The Stabilizing Effects of Sesame Oil Extraction Technologies on Seasonal Fluctuations in Food Consumption and Nutritional Status of Rural Farming Households in The Gambia

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(ABSTRACT)

It has been well documented that women and children in The Gambia are particularly vulnerable to malnutrition. The combination of heavy labor demands on women and a weaning diet low in calories takes its toll on women and children during the pre-harvest lean season. In 1995, the Small-Scale Sesame Oil Production project introduced an inexpensive, manual technology for edible oil extraction, called the ram press, to women in The Gambia. The overall aim of the project was to improve household nutritional security through the adoption of the ram press by women sesame growers.

A 13-month study was conducted to evaluate the success of the Small-Scale Sesame Oil Production project. The study involved 120 rural households: 40 households with access to motorized expeller technology (Expeller group) for sesame oil extraction, 37 households with access to manual ram press technology (Press group), and 43 households with access to both technologies (Combination group). Twenty-four hour recalls, food frequency data, anthropometric measurements, and production data were obtained at the baseline and at the post-harvest, peak sesame oil-pressing, and pre-harvest lean seasons.

At the baseline, women in the Expeller group had higher mean intakes of kilocalories than those in the Press and Combination groups. After introduction of the ram press, the Press and Combination women reported consistently higher intakes of kilocalories than the Expeller women at all seasons, with the largest differences at the peak oil-pressing and pre-harvest lean seasons.

At the baseline, the consumption of kilocalories for Expeller children was greater than that of the Combination and Press children. After introduction of the ram press, this trend was reversed and the intake of kilocalories for Combination and Press children was greater than that of Expeller children at all other seasons. The Expeller children exhibited a marked increase in weight-for-height z-scores at the peak oil-pressing season that decreased to near baseline levels thereafter. The Combination and Press children exhibited a steady increase in weight-for-height z-scores across seasons except for the pre-harvest lean season when their scores leveled off.

These results indicate that women and children in households with access to ram press technology experience much less of a seasonal fluctuation in food consumption than those without ram press technology. Findings of this study also indicate that when women are given choices as to which technology is best for them, they will maximize their benefits from the available technologies.

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CHAPTER 1: INTRODUCTION

The climate of tropical regions is characterized by dramatic seasonal fluctuations in rainfall. In most tropical regions, the year can be described in terms of the rainy season and the dry season. In West Africa, most countries experience a rainy season that lasts about 3 months (beginning in July and ending in October) and is followed by a dry season characterized by 9 to 10 months of less than 4 inches of rain per month. In rural areas, the dependence of agricultural production on the rainy season results in seasonal fluctuations in agricultural production, the demand for labor in agriculture, and food supply. These factors combine to produce seasonal changes in nutritional status, morbidity, and mortality (Chambers et al, 1981)[1].

Shortages in food supply occur when food stocks from last year's harvest begin to run out just before the current year's crop is harvested. This is referred to as the pre-harvest lean season. In a review of studies on seasonal intake (many carried out in West Africa), Annegers (1973)[2] found that the highest energy intakes occurred during the November/December post-harvest season and the lowest intakes occurred during the July/August pre-harvest lean season. This yearly cycle of low food intakes in the pre-harvest lean season and high food intakes in the post-harvest season was noted in The Gambia as early as 1953 and has been reported as recently as 1992 (ICN Focal Point, 1992)[3].

Distinct rainy and dry seasons lead to seasonal variations in labor and energy requirements. A short rainy season reduces the optimal time for plant growth and forces farmers to engage in intensive bouts of agricultural labor. In a review by Teokul et al (1986)[4], the authors reported that in Mali, adult women work in the fields 5 hours per day in the rainy season and not at all in the dry season. Women in Burkina Faso followed a similar pattern, working 3.7 hours per day in the rainy season and not at all in the dry season.

The combination of a decreased food supply and an increased labor demand during the pre-harvest lean season results in a decreased nutritional status. Seasonal weight loss during the pre-harvest lean season followed by weight gain in the post-harvest season is the rule for adults living in rural areas of developing countries (Teokul et al, 1986)[5]. Children are also victims of the pre-harvest lean season both directly and indirectly. Children may experience growth faltering during the rainy season and catch-up growth during the dry season. Child mortality rates may be higher in the rainy season. Children born during the pre-harvest lean season are more likely to have a low birth weight that those born in the dry season (Prentice and Cole, 1994)[6].

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[1] Chambers R, Longhurst R, Pacey A. Seasonal Dimensions to Rural Poverty. Frances Pinter Limited. London, Great Britain. 1981.

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[5] Teokul W, Payne P, Dugdale A. Seasonal Variations in Nutritional Status in Rural Areas of Developing Countries: A Review of the Literature. Food and Nutrition Bulletin. 1986;8(4):7-10.

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The Gambia

The Gambia, one of the smallest countries in West Africa, occupies a narrow strip of land on both sides of the River Gambia and is bordered on three sides by Senegal (see Figure 1.1). The national economy is dominated by agriculture that employs about 85 percent of the active population. Agriculture is based on the cultivation of groundnuts, rice, millet, sorghum, and maize. Groundnuts are the main agricultural commodity, comprising up to 37 percent of the gross national product (GNP) (Webb, 1989)[7]. The Gambia is one of the poorest countries in West Africa with a GNP per capita of US $220 and produces only 70 percent of its own food requirements. The per capita caloric intake is estimated at 86 percent of energy requirements, and the per capita protein consumption is estimated at 51 g per day (ICN Focal Point, 1992)[8].

Figure 1.1. Map of The Gambia[9].

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[8] ICN Focal Point. The Gambia Nutrition Country Paper for the International Conference on Nutrition. Republic of The Gambia, Ministry of Health, Nutrition Unit. 1992.
[9] http://www.gambia.com/history/images/gambiamap_big.gif

Women in The Gambia have a life expectancy at birth of 43 years and a maternal mortality rate of 10.5 deaths per 1000 deliveries or more than twice the average rate for developing countries (INC Focal Point, 1992)[10]. With an infant mortality rate (IMR) of 142, The Gambia has child mortality rates that are among the highest in West Africa when compared to other countries of similar size and GNP. Child mortality rates follow seasonal fluctuations with the highest rates of mortality during the rainy season. In a 1982-1983 study, 71 percent of child deaths in rural areas occurred during the 6-month rainy season (ICN Focal Point, 1992)[11]. The National Nutrition Surveillance Program of the Nutrition Unit, Ministry of Health of The Gambia estimates that in the dry and rainy seasons, respectively, 12 and 18 percent of children are malnourished (< 90 percent of the median weight-for-height). In a pilot study conducted by the Nutrition Unit of the Gambian Ministry of Health, 40 percent of children surveyed were suffering from chronic malnutrition that is an indicator of chronic dietary energy deficiency (ICN Focal Point, 1992)[12].

Growth faltering in Gambian children becomes increasingly evident after 3 months of age when supplementary foods are introduced (ICN Focal Point, 1992)[13]. This is partially due to the weaning practices of Gambian mothers. Most children (84.8 percent) are weaned by the age of 18-24 months and over half of infants in The Gambia (53.5 percent) are receiving supplementary foods by the age of 3 months. The traditional porridge (pap), commonly made from millet, is popular with most mothers as a child's first food; however, it has a high water content and is low in calories (Semega-Janneh, 1991)[14]. Children in rural parts of the country do not fare as well as their urban counterparts as indicated by a higher infant mortality rate, a lower average daily caloric consumption, a higher percentage of calories from cereals, and a lower percentage of calories from oil (Harpham, 1996)[15].

Prentice et al (1981)[16] found that during the dry season, infants were born at an average of 89 percent of expected weight-for-age. They showed rapid catch up growth until they reached an average of 98 percent of expected weight-for-age at 3 months (the mean age for introduction of weaning foods), and their growth rate decreased slightly thereafter. In the rainy season, however, infants progressed relative to standard growth curves for the first 3 months of life and then there was a rapid deterioration in nutritional status. This results in high mortality rates among children under 5 years of age in rural areas, especially during the rainy season (ICN Focal Point, 1992)[17].

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[10] ICN Focal Point. The Gambia Nutrition Country Paper for the International Conference on Nutrition. Republic of The Gambia, Ministry of Health, Nutrition Unit. 1992.

[11] ICN Focal Point. The Gambia Nutrition Country Paper for the International Conference on Nutrition. Republic of The Gambia, Ministry of Health, Nutrition Unit. 1992.

[12] ICN Focal Point. The Gambia Nutrition Country Paper for the International Conference on Nutrition. Republic of The Gambia, Ministry of Health, Nutrition Unit. 1992.

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CHAPTER 2: LITERATURE REVIEW

Food Consumption

A primary constraint on households during the rainy season is the decrease in food consumption. Benefice et al (1984)[18] found that the mean daily per capita energy intake of a group of herders in Senegal fell from 2619 kcal in the dry season to 2005 kcal in the rainy season. The herders consumed 100 percent of the FAO recommended intake of kilocalories in the dry season; however, their rainy season intake was only 88.6 percent of the FAO recommendation (WHO, 1985)[19]. In a study conducted in The Gambia, von Braun et al (1989)[20] reported mean daily per capita energy intakes of 2522 kcals in the dry season and 2380 kcals in the rainy season. Wandel et al (1992)[21] reported similar seasonal fluctuations in the household per capita energy intake of subsistence farmers in Tanzania. Household energy intake decreased from 130 percent of the FAO recommendation in the dry season to only 85 percent in the lean season. In a study conducted by the Medical Research Council of the Dunn Nutrition Unit, researchers found that pregnant and lactating women in a rural community of The Gambia consumed only 65 percent of their recommended dietary allowance (RDA) of energy during the dry season. This figure dropped to only 45 to 50 percent of the RDA during the rainy season (ICN Focal Point, 1992)[22]. This study did not take into account snacks, such as, groundnuts; however, Prentice et al (1981)[23] obtained similar results in The Gambia when snacks were included. They found that during the dry season, from November to June, women's energy intake was relatively stable at 1483 kcal per day for pregnant women and 1684 kcal per day for lactating women. This represented only 56 percent and 59 percent of the FAO RDA for pregnant and lactating women, respectively (WHO, 1985)[24]. During the rainy season, however, the mean intake of both groups fell to a minimum of 1302 kcal per day for pregnant women and 1203 kcal per day for lactating women in the month of August. This represented 49 percent and 42 percent of the FAO RDA for pregnant and lactating women, respectively. Geuns et al (1991)[25] found that for preschool children in Kenya, the mean intake of energy during the lean season only accounted for 68 percent of the FAO RDA.

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Availability of Vitamin A

Vitamin A deficiency is also common among women and children in West Africa and may follow seasonal patterns. In a study conducted in Senegal, Rankins et al (1993)[26] found that 71.5 percent of children studied had marginal or deficient serum retinol levels. Villard and Bates (1987)[27] found that the maximum vitamin A intake in The Gambia occurred in the mid to late dry season and corresponded to the peak in mango and palm oil consumption (April through June) with extremely low intakes generally in the rainy season and early dry season. The major sources of vitamin A (β-carotene) throughout the year were red palm oil, mangos, leaves, pumpkin, and peppers (Bates et al, 1994)[28]. The peak in consumption in the latter half of the dry season seemed to occur every year. Bates et al (1984)[29] found that there was a pronounced peak in plasma carotenoid levels for both pregnant and lactating women during the latter part of the dry season and the early rains (May through July) with a maximum in mid June corresponding to the peak of the mango harvest. Minimum values were observed in the early part of the dry season (November through February).

Agricultural Work

Another constraint on households during the lean season is the increase in agricultural work with a resulting increase in energy expenditure. Adams (1995)[30] found that among agricultural households in Central Mali, mean daily energy expenditure for men and women peaked during the rainy season. The only significant differences in energy expenditure between seasons were an increase in agricultural work for men and women and a decrease in resting for men. Panter-Brick (1993)[31] found that among subsistence farming households in Nepal, women's total energy expenditure peaked during the rainy season. In the dry season, pregnant and lactating women had lower energy expenditures than non-pregnant/non-lactating women; however, during the rainy season, all women had similar high energy expenditures due to the long hours of physical work necessary during the peak agricultural season. Lawrence and Whitehead (1988)[32] found that for women in The Gambia, the duration of agricultural work increased from a low of 0.5 hours per day in January to 4.5 hours per day in July. From January through March, women did very little agricultural work averaging only 26 minutes per day. In April and May, women began

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to prepare for the start of agricultural work in June and worked 1.0 hour per day. In June and July, fields were cleared and dug and the rice and groundnut crops were planted. Women worked an average of 2.5 to 4.5 hours per day during this period. During August and September, women's agricultural work continued at 3.5 to 4.5 hours per day spent weeding the rice and groundnut crops. In October through December, women's work fell to 1.0 to 2.0 hours per day. Lawrence and Whitehead (1988)[33] found that the Total Energy Expenditure (TEE) (adjusted for stage of pregnancy or lactation) was lowest in the months of January through March (2300 kcal per day), rose sharply at the beginning of the rains (2700kcal per day), and was intermediate during the harvest season (2400 kcal per day). During the rainy season, women in late pregnancy or early lactation tended to go to the fields less frequently; however, on field days, the duration of agricultural work was not significantly affected by the stage of pregnancy or lactation.

Child Care

The high labor demands on women during the rainy season may require them to endure long separations from their children which results in a decrease in the time spend on childcare. Roberts et al (1982)[34] found that there was no significant difference in the percentage of time women spent caring for their children when they were in the village, but when they went farming during the rainy season and left their children behind, they did not compensate by spending more time with them after returning from farming. For children 7 to 18 months, women spent 56 minutes per day caring for their children in the dry season; whereas, in the rainy season, women that didn't take their children to the field with them spent only 34 minutes per day caring for their children. The time spent on cooking is at its lowest point at the height of the agricultural work season as well. Lawrence and Whitehead (1988)[35] found that the total time spent on cooking fell from 2 hours per day in November through January to 1 hour per day in July and August. As a result, women usually only prepared one meal for their child which was set aside and eaten throughout the day.

Weight Loss

The seasonal decrease in caloric intake with an accompanying increase in energy expenditure may result in decreased weight gain or weight loss for adult members of the household. Patore et al (1993)[36] reported significant seasonal fluctuations in the cumulative weight of subsistence farming households in Ethiopia. Households in the study lost a significant ($p<0.05$) amount of cumulative weight (3.3 percent) between the post-harvest season and the pre-harvest season. The authors also found that the pre-harvest to post-harvest fluctuation in cumulative weight of poor households (3.7 percent) was double that of rich households (1.9 percent). Lawrence et al

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(1987)[37] found that for non-pregnant, non-lactating women in The Gambia, weight loss during the rainy season averaged 5 kg, most of which was accounted for by changes in maternal adipose tissue stores. Approximately one third of total body fat was mobilized between March and October in these women. Lawrence et al (1987)[38] concluded that fat loss during the rainy season was almost certainly the result of a declining food intake combined with an increase in total energy expenditure associated with agricultural work. Prentice et al (1981)[39] found that pregnant women in The Gambia gained only 0.4 kg per month during the wet season compared to 1.4 kg per month during the dry season. They also found that lactating women lost weight during the wet season at a rate of 0.74 kg per month. This was not significantly greater than the rate of weight loss (0.67 kg per month) for non-pregnant, non-lactating women during the same period. During the dry season, lactating and non-pregnant, non-lactating women gained weight at similar rates.

Nutritional Status

The lean season is a time of decreased nutritional status for many household members, especially women and children. In a study conducted among agricultural households in central Mali, Adams et al (1995)[40] found that the body mass index (kg/m^2) of women farmers decreased from a mean of 19.6 in the dry season to 19.1 in the rainy season. This difference was significant at $p<0.01$. Adams (1994)[41] also found seasonal trends in anthropometric indicators for children under 5 years of age. The author found that weight-for-height and weight-for-age z-scores reached their lowest point at the beginning of the harvest season, rose gradually throughout the harvest and dry seasons, and then began to deteriorate again with the beginning of the rainy season. Weight-for-height z-scores decreased from -0.90 in the harvest season to -1.18 in the rainy season, and height-for-age z-scores decreased from -1.47 in the harvest season to -1.64 in the rainy season. These differences were significant at $p<0.01$ and $p<0.05$, respectively. Branca et al (1993)[42] reported a similar trend in weight-for-height z-scores of children in a study conducted among rural subsistence farmers in Ethiopia. The authors found that weight-for-height z-scores of children under 5 years of age improved during the harvest season and then decreased to their lowest point during the rainy season. Similar trends of seasonal fluctuations in anthropometric indicators have been observed by Rosetta (1986)[43] and Benefice et al (1984)[44] in Senegal.

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Implications for Well-Being

The combined effects of the lean season have serious implications for individuals dependent on agricultural production for their livelihood. Durnin (1994)[45] concluded that physical activity is reduced when an individual's body mass index (BMI) falls to 17 kg/m^2 or less. The author also concluded it is possible that work capacity may be reduced at a BMI of less than 18.5, and heavy agricultural work imposes greater stress on individuals with a low BMI. In a review of the nutritional links to productivity, Kennedy and Garcia (1994)[46] reported that a positive association exists between BMI and the amount of time devoted to work. The authors concluded that an increased BMI appears to increase the capacity to carry out work. In a study conducted in the Philippines to examine the impact of nutritional status on agricultural productivity, Haddad and Bouis (1991)[47] found that taller workers tend to be involved in tasks that pay higher wages. The authors concluded that adults who depend on agricultural wage income and were stunted as a result of poor nutrition during childhood will earn substantially less over their lifetime than adults that were not stunted.

Women's and children's health may also be detrimentally affected during the lean season. In a study conducted in The Gambia, Roberts et al (1982)[48] reported that the breast milk output of lactating women decreased during the lean season. For mothers of infants aged 3 to 12 months, breast milk output decreased up to 10 percent per day. In another study in The Gambia, Prentice et al (1987)[49] reported that birth weights vary according to season. The authors found mean birth weights of 3.0 kg during the dry season and 2.8 kg during the rainy season. These differences were significant at $p<0.01$. In a study conducted in The Gambia to examine the outcomes of low birth weight infants, Downes et al (1991)[50] concluded that low birth weight is a strong risk factor for infant mortality. The authors also reported that low birth weight infants did not exhibit catch-up growth during the first year of life. In a longitudinal analysis of mortality in The Gambia, Moore et al (1997)[51] concluded that people born during the rainy season were up to 10 times more likely to die prematurely in young adulthood.

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[51] Moore SE, Cole TJ, Poskitt EME, Sonko BJ, Whitehead RG, McGregor IA, Prentice AM. Season of Birth Predicts Mortality in Rural Gambia. Nature. 1997;388:434.

Potential of Supplementation

Supplementation or an increase in food consumption during the lean season can have a positive impact on all household members. Diaz et al (1991)[52] conducted a study in The Gambia to test the hypothesis that moderate undernutrition causes a reduction in work output that can be reversed by providing a high-energy dietary supplement. The study was carried out for 12 weeks during the lean season. The authors found that, although there were no significant differences in the work output between men that received the supplement and men that did not, there were significant differences in body weight. Men gained weight during supplementation and lost weight when they were not supplemented. Ceesay et al (1997)[53] conducted a study to test the effects of a dietary supplement on birth weight and infant survival in The Gambia. The supplement was a high energy groundnut biscuit and provided a possible daily intake of 1015 kilocalories. Since the supplement was only consumed on a mean of 82 out of a possible 135 days, its effective contribution to the diet was about 615 kilocalories per day. The authors found that the birth weight of infants born to women who received the supplement was 136 g greater than that of infants born to women that did not receive the supplement ($p<0.001$). The increase in birth weight was greatest during the hungry season (201 g) and was significant at $p<0.001$. The authors concluded that provision of a high-energy supplement to women during the last 20 weeks of pregnancy could significantly reduce retardation of intrauterine growth and perinatal mortality. Similar results were obtained in The Gambia by Prentice et al (1983)[54] using a supplement that resulted in a net increase in energy intake of 431 kilocalories per day.

Project Background

Catholic Relief Services (CRS) introduced sesame as a crop to women's groups in The Gambia in 1983 in response to the inadequate nutritional situation. The main purpose of the project was to improve general nutrition with the idea that sesame oil could provide a much-needed source of calories in both the women's and children's diets. Sesame production quickly became popular because: it required minimal labor as compared to groundnuts; it was drought resistant and could be planted if the main crop of groundnuts failed; and it could be planted after early millet and maize in order to spread out the labor requirements (Galton-Fenzi, 1992)[55].

In order to facilitate sesame oil production, CRS installed 16 diesel powered oil expellers between 1983 and 1989, and Sesame Growers Associations (SGA's) were organized to take over management of the expellers from CRS (Galton-Fenzi, 1992)[56]. Sesame is primarily a woman's crop with production being driven by an interest in processing the seed to oil that can then be

[52] Diaz E, Goldberg GR, Taylor M, Savage JM, Sellen D, Coward WA. Effects of Dietary Supplementation on Work Performance in Gambian Laborers. American Journal of Clinical Nutrition. 1991;53:803-11.

[53] Ceesay SM, Prentice AM, Cole TJ, Foord F, Weaver LT, Poskitt EME, Whitehead RG. Effects of Birth Weight and Perinatal Mortality of Maternal Dietary Supplements in Rural Gambia: 5 Year Randomized Controlled Trial. British Medical Journal. 1997;315:786-90.

[54] Prentice AM, Whitehead RG, Watkinson M, Lamb WH, Cole TJ. Prenatal Dietary Supplementation of African Women and Birth-Weight. The Lancet. 1983:489-92.

[55] Galton-Fenzi, JD. Project Report to Determine the Potential of Expanding Sesame Production in The Gambia. Labat-Anderson Inc. Unpublished. 1992.

[56] Galton-Fenzi, JD. Project Report to Determine the Potential of Expanding Sesame Production in The Gambia. Labat-Anderson Inc. Unpublished. 1992.

consumed or sold on the local market (ICN Focal Point, 1992)[57]. Sesame production peaked during the 1986-87 growing season when approximately 12,000 ha of sesame were planted and approximately 4000 metric tons of seed were produced. From this harvest, approximately 350 metric tons of seed were pressed in the expellers producing 16 metric tons of oil that was consumed locally.

By 1993, however, a dramatic reduction in sesame production had occurred and production had fallen to an estimated 600 to 900 metric tons (Galton-Fenzi, 1992)[58]. The main reason for the reduction in sesame production was that out of the 16 expellers imported into the country for the SGA's, by 1994 only 6 were in working order. Consequently, women were too far away from the expellers, and the high cost of transporting the seeds, oil, and seed cake reduced the profitability of processing. The broken expellers had not been repaired due to the high cost of replacement parts and because the problems were beyond the repair skills of the local mechanics (Awor, 1994)[59]. Because of a lack of ongoing maintenance and proper cleaning of the seed, the currently operating expellers were reaching the end of their useful life (Galton-Fenzi, 1992)[60]. It was thought that once these expellers stopped working, sesame production would also end. The biggest challenge facing the SGA's was to find a way of providing significant benefits to its members in order to retain their interest and willingness to pay dues (Freudenberger, 1994)[61].

Ram Press Technology

One promising solution to that problem was the ram press. The ram press is a small scale, manual technology for edible oil extraction first disseminated in the Arusha region of Tanzania in 1986. The ram press is inexpensive and can be manufactured and repaired in rural workshops using labor intensive methods. Unlike the imported expellers, no special imported components are needed and spare parts can be made locally. It was originally designed for soft-shelled varieties of sunflower seeds, but can be used for a variety of other oilseeds, such as, sesame. The ram press does not require additional preparation (preprocessing) steps for the seed, such as, decorticating or roasting and produces cold pressed oil, which has a longer shelf life and tastes better than oil produced by a motorized expeller (Hyman, 1993)[62].

Appropriate Technology International (ATI) engineer Carl Bielenberg invented the ram press in November of 1985. Since then, several refinements have been made and the current model, developed by Erwin Protzen and L. Manyanga of the Center for Agricultural Mechanization and Rural Technology (CAMARTEC) in 1992, is durable, easy to maintain, and portable. Since the

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[57] ICN Focal Point. The Gambia Nutrition Country Paper for the International Conference on Nutrition. Republic of The Gambia, Ministry of Health, Nutrition Unit. 1992.

[58] Galton-Fenzi, JD. Project Report to Determine the Potential of Expanding Sesame Production in The Gambia. Labat-Anderson Inc. Unpublished. 1992.

[59] Awor, S. The Training of Technician/Mechanic, Trainers and Users on the Instillation, Operation and maintenance of the Ram Press at Illiassa and Njau Sesame Growers Associations of the Catholic Relief Services. Appropriate Technology International. Banjul, The Gambia. December, 1994.

[60] Galton-Fenzi, JD. Project Report to Determine the Potential of Expanding Sesame Production in The Gambia. Labat-Anderson Inc. Unpublished. 1992.

[61] Freudenberger, KS. Evaluation of the Sesame Growers Association. Banjul, The Gambia. Catholic Relief Services. Unpublished. January, 1994.

[62] Hyman, EL. Production of Edible Oils For the Masses and By the Masses: The Impact of the Ram Press in Tanzania. World Development. 1993;21(3):429-43.

ram press costs only a fraction of the price of an expeller, each kafo (a sub-unit of the SGAs) could potentially own one and women would no longer have to forgo pressing due to high transportation costs (Hyman, 1993)[63].

In 1994, the Thrasher Research Fund funded the Small-Scale Sesame Oil Production project in The Gambia. The project was designed to test the effect of the adoption of ram press technology on the nutrition security of women and children. The overall aim of the project was to improve household nutrition security directly and indirectly through the manufacture and use of ram press technology in The Gambia (Prehm and Silva-Barbeau, 1994)[64].

[63] Hyman, EL. Production of Edible Oils For the Masses and By the Masses: The Impact of the Ram Press in Tanzania. World Development. 1993;21(3):429-43.
[64] Prehm MS, Silva-Barbeau I. Thrasher Research Proposal of Ram Press Technology for Sesame Oil Production in The Gambia. VPI&SU. 1994.

CHAPTER 3: PURPOSE AND OBJECTIVES

The purpose of this study was to describe the stabilizing effects of the presence of ram press technology on seasonal fluctuations in the food and nutrition security of rural subsistence farming households in The Gambia.

The objectives of this study were:

1. To determine the effect of ram press technology on the household availability of macronutrients across seasons.
2. To determine the effect of ram press technology on the household availability of Vitamin A across seasons.
3. To determine the effect of ram press technology on the household consumption of oil across seasons.
4. To determine the effect of ram press technology on the household availability of oil during the previous year.
5. To determine the effect of ram press technology on women's intake of macronutrients across seasons.
6. To determine the effect of ram press technology on women's intake of vitamin A across seasons.
7. To determine the effect of ram press technology on women's nutritional status across seasons.
8. To determine the effect of ram press technology on children's intake of macronutrients across seasons.
9. To determine the effect of ram press technology on children's intake of vitamin A across seasons.
10. To determine the effect of ram press technology on children's frequency of intake of selected foods across seasons.
11. To determine the effect of ram press technology on children's nutritional status across seasons.

CHAPTER 4: MATERIALS AND METHODS

Introduction of Ram Press

The major phases of project implementation are presented in Figure 4.1. In December 1994, a CRS technician trained 4 machine shops in the Gambia on manufacturing of the ram press. In order to test the potential of using the ram press for sesame, CRS placed 16 imported Tanzanian presses with 20 different user groups in 16 villages in The Gambia (Samba-Ndure et al, 1995)[65]. The participants in this initial field testing were individuals and groups selected in conjunction with SGA leadership and CRS. ATI staff made three monitoring trips between February and April 1995 to oversee press operations and to evaluate the overall functioning of the press. In July 1995, through CRS field visits, 40 villages were selected to receive presses. These 40 villages were located in the North Bank Division of The Gambia (see Figure 1.1). In October 1995, through CRS and GAFNA field visits, 80 women sesame growers with preschool children from these 40 villages were selected to participate in the study. In February 1996, 40 presses were placed in the study villages and participants were trained in the use and maintenance of the ram press.

Pilot Study

In early 1994, a preliminary questionnaire was developed by the principal investigators of the Small-Scale Sesame Oil Production project in The Gambia in cooperation with CRS and GAFNA staff. Common household cooking and feeding utensils and handful sizes for women and children were standardized to gram weight measurements for all types of foods consumed (see Appendices A and B). A list of Mandinka and Wolof food names with their English equivalents was developed to facilitate the recording of dietary data (see Appendix C). Standardized recipes were developed for all commonly consumed food mixtures (Samba-Ndure et al, 1995)[66] (see Appendix D). A codebook containing local food names, their respective code in the Nutritionist IV Database, and their standardized weight measures was developed to facilitate coding of the dietary data in the nutritional analysis program Nutritionist IV (N-Squared Computing Incorporated. Salem, OR. 1992.)[67] (see Appendix E).

In May 1995, a pilot study was conducted by GAFNA in 10 villages in order to test and refine the survey instrument and to give the field team the experience necessary to conduct the study. These villages were outside of the actual study area and were divided into two groups: press villages, those where the initial testing of the ram press took place, and non-press villages, those without sesame ram presses. A sample of 40 women with preschool children between the ages of 1 and 5 years participated in the pilot study. These women were selected to have a socio-economic status and ethnic background similar to those that would participate in the actual study.

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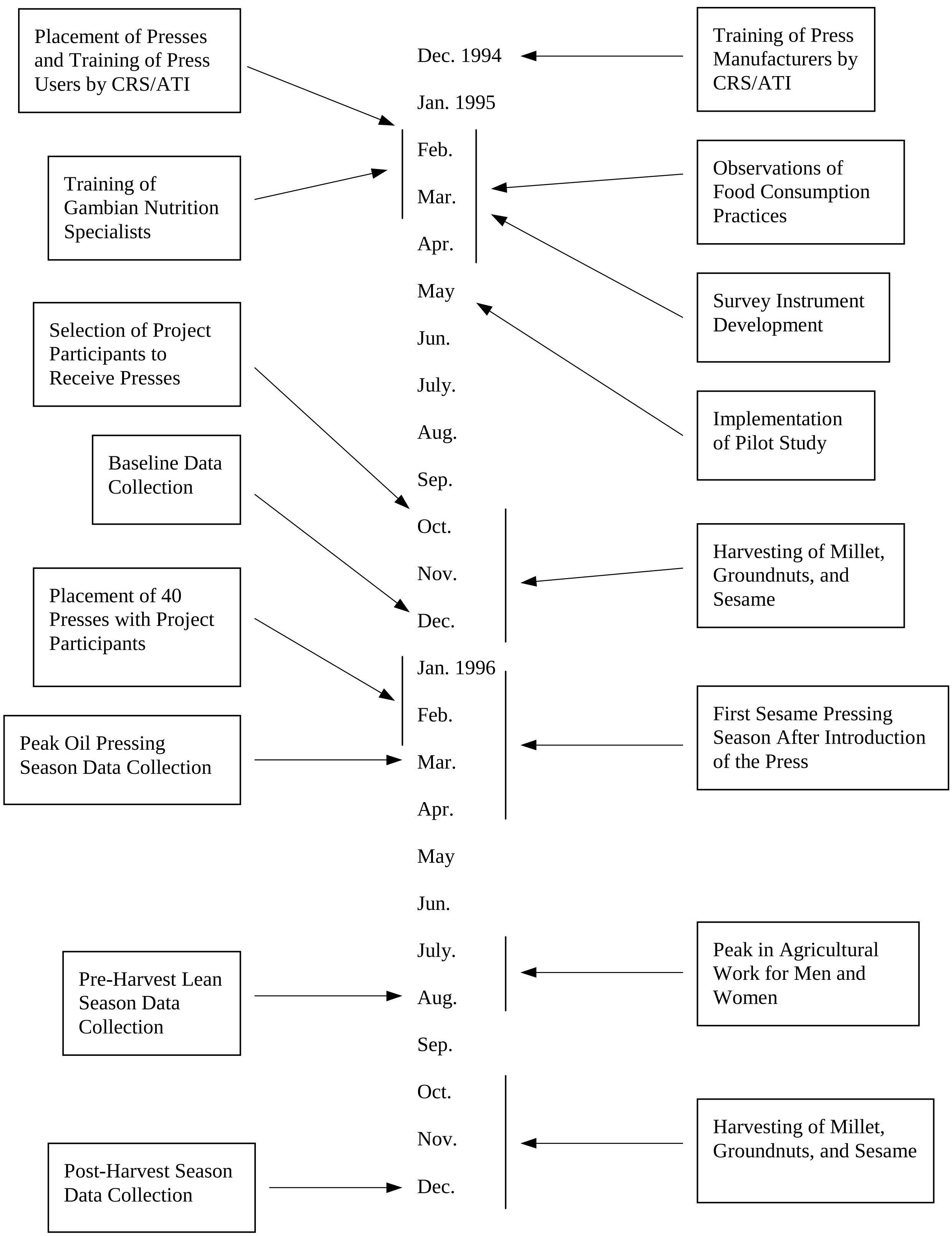
[65] Samba-Ndure K, Jawneh A, Jome KM, Prehm MS, Silva-Barbeau I. Small Scale Sesame Oil Production: A Means of Child Nutrition Security in The Gambia. Semi-Annual Project Progress Report. Thrasher Award #029034. 1995.

[66] Samba-Ndure K, Jawneh A, Jome KM, Prehm MS, Silva-Barbeau I. Small Scale Sesame Oil Production: A Means of Child Nutrition Security in The Gambia. Semi-Annual Project Progress Report. Thrasher Award #029034. 1995.

[67] N-Squared Computing Incorporated. Nutritionist IV Version 2.0 Users' Manual for IBM and Compatible Computers. Salem, OR. 1992.

Figure 4.1. Timeline of Project Implementation.



The analysis was conducted by GAFNA and the results were used to refine the final questionnaire (Samba-Ndure et al, 1995)[68].

Study Design

The research design consisted of an experimental group and a control group. The households that participated in the study were selected from the 32 villages that received ram presses in early 1996 and from 20 villages in the same area that had access to motorized expeller technology and no access to ram press technology. In order to ensure the possibility of statistically significant differences between groups, sample sizes were determined using power analysis. The results of a study of preschoolers receiving a home based food supplement in Bogota, Columbia (Mora et al, 1981)[69] and the results of a protein fortified weaning foods project in Mali (Silva-Barbeau et al, 1993)[70] were used to direct the analysis. The power computations were based on the following assumptions: $\alpha = 0.05$, $\sigma_e = \sigma_c = 1$, $\mu_e - \mu_c = 0.4$, $N_e = 2N_c$, where an experimental effect of 0.4 of a standard deviation was assumed with twice as many experimental subjects as control. For a one-tailed test, the number of subjects required to attain a power level of 0.7 was 44 for control and 88 for experimental for a total of 132 subjects. For this study, a control group of 40 women with preschool children (aged 1 to 5 years) and an experimental group of 80 women with preschool children (aged 1 to 5 years) were selected. Women with preschool children who were domestic sesame growers and were using a motorized expeller for processing were invited to participate in the study in order to obtain 40 mother/child pairs in the Control group. Women with preschool children who were domestic sesame growers, were members of an SGA with good management skills, and had been chosen to receive a ram press were invited to participate in the study in order to obtain 80 mother/child pairs in the Experimental group. For each household, the woman that agreed to participate in the study was designated as the 'target woman' and her child of preschool age was designated as the 'target child'. If she had more than one child of preschool age, then one of them was randomly selected to be the 'target child'. Control and Experimental households were matched as closely as possible on farm type, target child's age, distance to an expeller, and socioeconomic status (Prehm and Silva-Barbeau, 1994)[71].

Research Questionnaire

Results from the pilot study were used to revise the questionnaire and update it to its final version (see Appendix F). A protocol was developed to guide the data collection and insure that all data was collected in a precise and similar manner (see Appendix G). The questionnaire was

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[68] Samba-Ndure K, Jawneh A, Jome KM, Prehm MS, Silva-Barbeau I. Small Scale Sesame Oil Production: A Means of Child Nutrition Security in The Gambia. Semi-Annual Project Progress Report. Thrasher Award #029034. 1995.
[69] Mora JO, Herrera MG, Suescan J, de Navarro L, Wagner M. The Effects of Nutritional Supplementation on Physical Growth of Children at Risk of Malnutrition. American Journal of Clinical Nutrition. 1981;34:1885-92.
[70] Silva-Barbeau I, Haidara M, Sissoko H, Berthe M, Caldwell J, Barbeau WE. Addressing Child Feeding Concerns of Women Farmers in Mali: Composition and Effects on Child Nutrition of a Locally Developed Weaning Food. Ecology of Food and Nutrition. In Press. 1998.
[71] Prehm MS, Silva-Barbeau I. Thrasher Research Proposal of Ram Press Technology for Sesame Oil Production in The Gambia. VPI&SU. Blacksburg, VA. 1994.

designed to identify key direct benefits of ram press technology at the household, woman, and child levels and was composed of 7 sections.

Questions in section A were only asked at the baseline and were designed to obtain a basic description of the household, target woman and target child. Household questions included: the number of households in the compound; the number of individuals in the household; the relative wealth of the household; and the source, quantity and quality of the household's water supply. A detailed description of each household member was obtained that included their name, age in years, sex, and relationship to the household head. This profile of the household was updated at each subsequent data collection. The household's wealth ranking was obtained by convening a meeting of three key informants to determine the criteria for wealth ranking. The criteria established was based on (1) the household's ability to produce enough food for their families throughout the year, (2) the household's access to labor and farm machinery and (3) the household's involvement in non-farm activities, such as, petty trading and salaried employment. The key informants were people who knew the village well and did not come from households involved in the study. The key informants in each village then ranked each household participating in the study on a scale from 1 (poor) to 5 (rich) relative to all other households in the village. Information on the target woman included her date of birth or age, marital status, ethnic background, education, use of the nearest health center, and a description of her agricultural activities. Information on the target child included date of birth (from the infant welfare card), birth weight, and sex.

Questions in section B dealt with the health status of the target woman and target child. This section included questions about the child's weaning status, the child's incidence of diarrhea in the last two weeks, the child's incidence of illness during the last 7 days, the woman's enrollment in the Health and Nutrition supplementation program, and the woman's reproductive status.

This section also included questions on the anthropometric measurements for the woman and child. Women were weighed lightly clothed and without shoes on scales accurate to 100g. The scale was recalibrated at the beginning of each weighing session and weights were recorded to the nearest 0.1 kg. Children were weighed using the same method. Heights for both women and children 24 months of age and greater were measured to the nearest 0.1 cm with the subjects heels, buttocks, and upper back in contact with a calibrated upright board and a sliding horizontal bar that rested on the vertex. Children less than 24 months of age were measured using similar methods in a horizontal position (Jelliffe and Jelliffe, 1989)[72].

Section C consisted of a food frequency questionnaire for the target child and sought to describe the child's general consumption patterns and consumption of oil rich foods over the last 4 weeks. The target child's primary care giver was asked to report the frequency of foods consumed by the child in the previous four weeks. The food items included in the food frequency were grouped into the following categories: high fat/high protein foods, nutrient dense weaning foods, nutrient dense table foods, low calorie weaning foods, and milk and other snack foods.

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[72] Jelliffe D and Jelliffe EFP. Community Nutritional Assessment: With Special Reference to Less Technically Developed Countries. Oxford University Press. Oxford, England. 1989.

Sections D, E and F attempted to obtain detailed information on the food availability of the household, and the food consumption of the target woman and target child. Food consumption data was collected using two 24-hour recalls conducted on non-consecutive days of the same week. In section D, the woman responsible for household food preparation was asked to report all foods and amounts prepared for the household on the previous day. In sections E and F, the target woman was asked to report all foods and amounts consumed by herself and the target child on the previous day. Two non-consecutive 24-hour recalls were used to obtain food consumption data because a precision equal to that of a 1-day weighed food intake survey could be obtained with two 24-hour recalls at a much lower cost (Dop et al, 1994b)[73]. Ferguson et al (1993)[74] also concluded that a repeated 24-hour recall could be substituted for the weighed record for assessing food consumption patterns as long as nutrients contributed by snacks were not the dietary factors of interest. Dop et al (1994a)[75] found that the overly demanding design of the weighed food record could cause an instrument effect resulting in decreased consumption patterns on days following the first data collection. In a study conducted in The Gambia by the Dunn Nutrition Unit, Villard and Bates (1987)[76] reported that 24-hour recalls provided similar information to direct weighed intakes.

Section D also included questions that sought to describe the household's oil consumption during the last 7 days. Section G included questions that sought to describe the household's yearly oil availability and purchasing patterns.

Data Collection

Enumerators were trained in November 1995 on the proper procedures for collecting the data, and they were closely supervised by a Gambian Nutrition Specialist throughout the data collection. The baseline data collection was conducted in December 1995 and corresponded to the post-harvest season of plenty. After the baseline season, data was collected at three times during the following year in March, August, and December. These times corresponded to the peak oil-pressing season, the pre-harvest lean season, and the post-harvest season of plenty, respectively (Prehm, Silva-Barbeau, 1994)[77].

[73] Dop M-C, Milan Ch, Milan Cl, N'Diaye AM. The 24-Hour Recall for Senegalese Weanlings: A Validation Exercise. European Journal of Clinical Nutrition. 1994;48:643-53.
[74] Ferguson EL, Gibson RS, Opare-Obisaw C. The Relative Validity of the Repeated 24-Hour Recall for Estimating Energy and Selected Nutrient Intakes of Rural Ghanaian Children. European Journal of Clinical Nutrition. 1994;48:241-52.
[75] Dop M-C, Milan Ch, Milan Cl, N'Diaye AM. Use of the Multiple-Day Weighed Record for Senegalese Children During the Weaning Period: A Case of the 'Instrument Effect'. American Journal of Clinical Nutrition. 1994;59(suppl):266S-8S.
[76] Villard L and Bates CJ. Dietary Intake of Vitamin A Precursors by Rural Gambian Pregnant and Lactating Women. Human Nutrition: Applied Nutrition. 1987;41A:135-45.
[77] Prehm MS, Silva-Barbeau I. Thrasher Research Proposal of Ram Press Technology for Sesame Oil Production in The Gambia. VPI&SU. 1994.

Data Analysis

The Gambian Nutrition Specialist imputed all data from the questionnaires into Epi Info (Dean et al, 1990)[78] and Nutritionist IV (N-Squared Computing Incorporated., 1992)[79] using the codebook developed during the pilot study. Weights and heights obtained from each target woman were used to calculate body mass index (BMI) using the formula: BMI = body weight (kg) / height^2 (m^2) (Bray, 1992)[80]. The weight, height, age, and sex obtained for each child were used to calculate weight-for-height, weight-for-age, and height-for-age using the Epi Info software package. Since specific standards for height and weight of children have not been set for The Gambia, standards based on the growth reference curves developed by the National Center for Health Statistics (NCHS) and the Centers for Disease Control (CDC) using data from the Fels Research Institute and the United States Health Examination Surveys were used as a comparison (Dibley et al, 1987)[81]. These growth curves are recommended by the World Health Organization (WHO) for international use (WHO, 1986)[82]. The mean anthropometric indices for children were used to make comparisons of nutritional status between groups as this method can detect differences at smaller sample sizes (Briend, 1989)[83].

Dietary data were analyzed using Nutritionist IV software to calculate amounts of macronutrients (kcal, protein, carbohydrates, and fat) and micronutrients (vitamin A) in the diet. Gambian foods that were not in the Nutritionist IV database were added using values found by USDA (1997)[84] and FAO (1968)[85]. Results obtained by Hudson et al (1980)[86] and Hudson and Day (1989)[87] were used to calculate nutrient values for millet, sorghum, and maize prepared by the three cooking methods commonly used in The Gambia. Values for the vitamin A (β-carotene) content of foods were added using results obtained by FAO (1968)[88], Villard and Bates (1987)[89], McRae and Paul (1996)[90], and King and Burgess (1993)[91].

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[78] Dean AG, Dean JA, Burton AH, Dicker RC. Epi Info Version 5: A Word Processing, Database, and Statistics Program for Epidemiology on Microcomputers. Stone Mountain, GA. USD, Incorporated. 1990.

[79] N-Squared Computing Incorporated. Nutritionist IV Version 2.0 Users' Manual for IBM and Compatible Computers. Salem, OR. 1992.

[80] Bray G. Pathophysiology of Obesity. American Journal of Clinical Nutrition. 1992;55:488S-494S.

[81] Dibley MJ, Goldsby JB, Staehling NW, Trowbridge FL. Development of normalized curves for the international growth reference: historical and technical considerations. Am J Clin Nutr 1987;46:736-48.

[82] WHO, Working Group. Use and Interpretation of Anthropometric Indicators of Nutritional Status. Bulletin of the World Health Organization. 1986;64:929-41.

[83] Briend A, Hasan KZ, Aziz KMA, Hoque BA, Henry FJ. Measuring Change in Nutritional Status: A Comparison of Different Anthropometric Indices and the Sample Sizes Required. European Journal of Clinical Nutrition. 1989;43:769-78.

[84] U.S. Department of Agriculture, Agricultural Research Service. 1997. USDA Nutrient Database for Standard Reference, Release 11-1. Nutrient Data Laboratory Home Page, http://www.nal.usda.gov/fnic/foodcomp

[85] FAO. Food Composition Table for Use in Africa. Nutrition Division of FAO. Rome, Italy. 1968.

[86] Hudson GJ, John PMV, Paul AA. Variation in the Composition of Gambian Foods: The Importance of Water in Relation to Energy and Protein Content. Ecology of Food and Nutrition. 1980;10:9-17.

[87] Hudson GJ and Day KC. Water Content of the Rural Gambian Diet. Nutrition Reports International. 1989;400(2):335-9.

[88] FAO. Food Composition Table for Use in Africa. Nutrition Division of FAO. Rome, Italy. 1968.

[89] Villard L and Bates CJ. Dietary Intake of Vitamin A Precursors by Rural Gambian Pregnant and Lactating Women. Human Nutrition: Applied Nutrition. 1987;41A:135-45.

[90] McCrae JE and Paul AA. Foods of Rural Gambia. Medical Research Council Dunn Nutrition Centre. Cambridge, United Kingdom. 1996.

[91] King FS and Burgess A. Nutrition for developing countries. Oxford University Press. Oxford, New York. 1993.

The household availability of all nutrients and oil was adjusted for age and sex using adult equivalents derived from the daily average energy requirements reported in Energy and Protein Requirements (WHO, 1985)[92]. The 'adult equivalent' is a percentage of the daily average energy requirement of a 65kg male aged 18 to 30 years (see Appendix H). The adult equivalents used for this analysis were similar to the results obtained by Hudson (1995)[93], in The Gambia, who developed an algorithm based on body weight to estimate the distribution of food within a mixed sex and age group. Hudson (1995)[94] concluded that this was likely to be appropriate in most circumstances, unless detailed knowledge of local customs suggests otherwise. Adult equivalents have been used extensively to report household measures on a per capita basis that is adjusted for age and sex (Patore et al, 1993; Von Braun et al, 1989; Kennedy, 1989; Kumar and Hotchkiss, 1988)[95, 96, 97, 98].

In a similar manner, the children's intake of all nutrients was adjusted for age and sex using consumption units derived from the daily average energy requirements reported in Energy and Protein Requirements (WHO, 1985)[99]. The 'child's consumption unit' is a percentage of the daily average energy requirement of a male aged 4 to 5 years (see Appendix I).

A preliminary analysis of the baseline and peak oil-pressing season data revealed that about half of the experimental group participants were using not only the ram press, but also the motorized expeller for extraction of sesame oil. For this reason, this analysis further divided the sample into three study groups: the expeller group that used only motorized expeller technology, the press group that used only ram press technology, and the combination group that used both expeller and ram press technology. The SAS software package (SAS Institute Inc, 1988)[100] was used to calculate means and standard deviations for each variable measured. Due to the seasonal nature of the data, statistical significance at $p<0.05$ was determined by the Repeated Measures Analysis of Variance (ANOVA) method whenever appropriate. Otherwise, statistical significance was determined using the ANOVA method. During the course of the study, 8 households dropped out of the study. These dropouts were due to relocation of the family or

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[92] WHO. Energy and Protein Requirements. Report of a Joint FAO/WHO Expert Consultation. WHO Technical Report Series 724. World Health Organization. Geneva, Switzerland. 1985.
[93] Hudson GJ. Food Intake in a West African Village: Estimation of Food Intake from a Shared Bowl. British Journal of Nutrition. 1995;73:551-69.
[94] Hudson GJ. Food Intake in a West African Village: Estimation of Food Intake from a Shared Bowl. British Journal of Nutrition. 1995;73:551-69.
[95] Patore G, Branca F, Demissie T, Ferro-Luzzi A. Seasonal Energy Stress in an Ethiopian Community: An Analysis of the Impact at the Household Level. European Journal of Clinical Nutrition. 1993;47:851-62.
[96] Von Braun J, Puetz D, Webb P. Irrigation Technology and Commercialization of Rice in The Gambia: Effects on Income and Nutrition. International Food Policy Research Institute. Washington, D.C. Research Report 75, August 1989.
[97] Kennedy E. The Effects of Sugarcane Production on Food Security, Health, and Nutrition in Kenya: A Longitudinal Analysis. International Food Policy Research Institute. Washington, D.C. Research Report 78, December 1989.
[98] Kumar SK and Hotchkiss D. Consequences of Deforestation for Women's Time Allocation, Agricultural Production, and Mutrition in Hill Areas of Nepal. International Food Policy Research Institute. Washington, D.C. Research Report 69. October, 1988.
[99] WHO. Energy and Protein Requirements. Report of a Joint FAO/WHO Expert Consultation. WHO Technical Report Series 724. World Health Organization. Geneva, Switzerland. 1985.
[100] SAS/STAT Software, Copyright (c) 1998 SAS Institute Inc., SAS Campus Drive, Cary, North Carolina 27513, USA. All rights reserved. http://www.sas.com/rnd/app/stat/sasstat.html

death of the target child. These households were not included in the repeated measures ANOVA.

CHAPTER 5: RESULTS

Study Population

At the baseline, the study population consisted of 120 households with one mother/child pair from each household identified as the 'target woman' and 'target child'. The Expeller group consisted of 40 mother/child pairs with the Press and Combination groups containing 37 and 43 pairs, respectively (see Table 5.1). The mean size of households in the study was 14.6 persons, and the mean number of households per compound was 1.9 households. There were no significant differences between groups for these measures. Press households were assessed a mean qualitative wealth ranking of 2.9 (where 5 equals wealthy and 1 equals poor), whereas Combination and Expeller households were assessed rankings of 2.5 and 2.3, respectively. These differences were significant at $p<0.03$.

Table 5.1. General Characteristics of the Household at the Baseline.

	Expeller	Press	Combination
Number of Mother/Child Pairs	40	37	43
Household Size	14.25 ± 8.57[1]	15.05 ± 9.21	14.42 ± 7.18
Households per Compound	2.10 ± 1.46	1.95 ± 1.35	1.65 ± 1.31
Wealth Ranking	2.28 ± 1.13	2.86 ± 0.82*	2.51 ± 0.91

[1] Mean ± Standard Deviation.
* $p<0.05$.

Over 95 percent of the target women were in a polygamous or nuclear marriage as shown in Table 5.2, and in over 85 percent of households, the target woman's husband or father-in-law was the household head as shown in Table 5.3.

Table 5.2. Marital Status of the Target Women at the Baseline.

	Expeller	Press	Combination	Total
Married/Polygamous	20(16.7)[1]	20(16.7)	22(18.3)	62(51.7)
Married/Nuclear	20(16.7)	16(13.3)	19(15.8)	55(45.8)
Single	0(0.0)	1(0.8)	1(0.8)	2(1.7)
Widowed/Divorced	0(0.0)	0(0.0)	1(0.8)	1(0.8)
Total	40(33.3)	37(30.8)	43(35.8)	120(100.0)

[1] Frequency (Percentage of Total Reporting).

Table 5.3. Head of the Household at the Baseline.

	Expeller	Press	Combination	Total
Husband	35(29.2)[1]	29(24.2)	29(24.2)	93(77.5)
Father-in-law	2(1.7)	1(0.8)	9(7.5)	12(10.0)
Father	0(0.0)	5(4.2)	2(1.7)	7(5.8)
Brother-in-law	1(0.8)	1(0.8)	3(2.5)	5(4.2)
Other	2(1.7)	1(0.8)	0(0.0)	3(2.5)
Total	40(33.3)	37(30.8)	43(35.8)	120(100.0)

[1] Frequency (Percentage of Total Reporting).

Target women belonged to one of four tribal groups: Wolof, Mandinka, Fulani, or Other Minor Tribes as shown in Table 5.4.

Table 5.4. Ethnic Group of the Target Women at the Baseline.

	Expeller	Press	Combination	Total
Wolof	10(8.3)[1]	15(12.5)	12(10.0)	37(30.8)
Mandinka	10(8.3)	9(7.5)	11(9.2)	30(25.0)
Fulani	7(5.8)	8(6.7)	9(7.5)	24(20.0)
Other	13(10.8)	5(4.2)	11(9.2)	29(24.2)
Total	40(33.3)	37(30.8)	43(35.8)	120(100.0)

[1] Frequency (Percentage of Total Reporting).

The mean age of women in the study was 28.8 years with a mean height of 161.5 meters and a mean weight 55.4 kilograms (see Table 5.5). Only 6.7 percent of women were pregnant, but 61.7 percent were lactating. Over 80 percent of women were enrolled in the GAFNA/CRS Health and Nutrition Program with the mean length of enrollment being 18.9 months. Only 34.2 percent of women had attended some type of schooling with the average length of schooling being 3.0 years. Over 85 percent of women that attended school attended a Madrassa (or Koranic) school. There were no significant differences between groups for these measures.

Table 5.5. General Characteristics of Target Women at the Baseline.

	Expeller (n=40)	Press (n=37)	Combination (n=43)
Woman's Age (years)	29.68 ± 6.98[1]	29.24 ± 6.64	27.65 ± 7.17
Woman's Height (cm)	160.69 ± 5.26	162.71 ± 4.37	161.31 ± 4.92
Woman's Weight (kg)	55.96 ± 9.63	54.79 ±6.59	55.51 ±8.53
Number of Women That Were Pregnant	2(1.7)[2]	4(3.3)	2(1.7)
Number of Women That Were Lactating	20(16.7)	24(20.0)	30(25.0)
Number of Women Enrolled in HNP	33(27.5)	31(25.8)	34(28.3)
Length of Enrollment in HNP (months)	19.61 ± 7.88	18.42 ± 6.49	18.71 ± 5.49
Number of Women That Attended School	13(10.8)	13(10.8)	15(12.5)
Length of Schooling (years)	3.46 ± 1.81	2.15 ± 0.69	3.33 ± 2.64

[1] Mean ± Standard Deviation.
[2] Frequency (Percentage of Total Reporting).

A hand pump was the main source of water for 71.7 percent of households with the rest using a traditional well (16.7%), piped water (9.2%), or a cement lined well (2.5%) as shown in Table 5.6. Nearly 95 percent of women thought their household had a source of good, clean water, and nearly 75 percent of women thought they had enough water to meet their household needs.

Table 5.6. Water Source for the Household at the Baseline.

	Expeller	Press	Combination	Total
Hand Pump	30(25.0)[1]	27(22.5)	29(24.2)	86(71.7)
Traditional Well	5(4.2)	3(2.5)	12(10.0)	20(16.7)
Piped Water	4(3.3)	5(4.2)	2(1.7)	11(9.2)
Cement Lined Well	1(0.8)	2(1.7)	0(0.0)	3(2.5)
Total	40(33.3)	37(30.8)	43(35.8)	120(100.0)

[1] Frequency (Percentage of Total Reporting).

Black sesame was grown by 66.7 percent of women, and white sesame was grown by 24.2 percent of women. White sesame was grown by 17 women in the Expeller group and only 8 and 4 women in the Press and Combination groups, respectively (see Table 5.7). This difference was significant at p<0.002. Other crops commonly grown by women included groundnuts (grown by 85.0 percent of women), millet (54.2%), maize (30.8%), vegetables (28.3%), and rice (20.0%).

Table 5.7. Crops That Were Grown by Target Women at the Baseline.

	Expeller (n=40)	Press (n=37)	Combination (n=43)	Total
Groundnuts	31(25.8)[1]	37(30.8)	34(28.3)	102(85.0)
Black Sesame	25(20.8)	24(20.0)	31(25.8)	80(66.7)
Millet	27(22.5)	18(15.0)	20(16.7)	65(54.2)
Maize	16(13.3)	9(7.5)	12(10.0)	37(30.8)
Vegetables	15(12.5)	11(9.2)	8(6.7)	34(28.3)
White Sesame	17(14.2)*	8(6.7)	4(3.3)	29(24.2)
Rice	10(8.3)	5(4.2)	9(7.5)	24(20.0)
Melon	3(2.5)	3(2.5)	0(0.0)	6(5.0)
Beans	2(1.7)	0(0.0)	1(0.8)	3(2.5)
Pumpkin	2(1.7)	0(0.0)	0(0.0)	2(1.7)
Cassava	1(0.8)	0(0.0)	0(0.0)	1(0.8)

[1] Frequency (Percentage of Total Reporting).
* p<0.002.

Nearly 90 percent of the women raised some type of livestock. Women raised, on average, 2.8 goats, 1.1 sheep, 2.0 cattle, 8.1 poultry, and 0.1 other livestock (see Table 5.8). The only significant difference between groups was for cattle. Press women raised 3.6 head of cattle, whereas, Expeller and Combination women raised only 1.5 and 1.0 head of cattle, respectively. This difference was significant at $p<0.01$. Only 32.5 percent (n=39) of women were involved in some type of income generation other than agricultural production. Most of these women (n=22) were in the Expeller group with only 8 and 9 women involved in income generation in the Press and Combination groups, respectively. This difference was significant at $p<0.001$.

Table 5.8. Livestock Production and Income Generation of Target Women at the Baseline.

	Expeller (n=40)	Press (n=37)	Combination (n=43)
Number of Women Raising Livestock	34(28.3)[1]	35(29.2)	38(31.7)
Number of Goats	2.76 ± 3.55[2]	3.06 ± 3.61	2.53 ± 3.38
Number of Sheep	1.06 ± 1.59	1.77 ± 2.85	0.66 ± 1.21
Number of Cattle	1.53 ± 2.94	3.57 ± 5.03*	1.00 ± 2.81
Number of Poultry	6.65 ± 5.91	9.94 ± 9.70	7.68 ± 7.32
Number of Other Livestock	0.21 ± 1.20	0.06 ± 0.34	0.00 ± 0.00
Number of Women Involved in Income Generation	22(18.3)**	8(6.7)	9(7.5)

[1] Frequency (Percentage of Total Reporting).
[2] Mean ± Standard Deviation.
* $p<0.01$.
** $p<0.001$.

At the baseline, the mean age of the children participating in the study was 24.2 months with a mean height of 81.2 cm and a mean weight of 10.5 kg (see Table 5.9). The children in the study were distributed almost equally between sexes with 57 boys and 63 girls. Over 55 percent of children had already been weaned with the rest consuming a mixed diet of breast milk and weaning foods. Women reported breast feeding their children an average of 8.3 times per day. There were no significant differences between groups for any of these measures. Over half (55.8 percent) of the women reported that their child had been ill during the last 7 days. Children in the Expeller group reported being ill more frequently than children in the other two groups. Of the 67 children that were reported to have been ill, 43.3 percent of them were in the Expeller group with 28.4 percent of them in the Press group and 28.4 percent in the Combination group. This difference was significant at $p<0.03$. The duration of illness was longer for children in the Combination group (3.9 days) than for those in the Press (3.6 days) and Expeller (3.0 days) groups; however, this difference was not statistically significant.

Table 5.9. General Characteristics of Target Children in the Study Population at the Baseline.

	Expeller (n=40)	Press (n=37)	Combination (n=43)
Child's Age (months)	25.30 ± 9.27	23.87 ± 9.99	23.37 ± 9.67
Child's Height (cm)	82.76 ± 7.88	80.21 ± 8.72	80.56 ± 7.41
Child's Weight (kg)	10.68 ± 2.59	10.25 ± 2.79	10.65 ± 2.28
Number of Children Weaned	25(20.8)	22(18.3)	20(16.7)
Frequency of Breastfeeding (times per day)	7.27 ± 3.31	9.56 ± 3.60	8.04 ± 2.88
Number of Children Ill During the Last 7 Days	29(24.2)*	19(15.8)	19(15.8)
Duration of Children's Illnesses (days)	3.00 ± 1.06	3.64 ± 1.43	3.88 ± 3.04

[1] Mean ± Standard Deviation.
[2] Frequency (Percentage of Total Reporting).
* $p<0.05$.

The most common illnesses reported were fever and malaria, reported for 55.2 and 17.9 percent of children reporting illnesses as shown in Table 5.10.

Table 5.10. Frequency of Children's Illnesses During the Last 7 Days at the Baseline.

	Expeller	Press	Combination	Total
Fever	15(22.4)[1]	14(20.9)	8(11.9)	37(55.2)
Malaria	6(9.0)	2(3.0)	4(6.0)	12(17.9)
Chest Pain	3(4.5)	0(0.0)	1(1.5)	4(6.0)
Cough	1(1.5)	1(1.5)	1(1.5)	3(4.5)
Eye Infection	1(1.5)	0(0.0)	2(3.0)	3(4.5)
Ear Pain	0(0.0)	1(1.5)	1(1.5)	2(3.0)
Umbilical Cord	1(1.5)	0(0.0)	0(0.0)	1(1.5)
Boils	1(1.5)	0(0.0)	0(0.0)	1(1.5)
Diarrhea	1(1.5)	0(0.0)	0(0.0)	1(1.5)
Stomach Upset	0(0.0)	1(1.5)	0(0.0)	1(1.5)
Headache	0(0.0)	0(0.0)	1(1.5)	1(1.5)
Stomach Pain	0(0.0)	0(0.0)	1(1.5)	1(1.5)
Total	29(43.3)	19(28.4)	19(28.4)	67(100.0)

[1] Frequency (Percentage of Total Reporting).

Dietary Intake of Households

The mean household availability of kilocalories (per adult equivalent) is presented in Table 5.11 and Figure 5.1. Overall, the mean availability of kilocalories was highest at the baseline and post-harvest seasons, and lowest during the peak oil-pressing season. This seasonal effect was significant at $p<0.0001$. The Combination households consistently reported more calories available than the Press or Expeller households. This group effect approached significance at $p<0.07$.

Table 5.11. Mean Household Availability of Kilocalories (per Adult Equivalent) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	3262±1636	2286±816	2859±1418	3399±1327
Press (n=30)	3725±2172	2402±967	2971±1673	3619±1520
Combination (n=40)	4119±1758	2504±1077	3402±1851	4214±1887

Repeated measures analysis of variance:

I. Group effect: $p<0.07$.

II. Seasonal effect: $p<0.0001$.

III. Season*Group Interaction: not significant.

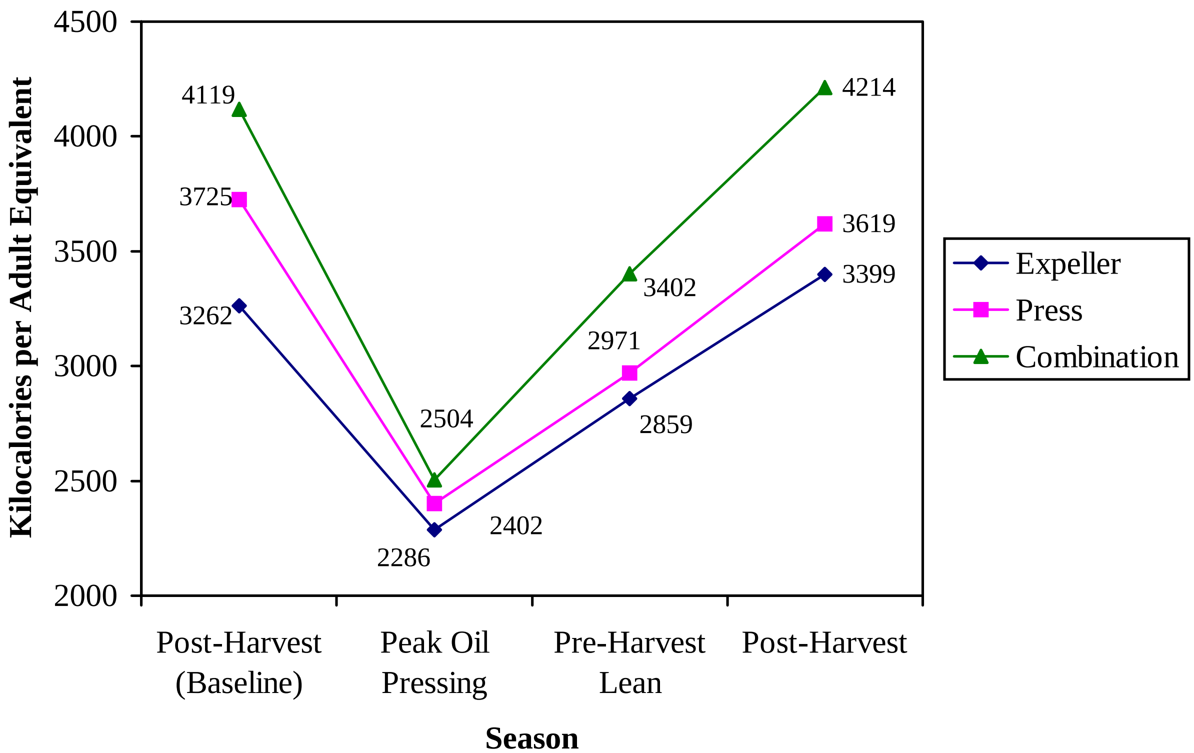

Figure 5.1. Mean Household Availability of Kilocalories Across Seasons.

The mean household availability of protein (per adult equivalent) is presented in Table 5.12 and Figure 5.2. The mean availability of protein followed a similar pattern to kilocalorie availability with the highest availabilities at the baseline and post-harvest seasons and the lowest availabilities at the peak oil-pressing and pre-harvest lean seasons. This seasonal effect was significant at $p<0.0001$. The Combination and Press households consistently reported more protein available than the Expeller households. This group effect was significant at $p<0.02$.

Table 5.12. Mean Household Availability of Protein (grams per Adult Equivalent) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	118.0± 53.3	92.2± 38.2	102.6± 54.3	127.6± 49.3
Press (n=30)	142.5± 76.5	112.3± 48.5	110.7± 55.2	142.2± 54.0
Combination (n=40)	156.9± 61.9	102.8± 43.8	126.0± 64.0	160.3± 67.8

Repeated measures analysis of variance:

I. Group effect: $p<0.02$.

II. Seasonal effect: $p<0.0001$.

III. Season*Group Interaction: not significant.

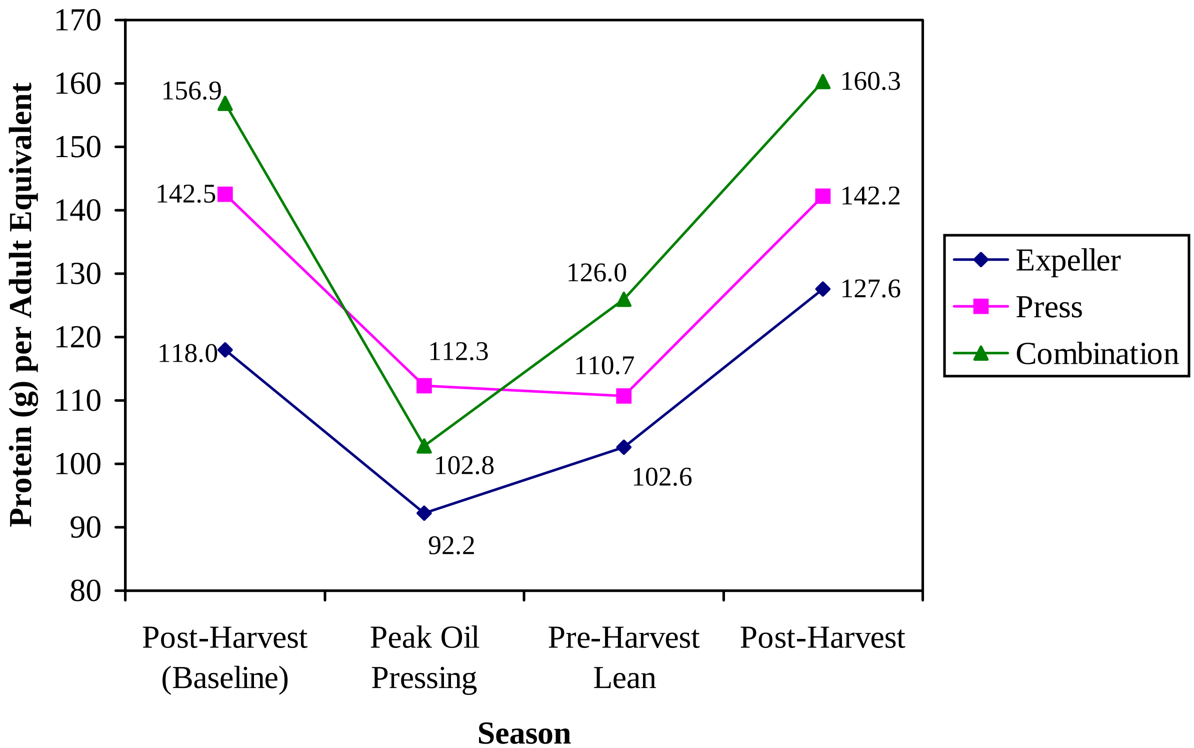

Figure 5.2. Mean Household Availability of Protein Across Seasons.

The mean household availability of carbohydrates (per adult equivalent) is presented in Table 5.13 and Figure 5.3. Overall, the highest availabilities of carbohydrates were reported during the baseline and post-harvest seasons and the lowest availabilities were reported during the peak oil-pressing season. This seasonal effect was significant at $p<0.0001$. The Combination households consistently reported the highest availabilities of carbohydrates. This group effect approached significance at $p<0.09$.

Table 5.13. Mean Household Availability of Carbohydrates (grams per Adult Equivalent) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	495.1±292.6	326.7±129.6	442.2±232.7	523.5±237.5
Press (n=30)	547.5±365.5	314.1±147.3	453.0±294.6	553.1±245.8
Combination (n=40)	618.4±319.3	349.4±180.8	532.9±334.4	666.2±329.3

Repeated measures analysis of variance:

I. Group effect: $p<0.09$.
II. Seasonal effect: $p<0.0001$.
III. Season*Group Interaction: not significant.

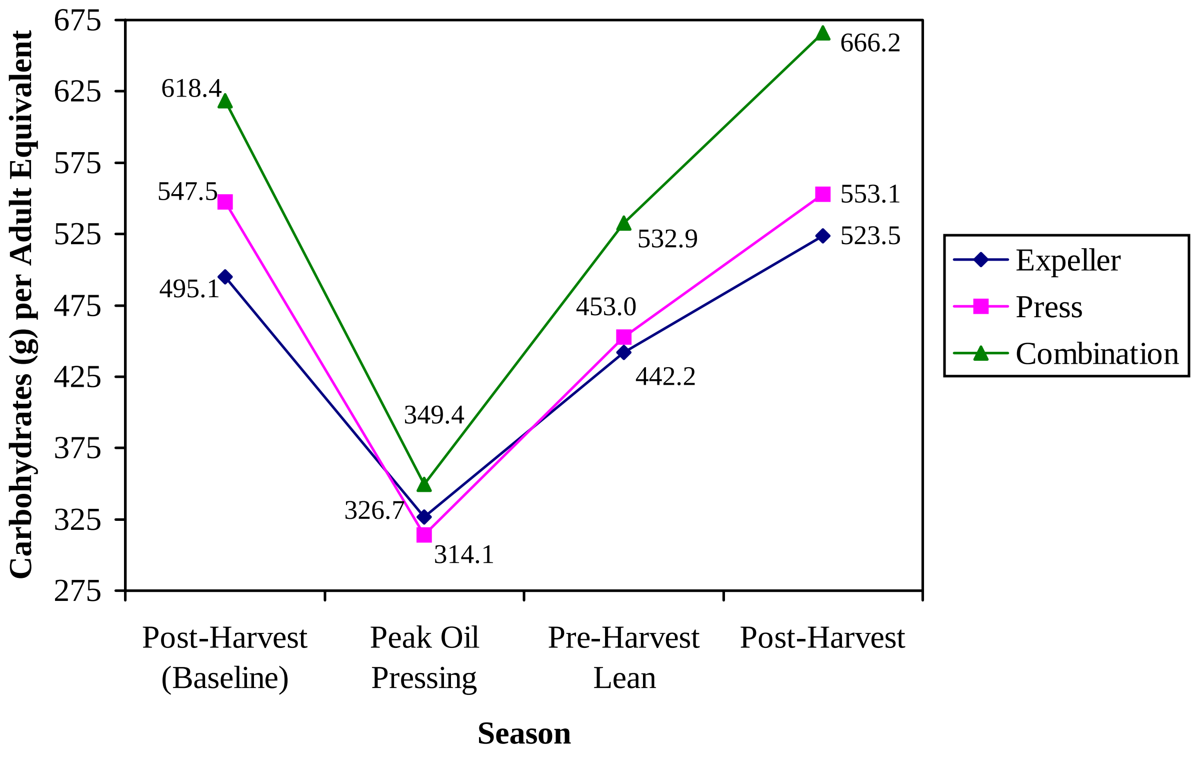

Figure 5.3. Mean Household Availability of Carbohydrates Across Seasons.

The mean household availability of fat (per adult equivalent) is presented in Table 5.14 and Figure 5.4. Overall, the highest availabilities of fat were reported at the baseline and post-harvest seasons and the lowest were reported at the peak oil-pressing season. This seasonal effect was significant at $p<0.0001$. The Combination and Press households consistently reported higher availabilities of fat than the Expeller households; however, there was no statistically significant group effect.

Table 5.14. Mean Household Availability of Fat (grams per Adult Equivalent) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	91.0±36.7	68.3±32.8	76.2±38.7	90.5±28.0
Press (n=30)	109.0±59.1	78.1±36.5	79.8±36.8	93.2±42.0
Combination (n=40)	113.5±44.9	77.8±30.6	85.5±37.8	102.4±41.5

Repeated measures analysis of variance:

I. Group effect: not significant.

II. Seasonal effect: $p<0.0001$.

III. Season*Group Interaction: not significant.

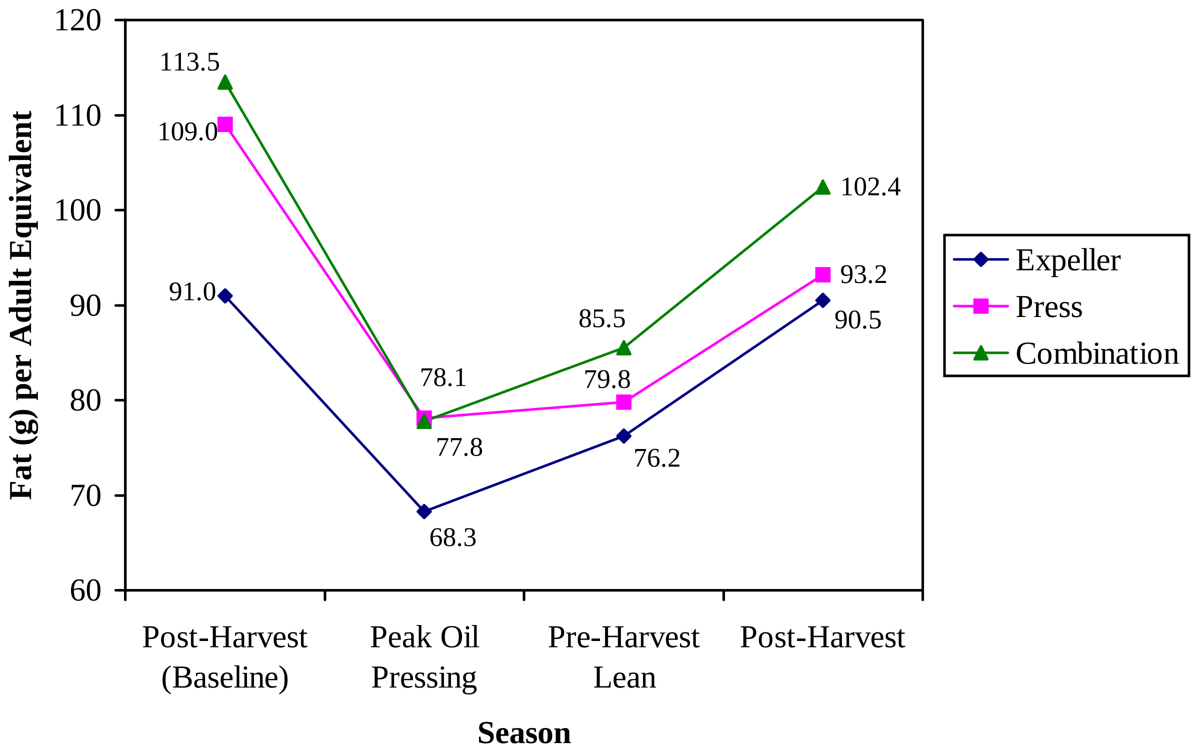

Figure 5.4. Mean Household Availability of Fat Across Seasons.

The mean household availability of vitamin A (per adult equivalent) is presented in Table 5.15 and Figure 5.5. The only apparent trend in vitamin A intake across seasons was the decrease for all groups at the pre-harvest lean season. Expeller households reported the highest availability at the baseline, Press households reported the highest availabilities at the peak oil-pressing and post-harvest seasons, and Combination households reported the highest availability at the pre-harvest lean season. This season*group interaction was significant at $p<0.04$.

Table 5.15. Mean Household Availability of Vitamin A (Retinol Equivalents per Adult Equivalent) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	609.8±544.5	472.6±469.4	384.1±406.0	350.2±276.0
Press (n=30)	517.7±685.1	523.9±426.2	369.6±403.6	518.4±723.5
Combination (n=40)	393.4±365.9	474.7±416.4	414.8±392.0	402.8±382.8

Repeated measures analysis of variance:

I. Group effect: not significant.
II. Seasonal effect: not significant.
III. Season*Group Interaction: $p<0.04$.

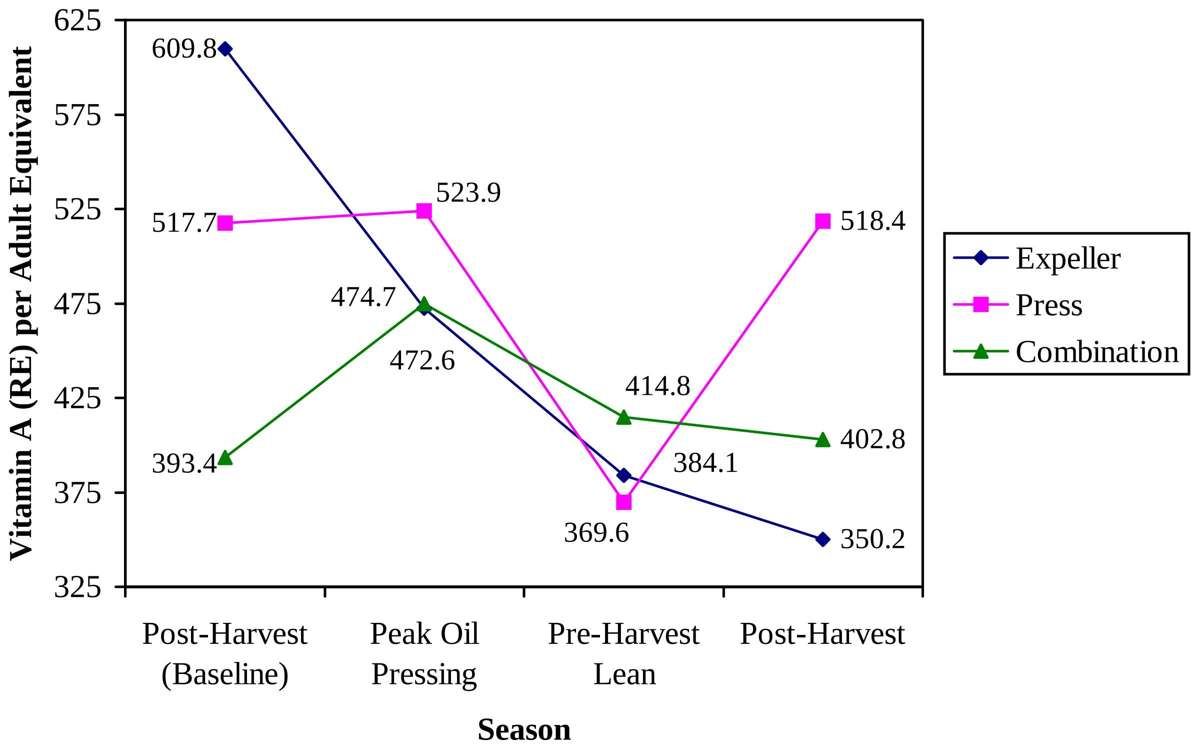

Figure 5.5. Mean Household Availability of Vitamin A Across Seasons.

The mean household consumption of oil (liters) during the last 7 days (per adult equivalent) is presented in Table 5.16 and Figure 5.6. The major trend in oil consumption was a peak during the peak oil-pressing season with a return to near baseline levels during the following seasons. This seasonal effect was significant at p<0.0001. After the baseline, the Press and Combination households consumed more oil than the Expeller households at all other seasons. This group effect approached significance at p<0.08.

Table 5.16. Mean Household Consumption of Oil (liters per Adult Equivalent) During the Last 7 Days Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	0.129±0.118	0.222±0.132	0.150±0.137	0.170±0.128
Press (n=30)	0.144±0.124	0.329±0.215	0.205±0.152	0.181±0.154
Combination (n=40)	0.121±0.134	0.329±0.308	0.227±0.165	0.213±0.150

Repeated measures analysis of variance:

I. Group effect: p<0.08.

II. Seasonal effect: p<0.0001.

III. Season*Group Interaction: not significant.

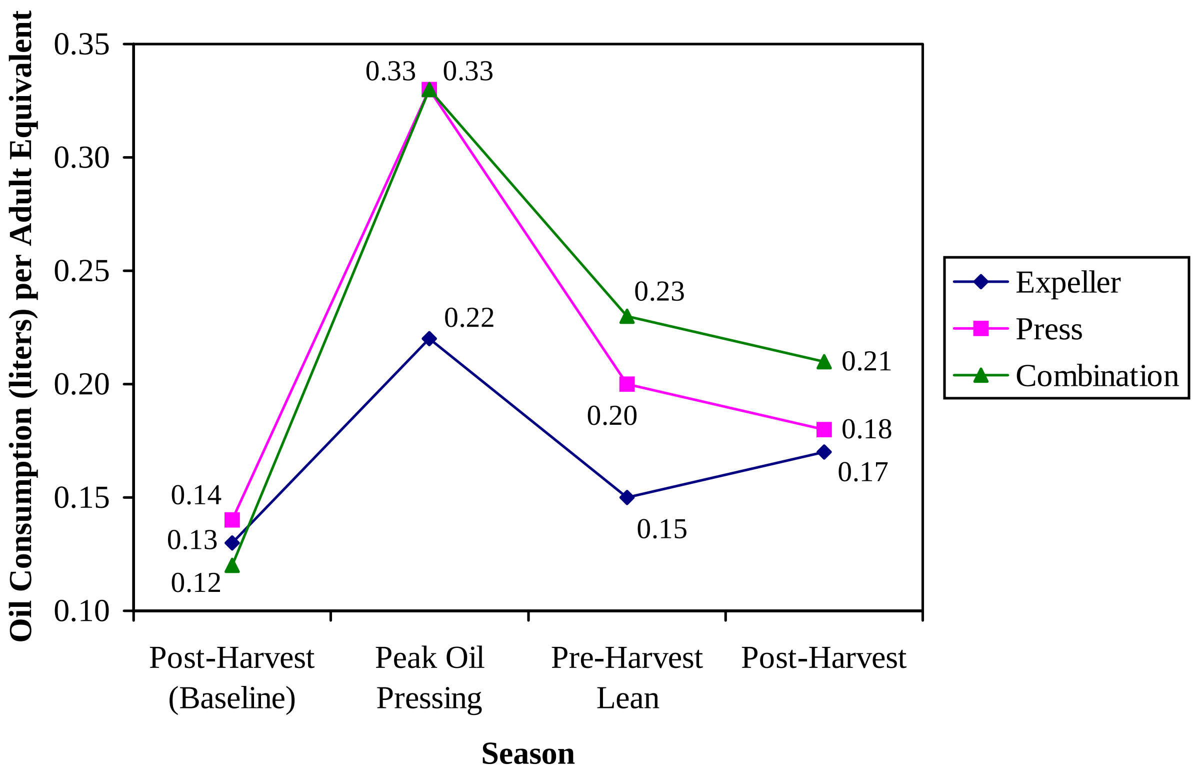

Figure 5.6. Mean Household Consumption of Oil During the Last 7 Days Across Seasons.

Dietary Intake of Women

The women's mean intake of kilocalories is presented in Table 5.17 and Figure 5.7. The major trend in women's intake of kilocalories was the decrease during the pre-harvest lean season with similar intakes for all other seasons. This seasonal effect was significant at $p<0.0008$. At the baseline, the Expeller and Press women consumed more kilocalories than the Combination women. After the baseline, the Press and Combination women consumed more kilocalories than the Expeller women at all other seasons, but especially at the pre-harvest lean season. At the pre-harvest lean season the Combination and Press women consumed 27.9 and 25.9 percent more calories, respectively, than the Expeller women. The large differences between groups at the peak oil-pressing season and pre-harvest lean season resulted in a season*group interaction that was significant at $p<0.0002$. In other words, although women in all groups had similar intakes at the baseline and post-harvest seasons, the Press and Combination women had significantly higher intakes at the peak oil-pressing and pre-harvest lean seasons.

Table 5.17. Women's Mean Intake of Kilocalories Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=38)	2622±781	2065±552	1808±498	2441±686
Press (n=30)	2560±1120	2556±641	2276±603	2598±535
Combination (n=39)	2155±747	2398±596	2312±935	2469±544

Repeated measures analysis of variance:

I. Group effect: not significant.

II. Seasonal effect: $p<0.0008$.

III. Season*Group Interaction: $p<0.0002$.

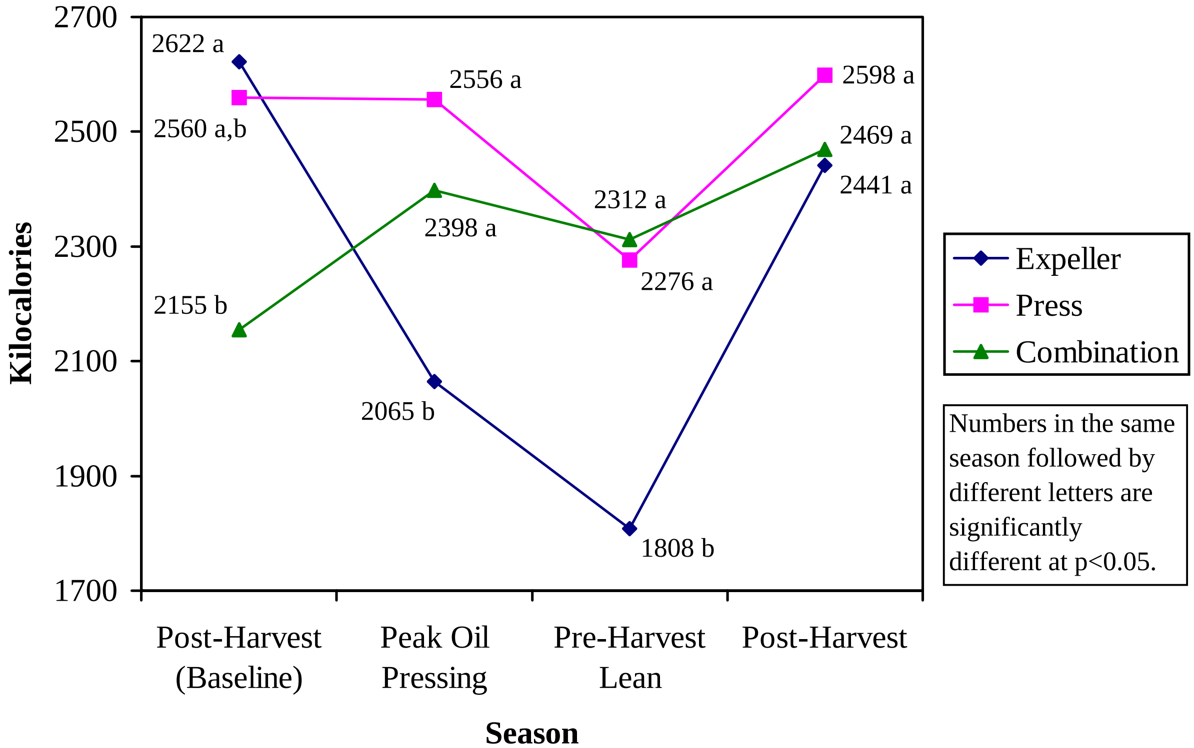

Figure 5.7. Women's Mean Intake of Kilocalories Across Seasons.

The women's mean intake of protein is presented in Table 5.18 and Figure 5.8. Women consumed the greatest amounts of protein during the peak oil-pressing season and the least amounts during the pre-harvest lean season. This seasonal effect was significant at $p<0.0001$. At the baseline, the Press and Expeller women consumed more protein than the Combination women. After the baseline, the Press and Combination women consumed more protein than the Expeller women at all other seasons. This group effect was significant at $p<0.005$. At the peak oil-pressing season, the Press and Combination women consumed 41.3 and 17.5 percent more protein than the Expeller women. At the pre-harvest lean season, the Press and Combination women consumed 35.0 and 31.4 percent more protein than the Expeller women. This season*group interaction was significant at $p<0.0007$.

Table 5.18. Women's Mean Intake of Protein (g) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=38)	97.2±31.4	86.52±8.5	67.2±19.9	97.9±30.7
Press (n=30)	98.3±50.1	122.2±37.5	90.7±24.9	107.6±23.8
Combination (n=39)	84.1±30.9	101.6±34.4	88.3±34.0	98.2±25.1

Repeated measures analysis of variance:
I. Group effect: $p<0.005$.
II. Seasonal effect: $p<0.0001$.
III. Season*Group Interaction: $p<0.0007$.

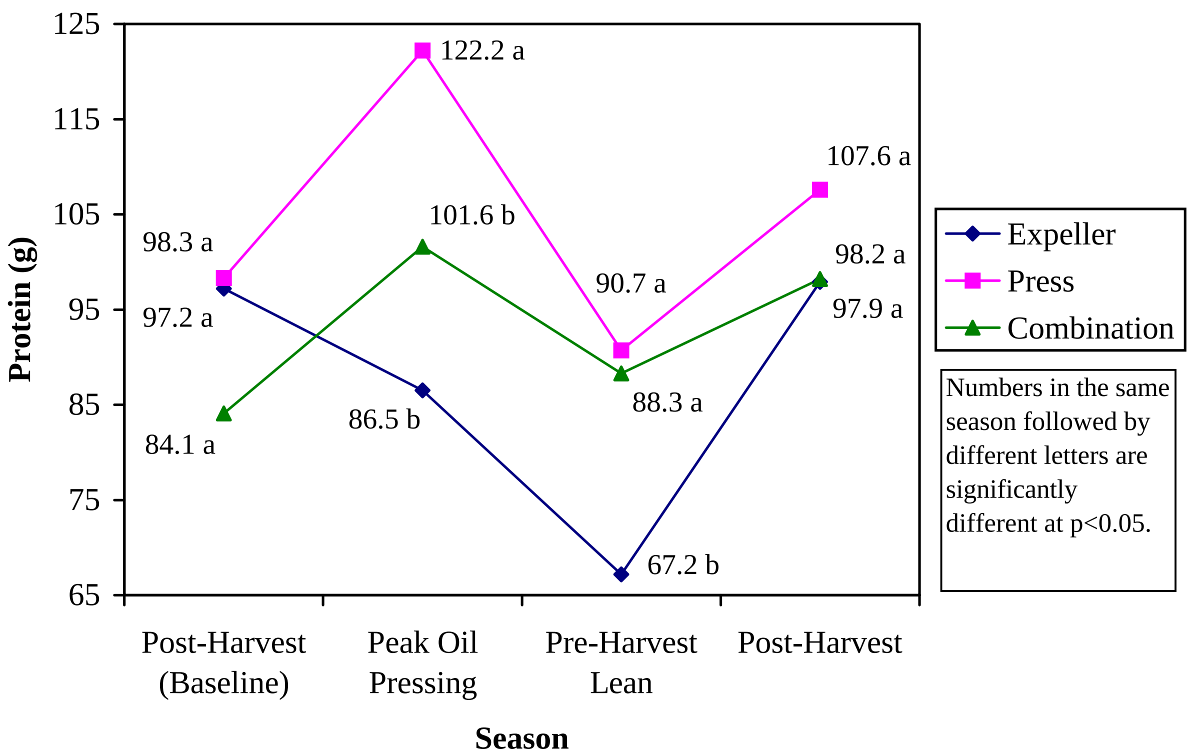

Figure 5.8. Women's Mean Intake of Protein Across Seasons.

The women's mean intake of carbohydrates is presented in Table 5.19 and Figure 5.9. Women consumed the greatest amounts of carbohydrates during the baseline and the least amounts during the peak oil-pressing season. This seasonal effect approached significance at $p<0.06$. At the baseline, the Press and Expeller women consumed more carbohydrates than the Combination women. After the baseline, the Press and Combination women consumed more carbohydrates than the Expeller women at all other seasons and especially at the pre-harvest lean season. At the pre-harvest lean season, Press and Combination women consumed 19.6 and 19.2 percent more protein than the Expeller women. This season*group interaction was significant at $p<0.003$.

Table 5.19. Women's Mean Intake of Carbohydrates (g) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=38)	346.3±113.0	266.8±81.4	273.3±74.7	300.4±86.0
Press (n=30)	345.6±157.2	307.7±84.2	326.8±105.7	331.8±89.5
Combination (n=39)	280.5±114.3	285.2±79.1	325.8±147.5	318.8±74.2

Repeated measures analysis of variance:

I. Group effect: not significant.

II. Seasonal effect: $p<0.06$.

III. Season*Group Interaction: $p<0.003$.

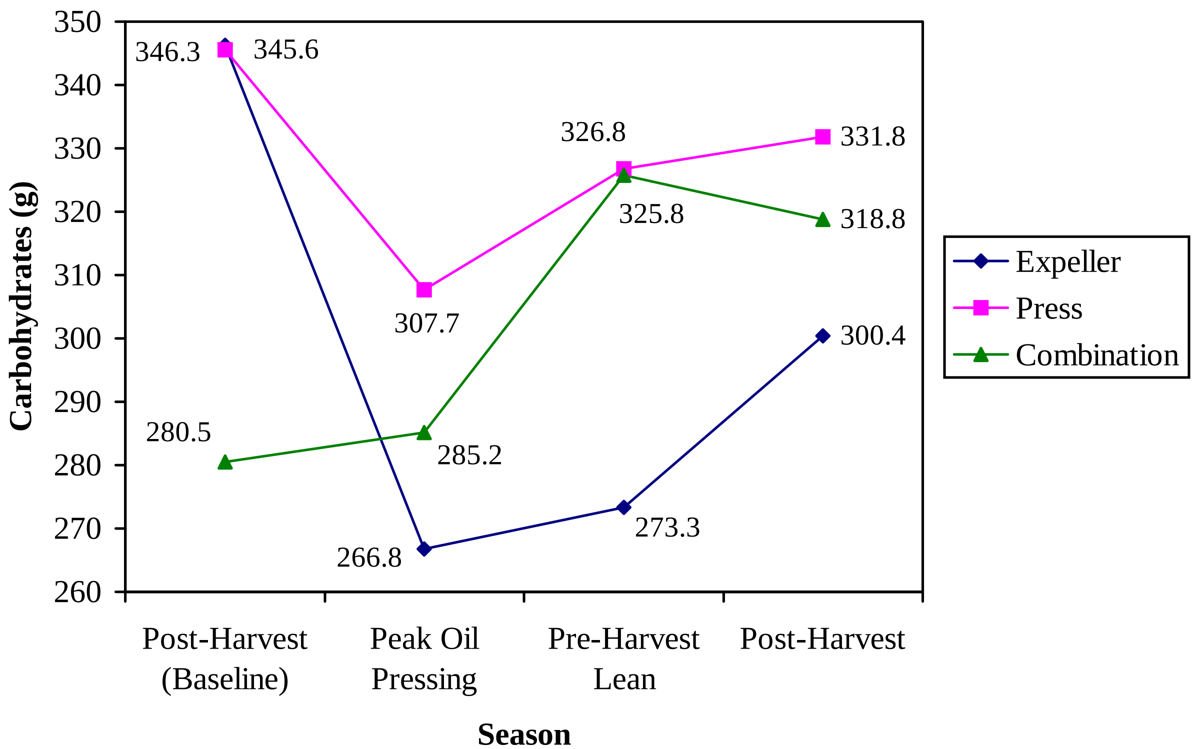

Figure 5.9. Women's Mean Intake of Carbohydrates Across Seasons.

The women's mean intake of fat is presented in Table 5.20 and Figure 5.10. The intake of fat was relatively unchanged except for a large decrease at the pre-harvest lean season. This seasonal effect was significant at p<0.0001. At the peak oil-pressing season, the Combination and Press women consumed 31.1 and 27.9 percent more fat than the Expeller women. At the pre-harvest lean season, the Combination and Press women consumed 47.8 and 35.2 percent fat than the Expeller women. This season*group interaction was significant at p<0.0002.

Table 5.20. Women's Mean Intake of Fat (g) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=38)	101.2±39.7	76.5±29.9	51.0±23.5	101.1±40.5
Press (n=30)	94.0±45.2	97.9±37.7	68.9±25.3	99.8±27.9
Combination (n=39)	82.8±31.1	100.4±34.6	75.4±39.8	95.3±31.3

Repeated measures analysis of variance:

I. Group effect: not significant.
II. Seasonal effect: p<0.0001.
III. Season*Group Interaction: p<0.0002.

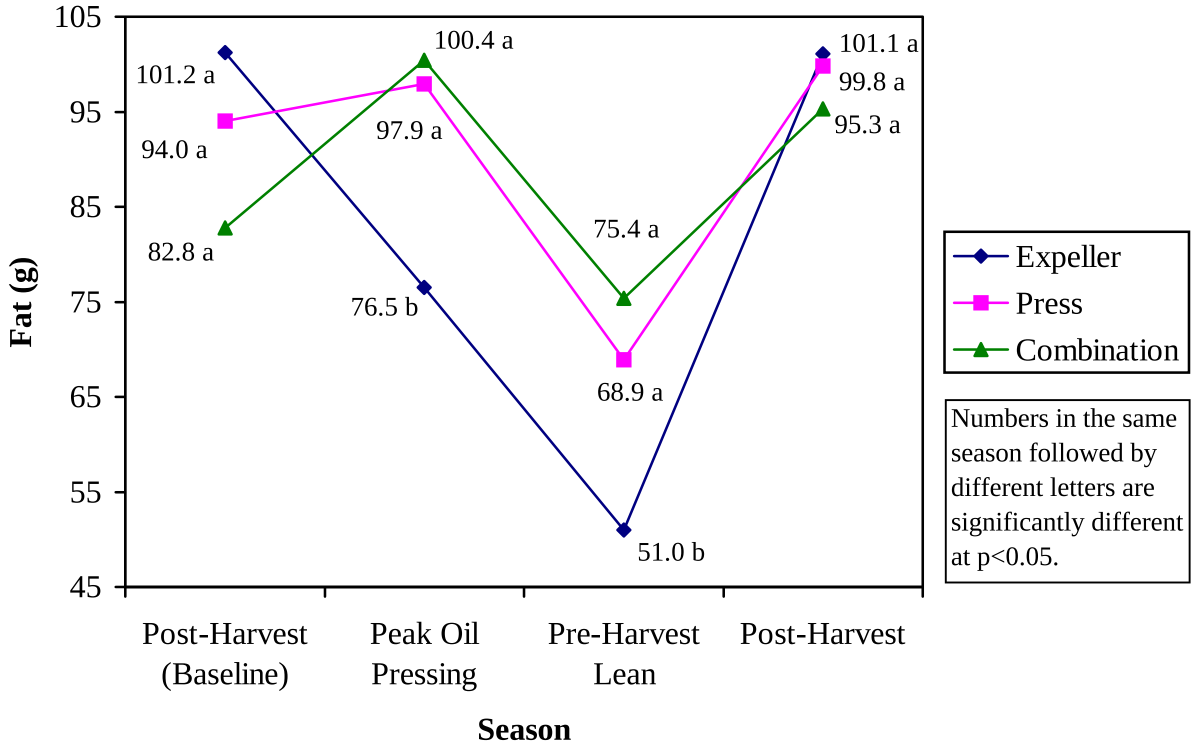

Figure 5.10. Women's Mean Intake of Fat Across Seasons.

The women's mean intake of vitamin A is presented in Table 5.21 and Figure 5.11. Women consumed the greatest amounts of vitamin A at the baseline and post-harvest seasons and the least amounts at the pre-harvest lean season. This seasonal effect was significant at p<0.008. At the baseline, the Expeller women had the greatest consumption of vitamin A. After the baseline, the Press women had the greatest consumption of vitamin A at the peak oil-pressing season, and the Combination women had the greatest consumption of vitamin A at the post-harvest season. This season*group interaction was significant at p<0.003.

Table 5.21. Women's Mean Intake of Vitamin A (RE) Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=38)	880.4±1743.9	240.1±115.5	205.9±151.0	303.5±606.3
Press (n=30)	409.5±372.4	359.7±249.9	230.0±96.0	316.2±221.2
Combination (n=39)	402.6±453.4	348.7±395.7	234.5±95.7	465.2±1074.1

Repeated measures analysis of variance:
I. Group effect: not significant.
II. Seasonal effect: p<0.008.
III. Season*Group Interaction: p<0.03.

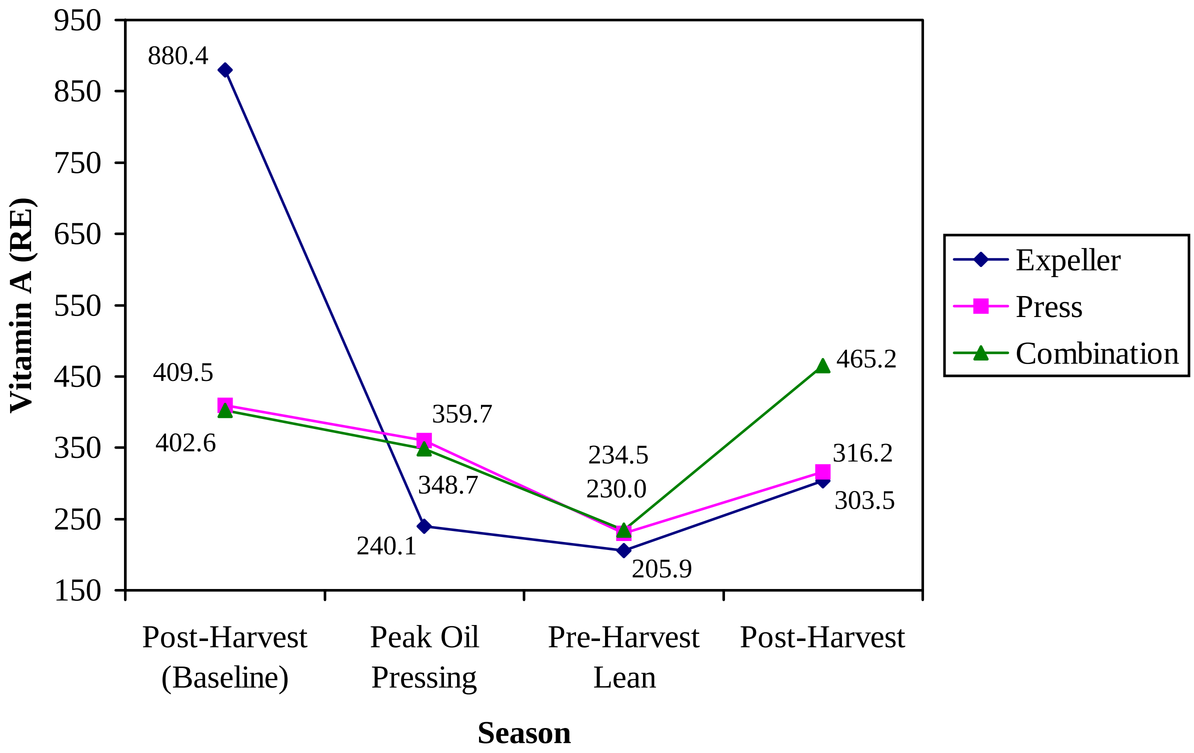

Figure 5.11. Women's Mean Intake of Vitamin A Across Seasons.

Dietary Intake of Children

The children's mean intake of kilocalories is presented in Table 5.22 and Figure 5.12. Children consumed the most kilocalories during the peak oil-pressing and post-harvest seasons and the least kilocalories during the baseline and pre-harvest lean seasons. This seasonal effect was significant at $p<0.0001$. At the baseline, the Expeller children consumed 30.6 percent more kilocalories than the Combination children and 35.9 percent more than the Press children. After the baseline, the trend was reversed and the Combination and Press children consumed more kilocalories than the Expeller children at all other seasons. The Combination children consumed 43.8, 26.1, and 14.7 percent more kilocalories than the Expeller children at the peak oil-pressing, pre-harvest lean, and post-harvest seasons, respectively. The Press children consumed 30.8, 11.7, and 14.4 percent more kilocalories than the Expeller children at the peak oil-pressing, pre-harvest lean, and post-harvest seasons, respectively. This season*group interaction was significant at $p<0.0001$.

Table 5.22. Children's Mean Intake of Kilocalories Across Seasons Adjusted for Age and Sex.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	1322±588	978±405	978±441	1239±393
Press (n=30)	972±450	1279±597	1093±506	1417±404
Combination (n=40)	1013±462	1407±637	1233±549	1421±418

Repeated measures analysis of variance:

I. Group effect: not significant.
II. Seasonal effect: $p<0.0001$.
III. Season*Group Interaction: $p<0.0001$.

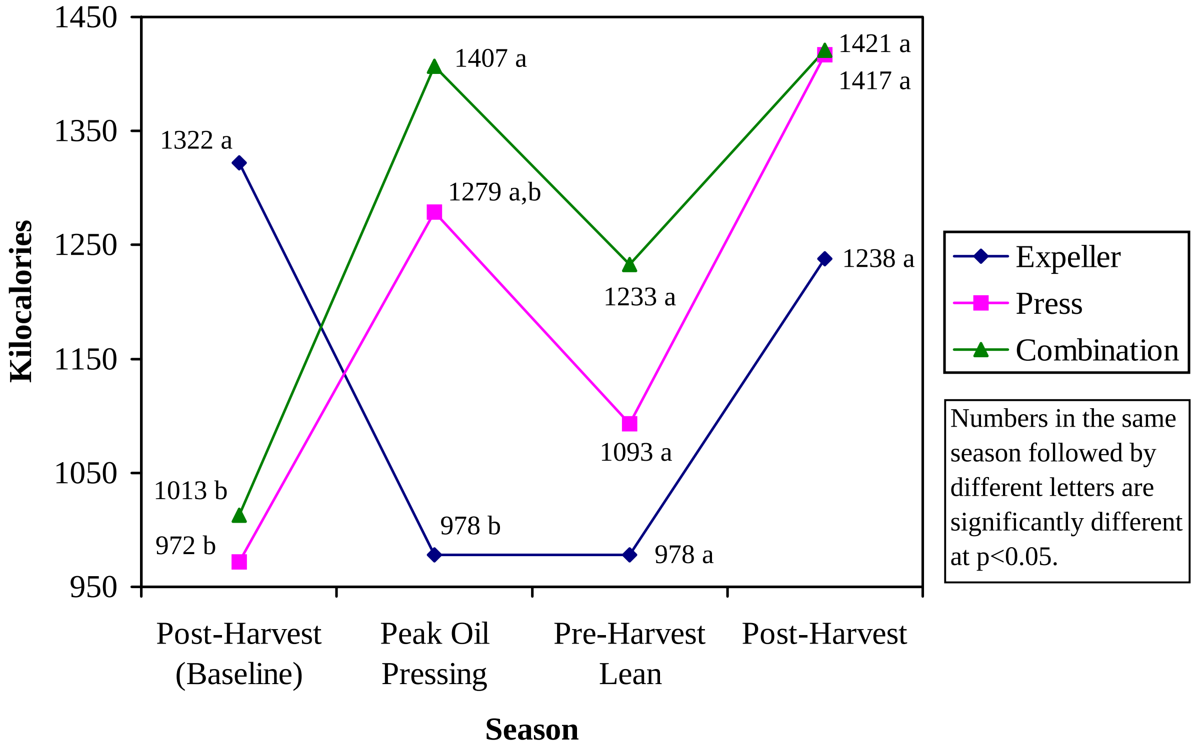

Figure 5.12. Children's Mean Intake of Kilocalories Across Seasons Adjusted for Age and Sex.

The children's mean intake of protein is presented in Table 5.23 and Figure 5.13. The intake of protein followed a similar pattern to the intake of kilocalories. Children consumed the greatest amounts of protein during the peak oil pressing and post-harvest seasons and the least amounts during the baseline and pre-harvest lean seasons. This seasonal effect was significant at p<0.0001. At the baseline, the Expeller children consumed more protein than the Combination and Press children. After the baseline, this trend was reversed and the Press and Combination children consumed more protein than the Expeller children at all other seasons. The Press and Combination children consumed 57.3 and 55.9 percent more protein at the peak oil-pressing season than the Expeller children. At the pre-harvest lean season, the Combination and Press children consumed 32.8 and 24.1 percent more protein than the Expeller children. This season*group interaction was significant at p<0.0001 and there was a group effect that was significant at p<0.03.

Table 5.23. Children's Mean Intake of Protein (g) Across Seasons Adjusted for Age and Sex.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	42.9±19.1	33.6±16.4	32.3±15.7	44.1±16.5
Press (n=30)	33.1±16.9	52.9±26.8	40.2±18.8	53.2±15.1
Combination (n=40)	35.8±17.2	52.5±27.8	43.0±17.8	50.7±14.8

Repeated measures analysis of variance:

I. Group effect: p<0.03.

II. Seasonal effect: p<0.0001.

III. Season*Group Interaction: p<0.0001.

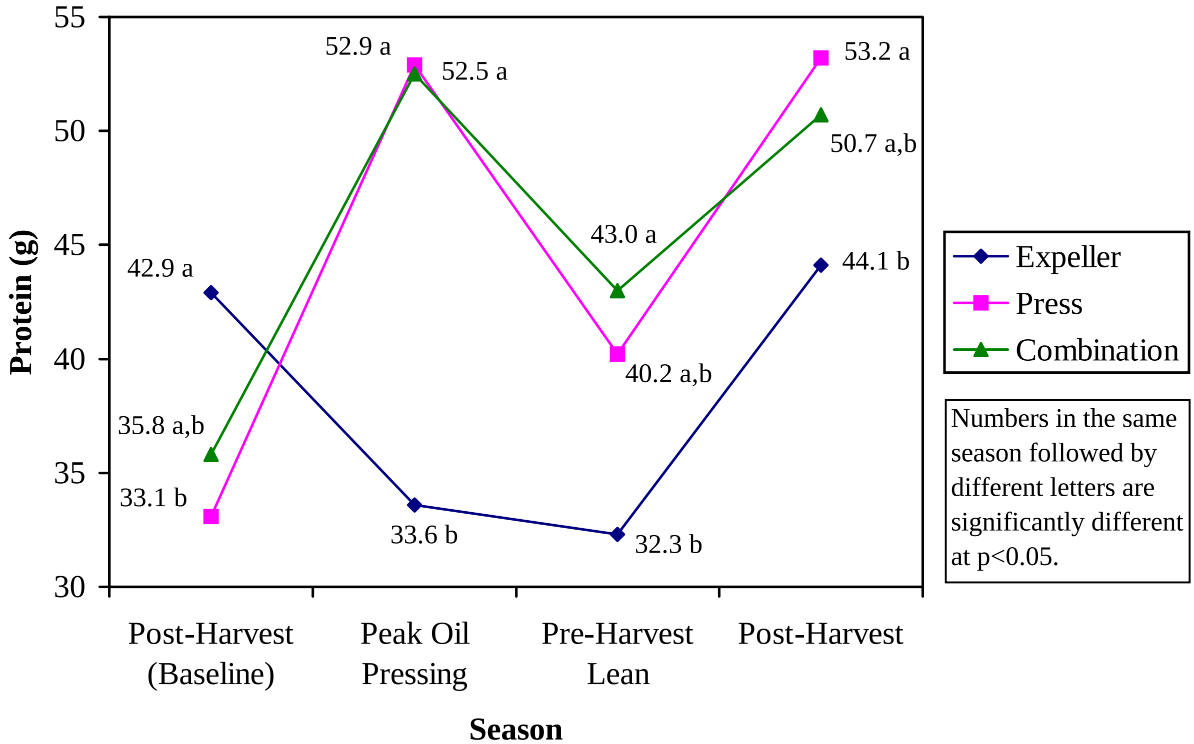

Figure 5.13. Children's Mean Intake of Protein Across Seasons Adjusted for Age and Sex.

The children's mean intake of carbohydrates is presented in Table 5.24 and Figure 5.14. At the baseline, the Expeller children consumed about 40 percent more carbohydrates than the Press and Combination children. After the baseline, the Combination and Press children consumed more carbohydrates at each season than the Expeller children. This season*group interaction was significant at $p<0.0001$. There were no statistically significant seasonal effects or group effects.

Table 5.24. Children's Mean Intake of Carbohydrates (g) Across Seasons Adjusted for Age and Sex.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	201.2±95.6	151.1±81.0	162.1±78.4	168.6±80.8
Press (n=30)	145.1±77.0	164.0±76.0	169.6±84.9	186.5±62.7
Combination (n=40)	143.0±74.0	186.4±88.9	187.6±78.7	196.2±71.6

Repeated measures analysis of variance:
I. Group effect: not significant.
II. Seasonal effect: not significant.
III. Season*Group Interaction: $p<0.0001$.

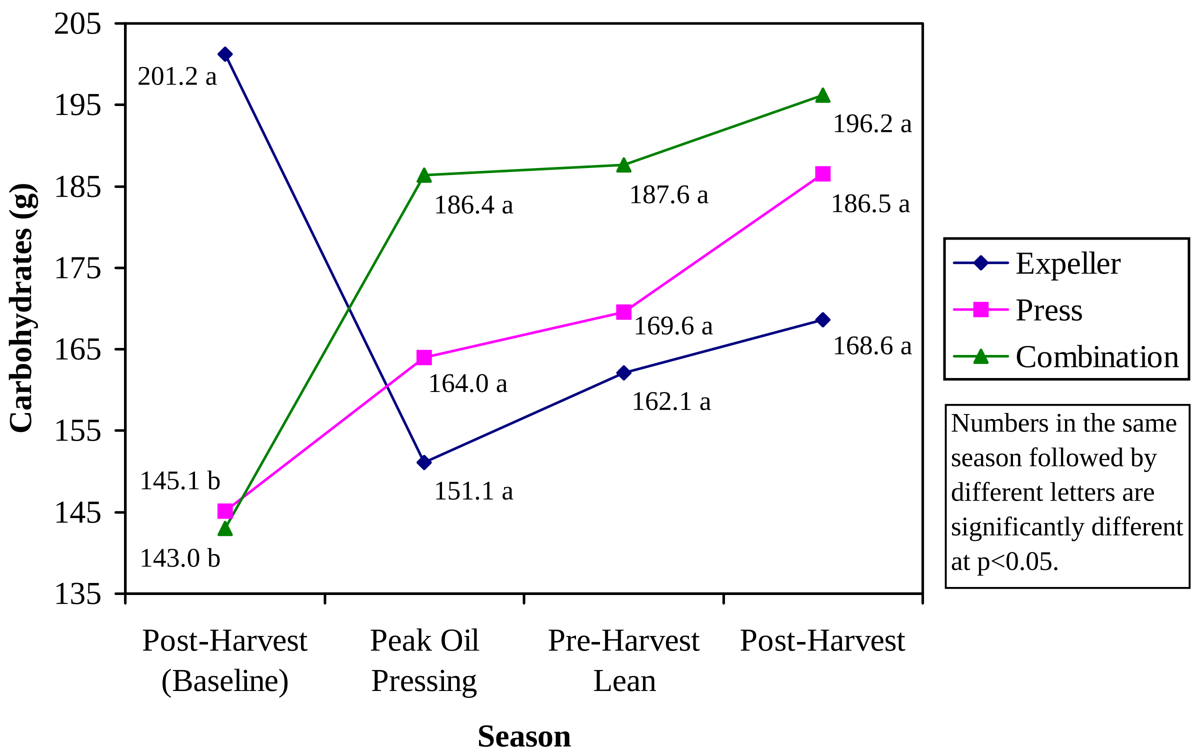

Figure 5.14. Children's Mean Intake of Carbohydrates Across Seasons Adjusted for Age and Sex.

The children's mean intake of fat is presented in Table 5.25 and Figure 5.15. Children consumed the greatest amounts of fat during the peak oil-pressing and the post-harvest seasons with least amounts during the pre-harvest lean season. This seasonal effect was significant at $p<0.0001$. At the baseline, the Expeller children consumed more fat than the Combination and Press children. After the baseline, the trend had reversed and the Combination and Press children consumed more fat at all other seasons. At the peak oil-pressing season, the Combination and Press children consumed 88.0 and 69.5 percent more fat than the Expeller children. At the pre-harvest lean season, the Combination and Press children consumed 56.1 and 24.8 percent more fat than the Expeller children. This season*group interaction was significant at $p<0.0002$ and there was a group effect that was significant at $p<0.05$.

Table 5.25. Children's Mean Intake of Fat (g) Across Seasons Adjusted for Age and Sex.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	42.4±26.2	28.9±18.1	23.4±13.9	47.4±26.2
Press (n=30)	31.8±18.5	48.9±31.8	29.2±17.4	55.2±19.6
Combination (n=40)	35.9±26.1	54.3±33.6	36.5±25.6	52.7±19.9

Repeated measures analysis of variance:

I. Group effect: $p<0.05$.

II. Seasonal effect: $p<0.0001$.

III. Season*Group Interaction: $p<0.0001$.

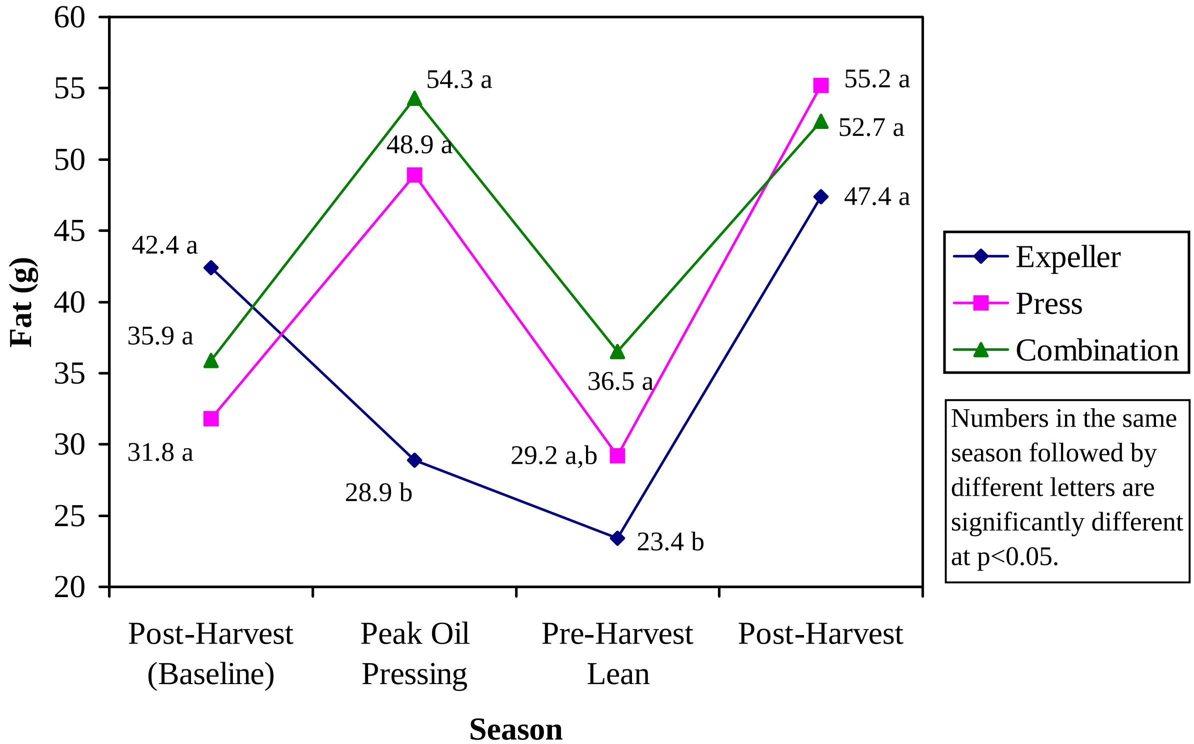

Figure 5.15. Children's Mean Intake of Fat Across Seasons Adjusted for Age and Sex.

The children's mean intake of vitamin A is presented in Table 5.26 and Figure 5.16. The major trend in children's vitamin A intake was the dip at the pre-harvest lean season; however, this seasonal effect was not statistically significant. At the baseline, Expeller children consumed more vitamin A than the Combination and Press children. After the baseline, the trend had reversed and the Combination and Press children consumed more vitamin A at all other seasons. The Combination and Press children consumed 226.4 and 157.8 percent more vitamin A than the Expeller children at the peak oil-pressing season and 312.6 and 203.5 percent more at the post-harvest season. This season*group interaction was significant at $p<0.05$.

Table 5.26. Children's Mean Intake of Vitamin A (RE) Across Seasons Adjusted for Age and Sex.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	208.6±240.1	93.2±111.5	88.3±64.0	82.3±53.7
Press (n=30)	146.3±109.8	147.1±138.6	112.2±65.0	167.5±149.1
Combination (n=40)	174.9±433.7	211.0±327.8	108.0±38.0	257.3±620.9

Repeated measures analysis of variance:

I. Group effect: not significant.

II. Seasonal effect: not significant.

III. Season*Group Interaction: $p<0.05$.

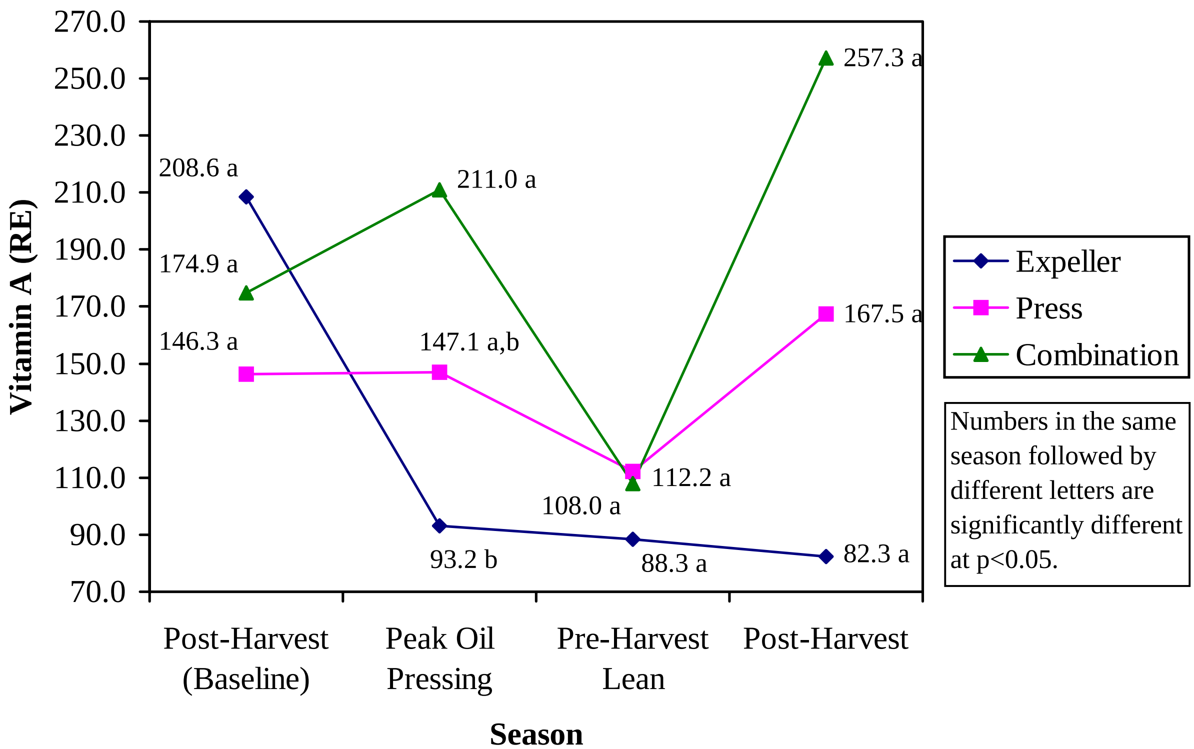

Figure 5.16. Children's Mean Intake of Vitamin A Across Seasons Adjusted for Age and Sex.

During the pre-harvest lean season, Expeller children consumed 22 out of the 27 foods included in the food frequency questionnaire less frequently than the Press and Combination children. The Press children had the highest frequency of consumption of 4 out of 6 high fat/high protein foods. Those foods were eggs, meat, fish, and butter with the difference for butter being significant at $p<0.0002$. The Combination children had the highest frequency of consumption for the other 2 high fat foods, roasted groundnuts and mafe jaro (dried fish), with the differences being significant at $p<0.01$ and $p<0.003$, respectively. The Press children also had the highest frequency of consumption of 5 out of 5 nutrient dense weaning foods with significant differences for churah gerteh ($p<0.0009$), mono and groundnut paste ($p<0.0001$), and mono and sesame paste ($p<0.02$). The Combination children had the highest frequencies of consumption for 5 of 6 nutrient dense table foods with significant differences for benachin ($p<0.02$), nyakatango ($p<0.04$), and palm oil fish stew ($p<0.006$). The Expeller children had the lowest frequencies of consumption for all high fat/high protein foods, nutrient dense weaning foods, and nutrient dense table foods. The Expeller children did have the highest frequencies of consumption for 2 of 5 high moisture/low calorie weaning foods with the difference for cherreh and water significant at $p<0.02$.

Nutritional Status of Women

The mean body mass index of non-pregnant/lactating women is presented in Table 5.27. A general trend can be seen for non-pregnant/lactating women as their body mass index decreased from the peak oil-pressing season to the pre-harvest lean season and then returned to near previous levels at the post-harvest season. This trend was true for both the Expeller and Press women; however, the Combination women did not experience the decrease in body mass index during the pre-harvest lean season. The only significant differences were for body mass index between groups at the pre-harvest lean season ($p<0.03$).

Table 5.27. Mean Body Mass Index (kg/m^2) of Non-Pregnant/Lactating Women Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller	22.2±4.3 (n=20)	22.0±3.7 (n=14)	20.9±2.6[a] (n=17)	21.4±2.8 (n=18)
Press	20.4±1.8 (n=24)	20.3±1.9 (n=18)	19.5±1.8[a] (n=14)	20.1±2.1 (n=11)
Combination	21.5±3.1 (n=30)	22.4±3.7 (n=20)	22.0±3.3[b] (n=25)	22.0±3.6 (n=21)

[a] Numbers in the same column followed by different letters are significantly different at $p<0.05$.

Nutritional Status of Children

The children's mean weight-for-height z-scores are presented in Table 5.28 and Figure 5.17. Except for the peak oil-pressing season, the Combination and Press children recorded higher weight-for-height z-scores than the Expeller children. The Expeller children experienced a marked increase in weight-for-height z-scores at the peak oil-pressing season and then decreased to near previous levels. The Combination and Press children experienced steadily increasing weight-for-height z-scores across seasons except for the pre-harvest lean season when their scores leveled off. By the post-harvest season, the Press and Combination children were 0.28 and 0.76 standard deviations above the reference weight-for-height standard, whereas the Expeller children were 0.63 standard deviations below the standard. The seasonal effect was significant at $p<0.0009$, and the group effect approached significance at $p<0.10$.

Table 5.28. Children's Mean Weight-for-Height Z-Scores Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	-0.88±1.25	0.16±1.55	-0.52±1.58	-0.63±1.67
Press (n=30)	-0.66±1.60	-0.31±1.53	-0.31±1.41	0.76±2.04
Combination (n=40)	-0.33±1.52	-0.16±1.54	-0.13±1.30	0.28±1.67

Repeated measures analysis of variance:

I. Group effect: $p<0.10$.

II. Seasonal effect: $p<0.0009$.

III. Season*Group Interaction: not significant.

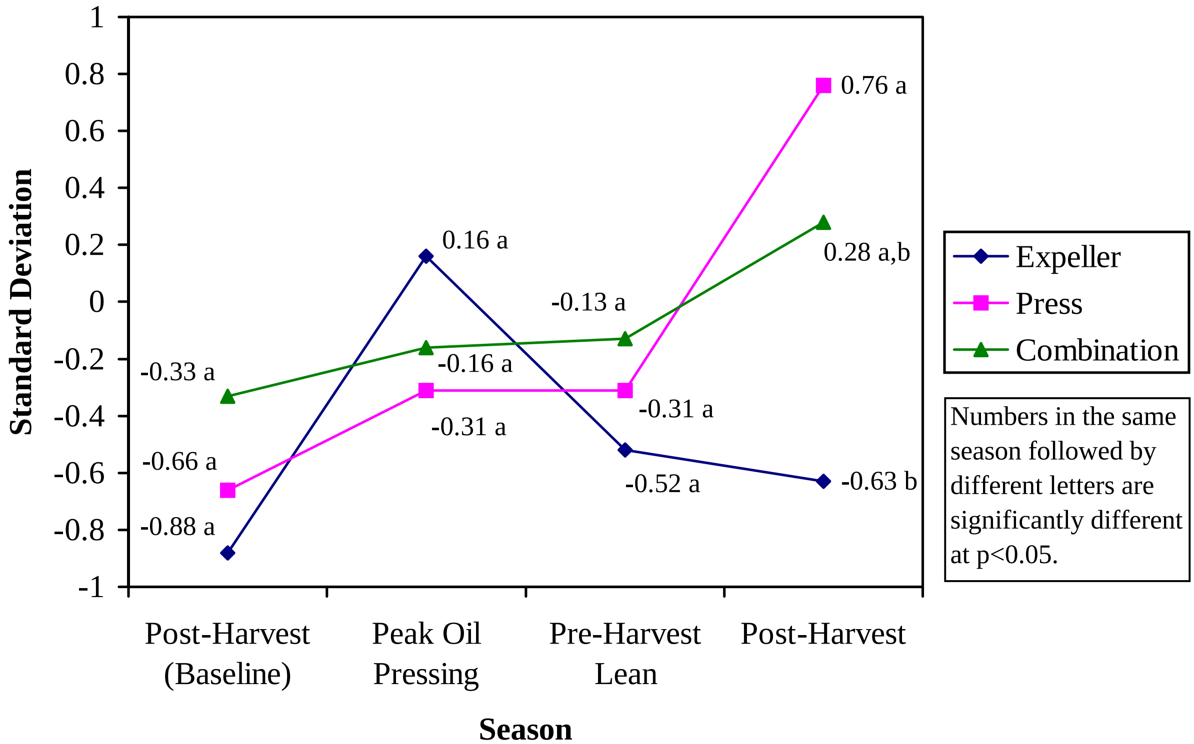

Figure 5.17. Children's Mean Weight-for-Height Z-Scores Across Seasons.

The children's mean weight-for-age z-scores are presented in Table 5.29 and Figure 5.18. The weight-for-age z-scores for Combination and Study children increased steadily across seasons except for a slight leveling off during the pre-harvest lean season. The Expeller children, however, experienced a marked increase in weight-for-age at the peak oil-pressing season and then returned to previous levels. The seasonal effect was significant at $p<0.0001$. At the peak oil-pressing season, the Expeller children recorded height-for-age z-scores that were about half a standard deviation higher than the Combination and Press children. By the post-harvest season, the Combination and Press children recorded weight-for-age z-scores that were at least a half a standard deviation higher than the Expeller children. This season*group interaction was significant at $p<0.005$.

Table 5.29. Children's Mean Weight-for-Age Z-Scores Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	-1.40±1.22	-0.51±1.41	-1.25±1.35	-1.22±1.51
Press (n=30)	-1.48±1.34	-1.06±1.34	-1.18±1.39	-0.69±1.23
Combination (n=40)	-1.33±1.42	-1.00±1.17	-0.95±1.07	-0.50±1.27

Repeated measures analysis of variance:

I. Group effect: not significant.

II. Seasonal effect: $p<0.0001$.

III. Season*Group Interaction: $p<0.005$.

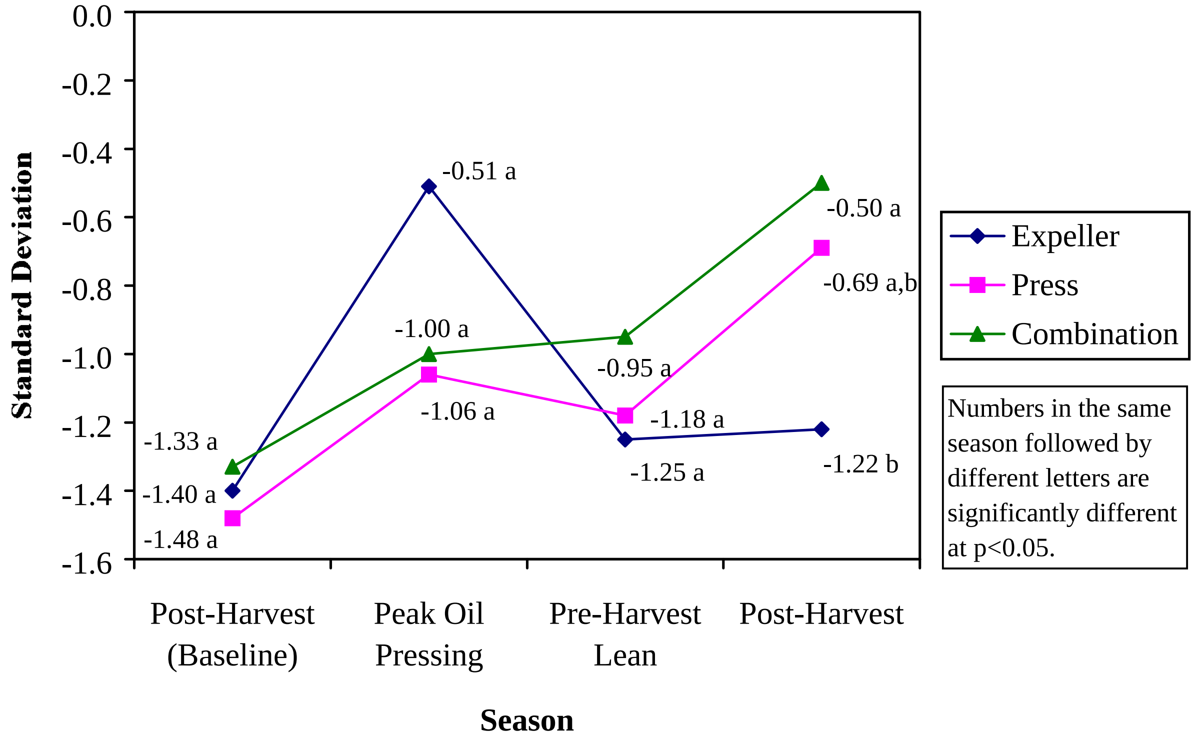

Figure 5.18. Children's Mean Weight-for-Age Z-Scores Across Seasons.

The children's mean height-for-age z-scores are presented in Table 5.30. There were no readily apparent trends and no statistically significant differences in children's height-for-age z-scores either between groups or across seasons.

Table 5.30. Children's Mean Height-for-Age Z-Score Across Seasons.

Group	Baseline Mean±S.D.	Peak Oil-Pressing Mean±S.D.	Pre-Harvest Mean±S.D.	Post-Harvest Mean±S.D.
Expeller (n=39)	-1.0±1.1	-1.0± 1.3	-1.4± 1.0	-1.1± 1.1
Press (n=30)	-1.5± 1.5	-1.4± 1.7	-1.5± 2.4	-1.6± 2.3
Combination (n=40)	-1.3± 1.4	-1.3± 1.8	-1.3± 1.6	-1.2± 1.5

Repeated measures analysis of variance:

I. Group effect: not significant.

II. Seasonal effect: not significant.

III. Season*Group Interaction: not significant.

Household Oil Production and Availability

The mean time of oil availability and the mean initial purchasing time of oil for the household are presented in Table 5.31. The Combination households reported longer times of availability and longer times before oil was purchased than either the Press or Expeller households; however, these differences were not statistically significant. The lack of a statistically significant difference in the time of availability and time of initial purchase of oil could be a result of households only growing sufficient quantities of sesame to meet short term oil needs.

Table 5.31. Length of Oil Availability and Time of Initial Purchase in Months in Relation to the Peak Oil-Pressing Season of March.

	Group	Mean (s.d.)	Range (min. - max.)
Length of Oil Availability from Peak Oil-Pressing (March) in Months	Expeller (n=37)	3.1(1.9)	1 - 8
	Press (n=31)	3.2(2.1)	1 - 8
	Combination (n=41)	3.5(2.7)	0 - 12
Time of Initial Oil Purchase After Peak Oil-Pressing (March) in Months	Expeller (n=37)	3.7(2.3)	0 - 8
	Press (n=31)	3.4(2.0)	0 - 7
	Combination (n=41)	3.9(1.7)	0 - 7

CHAPTER 6: DISCUSSION

The results of this study clearly show that seasonal fluctuations in household food supply and individual consumption continue to exist in The Gambia. These seasonal fluctuations follow the expected trend of highs in the post-harvest season and lows in the pre-harvest lean season. Similarly, the nutritional status of women and children in The Gambia is effected by this seasonal fluctuation. The trend of women's intake of kilocalories in The Gambia peaking at the post-harvest season and reaching a low point at the pre-harvest lean season has been well documented (Prentice et al, 1981)[101]. The women's intake of kilocalories closely follows this trend; however, current intakes are considerably higher than those obtained by Prentice et al (1981)[102]. This may be due to the high enrollment of women in the GAFNA/CRS supplementation project. The FAO recommended daily average energy requirement for women aged 18 to 30 years is 2350 kilocalories (WHO, 1985)[103]. After the baseline, women in the Press and Combination groups exceeded this recommendation by 2 to 10 percent at all seasons except the pre-harvest lean season. Even at the pre-harvest lean season, Press and Combination women consumed 96.9 and 98.4 percent of the FAO recommendation, respectively. The Expeller women, on the other hand, consumed only 87.9 percent of the recommended requirement at the peak oil-pressing season and only 76.9 percent at the pre-harvest lean season. The mean intake of protein for women in every group and at every season exceeded the FAO recommended safe level of protein intake for women aged 18 to 30 years.

As expected, the children's mean intake of kilocalories followed a similar pattern to the women's with the highest intakes in the post-harvest season and lowest intakes in the pre-harvest lean season. None of the reported mean intakes met the FAO (WHO, 1985)[104] daily average energy requirement for children aged 3 to 5 years. The Combination and Press children came closest to meeting the requirement at the post-harvest season with intakes equal to 91.6 and 91.4 percent of the recommended. After the baseline, the Expeller children never consumed more than 79.9 percent of the recommended intake of kilocalories and only consumed 63.1 percent at both the peak oil-pressing and pre-harvest lean season. On the other hand, at the pre-harvest lean season, the Combination and Press children consumed 79.5 and 70.1 percent of the recommended intake of kilocalories, respectively.

Both women and children in the Press and Combination groups derived a greater percentage of their caloric intake from protein and fat than Expeller women at both the peak oil-pressing season and the pre-harvest lean season. This suggests that women and children in the Press and Combination groups were consuming a higher proportion of high protein/high fat foods than the Expeller women. This is supported by both the household oil consumption and the children's food frequency. Households in the Press and Combination groups consumed more oil per person at the peak oil-pressing and pre-harvest lean seasons than those in the Expeller group. Children

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[101] Prentice AM, Whitehead RG, Roberts SB, Paul AA. Long-Term Energy Balance in Child-Bearing Gambian Women. The American Journal of Clinical Nutrition. 1981;34:2790-99.
[102] Prentice AM, Whitehead RG, Roberts SB, Paul AA. Long-Term Energy Balance in Child-Bearing Gambian Women. The American Journal of Clinical Nutrition. 1981;34:2790-99.
[103] WHO. Energy and Protein Requirements. Report of a Joint FAO/WHO Expert Consultation. WHO Technical Report Series 724. World Health Organization. Geneva, Switzerland. 1985.
[104] WHO. Energy and Protein Requirements. Report of a Joint FAO/WHO Expert Consultation. WHO Technical Report Series 724. World Health Organization. Geneva, Switzerland. 1985.

in the Combination and Press groups consumed high fat/high protein foods, nutrient dense weaning foods, and nutrient dense table foods more frequently than children in the Expeller group during the peak oil-pressing and pre-harvest lean seasons. Women and children in the Expeller group derived a greater percentage of their caloric intake from carbohydrates than those in the Press or Combination groups at both the peak oil-pressing and pre-harvest lean seasons. This suggests that Expeller women and children were consuming a higher proportion of cereals and grains during these seasons than the Press and Combination women. For children, this was also supported by the food frequency data as the children in the Expeller group consumed low calorie weaning foods more frequently than those in the Press and Expeller groups.

For the non-pregnant/lactating women, body mass index followed the expected pattern of a decrease at the pre-harvest lean season and an increase at the post-harvest season. This trend of seasonal fluctuations in body weight in The Gambia has been well documented and closely follows the seasonal fluctuations in intake (Lawrence et al, 1987; Prentice et al, 1981)[105,106].

The weight-for-height z-scores of children exhibited seasonal fluctuations similar to those observed by Tomkins et al (1986)[107] in urban Gambia, by Adams (1994)[108] in Mali, and by Benefice et al (1984)[109] in Senegal. Children in the Press and Combination groups made steady gains in weight-for-height throughout the study and surpassed children in the Expeller groups by the last data collection. The weight-for-age z-scores of children followed a similar trend to the weight-for-height z-scores. The Combination and Press children drew closer to the standard weight-for-age with each season. The Expeller children, on the other hand, remained at near baseline levels. These steady gains in nutritional status for the Press and Combination children occurred without the losses incurred by children in the Expeller group during the pre-harvest lean season. This was likely due to the higher caloric intakes of children in the Press and Combination groups during the peak oil and pre-harvest lean seasons.

Vitamin A availability and intake fluctuated considerably across seasons as expected. Bates et al (1994)[110] reported that the intake of vitamin A precursors by women in The Gambia was lowest in December and peaked in June with intermediate intakes in March and August; however, Villard and Bates (1987)[111] reported considerable variations in the year to year timing of peaks and troughs in vitamin A intake by Gambian women. Household availability and women's intakes of vitamin A were similar, if not slightly lower, than those reported for women in the

[105] Lawrence M, Coward WA, Lawrence F, Cole TJ, Whitehead RG. Fat Gain During Pregnancy in Rural African Women: The Effect of Season and Dietary Status. American Journal of Clinical Nutrition. 1987;45:1442-50.
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[108] Adams AM. Seasonal Variations in Nutritional Risk Among Children in Central Mali. Ecology of Food and Nutrition. 1994;33:93-106.
[109] Benefice E, Chevassus-Agnes S, Barral H. Nutritional Situation and Seasonal Variations for Pastoralist Populations of the Sahel (Senegalese Ferlo). Ecology of Food and Nutrition. 1984;14:229-47.
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Gambia by Bates et al (1994) [112]. Overall, the vitamin A availability and intake was highest at the baseline and post-harvest seasons, intermediate at the peak oil-pressing season, and lowest at the pre-harvest lean season. The Press and Combination groups seemed to have slightly higher intakes during the peak oil-pressing and post-harvest lean seasons. The decrease during the pre-harvest lean season may simply be due to a decrease in the amount of food consumed. The FAO/WHO (1988)[113] recommended level of daily vitamin A intake for women of 500 RE was not met by women in any group except for those in the Expeller group (880.4 RE) at the baseline. After the baseline, women in the Combination group consumed 69.7 and 93.0 percent of the FAO recommendation at the peak oil-pressing and post-harvest seasons, respectively. The vitamin A intake of children followed a similar pattern to that of the women. The children never exceeded more than 64.3 percent of the FAO/WHO (1988)[114] recommended safe level of intake for children aged 1 to 6 years. After the baseline, the Expeller children consumed less than 25 percent of the recommended intake of vitamin A during all seasons, whereas the Combination children consumed 52.8 and 64.3 percent of the FAO recommendation at the peak oil-pressing and post-harvest seasons, respectively.

The household trend of highest availabilities of kilocalories during the post-harvest season and lowest intakes during the peak oil-pressing was not expected. The highest availability of kilocalories was expected to occur in the post-harvest season, and the lowest availability of kilocalories was expected to occur in the pre-harvest lean season. One possible explanation for this is that the household dietary data does not include snacks, foods that were eaten outside of the household, or foods that were prepared for and eaten solely by the target woman and child. These types of foods would be more readily available during the peak oil-pressing season when groundnuts and other snack foods are plentiful, and these types of foods would only be evident in the woman's and the child's dietary recalls.

The peak in oil consumption during the peak oil-pressing season was expected as many households press most or all of their sesame immediately following the harvest. The increase in oil consumption by Press and Combination households is evident in their higher availabilities of fat per capita than Expeller households at the peak oil-pressing season and in their higher amount of kilocalories derived from fat. The Press households also have a higher availability of protein per capita than the Combination or Expeller households and a higher percentage of kilocalories derived from protein. This could be the result of increased income from access to ram press technology.

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CHAPTER 7: CONCLUSIONS

Findings of this study indicate that women and children with access to ram press technology (either alone or in combination with motorized expeller technology) experience much less of a seasonal fluctuation in food consumption and nutritional status than those without ram press technology. For women, access to ram press technology means a 465 to 500 kilocalorie advantage during the rainy season over women without ram press technology. This has significant implications toward women's weight loss, the birth weight of children, and infant mortality during the rainy season. Children of women with access to ram press technology enjoyed a 115 to 255 kilocalorie advantage during the rainy season over children of women without access to ram press technology. This results in an increase in nutritional status over the course of the year rather than the yearly stagnation experienced by children of women without access to ram press technology. At the household level, access to ram press technology means an increase in oil consumption, especially during the peak oil-pressing season. Access to ram press technology seems to have an impact on the vitamin A intake of households, women, and children, during the peak oil-pressing and post-harvest seasons.

Findings of this study also indicate that when women are given choices as to which technology is best for them, they will maximize their benefits from the available technologies. Over half of the households that were using ram press technology only, started using a combination of ram press and motorized expeller technology. These households consumed slightly more calories and oil than those using only ram press technology. Women in these households had similar caloric intakes to those using only ram press technology. Children in these households had slightly greater caloric intakes and a better nutritional status than those using only ram press technology. These women were able to combine the benefits of both technologies to the advantage of them and their families.

CHAPTER 8: RECOMMENDATIONS

1. Further study of the role of ram press technology in stabilizing the seasonal fluctuations in food consumption and nutritional status of women and children in The Gambia.
2. Further development of the ram press to enhance its utilization by women and to explore technologies that would allow greater quantities of oil to be pressed manually.
3. Replication of this study in other areas of West Africa where women are growing oil seeds that would be appropriate for ram press technology.
4. Continued support by Catholic Relief Services in The Gambia to promote manufacturing, utilization, and long term maintenance of ram press technology.
5. Continued support by Catholic Relief Services in The Gambia to maintain the current motorized oil expellers in order to prolong their life as long as possible.

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APPENDIX A. Standardized Gram Weight Measures of Common Household Cooking and Eating Utensils.

Local Name Wolof/Mandinka	English Name	Use of Utensil	Capacity
Mbatu/Dosser	Big Calabash	Measure cherreh, Nyelleng, and rice	720g
Kalera/Kalero	Cooking Pot	Cooking	3 kg rice
Cork/Calama	Wooden/Metal Calabash	Eating	40g (mono with or without sour milk)
Kudu/Kojaro	5ml Tablespoon	Eating	25g (mono with or without sour milk) 40g (for Nyelleng, Oil Stew, and Benachin)
Kudu/Kojaro	2ml Teaspoon	Feeding Children	10g (mono with or without sour milk)
Chunwarr/Chunwarro	Sauce Sprinkler	Sharing Sauce	-
Baku/Sunkalangho	Laddle	Stirring Food	-

APPENDIX B. Standardized Gram Weight Measures of Handful Sizes for Men, Women, and Children.

	Handful Size			
Food	Male	Female	Child (2-5)	Tablespoon
Nyeleng	40g	30g	10g	40g
Vegetable Oil Stew (with rice)	40g	30g	10g	40g
Palm Oil Stew (with rice)	40g	30g	10g	40g
Nyankatangho/Mbahal	40g	30g	10g	40g
Tia Durangho/Domoda	40g	30g	10g	40g
Benachin	40g	30g	10g	40g
Cherreh	40g	30g	10g	40g

APPENDIX C. Glossary of Mandinka and Wolof Food Names with Their English Equivalents.

Local Food Name	English Equivalent
Benachin (w)*	Whole grain rice, cooked with oil and vegetables, often with fish or meat.
Cherreh (w) or Futo (m)	Millet flour pellets steamed three times.
Churah Gerteh (w)	Lumpy gruel of rice and raw groundnuts pounded together.
Mbahal (w) or Nyakatango (m)	Whole grain boiled rice with groundnuts or locust beans.
Churo (m)	Rice porridge, often eaten with sour milk and sugar.
Nyelleng (w)	Steamed millet grids, often eaten with groundnut paste sauce.
Serreng (w)	Boiled and steamed millet.
Mono (m) or Rui (w)	Thin porridge of boiled flour pellets.
Tia Durango (m) or Domoda (w)	Roasted groundnut sauce, often eaten with rice.
Tia Yilaringho (m)	Roasted groundnuts.
Jambo and Tia (m)	Leaf sauce with groundnuts.
Jambo (m)	General term for leaf or leaf sauce.
Akara (w)	Fried pounded beans.
Padan (w)	Boiled rice.
Mafe Biswap (w) or Kucha (m)	Sauce made with leaves.
Plasas (b)	Palm oil sauce with leaves and groundnuts.
Futu Kanya (m)	A mixture of dried cherreh, groundnut paste and sugar.
Tia Kere Durango (m)	Raw pounded groundnut sauce, often eaten with rice.

* (m) - Mandinka, (w) - Wolof, (b) - Mandinka and Wolof

APPENDIX D. Standardized Recipes of All Commonly Consumed Food Mixtures.

Benachin: 6 Ingredients

Item	Food Name	Serving	Portion
484	RICE-WHITE-LONG GRAIN-COOKED	65.00	GRAMS
120	OIL-VEGETABLE-CORN	10.00	GRAMS
4912	FISH-AVERAGE-BOILED	21.00	GRAMS
1123	TOMATO PASTE-CANNED-LOW SODIUM	3.000	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.200	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	1.000	GRAM

Bread and Butter: 2 Ingredients

Item	Food Name	Serving	Portion
4925	BREAD-WHITE-WHEAT	100.0	GRAMS
104	BUTTER-REGULAR-TABLESPOON	8.570	GRAMS

Bread and Mayonnaise: 2 Ingredients

Item	Food Name	Serving	Portion
4925	BREAD-WHITE-WHEAT	100.0	GRAMS
5448	SALAD DRESSING-MAYONNAISE->65% OIL	8.570	GRAMS

Bread and Milk: 3 Ingredients

Item	Food Name	Serving	Portion
4925	BREAD-WHITE-WHEAT	20.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	55.00	GRAMS
561	SUGAR-WHITE-GRANULATED	25.00	GRAMS

Bread and Sauce: 5 Ingredients

Item	Food Name	Serving	Portion
1123	TOMATO PASTE-CANNED-LOW SODIUM	10.00	GRAMS
120	OIL-VEGETABLE-CORN	22.00	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	15.00	GRAMS
642	PEPPERS-HOT-RED-DRIED	3.000	GRAMS
4925	BREAD-WHITE-WHEAT	50.00	GRAMS

Bread and Sugar: 2 Ingredients

Item	Food Name	Serving	Portion
4925	BREAD-WHITE-WHEAT	75.00	GRAMS
561	SUGAR-WHITE-GRANULATED	25.00	GRAMS

Bread and Tea: 3 Ingredients

Item	Food Name	Serving	Portion
4925	BREAD-WHITE-WHEAT	72.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	16.00	GRAMS
561	SUGAR-WHITE-GRANULATED	12.00	GRAMS

Cherreh and Fish: 5 Ingredients

Item	Food Name	Serving	Portion
1967	CHERREH-MILLET	78.00	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.400	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	2.000	GRAMS
1123	TOMATO PASTE-CANNED-LOW SODIUM	3.000	GRAMS
4912	FISH-AVERAGE-BOILED	16.60	GRAMS

Cherreh Mbasse: 5 Ingredients

Item	Food Name	Serving	Portion
1967	CHERREH-MILLET	94.00	GRAMS
2790	COWPEAS-COMMON-BOILED	3.000	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.200	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	0.700	GRAMS
4924	GROUNDNUT BUTTER	2.000	GRAMS

Cherreh Mboom: 6 Ingredients

Item	Food Name	Serving	Portion
1967	CHERREH-MILLET	93.00	GRAMS
4916	SORREL-LEAVES-RAW	5.000	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	1.000	GRAM
642	PEPPERS-HOT-RED-DRIED	0.100	GRAMS
1123	TOMATO PASTE-CANNED-LOW SODIUM	0.400	GRAMS
4910	FISH-AVERAGE-DRIED-SALTED	0.900	GRAMS

Cherreh and Milk: 2 Ingredients

Item	Food Name	Serving	Portion
1967	CHERREH-MILLET	40.00	GRAMS
4911	MILK-COW-SOUR-FLUID	60.00	GRAMS

Cassava and Sauce: 5 Ingredients

Item	Food Name	Serving	Portion
1123	TOMATO PASTE-CANNED-LOW SODIUM	8.000	GRAMS
120	OIL-VEGETABLE-CORN	25.00	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	15.00	GRAMS
642	PEPPERS-HOT-RED-DRIED	10.00	GRAMS
4915	CASSAVA-ROOT-COOKED	50.00	GRAMS

Churah Gerteh and Milk: 4 Ingredients

Item	Food Name	Serving	Portion
484	RICE-WHITE-LONG GRAIN-COOKED	44.00	GRAMS
4922	GROUNDNUTS-WHOLE-RAW	23.00	GRAMS
561	SUGAR-WHITE-GRANULATED	13.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	20.00	GRAMS

Cherreh: 7 Ingredients

Item	Food Name	Serving	Portion
1967	CHERREH-MILLET	78.00	GRAMS
4922	GROUNDNUTS-WHOLE-RAW	12.00	GRAMS
4910	FISH-AVERAGE-DRIED-SALTED	2.000	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.400	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	2.000	GRAMS
2895	FISH-CISCO-RAW	3.000	GRAMS
1123	TOMATO PASTE-CANNED-LOW SODIUM	3.000	GRAMS

Churah (without groundnuts): 2 Ingredients

Item	Food Name	Serving	Portion
484	RICE-WHITE-LONG GRAIN-COOKED	70.00	GRAMS
561	SUGAR-WHITE-GRANULATED	30.00	GRAMS

Churah Gerteh: 3 Ingredients

Item	Food Name	Serving	Portion
484	RICE-WHITE-LONG GRAIN-COOKED	50.00	GRAMS
4922	GROUNDNUTS-WHOLE-RAW	30.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

CSB Mono with Milk: 3 Ingredients

Item	Food Name	Serving	Portion
4984	MONO-CORN SOY BLEND	60.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	20.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

CSB Mono Unspecified: 3 Ingredients

Item	Food Name	Serving	Portion
4984	MONO-CORN SOY BLEND	70.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	10.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

CSB Mono without Milk: 2 Ingredients

Item	Food Name	Serving	Portion
4984	MONO-CORN SOY BLEND	80.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

Futukanya: 3 Ingredients

Item	Food Name	Serving	Portion
1967	CHERREH-MILLET	50.00	GRAMS
4924	GROUNDNUT BUTTER	30.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

Green Leaves Drink: 3 Ingredients

Item	Food Name	Serving	Portion
4916	SORREL-LEAVES-RAW	3.000	GRAMS
561	SUGAR-WHITE-GRANULATED	12.00	GRAMS
1821	WATER-MUNICIPAL TAP	85.00	GRAMS

Mono without Milk: 2 Ingredients

Item	Food Name	Serving	Portion
1969	MONO-MILLET	80.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

Mono with Groundnut Paste: 3 Ingredients

Item	Food Name	Serving	Portion
1969	MONO-MILLET	75.00	GRAMS
561	SUGAR-WHITE-GRANULATED	15.00	GRAMS
4924	GROUNDNUT BUTTER	10.00	GRAMS

Mono with Milk: 3 Ingredients

Item	Food Name	Serving	Portion
1969	MONO-MILLET	60.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	20.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

Mono Unspecified: 3 Ingredients

Item	Food Name	Serving	Portion
1969	MONO-MILLET	70.00	GRAMS
50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	10.00	GRAMS
561	SUGAR-WHITE-GRANULATED	20.00	GRAMS

Nyakatango: 4 Ingredients

Item	Food Name	Serving	Portion
484	RICE-WHITE-LONG GRAIN-COOKED	71.00	GRAMS
4922	GROUNDNUTS-WHOLE-RAW	27.00	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.400	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	2.000	GRAMS

Nyelleng: 7 Ingredients

Item	Food Name	Serving	Portion
1968	NYELLENG-MILLET	80.00	GRAMS
4922	GROUNDNUTS-WHOLE-RAW	10.00	GRAMS
4910	FISH-AVERAGE-DRIED-SALTED	2.000	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.200	GRAMS
635	ONIONS-MATURE-BOILED-DRAINED	2.000	GRAMS
1123	TOMATO PASTE-CANNED-LOW SODIUM	3.000	GRAMS
2895	FISH-CISCO-RAW	3.000	GRAMS

Tia Durango: 6 Ingredients

Item	Food Name	Serving	Portion
484	RICE-WHITE-LONG GRAIN-COOKED	67.00	GRAMS
4924	GROUNDNUT BUTTER	5.000	GRAMS
1123	TOMATO PASTE-CANNED-LOW SODIUM	3.000	GRAMS
642	PEPPERS-HOT-RED-DRIED	0.200	GRAMS
4912	FISH-AVERAGE-BOILED	23.00	GRAMS
2895	FISH-CISCO-RAW	1.000	GRAM

APPENDIX E. Codebook.

Gambia Codebook as of September 30, 1997

Food Recalled	Food Coded		Comments
Fresh Milk	50	MILK-WHOLE-REGULAR-3.3% FAT-FLUID	1 liter = 1000g = D3.00
Canned Milk Tinned Milk	61	MILK-EVAPORATED-WHOLE-CANNED	1 tin = 170g
Egg	100	EGG-HARD COOKED-NO SHELL-LARGE-CHICKEN	1 whole = 50g = D1.25
Butter	104	BUTTER-REGULAR-TABLESPOON	1 piece = 15g = D0.50
Salad Oil Oil (unspecified)	120	OIL-VEGETABLE-CORN	1 cup(big) = 170g = D2.50 1 cup(small) = 80g = D1.25
Groundnut Oil	124	OIL-VEGETABLE-PEANUT	1 cup(big) = 170g = D2.50 1 cup(small) = 80g = D1.25
Oranges	273	ORANGES-RAW-ALL COMMON VARIETIES-WHOLE	1 serving = 130g
Paw paw	282	PAPAYAS-RAW	1 serving = 470g
Watermelon Melon	318	WATERMELON-RAW	1 piece = 340g = D0.50 1 piece = 450g = D1.00
Cherreh from Maize	429	CHERREH-MAIZE	1 dosser = 720g
Nyelleng from Millet	430	NYELLENG-MAIZE	1 dosser = 720g
Mono from maize	431	MONO-MAIZE	1 dosser = 720g
Macaroni Spaghetti	440	MACARONI-COOKED-TENDER STAGE-HOT	
Pancakes	451	PANCAKES-PLAIN-FROM HOME RECIPE	1 ball (small) = 60g = D0.50 1 ball (large) = 30g = D0.25
Rice	484	RICE-WHITE-LONG GRAIN-COOKED	1 cup = 250g = D1.25 1 kg = 1000g = D4.50
Sugar	561	SUGAR-WHITE-GRANULATED	1 tsp = 5g 1 Tbsp = 30g 1 cup = 220g = D1.75
Lettuce	629	LETTUCE-LOOSELEAF-RAW	
Onions	635	ONIONS-MATURE-BOILED-DRAINED	1 heap (small) = 45g = D1.00 1 heap (big) = 110g = D1.00
Peas	640	PEAS-EDIBLE PODDED-RAW	
Peppers	642	PEPPERS-HOT-RED-DRIED	1 heap = 10g = D0.50
Tea	733	TEA-BREWED	1 cup = 235g
Black Pepper	818	PEPPER-BLACK	
Sesame Seeds	820	SESAME SEED-DECORTICATED	
Salt	822	SALT-TABLE SALT	
Sesame Oil	923	OIL-VEGETABLE-SESAME	1 cup(big) = 170g = D2.50 1 cup(small) = 80g = D1.25
Limes	994	LIMES-RAW	1 item = 67g
Mango	999	MANGOS-RAW	
Tomato Paste	1123	TOMATO PASTE-CANNED-LOW SODIUM	1 tsp(2ml) = 30g = D0.50
Meat, Duck	1286	DUCK-FLESH & SKIN-ROASTED	
Biscuit	1384	COOKIE-SUGAR-FROM MIX	1 biscuit = 15g = D0.50
Pumpkin	1773	PUMPKIN-BOILED-DRAINED-MASHED	1 piece = 160g D1.00
Cherreh from Couscous	1963	CHERREH-COUSCOUS	1 dosser = 720g
Nyelleng from Couscous	1964	NYELLENG-COUSCOUS	1 dosser = 720g
Mono from Couscous	1965	MONO-COUSCOUS	1 dosser = 720g

Cherreh from Millet	1967	CHERREH-MILLET	1 dosser = 720g
Nyelleng from Millet	1968	NYELLENG-MILLET	1 dosser = 720g
Mono from Millet	1969	MONO-MILLET	1 dosser = 720g
Palm Oil	2690	OIL-VEGETABLE-PALM	1 cup(big) = 180g = D4.00 1 cup(small) = 75g = D2.00
Beans	2790	COWPEAS-COMMON-BOILED	1 cup = 70g = D0.50
Roasted Groundnuts	2806	NUTS-PEANUTS-DRY ROASTED-ALL TYPES	1 handful = 100g 1 cup (small) = 15g = D0.50 1 cup (big) = 25g = D0.50
Smoked Fish	2895	FISH-CISCO-RAW	1 whole = 90g = D1.00
Meat, Mutton	3265	LAMB-ALL CUTS-LEAN ONLY-COOKED	
Mayonnaise	5448	SALAD DRESSING-MAYONNAISE->65% OIL	15g per loaf of bread
Sesame Paste	7908	SESAME BUTTER (TAHINI) FROM KERNELS	1 ball = 30g 1 Tbsp = 14g
Green Leaves Never Die Leaves	4909	MORINGA OLEIFERA-LEAVES-RAW	
Dried Fish	4910	FISH-AVERAGE-DRIED-SALTED	1 whole = 65g = D1.00
Sour Milk	4911	MILK-COW-SOUR-FLUID	1 small calabash = 40g =D0.50 1 liter = 1000g = D3.00
Fresh Fish (Bonga) Kujali (white fish)	4912	FISH-AVERAGE-BOILED	1 whole = 370g = D1.00 1 piece = 400g = D15.00
Bitter Tomato	4914	TOMATO-BITTER-FRUIT-RAW	1 whole = 100g = D0.75
Cassava	4915	CASSAVA-ROOT-COOKED	1 piece = 80g = D0.50
Wonjo Bisap Leaves Sorrel Leaves	4916	SORREL-LEAVES-RAW	1 heap = 45g = D0.25 Ingredient in Mboom Ingredient in Cherreh
Mung Beans	4918	MUNG BEANS-COOKED	
Ripe Tomato	4920	TOMATO-RIPE-WHOLE	1 heap = 130g = D1.00
Sweet Pepper	4921	PEPPERS-SWEET-RAW-GREEN	
Raw Groundnuts	4922	GROUNDNUTS-WHOLE-BOILED	1 handful = 100g 1 cup = 165g
Groundnut Paste	4924	GROUNDNUT BUTTER	1 Tbsp (5ml) = 70g = D0.50
Bread (locally baked) Bread (machine baked)	4925	BREAD-WHITE-WHEAT	1 loaf = 175g = D1.00 1 loaf = 260g = D2.00
Cabbage	4926	CABBAGE-COMMON-RAW	1 piece = 85g = D0.50
Meat (steak) Meat (meat and bone) Afra Meat	4927	BEEF-COOKED	1 kg = 1000g = D24.00 1 kg = 1000g = D20.00 1 piece = 200g = D10.00 1 piece = 145g = D5.00
Garden Egg	4928	EGGPLANT-FRUIT-COOKED	1 heap = 240g = D0.50
Okra Ladies Finger	4929	OKRA-LADIES FINGER-COOKED	1 heap = 60g = D0.50
Banana	4930	BANANA-COMMON-RIPE	1 whole = 100g = D1.00
Potato Irish Potato	4931	POTATO-COOKED	1 kg = 1000g = D8.00
Sweet Potato	4932	SWEET-POTATO-COOKED	1 heap = 400g = D2.00
Netetu Locust Beans	4933	LOCUST BEAN-FERMENTED	1 cup (milk tin) = 130g = D1.00
Jambo Green Leaves	4934	AMARANTH LEAVES-RAW	1 heap = 40g = D0.25 Eaten with Rice
Nama Baobab Leaves	4937	BAOBAB LEAVES-RAW	1 heap = 40g = D0.25
Chicken Meat	4938	CHICKEN-YOUNG BIRD-RAW	
Cornbread	4940	CORNBREAD-HOMEMADE	

Beans	4941	KIDNEY BEANS-COOKED	
Jambo	4942	JAMBO-CUBES	
Guava	4943	GUAVA-WHOLE-RAW	1 whole = 90g
Kolanut	4944	KOLANUT-DRIED	1 whole = 60g
Nyelleng from Sorghum	4945	NYELLENG-SORGHUM	1 dosser = 720g
Onion Leaves	4946	ONION LEAVES-RAW	
Sorghum Cherreh	4947	CHERREH-SORGHUM	1 dosser = 720g
Cashew	4948	CASHEW-FRUIT	1 whole = 70g
Mono from Sorghum	4949	MONO-SORGHUM	
Benachin	4950	BENACHIN-CORN OIL	
Cherreh	4951	CHERREH	
Cherreh & Basse	4952	CHERREH MBASSE	
Cherreh & Mboom Jambo & Tia Cherreh Cherreh & Green Leaves	4953	CHERREH MBOOM	
Churah Gerteh	4954	CHURAH GERTEH	
Churah Churah Only	4955	CHURAH-NO GROUNDNUTS	
CSB Flour	4956	CORN SOY BLEND-DRY	1 small calabash = 60g
Futukanya	4957	FUTUKANYA	1 cup = 200g
Mono with Milk Pap with Milk	4958	MONO-WITH MILK	
Mono Only Mono and Sugar Pap Only Pap and Sugar Cherreh and Sugar	4959	MONO-WITHOUT MILK	
Nyakatango	4960	NYAKATANGO	
Nyelleng	4961	NYELLENG	1 dosser = 775g
Tia Durango Jambo and Tia Durango	4962	TIA DURANGO	
CSB Mono with Milk	4963	CSB MONO-WITH MILK	
CSB Mono Only	4964	CSB MONO-WITHOUT MILK	
Bread and Tea	4965	BREAD AND TEA	
Cherreh and Milk	4967	CHERREH AND MILK	
CSB Mono (unspecified)	4968	CSB MONO-AVERAGE	
Mono (unspecified) Pap (unspecified)	4969	MONO-AVERAGE	
Bread and Milk	4971	BREAD AND MILK	
Bread and Butter	4973	BREAD AND BUTTER	
Cherreh and Fish	4974	CHERREH AND FISH	
Cassava and Sauce	4975	CASSAVA AND SAUCE	
Bread and Sugar	4976	BREAD AND SUGAR	
Wonjo Drink Wonjo & Sugar & Water Green Leaves Drink	4977	GREEN LEAVES DRINK	
Bread and Sauce	4978	BREAD AND SAUCE	
Bread and Mayonnaise	4979	BREAD AND MAYONAISSE	
Mono and Groundnut Paste	4980	MONO AND GROUNDNUT PASTE	
Churah Gerteh and Milk	4981	CHURAH GERTEH AND MILK	
Cherreh from CSB	4982	CHERREH-CORN SOY BLEND	1 dosser = 720g
Nyelleng from CSB	4983	NYELLENG-CORN SOY BLEND	1 dosser = 720g
Mono from CSB	4984	MONO-CORN SOY BLEND	1 dosser = 720g

APPENDIX F. Questionnaire.

Small Scale Sesame Production: Evaluating Benefits to Women's and Children's Nutrition Security in The Gambia (12-95)

BASELINE STUDY QUESTIONAIRRE - PART 1

Directions: This sheet is to be filled out at the baseline. The respondent is the "target" mother. See protocol for description of "target" mother and child.

A. VILLAGE AND HOUSEHOLD SHEET

Date of Interview (mo/yy/dy):../../../ Interviewer ID#: ../
Village name:................ Village #: ../
Household ID#: ../../ Target Woman ID#: ../../../

1. How many times in the last 6 months has the target child gone to the health center? ....
2. Where is the nearest Lummo? ....
3. How much does it cost to get there? ....
4. How many households are there in this compound? ....
5. "Target" woman's marital status. (...)
   Married/polygamous (p) Married/nuclear (n)
   Single (s) Widowed/Divorced (w)

6. Ethnic group: (...)
   Mandinka (m) Wolof (w) Fulani (f) Jola (j) Other (o)

7. Mother's DOB (AGE) (day/month/year) ../../../
   (Use local calendar of events)

8. Child's DOB (AGE) (day/month/year) ../../../
   (Use IWC or local calendar of events)

9. Child's Sex: Male (m) Female (f) (...)

10. Child's Birth Weight? (if known) ___.___kg
(Ask mother for her ante-natal card or child's infant welfare card)

11. Did target woman attend any schooling? (...)
    Yes (y) No (n)

11.1 If yes: How many years of schooling? _____yrs

11.2 Madrassa school (m) Primary school (p) Other (o) (...)

12. Who is the head of the household ?
    Father (f) Father-in-law (i) Husband (h) Target woman (w)
    Brother-in-law (b) Other specify ....

13. What is your relationship to the head of household? ....

14. List all members of your household.

Names	Ages in Years	Sex	Relationship to Head of Household

To Be Verified On Seasonal Surveys After Baseline

14.1 Household Profile (for seasonal surveys after baseline)
Enumerators - refer to A.14 (List of Household members) and ask if anyone has joined or left the household who usually eat there since the last visit. For changes list name, sex, age and if persons have left or joined.

NAME	SEX M/F	AGE	MARK ONE	
			JOINED	LEFT

15. Source of your household's potable water: (...)

Piped water (p) Hand pump (h) Cement lined well (c)
Traditional well (t) River (r)

16. Do you feel that you have enough water for your household needs through the year?

Yes (y) No (n) (...)

16.1 If NO why do you feel that you don't have enough water for your household needs? ....
....

17. Do you feel that the water that you have is good water? (Good in terms of cleanliness)

Yes (y) No (n) (...)

17.1 If NO, why not? ....
....
....

QUALITATIVE ASSESSMENT

18. HOUSEHOLD Wealth Rank relative to other households in the compound or (in the village if the compound has only one household).

In a focus group situation determine the basis for wealth in the village (for example those who grow peanuts and acreage, or number of livestock). Depending on the village definition of wealth, identify someone in the village who knows relatively well everyone and have him/her rank these households. You can use pieces of paper, stones, peanut grain, etc. The most wealthy receives 5 pieces and the poorest 1 piece. You can use more than one informant and use the average rankings.

Wealth 5------4------3------2------1------Poor.

Ranking for this household. (...)

19. a. Do you grow black sesame? (...)
Yes (y) No (n)

b. Do you grow white sesame? (...)
Yes (y) No (n)

List crops other than black or white sesame that the target woman grows:

______________________ ______________________
______________________ ______________________
______________________ ______________________

20. List the type and number of livestock the target woman raises:

Type of Livestock	Number raised

20. Is target woman involved in any other income generating activity?

Yes (y) No (n) (...)

21. If yes, please list the type of activity woman is involved in?
....
....
....

B. MOTHER AND CHILD HEALTH DATA
(Three times per Year)

Date of the Interview (mo/yy/dy):../../../ InterviewerID#: ../
Household ID#: ../../ Target Woman ID#: ../../../
Target Child ID#: ../../../.../

1. Child's weaning status. (...)

Weaned completely (w) Mixed diet(breast milk and table foods) (m)

If still breast fed, how many times per day does the child breast feed?
....

3. Has child had diarrhea in the last 2 wks? (...)

Yes (y) No (n)

3.1 If yes, for how many days in the last 2 weeks has the child had diarrhea? ___________days

3.2 Has the child been otherwise ill in the last 7 days? (...)

Yes (y) No (n)

3.3. If yes specify(name of illness).....................................

4.0 Is mother enrolled in the HNP Program (GAFNA/CRS Program)? (...)

Yes (y) No (n)

4.1 If yes, how long have they been enrolled? _________months

4.2 Reproductive Status:

a. Pregnant (trimester? 1, 2 or 3): (p1) (p2) (p3) (...)

b. Lactating: Yes (y) No (n) (...)

4.3 Mother: Height (cm) .... Weight (kg) ....
4.4 Target child: Height (cm) .... Weight (kg) ....
Length (cm) if younger than 24 months ....

C. FREQUENCY OF CONSUMPTION OF SESAME OIL, OIL RICH FOODS AND OF FOODS INFLUENCED BY INCOME (PRESTIGIOUS FOODS, FOODS BOUGHT IN THE MARKET, SPECIAL SNACKS, ETC.)

TARGET CHILD ONLY!

1. ASK THE MOTHER/FATHER/OR WHOEVER THE CHILD SPENDS MOST TIME WITH. On the average, how often did the child eat the following foods in the past 4 weeks.

[For foods that have an asterisk (*) mark whether a sesame product was used in the preparation] Yes (y) No (n)]

FOOD	3 or more times/ day	1 to 2 times/ day	2 to3 times/ week	Once/ week	2 to 3 times/ month	Once/ month	never	Use sesame y/n
churah gerteh								
cow's milk (fresh)								
cow's milk (sour)								
*tia durangho								
Cherreh with salt and water								
jambo & tio								
nyankatango								
mono only								
mono & milk								
mono & sour milk								
mono & g/nut paste								
mono & oil								
mono & sesame oil								

FOOD	3 or more times/ day	1 to 2 times/ day	2 to3 times/ week	Once/ week	2 to 3 times/ month	Once/ month	never	Use sesame y/n
Mono & sesame paste								
eggs								
*pancakes								
meat								
fish								
roasted groundnuts								
*futu kanya								
*benachin								
Mafe jaro (d. fish)								
palm oil fish stew								
Boiled rice								
Bread								
Butter								
Biscuits								

Small Scale Sesame Production: Evaluating Benefits to Women's and Children's Nutrition Security in The Gambia
(12-95)
BASELINE STUDY QUESTIONAIRE - PART II

Date of the Interview (mo/yy/dy):../../../ InterviewerID#: ../
Village#: ../ Household ID#: ../../ Target Woman ID#: ../../../

D. I. HOUSEHOLD DIETARY DATA (Version 5, 8-18-95)

Need to standardize measurements: Calabashes, handfuls, etc. See protocol

Ask the person responsible for cooking the previous day.

Foods (that you prepared for the household yesterday)	Methods of Preparation(i.e. fried, steamed, boiled, etc)	Amount [Units (i.e. cups, calabashes, etc)]	Gram Equiva-lent[1]	Persons from this household who did not eat from this food yesterday?*	Persons not from this household who ate from this food yesterday?

Note: Quantity in local measures. How many ladles, handfuls, pieces sizes, cup size, etc.

D. I. See Coding guide
*Specify age and gender of each person

PROBES:
How did you prepare this dish? (list of ingredients to be included)
Meats: What type of meat did you eat?
Did you use anything to cook it with?

D. II. How much oil did your household use in the last 7 days?

.................(indicate unit eg. Litres, cups etc.)

a. What type of oil was used?...............................

b. If more than one type of oil was used, how much of it was sesame?
.................(unit)

c. Was any of it used for foods to be sold? (...)
Yes (y) No (n)

d. If yes, how much was used for foods to be sold?
....

E. MOTHER DIETARY DATA (24-hour recall)

Date of the Interview (mo/yy/dy):../../../   InterviewerID#: ../
Village #: ../   Household ID#: ../../   Target Woman ID#: ../../../

I. REFER TO THE PROTOCOL ON HOW TO GATHER THIS INFORMATION Ask the mother to recall all the foods and beverages that she consumed in the preceding 24 hours (from the time that she got up to the time that she went to bed yesterday.).

Foods (that you prepared for the household yesterday)	Methods of Preparation(i.e. fried, steamed, boiled, etc)	Amount [Units (i.e. cups, calabashes, etc)]	Gram Equivalent[1]

Quantity in local measures. How many ladles, handfuls, pieces size, cup size?

PROBES:
Was there something (snack, beverage, etc) that you ate between this time and that time?
2. Meats: What part of the meat did you eat?

[1]See Coding Guide.

F. CHILD DIETARY DATA(24-hour recall)

Date of the Interview (mo/yy/dy):__/__/__/   InterviewerID# __/
Village # __/   Household ID#__/__/   Target Child ID# __/__/__/___/

I.ASK THE MOTHER AND FATHER AND WHOEVER ELSE TOOK CARE OF THE CHILD IN THE LAST 24-HOURS TO REMEMBER AND REPORT ALL THE FOODS AND BEVERAGES THAT THE CHILD CONSUMED IN THE PRECEDING 24-HOURS. Refer to the protocol on how to gather these data.

Foods (that you prepared for the Household yesterday)	Methods of Preparation (ie. fried, steamed, boiled etc.)	Amount [Units (i.e. cups, calabashes, etc.)]	Gram Equivalent[1]	Density (pap only) v. thick, thick, or thin

*Quantity in local measures. How many ladles, handfuls, pieces size, cup size?
PROBES:
Was there something (snack, beverage, etc) that you ate between this time and that time?
2. Meats: What part of the meat did you eat?

CHILD: Height (cm) __________   Weight (kg) __________
Length (cm) (if younger than 24 months) __________

G. HOUSEHOLD STORAGE OF OIL, CAKE, AND SEED.

1. OIL (Control)

How long did the oil you pressed last season last with the household?

____

2. CAKE (Control)

How long did the cake you pressed last season last with the household?

____

3. SEEDS (Study)

When was the last time you pressed for oil the seeds from the last years harvest?

____

4. OIL BUYING (Both)

What time of year do you buy oil? (non-sesame oil)

____

APPENDIX G. Protocol.

Small Scale Sesame Production: Evaluating Benefits to Women's and Children's Nutrition Security in The Gambia (11-95)

NOTES TO QUESTIONAIRE

The baseline will be done in two parts: I. Village and Household Information and Women and Children's Health Data; and II. Dietary Data

I. SET UP OF BASE-LINE

SAMPLE

Target woman and child
Woman needs to be: growing black sesame, have preschool aged child 1-5 years of age, be willing to participate in survey and small group discussions during each season.

Target child
1-5 years of age; if woman has more than one preschool child 1-5 then randomly select which one will be the target child. Could gather age and anthropometrics on all children in case there is a lack of nutritionally vulnerable children in the household.

Study and control households
They should be similar in size and of lower socio-economic status to ensure that there are nutritionally vulnerable children.

II. INFORMATION ON SPECIFIC QUESTIONS

A. Village and Household Sheet

Heading--see categories on coding sheet to fill this in

A.7.: Use local calendar of events as needed to help her identify her birthyear.

A.8.: Use local calendar and get as accurate to the month and day as possible.

A.14.: It is important to distinguish the members of the household who eat together from the same cooking pot regardless of how they are related. All the people, their age and gender that eat from the same cooking pot should be listed here. Since this is an important piece of information this will be checked every season when the food consumption information is gathered.

A.18.: Household Wealth Ranking - The determination of household's wealth for the pilot was assessed first by convening a meeting of three key informants to determine the criteria for wealth ranking. The criteria established was based on (I) the farm families' ability to produce enough food for their families throughout the year, (ii) households access to labor and farm machinery and (iii) households involvement in non-farm activities such as petty trading and salaried employment. The key informants were people who knew the village well and did not come from households involved in the study.

B. Mother and Child Health Data

B.3 and 3.1 - Not sure if this is a problem in translating "the last 2 weeks". The idea here is to ask for the last 14 days if the child has been ill and if so how many days.

B.4.3 - Anthropometric Measurements

Technique:

After removing the shoes, the subject should stand up as straight as possible on a flat floor, or board, by the scale with feet together and with heels, buttocks, shoulders, and back of the head touching the upright. The feet should be bare, flat on the floor, and with the heels almost together. The legs should be straight and the shoulders relaxed. The head should be looking straight forward and held comfortably erect, with the lower border of the orbit in the same horizontal plane as the external auditory meatus (the 'Frankfort plane'). The arms should be hanging by the sides in a natural manner ('stand tall and look straight ahead').

The headpiece, which can be a metal bar or a wood block, is gently lowered, compressing the hair, and making contact with the top of the head. If a child has unusually thick hair, it should be taken into account. When an assistant is available, this person should place one hand against the child's knees to detect any flexion of the lower limbs and the other hand on the upper surfaces of his feed to detect any lifting of the heels from firm contact with the floor or platform. The eyes of the measurer should be as level as possible with the reading to avoid optical errors (parallax).

Length:

In very young children, recumbent length (crown-heel length) has to be employed, as the measurement of standing height is either impossible or very inaccurate with an uncooperative child. It is usually measured with a length-board, often made of wood.

Recumbent length is usually considered necessary for children up to 2 or 3 years of age or until the child can stand unassisted, according to different authorities. Length can be more than standing height by as much as 2 cm (nearly 1 in), so that the procedure used has to be reported.

Community Nutritional Assessment by Derrick B. Jelliffe and E. F. Patrice Jelliffe, pages 78 and 81.

C. Frequency of Consumption of Sesame Oil, Oil Rich Foods and Foods Influenced by Income

This is for the target child for the last four weeks. The food frequency should be done with the health data and not on the day that you are doing the 24 hour recall.

PART II. PROTOCOL FOR THE COMPLETION OF THE DIETARY DATA COLLECTION

I. Household Data, 24-hour recall, and Food Frequency

D. Household consumption data

The purpose of this is to get accurate measurements of what a household is consuming in a day. From this data, we can get per capita age adjusted intake.

INTERVIEWERS: Interviewers have to be intimately knowledgeable about the foods, the cooking methods, the utensils used and common household measurements.

BEFORE: Before starting any type of dietary collection you need to:

1. Visit the villages and observe cooking patterns, methods, utensils and common household measures.
2. You may need to buy a set of these utensils and measures to carry around as models. For instance, if the woman say a ladle, a spoon, a can, you should have these to show and ask. Is this the size of the spoon you are referring to? Or small? Or bigger? Was the ladle or spoon "heaping" full? Or was it "leveled"?
3. Convert these household measures into grams and/or use if you or Dunn have them gram equivalents from standard measure.
4. Since people eat in a common bowl by hand, you have to standardize "handfuls". Determine what is the weight of a "woman's handfuls", a "man's handfuls" and small child's handfuls". Preferably of different foods for example, rice, rice with sauce, etc, etc.

Convert these into grams.

5. Pieces of meat. What is the size normally eaten? Leg or breast of chicken? Etc. Convert these into grams.
6. Oil? What is the amount of oil used in different dishes? Convert these into grams or ml.

E and F. The 24-hour recall

The 24-hour recall should be done on two nonconsecutive days. This is to capture more of the variability in an individual's diet because eating behaviors on consecutive days are correlated.
AVOID: holidays and weekends. These days may be special and therefore non-representative.

A. Usual problems and how to avoid

want to please enumerator
can’t remember
hard to know how much they ate
can’t remember things that they didn’t eat at home

B. What to keep in mind

1. Order that they do the recall in -? Start from the most recent thing eaten and work backwards.
2. Time - ask was there anything else between what they mentioned in one time period and another. Don’s ask what they had in the morning directly if you think there is a chance they didn’t have anything. Most people will say what they usually have although they didn’t that particular day.
3. Careful use of questions - not leading ones. Didn’t you have something else? versus Was there anything else?
4. Making sure you got it all and understand - women may cook the same dish quite differently or they may say some type of dish that could have any number of different things in it. If they tell you they made a mixed dish then ask what it had in it being sure to find out how much oil they used, etc. Spices don’t matter but all the other types of ingredients will.

C. Go through exactly then as it should be done - see below.

D. BEGIN:

I would like you to tell me everything (you or the name of child or woman) had to eat and drink all day yesterday (name the day) from midnight to midnight. (You can also use the last full day starting with the last meal and working backwards, use either approach depending which you think enumerators and village women will understand better). Include everything (you or name or child or woman) ate and drank at home and away--even snacks, coffee, etc, etc.

LET THE WOMAN TELL YOU. DO NOT INTERRUPT THE RESPONDENT.

When the respondent stops,

ASK:

Anything else?
Give respondent enough time to recall.

SAY:

Now I'm going to ask you specific questions about the foods and beverages we just listed. When you remember anything else you ate or drank as we go along, please tell me.

SAY:

About what time (or when) did (you or name of child) begin to (eat/drink) the (name the food)? Here we are interested if the food was eaten as "breakfast", "lunch", "supper" or in between meals "snacks".

ASK:

How much did (you or child's name) eat of the (name the specific food)?
How many Ladles or spoons (heaping or leveled)? Handfuls? pieces (size, small, medium, big?), or cup? (half cup, quarter cup, etc.)

AT THE END:

Is there anything else? Do you remember anything else that you (or child's name) ate or drank yesterday?

APPENDIX H. Adult Equivalents Used to Adjust Household Consumption Measures.

Age (years)	Male		Female	
	Daily Average Energy Requirements [a] (kcal)	Adult Equivalent	Daily Average Energy Requirements [a] (kcal)	Adult Equivalent
<1	950	0.32	950	0.32
1-2	1150	0.38	1150	0.38
2-3	1350	0.45	1350	0.45
3-5	1550	0.52	1550	0.52
5-7	1850	0.62	1750	0.58
7-10	2100	0.70	1800	0.60
10-12	2200	0.73	1950	0.65
12-14	2400	0.80	2100	0.70
14-16	2650	0.88	2150	0.72
16-18	2850	0.95	2150	0.72
18-30	3000	1.00	2350	0.78
30-60	2950	0.98	2350	0.78
>60	2450	0.82	2100	0.70

[a] WHO. Energy and Protein Requirements. WHO Technical Report Series 724. World Health Organization. Geneva, Switzerland. 1985.

APPENDIX I. Child Consumption Units Used to Adjust Children's Consumption Measures.

Age (months)	Male		Female	
	Daily Average Energy Requirements [a] (kcal)	Adult Equivalent	Daily Average Energy Requirements [a] (kcal)	Adult Equivalent
<1	895	0.53	835	0.49
1-2	1200	0.71	1140	0.67
2-3	1410	0.83	1310	0.78
3-4	1560	0.92	1440	0.85
4-5	1690	1.00	1540	0.91
>5	1810	1.07	1630	0.96

[a] WHO. Energy and Protein Requirements. WHO Technical Report Series 724. World Health Organization. Geneva, Switzerland. 1985.

VITA

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Education

Master of Science, Human Nutrition, Foods and Exercise, May 1998
Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA
Thesis: The Stabilizing Effects of Sesame Oil Extraction Technologies on Seasonal Fluctuations in Food Consumption and Nutritional Status of Rural Farming Households in The Gambia.
Advisor: William E. Barbeau

Bachelor of Science, Forestry, August, 1988
Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, VA

Experience

Research Assistant, Small Scale Sesame Production in The Gambia, West Africa,
Department of Human Nutrition, Foods and Exercise, VA Tech, Blacksburg, VA,
August 1996 - Present

- Code 24-hour recalls and food frequency data using Nutritionist IV software.
- Perform statistical analysis of dietary data using SAS software.
- Travel to The Gambia and train a Gambian nutrition specialist in coding of dietary data.

Research Assistant, Peanut CRSP,
Office of International Research and Development, Virginia Tech, Blacksburg,
January 1998 - Present

- Identify and contact key informants in order to obtain relevant literature.
- Conduct a literature search for relevant research including gray literature.
- Write abstracts for all relevant literature and develop a database of resources.

Research Assistant, Child and Adult Care Food Program,
Department of Human Nutrition, Foods and Exercise, VA Tech, Blacksburg, VA,
August 1997 - Present

- Develop a procedure for nutritional analysis of child care menus.
- Train and supervise the dietary data coder in using Food Processor software.
- Maintain quality control of dietary data and perform statistical analysis of the data.

Abstracts and Papers Published

Hull SG, Silva-Barbeau I, Prehm MS, Barbeau WE. Mitigating Caloric Deficits During the Pre-Harvest Lean Period: Effects of Household Access to Sesame Oil Extraction Technologies on Diets of Women and Children in The Gambia. Paper presented at Experimental Biology '98, San Francisco, CA. April, 1998.

Silva-Barbeau I, Prehm MS, Samba-Ndure K, Jome K, Jawneh A, **Hull SG**. The Direct and Indirect Benefits of Sesame Oil Production on the Nutritional Security of Women and Children: The Experience With Woman-Led Monitoring of a Ram Press Technology in The Gambia. Paper presented at the 16th International Congress of Nutrition, Montreal, Canada, July 27-August 1, 1997.

Hertzler AA, Bowens J, **Hull SG**. Developing Methods for Obtaining Dietary Information from Preschoolers - A Pilot. Journal of the American Dietetic Association. 1993;93(10):1159-61.

Reports Published

Silva-Barbeau I, Prehm MS, **Hull SG**, Samba-Ndure K, Jome K, Jawneh A, Sey A. Small Scale Sesame Oil Production: A Means to Improved Child Nutrition Security in The Gambia. Semi-Annual Project Report (7/1/97-12/31/97). Silva Associates. Blacksburg, VA. March, 1998.

Professional Conferences

"Experimental Biology '98" sponsored by the Federation of American Societies for Experimental Biology at San Franciso, CA. April, 1998.

"Methodology for the Detection of Nutrition Problems" Conference sponsored by the Universidad Autonoma de Yucatan, Yucatan, Mexico. May, 1992.

Honors

P. Howard Massey "International Nutrition Scholar" Award, 1992

Member of Phi Kappa Phi