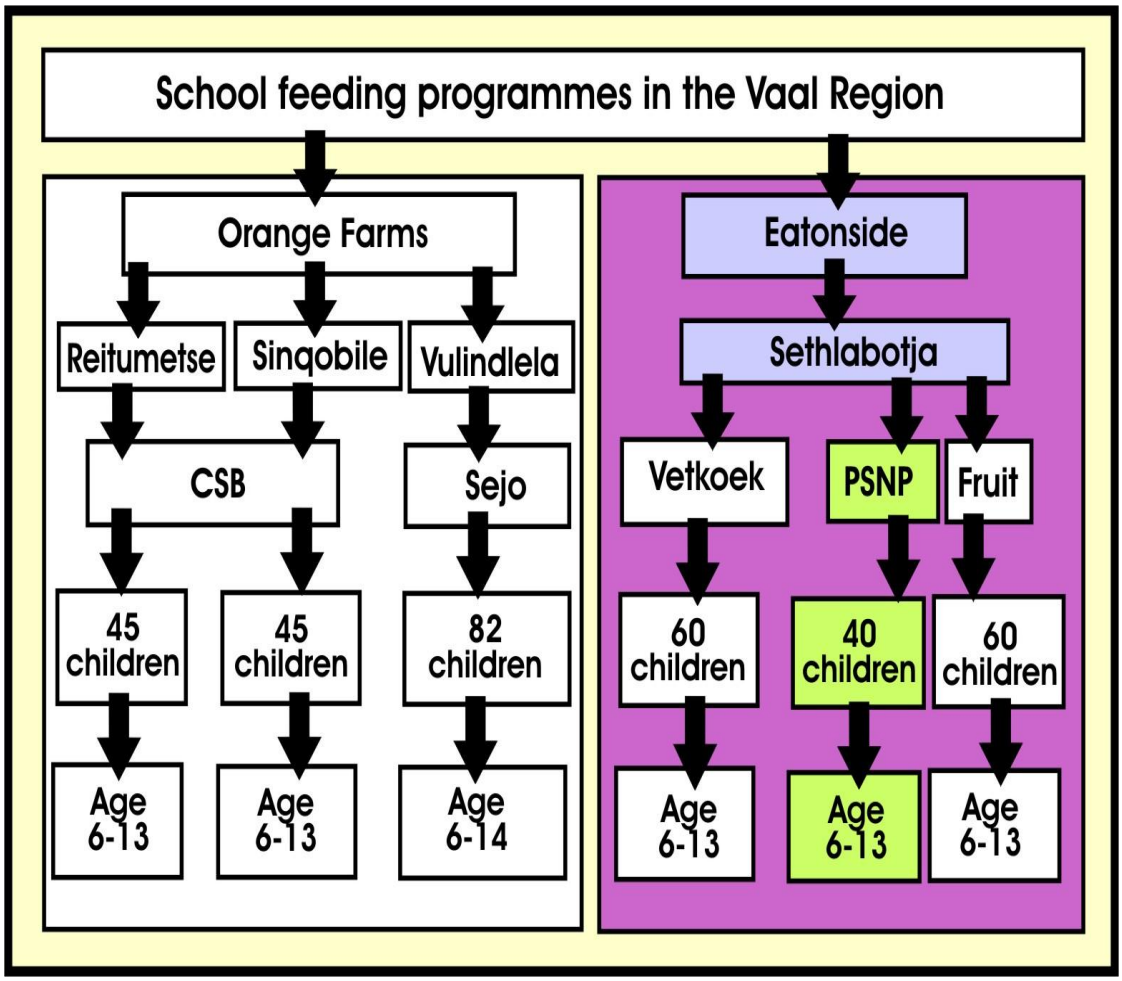

Figure 3.12 Primary school nutrition programme

The children received food as per menu one (Table 3.2) and two (Table 3.3) for the duration of the study,which was seven mothts (as discussed in 1.3) with the exception of weekends, public holidays and school holidays (Napier 2006:167). The PSNP menu consisted of a winter and a summer menu. In winter (menu 2), porridge was cooked every second day and bread was given only twice a week, whereas the summer menu (menu 1) consisted mainly of bread, while fortified biscuits were given only once a week.

The children received a vitamin C-enriched drink, milk or maas as part of the menu. Peanut butter and jam or pilchard fish was used as filling on the sandwiches; it was noted, however, that the children did not receive this very often. The menu suggests bread with no filling except margarine to be served

on Fridays, but the researcher observed that the children received bread with margarine and without any other filling more than once a week.

Table 3.2 Menu 1: PSNP (Gauteng Department of Health 1997:5-6).

Day	Menu	Quantity per child
Monday	• Fortified biscuits • Vitamin C-enriched drink	4 x 25 g 200 ml
Tuesday	• Bread • Peanut butter • Jam • Vitamin C-enriched drink	2 slices (80 g) 30 g 20 g 200 ml
Wednesday	• Bread • Peanut butter • Jam • Milk	2 slices (80 g) 30 g 20 g 100 ml fresh full cream
Thursday	• Bread • Fish • Margarine • Vitamin C-enriched drink	2 slices (80 g) 30 g 20 g 200 ml
Friday	• Bread • Margarine • Maas	2 slices (80 g) 20 g 200 ml

Table 3.3 Menu 2: PSNP (Gauteng Department of Health 1997:5-6).

Day	Menu	Quantity per child
Monday	• Grain sorghum porridge • Sugar • Oil • Fresh full cream milk / maas	400 ml = 80 g 15 g 10 g 100 ml
Tuesday	• Bread • Peanut butter • Jam • Fruit juice, sweetened	2 slices (80 g) 30 g 20 g 200 ml
Wednesday	• Maize meal porridge • Dried legumes • Oil	400 ml (100 g) 40 g 10 g
Thursday	• Bread • Margarine • Jam • Fruit juice, sweetened	2 slices (80 g) 20 g 20 g 200 ml
Friday	• Maize meal porridge • Soya mince • Oil	200 ml (100 g) 40 g 10 ml

3.4.2.1 Criteria for the children receiving the product

In a discussion with the school principal at the Sethlabotja School, it appeared that the following inclusion criteria are used:

- Children must be attending the Sethlabotja school;
- There must be evidence that the children are in need of nutritional intervention;
- Children with parents who are unemployed are included; and
- Children who are from bigger families with a low income are included.

Schools have the responsibility of identifying those learners in dire need, and must make application annually via the District Office. Information sessions are held towards the end of each school year, during which application (Annexure M) and assessment (Annexure N) forms are distributed. Needy learners are assessed according to the criteria provided on the assessment form. Schools that meet the criteria complete both the assessment and application forms and submit these forms by the end of January each year to the relevant district office for attention of the designated District official (NSNP 2008).

3.4.2.2 Shelf life

No specific shelf life testing was conducted on the food items used in the PSNP menu.

3.4.2.3 Sensory evaluation

No specific sensory evaluation was conducted on the food items used in the PSNP menu.

3.4.3 Corn Soya Blend

The third product that will be discussed is the Corn Soya Blend (CSB), provided in the Reitumetse and Sinqobile primary schools in Orange Farm, as indicated in Figure 3.13.

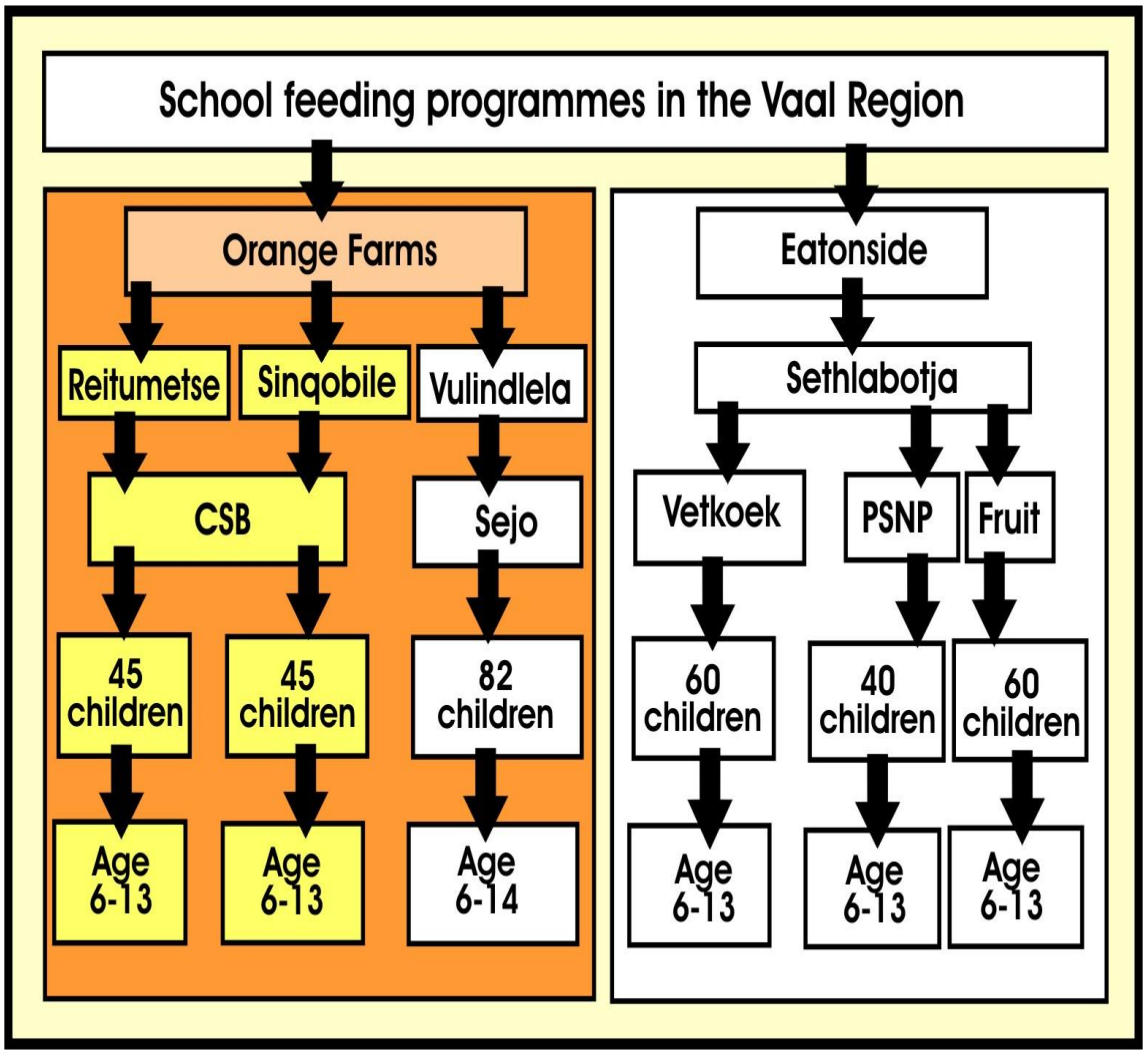

Figure 3.13 Corn Soya Blend used in Orange Farm

As described previously, permission was obtained from the principals of the Reitumetse and Sinqobile primary schools to undertake the research project. A public meeting with parents, school principals, teachers, representatives of Vaal University of Technology, Master's degree students (MTech students) and JAM representatives was held before commencement of the study (Figure 3.14.) Parents were asked to sign letters of consent to enable learners to take part in the study conducted by Chibe (2007). The process was conducted under the leadership of Prof. W. H. Oldewage-Theron.

Figure 3.14 Stakeholders meeting at the Sinqobile Primary School

The fortified CSB utilised in the JAM school feeding programme at Orange Farm consisted of a mixture of 65 percent pre-cooked maize meal, 25 percent soya and 10 percent sugar. The product provided carbohydrates, proteins, fats, vitamins A, D and E as well as the minerals calcium and iron. The JAM guidelines indicated that each child should receive a serving equivalent to 100 g of CSB mixture once a day (JAM 2004:6). The primary school children consumed the CSB soft porridge provided daily by JAM (Chibe 2007: 38). At the Reitumetse Primary School, an average of 475 ml of porridge (67 g dry CSB mix) was provided per serving. At the Sinqobile Primary School an average of 429 ml of a stiffer porridge (73 g dry CSB mix) was consumed (Figure 3.15). Although JAM recommends that the equivalent of 100 g dry CSB mix should be provided per child for each school day, in an attempt to meet 70 percent of the RDA as stipulated by UNICEF, this was not possible because of preparation limitations in the schools (Chibe 2007:49-50). Furthermore, a 100 g dry portion would result in an even bigger portion, which on average is too much for children aged six to 13 years to consume. The cooked portion size varied from 475 ml to 429 ml of porridge daily, which already is a big portion.

Figure 3.15 Children consuming CSB in Orange Farm

3.4.3.1 Criteria for the children receiving the product

The school feeding beneficiary selection for JAM includes the following:

- Children must be between the ages of three and 14 years;
- Children must be attending a pre-school or primary school;
- The programme is targeted specifically at marginal schools, particularly in rural areas, where protein and energy malnutrition are a problem;
- JAM works only on invitation from the community, which must indicate that it needs assistance for its children;
- Through research conducted by JAM in each school, it must be evident that the parents are actively involved in the activities of the school and that the children are in need of nutritional intervention;
- The community is required to form a Parent Teacher Association (PTA) before the school can be accepted as part of the school feeding programme (A contract is signed with the PTA to ensure community support and commitment to the programme) (JAM Report 2006).

3.4.3.2 Nutritional breakdown of the product

The nutrition information for CSB is as follows:

- Moisture - maximum 10%
- Protein - minimum 14%
- Fat - minimum 6%
- Fibre - maximum 5%
- Energy(Kcal/100 g) - minimum 350 Kcal/100 g (1464.4 kJ/100 g)

CSB is fortified with micronutrients as indicated in Table 3.4.

Table 3.4 Micronutrient fortification of CSB per 100 g product (JAM 2006:3)

Nutrient	**Unit**	**Specifications: Fortified CSB**
Vitamin A	[1] IU/µg [2] RE	1664 / 998.4
Thiamine	mg	0.128
Riboflavin	mg	0.448
Niacin	mg	4.8
Folate	µg	60
Vitamin C	mg	48
Vitamin B12	µg	1.2
Iron	mg (ferrous fumarate)	8
Calcium	mg (calcium carbonate)	100
Zinc	mg (zinc sulphate)	5

[1] IU International Units

[2] RE Retinol Equivalents

3.4.3.3 Raw material specification

According to Chibe (2007:23), during her discussions with Mr Boros, the Orange Farm project manager, the following specifications for CSB were indicated:

- All raw materials used for the production of the CSB should be of good quality and free of foreign materials (substances hazardous to health, excessive moisture, insect damage and fungal contamination);

- The raw materials should comply with all relevant food laws and standards;
- All raw materials should be stored in dry, ventilated and hygienic conditions;
- The variation of the final product with respect to contents of moisture, protein, fibre, fat and micronutrients should not exceed five percent of the original value, using standard analytical techniques.
- The product should be free from abnormal smell, live pests and should be of merchantable quality;
- The end product should be of a colour distinctive to this product and a uniform fine texture with the following particle size: 100 percent passing through a 1.0 mm sieve and a minimum of 95 percent passing through a 0.6 mm sieve; and
- Shelf life must be a minimum of six months, subject to proper transport and storage conditions.

3.4.3.4 Nutritional compliance

The nutritional compliance of the CSB porridge for energy, vitamin A, thiamine, riboflavin, niacin, folate, vitamin C, vitamin B12, iron, calcium and zinc was measured in terms of the RDA guidelines for the specific gender and age group (Chibe 2007:24). Methods of preparing and cooking the CSB porridge were observed during three separate visits to the schools. The quantity of water used was measured and the amount of raw product was weighed to determine raw and cooked portion size, and the serving method was observed. Adjustments were made regarding the CSB porridge preparation procedures to ensure regulatory compliance. After the adjustments were made, the number and size of portions served, and the gender and grade of respondents were reported over the two-month trial period for sensory acceptance. The results will be discussed in Chapter 4.

3.4.3.5 Sensory perception of the product

Consumer acceptance testing (Annexure O) was used to assess the acceptability of the CSB product by the schoolchildren. This method was utilised in order to keep the procedure as easy as possible for the schoolchildren to understand. A three point hedonic scale was utilised indicating good, average and bad through facial expressions. During the preparation and presentation of the sample, the following procedures were observed: the correct amount was served at the correct temperature using the correct serving utensils, and as little information as possible was provided to the children in order to prevent bias (Chibe 2007:24).

3.4.3.6 Shelf life specification

The dry ingredients have a shelf life of one year, according to JAM specifications; however, the prepared product should be consumed after preparation.

The fourth product that will be described is the sorghum product, Sejo.

3.4.4 Sorghum product: Sejo

Eighty-two children in Vulindlele Primary School in Orange Farm received the sorghum product, Sejo (Figure 3.16). According to the manufacturers, Sejo is a powerful sorghum meal, which can be used as a complete meal replacement. Sejo has 24 vitamins and minerals added at 100 percent of RDA. The product is high in energy, can be used as an immune booster and has a low glycemic index. The product is manufactured by Origin Organic Nutritions in Gauteng (according to the information on the packaging material).

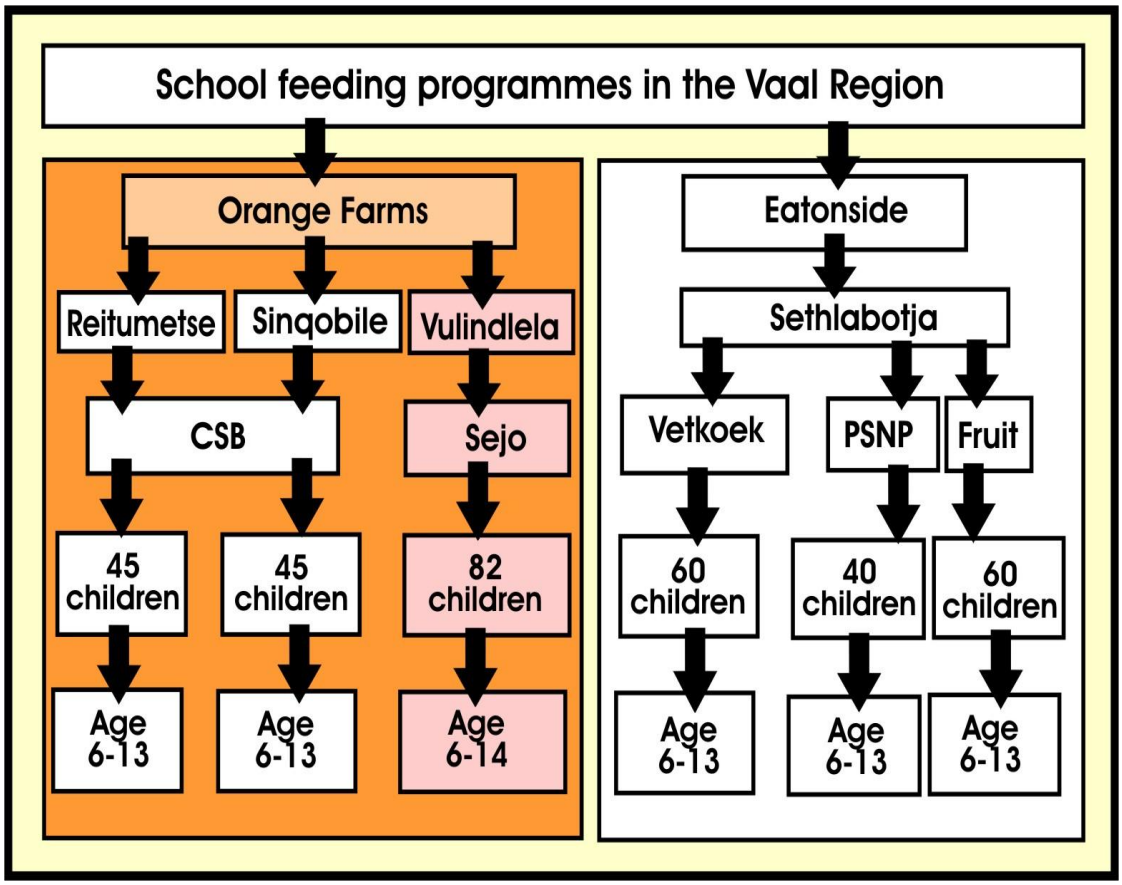

Figure 3.16 Sejo product used in Orange Farm

3.4.4.1 Criteria for the children receiving the product

The criteria for the children receiving Sejo are exactly the same criteria as used for the CSB.

3.4.4.2 Nutritional breakdown of the product

The ingredients in Sejo are pre-cooked sorghum, sugar, citric acid, salt, vitamin and mineral supplements and sweeteners. The product specification for 100 g of the Sejo Immune Enhancing Meal Formula is indicated in Table 3.5. The RDA complies with Government Gazette No. 15223 (Regulation 2034: Regulations Governing Labelling and Advertising of Foodstuffs) 29 October 1993 and applies to adults and children older than 10 years.

Table 3.5 Product specification for 100 g Sejo (Info as per packaging material)

Nutritional content	**Amount per 100 g portion**	**Percentage RDA**
Carbohydrate	78 g	
Energy	1439 kJ	
Fat	2.4 g	
Total dietary fibre	4.7 g	
Protein	6 g	
Vitamins		
ßeta-carotene	3.3 IU	100% RDA
Vitamin B1 (Thiamine)	1.4 mg	100% RDA
Vitamin B2 (Riboflavin)	1.6 mg	100% RDA
Niacin	18 mg	100% RDA
Pantothenic acid	6 mg	100% RDA
Vitamin B6	2 mg	100% RDA
Vitamin B12	2 mcg	100% RDA
Vitamin C	60 mg	100% RDA
Vitamin D3	5 mcg	100% RDA
Vitamin E	10 mg	100% RDA
Biotin	100 mcg	100% RDA
Folic acid	200 mcg	100% RDA
Phosphatidylcholine (30%)	350 mg	*
Minerals		
Calcium (hydrogen phosphate)	800 mg	100% RDA
Chlorine	250 mg	*
Chromium polynicotinate	200 mcg	100% RDA
Copper	1.0 mg	100% RDA
Iodine	150 mcg	100% RDA
Iron	14.0 mg	100% RDA
Magnesium	300 mg	100% RDA
Manganese	2.50 mg	100% RDA
Molybdenum	150 mcg	100% RDA
Phosphorous	769 mg	100% RDA
Potassium	160 mg	100% RDA
Selenium	200 mcg	100% RDA
Sodium	91.25 mg	*
Zinc	15 mg	100% RDA
ßeta-sitosterol	60 mg	*

* RDA not established

3.4.4.3 Sensory evaluation

Consumer acceptance testing was conducted to determine the acceptability of the Sejo product by the schoolchildren. During the preparation and presentation of the sample, the following procedures were observed: the correct amount was served, at the correct temperature, using the correct serving utensils. As little information as possible was provided to the children in order to prevent bias; however, fieldworkers were available to translate into Sotho if the children did not understand the questions.

3.4.4.4 Shelf life specification

The information on the package indicates that the Sejo has a shelf life period of one year after the date of manufacture.

The final group that will be discussed is the fruit group.

3.4.5 Fruit group

The fruit group was used as the control group for the vetkoek and PSNP groups, as indicated in Figure 3.17.

3.4.5.1 Sensory evaluation

No sensory evaluation was conducted. In general discussions with the children receiving the fruit, it was clear that children enjoyed the fruit and there was no wastage. During the researchers' visits to the school the children were randomly asked how they liked the fruit provided and which specific fruit they preferred.

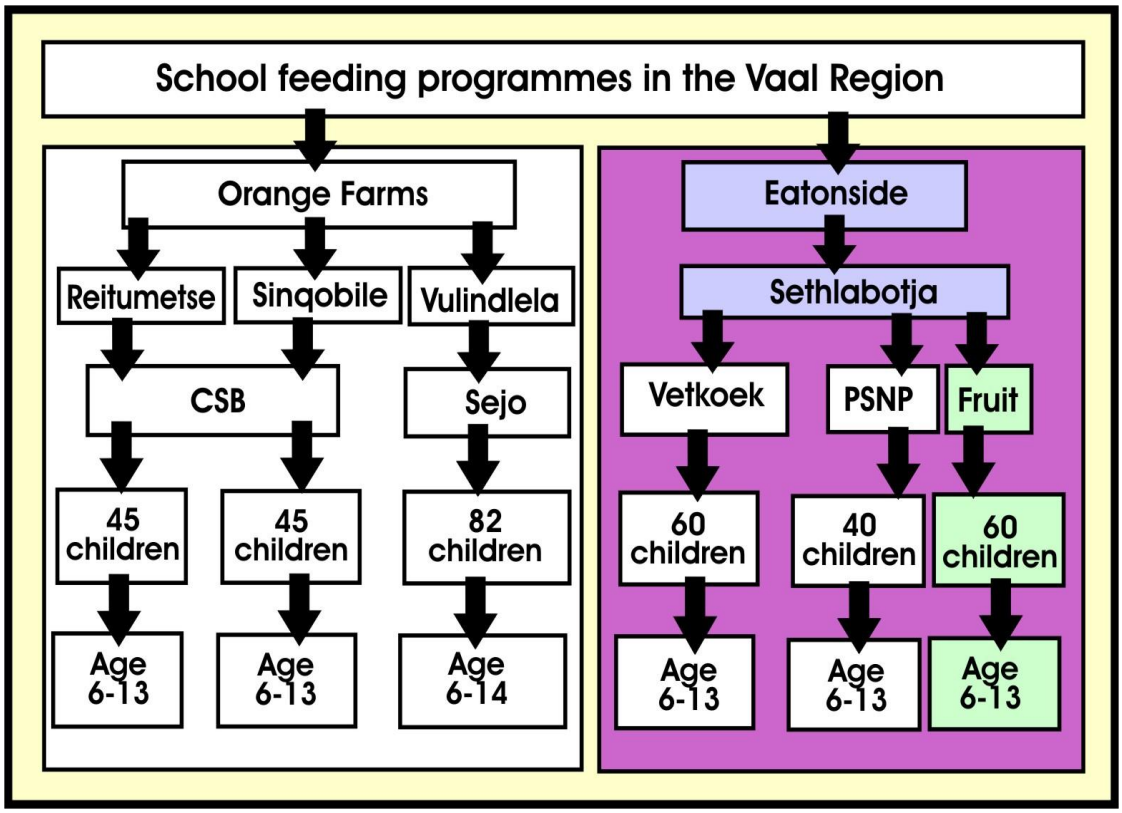

Figure 3.17 Fruit as the control group used in Eatonside

3.4.5.2 Shelf life

No shelf life studies were conducted because fresh fruit in season was delivered to the school every second day.

3.5 Phase 3 Intervention

Only the intervention part of phase three will be discussed below, as mentioned in 3.2 8. The analysis and evaluation will be discussed in Chapter 4.

3.5.1 Sample

In Sethlabotja in Eatonside, the sample consisted of 160 randomly selected boys and girls aged six to 13 years old. All the children in the group

participating in the PSNP were identified (n=40) and the rest of the group were randomly divided into the vetkoek and fruit groups, with 60 children in each group. The fruit group in this school was used as control group for all the participants. All the children in the schools in Orange Farm received school feeding on a daily basis, and could therefore not be considered for the control group. Sinqobile Primary School presents classes from grade zero to nine, whereas Sethlabotja, Reitumetse and Vulindlela Primary Schools present classes from grade zero to grade seven. For comparative purposes in this study, voluntary participants from grade one to seven from all the schools were included. This study population was determined not through specific selection, but by the application of opportunity sampling (Chibe 2007:38). For the CSB group, 90 children participated, and for the Sejo group, 82.

3.5.2 Vetkoek group

The intervention study, implemented by Napier (2006) and described by Kearney (2006), used the developed vetkoek as part of a school feeding programme. The effect of the vetkoek was compared to the effect of a single fruit per day and to the existing PSNP already in place in the school. Children aged six to thirteen years (n=160) were randomly assigned to one of the two groups: the vetkoek group (n=60) and the fruit group (n=60), while the remaining children were already part of the PSNP (n=40) (Table 3.6). The vetkoek, PSNP and fruit were distributed daily during the school week. The children lined up in front of the kiosk: the grade one to four group gathered at 09h30 and the grade five to seven group at 14h00 (the grade five to seven group attended the school's afternoon session, which only started at 12h00 and so the afternoon break was at 14h00). The community workers were responsible for the distribution of the vetkoek as well as the fruit during school break in the mornings (09h30) and afternoons (14h00). The community workers had a class register listing the names of all the children who participated, and they ticked the names as they received the vetkoek, to

ensure that the children received only one 120 g vetkoek each, and to record absenteeism. Water was made available for the children to drink while eating the vetkoek. The children were not allowed to leave the kiosk area until they had finished their portion of vetkoek. Children received the same type of vetkoek every day for the duration of the study, with the exception of weekends, public holidays and school holidays (Napier 2006:165).

Children were assessed at baseline and again after seven months of the intervention. The measurements used for this intervention were the same as in the baseline survey, namely: 24-hour dietary recall, anthropometric and biochemical measurements and school attendance records for all three groups. School attendance was recorded for all the children in the study on a daily basis by the teachers in a school attendance register. The register was divided into the four terms of the year, and was collected at the beginning of each new term for record-keeping purposes. Random observations were conducted to see if the children were present as indicated on the school attendance registers.

Table 3.6 Children participating in the study, categorised by age

Age	**Group 1 Vetkoek N=60**	**Group 2 Fruit N=60**	**Group 3 PSNP N=40**
6 years	1	0	0
7 years	12	4	10
8 years	18	13	14
9 years	19	24	10
10 years	9	15	6
11 years	1	4	0

3.5.2.1 Infrastructure provision

The researcher was instrumental in planning and providing the necessary infrastructure for the preparation and serving of the vetkoek. A production kitchen had to be erected on the school premises. A wooden hut measuring

4x4 m² with a veranda and corrugated iron roof was erected. Insulation panels were installed and the walls and ceiling were painted white. The kitchen had a door and one window opening to the outside that could be used as a serving hatch. A security door was installed to provide safety. A square cement slab was laid in front of the kitchen to keep children from standing in the mud in rainy seasons and to keep dust out of the kitchen. Water and electricity were installed from the adjacent building. A double basin stainless steel sink was installed. Shelves were mounted against the wall for storing the ingredients, small utensils and small equipment. The kitchen was equipped with a serving trolley, a stainless steel table, a deep fat fryer, an electronic scale, storage containers for ingredients and all the small utensils required to prepare the product. Cleaning equipment such as floor mops, brooms, brushes, dishcloths and buckets were provided, as well as the following cleaning materials: dishwashing liquid, disinfectant and all-purpose cleaning material.

An existing gas stove was installed in compliance with the “SABS 0157” and the “Vessels Under Pressure Act”. A separate storage area was constructed outside the wooden kitchen for the safe storage of the gas bottles used for the gas stove.

A portioning frame was designed by the researcher and constructed from stainless steel by an artisan for use by the community workers to portion each batch of vetkoek into 20 x 120 g portions. The frame was 2 cm high, 40 cm long and 25 cm wide. When the dough was prepared, the women who had been trained rolled out the dough to the same size as the portioning frame, and the frame was then placed on the dough and pressed down, which resulted in 20 vetkoek portions of 120 g each. At present (2008), the kitchen is still being utilised to distribute the food that forms part of the PSNP.

3.5.2.2 Training of the volunteer community workers

The school principal identified caregivers in the community for whom the researcher provided training in personal hygiene, basic kitchen hygiene and safety, basic food preparation, cooking methods and the use of electrical equipment. Training also included the preparation of the vetkoek recipe. These trained community workers (Figure 3.18) were responsible for the preparation and portioning of the vetkoek on a daily basis. Initial training was presented in the student-training restaurant at the Vaal University of Technology (VUT) and all demonstrations were conducted in the kitchen. Video sessions on personal and kitchen hygiene were presented in the Goldfields library at VUT. Subsequent training was provided in the wooden kitchen built on the school premises. Training in hygiene and safety was given on a continued basis to maintain standards and to ensure that a product of good quality was prepared daily.

3.5.2.3 Quality, portion control and compliance

After the initial training, the researcher visited the school every day for the first month to perform quality control; thereafter, weekly visits were conducted. During these visits, quality, portion and stock control was conducted. These visits occurred randomly and no appointments were made beforehand. If any portion size did not correspond to the prescribed 120 g portion, the inconsistency was addressed immediately and corrected. The school appointed a teacher to manage the caregivers who prepared the vetkoek and to check the quality and the progress of the feeding. The teacher also checked that the daily feeding took place as planned and in the correct manner.

Figure 3.18 Trained community workers

3.5.2.4 Provision of supplies

A local supplier able to deliver the ingredients to the school in the informal settlement was identified. The supplier was able to deliver spinach and fruit on a daily basis, and the dry ingredients on a weekly basis. A standard order was compiled and was given to the supplier every Friday for delivery on the following Monday. Ingredients delivered were checked against the standard order provided by the researcher. All invoices, which were kept in a file in the kitchen, were collected by the researcher during visits to the school. Trained community workers, with the assistance of teachers, were responsible for receiving delivered goods.

Part of the researcher's grant from the National Research Foundation was used for building the kitchen and for payment of the supplies used in this study. The finance department of the VUT processed the invoices for payment.

3.5.3 Primary School Nutrition Programme

An assessment from the Department of Health was used by the school to determine which learners qualified for the school feeding scheme in Sethlabotja. The teachers had to identify needy children between the ages of six and fourteen. Teachers had to determine the number of dependants in the household, including children and elderly, disabled and unemployed adults. The highest qualification of the care provider, the employment status and the total income of the household had to be taken into account. Any food support that the family received had to be indicated. After careful consideration of all the above factors, the teachers determined which children should receive school feeding daily (Napier 2006:85). At the time of this study, 334 children identified by the teachers according to the guidelines were included in the PSNP programme.

Children in the Sethlabotja School received food according to menu one of the departmental menus, as indicated in Tables 3.2 and 3.3. The menu included bread with margarine and peanut butter or fish, or fortified biscuits and a vitamin C-enriched drink. No hot food was prepared in Sethlabotja at the time of the study in that particular season (summer). The feeding took place during the first break and food was distributed by community workers appointed by the SGB and teachers of the school.

3.5.3.1 Quality, portion control and compliance

All school feeding programmes are monitored by regional/district or provincial staff on a regular basis.

3.5.3.2 Provision of supplies

Stock was delivered to the school on a monthly basis. All stock was kept in the main office building on the school premises in a small storage room and

sandwiches were prepared in the same room. One teacher was appointed to supervise the PSNP in this school. The school secretary kept records of the food they received, and all duplicate slips were organised and filed.

3.5.3.3 Evaluation of the menu

In 2003, Wentzel-Viljoen developed a model for the monitoring and evaluation of nutrition and nutrition-related programmes in South Africa. In this study, an extensive evaluation of the PSNP in the North West Province was conducted. The objectives of this assessment were to evaluate the existing programme against criteria outlined in the policy framework and to determine whether the implementation of the programme adhered to the standards of the Reconstruction and Development Programme. Additional objectives were to evaluate the cost effectiveness of the programme and its impact on the target population, to identify inadequacies and to determine to what extent programme objectives were being met (Wentzel-Viljoen 2003).

Currently, in terms of the Division of Revenue Act (DORA), periodic reporting on the activities of the programme is a statutory requirement. The Department of Education has field officers visiting the schools occasionally to evaluate the programme.

3.5.4 Corn Soya Blend

The primary school children (n=90) consumed the CSB soft porridge provided daily by JAM. At the Reitumetse Primary School, an average of 475 ml of porridge (67 g dry CSB mix) was provided per serving. At the Sinqobile Primary School, an average of 429 ml of porridge (73 g dry CSB mix) was consumed. Although JAM recommends that the equivalent of 100 g dry CSB mix should be provided per child for each school day, in an attempt to meet 70 percent of the RDA as stipulated by UNICEF, this was not possible because of limitations with regard to preparation of the porridge at the

schools. Moreover, portion sizes for the children had to be feasible (Chibe 2007:49-50).

3.5.4.1 Training of the staff

The volunteers were trained to use the correct procedures when preparing the CSB porridge. To reduce time and cost, group training was conducted with demonstrations. The training tools included a notebook, measuring jugs, buckets, raw CSB and water.

3.5.4.2 Provision of supplies

The JAM project facilitator for Orange Farm conducted the stock inventory on a weekly basis. The deliveries, which were made by JAM, depended on the quantity available during the weekly inventory. For Reitumetse School, eight 25 kg bags were delivered every two weeks, on average, and Sinqobile School received twelve bags of 25 kg every two weeks. The schools made use of the first in first out (FIFO) stock control method, which means that the stock that was delivered first must be used first. Extra CSB stock for one week was allowed for flexibility. Both schools provided a general storeroom where the dry mixture could be stored and the products prepared.

3.5.5 Sejo

The Sejo group consisted of 82 children randomly selected from among the children who had parental permission to participate in the study, had completed all the questionnaires and had blood samples collected (Figure 3.1). The children received a portion of 100 g of Sejo daily, with the exception of weekends, public holidays and school holidays.

3.5.5.1 Provision of supplies

The same procedure used for CSB deliveries was followed for deliveries of the Sejo. The deliveries, which were made by JAM, depended on the quantity available during the weekly inventory. The dry Sejo was delivered weekly to the Vulindlele School. The school used the FIFO stock control method and extra Sejo stock for one week was allowed for flexibility. The dry mixture was stored and the product prepared in a general storeroom.

Figure 3.19 Children participating in the study.

3.5.6 Fruit

The fruit group consisted of 60 children randomly selected from among the children who had parental permission to participate in the study, had completed all the questionnaires and had had blood samples collected. Their names were listed on a register for attendance control. The women of the community responsible for preparation and distribution of the vetkoek were also responsible for the distribution of the fruit, and had to ensure that the fruit was handed out to the correct children. The children lined up next to the ablution building; the grade one to four group gathered at 09h30 and grade five to seven group at 14h00. The type of fruit depended on cost and

availability and included apples, bananas, oranges and pears. Children received fruit every day for the duration of the study, with the exception of weekends, public holidays and school holidays.

3.5.6.1 Quality, portion control and compliance

The researcher visited the school every day for the first month; thereafter, weekly visits were conducted to ensure that the distribution of fruit took place according to the guidelines provided, that the amounts ordered were delivered, that the fruit was of good quality and that all the fruit was of equal size.

3.5.6.2 Provision of supplies

The researcher ordered the fruit on Friday mornings for delivery early on Monday morning, and on Tuesdays for delivery on a Wednesday morning. This was done to ensure that children received fresh fruit daily, as there is no cold room storage facility available at the school. Fruit portion size varied according to the specific type of fruit available in season. The portion size for apples and pears varied from 70 g to 80 g per portion and for bananas and oranges, from 100 g to 110 g per portion. When ordering the fruit, the researcher took into account that some of the fruit might be bruised or damaged and ordered an extra ten portions per day; thus, 70 portions were ordered. This allowed extra fruit for the community workers to consume.

3.5.6.3 Evaluation of the menu

Community workers handing out the fruit commented on the fact that the children appreciated the variety. Fruit in season was given and included apples (Golden Delicious and Star King), bananas, pears, oranges and naartjies.

3.6 Conclusion

As mentioned in 3.2.8, evidence from the preliminary survey indicated that the socioeconomic status of both the communities was poor, household food security was a problem and health problems existed. The purpose of this study was to analyse the five different school feeding products used as part of the above-mentioned school feeding programmes, namely, vetkoek, PSNP, CSB, Sejo and fruit; the group receiving the fruit acted as a control group. The objectives were to compare the nutritional status of the children participating in the programmes, to conduct a nutritional analysis of each product as well as to compare acceptance and shelf life of the different products, and finally, to compare the resulting impact on school attendance. All the results for phases one and two, and the intervention part of phase three, as well as the evaluation, data analyses and comparison of all the feeding strategies used in and around the Emfuleni Municipality as investigated in this study, will be discussed in Chapter 4.

As these products and their impact on the nutritional status of the children have never been compared with one another, this will lead to new knowledge about school feeding products currently being used in the Vaal Region in South Africa, and recommendations for improvement in the future (Chapter 5).