Comprehensive Food and Nutrition Security and Vulnerability Analysis (CFSVA+N)

RURAL MADAGASCAR

FULL REPORT

Data collected in August/September 2010

In partnership with:

Office National de Nutrition
VPM/Santé Publique
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Rural Madagascar Comprehensive Food and Nutrition Security and Vulnerability Analysis
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The views expressed herein can in no way be taken to reflect the official opinion of the donor.

For information about Food Security Analysis, visit www.wfp.org/food-security
For information about nutrition security, visit http://www.unicef.org/nutrition/index_4050.html

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Foreword

Madagascar remains a low-income, food deficit country with a high level of undernutrition. UNICEF and WFP country offices continue to support Madagascar in efforts to achieve the Millennium Development Goal (MDG) of eradicating extreme poverty and hunger in the country by 2015.

Since the beginning of 2009, major political and economical changes have occurred in Madagascar resulting in the country suffering from a diminished capacity to monitor and plan for food and nutritional insecurity and establish a solid and comprehensive baseline data to take into consideration the impact of the deep changes that the Country has experienced. Furthermore, as clearly evident in several food security- and nutrition- focused surveys, the relationship between food security and nutrition in Madagascar is quite complex.

In response to the situation, in 2010 , UNICEF and WFP carried out a joint Comprehensive Food and Nutrition Security and Vulnerability Analysis (CFSVA+N)., Information on household livelihoods, food and nutrition security and vulnerability was compiled and critically analysed through an innovative methodological approach. Most importantly, the study aims to identify the underlying causes of food insecurity and malnutrition, the impact of shocks and households ability to cope. With answers to these questions, policymakers can be guided in responding appropriately to reduce vulnerability.

Sincere gratitude is extended to all the cluster members for their valuable input and support during this exercise, especially the Office National de Nutrition (ONN), the Ministère de la Santé Publique, the Institut National de la Statistique (INSTAT), Direction Générale de la Météorologie and the Direction du Suivi Evaluation et de la Communication/Statistique Agricole.

Special thanks go to the Bill and Melinda Gates Foundation, IFAD and UNDP for providing financial resources to implement the CFSVA+N exercise. Without these resources, the study would not have been possible.

We hope that this report will shed further light on the food and nutrition security situation in Madagascar.

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Table of Contents

List of tables

List of figures

KEY FINDINGS

Food security and vulnerability

- Poor rural households devote some 66 percent of their expenditures to food with the lion's share of this food bill spent on rice (32 percent). The southern and the west south-western zones have the highest share of food expenditures, at 69 percent and 70 percent respectively.
- Casual labourers are the poorest livelihood group by asset ownership across all zones except in the MF cyclone eastern coast and west south-western, where the poorest are small farmers (generally the second poorest income group across all zones).
- Nationally, 53 percent of rural households have unacceptable food consumption, i.e., they consume limited or insufficient nutritious foods to maintain an active and healthy life. Of these, 12 percent have poor food consumption, mainly surviving on tubers (cassava 5.5 days a week) with proteins essentially absent from their diet. In the southern zone more than half of households have poor and only 22 percent acceptable consumption. The west south-western zone has the second highest prevalence of poor consumption (19 percent), followed by the HF cyclone eastern coast (12 percent), where a concerning 54 percent have borderline consumption.
- More than a third are classified as food insecure and almost half are vulnerable to food insecurity. Just 17 percent of households are considered food secure. The southern is the most food insecure zone (68 percent) followed by the HF cyclone eastern coast and the west south-western.
- Only 28 percent of farmers considered they had enough land to cultivate during the 2009-2010 agricultural season. The issue of land access and land tenure security is preventing smallholders from gaining access to more land, and hampering extensive farming and economies of scale. Overall, 70 percent of farming households cultivate less than 1.5 hectares and average land size is 1.2 ha. The number of smallholder farmers is high in the west south-western, southern and in the MF cyclone eastern coast
- Many irrigation schemes are poorly maintained further contributing to low crop yields, while 30 percent of households have either no irrigation or irrigate less than a quarter of their land, a proportion that rises to almost half in the southern zone, the area most exposed to drought.
- Overall, 84 percent of households experience a time of the year when they don't have enough cash or food. February and October emerge as the most difficult months, with around a third facing a lack of cash/food then. Again it is the southern zone where households are hit the hardest followed by the west south-western.

- Just over half of all households 'always or often' reduce their daily rations (thereby cutting their calorie intake) and switch to less preferred food (which is likely to be of lower nutritional value) to cope with shortages. In the southern zone 72 percent reduce their daily rations and 67 percent cut the number of meals they eat.
- Those at greater risk of food insecurity include: households with more members; households headed by a woman or by an elderly person; households with a higher percentage of dependents; small farmers and casual labourers; informal sector workers; households that cultivate less land and/or a lower variety of crops; farmers whose total cereal production is lower; farmers who report a harvest period of less than two months; households who rely on receiving gifts and hunting/gathering as a food source; and farmers that are net consumers (ie., in deficit) rather than net producers (ie., with surplus).

Nutrition security

- The global acute malnutrition (GAM) prevalence for children under five in rural Madagascar is 5.4 percent, representing 176 000 children at any point in time, with the proportion peaking in the southern zone at 7.1 percent. There is a higher prevalence of acute malnutrition among boys than girls (6.2 percent vs. 4.2 percent).

- Children under two years old at greater risk of acute malnutrition are (in order of importance): children whose mothers have poor educational level, children who are ill and children who do not receive age-appropriate infant feeding (optimal complementary feeding or exclusive breastfeeding).Neither household food insecurity nor household wealth is associated with wasting, yet maternal education is. This suggests that poor infant feeding habits impact a child's nutritional status irrespective of wealth and food security in Madagascar.

- Almost half (49 percent) of under-fives suffer from stunted growth, representing 1.6 million children, with the highest level found in the highlands (64 percent). Stunting is higher among boys (53 percent) than girls (45 percent) in all livelihood zones except for the central highlands.

- Some 20 percent of children under-six months are already stunted and there is a higher prevalence of stunting among children born with a low birth weight and among children born to short mothers, pointing to poor nutritional/health practices of pregnant women and lactating women.

- In total 75 percent of children under-six months are exclusively breastfed with the lowest level in the southern zone (57 percent). No difference is seen by maternal education and household wealth. However 82 percent of girls are exclusively breastfed compared with

only 68 percent of boys, which may explain the higher GAM and stunting levels seen among boys than girls.

- Feeding practices for 6-23 month olds are very poor with only 13 percent of this age group having received the minimum acceptable diet (encompassing meal frequency and dietary diversity). Children from the wealthiest households or whose mother is educated are three times more likely to receive an acceptable diet compared to those from poor or less educated households.

- Fewer 6-23 month olds from households with a borderline food consumption profile received the minimum acceptable diet (six percent) than those in households with poor food consumption profile (nine percent). An analysis reveals borderline households are more likely to sell micronutrient rich foods such as fruits and vegetables in order to purchase rice and less nutritious foods and non-food items.

- In total, 44 percent of children were sick during this time period with the lowest proportion in the central highlands and the highest in the southern zone. Treatment was sought for only 26 percent of sick children. Younger children are more likely to be seen by a health provider - as are boys (28 percent compared with 23 percent for girls). The proportion of children for whom treatment was sought increases with increasing wealth index, though no significant difference is seen by maternal education level.

- Only around a quarter (26 percent) of households have access to an improved water source in the dry season, with the lowest access seen in the southern zone (13 percent). And just 2.6 percent of households report having access to improved sanitation varying from 6.2 percent in the central highlands to 0.2 percent in the southern zone. Worryingly, some 58 percent of households state that they practise open defecation and 93 percent of Fokontany[1] claim that open air defecation is practised in their Fokontany.

- Only 22 percent of women report using soap to wash their hands following latrine use with the highest proportion in the central highlands (43 percent) and the lowest in the southern zone (11 percent). Significantly more mothers from wealthier households wash hands compared to those from poor households. Indeed households state that six percent of their household income is spent on soap.

[1] Fokontany: lowest administrative division in Madagascar.

1.0 STUDY RATIONALE

1.1. Objectives and methodology

Efforts to improve Madagascar's food security and nutrition over the last two years have been thwarted by political instability which has disrupted data collection.[2] With up-to-date critical information needed to contribute to evidence based decision making, UNICEF and WFP agreed to carry out a joint Comprehensive Food and Nutrition Security and Vulnerability Analysis (CFSVA+N) in 2010.

The survey's primary objectives are to:

- Provide an accurate and detailed assessment of the current food and nutrition security situation
- Assess the causes and risk factors for food and nutrition insecurity
- Identify potential ways to mitigate food and nutrition insecurity
- Reveal pockets of vulnerability where special assistance may be required.

This marks the country's first country-wide study of food security and vulnerability since the 2005 CFSVA[3].It complements the Demographic and Health Survey (DHS) 2008/2009 by updating the regional level data that it presented.

Methodology

Madagascar is administratively divided into 22 regions and 119 districts (107 rural, 12 urban). In view of the heterogeneity in livelihoods within the regions, the country is also stratified into nine (eight rural and one urban) livelihood zones using indicators that reflect the socio-economic and geographical factors linked to food security and nutrition, demographic characteristics and malnutrition rates[4]. The strata were validated by the Madagascar food security and livelihoods cluster. The survey was designed to provide anthropometric and food security data representative at regional AND livelihood zone level for the rural areas of Madagascar.[5]

[2] The 2009 political crisis disrupted the data collection process of the Demographic and Health Survey (DHS) 2008/09 affecting the tracking on MDG 1 (hunger target) and the evaluation of the five-year National Nutrition Action Plan.

The most recent national poverty reduction strategy, the Madagascar Action Plan (MAP), will come to an end in 2012. The United Nations Development Assistance Framework (UNDAF), previously aligned with the MAP, has been revised and extended by two years due to the current political uncertainty. This represents a crossroads for long-term programming. The last Common Country Assessment (CCA) dates back to 2001.

[3] http://documents.wfp.org/stellent/groups/public/documents/ena/wfp108512.pdf

[4] Principal Component Analysis (PCA) and Cluster Analysis (CA) were used to group the districts with similar characteristics. Indicators used for the stratification were: 1) cyclone impact frequency; 2) elevation; 3) average 10-years rainfall; 4) %age of population reliant on livestock breeding as main activity; 5) average size of cultivated land per household; 6) contribution of each district to national production for the main crops; 7) %age of literate population; 8) %age of children attending primary school; 9) %age of female headed households; 10) underweight and stunting prevalence.

[5] While the report presents livelihood zone level data, the annexes compile data both at regional and livelihood zone levels.

Livelihood zones (strata) and their main characteristics

Table 1 - Characteristics of the eight livelihood zones

	Geography	Livelihoods	Demographics	Malnutrition
Medium frequency cyclone east coast	Medium elevation; very high average annual rainfall; medium frequency of cyclones	Low percentage of population reliant on livestock; medium sized farming areas; low production of cereals and tubers	High percentage of children in primary school against total population; medium literacy rate; low percentage of female headed households	Medium prevalence of stunting and high prevalence of underweight
High frequency cyclone eastern coast	Low elevation; high average annual rainfall; very high frequency of cyclones	Low percentage of population reliant on livestock; medium sized farming areas; medium production of rice and cassava, low production of other staple crops	Medium percentage of children in primary school against total population; medium literacy rates. High percentage of female headed households	Low prevalence of stunting and medium prevalence of underweight
West-south western	Low elevation; low average annual rainfall; high frequency of cyclones	Medium percentage reliant on livestock; farming areas of medium size; low production of rice, sweet potatoes, potatoes and tarot. Medium production of cassava and maize	Low percentage of children in primary school against total population, and low literacy rate. High percentage of female headed households	Low prevalence of stunting and medium prevalence of underweight
Western	Low elevation with medium-average annual rainfall and medium frequency of cyclones	Medium-high percentage reliant on livestock; medium sized farming areas; medium production of rice, cassava and maize; very low production of sweet potatoes, potatoes and tarots	Medium percentage of children in primary school against total population, and medium literacy rate. Medium percentage of female headed households	Low prevalence of stunting and underweight
Southern	Medium elevation; low average annual rainfall; medium frequency of cyclones	High percentage of population reliant on livestock; medium sized farming areas; very high production of cassava and high production of maize; low production of rice	Low percentage of children in primary school against total population, and very low literacy rate. High percentage of female headed households	Medium prevalence of stunting and high prevalence of underweight
Central highlands	High elevation; high average annual rainfall; low frequency of cyclones	Medium percentage reliant on livestock. Farming areas of medium size. Medium production of rice and cassava; low production of maize, high production of sweet potatoes and tarot, very high production of potatoes	Low percentage of children in primary school against total population; very high literacy rate. Low percentage of female headed households	Medium prevalence of stunting and low prevalence of underweight
Large farming plains	Medium elevation; low average annual rainfall; medium frequency of cyclones	High percentage reliant on livestock; large farming areas; high production of rice and maize; medium production of cassava; low production of other staple crops	Low percentage of children in primary school against total population and high literacy rate; low percentage of female headed households.	Medium prevalence of stunting and low prevalence of underweight
Southern highlands	High elevation with medium average annual rainfall and low frequency of cyclones	Medium percentage of population reliant on livestock. Farming areas of small size. Medium production of rice; high production of cassava and maize; very high production of sweet potatoes, potatoes and tarot	Medium percentage of children in primary school against total population and high literacy rate; medium percentage of female headed households	High prevalence of stunting and medium prevalence of underweight

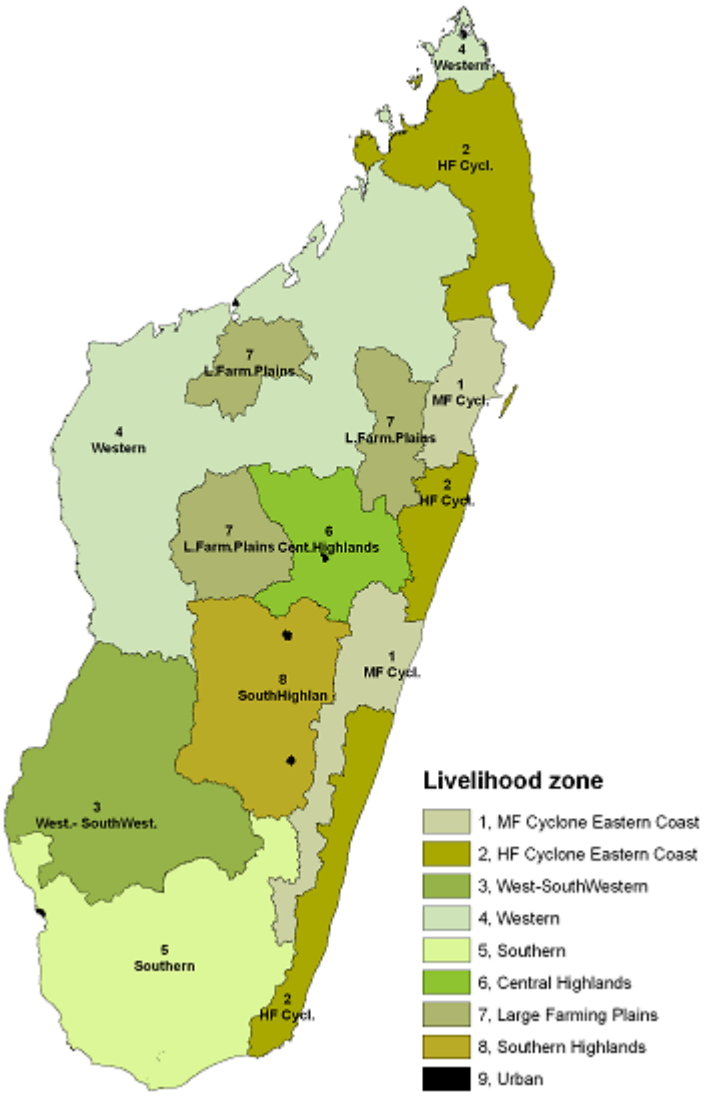
Data collection

Household questionnaires, community questionnaires and nutrition questionnaires (which included anthropometric measurements) were used to collect data in September 2010. Overall 552 Fokontany were visited, in which, 14,019 households were surveyed; 4,176 food security household questionnaires were administered and 7,444 children under five were measured. September[6] is considered to be a relatively "normal" period of time for all the zones as it is neither a month for harvesting the main crop nor does it falls within the lean season (see 4.2 "seasonality of earnings").

However, it is worth noting that in August/September 2010 part of the south faced severe food difficulties which were considered unusual at this time of the year.

Details on the sampling procedure are provided in Annex I.

Fig. 1 – Livelihood zones (strata) adopted by the CFSVA + N



[6] Data collection started on the 23rd August and was completed at the end of September in most of the zones. In some zones it spilled over to the first week of October.

2.0 GENERAL OVERVIEW OF MADAGASCAR

2.1. Socio political context

For the past two decades, Madagascar has suffered recurrent crises that have sent the economy into decline, weakened the socio-cultural fabric of society and prompted chronic poverty.

From 1996 to pre-crisis 2002 a programme of economic stabilization and structural re-adjustment, with the assistance of international institutions, contributed to a trend of national economic improvement with an average annual GDP increase of 4.6 percent[7]. This economic growth was mostly due to the expansion of free-trade zones and investment in infrastructure and services. However, such improvement did not translate into rural development with poverty rates remaining stagnant at 76.5 percent[8].

The political crisis in 2002 affected all economic sectors, with a decline in economic growth and increase in unemployment (from 3.2 percent in 1997 to 4.5 percent 2002). This translated into a surge in national poverty levels from 69.6 percent in 2001 to 80.7 percent in 2002[9].

Between 2002 and 2008, Madagascar embarked on a rapid development programme with significant improvements in social, economic and governance indicators, resulting in a GDP growth rate of seven percent by 2008[10]. Of note was an increase in public sector investment in public buildings and infrastructure, as well as a significant increase in foreign investment, particularly in the mining, trade and goods and services (telecommunications, transport, tourism and textiles) sectors (UNDP, 2009)[11]. But with no focus on equity or redistribution of national wealth, poverty remained rampant, as seen in the deterioration in the GINI coefficient from 0.365 in 2005 to 0.403 in 2010[12] (as highlighted in the next section).

Table 2 - Proportion of the population living under the poverty line

	1993	1997	1999	2001	2002	2004	2005	2010
Urban	50.1	63.2	52.1	44.1	61.6	53.7	52.0	54.2
Rural	74.5	76.0	76.6	77.1	86.4	77.3	73.5	82.2
Madagascar	70.1	73.3	71.3	69.6	80.7	72.1	68.7	76.5

Source: EPM-Madagascar 2010

In 2009 Madagascar experienced a violent and severe political crisis, which paralyzed government administration. In mid-March, 2009, an army faction forced the then President, Marc Ravalomanana, to resign and hand over power to the army leadership, which immediately transferred power to the opposition leader and ex-mayor of Antananarivo Andry Rajoelina. The High Transitional Authority (HTA) that came into power has not been recognized by the international community including the African Union, the Southern African Development Community, the European Union and the United Nations.

[7] World Bank, http://go.worldbank.org/1XJIO19Z90
[8] Labor market conditions in Madagascar, World Bank, Report No. 57652-MG, 2010
[9] Evolution de la Pauvreté à Madagascar: 1993-1999, INSTAT, 2001
[10] The Economist Intelligence Unit, Country Report, March 2010.
[11] Vulnerability Assessment Madagascar, Interagency Working Group on Monitoring Vulnerability, 2009
[12] EPM- Madagascar2010

As a reaction, development aid packages to Madagascar were frozen and foreign aid decreased by 40 percent[13]. The decrease in the available budget has primarily affected public services, since 86 percent of foreign aid to Madagascar is destined to support - directly or indirectly - public sector services[14]. By dramatically reducing public spending the HTA managed to maintain Madagascar's fiscal space. Public investment was reduced; while wage payments and essential operating expenditures were maintained.

Table 3 - Public spending between 2008 and 2010

	2008 (AR bn)	2009 (AR bn)	2010(AR bn)
Current spending	1,677	1,494	*1,364*
Public-sector wages	760	764	*758*
Capital spending	1,046	592	*468*

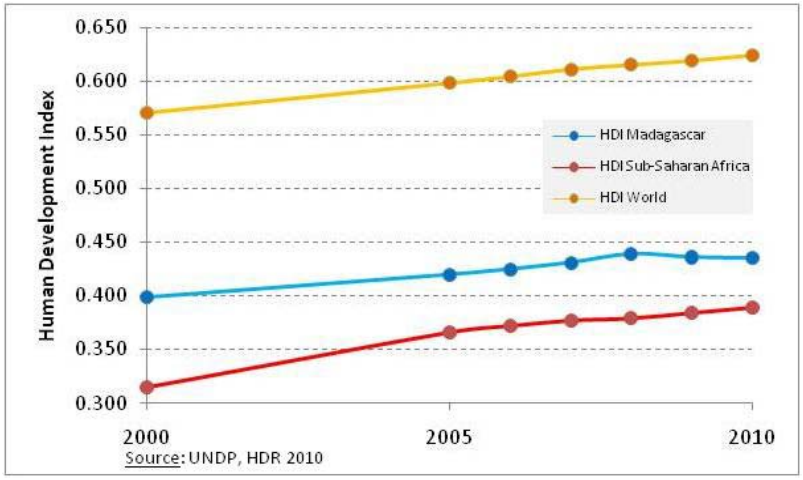
Source: The Economist Intelligence Unit, Country Report, March 2010

The international community has pressed all political parties to find a viable political solution, and ultimately hold new elections. The four main political movements were invited by the international mediation group, headed by the African Union to participate in power-sharing negotiations. No successful negotiations have been concluded so far, resulting in sanctions from the African Union against transitional political leaders in March 2010. Until such a political solution is found, the recognition of the transition government by the international community remains in limbo; and many donors, are waiting for this recognition or successfully held elections to be able to 'release funding'.

2.2. Macro economical context[15]

During the 1960s, Madagascar was one of the better-performing African economies before years of economic mismanagement brought it to its knees. It is classified as a low-income food deficit country and is among the least developed and poorest in the world with per capita income having declined from 473USD in 1970 to 410USD in 2008[16].

Fig. 2 – Human development index

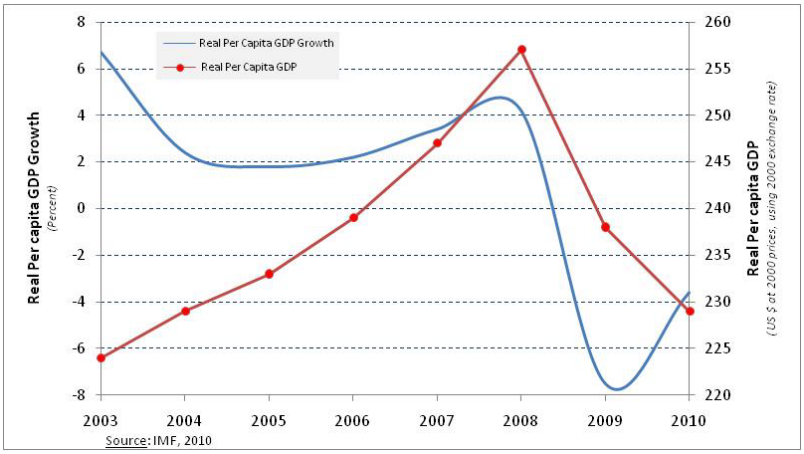


It ranks 135th out of 168 countries according to the 2010 Human Development Index (HDI)[17]. As mentioned above, the 2010 National Household Survey[18] finds that more than three-quarters of the population (76.5 percent) lives below the poverty line, with poverty rates significantly higher in rural areas (82.2 percent) than in urban areas (54.2 percent).

[13] From an initially expected USD 740 million to USD 433 million and included USD 170 million in direct budget support. Source: Julien Chevillard, Analyse préliminaire de l'impact de la crise institutionnelle et politique, 2009, UNDP. The freeze in the assistance affected mainly development aid.
[14] Vulnerability Assessment I, Interagency Working Group on Monitoring Vulnerability, 2009
[15] Paragraph 1.1 developed by Madagascar CO and Unicef Madagascar
[16] World Bank, http://go.worldbank.org/D41QD46W10
[17] Human Development Report, UNDP, 2010.
[18] EPM 2010

The 2009 political domestic crisis combined with the global financial turmoil dealt a further blow to economic growth plunging it into severe recession with GDP dropping by almost five percent in 2009. Particularly hard hit were the tourism sector (50 to 80 percent decline in occupancy rates), the textile exporting sector (estimated 25 percent decline in value), the shrimp sector (due to structural issues), and the construction and public works sector (due to quasi-paralysis of public investment following decline in donor funding). This led to several thousand job losses in the formal sector and to an increase in unemployment from 2.8 percent in 2005 to 3.8 percent in 2010 although 42 percent of the population are under-employed (i.e. part-time or seasonal work only).[19]

Fig. 3 – Gross domestic product



Madagascar's primary sector, essentially agriculture and mining, has been resilient with an exceptional rice harvest in 2009 (up by 40 percent from 2008 levels) while the mining sector grew significantly thanks to the "ilmenite" mining project (the largest project in Madagascar's history) that started production in mid-2009.

Nonetheless, the economic situation remains extremely fragile with recovery largely dependent on an internationally-recognized resolution of the political crisis.

Agriculture: structural issues and food security

The Madagascar economy is largely dependent on agriculture (accounting for 26 percent of the national GDP). Nearly 80 percent of the population lives in rural areas, where about 78 percent of the active population is engaged in agricultural activities.

The majority are subsistence farmers with few households producing higher value products such as fruits, cash crops or other vegetables, making the sector relatively isolated from the country's recent economic woes. Since the vast majority are economically undiversified, they are exposed to climatic variations, be they predictable (the lean/dry season) or unpredictable (cyclones, floods, and droughts).

Large areas of Madagascar's fertile lands remain unfarmed. The major challenge is to increase farm productivity, which remains low because of lack of equipment, agricultural inputs and technical skills. What's more the parcelling of farm lands prevents extensive farming and economies of scale. According to the 2010 national household survey, more than 70 percent of farming households are categorized as smallholder farmers, exploiting less than 1.5 ha of land. Access to land and land tenure security are the chief causes of this problem.

Land tenure reform, which was launched in 2005, aims to allow the poorest farmers to secure access to the land they work, giving them the chance to exercise their ownership rights[20]. However, while some farmers seem reluctant to approach the local land tenure offices for fear of becoming subject to property taxation[21], others are put off by the excessive costs of land tenure certification fees (albeit much lower

[19] Madagascar Economic Update – Economic crisis? Not yet but almost there. World Bank, May 19, 2009
[20] La réforme foncière à Madagascar, http://www.foncier.gov.mg
[21] Les Guichets Fonciers, ou l'administration foncière de proximité à Madagascar – FIDA, http://www.foncier-developpement.fr

than those for title deeds)[22]. Plus much of the funding for this reform has been suspended by donors following the 2009 institutional crisis, jeopardizing the perpetuation of this reform[23].

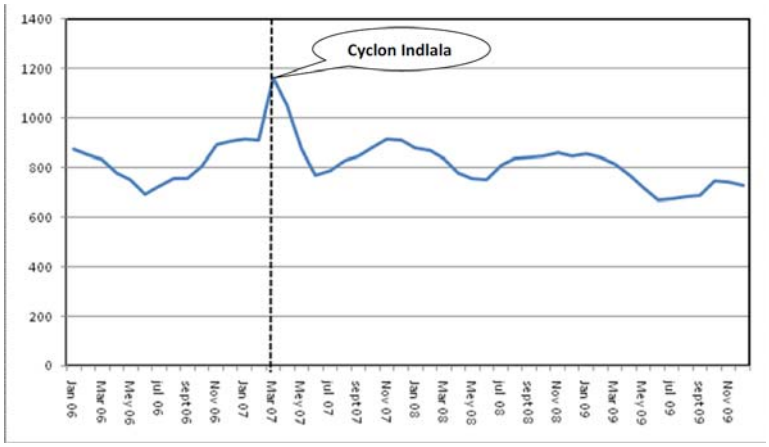
Lack of growth in the sector can also be attributed to the country's outdated and badly-maintained transport network system, affecting not only the connectivity between the farms and the consumers but also trade development between regions. The cost of transporting agricultural products to urban centres becomes excessive and contributes to market segmentation.

2.3. Market and prices[24]

High food prices and the global financial crises have had a severe impact on household food security in many developing countries. On average, the Consumption Price Index (CPI) in Madagascar rose by 10 percent a year over the past five years with the increase much higher in non-food than in food products. Prices rose somewhat faster in the High Frequency Cyclone Eastern Coast zone and West-South Western zone but also in urban centres.

Rice price trends

Fig. 4 – Real retail prices of rice at national level



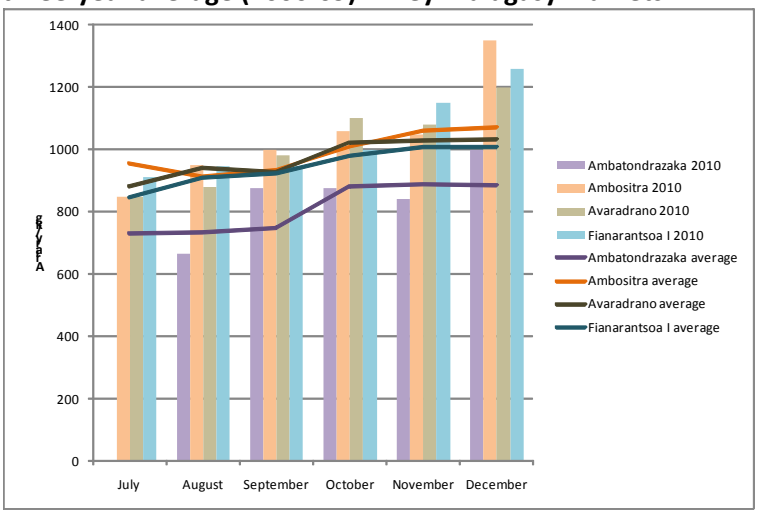
Malagasy households spend an average of 32 percent of their total expenditure on rice (except in the south where the orientation is more towards cassava). In addition, it accounts for nearly half of domestic agricultural production. After a considerable peak in 2007 caused by 'Cyclone Indlala', rice prices exhibited a mild decreasing trend, which can be explained by the increase in domestic production.

The relative decline in prices has hit the producers (farmers) who also have to cope with the increasing cost of inputs[25]. Though an overall fall in prices is typically beneficial to consumers, this was countered by the general rise in prices of other products and services[26].

[22] Local land tenure administration – Case Study, Laure Prouin, IFAD intern, 2008
[23] La réforme foncière à Madagascar, http://www.foncier.gov.mg
[24] Paragraph 1.2 developed by Madagascar CO and Food Security Analysis Service
[25] Prices of fertilizers and other inputs (Source: CFSAM 2010).
[26] The community survey shows that rise in consumer prices of agricultural products affected more than half of fokontany in the West-South western while decline in producer prices of agricultural products is the main economic shock that have had negative impacts on food security in the Medium Frequency Cyclone Eastern Coast, in the Highlands and the Large Farming Plains. Moreover, many have lost their job since the beginning of the political crisis in January 2009 (Madagascar Economic Updates - April 2010, World Bank).

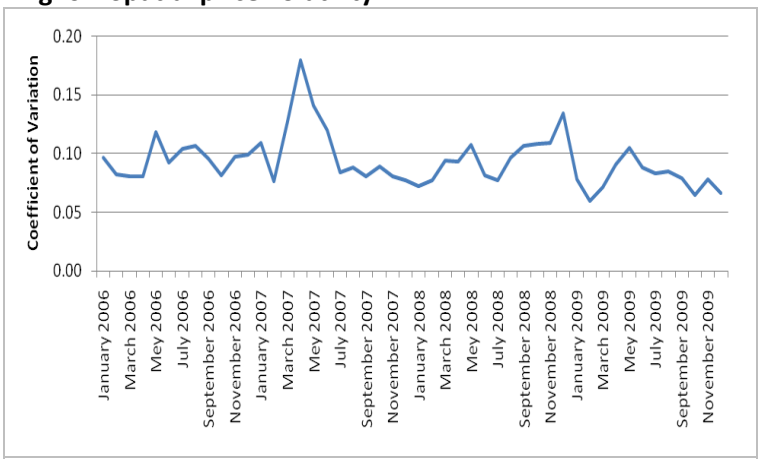
Although a mild declining trend has been observed over the long term, more recent trends in nominal prices (in relation to the three-year monthly average) show that prices in December 2010 were higher than the three-year average. This could reflect inflation as well as seasonal factors. The gap in the data series for 2010 makes it difficult to ascertain whether the increasing trends are typical or not. The price levels in July-December 2010 seem to follow a similar trend as the past three-year monthly averages across four key markets – Ambatondrazaka, Ambositra, Avaradrano and Fianarantsoa[27].

Fig. 5 – Trend of nominal prices in 2010 relative to monthly three-year average (2006-09) in key Malagasy markets



Price volatility [28]

Fig. 6 – Spatial price volatility



From 2006-2009, rice prices in rural Madagascar were relatively stable, with volatility remaining within a low but predictable range of five to 20 percent (price variability) between markets; this is indicative of good performance of retail markets of rice.

In the last six months of 2010, prices showed greater volatility (fluctuations around 45 percent in July-December 2010), making households and traders less able to anticipate prices.

It is also important to understand how prices behave across time within the same markets. It is possible that the volatility of prices across time, within the same markets, is linked to their market-specific seasonal calendars. To obtain a clearer picture on the trends in volatility, an extra-seasonal index for variation was constructed[29]showing how variant the seasonal index of retail prices is in a given month. Across major markets where data is available, monthly variation of the seasonal index averages eight percent. However, in the majority of markets, the level of

[27] These markets were identified as key markets through the Granger Causality analysis presented further below. Ie., they are the most important leading markets in terms of forecasting prices in other major markets in Madagascar.

[28]Volatility consists of two distinct components; spatial volatility, or variation between geographical disparate markets, and temporal volatility, or the variation within a market through time.

[29] CVs that are calculated using nominal spot prices are limited in that seasonal components of price behaviour can bias the coefficient upwards. By using seasonal indices as the reference price, temporal volatility is limited to only that which is external to normal seasonal patterns. In this case, the standard deviation from mean of the seasonal index for each month relative to the mean of the seasonal index comprises the CV. The result is a measure of extra-seasonal price variation for each month. In other words, this shows how variant the seasonal index of retail prices is in a given month.

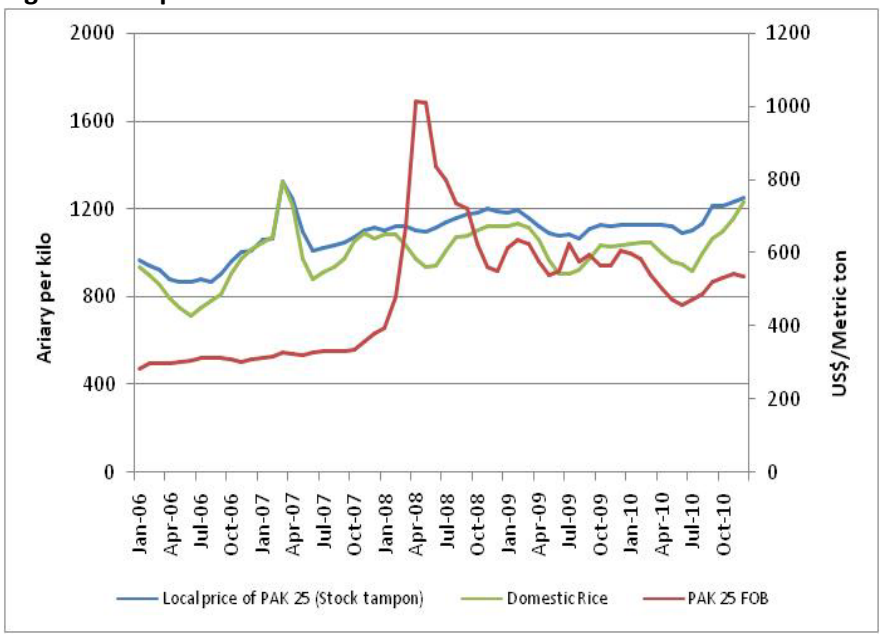
volatility peaks in March and April at 15 percent. However, if the months when Cyclone Indlala hit in 2007 are excluded from the extra-seasonal calculations, such seasonal variability spikes disappear, and markets exhibit very predictable and stable ranges of variance throughout the year. This suggests that markets are normally predictable month-to-month, and reacted with relative resilience to the cyclone shock.

Generally speaking, despite seasonal patterns, Malagasy markets exhibit relative stable prices both between markets and throughout the season; levels of volatility occur in a low, predictable range. Stability of prices is one condition of the appropriateness of a cash and voucher transfer, particularly in the South where the prevalence of food insecurity is very high. However, the local availability of goods on markets throughout the year and the cost-effectiveness also have to be analyzed. In fact, while prices may provide some indication of availability, monitoring prices will not be sufficient to understand localized availability conditions where responses might want to be targeted. Availability will be deeply explored in chapter 3.0, by looking at cereal balance sheet and market integration / dependency.

Cross border and international trade

There is a weak correlation (0.5)[30] between Malagasy and international prices, suggesting poor integration between the two markets. For instance, both domestic and imported varieties of rice purchased in local markets remained insulated from the global price spike of April 2008, which affected international prices substantially (e.g. Pakistani 25 percent broken, see Figure 7). Gradually over the course of the year however, market prices increased by five percent in nominal and 2 percent in real terms[31].

Fig. 7 – Rice price evolution in local and international markets



Source: OSIRIZ/InfoArroz & ODR bulletins

But international price volatility may still exert upward price pressure on domestic markets. Indeed World Bank research suggests that Madagascar is not completely segmented from international markets[32]. One possible explanation is that rice is mainly imported in the lean season to offset supply shortfalls, which would explain the lagged upward trend in local market prices in 2008[33].

Since 2006, prices of imported rice have remained higher than that of local varieties, perhaps reflecting increases in agricultural production and a recent pattern of favourable local growing conditions. However, wholesalers, who both import and export, have been accused of using their import capacity as a bargaining chip to negotiate low prices from local producers. This further explains why imported varieties of rice tend to follow the seasonal trend observed with domestic varieties, rather than the behaviour of the international wholesale market. This integration of prices between local and imported varieties results in

[30] National price of imported rice from 2006 to December 2010.
[31] Rapport sur l'analyse de marches et la faisabilité d'une intervention basée sur le transfert d'espèces/coupons, WFP Madagascar, Juin 2009.
[32] Madagascar Economic Updates - October 2010, World Bank.
[33] Rapport sur l'analyse de marches et la faisabilité d'une intervention basée sur le transfert d'espèces/coupons, WFP Madagascar, Juin 2009.

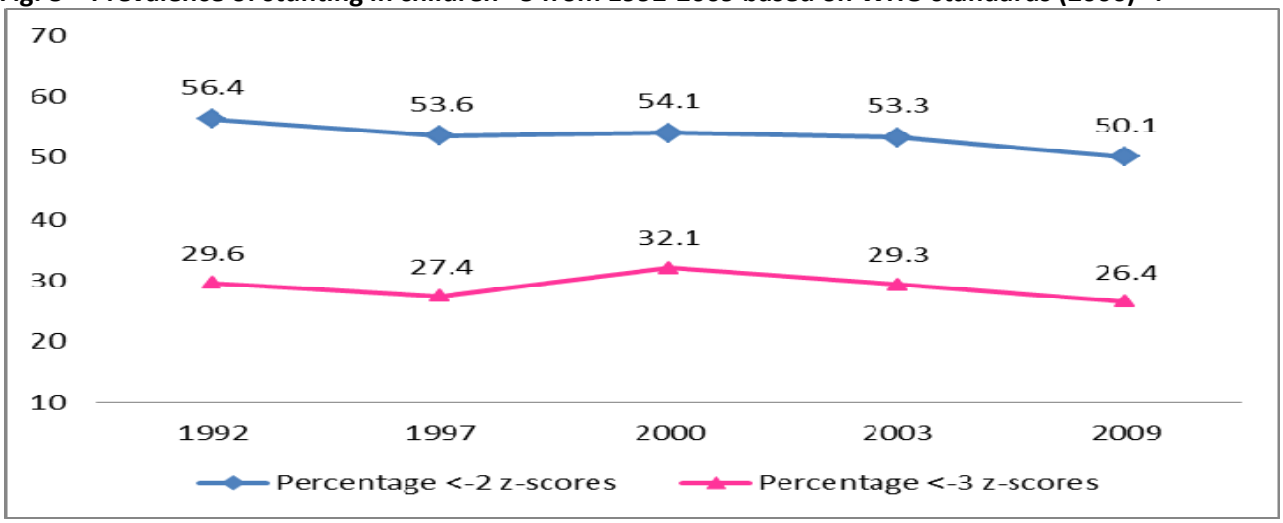
imports having limited capacity to dampen seasonal price effects, even though imports tend to be concentrated during the lean season.

2.4. Trends in nutrition indicators

The first demographic health survey (DHS) was carried out in 1997 followed by two further surveys in 2004 and 2009, which allow trends analysis in nutrition and health data over time, so the country's progress towards the MDGs and the limiting factors can be assessed. It is important to look at trends in nutrition indicators by wealth quintiles (as the last two surveys did). For example children under five are especially susceptible to socio-economic effects because of their dependence on others to ensure their health and nutritional status.

Nutrition status of children

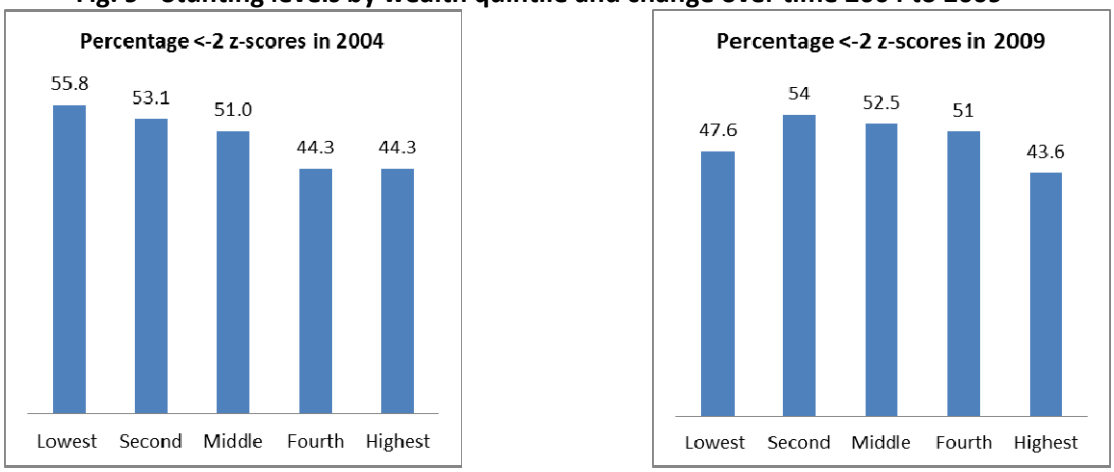
Fig. 8 – Prevalence of stunting in children <5 from 1992-2009 based on WHO standards (2006)[34].



Recent data shows that Madagascar is 6th in the world with regards to stunting in children under five[35].. In Madagascar more than half of under-fives suffer from stunted growth. There has been little change in the prevalence of stunting in this age group over the last 17 years from levels of 56.4 percent in 1992 to 50.1 percent in 2009. However, when we look at trends in stunting by wealth group, in can been seen there has been a considerable decrease in stunting in the poorest quintile between 2004 and 2009. Such a fall is not observed in the other quintiles with an increase in stunting levels in the fourth quintile.

[34] DHS Madagascar 1992 to 2009
[35] State of the World's Children 2011. Madagascar ranks 6th behind Afghanistan, Yemen, Timor-Lesete, Malawi, and Ethiopia.

Fig. 9 - Stunting levels by wealth quintile and change over time 2004 to 2009[36]



Based on 2006 WHO standards

Anaemia prevalence

Anaemia levels have dramatically decreased for women (from 46 percent to 35 percent) and children (from 69 percent and 50 percent) between 2003 and 2009. This reduction may be due to the introduction of bi-annual de-worming of pregnant women and children under five and the higher focus on malaria prevention (2007 nationwide mosquito net campaign, introduction of rapid diagnostic tests and of Artemisinin-based combination therapy).Nevertheless the levels remain high and anaemia remains a serious public health issue in Madagascar with a large disparity seen between women and children in the richest household and those in the poorest.

Infant feeding trends

There has been a steady increase in the proportion of children who are breastfed within the first hour of life from 34.3 percent in 1997 to 72.4 percent in 2009, with a relatively equitable distribution by wealth quintiles.

While the same equitable distribution is seen for the average duration of breast feeding, the length of time a child is exclusively is breast fed varies by quintiles, as seen in the graph below, with richer children breastfed exclusively nearly three times longer than children in the poorest quintile. Nevertheless, the average length of time for exclusive breastfeeding remains low and not in-line with international recommendation of six months[37].

[36]converted from the 1997 NCHS/CDC/OMS reference using the algorithms suggested by Yang H and de Onis M Algorithms for converting estimates of child malnutrition based on the NCHS reference into estimates based on the WHO Child Growth Standards *BMC Pediatrics 2008, 8:19*

[37]WHO (2001). The optimal duration of exclusive breastfeeding: report of an expert consultation. Geneva, World Health Organization.

Fig. 10 – Mean duration of breastfeeding and exclusive breastfeeding

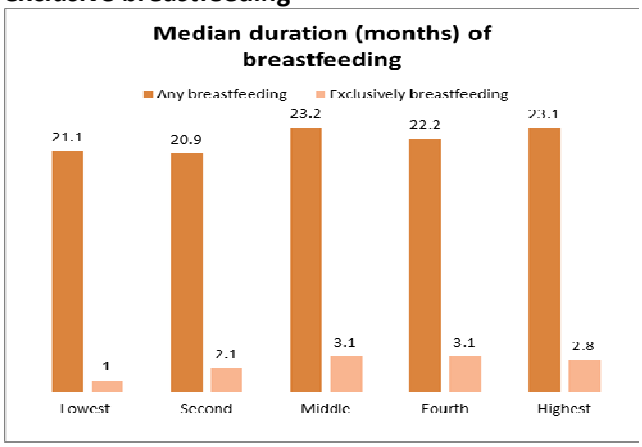
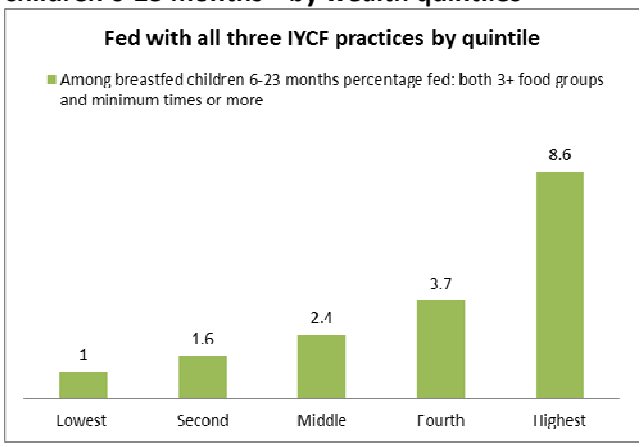


Fig. 11 – Optimal complementary feeding practices children 6-23 months[38] by wealth quintiles

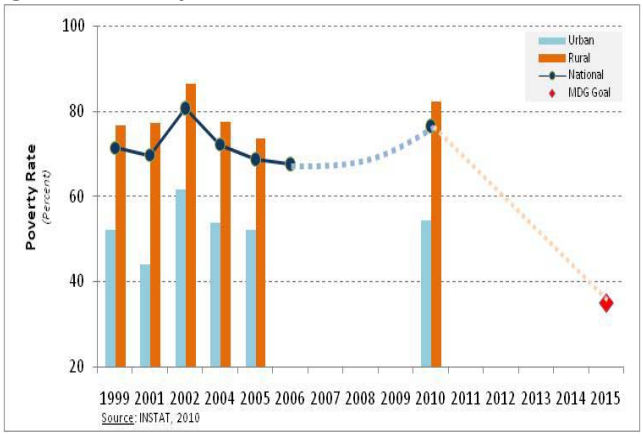


For complementary feeding the variation by quintile wealth is marked with eight times more children in the richest quintile benefiting from optimal complementary feeding defined as breastfed children 6-23 months who received food from 3 or more different food groups and were fed the minimum number of times for their age.

2.5. MDG tracking related to food security and nutrition[39]

In 2008 Madagascar seemed to be making good overall progression the MDGs. It was one of the countries improving on the Human Development Index, such as cutting child and infant mortality rates[40] and increasing primary school enrolment[41]. Nevertheless only three MDGs (MDGs 2, 3 and 6) were expected to be met (gender equality, primary education for all, and the fight against HIV/AIDS, malaria and other diseases).

Fig. 12 – Poverty rate trends



In the last three years MDG progress has been severely shaken by the political crisis, with MDGs 1, 4, 5, 7 and 8, which were already off-track, at risk of being derailed further, and MDGs 2, 3 and 6 now at risk of deteriorating.

On **MDG1 target 1A** ("*halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day*"), the challenge is insurmountable since it would entail cutting the poverty rate from 76.5 percent to 35 percent by 2015[42].

[38] PAHO/WHO. (2002). Guiding principles for complementary feeding of the breastfed child. Washington DC, Pan American Health Organization/World Health Organization.

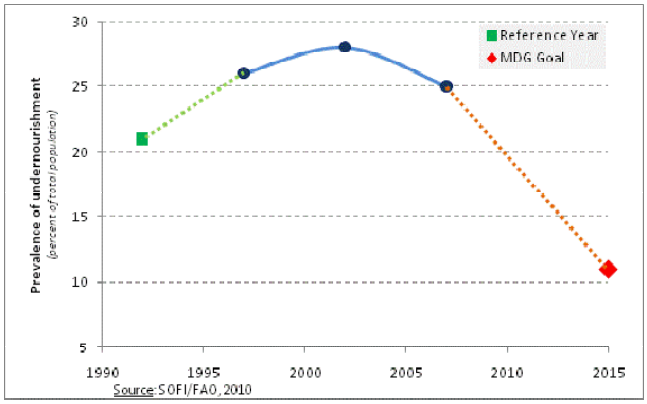
[39] Paragraph 1.4 developed by Madagascar CO
[40] INSTAT and DHS 2003/04.
[41] EPM 2005.
[42] EPM 2010.

As for **MDG1 target 1C** ("*halve, between 1990 and 2015, the proportion of people who suffer from hunger*"), two indicators are used to track progress:

- The prevalence of underweight among children under five
- Proportion of population below minimum dietary energy consumption (MDEC).

Trends on these indicators suggest that reaching the MDG target 1C is a huge challenge.

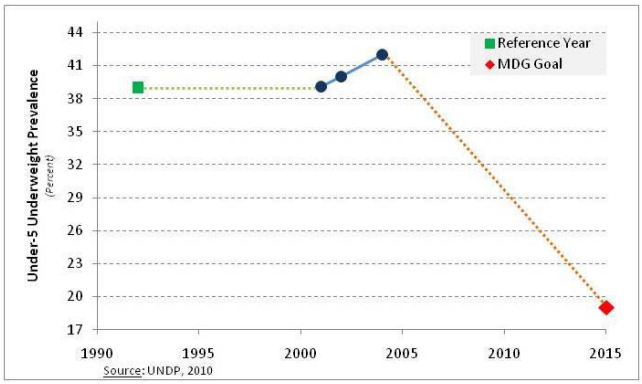
Fig. 13 – Undernourishment trends



About a quarter of the population is undernourished (up from about a fifth in the 1990s) i.e., their food intake regularly provides less than their minimum dietary energy requirements (MDER: 2,133kcal per adult equivalent per day)[43]. This means Madagascar is one of the 20 countries in the world with the highest burden of under-nutrition[44].

More than 40 percent of **under-fives are underweight (equivalent to 37.8 percent based on WHO 2006 Standards)[45], a percentage that has changed little since 1992**[46] . As mentioned above stunting among under-five is as high as 50.1 percent, second only to Afghanistan and Yemen[47], with little change in stunting prevalence over the last 17 years.

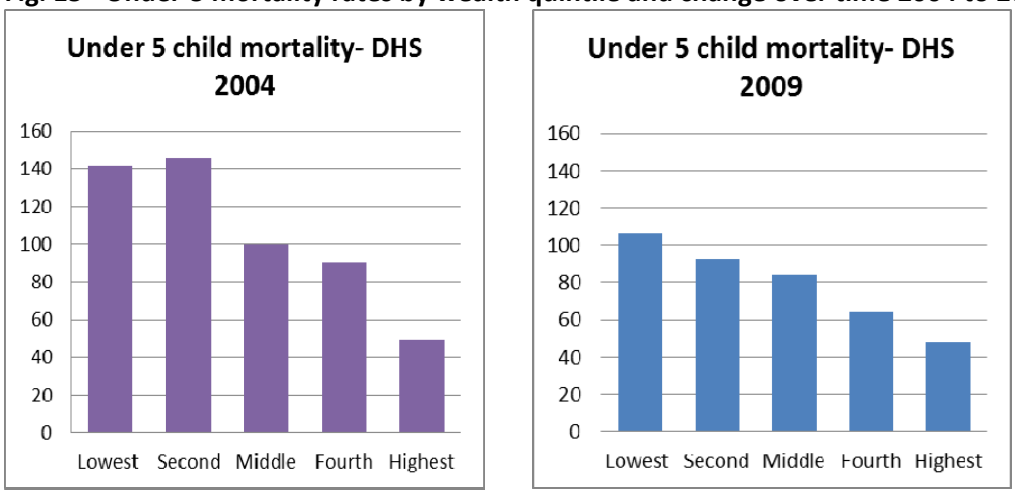
Fig. 14 – Underweight trends



Despite the slow progress on MDG 1, improvements have been noted in **MDG4 target 4A** "*reduce by two thirds, between 1990 and 2015, the under-five mortality rate"*), with a steady decline from 159 deaths per 1000 live births in 1997 to 72 deaths per live birth in 2008. In addition, when comparing the disaggregated data of 2004 with those of 2009 (figure 15), it can be seen that the biggest reduction in under-five mortality is in the poorest quintile resulting in a reduction in the quintile ratio[48] from 2.9 in 2004 to 2.2 in 2009. However there remains a stark inequity by economic group with the children in the poorest quintile twice more likely to die than those in the richest quintile (106 per 1000 and 48 per 100 respectively).

[43] The State of the World Food Insecurity, FAO, 2010
[44] Lancet Nutrition Series 2008
[45] DHS-III 2003-2004, based on NCHS/WHO/CDC 1977 Standards
[46] Unfortunately, the latest DHS (2008-2009) did not display underweight prevalence as a result of the poor quality of the data
[47] State of the World's Children 2010
[48] Quintile ratio = results in the worst of quintile over results in the best off quintile

Fig. 15 - Under-5 mortality rates by wealth quintile and change over time 2004 to 2009



deaths per 1000 live births in the 10 years preceding the survey

2.6. Natural disasters and climate change[49]

Its geographic location makes Madagascar the country in Africa most exposed to climatic shocks, after the Comoros Islands. Over the past 35 years at least 50 natural disasters, including cyclones, drought, epidemics, floods, famines and locust infestations, have affected more than 11 million people[50]. Severe floods occur in the south-east and west of the country and drought is recurrent in the southern part of the island. Madagascar also faces severe loss of forest cover, accompanied by erosion.

With almost a quarter of the population concentrated in areas vulnerable to cyclones, floods or droughts, reoccurring natural disasters hit large numbers of people, causing additional hardship for an already economically vulnerable population. More than 75 percent of the 20 million Madagascans live on less than a dollar a day, severely hampering their coping mechanisms.

Over the last decades, climatic disturbances have become more frequent and severe leading to human casualties, loss of crops and animal production, infrastructure damage, natural resources degradation (water, soil, forest) and coastal erosion. The Malagasy are facing repeated and increasing vulnerability as such blows exacerbate the already precarious conditions of food security and livelihood, water supply, irrigation systems, public health, and environmental management.

Temperatures in Madagascar have risen by about 0.5 degrees Celsius over the last 30 years[51] though computer models[52] forecast an average temperature increase of 2.5 -3 degrees Celsius in the next 50 to 100 years. They also predict a fall in average annual rainfalls with a marked decrease during the dry season and an intense increase during the rainy season - except for the southern part where rainfalls will remain the lowest, with extension of the drought period. Such warming will disrupt the agro climate and force changes in the farming system and economic orientations of the regions. Insufficient and irregular rainfall in three regions in southern Madagascar since 2008 had devastating impacts on the 2010 main harvest, leaving many vulnerable families in need of assistance.

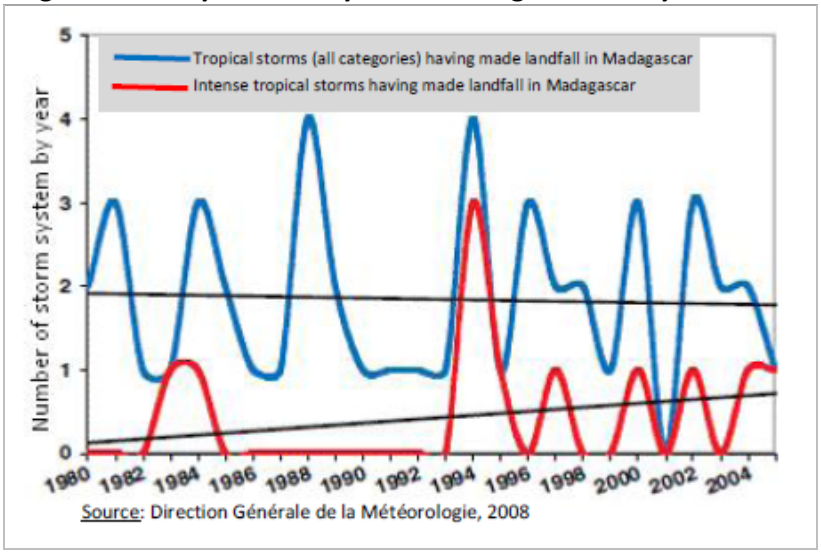
While the annual number of cyclones striking the country has not changed over the last 25 years the frequency of intense and very intense tropical cyclones is markedly up since 1994. Between 1980 and 1993, only one out of 20 storms with sustained wind speed above 200 km/h reached Madagascar. Since then cyclones in this category have hit the island every two years. An increase in the frequency of intense

[49] Paragraph 1.2 developed by Madagascar CO
[50] EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain - Brussels - Belgium.
[51] Programme d'action national d'adaptation aux changements climatiques, Ministère de l'Environnement, des Eaux et Forêts.
[52] Le climat et le changement climatique à Madagascar, Direction Générale de la Météorologie, 2009

tropical cyclones and in the number of cyclones passing through the north of the country is forecast towards the end of this century.

An in-depth analysis on rainfall variation, drought occurrence, and a water satisfaction model for maize and cassava will be discussed in chapter 8.

Fig. 16 – History of storm systems striking the country



3.0 FOOD AVAILABILITY AND MARKET INTEGRATION[53]

3.1. Cereals' balance

The main staple crops in Madagascar are rice, cassava and maize, followed by sweet potatoes[54]. Rice contributes the most caloric intakes and per capita rice consumption (approximately 115 kg/year per capita) is among the highest in the world[55][56]. Cassava also contributes importantly to the diet (approximately 117 kg/year per capita[57]), especially in the south where it accounts for more than 27 percent of caloric intake. Maize, although not extremely important overall (approximately 21 kg/year per capita[58]), provides 15 percent of all caloric requirements in the south. Sweet potato (approximately 16 kg/year per capita[59]) plays a more important role in the south, the west and the highlands[60].

Table 4 - Cereal Balance sheet for 2005, 2007, 2008

LIVELIHOOD STRATA		2005	2007	2008
MF Cyclone Eastern Coast	Cereal available for human consumption (mt)	184,944	193,973	203,756
	Total population (urban + rural)	1,816,657	1,920,187	1,962,901
	C.E requirement Needs	326,998	345,634	353,322
	Cereal Equivalent Net Balance (mt)	-142,055	-151,661	-149,566
HF Cyclone Eastern Coast	Cereal available for human consumption (mt)	422,032	443,065	431,089
	Total population (urban + rural)	3,762,686	3,977,118	4,065,588
	C.E requirement Needs	677,283	715,881	731,806
	Cereal Equivalent Net Balance (mt)	-255,252	-272,816	-300,716
West-Southwestern	Cereal available for human consumption (mt)	165,153	173,158	185,339
	Total population (urban + rural)	784,129	828,816	847,253
	C.E requirement Needs	141,143	149,187	152,506
	Cereal Equivalent Net Balance (mt)	+24,010	+23,971	+32,834
Western	Cereal available for human consumption (mt)	371,673	395,104	443,398
	Total population (urban + rural)	2,282,690	2,412,779	2,466,450
	C.E requirement Needs	410,884	434,300	443,961
	Cereal Equivalent Net Balance (mt)	-39,211	-39,196	-563
Southern	Cereal available for human consumption (mt)	366,471	378,213	393,172
	Total population (urban + rural)	2,018,455	2,133,485	2,180,944
	C.E requirement Needs	363,322	384,027	392,570
	Cereal Equivalent Net Balance (mt)	+3,149	-5,815	+602
Central Highlands	Cereal available for human consumption (mt)	379,709	398,886	387,741
	Total population (urban + rural)	4,926,482	5,207,239	5,323,072
	C.E requirement Needs	886,767	937,303	958,153
	Cereal Equivalent Net Balance (mt)	-507,057	-538,417	-570,412
Large Farming Plains	Cereal available for human consumption (mt)	557,108	586,650	621,850
	Total population (urban + rural)	1,721,748	1,819,869	1,860,351
	C.E requirement Needs	309,915	327,576	334,863
	Cereal Equivalent Net Balance (mt)	+247,194	+259,074	+286,987
Southern Highlands	Cereal available for human consumption (mt)	683,085	709,981	771,468
	Total population (urban + rural)	1,287,153	1,360,507	1,390,771
	C.E requirement Needs	231,688	244,891	250,339
	Cereal Equivalent Net Balance (mt)	+451,398	+465,090	+521,129
NATIONAL LEVEL	**Total Cereal available for human consumption (mt)**	3,130,176	3,279,031	3,437,814
	Cereal Equivalent requirement Needs	3,348,000	3,538,800	3,617,519
	CEREAL EQUIVALENT NET BALANCE (mt)	-217,824	-259,769	-179,706

Table 4 gives the cereal equivalent (CE) net balance for the period between 2005 and 2008 for each livelihood zone, based on data from the Ministry of Agriculture. The CE requirement needs values were calculated based on the above mentioned per capita yearly consumption by crop converted into CE[61].

[53] Chapter 3 developed by Madagascar CO. Food availability refers to the existence of enough food within domestic boundaries to provide the population with its nutritional requirements.
[54] Recensement Agricole 2004-2005, Ministère de l'Agriculture, de l'Elevage et de la Pêche, 2007
[55] Agricultural Technology, Productivity,Poverty and Food Security in Madagascar, Bart Minten, 2005. Note sur le prix du riz à Madagascar, Hélène DAVID-BENZ, Cirad, UMR Moisa, Observatoire du Riz, 2011.
[56] Note sur le prix du riz à Madagascar, Hélène DAVID-BENZ, Cirad, UMR Moisa, Observatoire du Riz, 2011
[57] Statistique Agricole; Rapid Joint Crop and Food Security Assessment Mission (CFSAM), FAO/WFP/Ministry of Agriculture, 2010
[58] Statistique Agricole; Rapid Joint Crop and Food Security Assessment Mission (CFSAM), FAO/WFP/Ministry of Agriculture, 2010
[59] Statistique Agricole; Rapid Joint Crop and Food Security Assessment Mission (CFSAM), FAO/WFP/Ministry of Agriculture, 2010
[60] Food Security in Madagascar: A Situation Analysis, Gilles Bergeron, 2002
[61] Cereal equivalent conversion factors: milled rice = 1.0238; maize = 1.0266; cassava = 0.3108; sweet potato = 0.2766

The table 5 below provides the national-level CE net balance for 2009 and 2010, based on the 2009 and 2010 CFSAM.

Table 5 - Cereal Balance sheet for 2009 and 2010

	2009	2010
Total Cereal Equivalent Production (mt)	4,158,000	4,829,000
Cereal Equivalent available for human consumption (mt)	3,462,000	3,781,000
C.E requirement Needs	3,668,000	3,983,000
CEREAL EQUIVALENT NET BALANCE (mt)	-206,000	-202,000

Based on those figures, it would appear that, on a yearly basis, Madagascar produces around 90 percent of its domestic cereal needs. Earlier studies reported that, during the 1998-2008 decade, the national cereal production had basically covered 88 percent of the domestic needs[62]. But food availability varies widely from region to region with **some areas suffering chronic insufficient local production to meet the needs of local people, while a few areas have a net cereal surplus.**

3.2. Supply and market integration

As mentioned in chapter 1.0, the overall performance at farm level is low in Madagascar. The agricultural productivity in all key crops (rice, manioc, but also maize and sweet potato) remains quasi-stagnant due to the use of **traditional cultivation methods** and resistance to using improved production techniques. At national scale, the problems of food availability can also be traced to the **lack of access to market and storage facilities** and to **poor communication infrastructures** leaving many remote areas isolated and unable to trade surpluses or obtain agricultural inputs, particularly during rains when entire regions become periodically inaccessible.

The poor access to factors of production (land, labour, capital and liquidity, and knowledge) and the bottlenecks in input and output markets (poor infrastructures conditions) prevent farmers from adopting improved technologies. Soaring prices of agricultural equipments and inputs also limit the adoption of modern technologies. Intermediary operators limit their trade to the same area to avoiding long distance travel[63].

The CFSVA+N confirms the difficulties Malagasy face in accessing markets. In fact, almost a quarter of the sampled fokontany didn't have a market with the nearest one up to three hours away. Only the West-South Western and Large Farming Plains have more opportunities of exchange with a market in two fokontany out of five.

In the December to March rainy season travel to market is disrupted in virtually all zones because transport becomes so difficult due to poor road conditions. Prices are at their highest during this two month period.

Walking is still the most used means of transport in rural Madagascar, with the nearest bush-taxi typically a one to three hour walk from the community. The High Frequency Cyclone Eastern Coast, the West-South Western and the Large Farming Plains are the least isolated areas and The Middle Frequency Cyclone Eastern Coast and the Southern are the most isolated. Though it varies greatly by zone the average cost of transport, linking the *fokontany* and the district capital, is 5000 Ariary. For example, it costs an equivalent of 0.7 kg of rice per hour to drive from the *fokontany* to the district capital in MF Cyclone Eastern Coast and over 2 kg of rice per hour in the Large Farming Plains. Such variations are mainly down to poor infrastructure, but also because of oligopolistic behaviour and collusion between collectors and wholesalers.

[62] Rapport sur l'analyse de marchés et la faisabilité d'une intervention basée sur le transfert d'espèces/ coupons, Boubacar Ndaw,2009

[63] Food Security in Madagascar: A Situation Analysis, Gilles Bergeron, 2002

Improvements in road infrastructure and production (especially rice) since 2005[64] means there is a relatively good flow of food from surplus to deficit areas.

Using price correlations and Granger causal analysis, it has been observed that[65]:

- The West-South Western markets are mainly correlated with the Southern and Southern Highlands markets. All other markets are fairly well correlated, especially those in Central Highlands with those in Large Farming Plains.
- Within the livelihood zones, markets that are geographically linked are more correlated. For example, markets in the HF Cyclone Eastern Coast tend to be less correlated because they are not geographically linked while those in the north are well linked with the southeast.
- The markets of reference in the Large Farming Plains influence prices in Western and Upper Eastern Coast and Southern Highlands, which in turn affect prices in Southern and Lower Eastern Coast. Specifically, markets of Ambatondrazaka, Antananarivo, Fianarantsoa and Ambositra play a major role in forecasting wholesale prices and organizing trade flows in the whole country. Central Highlands markets seem to be isolated from the rest of the districts. Figure 17 below illustrate the markets that forecast and the markets that follow price changes. In addition, table 6 provides details on causality between markets, as identified by the Granger causal analysis. Such links help identify potential knock-on impacts that a price shock in one particular market has on the other markets with which it is integrated.
- Within the livelihood zones there are some districts that are not correlated with other markets[66]. The following markets have particularly poor links:
    - Central Highlands livelihood zone
    - *Antalaha, Maroantsetra and Sainte Marie* (as they are only accessible by boat).
    - Suburban markets in the east coast (*Toamasina II* and *Vatomandry*).
    - *Fianarantsoa I* and *Tulear I* are well correlated with each other but not correlated with any other urban markets.
    - *Antsiranana* also shows little integration with other district markets, with the exception of markets in Toamasina I, Fianarantsoa I and Sambava.

[64] Source: CFSAM 2010

[65] Granger causality is a statistical hypothesis test for determining whether one time series is useful in forecasting another. A time series X is said to Granger-cause Y if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y. In the context of market analysis, this statistical test can help to ascertain whether prices in Market X forecast, or granger cause, prices in Market Y – therefore establishing an indicator of causality.

[66] In these segmented markets price fluctuations are only minimally explained by price fluctuations in surrounding markets.

Fig. 17 –Markets that forecast price changes and markets that follow price changes (source: Bulletins OdR / WFP calculations)

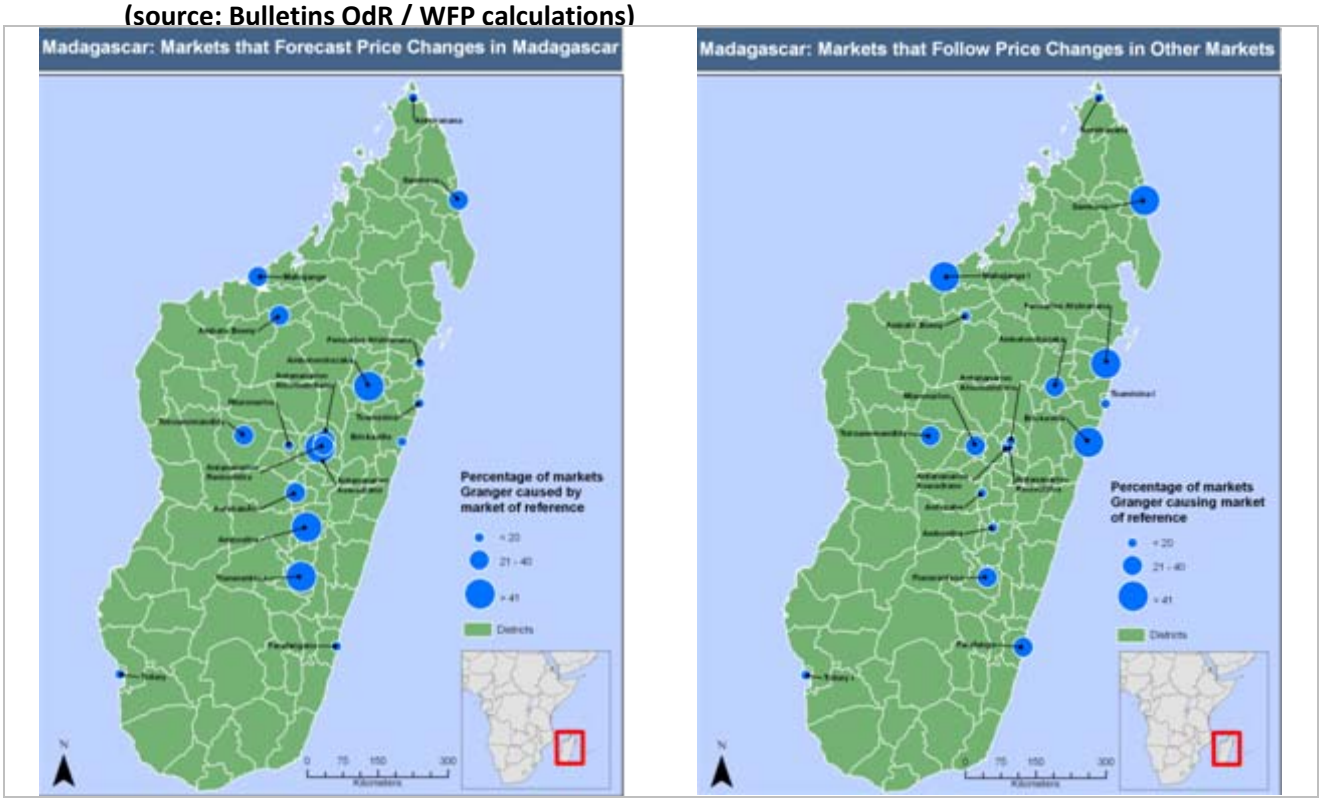


Table 6 - Level of price forecasting according to Granger

Price Forecasting

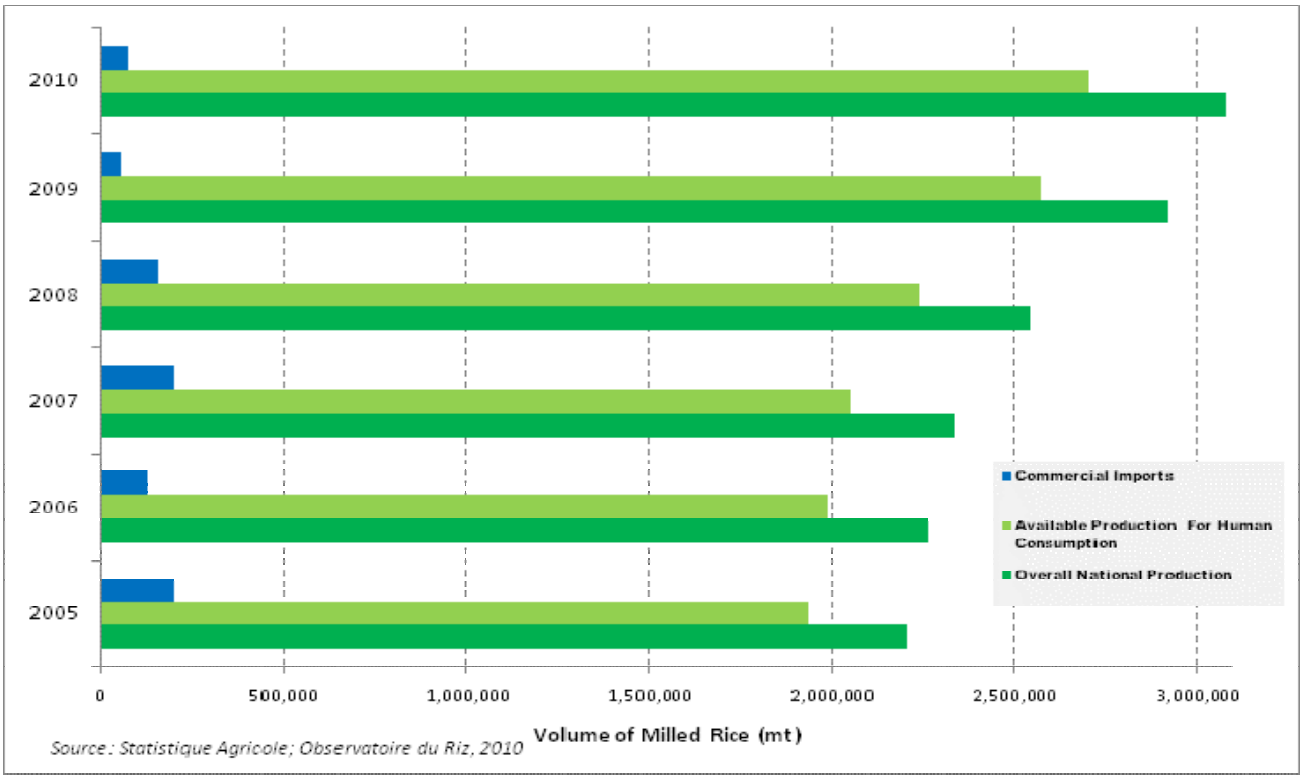
Market (district)	Granger causes at 1% and 5% level of significance
Ambositra	Antisranana i, Avaradrano, Mahajanga i, Miaronarivo, Sambava, Tsiroanomandidy, Ambato Boeny, Ambatondrazaka, Antananarivo, Antsirabe i, Brickaville, Fianarantsoa i, Toamasina i, Toliary i
Fianarantsoa	Farafanga, Sambava, Ambatondrazaka, Antsirabe i, Avaradrano, Brickaville, Fenoarivo Atsinanana, Mahajanga i, Miaronarivo , Tsiroanomandidy
Avaradrano	Antsirianana i, Brickaville, Fenoarivo Atsinanana, Mahajanga i, Miaronarivo, Sambava, Ambato Boeny, Fianarantsoa i, Toamasina i, Tsiroanomandidy
Ambatondrazaka	Antananarivo, Antsirianana i, Avaradrano, Fenoarivo Atsinanana, Mahajanga i, Sambava, Toamasina i, Atsomondrano, Farafanga
Ambato Boeny	Mahajanga I, Sambava, Toamasina I, Brickaville, Fenoarivo Atsinana, Fianarantsoa I, Antanarivo, Atsomondrano, Farafanga
Antananarivo	Antsirianana i, Brickaville, Fenoarivo Atsinanana, Miaronarivo, Sambava, Tsiroanomandidy
Atsomondrano	Antsirianana i, Ambatondrazaka, Brickaville, Fenoarivo Atsinanana, Fianarantsoa, Mahajanga i
Sambava	Toamasina i, Ambato Boeny, Ambatondrazaka, Fianarantsoa i, Tsiroanomandidy
Antsirabe	Ambatondrazaka, Farafanga, Mahajanga i, Miaronarivo, Sambava
Mahajanga i	Toamasina i, Brickaville, Fenoarivo Atsinanana, Fianarantsoa i, Sambava
Tsiroanomandidy	Brickaville, Mahajanga i, Miaronarivo, Sambava, Toamasina i
Miaronarivo	Mahajanga i, Farafanga, Toamasina i
Farafanga	Brickaville, Fenoarivo Atsinanana, Sambava
Antsiranana	Toamasina i, Fianarantsoa i, Sambava
Toamisina i	Sambava, Brickaville
Brickaville	Ambatondrazaka
Fenoarivo Atsinanana	Antsirabe i
Toliary i	N/A

In conclusion, markets in the surplus-producing zones generally have an important bearing on major markets in the deficit areas, with the exception of the Central Highlands which shows variable integration. Because of that, there might be greater risk of inflation and non-competitive behaviour amongst traders as well as potential availability problems in deficit areas which are also characterised by segmented markets.

3.3. Key trends in production and imports

Madagascar is above all a rice economy[67]. About 70 percent of all cultivated lands are sown in rice. The average rice yield currently stands around 2.8 – 3.0 tons per hectare. Much higher levels (six to nine tons/hectare) are obtained in very few districts where practices that foster sustainable and profitable production, such as the System of Rice Intensification (SRI -Système de Riziculture Intensif, or SRA—Système de Riziculture Amélioré), are well adopted by farmers. But in general, if production increases, it is due more to an increasing the areas of cultivation than to an improvement in yields. Most domestic rice is produced by small farmers for subsistence purposes. The rice that enters the market essentially comes from a few select areas (Lake Alaotra and Marovoay plains in particular) or from commercial imports[68].

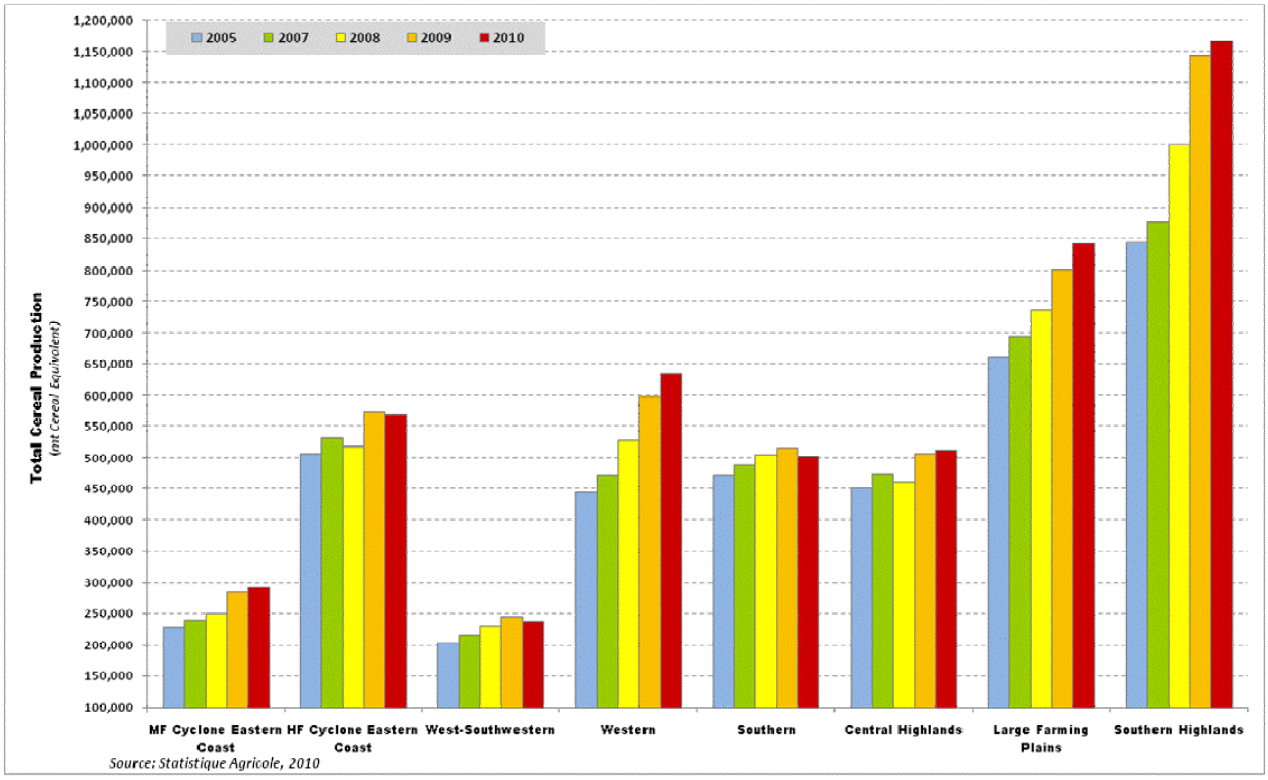
Fig. 18 – Availability of milled rice



Rice imports account for a maximum of 10 percent of the domestic demand[69] though they have always played an important role in covering some intra-regional and lean season deficits[70]. The bulk of rice entering the market during the lean period comes from commercial imports particularly in urban centres[71]. The figure 19 shows the evolution of domestic rice production and the volumes of commercial rice imports in Madagascar from 2005 to 2010.

[67] Agricultural Technology, Productivity,Poverty and Food Security in Madagascar, Bart Minten, 2005
[68] Food Security in Madagascar: A Situation Analysis, Gilles Bergeron, 2002
[69] Note sur le prix du riz à Madagascar, Hélène DAVID-BENZ, Cirad, UMR Moisa, Observatoire du Riz, 2011 ; Diagnostic et perspectives de développement de la filière riz à Madagascar, Ministère de l'Agriculture, 2001
[70] Review of Madagascar's Rice sub-sector, Louis Bockel 2002
[71] La filière riz malgache face à la hausse des prix internationaux: Situation actuelle, perspectives et actions envisageables, Olivier Jenn-Treyer, 2008

Fig. 19 – Trends in national cereal production (rice, cassava, maize, sweet potato expressed in cereal equivalent) from 2005 to 2010, by livelihood zones.



In 2008/09, there was a marked increase in overall agricultural production[72]. Rice production increased by 16 percent over the previous year thanks to a series of incentives, including financial support (subsidized fertilizers and seeds) and technical extension assistance, provided by the Government "Sustainable Green Revolution" initiative in 2008. Maize production increased by 22 percent - though it was done by the same percentage in the drought-prone south due to scant and erratic rainfalls. Meanwhile tropical cyclone IVAN heavily destroyed or flooded/silted cereal fields in the HF Cyclone Eastern Coast and the Central Highlands zones causing a decline in cereal production in 2008.

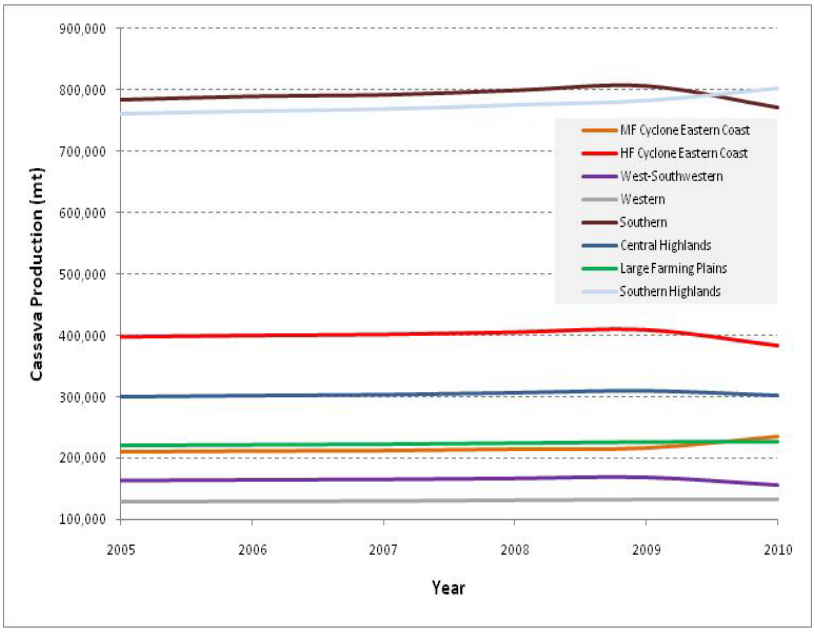
Improved agricultural techniques, initiated by various rural development projects, have boosted production in areas such as the Southern Highlands since 2008[73].

The 2009/2010 agricultural season was reported to be relatively strong. Although the southern regions of the country experienced another year of crop failure due to lack of rainfalls, while the south-eastern districts lost half of their rice harvests following the tropical storm Hubert, the season ended with a surplus of rice of 142,000 mt of CE and a surplus of roots of 74,000 mt of CE[74].

[72] Rapid Joint Crop and Food Security Assessment Mission, FAO/WFP, June 2009
[73] Community data, CFSNVA,2010
[74] Rapid Joint Crop and Food Security Assessment Mission, FAO/WFP/Ministry of Agriculture, June 2010

Cassava, maize and sweet potato demands are high in times of hardship (disasters or lean season), whereas consumption of rice declines considerably. Cassava constitutes a key dietary reserve during the period of declining household stocks and climbing rice prices[75]. Cassava cultivation methods are mostly traditional and farmers rarely use external inputs, except in a few specific areas where farmers have begun to use improved technologies such as manure application, plant spacing and annual fallows. Again, the increase in production of these crops is mainly due to expanding the cultivation area rather than growing productivity.

Fig. 20 – Trends in cassava production



The agricultural related information collected through the CFSVA+N are reported in chapter 5.0. They complement the data on food availability by providing information on households' performance on production. Since the vast majority of the population relies on agriculture, these data are crucial in understanding households' access to food.

[75]Food Security in Madagascar: A Situation Analysis, Gilles Bergeron, 2002

4.0 FOOD ACCESS: HOUSEHOLD ECONOMICAL STATUS[76]

This chapter presents the main income groups identified using household data and describes the seasonality of the main income activities. Furthermore, pockets (i.e. areas and groups) with high levels of poverty are identified using wealth indicators, income and expenditures data.

4.1. Main income activities/groups

As mentioned in chapter 1.0, the primary sector, including agriculture, livestock and fishing, is the foundation of the Malagasy economy, involving more than 80 percent of the active population and contributing to about 26 percent of GDP. The CFSVA+N confirms the importance of it, particularly of agriculture: 60 percent of the surveyed households practise agriculture and/or gardening, 43 percent as their main activity. Informal sector and casual labour are the second and the third income sources in order of importance.

Using the relative contribution to the total income (proportional piling), households were divided into income groups[77]. Out of the ten income groups identified by the analysis, four are particularly significant as they represent 75 percent of the total population. These are: small farmers (20 percent); medium/big farmers (19 percent); informal sector workers (20 percent) and casual labourers (16 percent). While the amount of land cultivated distinguishes the small from the medium/big farmers, informal sector workers differ from the casual labourers for the absence of a formal contract. The paragraphs below give details on the most important groups. From the food security and nutrition perspective, it will be also important to consider the agro-pastorals (7 percent).

Table 7 – Income groups distribution

Income Groups	% HHs	*Short description*
small farmers	20%	*90% from agriculture; < 1 ha cultivated*
informal sector workers	20%	*86% from informal lab.*
medium/big farmers	19%	*89% from agriculture; 1ha or plus cultivated)*
casual labourers	16%	*85% from casual labour*
Agro-pastorals	7%	*71% from livestock*
Public salaried /remittance receivers	5%	*41% from salary 15% from remittances*
Fishermen	3%	*77% from fishing*
Private salaried	3%	*89% from salary*
Agric. labourers	2%	*87% from agric. labour.*
Other activities	*6%*	*63% from other activities; 23% from trading*

The other groups are relatively small in size and will therefore not be further analyzed in this report. These are: public salaried, fishermen, private salaried/remittance receivers, agricultural labourers[78] and a residual group reliant on "other activities"[79].

[76] Chapter developed by WFP Food Security Analysis Unit

[77] Respondents named the three most important income activities in order of importance and estimated the contribution of each of them to the overall household's income. A Principal Component Analysis (PCA) and Cluster Analysis (CA) were conducted on these answers to identify homogeneous clusters (income groups).

[78] Agricultural labourers differ from the casual labourers because they have a more regular/formal contract. The casual labourers are frequently, but not necessarily, employed in agriculture. Yet, their main characteristic is the lack of a stable employment.

[79] The small group of agricultural labourers was kept separated from the casual labourers because the latter are not necessarily employed in agriculture. Data show that households reliant on public salary frequently complement with remittances (this led to the creation of the "public salaried/remittance receivers" group). This group was not combined with the private salaried because of the differences in wealth between the two.

Farmers

Overall, 39 percent of the sampled households have been classified as 'farmers'; on average, farmers get 89-90 percent of their income from agriculture[80], showing that the vast majority of Malagasy households are economically undiversified.

'Small farmers' (cultivating less than 1 ha, which is the average land area cultivated in the country) account for 20 percent of the total sample and 'medium/big farmers' (cultivating 1 ha or more) account for 19 percent. While the percentage of small farmers is high in the West-South Western zone (33 percent), medium/big farmers are more concentrated in the Western and Large Farming Plains zones (28 percent). The Central and Southern Highlands have the lowest percentage of farmers (15 percent and 28 percent respectively). In the Central Highlands, this is due to the significant presence of the informal sector workers (26 percent), private salaried (nine percent) and agricultural labourers (six percent); in the Southern Highlands it depends on the presence of the informal sector workers (28 percent) and agro-pastorals (18 percent).

Fig. 21 – Small farmers by livelihood zone (% HHs)

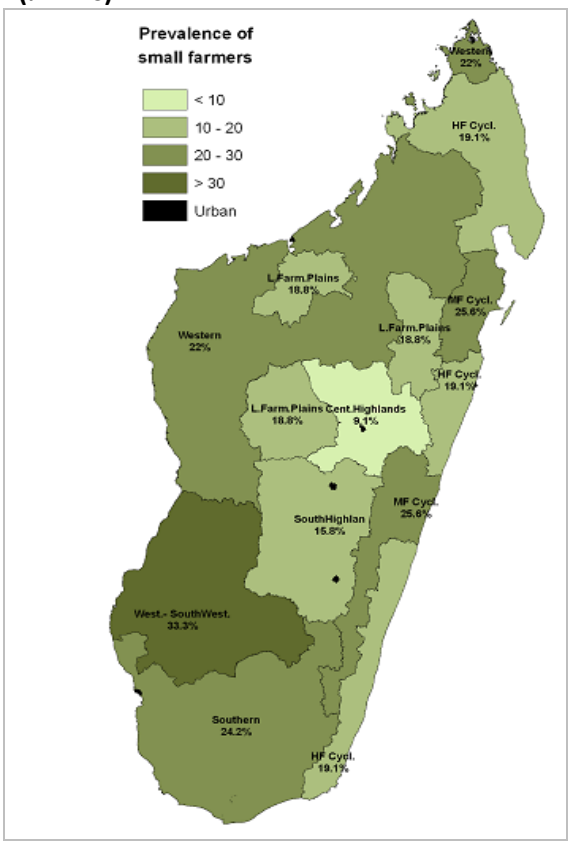
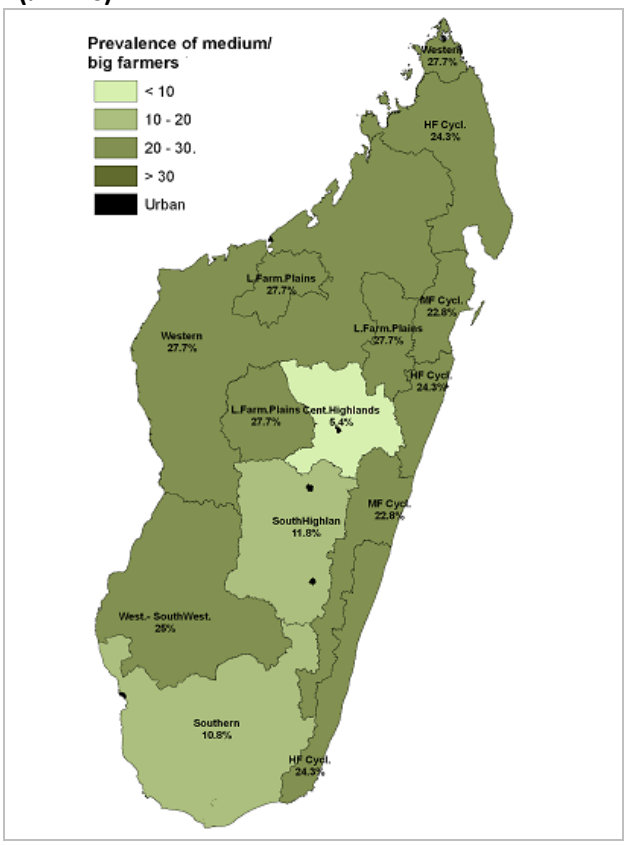


Fig. 22 – Medium/big farmers by livelihood zone (% HHs)



[80] This includes agricultural production, sale of agricultural products and sale of vegetables.

Informal sector workers, casual labourers

Informal sector activities are characterized by the absence of a formal contract with an employee. Such workers include drivers, guardians, artisans, small traders, shop-keepers, etc. Casual labourers are daily labourers who are usually (but not necessarily) employed in the agricultural sector, but different to agricultural labourers because they don't have a stable occupation.

The rise in unemployment caused by the domestic crisis has fuelled an increase in the number of informal sector workers and casual labourers. Such workers are often vulnerable and exposed to economic shocks.

Informal sector workers are more common in the Central and Southern Highlands (26 percent and 28 percent respectively) while casual labourers are more present in the eastern part of the country, with peaks in the Medium Frequency Cyclones Eastern Coast (23 percent) and the Large Farming Plains (22 percent).

Fig. 23 – Informal sector workers, by livelihood zone (% HHs)

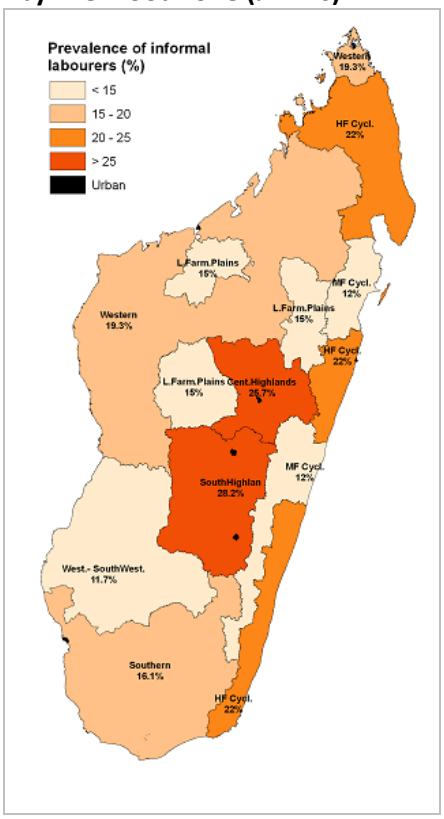


Fig. 24 – Casual labourers, by livelihood zone (% HHs)

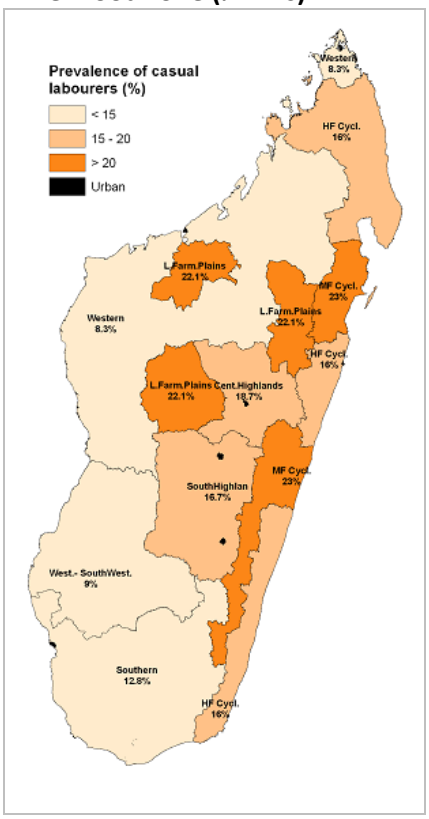
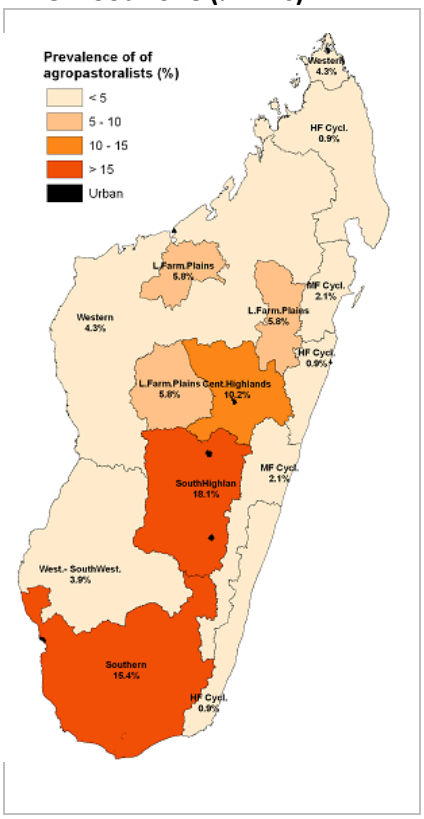


Fig. 25 – Agropastoralists, by livelihood zone (% HHs)



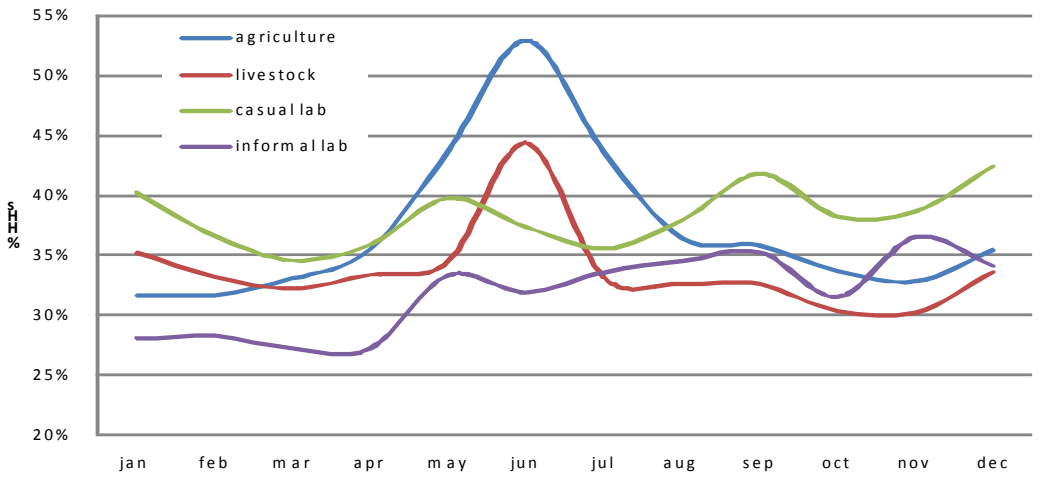
4.2. Seasonality of earning

In order to distinguish low-income months from high-income months, households were asked to identify the months with the higher earning potential from their two main activities.

Particular attention should be devoted to the agricultural seasonal patterns, especially in the zones where agriculture's contribution to total income is high (e.g., West-South Western; MF Cyclone Eastern Coast, Western and Large Farming Plain).

Overall May and June are the months when household income is likely to be higher.

Fig. 26 – Seasonality of earnings: peak of earnings from the main activities (% HHs)



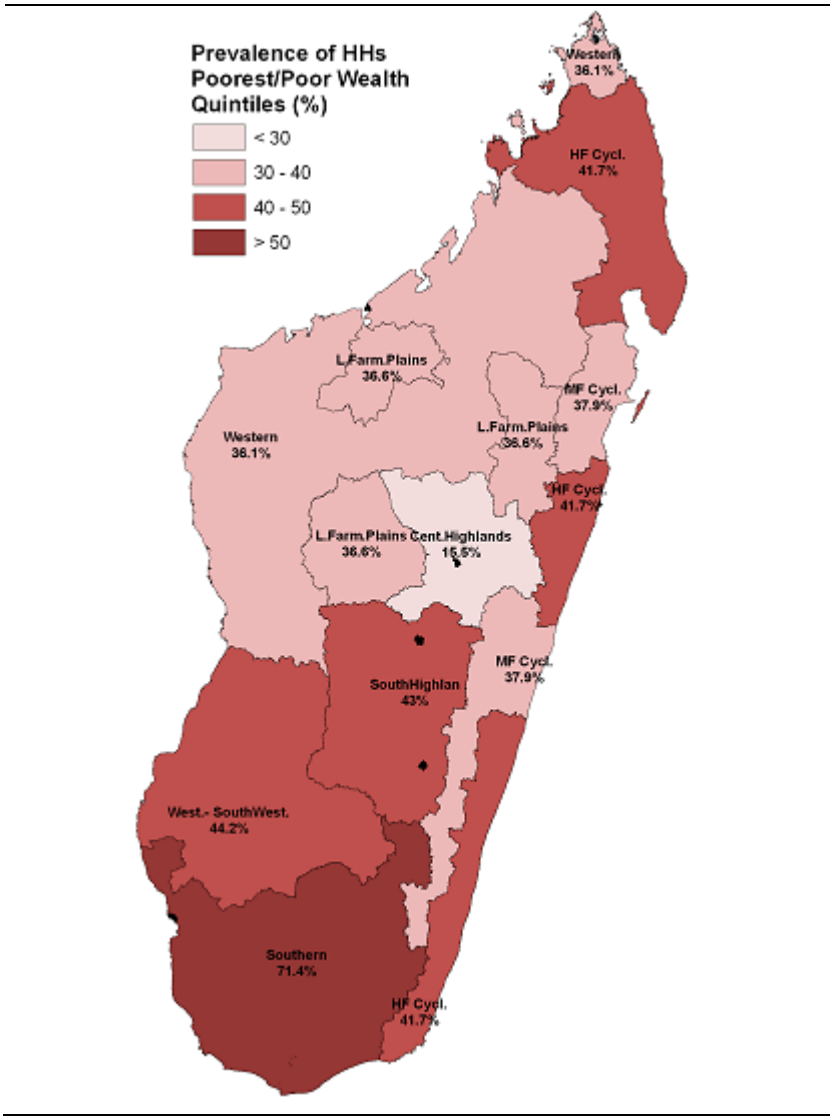
The peak in earnings from agriculture occurs in June when surpluses are sold after the main harvests which mostly take place between April and May in all zones. Agricultural earnings hit a low point between January and February, which is the lean season in many zones. Livestock earnings also peak in June, whereas informal sector and casual labour report an irregular increase that hits a high point in December.

4.3. Wealth

Non-productive assets and some aspects of housing infrastructures give a good idea of a household's prosperity. Combining them into a household wealth index (WI), gives a proxy indicator of wealth. Figure 27 shows the distribution of wealth across the zones; in particular, it focuses on the two poorest quintiles.

Evidently, the Southern livelihood zone reports the highest prevalence of poverty and a remarkable difference with the other zones. Here 71 percent of the households fall in the two poorer quintiles, of which 40 percent in the poorest. This zone is followed by the West-South-Western. Here, 44 percent of the households fall into the two lowest quintiles (that is close to the national average), 27 percent of which are in the poorest quintile.

Fig. 27– Two poorest wealth quintiles by Livelihood Zone (% HHs)

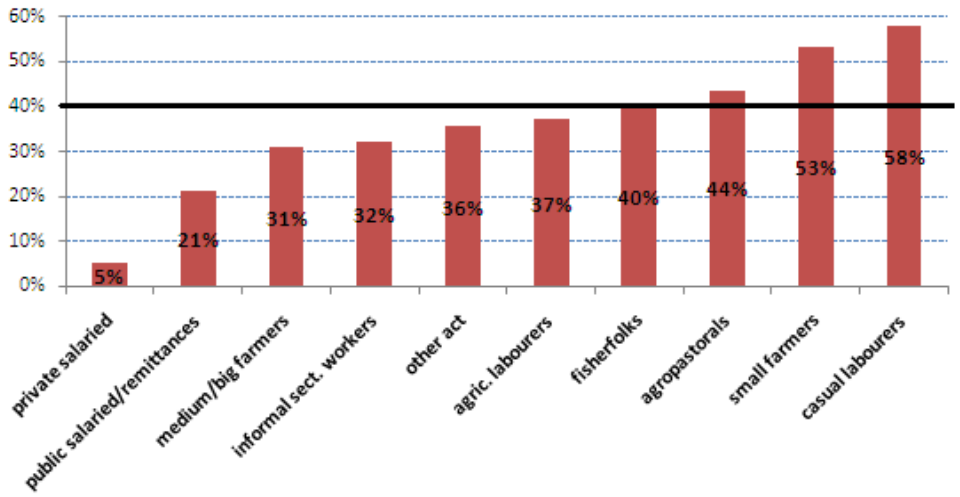


Who is more likely to be poor?

This paragraph considers the association between poverty and key demographic characteristics or income groups. It reports only the significant relationships identified during the analysis, and focuses just on the main income groups described above (farmers, informal and casual labourers, and agro-pastorals).

- Female-headed households and households that experienced a recent death are more likely to fall in the poorest quintiles ($p<0.01$).
- Poorer households have a higher percentage of dependents ($p<0.05$) and higher crowding index ($p<0.01$).
- Casual labourers are by far the poorest income group, followed by the small farmers. Perhaps surprisingly the percentage of poorest/poor among the informal sector workers and medium / big farmers is below the country average (see figure 28).

Fig. 28 – Two poorest wealth quintiles by income groups (% HHs) (black line: country average)



At livelihood zone level casual labourers were the poorest income group in all the zones, except in the Medium Frequency Cyclone Eastern Coast and West-South Western, where the small farmers were the poorest[81].

4.4. Expenditures and income

The survey examined the expenditure patterns of the sampled households and collected the income derived by each income activity.[82] The CFSVA+N is neither an extensive expenditure nor an income survey. However, total income provides an opportunity for relative comparisons of purchasing power among different zones and groups. Expenditures can be considered as a proxy for purchasing power, although livelihood strategies and seasonality can influence the expenses.

Overview

The tables below pull together the two lowest quintiles of the per capita total expenditures, per capita income and wealth index. The Southern livelihood zone shows unquestionable traits of poverty: not only is it the zone with the highest percentage of households in the poorest/poor wealth quintiles (71 percent), but has the lowest per capita income (60 percent of the households in the poorest/poor quintiles) and half of its households are in the two lowest expenditure quintiles. The Medium Frequency Cyclone Eastern Coast also raises concerns, because despite a generally good performance on the asset side, households report low expenditures and low income.

[81] In several zones (ie., Medium and High-Frequency Eastern Coast, the West-South Western and the Southern) agricultural labourers showed the highest level of poverty but the number of households was too small to support such evidence.

[82] Information was collected on household expenditures using a 30-day recall period for food items and non-food items that are frequently bought. A 6-month recall period was used for non-food items that are less frequently purchased (medical/health care, clothing and shoes, seeds and fertilizers, etc.). To ensure comparability, all the expenditures are expressed on monthly basis.

Table 8 – Per capita expenditures, income and wealth by livelihood zones (% HHs in the two lowest quintiles)

Livelihood zones	Total per capita expenditures (lowest/low)	Per capita income (poorest/poor)	Wealth Quintiles (poorest/poor)
Central Highlands	31%	23%	15%
HF Cyclone Eastern Coast	48%	**49%**	42%
Large Farming Plains	25%	30%	37%
MF Cyclone Eastern Coast	**56%**	**47%**	38%
Southern	**50%**	**60%**	**71%**
Southern Highlands	25%	37%	43%
Western	**52%**	36%	36%
West-South Western	8%	27%	44%

Casual labourers also report low income and expenditures, thus confirming a tendency towards poverty. Small farmers also give signs of distress with more than half in the poorest wealth quintiles, the highest (60 percent) on low income and a considerable high percentage of households among the lowest/low per capita expenditures.

Table 9 – Per capita expenditures, income and wealth by income groups (% HHs in the two lowest quintiles)

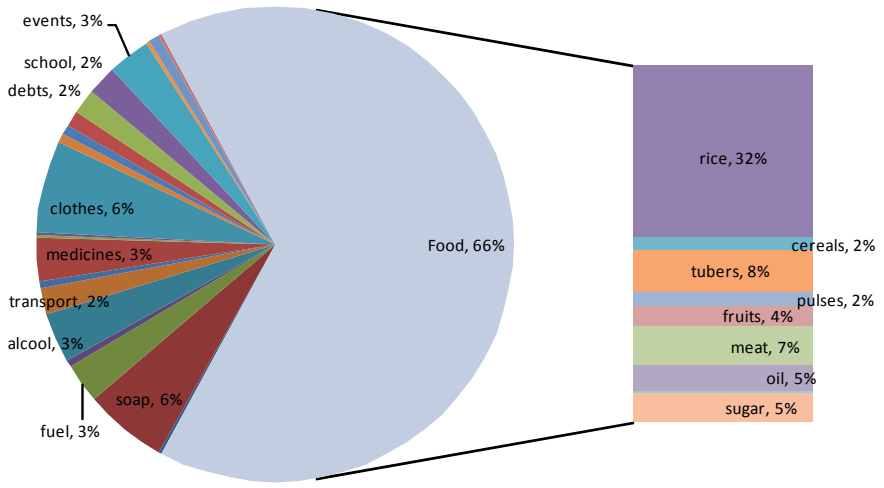
Income groups	Total per capita expenditures (lowest/low)	Per capita income (poorest/poor)	Wealth Quintiles (poorest/poor)
small farmers	**46%**	**60%**	**53%**
medium/big farmers	**48%**	46%	31%
informal labourers	32%	29%	32%
pub. salaried/remittances	28%	14%	21%
casual labourers	**48%**	**49%**	**58%**
agro pastoralists	33%	33%	44%
fisher folks	38%	35%	40%
private salaried	7%	7%	5%
other act	33%	23%	36%
agric. labourers	**53%**	43%	37%

Although households headed by a woman are more likely to fall in the two poorest quintiles, the mean per capita expenditures is approximately the same for the male and female-headed households and no significant difference emerged on the expenditure quintiles. Even though there is no significant difference in the average income, households headed by women are more likely to fall in the poorest quintile compared with the male headed households (24 percent versus 19 percent, $p<0.05$).

Food, non-food and total expenditures

Figure 29 shows that 66 percent of expenditures are devoted to food. The most was spent on rice (32 percent), followed by tubers (eight percent) meat (seven percent), soap and clothes (six percent).

Fig. 29 – Share of food and non food expenditures (% spent on each item)



Market prices, consumption preferences and income activity clearly to a large extent determine the percentage spent on different foods by livelihood zone and income-group. It is useful to analyse this to estimate the impact price increases of specific items would have on the household financial resources and consumption preferences. From this perspective, any increase in the price of rice is expected to have less serious consequences in the Southern and Western zones, on the agro-pastorals, medium/big farmers and agricultural labourers – because they spend proportionally less on this staple.

The table below disaggregates the share of food expenditures on specific food items by livelihood zones and income group.

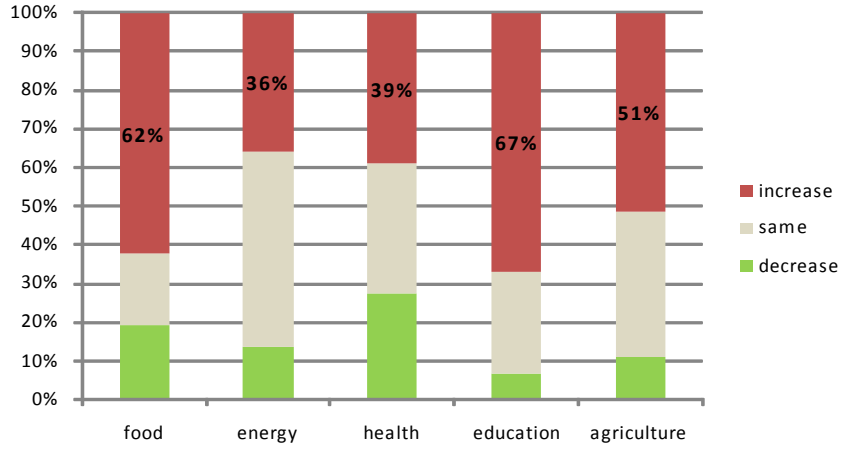
Table 10 – Food expenditures (%) by livelihood zone and income group

	% food expenditure out total exp	Share of expenditure on specific food items								
		rice	cereal	tuber	pulse	fruit	meat	oil	milk	sugar
By Livelihood Zone										
MF Cyclone Eastern Coast	64	36	1	2	3	4	6	7	0	7
HF Cyclone Eastern Coast	67	38	1	5	3	3	5	5	0	6
West-South Western	70	32	3	18	2	4	6	2	0	3
Western	60	25	1	2	3	4	11	8	0	6
Southern	65	14	8	34	1	2	2	1	0	2
Central Highlands	64	31	2	3	3	5	9	5	1	6
Large Farming Plains	67	33	1	4	2	4	11	6	1	5
Southern Highlands	69	35	3	6	2	6	7	4	0	5
By Income Group										
small farmers	67	31	2	11	2	4	6	5	0	6
medium/big farmers	58	26	1	3	3	4	8	6	0	6
informal labourers	67	34	2	7	3	4	7	5	1	4
pub. salaried/remittances	64	28	3	4	2	6	9	5	1	5
casual labourers	74	42	2	9	2	4	4	4	0	6
Agro pastoralists	60	20	4	14	2	4	7	4	0	5
Fisher folks	68	35	2	11	2	3	4	6	0	5
priv salaried	61	28	3	4	2	6	9	4	2	3
other act	68	34	3	6	3	4	8	5	1	5
agric. labourers	68	26	3	15	4	6	6	3	0	5
Madagascar	**66**	**32**	**2**	**8**	**2**	**4**	**7**	**5**	**0**	**5**

Expenditure increase

Asked what they perceived to be the main changes in expenditures households reported the highest increase on education and food (67 percent and 62 percent respectively). This is probably due to Government reducing grants for school fees and related costs, and the delay of allowances.

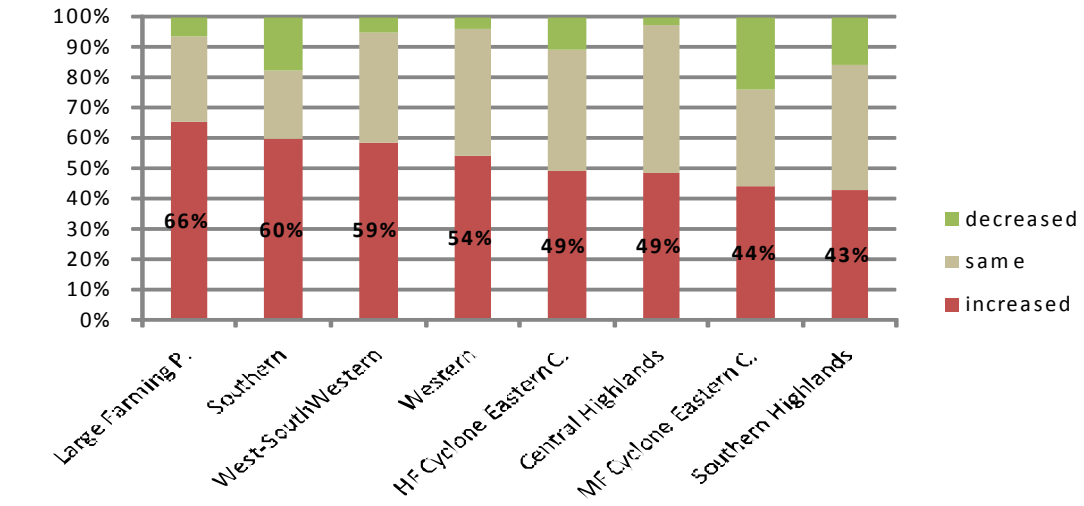
Fig. 30 – Households' perception on change in expenditure (% HHs)



While no major difference has been noticed between the zones on education expenditures, the percentage of households reporting an increase in food expenditure is as high as 90 percent in the West-South-Western. No interesting difference has been noticed between the income groups.

Household perception on agricultural inputs expenditures has been disaggregated by livelihood zone to help identify the zones with the highest increase in the cost of food production. Agricultural inputs' price increase was mentioned more frequently in the Large Farming Plains, the Southern and West-South Western.

Fig. 31 – Perception on change in agricultural expenditure (% HHs)



5.0 FOOD ACCESS: HOUSEHOLD AGRICULTURAL PRODUCTION

Household access to food depends on the ability of the households to acquire food supplies. Since agricultural production is one of the main channels through which Malagasy households obtain food, this chapter looks at natural capital and households' performance on agriculture. In particular, issues such as land adequacy, crop variety, and harvest duration are considered. Particular attention is devoted to household market behaviour (purchase and sales patterns, market dependency) and to identifying surplus / deficit areas.

5.1. Main crops overview

Considering the centrality of agriculture in the Malagasy economy, it is understandable that the vast majority (83 percent) of the households practised agriculture during the 2009-10 season. As described above (see chapter 3.0), rice, cassava and maize are the main crops produced in the country. Not only does the CFSVA+N confirm this scenario, but it also provides a wealth of information on agricultural production to shed light on issues related to households' access to food.

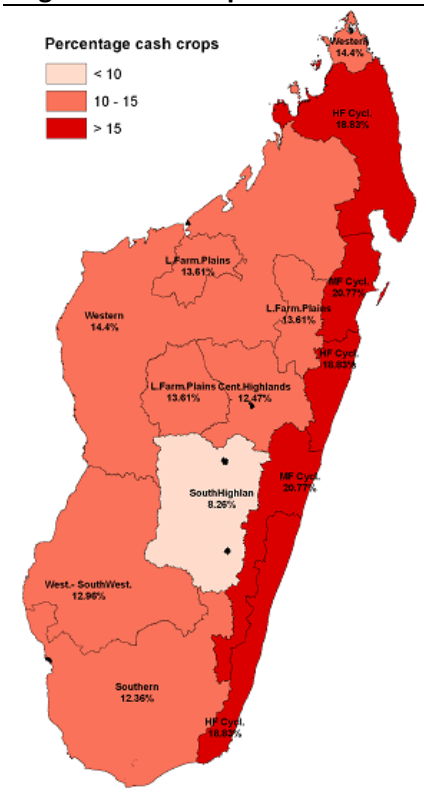
Table 11 – Main crops

Crops	**Cultivated as main crop** (% HHs)	**Cultivated** (% out of the total HHs)	**Cultivated** (% out of the total crops)
Rice 1st season	52%	58%	18%
Rice 2nd season	30%	51%	16%
Cassava	9%	74%	23%
Maize	2%	36%	11%
Sweet potatoes	1%	28%	9%
Haricot	0%	18%	6%
Arachids	0%	11%	3%

Malagasy agriculture is heavily based on rice production: 58 percent of the surveyed households cultivated rice in the 1st season and 51 percent cultivated it in the 2nd season. Cassava is the second main crop, with 74 percent of the households cultivating it in the 2009-10 season (23 percent as main crop). Maize is cultivated by more than a third of the farmers (11 percent as main crop). The Southern zone shows different traits compared with the rest of the country: here cassava prevails over rice and maize production is very important.

Cash crops are particularly important in the Eastern coast due to the high production of vanilla and coffee in the High Frequency Cyclone Eastern Coast (19 percent and 23 percent of the households), and of letches, coffee and sunflowers in the Medium Frequency Cyclone Eastern Coast (20 percent, 16 percent and 22 percent of the households respectively). Cash crop production is particularly rare in Southern Highlands (only 8.3 percent of the total crops).

Fig. 32 – Cash crop distribution



5.2. Land adequacy and crop variety

Land adequacy and crop diversification are crucial for the livelihood of farming households, especially if agriculture is the main source of income: by enhancing crop production households increase access to a variety of food either for self consumption or to sell.

As mentioned in chapter 1.0, while large areas of the country remain unfarmed, parcelling of land prevents extensive farming and economies of scale. This is one of the major structural problems of the Malagasy agriculture, along with poor availability of inputs and skills, and the lack of a proper network system. In view of that, land size, households' perception regarding land adequacy and crop variety are discussed in this section.

In Madagascar's context, these issues are interesting not only because they are directly linked to production, food availability and access, but also because they recall the issues of land access / tenure, expansion of farmlands and destruction of forests – the latter can be avoided only by increasing land productivity or with a controlled plan of expansion.

Overall, half (52 percent) of the farming households cultivate less than one hectare and the average land size is 1.2 ha.

Environmental issues

Settlements, shifting cultivation, overgrazing, charcoal production, human-made bush fires, and uncontrolled expansion of farmland are destroying Madagascar forests. By affecting the hydrological balance, deforestation destroys rice fields, thus leaving the farming populations poorer and more food insecure. In the face of the increased vulnerability and food insecurity, households tend to adopt coping strategies that further contribute to the stripping of vegetative cover and degradation of watersheds[83].

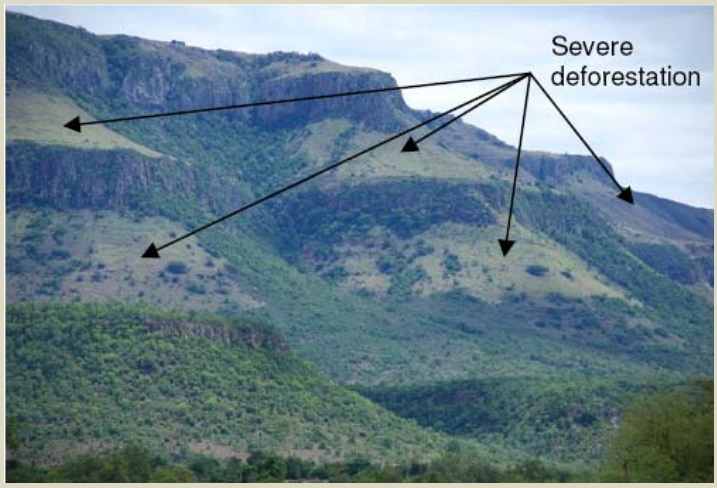
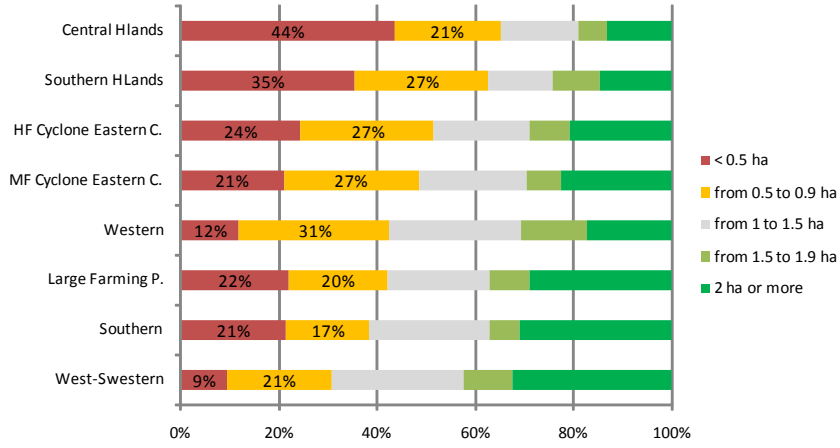


Table 12 – Land size by livelihood zone (% HHs)



In the Southern and the West-South Western zones, large plots of land are more prevalent while the Central Highlands has the highest percentage of households farming less than one ha (65 percent), followed by the Southern Highlands. This is not surprising as the landscape in the Highlands (particularly the central part) does not support extensive agriculture.

[83] Source: "Programme review and formulation support mission", WFP, 2009

In order to find out whether farmers would cultivate more land if it were available to them, households were asked if they had access to sufficient land during the 2009-10 agricultural season. Only 28 percent considered they had sufficient land to cultivate. Farmers in the Central Highlands were particularly unhappy with the amount of land available, though here land insufficiency is not related to land tenure security but rather depends on the narrowness of the valleys, and low-lying lands (between rounded and eroded hills).

Fig. 33 – Landscape in the Central Highlands

Overall, almost half of the farming households cultivate four or five crops, though this relative high variety is due to growing different types of rice. When different rice species are considered as one crop, 41 percent of the households cultivate four of five crops. In both cases, the Western, the South-South Western and the Southern livelihood zones have the lowest crop variety even though land size tends to be larger while the Southern Highlands and Central Highlands have the highest variety. Only nine percent cultivate one crop. The relationship between crop variety and food security will be deeply explored in chapter 7.0.

Table 13 – crop variety by livelihood zone (% HHs)

(different types of rice analysed as different crops)

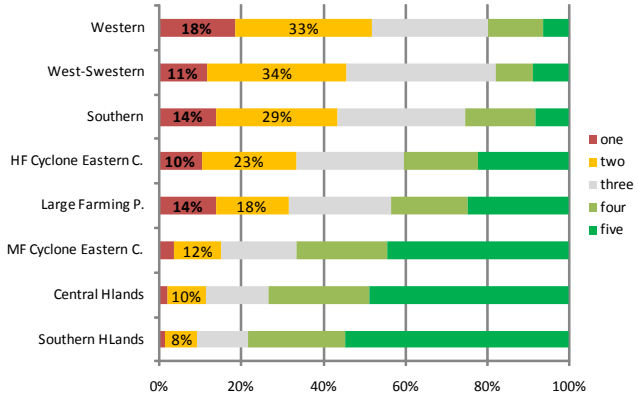
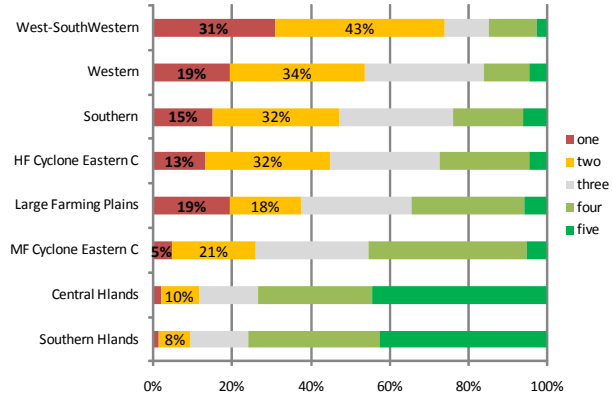


Table 14 – crop variety by livelihood zone (% HHs)

(different types of rice treated as one crop)



5.3. Irrigation

Irrigation schemes supply water to about 40 percent of all cultivated lands[84] but many are poorly maintained so crop yields are low.

This is mainly because farmers are pushing into the hills in a bid to increase stagnating yields in lowland areas. But upper watershed land use is often based on unsustainable management practices leading to upland soil erosion and water surface run-off, causing sedimentation for downstream irrigation infrastructure and contributing to the flooding of crop fields in the rainy season and water shortages in the dry season. Many water users are unable to pay to maintain damaged irrigation schemes.

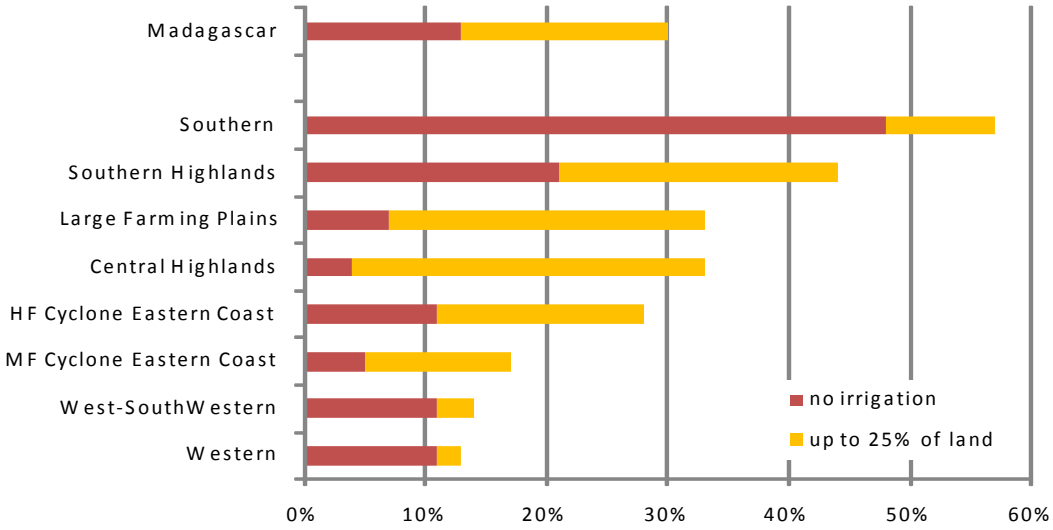
There had been a history of failed irrigation development because of continued upland degradation in the run up to 2006, when the Government adopted a more integrated and holistic approach with the National Program of Watershed Management and Irrigation Improvement. Since 2007, several projects have been funded[85] to lay the foundations for sustainable management of watersheds and irrigated areas.

[84] Irrigation and Watershed Management Project, World Bank, 2008

[85] E.g., World Bank funds for projects in Marovoay, Itasy, Andapa, Lac Alaotra; IFAD funds for projects in Lac Alaotra, Anosy; USAID/Food for Peace funds for projects in the East coast; African Development Bank funds for projects in the Southwest...

According to the survey data, 30 percent have either no irrigation or irrigate less than quarter of their land. Thirty percent irrigate between 25 and 50 percent of the land; 17 percent between 50 and 75 percent and the remaining 21 percent irrigate between 75 and 100 percent of the land.

Table 15 – Percentage that have irrigated less than 25% of land by livelihood zone (% HHs)



While the analysis doesn't reveal a clear relationship between wealth and utilization of an irrigation system, there's a clear link between irrigation and crop type. On average, the share of irrigated land is higher for households that cultivate rice as the main crop (50 percent for the households that cultivate rice during the 1st season as main crop; 52 percent for households that cultivate rice during the 2nd season as main crop). The share is comparatively lower for households that cultivate cassava, maize or sweet potatoes as main crop (15 percent, 20 percent, and 15 percent respectively). Such results are not surprisingly since rice is highly dependent on water.

The poorest irrigation is in the Southern zone where almost half of households report no irrigation, followed by the Southern Highlands. Although the low cultivation of rice is a factor in explaining the lack of irrigation in the Southern zone, poor irrigation is nevertheless alarming because this area is most exposed to droughts (see chapter 1.0 and 8.0).

Household rice cultivation (1st and 2nd season)[86]

First-season rice cultivation is the highest in the West-South Western (26.3 percent of all crops in that livelihood zone), followed by the High Frequency Cyclone Eastern Coast and the Large Farming Plains. And the highest percentage of second-season rice among all crops grown is in the Western (28.1 percent of the total crops in that livelihood zone), followed by the West-South Western and the HF Cyclone Eastern Coast reporting 25 percent and 23 percent respectively.

Households that cultivate rice both in the first and second season were concentrated particularly in the West-South Western (56 percent), Medium and Frequency Cyclone Eastern Coast (48 percent and 39 percent respectively) and Large Farming Plains (36 percent).

[86]First and second seasons occur in different months according to the livelihood zone. For this reason it is not possible to link the terms "first" and "second" seasons with a period of the year.

Fig. 34 – Rice 1st season distribution (% out of total crops within a livelihood zone)[87]

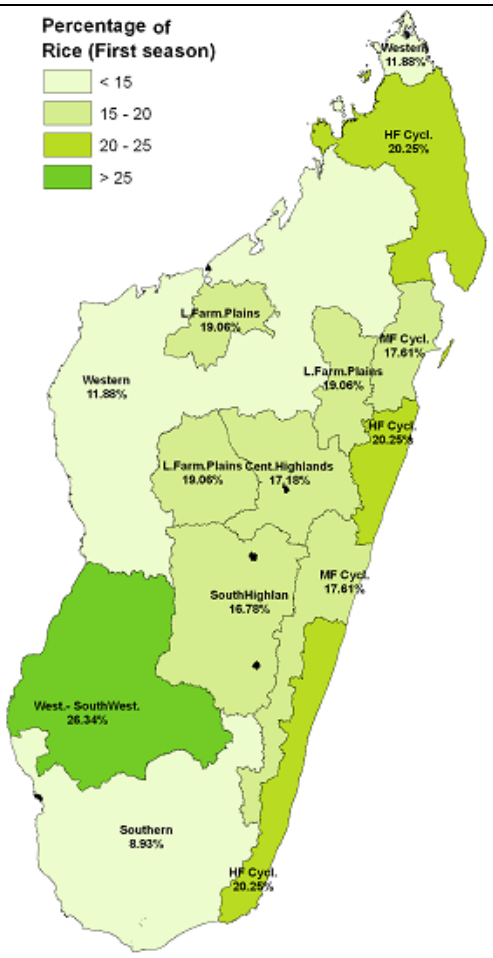
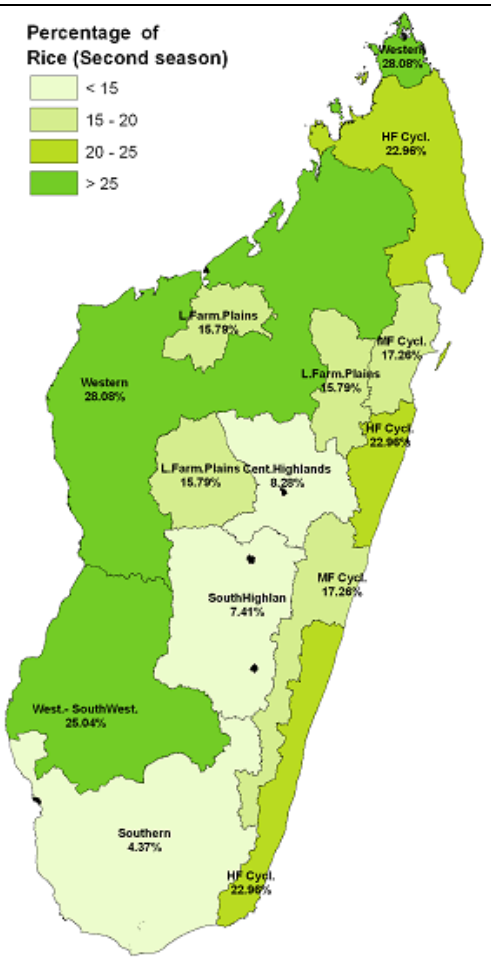


Fig. 35 – Rice 2nd season distribution (% out of total crops within a livelihood zone)



Households' rice production performance has been assessed according to duration of harvest and decrease in production[88]. Key results for the two seasons of rice are described in the chart below and can be summarized as follows:

- Since rice is a very important crop for the High Cyclone Eastern Coast, it is worrying to see that this zone had the highest percentage of households with poor harvest (19 percent) in the first season and the third highest in the second (19 percent).
- When both first and second seasons are considered, households farming rice in Southern zone tend to have a very short harvest period. This is because the zone is drought-prone and because farmers give preference to cassava and maize.
- In the West-South Western, the percentage of households reporting decreased production is far below the average in the first season, but is very high during the second season (77 percent of the households).
- No linear relationship has been identified between the decrease in production and the amount of land cultivated. Yet, households with more land (i.e., 1.5 ha or more) reported a decrease more frequently than the small farmers.

[87] All the maps that report the distribution of different crops throughout the country (ie., rice, cassava and maize), the %age of rice, cassava and maize cultivated is computed taking the total crops as denominator.

[88] Households were asked to report the number of months the harvest would last, and the amount produced in the 2009-10 and in the 2008-09 seasons. The report focuses only on rice, cassava and maize. For each crop, results refer only on the farmers that cultivated that specific crop. Short (or poor) harvest is defined as a harvest that lasts less than 2 months.

- Approximately half of households reported a decrease in rice production (as well as cassava and maize) in 2009/10 compared with the previous season (47 and 50 percent in the 1st and 2nd season respectively). Such a high percentage is explained by the marked increase in overall agricultural production in 2008/09, probably facilitated by the series of incentives (i.e., subsidized fertilizers and seeds) and technical extension assistance provided during the 2008/09 agricultural campaign by the government through funds under the Green Revolution Initiative. Such funds were not sufficiently available during the 2009/2010 campaign after the suspension of development aid packages to Madagascar following the 2009 political upheaval. During the latter campaign, the only accessible funds to support the continuation of the initiative were a small amount left over from the 2008/09 funding, not enough to achieve the same level of performance.

Table 16 – Rice 1st season: poor harvest and decrease in production (% HHs)

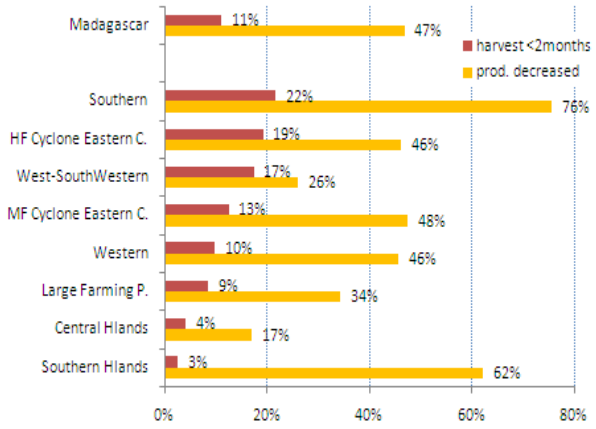
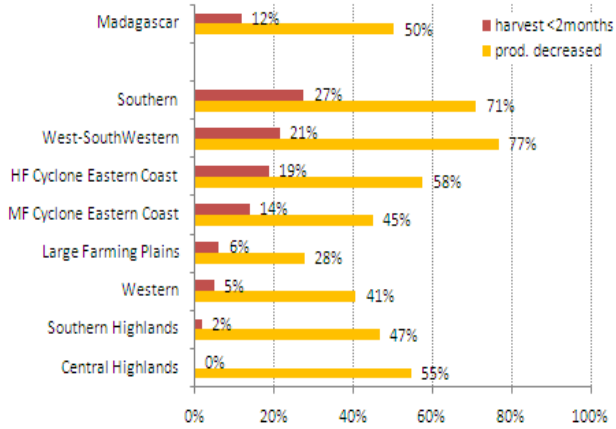


Table 17 – Rice 2nd season: poor harvest and decrease in production (% HHs)



5.4. Household cassava cultivation

Cassava is grown all over the island, but grows best on flat terrain where soils are deep, light and rich in organic matter[89]and average annual temperatures are 23 – 25 degree Celsius[90].

In the Southern zone cassava accounts for about a third of all the crops cultivated and about a quarter in the adjacent West-South Western zone.

In fact cassava is the major crop for 57.7 percent of the households in the Southern and for 12.5 percent of the households in the West-South Western. In both zones cassava performs better than other crops because of the edaphic characteristics of soils and climatic conditions.

In the other zones where the agro-ecological conditions favour the cultivation of other crops, the percentage of households cultivating cassava as the major main crop ranges between one percent and six percent.

[89]Food Security in Madagascar: A Situation Analysis, Gilles Bergeron, 2002
[90] Filières de l'Agriculture, de l'Elevage et de la Pêche, Fiche n°113 : Filière Manioc, Ministère de l'Agriculture, 2004

It is of considerable concern that the households in the two chief cassava producing zones have the highest percentages of households reporting a decrease in production (71 percent in the West-South Western and 61 percent in the Southern) and that the Southern has the highest prevalence of households with a short harvest period (31 percent).

Table 18 – Cassava: poor harvest and decrease in production (% HHs)

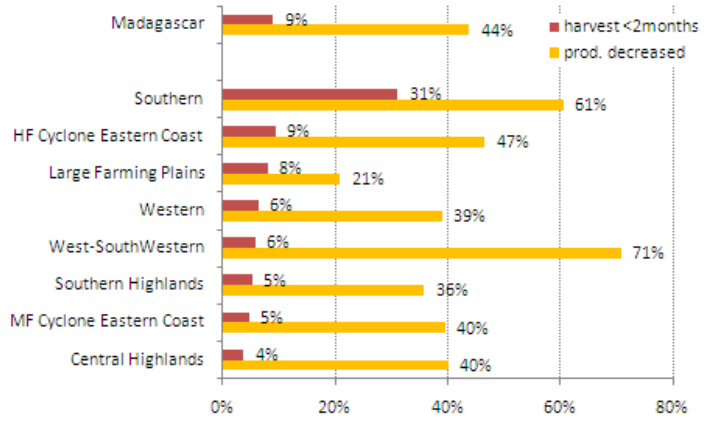
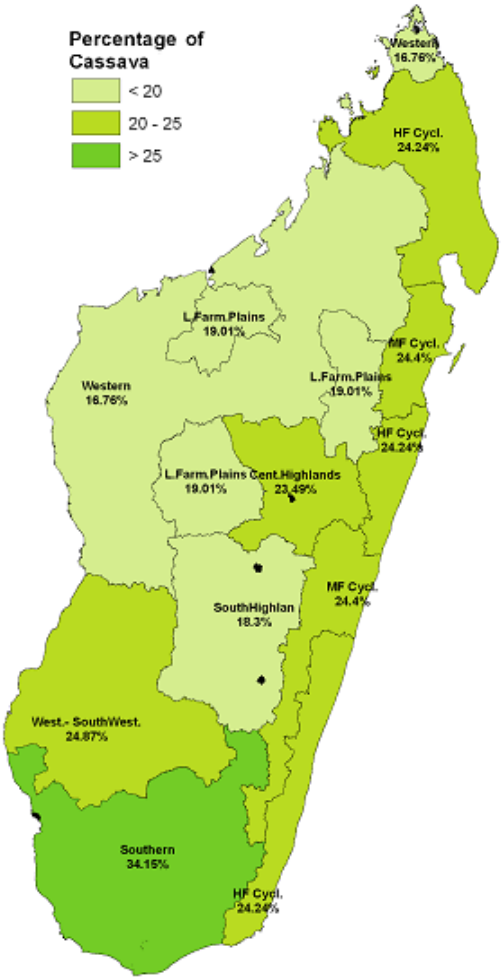


Fig. 36 – Cassava distribution (Percentage out of total crops within a livelihood zone)



5.5 Household maize cultivation

Maize is a warm weather crop, that grows best in light soils, with an optimal moisture regime (such as in recession cropping "baiboho"). A water deficit in the 20 to 30 days before flowering and 10-15 days after flowering causes up to a 50 percent reduction in yield[91]. The critical temperature detrimentally affecting yield is approximately 32 ºC[92].

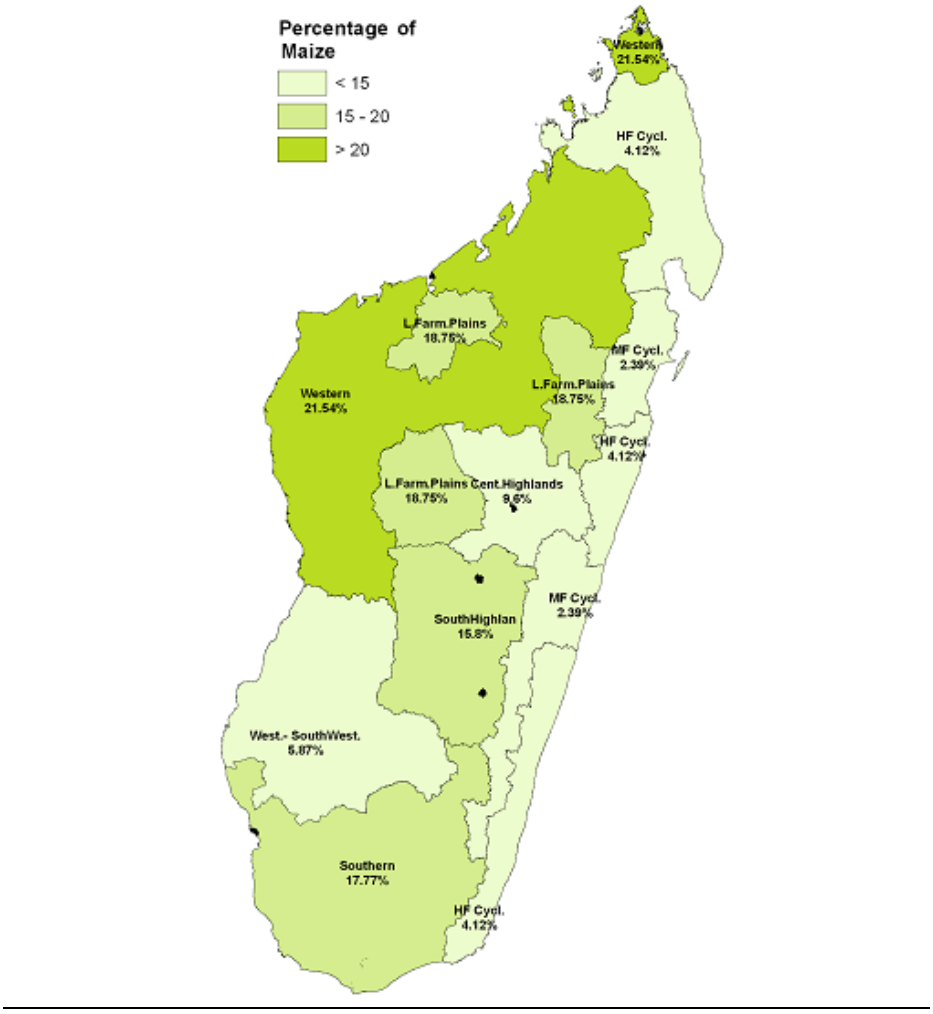
Maize is mostly grown in the Southern, Western and Large Farming Plains. The Western zone has the highest percentage of maize cultivation (21.5 percent) followed by the Large Farming Plains, where the agro-climatic conditions are more suitable for maize production than in the South (average yield of 1.3 mt/ha in the South, 1.9mt/ha in the Western, and 2.2mt/ha in the Large Farming Plains[93]

But it has become the food staple of the population in the Southern (replacing sorghum[94]) since its introduction to the area in the 1980s to satisfy the high demand for export[95] and by development projects

[91] Filières de l'Agriculture, de l'Elevage et de la Pêche, Fiche n°108 : Filière Maïs, Ministère de l'Agriculture, 2004
[92] Maize production, Jéan du Plessis, 2003
[93] Statistique Agricole, 2005 to 2008
[94] L'amélioration du rendement du sorgho dans le sud de Madagascar, Arraudeau, 1971
[95] Instabilité des cours de maïs et incertitude en milieu rural: le cas de la déforestation dans la région de Tuléar (Madagascar), Faroux, 2000

in the decade after the severe drought of 1991-1992.[96] Now it represents 18 percent of total crops and is the major main crop for 12 percent of households (versus a country average of 2 percent). While 41 percent of all households report a decrease in maize production the percentage rises to more than half in the Southern zone (54 percent) mainly due to crop failures caused by low and erratic rainfall over three consecutive years [97]. It is also the zone with the shortest harvest (56 percent of households had a short harvest).

Fig. 37 – Maize distribution (% out of total crops within a livelihood zone)



[96] Projet Objectif Sud, Sécurité alimentaire et développement économique pour le grand sud e Madagascar, Dillot, 2000 and Evaluation globale de la coopération de l'Union Européenne dans les domaines agricoles et du développement rural – Madagascar, 1998.

[97] Rapid Joint Crop and Food Security Assessment Mission, FAO/WFP, 2009 and Rapid Joint Crop and Food Security Assessment Mission, FAO/WFP/Ministry of Agriculture, June 2010.

5.6 Households' dependency on markets

Food consumption sources

Although the primary sector is the mainstay of the Malagasy economy and absorbs about 80 percent of the active population, some 67 percent of the food consumed the week before the survey (Sept 2010) was bought, 27 percent was derived from own production, 2.4 percent from hunting/fishing and two percent from gifts[98].This suggests that own production alone cannot meet the internal food requirements of most households.

Table 19 gives details on the main commodities consumed in Madagascar. It is noteworthy that some 62 percent of households report "purchase" as the main source for rice, the most consumed food and the most produced crop in the country.

Table 19 – Source for the main commodities (% HHs)

Commodities	Main source (% HHs)		
	Own production	Purchase	Other
Rice	37%	62%	1%
vegetables	35%	59%	5%
Sugar	5%	94%	1%
Cassava	51%	47%	2%
Oil	1%	98%	1%

Informal sector workers are most likely to purchase their food while medium/big farmers are least likely; followed by agro pastoralists and small farmers, indicating that land access and agricultural production are associated with less market dependency.

Geographical differences are presented in table 20. The highest dependency on purchase is found in the West- South Western and the minimum in the Western, though it should be noted that the survey was carried out in September which normally coincides with the harvesting of the 1st season of rice in these areas, which heavily influences households' purchasing behaviour.

Table 20– Food from purchase by livelihood zone

Livelihood Zone	% food from Purchase
MF Cyclone Eastern Coast	60.2%
HF Cyclone Eastern Coast	68.4%
West-South Western	81.1%
Western	59.7%
Southern	67.8%
Central Highlands	72.8%
Large Farming Plains	70.1%
Southern Highlands	65.0%
Madagascar	**67.4%**

[98]All the households were asked to report the main source of the food consumed the week before the survey. Therefore these %ages have been computed on the entire sample.

Market behaviour: purchase and sales

Households were asked the number of months they relied on production/purchase, and to name one month characterized by a peak in purchase and sales for the main commodities. Recall period was the 12 months before the survey, allowing for a seasonal analysis of market dependency.

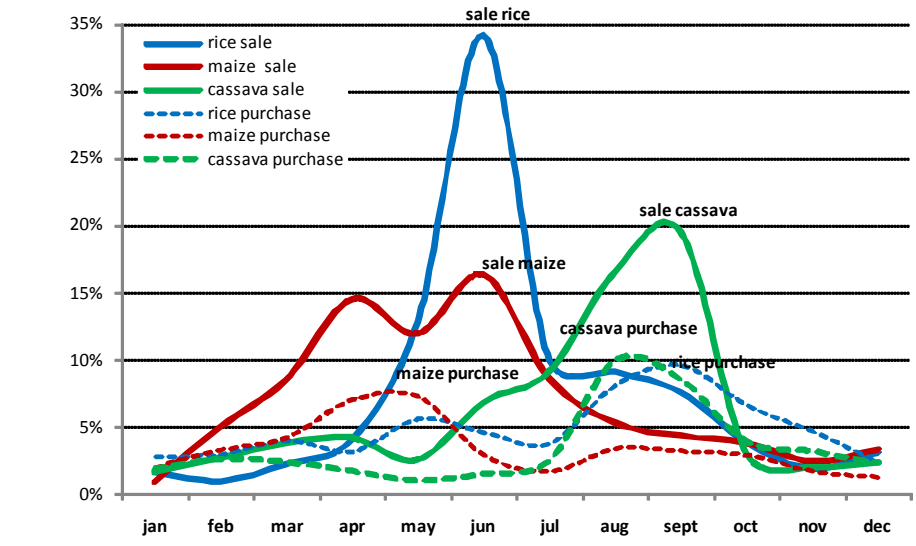
Households in the Southern and the West-South Western zones show a higher dependency on markets for rice and cassava buying them for 10.2 and 8.7 months respectively, suggesting that a significant part of the population does not produce at all or enough[99].

Table 21 – Number of months HHs purchase rice and cassava at the market

	rice procured at the market		cassava procured at the market	
	Average no. months	>6months (%HHS)	Average no. months	>6months (%HHS)
MF Cyclone Eastern Coast	6.3	57%	2.5	18%
HF Cyclone Eastern Coast	7.3	59%	5.3	42%
West-South Western	8.7	70%	8.6	70%
Western	5.9	46%	6.9	60%
Southern	10.2	86%	9.0	80%
Central Highlands	6.7	58%	5.0	42%
Large Farming Plains	6.0	45%	3.7	29%
Southern Highlands	6.3	49%	4.6	37%
Madagascar	6.8	56%	5.6	46%

The chart below identifies the months where purchase and sales are particularly important for households[100]. In general, fluctuations in purchases tend to be flatter, indicating greater stability over the time, while fluctuations in sales are more erratic, suggesting sudden changes and unpredictability.

Fig. 38 – Peaks of sales and purchase for the main commodities (% HHs)



[99] Maize is not analysed due to the low number of reliable data.

[100] All the surveyed households were asked to mention the peak month for purchase of rice, cassava and maize. Only the households producing the commodity under analysis were asked to indicate the peak month for sales.

Rice sales peak in June (35 percent of rice producing households said June was particularly important for sales) throughout the country and are based on the farming calendar. In almost all the zones, the harvest for the 2nd season of rice takes place between the end of March and beginning of May (mostly April). Since time is needed to process and dry the crop, surpluses tend to be sold in June. Farmers mainly sell to acquire other products or non-agricultural inputs. In the Southern and Central Highlands the sales peak starts earlier (in May and spills over to June); in the HF Cyclone Eastern Coast the peak is particularly significant (mentioned by 53 percent of the households).

Purchases reach a maximum in September (reported by 10 percent), but there are some geographical differences: households in the Eastern Coast, the Highlands and the Large Farming Plains prefer buying rice between August and October (pre-harvest 1st season); households in the Southern and West-South Western have a clear preference for May (harvest rice 2nd season). In most of the country the main reason for purchasing rice is 'stock-running out', but in the Southern and West-South Western the main reason is because prices fall (mentioned by 76 percent and 65 percent of the households respectively) at harvest time.

Since most farming households sell rice in June, the lowest rice prices both at the retail and producer level occur then too. It is possible that the massive sales in June are fuelled by poor storage infrastructure, compelling farmers to sell at a low price then and buy at higher prices during the lean season (February/March).

For the five main rice producing zones prices (of paddy) follow the same seasonality patterns with prices peaking around March[101] except in the Southern Highlands where the peak appears between November and January.

The sales/purchase habits, combined with the price data, provide relevant information for identifying the most appropriate period for in-kind/cash programmes. For instance, they clearly suggest that general food distribution interventions are not suitable in June when there is a rice glut.

Fig 39 - Seasonal Index of rice retail price per livelihood zone

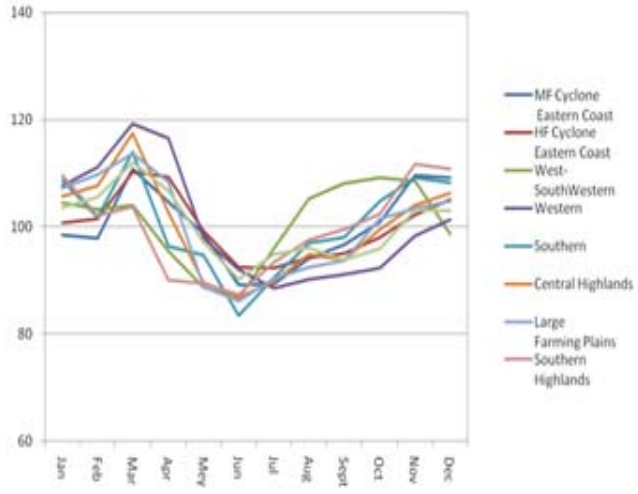
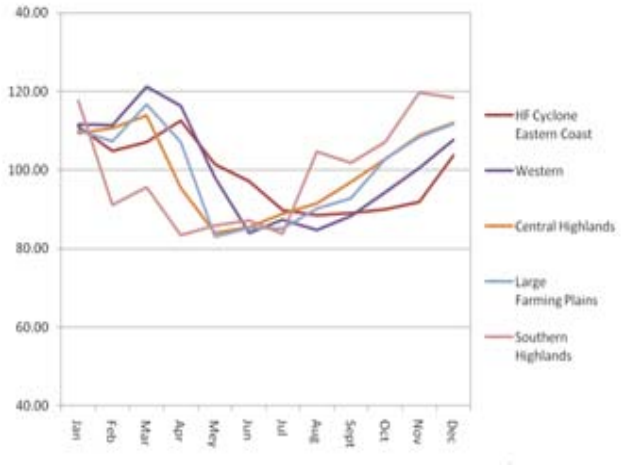


Fig 40– Seasonal Index of paddy price in main producing areas



Overall, cassava is more frequently sold and purchased in August and September. The West-South Western, the Western and the Southern show a strong seasonality on this commodity: here purchase reaches the maximum in August (26 percent, 21 percent and 21 percent respectively) and remains high also in September. Again there's a clear link with the farming calendar: the main cassava producing zones, the

[101] 84% of the rice production comes from these zones.

Southern and the West-South Western zones, harvest in May, June and July (spilling over to August for hill cultivated cassava - tanety) with the sales peak in the post-harvest period[102]. As for rice, most households in the Southern and West-South Western zones buy cassava when the price falls rather than because their stock is running out.

Net consuming / net producing farmers

A net producing (i.e., produce more than they consume – surplus) farmer with a surplus that he can store is likely to be more resilient to strong variations in prices or crop damage, for instance. The monetary value of the surplus increases as the price of the commodity goes up and can be sold when market prices are most favourable.

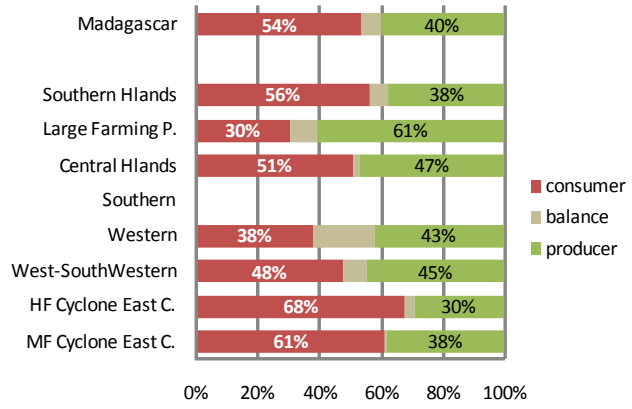
A high prevalence of net consuming (i.e., consume more than they produce – deficit) households in a deficit zone is a sign of concern, as it suggests that many households are dependent on the market and are therefore exposed to price fluctuations.

During the survey, households estimated the amount of rice, maize and cassava they needed last year. Such estimates were compared against the amount of rice, maize and cassava they produced in the agricultural season 2009-10[103].So, each farming household was classified as 'net consumer' or 'net producer'. The charts below provide the results disaggregated by livelihood zone. Overall, the analysis showed that:

- The Large Farming Plains have the highest percentage of rice and maize net producers, suggesting this zone has a good amount of marketable surplus for these two commodities.
- Even though the Southern has the highest concentration of maize production, households consume more than they produce. A similar situation of deficit has been observed in the West-South Western.
- The increase in the amount of land significantly boosts ($p<0.001$) the chances of being a 'net producer'. The link is stronger with rice and maize ($r=0.25$) than cassava ($r=0.18$).

Detailed description on the net consumer / producer status for the three crops is reported below:

Fig. 41 – rice net consumers / net-producers by livelihood zone (%HHs)

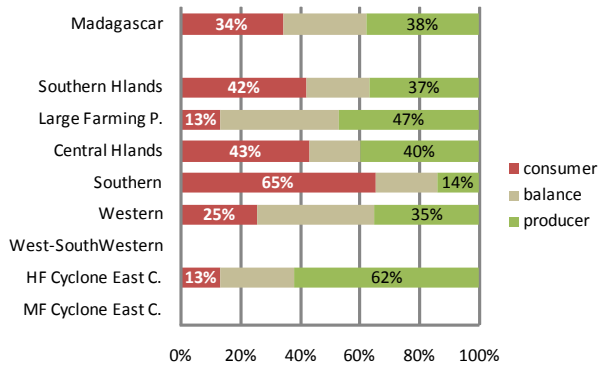


Overall, half (54 percent) of the households cultivating rice are 'net consumers' (deficit); 40 percent are 'net producers' (surplus). The highest presence of net consumers is found in the Eastern Coast (68 percent in the High Frequency Eastern Coast and 61 percent in the Medium Frequency). Large Farming Plains is unquestionably the zone with the highest percentage of rice net producers (61 percent).

[102] Livelihood zone disaggregated data are not reported on cassava sales preferences due to the low number of cases.

[103] Analysis was done on only on the farming households. In particular, for each commodity, only the households that reported the amount produced in 2009-10 were considered.

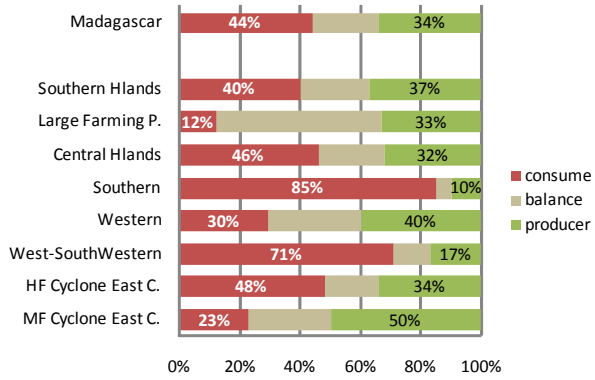
Fig. 42 – maize net consumers / net-producers by livelihood zone (%HHs)



Overall, a third of households cultivating maize are net consumers and 38 percent net producers. The highest percentage of net consumers (68 percent) and the lowest of net producers (14 percent) are in the Southern zone, which is alarming since the zone has the highest concentration of maize producers.

The situation in the other two zones where maize production is important (The Western and the Large Farming Plains) is much better with 25 percent net consumers in the former and only 13 percent in the latter. Considering these results and the positive cereal equivalent balance, this zone has the greatest potential in terms of surplus.

Fig. 43 – Cassava net consumers / net-producers by livelihood zone (%HHs)



The main two cassava producing zones (Southern and the West-South Western) also show the highest percentages of net consumers (85 percent and 71 percent) and the lowest percentage of net-producers.

It is worth pointing out that surpluses protect households from external shocks such as price rises and crop failures – but only when there are proper storage facilities and good road networks. By ensuring the preservation of harvest, storage allows producers to sell when prices are most favourable or at a time convenient to them. By connecting producers to markets, roads allow them to turn surpluses into cash. Both surplus and deficit zones would benefit from structural interventions (creation / improvement of storage facilities, road maintenance, etc.). Of course, such interventions should only be implemented after careful consideration of what has been implemented so far and what outcomes have been achieved.

Gender disparities on agricultural production

A gender disaggregated analysis was conducted on farming households (ie., small farmers or medium/big farmers) to identify disparities between male and female-headed households. Significant differences are reported below ($p<0.05$).

Female-headed farming households are less likely to own the land they cultivate and more likely to rent it. Gender disparities go beyond land ownership to the amount of land cultivated, crop variety, duration of stock from the main crop (see table below).

	male headed	female headed
duration of stock from main crop (no.	5.8	5.2
land cultivated (ha)	159.2	112.4
Average number of crops	3.4	2.8
total cereals production (kg)	1,176	693
% rice net producer households	49.1%	40.3%
% maize net producer households	43.2%	45.9%
% cassava net producer households	37.2%	34.7%

In terms of surplus, female-headed households are evidently less likely to be rice net-producers (40 percent versus 49 percent, $p<0.05$) and less likely to be cassava net-producers (35 percent versus 37 percent, $p<0.05$). The situation is inverted in the case of maize, where female-headed households have a slightly higher percentage of net producers.

6.0 FOOD CONSUMPTION[104]

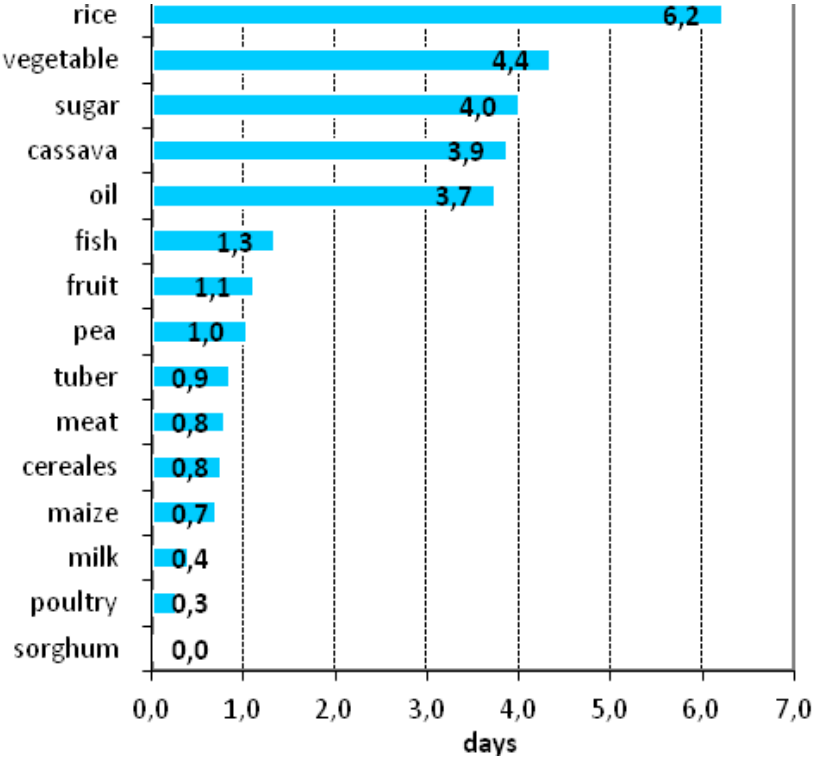
This chapter describes the typical diet at the time of the survey (dietary diversity); presents the Food Consumption Groups (FCGs) and their distribution across the country; and shows seasonality of food shortages.

6.1. Typical diet

The Malagasy diet is based mainly on rice (average weekly consumption is 6.2), vegetables (4.4 times a week) and tubers (mainly cassava, 3.9). Vegetable and animal proteins are rarely consumed (once and 2.3 times respectively). Fish is the most popular animal protein, with an average weekly consumption of 1.3 days.

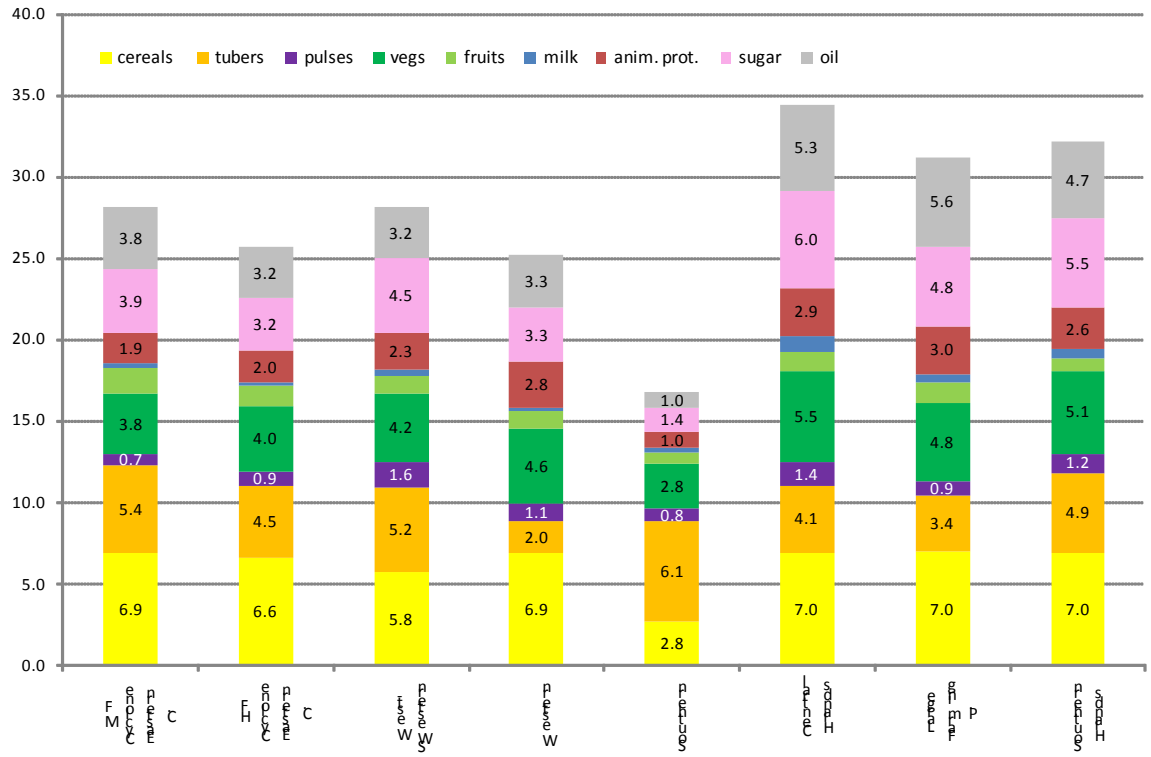
The Southern zone appears to have the poorest diet. Here households eat cassava almost every day (6.1), followed by cereals, and vegetables (2.8). The high cassava consumption is easily explained by the comparative high cassava production and the low rice production in this zone. Given it is the poorest zone of the country, it is unsurprising that households tend to rely on cheaper commodities

Fig. 44 – Average number of days food items are consumed in a week



[104] Chapter developed by WFP Food Security Analysis Unit

Fig. 45 – Average number of days food items are consumed a week by livelihood zone [105]



Pulses, an important source of vegetable protein, are rarely consumed throughout the entire country because production is so low. The link between production and consumption is also clear for tubers. Zones with a relative higher cultivation of tubers (Southern, Southern Highlands, West-South Western and the Eastern Coast zones) also have above national average tuber consumption.

Food consumption groups: how many? Where?

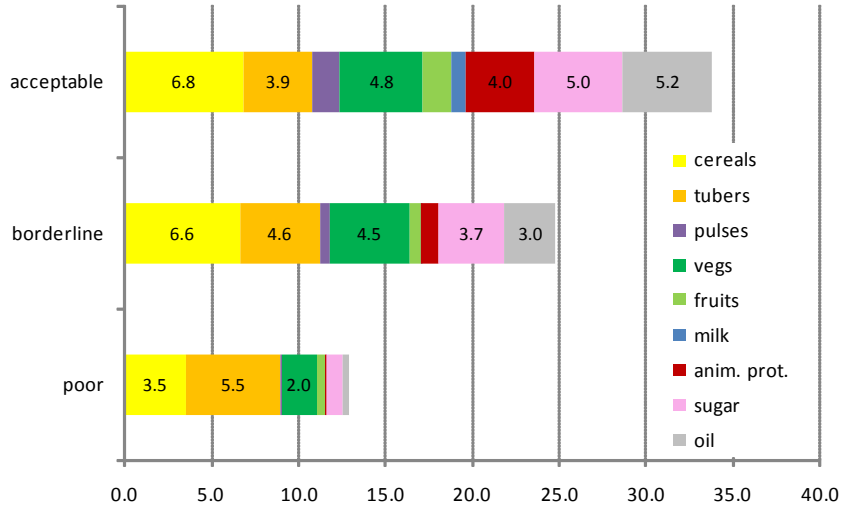
A Food Consumption Score (FCS) was computed to divide households into poor, borderline or acceptable consumption groups by analysing the diversity, frequency and nutritional value of their food (details on the FCS methodology are in Annex II)

Using this methodology, 11.8 percent of households exhibit poor food consumption, 41.1 percent borderline and 47.1 percent acceptable.

- Poor food consumption households mainly eat tubers (cassava, 5.5 days a week), cereals (3.5 days a week) and vegetables (2 days a week). Proteins are essentially absent from their diet.
- Borderline consumption households show a clear switch from cassava to cereals and an increase in consumption of all other food items (in particular, vegetables, sugar and oil). Animal proteins are also introduced into the diet.
- Acceptable consumption households have a more varied and plentiful diet, characterized by a significant presence of cereals, tubers, vegetables, animal proteins, sugar and oil.

[105] Tubers and cereals are here disaggregated to provide a better description of the diet. Yet, in the FCS computation, they are part of the same group (see Annex II for details).

Fig. 46 – Average number of days a week food items are consumed by consumption group



The results confirm that the Southern is the zone with the poorest consumption both in terms of percentages and absolute numbers, followed by the Eastern Coast. In particular, the following can be noticed:

- More than half of households in the Southern zone have poor food consumption and only 22 percent acceptable consumption. The number of households with poor consumption is estimated to be 205,252, the highest in the country.
- The West-South Western zone has the second highest prevalence of poor consumption (19 percent), but the absolute number of poor consumption households is much lower (31,132) due to the lower population density.
- The High Frequency Cyclone Eastern Coast follows with 11.6 percent having poor consumption which equates to very high numbers (95,035 households), and a concerning 53.7 percent or 438,677 people have borderline consumption.

Fig. 47 – Poor Consumption distribution (% HHs)

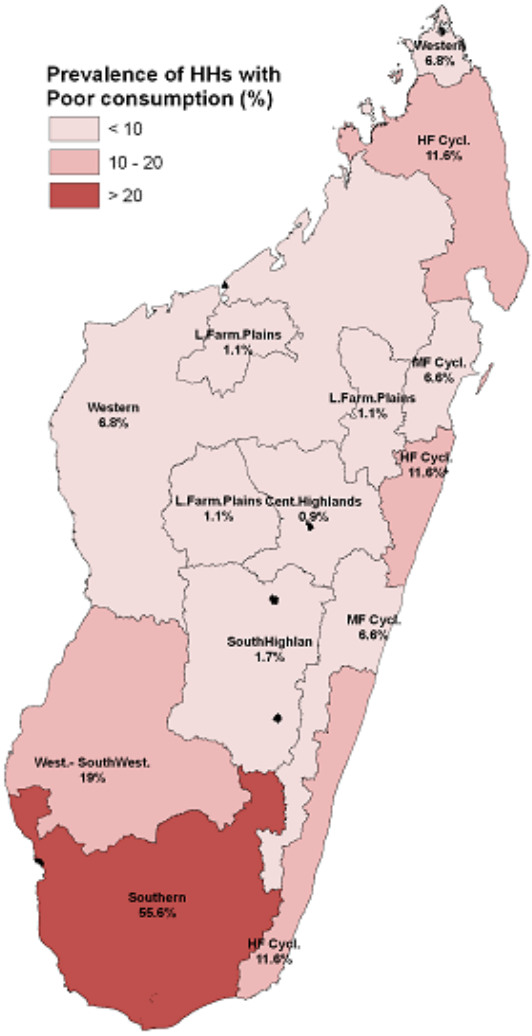


Table 22 - Food consumption groups (number of HHs and percentage)

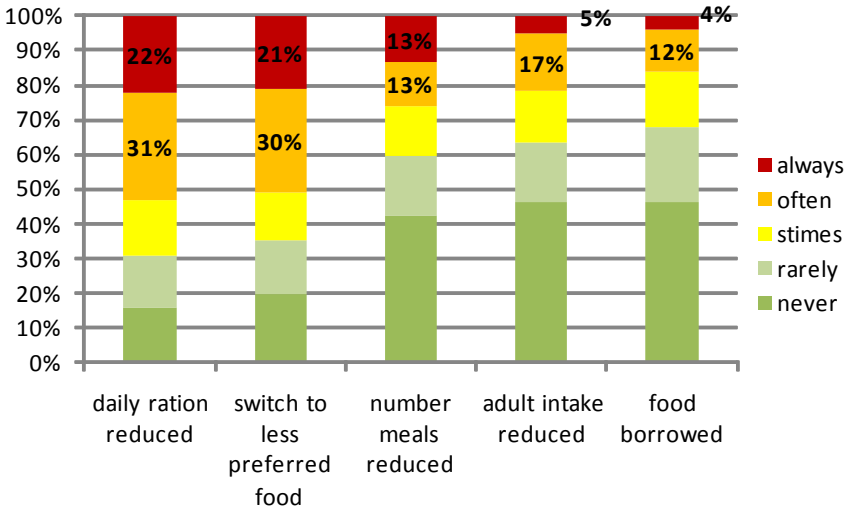
	poor		borderline		acceptable	
Southern	205,252	*55.5%*	83,060	*22.5%*	81,315	*22.0%*
HF Cyclone Eastern Coast	95,035	*11.6%*	438,677	*53.7%*	283,797	*34.7%*
West-SouthWestern	31,132	*19.4%*	48,116	*30.0%*	81,360	*50.7%*
Western	30,731	*6.9%*	181,371	*40.5%*	235,472	*52.6%*
MF Cyclone Eastern Coast	23,323	*6.5%*	208,835	*58.0%*	127,864	*35.5%*
Southern Highlands	8,049	*1.8%*	192,360	*42.2%*	255,064	*56.0%*
Central Highlands	4,299	*0.9%*	119,199	*25.6%*	342,977	*73.5%*
Large Farming Plains	3,341	*1.1%*	116,038	*39.4%*	175,254	*59.5%*
Madagascar	401,161	*11.9%*	1,387,656	*41.2%*	1,583,104	*46.9%*

6.2. Lack of cash or food

Coping

The study examined how frequently households were forced to cut their daily ration or number of meals or switch towards less preferred food, or reduce adult food intake. Answers on the single coping strategies were analysed separately and used to compute a reduced coping strategy index (CSI) (details on the methodology in Annex II).

Fig. 48 – Frequencies of exploitation of coping strategies (% HHs)



Just over half of all households 'always or often' reduce their daily rations and switch to less preferred food to cope with shortages.

These strategies may not be considered as particularly severe, but they clearly impact on the quality of the diet since less preferred food is likely to be of lower nutritional value) and on the calorie intake of the households (portions are reduced).

Table 23 – CSI and coping strategies by livelihood zone and income groups

Livelihood Zone/Groups	Reduced CSI	% of households who applied the strategies often or always				
		daily ration reduced	number of daily meals reduced	food borrowed	switch to less preferred food	adults reduce food intake
Livelihood Zones						
Southern	**24.0**	**72%**	**67%**	**30%**	**70%**	**38%**
HF Cyclone Eastern Coast	16.9	56%	24%	21%	49%	28%
West-SouthWestern	16.3	50%	38%	18%	51%	19%
Western	15.6	56%	45%	15%	61%	14%
Southern Highlands	12.6	46%	21%	15%	39%	22%
Central Highlands	12.4	65%	2%	7%	67%	21%
MF Cyclone Eastern Coast	11.7	42%	18%	17%	39%	13%
Large Farming Plains	6.7	22%	6%	5%	19%	7%
Income Groups						
small farmers	16.5	56%	34%	20%	47%	25%
medium/big farmers	13.2	51%	22%	13%	47%	17%
informal labourers	13.9	51%	26%	13%	50%	22%
pub. salaried/remittances	10.8	33%	18%	18%	35%	10%
casual labourers	16.3	58%	30%	22%	54%	20%
agropastorals	15.4	52%	26%	12%	63%	28%
fisherfolks	13.8	46%	26%	15%	39%	22%
private salaried	14.7	53%	16%	16%	59%	33%
other act	14.8	56%	23%	17%	65%	21%
agric. labourers	18.1	74%	19%	20%	76%	30%
Madagascar	**14.8**	**53%**	**26%**	**16%**	**51%**	**22%**

Again the findings confirm that the Southern zone has the greatest problems in accessing food: here the reduced CSI is as high as 24 (which correspond to a medium score on the CSI scale) and all five coping strategies reach the highest values[106]. It is followed by the High Frequency Cyclone Eastern Coast (16.9) and the West-South Western (16.3), which have been already identified as zones with high poor consumption. As far as income groups are concerned small farmers, agricultural labourers and casual labourers have the highest reduced CSI.

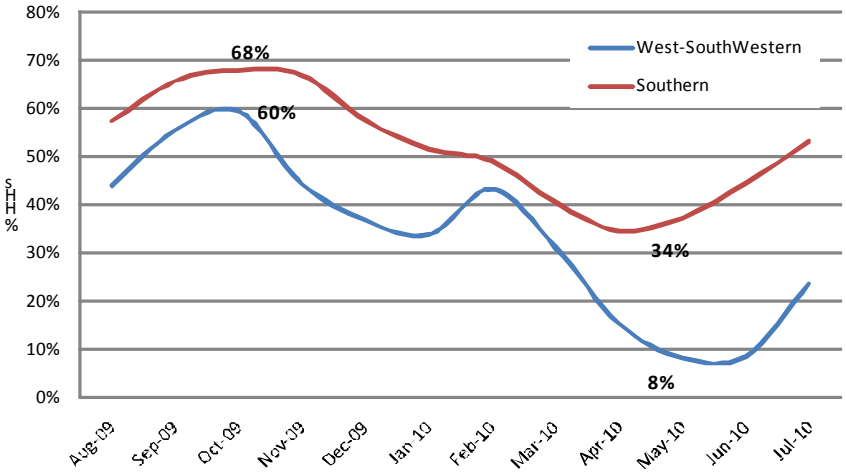
Seasonal patterns

Overall, 84 percent of households experience a time during the year when they don't have enough cash or food. Predictably, the Southern showed the highest prevalence of households (92 percent) reporting this problem, followed by the West-South Western (89 percent). February and October emerge as the most difficult months, with around a third facing a lack of cash/food in those months.

When monthly data was disaggregated at livelihood zone level it could be seen that varying lean seasons coincided with the peak of lacking cash/food while post harvests tallied with comparative times of plenty.

[106] The average value in Madagascar is 14.8, but the reduced CSIvaries between 0 and 56. Therefore in the Southern a medium level of coping is observed.

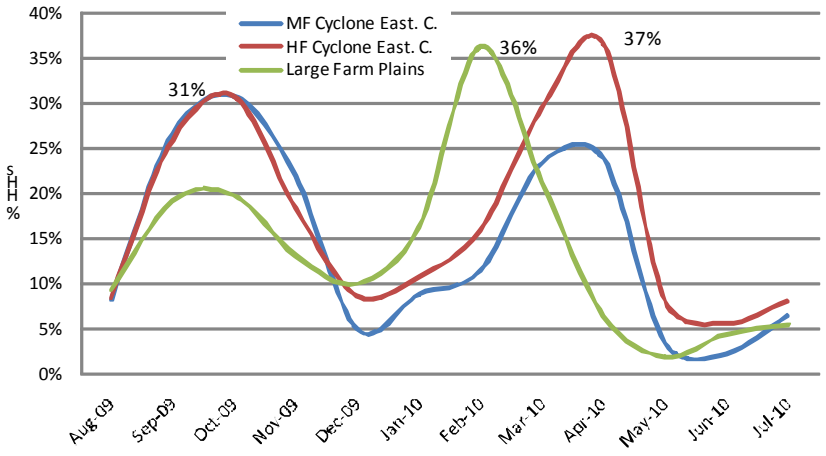
Fig. 49 – lack of food / cash: seasonality in the Southern zones (% HHs)



The Southern and West-South Western zones are characterized by a peak in the prevalence of lacking cash/food in September, followed by a slow decline. The situation is at its best between April and May.

The Southern zone shows greater signs of vulnerability compared with the rest of the country. The prevalence of households with lack of cash/food is consistently higher than the West-South Western throughout the year.

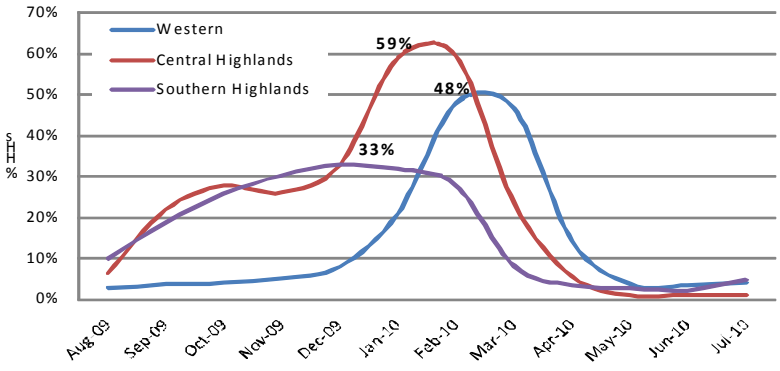
Fig. 50 – Lack of food / cash: seasonality in the Eastern Coast and Large Farming Plains (% HHs)



The two zones in the Eastern Coast and the Large Farming Plains are characterized by two peaks. The first, in October, is particularly serious for the Medium Frequency Cyclone Eastern Coast. The second occurs between February and April. December and May/June are relatively less painful periods for these areas.

Fig. 51 – Lack of food / cash: seasonality in the Highlands and the Western Zones (% HHs)

The Western and the Highlands have a unique peak, between December and February, although the severity of such a peak is evidently different from one zone to another.



The summary table below shows the link between poor consumption and the problematic/favourable months. While there is no equation to predict food consumption at these periods, it is possible to relate these data qualitatively to contextualize the findings and build scenarios (assuming that 2010 was very similar to a "normal year").

The table highlights the more challenging (red cells) and less problematic (green cells) months per livelihood zone. It suggests that:

- The 56 percent and 19 percent of poor food consumption in the Southern and West-South Western that are observed at the time of the survey occurred in a month characterized by a peak of problems in accessing food, so consumption is expected to be better in the rest of the year. Similar conclusions can be drawn for the Medium Frequency Eastern Coast (1st peak in October) and the High Frequency Eastern Coast (2nd peak in October).
- On the other hand, the situation found at the time of the survey would likely deteriorate in the Large Farming Plains in February, the Western in February-March, the Central Highlands in January-February and – to a certain extent – in the Southern Highlands in December-January.

Table 24 – Problems with food: summary table (*)

Livelihood Zone	months											
	Oct '10	Nov '10	Dec '10	Jan '10	Feb '10	Mar '10	Apr '10	May' 10	Jun '10	Jul '10	Aug '10	Sept '10
Southern												
West-SouthWestern												
HF Cyclone Eastern Coast												
MF Cyclone Eastern Coast												
Western												
Southern Highlands												
Large Farming Plains												
Central Highlands												
Madagascar												

(*) red cells = peak of problems; green cells = favourable months.

7.0 FOOD INSECURITY[107]

A food insecurity classification was identified by combining four food access indicators: wealth index, food consumption score, coping strategy index and per capita monthly expenditures (methodological details are in Annex II). This chapter presents the findings of the analysis. In particular, it reports the prevalence of food insecure in Madagascar and their geographical distribution. It describes the profile of the food insecure and highlights the main driving forces of poor consumption.

The food security classification goes a step beyond the actual consumption. In fact, it introduces elements of sustainability by combining consumption with income, expenditures and coping strategies.

7.1. Food insecure: How many? Where?

The analysis divided the sample into three homogeneous clusters:

- Food insecure, 35.2 percent of the total sample
- Vulnerable, 47.9 percent
- Food secure, 16.9 percent

The table below describes the characteristics of the three groups based on the four indicators that are the foundation of the classification.

Table 25 – food insecure, vulnerable and food secure: description

	Total per capita exp (*)	% HHs in the poorest expenditure quintile	Mean FCS	% poor consumption HHs	reduced CSI	% HHs in the poorest wealth quintile
food insecure	11,298	30%	28.5	25%	27.1	35%
Vulnerable	13,998	19%	36.3	6%	7.5	15%
food secure	42,226	1%	57.3	1%	9.5	1%

(*) Expenditures are reported in Ariary. In September 2010, 1USD corresponded approx. to 2,000 Ariary

The three groups are clearly defined:

- **The food insecure households** have the lowest monthly per capita expenditures (11,298 Ariary, US$ 5.6) and the highest percentage of households in the poorest wealth quintile (35 percent). This is a clear indication of poverty and low purchasing power. In terms of consumption, they have the lowest FCS (mean value is 28.5 and 25 percent have a poor consumption) and very frequently employ stressful coping mechanisms to access food (Reduced CSI = 27.1).
- **The vulnerable to food insecurity** show only a mild increase in the expenditures compared with the food insecure (13,998 Ariary, US$ 6.9), but a notable increase in the amount of assets owned (only 15 percent in the poorest wealth quintile). This suggests an improved economical status compared with the food insecure. In addition, they eat much better (mean FCS is 36.3 and only six percent have a poor consumption) and have a low tendency to engage in stressful coping mechanisms (CSI equal to 7.5).
- **The food secure** have an unquestionably higher purchasing power with a total per capita monthly expenditure averaging 42,226 Ariary (US$ 21.1) and only one percent is in the poorest wealth quintile. The percentage of households with poor consumption is minimum (one percent) and the tendency towards coping mechanisms is also low (9.5).

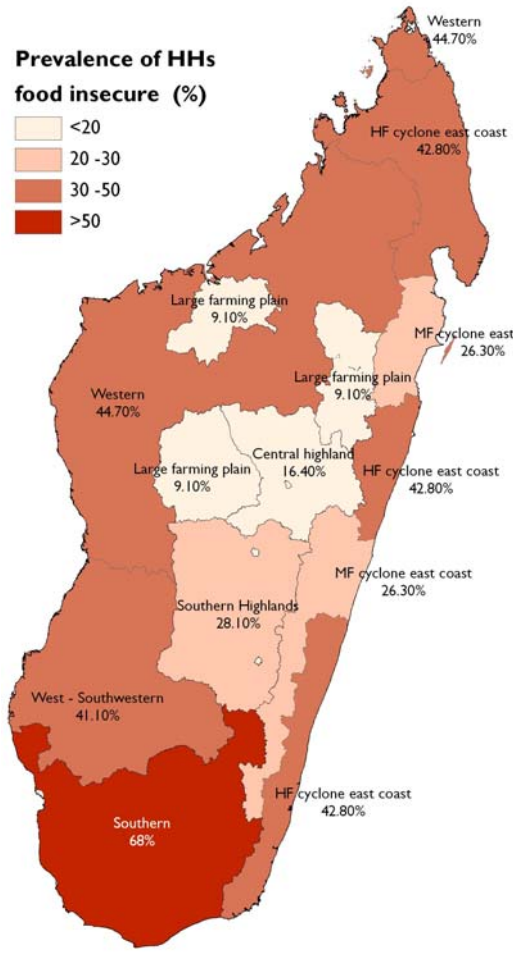
[107] Chapter developed by WFP Food Security Analysis Unit (HQ)

The geographical distribution of the food insecurity is represented in the map below. As expected, the southern is the most food insecure zone, with 68 percent of households considered as food insecure**.** This result is the natural consequence of the very bad performance on all the four indicators examined above.

This appears at odds with the fact that WFP concentrates its activities in this part of the country. But WFP emergency response is implemented for a limited period of time (three to four months) and reaches only a very small proportion of the population. In fact, emergency interventions in the South (implemented in Anosy, Androy and Atsimo Andrefana) normally target between 10,000 and 20,000 households, reaching 40,000 in exceptional circumstances such as drought (eg. 2006, 2009, and 2010). In order to combat the high prevalence of food insecurity in the zone we recommend funding and deploying more structural efforts.

The Western has the next highest percentage of food insecure households (44.7 percent), followed by the High Frequency Cyclone Eastern Coast (42.6 percent) and the West-South Western (40.9 percent). Unlike the Southern, the HF Cyclone Eastern Coast and the West-South Western, the Western did not report high poor consumption prevalence. The high level of food insecurity in this zone is mainly driven by the comparative low per capita expenditures and poor wealth. It is also a cereal deficit area (see chapter 3.0)**.**

Fig. 52 – Food Insecurity distribution (% HHs)



The heart of the country appears more food secure; in particular the Large Farming Plains and the Central Highlands report the lowest level of food insecurity (9.1 percent and 16.6 percent respectively). In terms of absolute estimates, the highest number of food insecure households is located in the HF Cyclone Eastern Coast (343,291), followed by the Southern (246,046) and the Western (194,233). Interestingly, the Southern Highlands, where the food insecurity prevalence is low, have a sizeable number of food insecure households.

Table 26 – Food Security Groups – number and percentage of households, by livelihood zone

	food insecure		vulnerable		food secure	
HF Cyclone Eastern Coast	343,291	42.8%	352,309	43.9%	106,528	13.3%
Southern	246,046	68.0%	82,701	22.9%	33,150	9.2%
Western	194,233	44.7%	185,239	42.6%	55,199	12.7%
Southern Highlands	125,986	28.1%	240,287	53.6%	82,338	18.4%
MF Cyclone Eastern Coast	94,387	26.3%	236,406	65.8%	28,306	7.9%
Central Highlands	74,992	16.4%	233,412	50.9%	150,049	32.7%
West-South Western	65,341	41.1%	51,288	32.3%	42,307	26.6%
Large Farming Plains	26,667	9.1%	203,219	69.2%	63,863	21.7%
Madagascar	**1,170,942**	**35.3%**	**1,584,862**	**47.8%**	**561,738**	**16.9%**

7.2. Who is more likely to be food insecure?

Household characteristics and behaviours that show a significant association with food insecurity are presented below. The purpose of the analysis is to highlight the vulnerability factors associated with food insecurity. A more in-depth analysis of the driving forces behind food insecurity can be found in the paragraph "Why?"

Human and social capital

Food insecure households tend to have more members - an average of 5.4 compared with 4.9 in vulnerable households and 4.8 in food secure. A fifth of food insecure households have seven or more members compared with 15 percent of the vulnerable and 11 of the food secure. Although larger in size food insecure households have a weaker human capital i.e., can rely on a limited or less qualified labour force. Indeed, food insecure households are more frequently headed by a woman or by an elderly person, and have a higher percentage of dependents.[108]

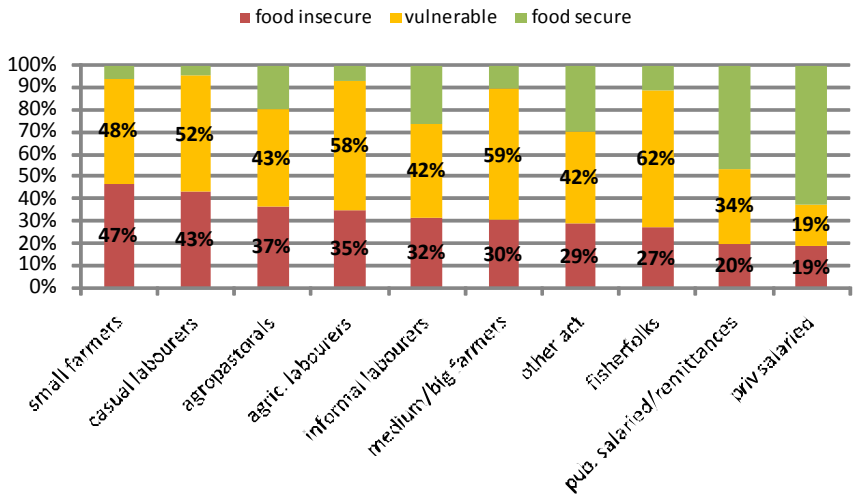
Economic profile

Food insecurity is more pervasive among small farmers and casual labourers. Nearly half (46.6 percent) of small farmers are food insecure and only 5.9 percent are classified as food secure. All report a level of food insecurity higher than the zone average across all livelihood zones except the Central Highlands. Similarly, 43.1 percent of casual labourers are food insecure and only 4.7 percent are food secure.

Food insecurity is largely above the country average for informal sector workers (47 percent versus a country average of 35 percent) while vulnerability to food insecurity is particularly high among the medium / big farmers (59 percent versus a country average of 48 percent).

The strongest food security profile is for households reliant mainly on private salaries (lowest level of food insecurity and lowest level of vulnerability) and those reliant mainly on public salaries and remittances.

Fig. 53 – Food consumption groups by livelihood group (% HHs)



[108] Female headed households are 28 % among the food insecure, 19 % among the vulnerable and 15 % among the food secure. Elderly headed households are 17 % among the food insecure, 14 % among the vulnerable and 12 % among the food secure. The %age of dependents is 57 % among the food insecure, 54 % among the vulnerable and 42 % among the food secure households. The analysis considered also the association between food security and chronic illness, presence of orphans, migration. No clear significant relationship was found with these indicators.

Agricultural production

Food insecure households cultivate less land than the vulnerable and the food secure. While the average land size in rural Madagascar is 1.2 ha, the food insecure cultivated an average 0.96, the vulnerable 1.24, and the food secure, 1.77.[109] As mentioned in chapter 4.0, half of households (51.9 percent) cultivate less than a hectare.

The correlation between cultivating less land and food insecurity is found in each livelihood zone. The table below shows that the larger discrepancies between food secure and food insecure can be found in the Southern, the Large Farming Plains and the Western zones.

Table 27 – Amount of land cultivated (average ha) by the food security groups

	food insecure	vulnerable	food secure
MF Cyclone Eastern Coast	1.01	1.35	1.48
HF Cyclone Eastern Coast	1.05	1.24	1.58 *
West-South Western	1.04	1.31	1.99 *
Western	1.00	1.37 *	2.10 *
Southern	1.14	1.27	2.43 *
Central Highlands	0.59	0.99 *	1.45 *
Large Farming Plains	1.03	1.50	2.30 *
Southern Highlands	0.67	1.07 *	1.55 *
Madagascar	**0.96**	**1.24 ***	**1.77 ***

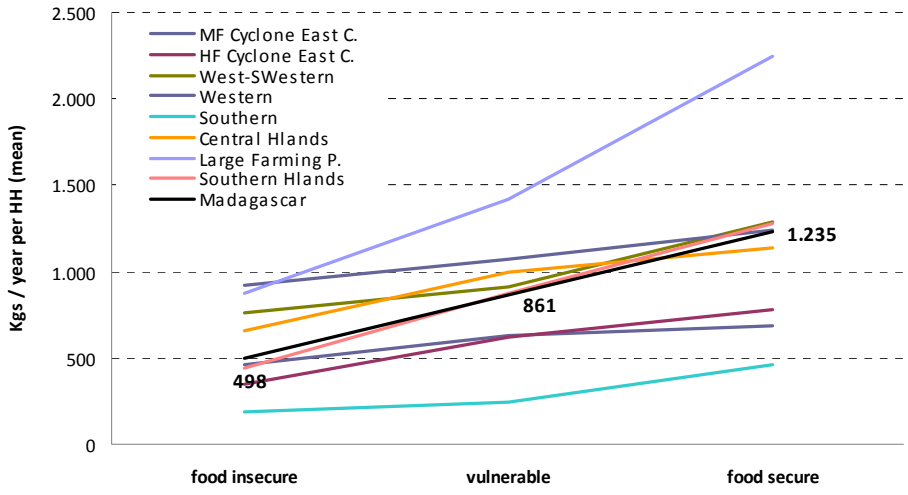
(*) = significant difference (p <0.05) with the average computed on the food insecure

On average food insecure households tend to cultivate a lower variety of crops (3.1 on average, p<0.05) compared with the food secure (3.4), but the vulnerable grow the highest variety (3.6).

Total cereal production, which can be used as a proxy for total production, is lower among the food insecure and increases as long as the food security status improves. At country level, food insecure farmers reported cereal production of 498 kg/year per household during the 2009-2010 agricultural season, compared with 861 kg/year per household by vulnerable farmers and 1,235 Kg/year per household by food secure. These estimates suggest that the food secure tend to produce 2.5 times more than the food insecure.

The positive linear relationship between total cereal production and food security, which can be observed in all the zones, is particularly evident in the Southern Highlands (food secure produce three times more than the food insecure), and the Large Farming Plains (2.6 times more). This is because there is such a wide gap in land access between the food insecure and the food secure in these zones.

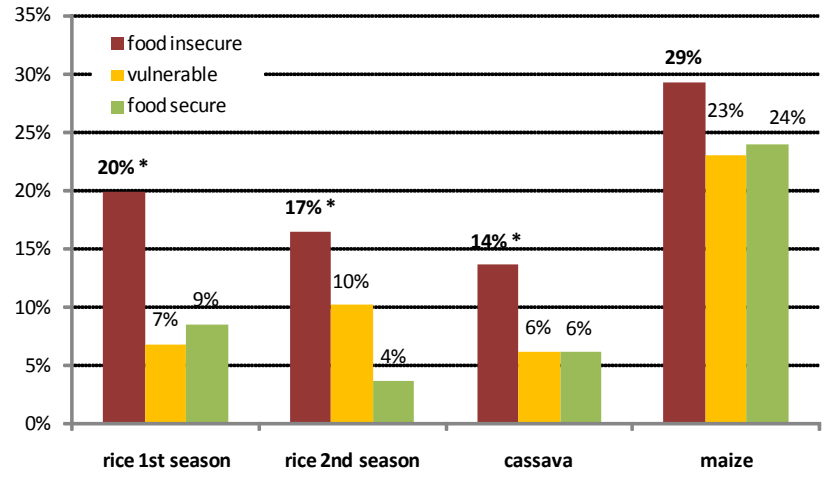
Fig. 54 – Cereal production (Kgs / year per HH) by the food security groups



[109] Differences between each couple are statistically significant.

Food insecure farmers report a short harvest period i.e., less than two months, more frequently than the vulnerable and food secure. Differences between food insecure and the other two groups are statistically significant ($p<0.05$) for rice (1st and 2nd season) and cassava (see figure below).

Fig. 55 – Short harvest (% HHs) across the food security groups (*) = differences statistically significant (P<0.05)



Since only the households cultivating rice, cassava and maize were included in the analysis, the limited number of cases did not allow for disaggregating by livelihood zone. However, the indicator "duration of stock of the main crop" suggests that we are observing a generalized trend. Indeed throughout the country, with the exception of the Western zone, the food insecure have a duration of stock from the main crop that is shorter than that of the vulnerable/food secure (details are in the table 28).

Table 28 – Duration of stock of the main crop by the food security groups

	duration of stock main crop			
	Vulnerable /secure	food insecure	total	p<0.05
MF Cyclone Eastern Coast	4.4	3.3	4.1	*
HF Cyclone Eastern Coast	4.6	3.6	4.1	*
West-SouthWestern	6.5	4.3	5.5	
Western	7.5	7.7	7.6	
Southern	3.8	3.1	3.3	
Central Highlands	7.2	4.7	6.8	*
Large Farming Plains	5.6	4.5	5.5	
Southern Highlands	6.3	6.0	6.2	
Madagascar	5.8	4.6	5.4	*

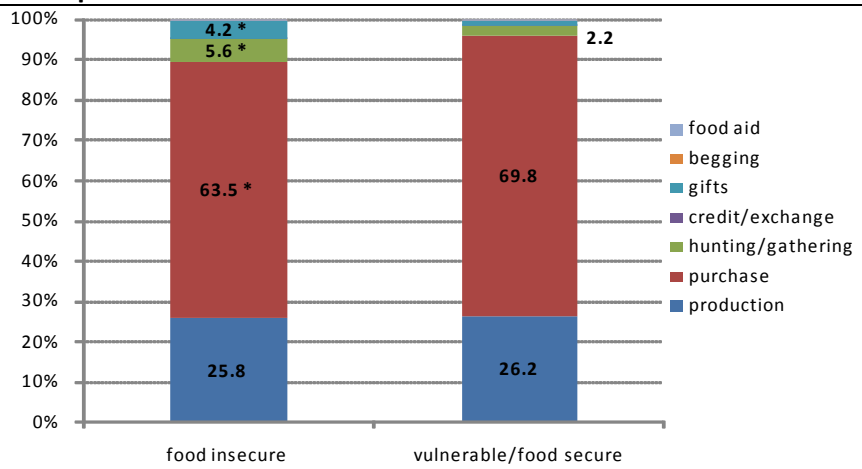
The findings above provide empiric evidence on the association between good agricultural production/harvest and food security status. This encourages the promotion of interventions aimed at increasing production and improving storage facilities in a sustainable manner. Such interventions should limit the use of coping strategies that accelerate environmental destruction of forests and vegetation cover. The harvest from the main crop tends to be shorter in the Southern zone (3.3 months on average) followed by the two zones on the Eastern Coast. Therefore, these are the areas to target for strengthening agricultural production or other livelihood activities alternative to farming.

Market behaviour

Analysing households' reliance on various food sources gives a good indicator of the sustainability of their food consumption practices and helps predict the effects of shocks (ie., price increase, disruption of crop production).

The survey reveals that food insecure households rely less on purchasing food because they hunt/gather and receive giftsmore frequently (differences on these three sources are statistically significant, p<0.05). In other words, their tendency to purchase less is not because they harvest more, but because they opt for less predictable strategies, such as receiving gifts and collecting fruits and roots.

Fig. 56 –Relative contribution (%) of main sources to total current consumption



With the exception of the Central Highlands, such a pattern has been identified across all livelihood zones. The Southern zone reports the highest percentage of food insecure households reliant on hunting/gathering (13 percent) and a notable percentage receiving gifts (six percent).

Regardless of the type of work, the food insecure households are slightly less reliant on purchasing food than the vulnerable/food secure (63.5 percent vs. 69.8 percent). But the situation reverses for farmers : food insecure farmers show a higher dependency on markets for rice and cassava compared with the food secure / vulnerable farmers[110].The Westen zone is the only zone where this pattern is not found perhaps because here the food insecure farmers are mostly producing food crops (rice, cassava, maize), while the vulnerable/food secure ones divide up their activities between cash crops (onion, vanilla, coffee, lima beans, groundnut, beans) and food crops, allowing them to purchase the food commodities they need.

Table 29 – Rice and cassava: dependency on markets(average number of months HHs rely on markets)

	Rice (number months)		Cassava (number months)	
	vulnerable/secure	food insecure	vulnerable/secure	food insecure
MF Cyclone Eastern Coast	6.2	6.6	2.1	3.3 *
HF Cyclone Eastern Coast	6.8	7.8*	4.6	6.1 *
West-South Western	8.5	8.8	8.2	8.8
Western	6.3	5.3*	7.2	6.2
Southern	10.1	10.2	8.5	9.2
Central Hlands	6.5	7.6*	5	5.5
Large Farming Plains	5.8	7.6*	3.7	4
Southern Hlands	5.8	7.8*	4.1	5.7 *
Madagascar	6.5	7.4*	4.8	6.7 *

(*) = significant difference between the mean computed on the food insecure and the vulnerable / food secure (p<0.05). Results refer only on the households cultivating rice and cassava. Vulnerable and food secure households were merged in the same group.

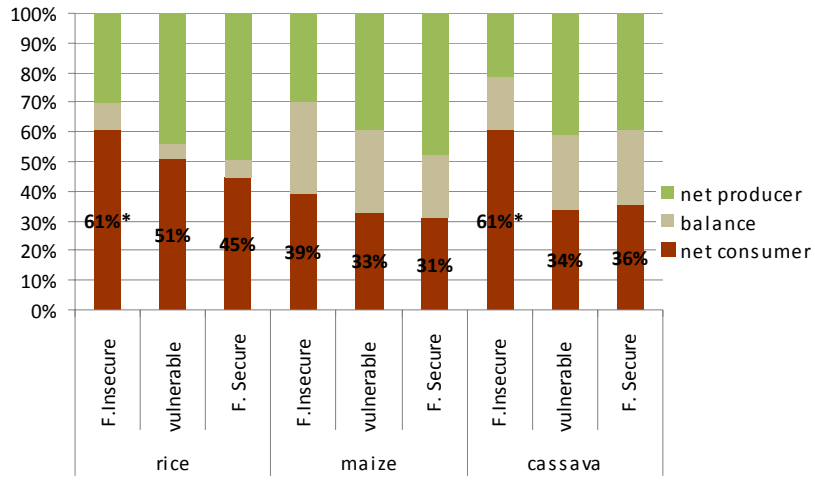
The net consumer/net producer data further confirm the relationship between production and food security, as the food insecure households report higher prevalence of net consumers (ie., households in deficit) and lower prevalence of net producers (ie., households with surplus, p<0.05). Due to the limited number of cases, these data cannot produce solid evidence at livelihood zone level. However, we can

[110] The analysis considered the number of months households farming rice and cassava procured these commodities on the market. Maize data did not allow for a solid analysis.

generally say that the trend observed at country level is confirmed in each livelihood zone with the exception of the Western. For rice, the largest differences between food insecure and food secure are in the Southern Highlands, HF Cyclone Eastern Coast and MF Cyclone Eastern Coast. For cassava, it is evidently in the Southern (91 percent of the food insecure are net consumers versus seven percent of the food secure).

Since food insecure farmers are more often net-consumers, they are more exposed to price increases, plunged into deeper food insecurity if prices rise. The identification of households based upon the net-consumer and food security status help targeting social safety net interventions. They are more likely to benefit from in-kind contributions during the lean season, and cash/voucher transfers during the pre-harvest or post harvest, when expenses are likely to be higher.

Fig. 57 –Net producer / consumer status (% HHs) by food security groups



7.3. Driving forces of food insecurity

To understand which factors impact food consumption in Madagascar, a multivariate analysis has been conducted on some of the key indicators already examined at bivariate level. Independent variables pertaining to the different domains (e.g., human capital, economic status, natural capital and agricultural production) were included in the regression models.

Least-squares based linear regression models

Least-squares based linear regression models regress a series of independent variables by the continuous dependent variable (the FCS).[111]

The model used the FCS as the dependent variable instead of the food security classification since the latter is a combination of four indicators and does not give a clear identification of the dependency effects.

The same model was run at different levels: first a country-level model was identified which included all the households in the dataset; this model was then applied to the most food insecure areas of the country (the Southern, the West-South Western and the High Frequency Cyclone Eastern Coast) to determine whether the effects of the independent variables are similar in all the zones or whether they had a particularly strong effect in a certain zone.

Country-level

A highly significant country-level model emerged ($F30, 3569; p<0.001$) accounting for 36 percent of the total variance (Adj $R^2 = 0.359$). Some key independent variables were deliberately retained in the model, although they were not significant predictors for the food consumption score. In fact, the main purpose of the analysis was to study the effects of possible characteristics on consumption, not to identify the best

[111]The variables included in the model were the following: 1) livelihood zone, 2) income group, 3) household size, 4) age of the household head, 5) household's dependency rate, 6) whether the household is headed by a woman, 7) crowding index, 8) wealth index, 9) total per capita expenditures, 10) whether the household cultivated land in 2009-10 season, 11) amount of land cultivated in the 2009-10 season, 12) crop variety, 13) duration of stock from the main crop, 14) share of land irrigated, 15) cereal production in 2009-10 season, 16) TLU index.

predicting model. The variables that emerged as highly associated with the food consumption score are discussed below.

- **Livelihood zones** – the Southern was taken as reference group for testing the FCS changes. The multivariate analysis confirmed that, *caeteris paribus*, households living in the rest of the country tend to have significantly higher FCS than the households in the Southern ($p<0.001$). This is particularly valid for the Large Farming Plains, Central Highlands, the Western and Southern Highlands.
- **Income groups** – the small farmers were taken as reference group. All the groups reported significantly higher FCS than the small farmers (at least $p<0.05$), except the casual labourers. This is consistent with the bivariate level findings, according to which small farmers and casual labourers had the two lowest FCS means (31.4 and 32.4 respectively).
- **Economic status / wealth** – as expected, wealth was significantly associated with FCS and showed a strong positive effect on the dependent variable ($p<0.001$). Also expenditures (measured by the per capita total expenditure) were significantly associated with higher FCS ($p<0.001$), even if the influence seems to be a bit lower than wealth.
- Regarding the **demographic traits**, the household size and the age of the bread-winner were the only two characteristics with a significant effect on the FCS ($p<0.005$), the first contributing with a mild positive impact, the second into a negative way. While the negative impact of old age on consumption is not surprising, the positive relationship between household size and FCS is not consistent with the bivariate level associations. However, since the model's effects are "net" of other effects, a mild positive coefficient means that large households are not necessarily more food deprived than small households once we take a series of other factors under control.
- Considering that some of the structural problems of agricultural production fuel food insecurity in the country, a selection of variables related to natural capital and production has been included in the model. Crop variety and amount of land cultivate dare significantly associated with higher FCS (at least $p<0.05$). However, other agricultural related indicators did not show a significant effect (e.g., duration of stock, net consumer/producer status, cereal production). It is possible that the lack of improved infrastructure (roads, community level warehouses, etc.) is an obstacle that does not facilitate getting a solid income despite the presence of surplus or good production.

Southern, West-South Western, High Frequency Cyclone Eastern Coast

When the models are applied to the zones, a more limited number of variables are significant. This is partially explained by the lower case-to-predictor ratio, but it is also be linked to structural problems affecting all households living in the same zone, regardless of the agricultural performance and the human capital. The comparison between the models is summarized below:

- **Economic status / wealth** - In all of the three most food insecure zones (the Southern, the West-South Western and the High Frequency Cyclone Eastern Coast) wealth and per capita expenditures are highly significant predictors of food consumption score ($p<0.001$). Interestingly, also the capability of many income groups to significantly influence the FCS vanishes within the zones. Only the fisherfolks seem to perform better than the small farmers in the Southern and the HF Cyclone Eastern Coast ($p<0.05$), whereas the agro pastoralists are more advantaged than the small farmers in the West-South Western ($p<0.05$).
- **Agricultural production** – Crop variety was found to have a significant impact on food consumption both in the Southern and the HF Cyclone Eastern Coast, whereas stock duration of the main crop was significant only in the Southern.
- **Human capital** – In the Southern demographic characteristics do not seem to play a significant role in determining food security, but large households are more likely to have lower FCS in the West-South Western and HF Cyclone Eastern Coast. In the latter, the number of people per room is a significant predictor of low FCS.

8.0 SHOCKS: NATURAL DISASTERS IN MADAGASCAR[112]

This chapter focuses on the main shocks that hit the country and increase household food security status. The CFSVA household level and community level data confirm that natural shocks, in particular drought and floods (caused by cyclones) are much more frequent than the social shocks. Therefore the entire analysis is concentrated on these natural disasters.

8.1. Climate overview

Madagascar's climate is broadly bi-modal with two distinct periods, a warm wet season (from October to April) and a cool dry season (from May to September). This general description is subject to geographical variation as the dry season is well defined and long (up to eight months) in the southwest, while in the northeast there is no proper dry season to speak of, at most 2-3 month period of reduced rainfall.

The seasonal rainfall spatial pattern in Madagascar is broadly one of a northeast to southwest decreasing rainfall gradient [see figure 58(a)]: in the southwest, climate is semi-desert (Sahelian) while the north-eastern coast is sub-equatorial with year round high rainfall and humidity.

8.2. Drought affected areas

Rainfall distribution and variability

The analysis was based on the USGS-FEWSNet rainfall estimate dataset (designated as RFE), which is available for Africa at a spatial resolution of eight kilometres and with a time step of 10 days, covering the seasons from 1995 to present.[113]Total precipitation was calculated for each of 15 rainfall seasons (between early August and late July of the following year) between 1995-96 and 2009-10. The average seasonal rainfall was calculated based on these 15 seasons and the result is shown in figure 58 (a).

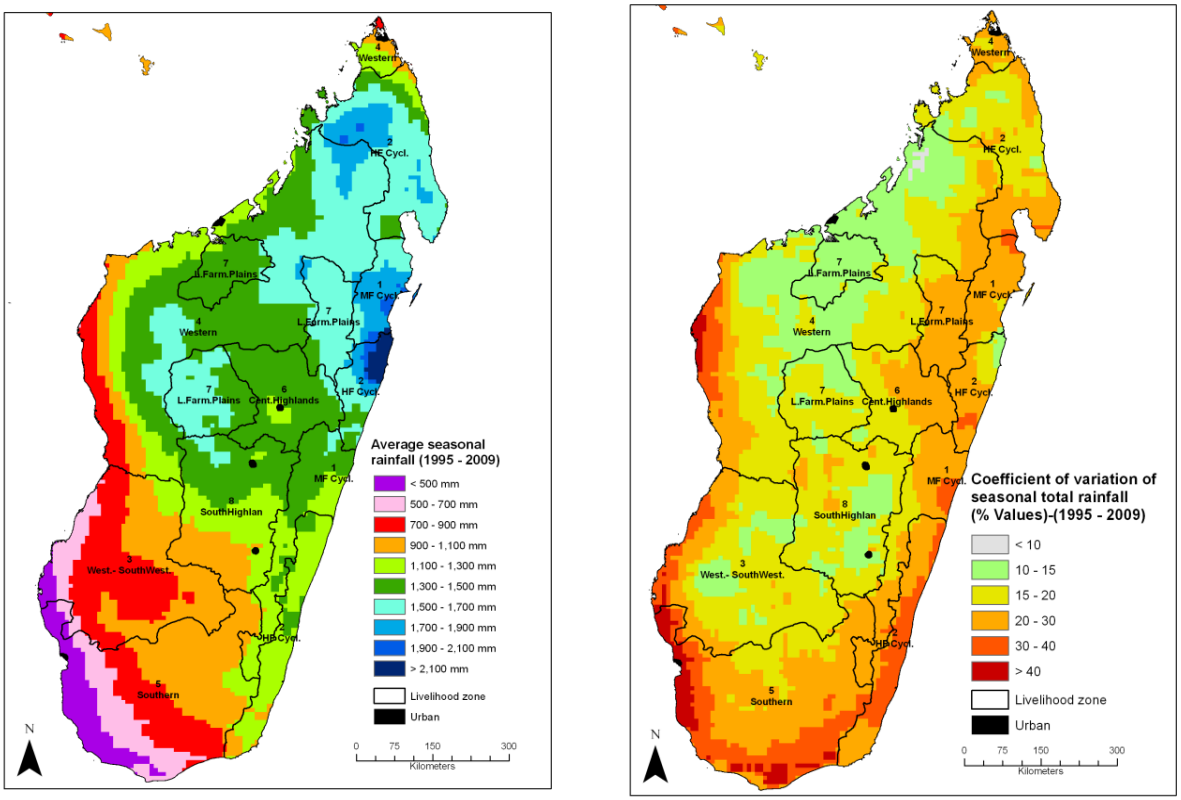
The map clearly shows the geographical variation in seasonal rainfall amounts – from below 500 mm in the southwest to over 2000 mm in the northeast coast; the east coast and the highlands generally receive over 1200-1500 mm of rainfall while the western coast and the south in general receive under 1000 mm on average. These areas of lower rainfall are also characterized by a higher degree of seasonality (ie., less uniform distribution of rainfall throughout the year).

The interannual variability was also analysed considering the coefficient of variation[114] of the total seasonal rainfall [see figure 58(b)]. The interior and the northwest coastal areas have the lowest interannual variability. High interannual variability characterizes most of the coastal areas, in particular the southern and south western coasts. In the southern zone and southwestern coastal areas the degree of interannual variability in seasonal rainfall is comparable to that of Sahelian regions and is associated with relatively low average rainfall amounts. Where these are comparable to the water requirements of crops, high interannual variability in seasonal rainfall has a significant impact on the reliability of rainfed crop production.

Eastern and northeastern coastal areas also display high interannual variability, but associated with the high average seasonal rainfall arising from the interaction of incoming wet air masses with near coastal topography and impact of frequent large scale storm systems. Here, rainfall interannual variability is related to interannual variations in the occurrence of high rainfall and impacts on crop production are unrelated water supply shortages.

[112] Chapter developed by WFP Food Security Analysis Unit (HQ), GIS Team.
[113] The data is available on-line from http://earlywarning.usgs.gov/fews/africa/web/datatheme.php. In spite of some shortcomings (underestimation of very high rainfall events) it is a widely used rainfall dataset for monitoring / early warning of the agricultural season in the continent.
[114] Coefficient of Variation (CV) = Standard Deviation divided by the average

Fig. 58 – (a) Average total seasonal rainfall (1995-2009) in Madagascar. (b) Coefficient of Variation of total seasonal rainfall (1995-2009)



Drought occurrence

The way used here to evaluate whether drought occurred in a season is the difference between the total rainfall for a given season and the long term average seasonal total, scaled (divided) by the standard deviation of the average seasonal total – this is known as a scaled anomaly and denoted by Z (see Annex II for methodological details on this Index). The distribution of Z values across Madagascar over the period of record is shown in figure 59.

The maps clearly show that droughts are a regular occurrence in Madagascar, and have taken a greater grip on the country in the past seven years with the exception of 2006/07. The 2005/06 season and the period between the 2007/08 and 2009/10 seasons were particularly difficult. This concurs with reports of widespread crop failiures (and associated impacts on household food security). Drought impacts on crops are far more severe in areas of lower rainfall, such as the southern and southwestern regions than in areas of high or very high rainfall (north and northeast) where fluctuations occur mostly above the crop's water requirements (though they may impact on hydrological water supply).

Fig. 59 (part 1)– Seasonal rainfall totals as standardized deviations from the average (Z) for 1995/96 to 2009/2010. Values of Z between -1.25 and 2.00 indicate moderate drought, Z values below -2.00 indicate severe (or worse) drought.

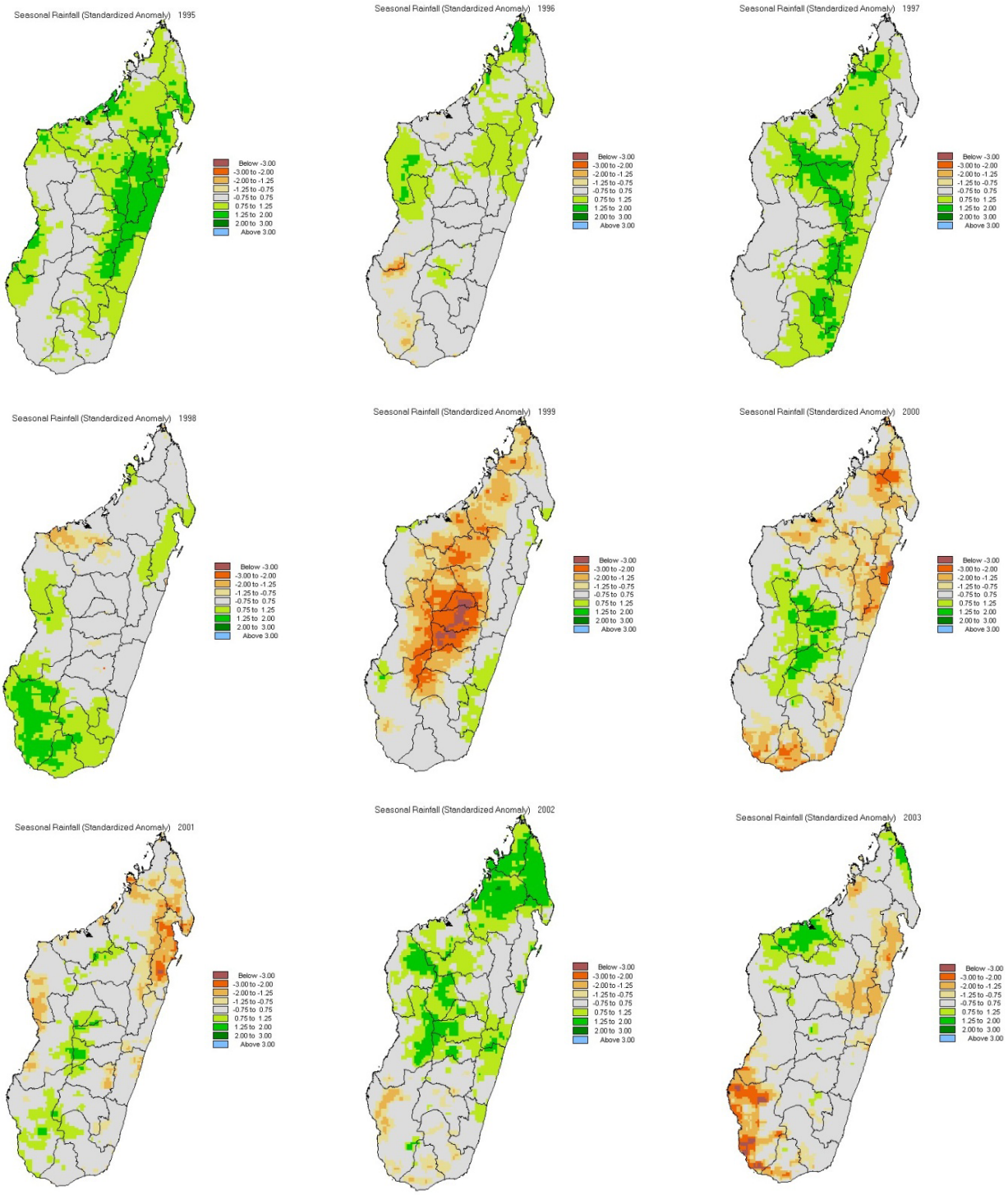
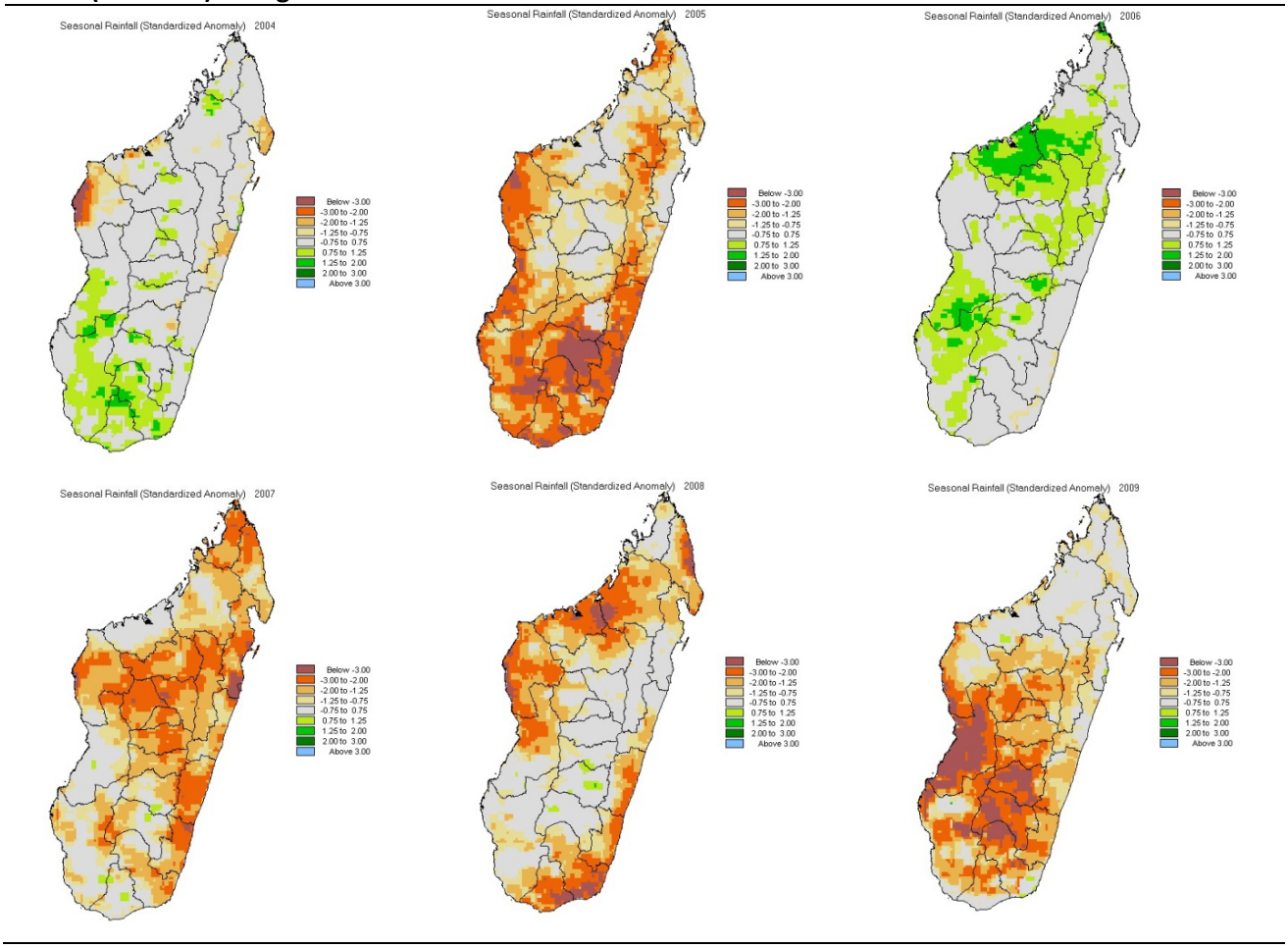


Fig. 59 (part 2) – Seasonal rainfall totals as standardized deviations from the average for 1995/96 to 2009/2010. Values of Z between -1.25 and 2.00 indicate moderate drought, Z values below -2.00 indicate severe (or worse) drought.



Crop specific analysis

To bring the impact on crops more into focus, another approach has been adopted which considers the water requirements of crops and estimates to what degree these have been met by the seasonal rainfall. This approach runs a simple water balance model with a 10 day time step. Rainfall is monitored from the beginning of the season and at each time step the available water (rainfall plus water stored in the soil) is compared to the water requirements of the crop. Everytime the available water is below the crop requirement a deficit is registered. Deficits are added throughout the season and at the end, a numerical index (water resources satisfaction index, WRSI) is defined as :

WRSI = 100 – (total deficit / total crop requirement)

This WRSI is 100 for seasons with an optimal water supply (no deficits) and would be 0 for no rainfall. In practice, values below 50 are indicative of complete crop failure. The model is tuned to crop types by using tables of seasonal water requirements published by FAO for specific crops. In this way, the behaviour of crops with higher water requirements (maize) is accounted for and differentiated to some degree from those that are less demanding (such as cassava). This model was run for Madagascar for a standard maize crop and for a standard cassava crop. Details on the methodology and how it was adapted for cassava are provided in Annex II.

Occurrence of significant impacts on crop production are evaluated by deriving the magnitude and frequency of deviations of WRSI from a reference value, its medium term median value. Deviations from the median are related to qualitative drought levels:

Mild drought: **WRSI within 80-90% of the median**

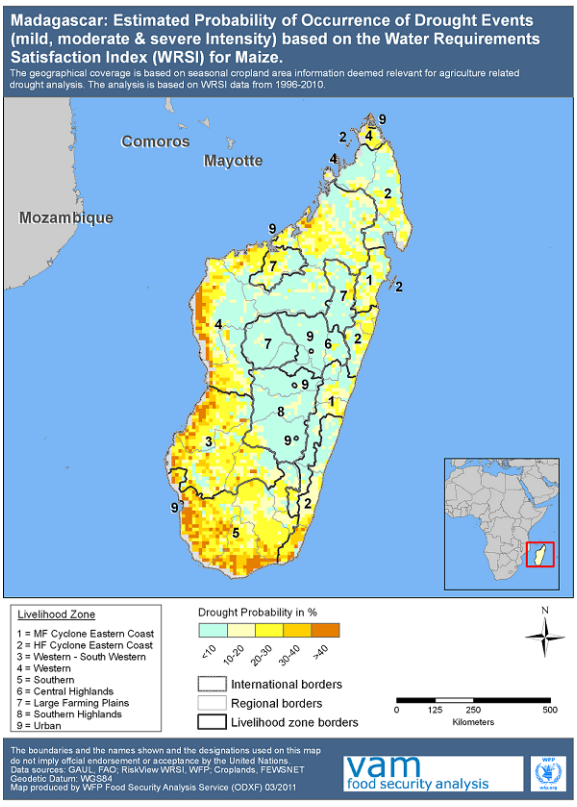
Moderate drought: **WRSI within 70-80% of the median**

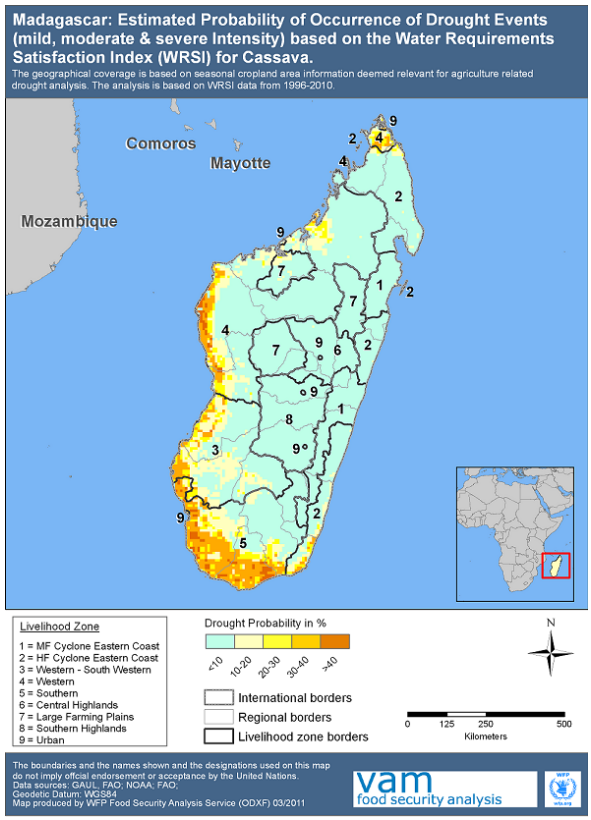
Severe drought: **WRSI below 70% of the median**

The WRSI model was run for each season (1995-1996 to 2009-2010). From the set of seasonal outputs, the long term median was derived and the ratios of the median derived for each season. This set was then converted into frequencies of occurrence.

Results are presented for maize and cassava in figure 60 for the probability of occurrence of mild or worse drought events. In effect, the probability of the WRSI falling below 90 percent of the long term median within the 15 year period.

Fig. 60 – WRSI derived frequency of drought events (all levels) in Madagascar within the period 1995-2009.





The spatial pattern of drought frequency clearly shows the more drought-prone nature of the southern third of the country and the western coast. But the probability of drought for cassava is generally lower as a result of the lower water requirements of this crop.

In the extreme south of the country, cassava is more likely to be affected by drought than maize, because the rainfall season here is quite short and the water supply may be insufficient for such a long development cycle crop .

The differences in sensitivity to water deficits are made clear by the production figures for 2010 – maize production fell in livelihood zones Southern and South Western by 25 percent and 21 percent respectively, compared to insignificant variations (drops of three percent and five percent respectively) in cassava production (compared to the mean of the previous five years).

Considering the water requirements of a standard maize crop and the sensitivity of this crop to water supply deficits during key stages of its development (flowering and early grain filling) vs the average rainfall

amounts and the degree of interannual variability in rainfall, it may be questionable that maize is the most suitable crop for the southern and western regions. Farmers are attempting to compensate for their reduced yield by planting larger areas in these regions (see "Land Adequacy and Crop Variety" in Section 5: Food Access) because this reduces plant density and minimises competition for scarce water resources.

Drought impact on farming households

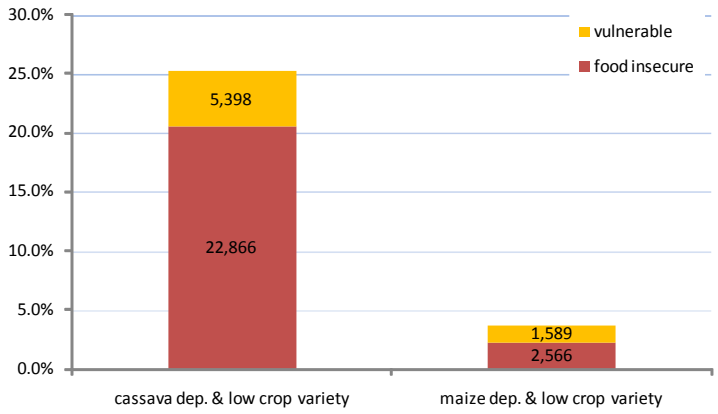
The analysis above provided elements to follow the drought trends over the time. Crop specific analysis was conducted according to the particular water requirements of cassava and maize. In an attempt to understand the impact of drought on the population, this section links the findings above with the type of households that live in these zones.

The analysis focuses only on farmers[115] in the two most drought-affected zones – the Southern and the West South-Western livelihood zones. A descriptive analysis has been conducted combining the food security status (i.e., food security classification) with low-resiliency indicators (ie., heavily cassava-based production; heavily maize-based production; low crop variety).[116] The purpose of investigation is to estimate the percentage and number of households that will be seriously hit in case of drought. The analysis does not pretend to predict exactly the caseload, because many other intervening factors exist while we are limited to key factors that are unquestionable indicators of vulnerability.[117]

As mentioned above, the probability of drought for cassava is generally lower than the probability of drought for maize because of the lower water requirements of this crop (except for the extreme south areas of the country where cassava has higher probabilities of drought compared to maize). Figure 61 reports the percentage (and absolute number) of farmers who are food insecure and vulnerable to food insecurity for households that are cassava dependent and have low crop variety and for households that are maize dependent and have low crop variety.

Findings suggest that, if a drought that hits the cassava production occurs in the Southern livelihood zone, 20 percent of the farmers (i.e., 22,866 households) will be very likely to suffer from this shock, since they are food insecure, cassava dependent and with a low crop variety. A further five percent of the farmers (ie., 5,398) with a stronger food security profile are likely to face trouble because they are already vulnerable to food insecurity.

Fig. 61 – Farming households poorly resilient to drought: Southern



Farmers in the districts of Atsimo Andrefana, Androy and Anosy in the Southern Livelihood Zone are likley to be worse hit by drought: here we have the highest number of food insecure, cassava-dependent farmers with low crop variety (10,263 and 4,936 and 7,324 households respectively). These numbers are particularly relevant for the Atismo Andrefana and Androy which are characterized by a very high probability of drought occurrence (based on the cassava water requirements). If a drought hits maize, the expected impact would be lower, hitting two percent of farmers (ie., 2,566 households) who are food insecure and one percent (1,589 households) who are vulnerable.

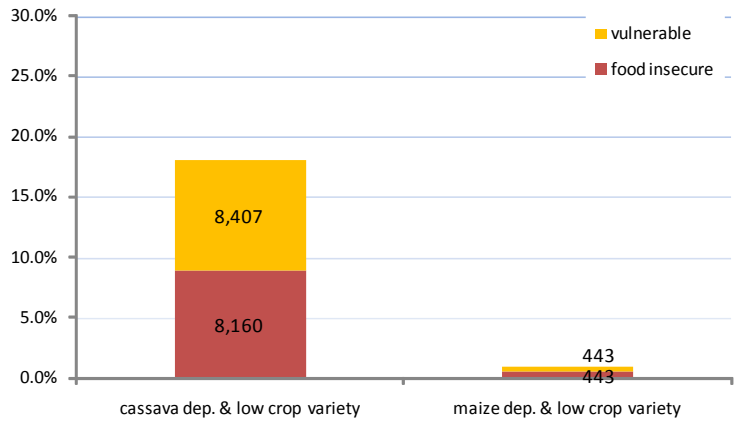
[115] Although farmers are the first to be impacted by drought, there are of course secondary effects on other groups.

[116] Farming households with low crop variety cultivate 1 or 2 crops. A household is considered as cassava (or maize) dependent if cassava (or maize) is the main or the second crop in order of importance.

[117] The lack of irrigation system, for instance, was not considered in the analysis because the data did not specify which type of irrigation system the household adopted and drought also has an effect on the irrigation system, depending on the type used.

Overall, the drought impact is less severe in the West South-Western livelihood zone because the number of less resilient households is much lower. In fact, if a drought hits cassava production here, nine percent of the farmers (ie., 8,160 households) will be very likely to suffer (because they are food insecure, cassava dependent and with a low crop variety). In addition, another nine percent (ie., 8,407 households) will probably face trouble since they are already vulnerable rather than food insecure.

Fig 62 – Farming households poorly resilient to drought: West South-Western



The way a household reacts to the shocks has a direct impact on their quantity and quality of food intake. In the Southern and the West-South Western zones, the most frequent strategy is to reduce the number of meals consumed during the day (reported by 21 percent of the households in the Southern and 18 percent in the West-South Western). However, while the households in the Southern show a notable tendency to borrow money and increase their working hours (11 percent), those in the West-South Western frequently cut portion sizes (24 percent) and switch towards less expensive food. This may be explained by the fact that households in the Southern are generally more food insecure than those in the West-South Western, so many of them cannot reduce or deteriorate their consumption further and therefore put their efforts into increasing their household purchasing power.

8.3. Cyclone-prone areas

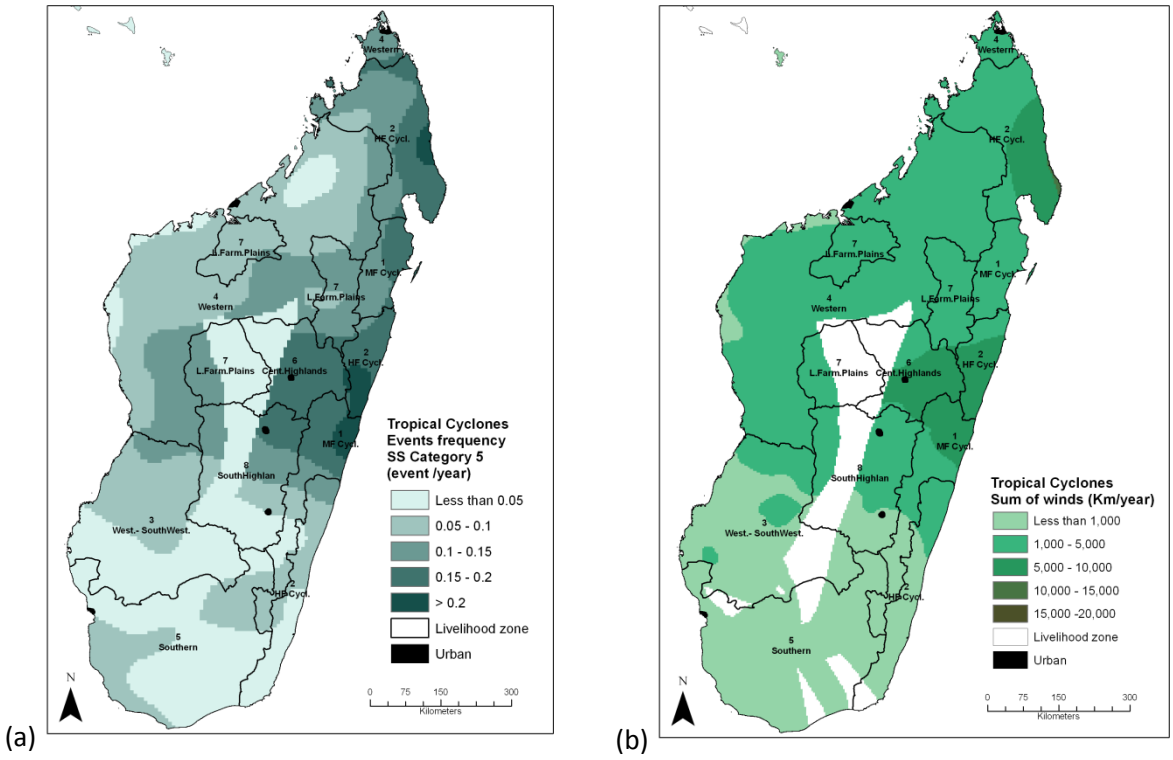
Madagascar is often hit by cyclones and tropical storms and depressions, mostly occurring from mid January to mid March. The eastern coast (in particular the northeast) is the most proneas storm tracks tend to move from east to west across the tropical south Indian Ocean. Topography, in particular the steep slopes on the eastern side of the island, are a reinforcing factor for cyclone damage – it fosters a tendency for cyclones to veer southwards, enhances rainfall and resultsin flashfloods and landslides.

Other regions of Madagascar are also impacted, as cyclones progress along the Mozambique channel, but with less intensity than on the eastern coast. Storm intensity decreases as they move inland away from the coast and the ocean surface supply of heat and moisture.

An assessment of the geographical distribution of cyclone impact in Madagascar was prepared based on the datasets available in the PREVIEW Global Risk Data Platform (http://preview.grid.unep.ch/index.php?preview=home&lang=eng). These are based on a dataset of tropical storm tracks from WMO (World Meteorological Organization) and modelling to convert point track data into wind speed profiles and storm categories. The dataset includes maps of wind intensity, storm frequency and cumulative wind.

Figure 63 shows two representative indicators – (a) The frequency of tropical cyclone category 5 (number/year), the strongest category on the international Saffir-Simpson scale (1 to 5). (b) Sum of winds, the cumulative wind speed within a period (year in this case); this is an indicator of the cumulative storm intensity.

Fig. 63 – (a) Frequency of tropical storm category 5) and (b) Cumulative yearly sum of winds



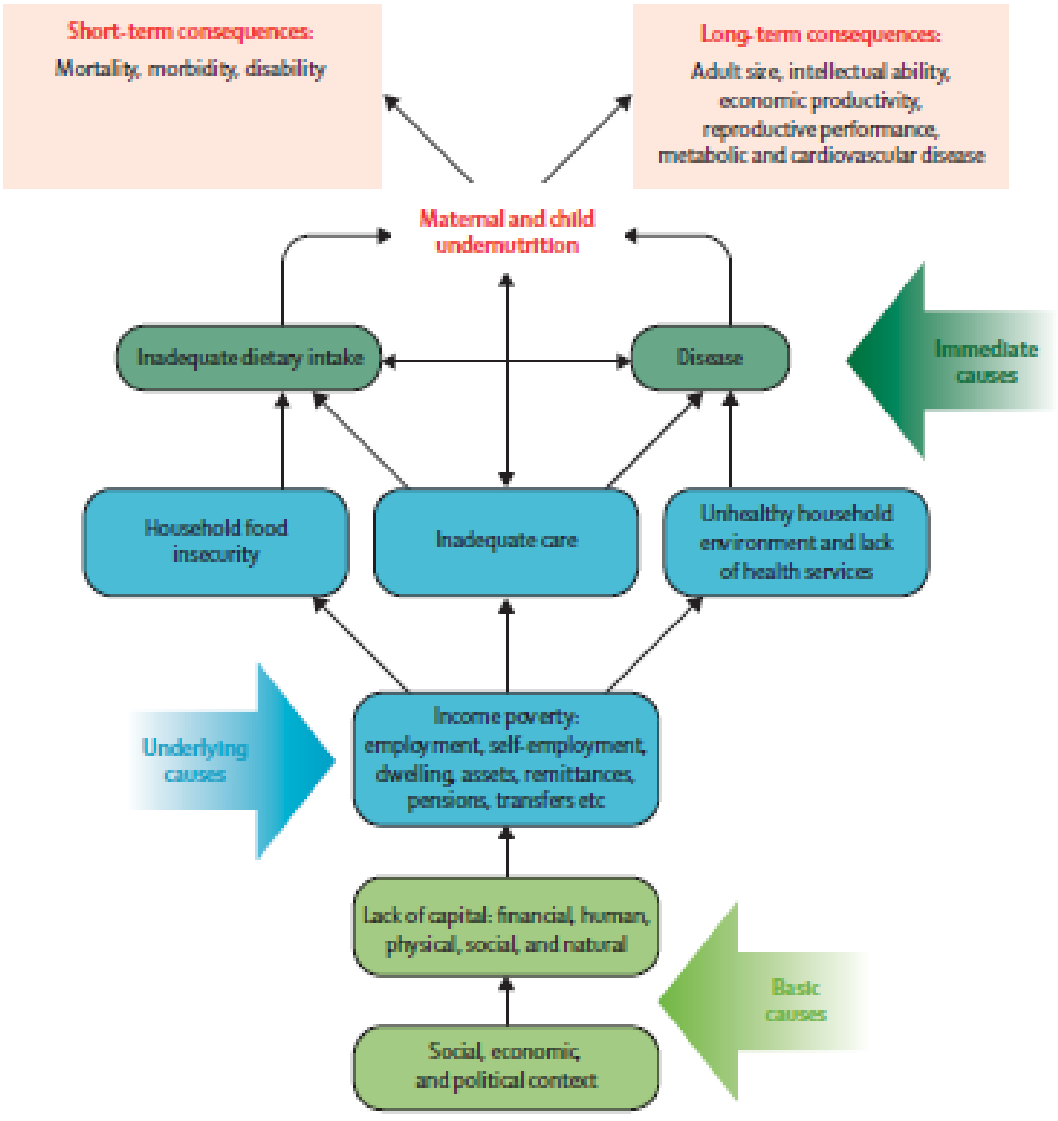
The geographic distribution of these indicators makes clear the contrast between the eastern coast and the rest of the country. Higher frequencies of large storms and cumulative wind speeds are found on the north-eastern coast than elsewhere with the southern regions experiencing the minimum impact.

9.0 PREVALENCE OF MALNUTRITION[118]

This chapter presents the prevalence of the three types of malnutrition (wasting, stunting and underweight) by background characteristic and livelihood zones in children under-five years of age.

The following chapters will explore the causes of acute malnutrition and in some case of stunting based on the immediate and underlying causes of malnutrition taking into account background characteristic (basic causes) as defined in the 1992 UNICEF conceptual framework of acute malnutrition.

Fig. 64 - Framework describing causes and consequences of maternal and child undernutriton



Source: Lancet series on Maternal and Child Undernutrition (2008)

[118] Chapter developed by UNICEF Madagascar

9.1. Global acute malnutrition

Overall, the global acute malnutrition (GAM) prevalence for children under five for the rural zones covered by the CFSVA+N is 5.4 percent (4.8-6.0; 95 CI).

Livelihood zones

There are significant differences between the livelihood zones (p=0.033) with the highest level of acute malnutrition found in the Southern zone (7.1 percent) followed by the Medium Frequency Cyclone Eastern Coast zone (6.2 percent) and the Western zone (6.2 percent) (See figure 65).

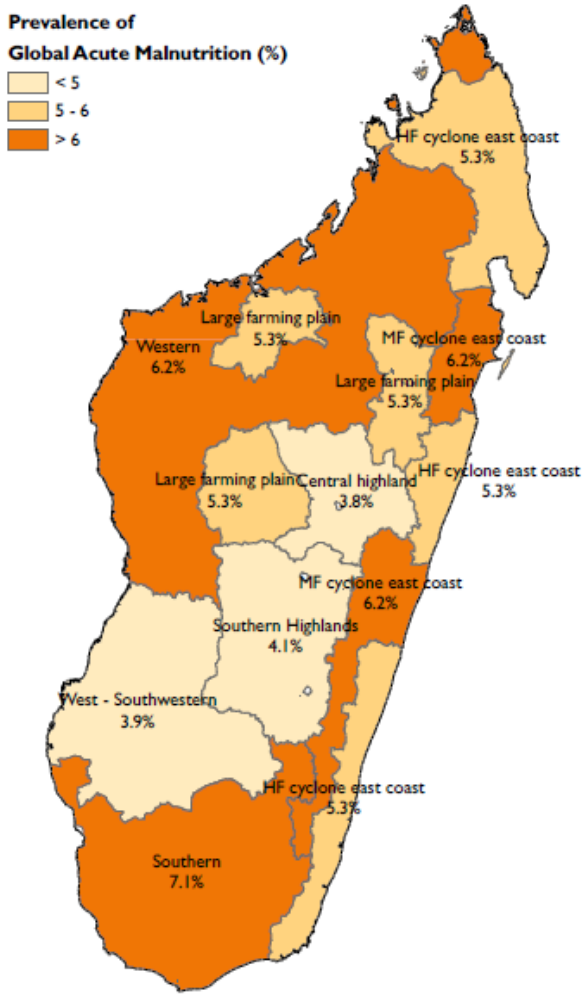
Annex V shows the details for global and severe acute malnutrition for each livelihood zone and by region.

Global acute malnutrition is highly subject to seasonal variations and the impact of natural shocks (droughts, flooding) and here reflects the situation for August/September 2010. For the Southern and West South-Western zones, September is considered a particularly difficult month. For the other zones it is neither considered the best nor worst month with regard to access to food/cash.

For the Southern zone, the 2009/2010 agricultural season saw a serious reduction in harvest as a result of crop failure due to erratic and poor rainfall as highlighted in chapter 3. For the Medium Frequency East Coast zone, the tropical storm Hubert gravely affected the harvest with the loss of half of the rice harvest (particularly high levels of GAM were noted in the region of Vatovavy Fitovinany which was hit the hardest by the tropical storm[119]).

So it is not surprising that the highest level of GAM is noted in the Southern zones, although the West South-Western zone has relatively low levels of acute malnutrition.

Fig. 65 - Distribution of wasting by livelihood zone



Considering that the primary sector involves more than 80 percent of the active population it is important to look at seasonality in earnings from the agricultural activities. Figure 26 in chapter 4 shows that at country level, the peak in earnings from agriculture occurs in June with the minimum earnings from agriculture between January and February. These stark differences in agricultural earnings are not as pronounced in the southern part of the island (the Southern, West South-Western zone and the Southern Highlands) as seen in table 24 of chapter 6.

[119]FAO/PAM Rapport Special - Mission FAO/PAM d'évaluation de la sécurité alimentaire a Madagascar – Novembre 2010

Table 30 – Problems with food and poor consumption prevalence: summary table (*)

Livelihood Zone	months											
	Oct '09	Nov' 09	Dec'09	Jan '10	Feb '10	Mar' 10	Apr '10	May 10	Jun '10	Jul '10	Aug 10	Sept '10
Southern												
West-Southwestern												
HF Cyclone Eastern Coast												
MF Cyclone Eastern Coast												
Western												
Southern Highlands												
Large Farming Plains												
Central Highlands												

(*) red cells = peak of problems; green cells = favourable months.

The second factor affecting acute malnutrition is seasonal trends in morbidity. A great variation exists across the country and even within an area as a result of micro-climates. Nevertheless, monthly health centre data shows the following broad seasonal variation in diarrheal disease and acute respiratory infection in children under five.

Table 31 - Periods with higher level of diarrhoea in children under 5 years

	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Central highlands												
Southern highlands												
East Coast												
West Coast												
South												

Table 32 - Periods with higher level of acute respiratory disease

	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Central highlands												
Southern highlands												
East Coast												
West Coast												
South												

Mid-upper arm circumference

The mid-upper arm circumference is used for community level screening (referral of all children with a MUAC<125mm to the health centre) and for admission for the treatment of severe acute malnutrition (MUAC<115mm).

The total prevalence of children 6-59 months with a MUAC< 125mm is 6.3 percent (5.6-7.1; 95 percent CI), with no statistical difference by livelihood zone. This confirms the prevalence of acute malnutrition we find above.

Table 33 - Wasting (by Mid-upper arm circumference) by livelihood zone

	% global wasting (MUAC<125mm)	95% CI	% severe wasting (MUAC<115mm)	95% CI	Denominator (n)
MF cyclone east	7.3	[5.3 - 9.9]	0.42	[0.15 - 1.13]	749
HF cyclone east	6.8	[5.4 - 8.4]	0.91	[0.57 - 1.44]	1795
West-	2.9	[1.6 - 5.0]	0.38	[0.09 - 1.57]	503
Western	6.0	[4.2 - 8.9]	1.13	[0.46 - 2.69]	1414
Southern	6.8	[5.0 - 9.2]	1.62	[0.88 - 2.94]	1550
Central highland	5.8	[3.9 - 8.4]	0.39	[0.12 - 1.32]	593
Large farming	4.8	[3.7 - 6.4]	1.22	[0.64 - 2.31]	1086
Southern Highlands	6.9	[5.3 - 8.9]	1.14	[0.61 - 2.10]	1029
Madagascar	6.3	[5.6 - 7.1]	0.98	[0.74 - 1.30]	8719

Child gender

A significant difference in GAM between boys and girls is in fact noted, with a higher prevalence of acute malnutrition among boys than girls (p=0.03).

Considering the gender difference, the data was further disaggregated to investigate potential differences between boys and girls by livelihood zone.

This difference between the sexes is statistically significant only in the High Frequency Cyclone East Coast, the Western zone and the West-south Western zone where the difference is the most pronounced with 6.5 percent of boys suffering from acute malnutrition compared to 1.2 percent of girls.

Fig. 66 - Prevalence of acute malnutrition by Sex

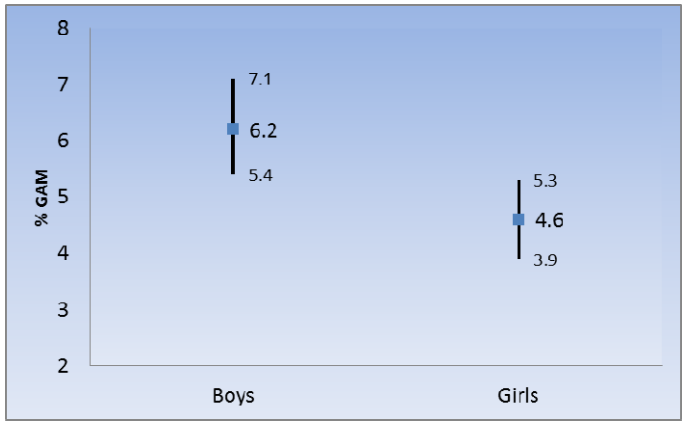


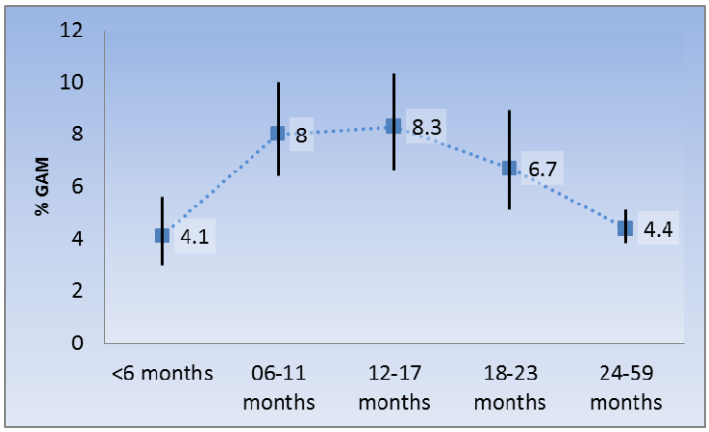
Table 34 - Acute malnutrition (weight-for-height z-scores and/or oedema) using WHO standards 2006 by livelihood zone and sex

	Boys		Girls		P*
	GAM (%)	95% CI	GAM (%)	95% CI	
MF cyclone east coast	6.9	[4.4 - 10.5]	5.6	[3.7 - 8.6]	0.3
HF cyclone east coast	6.2	[4.9 - 7.8]	4.4	[4.3 - 6.6]	0.03
West- Southwestern	6.5	[3.7 - 11.2]	1.2	[0.4 - 3.7]	0.0003
Western	7.9	[6.0 - 10.4]	4.3	[2.9 - 6.5]	0.006
Southern	8.6	[6.2 - 11.8]	5.6	[4.3 - 7.3]	0.05
Central highland	4.0	[2.4 - 6.6]	3.5	[2.3 - 5.5]	0.5
Large farming Plains	5.0	[3.6 - 7.0]	5.6	[4.1 - 7.5]	0.5
Southern Highlands	3.8	[2.5 - 5.7]	4.5	[2.5 - 7.9]	0.6
Madagascar	**6.2**	**[5.4 - 7.1]**	**4.6**	**[3.9 - 5.3]**	**0.0007**

Age group

There is a significant difference in GAM prevalence (p=0.0000) with ***highest levels noted in children 6-23 months***. This corresponds to the age group for the introduction of complementary food, exploration of the environment and maturation of the immune system and therefore the higher GAM levels are expected, highlighting the fragility of this age group. Worryingly, 4.1% of children under-six months of age suffered from GAM, a time period where children should be exclusively breastfed and less likely to be exposed to pathogens.

Fig. 67 - Prevalence of GAM by age group

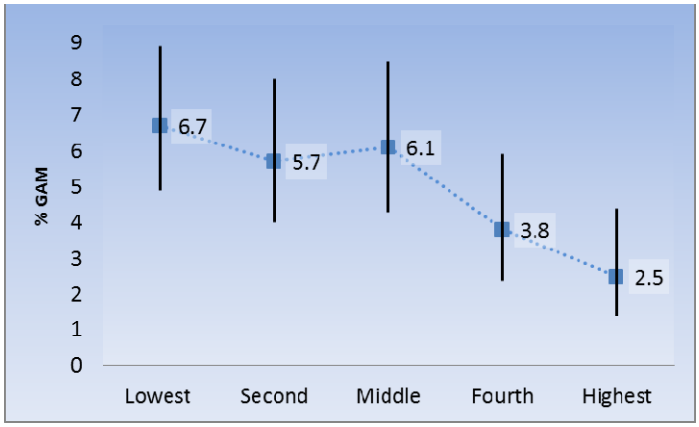


Household wealth and maternal education level

A ***significant difference by wealth index*** was noted with (p=0.02), with a distinct divide between the first three quintiles and the last two[120].

In order to look at the link between maternal education and acute malnutrition, maternal education was divided into those with no education, those who completed primary school and those that completed secondary education. So for ***maternal education level a significant difference in GAM prevalence*** is noted (p=0.0002) with a significantly higher level of GAM among mothers with no or only primary level education compared to mothers with secondary level education or more. The association between maternal education and GAM exits when taking wealth index into account.

Fig. 68 - Prevalence of GAM by wealth index



No difference in GAM or SAM was noted for female headed households compared to male headed household.

Table 35 - Acute malnutrition using WHO standards 2006 by maternal education

	% global malnutrition	95% CI	Denominator (n)
No education	**7.2**	**[5.6 - 9.3]**	**1042**
Primary education	**5.3**	**[4.2 - 6.8]**	**1391**
Secondary education	**1.7**	**[0.8 - 3.2]**	**442**

Child morbidity

Child illness is known to have an immediate impact on acute malnutrition Indeed the ***prevalence of global and severe acute malnutrition is significantly higher among children who were ill*** in the two weeks prior to the survey (p=0.0000 for global acute malnutrition and, p= 0.0474 for severe acute malnutrition).

[120]Further analysis by livelihood zone was not conducted, due to the small sample size and low prevalence of acute malnutrition by livelihood zone

Table 36 - Prevalence of acute malnutrition by health status of the child.

	% global acute	95% CI	% Severe acute	95% CI	Denominator (n)
Recent morbidity	7.0	[6.1 - 8.0]	0.87	[0.57 - 1.35]	4361
No recent morbidity	4.2	[3.6 - 4.9]	0.47	[0.31 - 0.71]	5613
Total	5.4	[4.9 - 6.1]	0.65	[0.48 - 0.88]	9974

Since wealth index and child age are both associated with global acute malnutrition and recent illness, it is important to look at global acute malnutrition and sickness when we take these two factors into account.

The odd ratio of a child suffering from acute malnutrition is 1.64 (1.37 – 1.95, 95 percent CI) times higher if the child is sick in the two weeks prior to the survey (p =0.000), however if we take wealth index into account the association between child acute malnutrition and child sickness is less evident (p =0.0629) with a pooled odd ratio of 1.34 (0.98 – 1.84, 95 percent CI).

If we take child age into account, the association is still present but it is strongest in children less than six months where the odds of acute malnutrition are 1.9 times greater in children who are sick compared to children who are 24-59 months where the odds are 1.42 times higher. This highlights the importance of promoting exclusive breastfeeding in children under-six months where such children are less at risk of ill health if breastfed[121].

Table 37 - Odds of acute malnutrition if sick in the 2 weeks prior to the survey by age category

	Odds Ratio	95% CI	p*
<6 months	1.94	[1.05 – 3.51]	0.030
6-23 months	1.65	[1.24 – 2.19]	0.000
24 – 59 months	1.42	[1.11 – 1.82]	0.005

** Mantel-Haenszel test*

Household food security and acute malnutrition

As seen in the conceptual framework, household food security has an impact on child malnutrition by influencing child dietary intake. In this analysis, household food security is assessed using two indicators, food consumption score and food insecurity category, details of which are in Annex II.

Table 38 - Prevalence of acute malnutrition by household food consumption profile

Food consumption	% global acute malnutrition	95% CI	% Severe acute malnutrition	95% CI	Denominator (n)
Poor	8.0	[5.8 – 10.8]	0.89	[0.29 - 2.65]	440
Borderline	5.8	[4.4 – 7.7]	0.68	[0.34 - 1.35]	1182
Acceptable	3.7	[2.8 – 5.0]	0.31	[0.12 - 0.84]	1470

There is a ***positive linear and significant link between household food consumption score and global acute malnutrition in children under five*** (p= 0.004), the association exists even when you take wealth and maternal education into account. It is not possible to look at this trend within each livelihood due to the low prevalence of acute malnutrition. For severe acute malnutrition the same trend is seen however, again the prevalence is too small to look at the significance of the trend.

[121]WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality. Effect of breastfeeding on infant and childhood mortality due to infectious diseases in less developed countries: a pooled analysis. *Lancet*, 2000, 355:451–455.

Chapter 6 of this document describes in detail the typical Malagasy diet and the distribution across the country of households with poor food consumption groups (FCGs).

Food overall household security, there is a ***significantly higher prevalence of global acute malnutrition in households who are food insecure compared to households that are food secure*** (*p*= 0.007), the association exist even when we take wealth and maternal education into account. It is not possible to look at this trend within each livelihood due to the low prevalence of acute malnutrition. For severe acute malnutrition the same trend is seen however, again the prevalence is too small to look at the significance of the trend

Table 39 - Prevalence of acute malnutrition by household food security

Food security category	% global acute malnutrition	95% CI	% Severe acute malnutrition	95% CI	Denominator (n)
Food secure	4.1	[3.1 – 5.2]	0.55	[0.29 - 1.05]	1779
Food insecure	6.5	[5.1 – 8.2]	0.34	[0.13 - 0.79]	1281

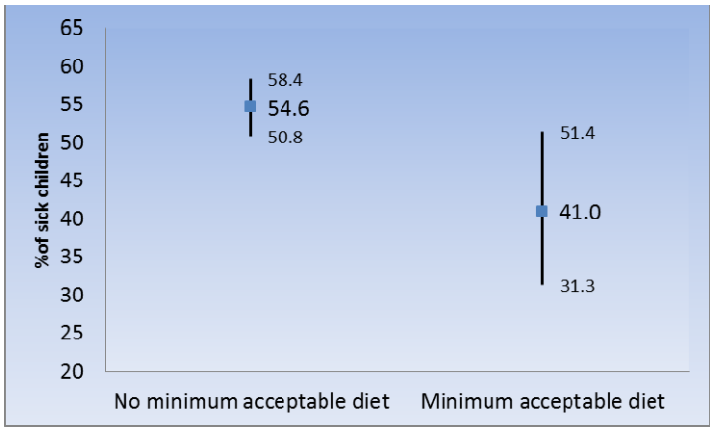
Infant and young child feeding practices and acute malnutrition

A ***higher prevalence of acute malnutrition is found among children who are not exclusively breast fed compared to children who are exclusively breastfed*** (28.9 percent compared to 19.7 percent). However the sample size and prevalence of acute malnutrition is too small to determine the significance of this difference.

Fig. 69 - Proportion of infants < 6 months who were sick in the 2 weeks prior to the survey by breastfeeding status

Since infant feeding practices are thought to have an effect on malnutrition by influencing dietary intake[122] and by impacting child health, the link between morbidity and exclusive breast feeding was explored. For morbidity, a ***significantly higher proportion of infants under six months who were not exclusively breastfed were sick in the two weeks prior to the survey*** (*p*= 0.0001).

Fig. 70 - Proportion of sick children by acceptable diet status



There is ***a higher prevalence of acute malnutrition among children who have not received the minimum acceptable diet*** (7.7 percent compared to 3.8 percent); however the sample size is too small to determine the significance of this difference.

With regards to child morbidity, among children who were sick in the two weeks prior to the survey significantly less children received a minimum acceptable diet (*p*=0.01).

[122] Insufficient detailed information was collected on dietary intake to assess the quantitative adequacy of dietary intake for children.

9.2. Why? (Driving forces for acute malnutrition)

To understand which factors impact wasting[125] in Madagascar, a multivariate analysis has been conducted on some of the key indicators already examined at bivariate level. Independent variables pertaining to the immediate, underlying and basic causes of acute malnutrition as defined in the conceptual framework (e.g., household food security, dietary intake, morbidity, care practices, poverty and environmental variables) were included in the regression models.

Least-squares based linear regression models

Least-squares based linear regression models were developed, which regressed a series of independent variables by the continuous dependent variable (the z-score for acute malnutrition). Two models were designed one for children under five and one for children under two as dietary adequacy[123] was assess only for children under two and included in the model.[124]

The model was run only at country-level due to the low prevalence of acute malnutrition.

For all children less than 5 years

A significant country-level model emerged (F80.02; p<0.0000) accounting for 21.5 per cent of the total variance (Adj R^2 = 0.2146). The variables that emerged as significantly associated with wasting of children under-five are discussed below.

- **Maternal education** – Maternal education (as a dichotomous variable; no education and primary education versus secondary education and above) is associated with wasting (p=0.036) and has the largest impact on wasting.
- **Child morbidity** – Child morbidity is positively associated with wasting (p=0.04) with the second largest impact.
- **Household food insecurity** – a weak but positive association was found (p=0.052) between household food insecurity and child wasting.
- **Economic Status / Wealth** – as expected, wealth was significantly associated with wasting and showed a strong positive effect on the dependent variable (p<0.005).
- **Child age** – as expected, child age was significantly associated with wasting (p=0.000) however the impact varies with age; largest impact seen in the 6-23 months.

For all children less than 2 years of age.

A significant country-level model emerged (F37.28; p<0.0000) accounting for 23.5 per cent of the total variance (Adj R^2 = 0.2354). The variables that emerged as significantly associated with wasting of children under-two are discussed below.

- **Maternal education** – Maternal education (as a dichotomous variable; no education and primary education versus secondary education and above) is strongly associated with wasting (p=0.004) and has the largest impact on wasting.
- **Child morbidity** – Child morbidity is positively associated with wasting (p=0.005) with the second largest impact.
- **Acceptable diet** – consumption of an acceptable diet is significantly and positively associated with wasting (p=0.02) in children under-two.

[123] Dietary acceptability for children less than 6 months; exclusive breastfeeding at least 10 times in 24h prior to the survey and for children 6-24 months this includes dietary diversity and frequency the day prior to the survey.

[124] The variables included in the model were the following: 1) livelihood zone, 2) household size, 3) age of child, 4) sex of child, 5) maternal educational level, 6) food consumption score, 7) wealth index, 8) food security category, 9) hand washing by mothers, 10) access to safe water, 11), morbidity and care seeking behaviour in the two weeks prior to the survey 12) coping strategy index.

[125] Due to the low prevalence of edema, and continuous nature of wasting, the latter was used in the regression model.

- **Child sex** – A significant difference is seen between sexes with boys more likely to be wasted than girls (p=0.01), previous analysis showed less exclusive breastfeeding among boys than girls which explain the difference seen in this age group.

Interestingly neither **household food insecurity** nor **household wealth** is associated with wasting in under-two year olds, yet maternal education is. This suggests that poor infant feeding habits impacts a child nutritional status irrespective of wealth and food security exists in Madagascar.

9.3. Stunting

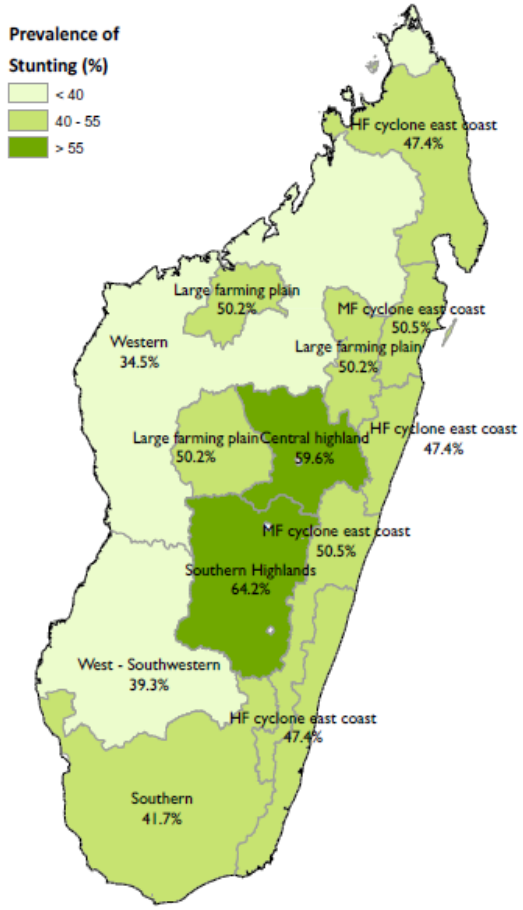
Livelihood Zones

Overall, the stunting prevalence for rural zones covered by the CFSVA+N is **48.7 per cent (47.1-50.3, 95 percent CI), just slightly** less than that found in the latest DHS of 50.9 percent in rural areas.

Significant differences in stunting prevalence among the livelihood zones is noted (p=0.000) with the highest level of stunting found in the southern highlands (64.2 percent) followed by the central highland (59.6 percent) (see figure 71).

Annex V shows the detail for global and severe stunting by livelihood zone and region.

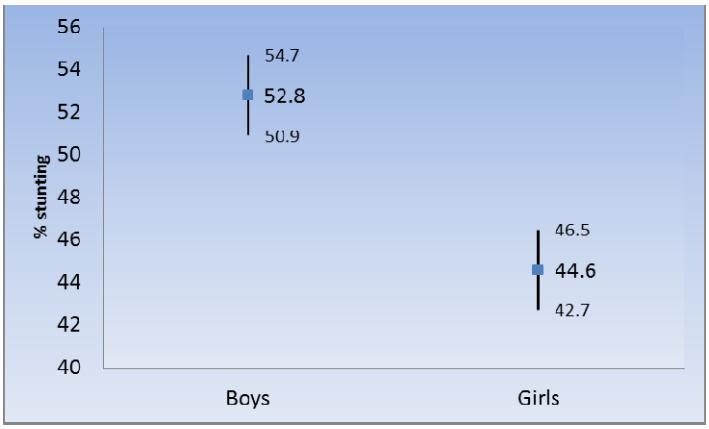
Fig. 71 - Distribution of stunting by livelihood zone



Child gender

A significant difference between boys and girls is noted, with ***a higher prevalence of stunting found among boys than girls***. A significant difference between the sexes is noted in all livelihood zones except for Central highlands. This suggests that in Madagascar, boys are "treated" differently to girls resulting in a longer-term negative impact on the development of boys (this will be explored further in the next chapters).

Fig. 72 - Prevalence of stunting by Sex



Age group

Since stunting is a result of a cumulative impact of chronic malnutrition (poor dietary intake and/or recurrent infection disease), it is to be expected that ***the prevalence of stunting (both global and severe) increases with age***. The difference among age groups being significant (p=0.000). This pattern is seen in all livelihood zones. However, worryingly 20 percent of children less than six months are already stunted which suggests poor nutritional/health practices during pregnancy and in the first six months of the child's life and highlights the importance of concentrating on improving maternal nutrition thereby improving intra-uterine growth and promoting exclusive breastfeeding in the first six months of life.

Table 40 - Stunting (height-for-age z-scores) based using the WHO standards 2006 by age group

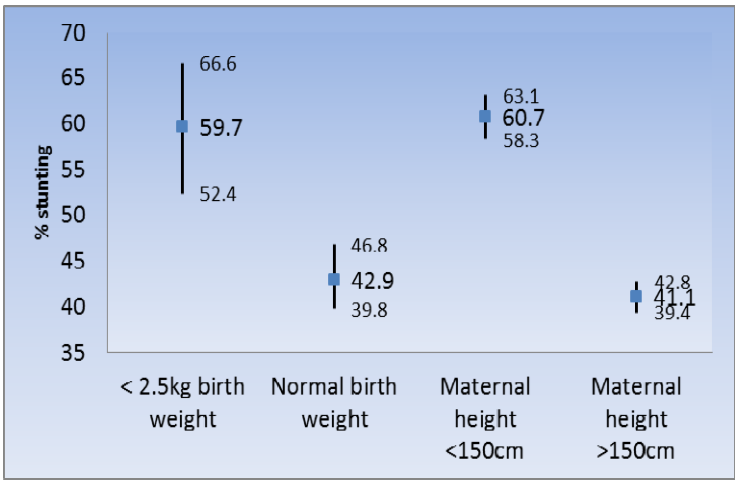
	Global stunting (%)	95% CI	Severe stunting (%)	95% CI	Denominator (n)
Age in months					
<6	19.7	[17.0 - 22.6]	4.9	[3.6 – 6.8]	296
6-11	33.9	[30.3 – 37.7]	11.8	[9.5 – 14.5]	307
12-17	48.3	[45.0 – 51.7]	18.9	[16.4 – 21.7]	341
18-23	58.3	[54.5 – 61.9]	25.3	[22.2 – 28.6]	347
24-59	53.2	[50.4 - 56.0]	19.2	[17.0 - 21.6]	1836
Madagascar	**48.7**	**[47.1 - 50.3]**	**18.8**	**[17.7 - 20.0]**	**10274**

Low birth weight and maternal height

Low birth weight and maternal height have been associated with stunting in children under-five. Therefore this section explores these links[126,127].

For both global stunting and severe stunting, a ***higher prevalence of stunting was noted among children who were born with a low birth weight*** (p=0.02 for global stunting and, p=0.0003 for severe stunting). Within the livelihood zones, the same pattern is seen expect for the two zones with the highest level of stunting (central and southern highlands zones) where no difference in stunting level based on birth weight is observed.

Fig. 73 - Prevalence of stunting by birthweight and maternal height



For maternal stature a ***higher prevalence of stunting is seen in children from mothers with a height less than 150cm*** (p=0.000) compared to mothers with a height above 150 cm, independent of birth weight. This pattern is seen in all livelihood zones which suggest that to effectively break the cycle of stunting in Madagascar more emphasis on maternal health and nutrition is needed, in order to improve birth out-come thereby reducing short stature in the future generation.

Household wealth and maternal education level

A significant difference in global and severe stunting is seen among wealth quintiles (p=0.0009). However the significant differences are only in the highest quintiles with the range of stunting the similar for the first four quintiles. Within the livelihood zones, the significant difference is seen only in the central highland and the high frequency cyclone east coast zone.

[126]Martorell R, Ramakrishnan U, Schroeder DG, Melgar P, Neufeld L. 1998. Intrauterine growth retardation, body size, body composition and physical performance in adolescence. Eur J Clin Nutr. 52 Suppl 1:S43-52

[127]Leary S, Fall C, Osmond C, et al. Geographical variation in relationships between parental body size and offspring phenotype at birth. Acta Obstet Gynecol Scand 2006; 85: 1066–79.

Fig. 74 - Prevalence of stunting by wealth index

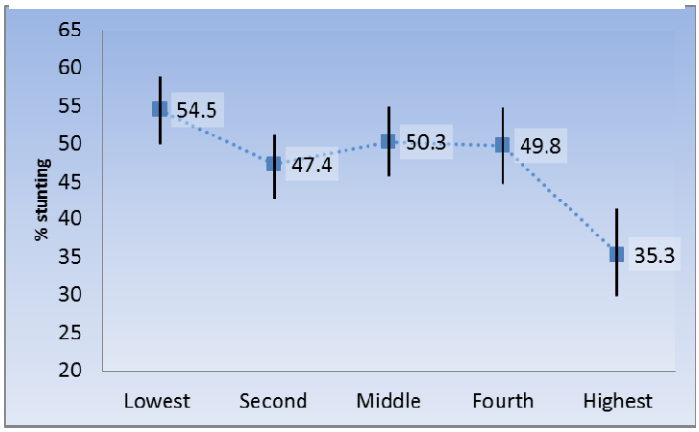


Table 41 - Stunting (height-for-age z-scores) based using the WHO standards 2006 by maternal education level

	Global stunting (%)	95% CI	Severe stunting (%)	95% CI	Denominator (n)
No education	47.5	[43.6 - 51.3]	19.3	[16.5 - 22.4]	1024
Primary	48.5	[45.3 - 51.7]	17.3	[14.8 - 20.0]	1387
Secondary	42.3	[36.8 - 48.0]	13.1	[9.7 - 17.4]	441
Madagascar	**48.7**	**[47.1 -**	**18.8**	**[17.7 - 20.0]**	**10274**

Interestingly, no significant difference in global stunting level is noted among children from mothers with different education levels. The same pattern is seen in all zones except the central highland zone where a significant difference is seen by maternal education (p=0.03), with the prevalence of stunting at 78.2 percent (54.4 - 91.5, 95 percent CI) among children from mothers with no education compared to 38 percent (21.5 - 57.9, 95 percent CI) from mother with at least a secondary level education.

9.4. Underweight

Underweight is a composite indicator of weight-for-height and height-for-age, considering the different aetiology of these two types of malnutrition, this indicator will not be used for further exploration. However it is used for tracking of MDG 1 attainment at the country level and therefore the prevalence is presented in this chapter broken down by background characteristics.

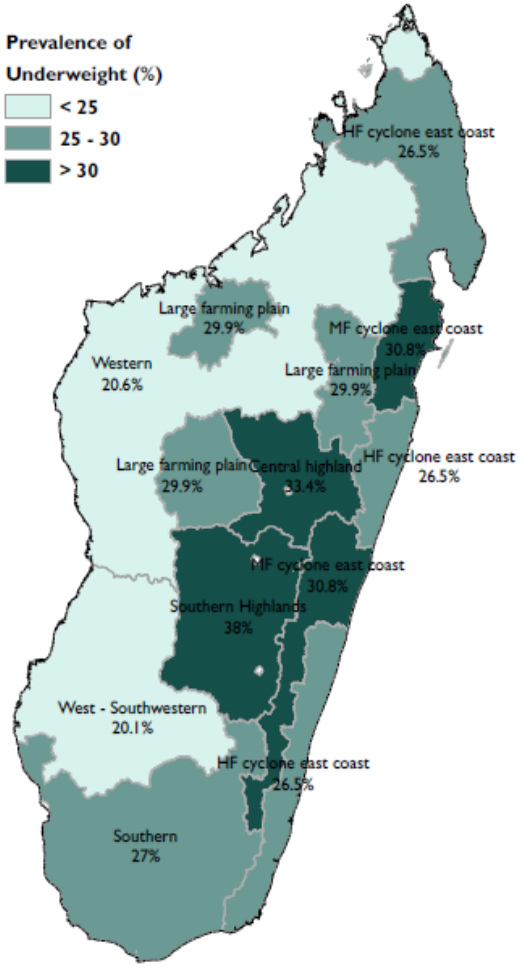
Livelihood zones

Overall, the underweight prevalence for rural zones covered by the CFSVA+N is 27.9 percent (25.8-30.1, 95 percent CI). This is slightly lower than the most recent nationwide rural data from the 2003/2004 DHS which found a prevalence of 36.4 percent in rural Madagascar.

Significant differences in underweight prevalence between the livelihood zones is noted (p=0.000) with the highest level found in southern highlands followed by the central highland (38 percent), this is probably due to the high level of stunting in these zones (see figure 75).

Annex V shows the detail for global and severe underweight by livelihood zones and region

Fig. 75 - Distribution of underweight by livelihood zone



10.0 INFANT AND YOUNG CHILD FEEDING PRACTICES[128]

Infant and young child feeding is an important underlying cause of malnutrition. Along with household food security, it influences a child's dietary intake which subsequently has an impact on the child's nutritional status. In addition inadequate infant feeding practices adversely affects a child health which congruently impacts the child's nutritional status.

10.1. Household food security and child nutritional status.

As seen in chapter 9, there is a higher prevalence of GAM among children who live in food insecure households compared to those in food secure households (6.5 percent and 4.1 percent respectively). Considering this relationship, it is important to revue "who are the food insecure":

Households who are at risk of food insecurity tend to be:

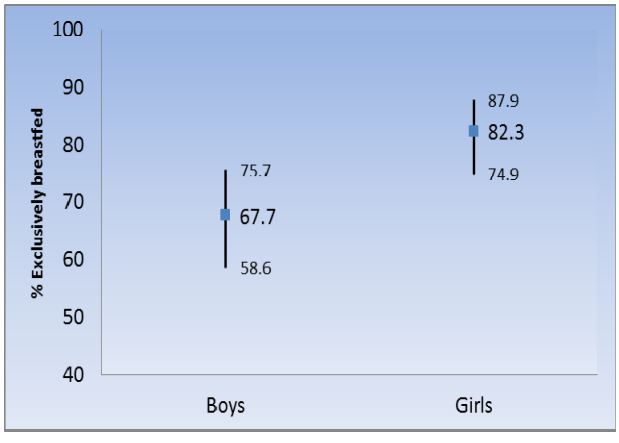
- Large households with more members.
- Households headed by a woman or by an elderly person, and those with a higher percentage of dependents
- Small farmers and casual labourers and Informal sector workers.
- Households that cultivate less land (less than a hectare)
- Households that cultivate a lower variety of crops.
- Households whose food sources are less predictable than producing their own or purchasing, i.e., they rely upon receiving gifts and hunting/gathering,
- Farmers who are net consumers (ie. in deficit) rather than net producers (ie. with surplus).

Details of household food security can be found in chapter 7.

10.2. Infant and young child feeding practices.

To assess infant and young child feeding practices, the eight key indicators as defined by the November 2007 consensus meeting on "Indicators for assessing infant and young child feeding practices" were used[129], as well as other indicators which are pertinent for Madagascar[130]. However it is important to note that the results are not comparable to the latest DHS as different definitions for the indicators where used.

Fig. 76 - Percentage of infants < 6 months exclusively breastfed by sex



Exclusive breastfeeding under six months

In total, **74.5 percent (68.5-79.7, 95 percent C.I.)** of children less than six months of age were exclusively breastfed, with no difference seen by livelihood zones. Although the sample size of children 0-5.9 months is too small to effectively look at differences between zones, the lowest level were found in the southern (57 percent) and west-south western zones (61 percent).

No difference was noted by wealth index or maternal education, *but* ***a significantly higher proportion of girls are exclusively breastfed than boys*** (*p*= 0.005).

[128] Chapter developed by UNICEF Madagascar

[129] WHO Indicators for assessing infant and young child feeding practices Conclusions of a consensus meeting- Washington DC, November 2007

[130] UNICEF, VP/SPM -Recherche Formative sur le Parcours de Soins Santé Maternelle et Infantile - Madagascar – Connaissances, Attitudes, Croyances, Pratiques et Coûts relatifs aux soins de la femme enceinte et de l'enfant, 2008

This disparity between the sexes may explain the higher GAM and stunting levels seen among the boys. These results suggest that there are widespread cultural beliefs related to exclusive breastfeeding that are different for boys and for girls and ***that these beliefs transcend maternal educational levels and wealth***.

Early initiation of breastfeeding

In total the proportion of living 0-24 month old children who were put to the breast within one hour after birth is low at**58.5 percent (54.-62.1, 95 percent C.I.).**

There is ***a significant difference among the livelihood zones regarding the early initiation of breastfeeding*** (p=0.000), with the lowest level seen in the southern zone (29 percent).

A significant difference by maternal educational level is noted (p=0.007) but no difference was noted by wealth index or by child gender. And 61.3 percent (57.2-65.2, 95 percent CI) of new-borns were put to the breast within 1h of birth if the mother sought antenatal follow-up from a health professional compared to 46.8 percent (36.1-57.7, 95 percent CI) if the mother sought antenatal follow-up from a traditional birth attendant (p=0.01), irrespective of maternal education. This suggests that parenting education may compensate for poor education level with regards to behaviour change.

Table 42 - Children born in the last 23.9 months who were put to the breast within one hour of birth by maternal education

	% infants	95% CI	Denominator
No education	50.3	[43.7 - 56.9]	433
Primary education	60.9	[56.0 - 65.6]	582
Secondary education	64.5	[56.0 - 72.1]	171
Madagascar	**58.5**	**[54.8 - 62.1]**	**1281**

Continued breastfeeding at 1 year

Overall, the ***proportion of children who continue to breastfeed at 1 year is high, 96 percent*** (92.4 - 97.7, 95 percent CI) and corresponds with the levels found in the latest DHS. No difference was noted between livelihood zones however the sample size of children 12-15.9 months is too small to effectively look at by livelihood zones.

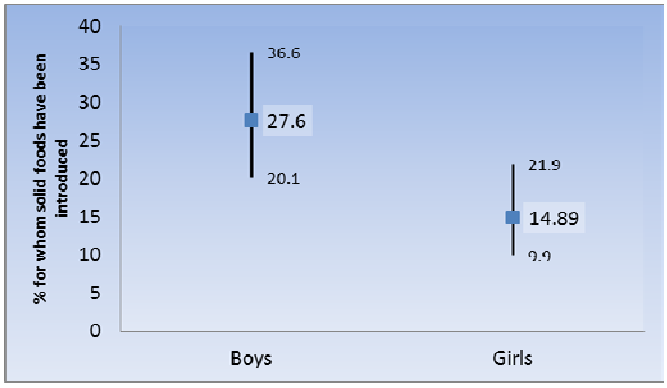
No differences were seen by sex, or maternal education level or wealth index.

Introduction of solid, semi-solid or soft foods

In total ***the proportion of 6-8.9 months old infants who received solid food is high at 91 percent of all children***. No statistical difference was noted between livelihood zones however the sample size of children 6-8.9 months is too small to effectively look at differences between specific zones.

Considering the low level of exclusive breastfeeding it is interesting to look at the characteristics of the child and household with regards to introduction of solid foods in infants under 6 months.

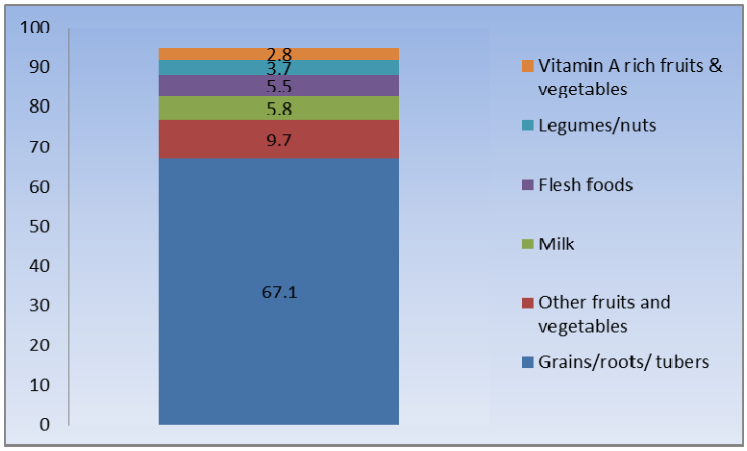
Fig. 77 - Introduction of solid or semi-solid foods in infants < 6 months by sex



For children under the age of 6 months, 21.4 percent (16.5-27.3, 95 percent CI) have had ***solid or semi-solid foods introduced, with a significant difference between the sexes***. Nearly twice as many boys having had solids or semi-solid foods introduced

than girls. Indeed in the latest DHS, median length of time boys were exclusively breastfed is less than for girls (2.1 months compared to 2.6 months). Further highlighting that solids and semi-solids are introduced earlier for boys than for girls, this difference may contribute to the difference seen in malnutrition levels seen between boys and girls (stunting and acute malnutrition). No difference was noted by wealth quintiles or maternal education. The sample size is too small to effectively look at difference by livelihood zone, although looking at trends it seems that the southern and western zones have the highest proportion of children under-six months for which solid or semi-solid foods were introduced (40.5 percent and 31 percent respectively).

Fig. 78 - Types of food given to children < 6 months



Of those that are not exclusively breastfed, 67 percent received foods from the "grain, roots and tuber" food group and just fewer than 10 percent have received other fruits and vegetables with no difference seen between the livelihood zones.

Minimum dietary diversity

Overall, only **14.4 percent (11.5-17.8, 95 percent C.I.)** of children 6-23.9 months have received a minimum dietary diversity with no significant differences noted by livelihood zones; however the sample size in some livelihood zone is too small to effectively look at difference between livelihood zones.

There is a significant difference in the ***proportion of children 6-23.9 months who received a minimum dietary diversity by maternal education*** (p =0.000) and a ***very large difference in minimum dietary diversity by wealth quintile*** particularly with regards to the highest quintile were 39.4 percent of children received a minimum dietary diversity compared to the other wealth quintiles with only 11 percent of children (p =0.000) receiving the minimum dietary diversity.

Fig. 79 - Proportion of children 6-23.9 months of age who receive a minimum dietary diversity by maternal education

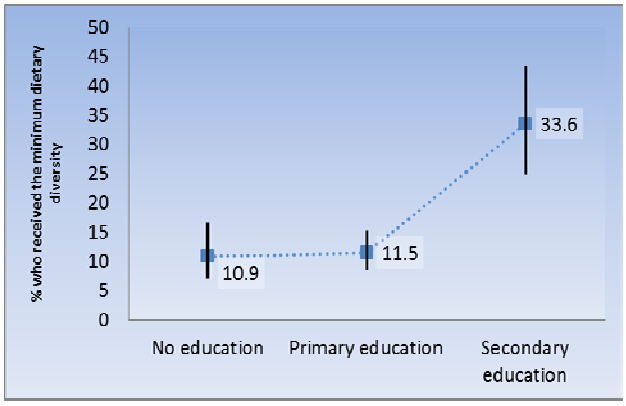
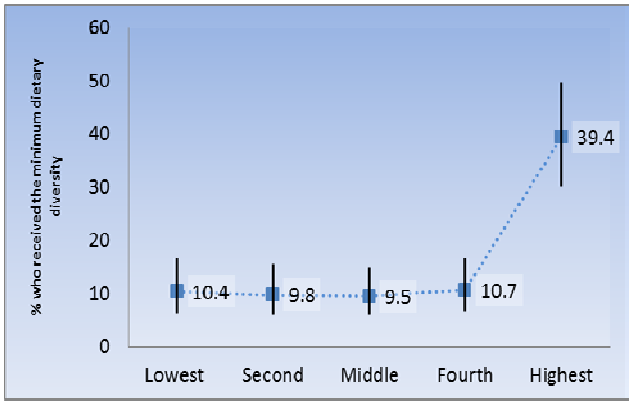


Fig. 80 - Proportion of children 6-23.9 months of age who receive a minimum dietary diversity by wealth index



No difference between boys and girls in the consumption of the minimum dietary diversity is seen for each age group. However, ***the age group 6-11.9 months has the worst dietary diversity*** with only 7.9 percent of infants receiving the minimum dietary diversity.

Fig. 81 - Minimum dietary diversity by age group

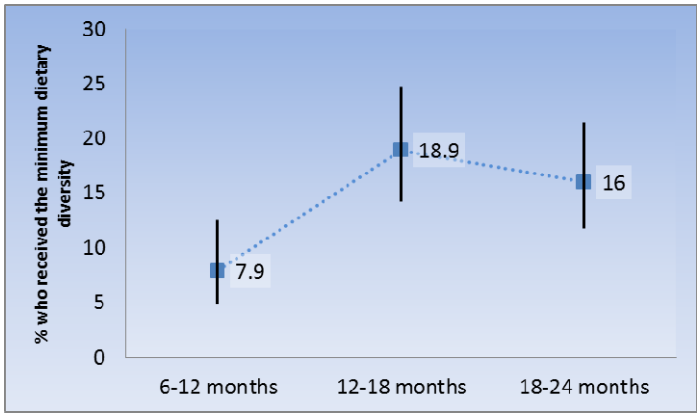
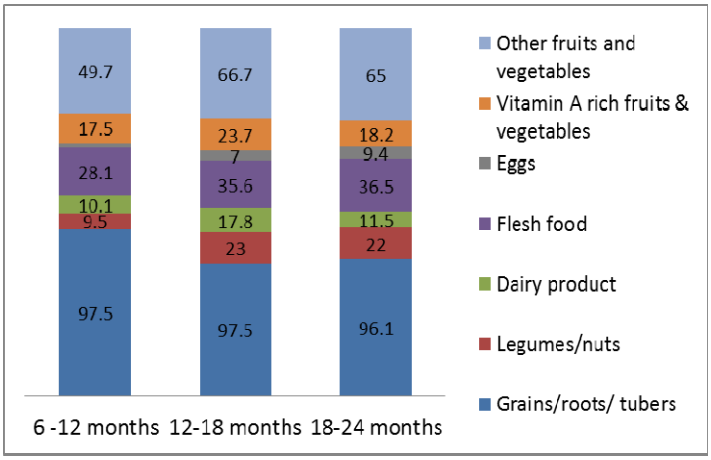


Figure 82 looks at the proportion of children who have received foods from the different food groups by age group. It can be seen that children 6-12 months have received less micronutrient rich compared to older children. The low proportion of children 6-12 months who have eaten micronutrient rich foods is worrying since for this age group it is recommended that approximately 65 percent of energy intake is from breast milk, and that introduction of micronutrient rich complementary foods is necessary to fill the energy gap and meet the micronutrient requirement of infants which can no longer be met by breast milk alone[131].

Fig. 82 - Proportion of children who received food from the different food groups by age group



Minimum meal frequency

For the total sample, the proportion of children (breastfed and non-breastfed) that have received the minimum number of meals in the day prior to the survey is **73.0 percent (69.5 - 76.3, 95 percent C.I.)** however when this is disaggregated by breastfeeding status, a significant and large difference is seen between these groups with only 28.2 percent of non-breastfed children receiving the minimum number of meals compared to 83.4 percent of breastfed children. The sample size is too small to effectively look at differences in minimum meal frequency by livelihood zones, however the southern zones has by far the lowest proportion of children who received the minimum number of meals (33.1 percent).

[131]WHO. *Complementary feeding. Family foods for breastfed children*. Geneva, World Health Organization, 2000.

Table 43 - Proportion of children 6-23 months who received the minimum number of meals by livelihood zone

	Breastfed children		Non breastfed children		All children	
	% of children	Denominator	% of children	Denominator	% of children	Denominator
MF cyclone east coast	82.1 [67.1 - 91.2]	67	19.5 [5.6 - 49.3]	12	72.7 [59.0 - 83.0]	79
HF cyclone east coast	84.2 [76.6 - 89.7]	164	43.6 [26.4 - 62.5]	31	77.2 [70.7 - 82.7]	195
West-Southwestern	89.4 [74.1 - 96.1]	53	10.5 [2.2 - 38.2]	13	70.6 [54.9 - 82.6]	66
Western	86.3 [78.6 - 91.5]	163	56.1 [36.9 - 73.7]	44	77.5 [69.7 - 83.9]	207
Southern	49.8 [39.7 - 59.8]	126	2.16 [0.5 - 8.8]	54	33.1 [25.8 - 41.3]	180
Central highland	99.1 [96.4 - 99.8]	43	21.9 [5.4 – 58.0]	11	87.5 [74.0 - 94.5]	54
Large farming plain	80.3 [71.8 - 86.6]	114	31.7 [14.9 - 55.0]	21	73.0 [64.0 - 80.4]	135
Southern Highlands	90.3 [81.6 - 95.2]	90	38.4 [5.9 - 86.0]	5	86.8 [78.1- 92.3]	95
Total	**83.4 [80.1 - 86.3]**	**820**	**28.2 [20.9 - 36.9]**	**191**	**73.0 [69.5 - 76.3]**	**1011**

No difference in minimum number of times a breastfed child is fed was noted by gender or wealth quintiles. However **a significant difference can be seen by maternal education** (p=0.004), with children from mothers with a lower education less likely to receive the minimum number of feeds.

Table 44 - Proportion of children 6-23 months who received food the minimum number of time by maternal education

	% of breastfed children	95% CI	Denominator
No education	66.9	[59.7 – 73.3]	345
Primary education	78.6	[74.1 – 82.5]	457
Secondary education	82.0	[72.0 – 88.9]	132

Minimum acceptable diet

In total ***the proportion of children (breastfed and non-breastfed) that have received the minimum acceptable diet during the day prior to the survey is quite low*** (13.3 percent) with very little difference between children who are breastfed and children who are not breastfed.

Table 45 - Proportion of children 6-23.9 months of age who received the minimum acceptable diet by livelihood zone.

	Breastfed children		Non breastfed children		All children	
	% of children	Denominator	% of children (95% CI)	Denominator	% of children	Denominator
MF cyclone east coast	17.1 [7.7 - 33.8]	67	19.5 [5.7,49.3]	12	17.4 [7.6 - 35.1]	79
HF cyclone east coast	11.5 [6.6 - 19.5]	164	30.0 [15.7,49.7]	31	14.4 [9.6 - 21.1]	195
West-Southwestern	22.1 [11.3 - 38.8]	53	10.5 [2.3,38.2]	13	19.3 [10.3 -	66
Western	9.4 [5.4 - 15.9]	163	16.8 [6.5,37.0]	44	11.2 [6.6 - 18.4]	207
Southern	4.3 [1.9 - 9.7]	126	0.9 [0.1,6.7]	54	3.1 [1.4 - 6.8]	180
Central highland	16.7 [7.4 - 33.5]	43	0	11	14.2] [6.4 - 28.5]	54
Large farming plain	7.8 [4.2 - 14.1]	112	6.1 [1.4,22.7]	21	7.5 [4.3 - 13.0]	133
Southern Highlands	13.7 [8.4 - 21.5]	90	38.4 [5.9,86.0]	4	14.5 [9.1 - 22.4]	94
Total	**12.2 [9.5 - 15.5]**	**818**	**13.3 [8.4,20.4]**	**191**	**12.3 [9.8 - 15.3]**	**1008**

No differences by livelihood zone was noted, however the southern zone had by far the lowest percentage of children who receive the minimum acceptable diet (3.1 percent).

No difference between genders was noted in the proportion of children who have received the minimum acceptable diet. However ***a significant difference was noted by maternal education*** (p=0.0000) ***and wealth index*** (p=0.000).

Fig. 83 - Proportion of children 6-23.9 months of age who receive the minimum acceptale diet by maternal education

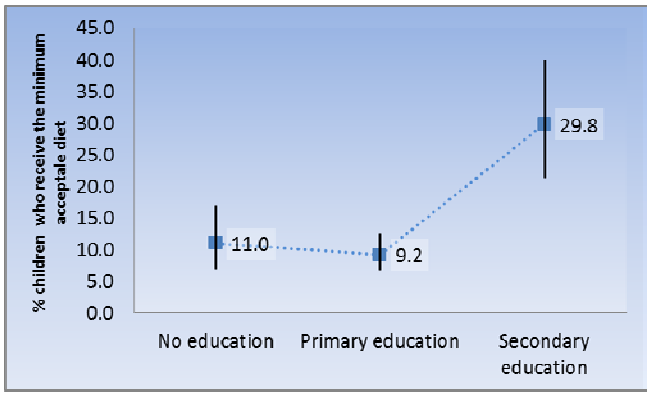
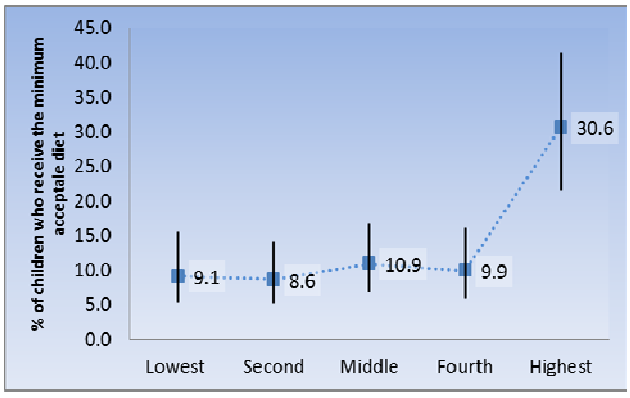


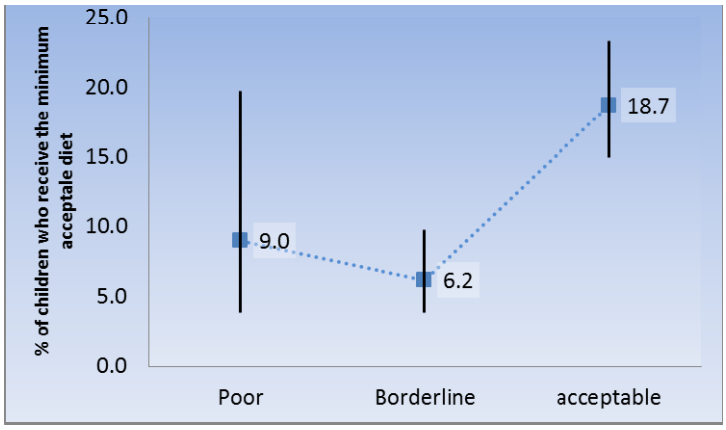
Fig. 84 - Proportion of children 6-23.9 months of age who receive the minimum acceptale diet by wealth index



Since wealth index and maternal education are both associated with a child receiving the minimum acceptable diet, it is important to look at minimum acceptable diet when you take these two factors into account.

The odds of a child receiving an acceptable diet is 1.79 (1.34 – 2.40 95 percent CI) times higher if the mother is educated (p =0.000), however if you take wealth index into account the association between a child receiving an acceptable diet and maternal education is less evident (p =0.2724) with a pooled odd ratio of 1.25 (0.89 – 1.76 95 percent CI).

Fig. 85 - Proportion of children receiving an acceptable diet by household food consumption profile.



As seen in Chapter 6 of this report, the Malagasy diet is based mainly on rice (average weekly consumption is 6.2), vegetables (4.4 times a week) and tubers (mainly cassava, 3.9). Vegetable and animal proteins are rarely consumed (once and 2.3 times respectively). Fish is the most popular animal protein, with an average weekly consumption of 1.3 days. Nationally, over half (53 percent) of rural households have an unacceptable food consumption, i.e. they consume limited or insufficient nutritious foods to maintain an active and healthy life. Of these, 12 percent have a poor food consumption profile. Therefore it is interesting to see how these levels of household food consumption affect infant feeding practices. Significantly more children from households with an acceptable food consumption profile are benefiting from an acceptable dietary intake compared to households with a poor or borderline food consumption (p =0.0004). Nevertheless this still remains low with only 19 percent of children in these households receiving the minimum acceptable diet. Interestingly fewer children received the minimum acceptable diet in households with a borderline food consumption profile (six percent) than those in households with poor food consumption profile (nine percent).

Compared to the two other groups (poor and acceptable), households with borderline food consumption are those who that:

- Have younger head of households (under 24 years) or elder head (over than 60 years).
- Have more orphans (4 percent of children).
- Spend more on rice rather than on other cereals (they eat less maize).
- Spend more on sugar/salt, traditional medicines and clothes.
- Are « casual laborer » or vegetable sellers.
- More practice cash crop agriculture (rice, cane sugar or exported crops).
- Net seller (net seller of cassava) with main source of food is “own production”.
-

Therefore, these groups are more likely to sell micronutrient rich foods such as vegetables in order to purchase rice.

Food group consumption profile including iron-rich food

Table 46 - Proportion of children who received food from each food group the day prior to the survey by livelihood zones

	% of children who ate grains/roots/ tubers	% of children who ate legumes/ nuts**	% of children who ate dairy product	% of children who ate flesh food**	% of children who ate eggs**	% of children who ate vitamin A rich fruits & vegetables **	% of children who ate other fruits and vegetables
MF cyclone east coast	100	32.5 [7.9 - 51.6]	21.2 [9.6 - 40.6]	44.4 [30.8 - 58.9]	16.7 [7.1 - 34.3]	23.6 [11.1 - 43.3]	66.2 [53.8 - 76.7]
HF cyclone east coast	96.8 [93.8 - 98.4]	25.4 [18.0 - 34.6]	19.0 [12.5 - 27.7]	30.8 [23.6 - 39.1]	9.5 [4.5 - 18.9]	15.9 [10.1 - 24.1]	50.9 [42.8 - 58.9]
West-Southwestern	100	24.3 [13.7 - 39.4]	10.9 [5.3 - 20.8]	43.6 [27.1 - 61.8]	3.7 [1.1 - 11.4]	6.3 [2.2 - 17.0]	66.5 [46.3 - 82.1]
Western	98.4 [93.5 - 99.6]	8.0 [4.8 - 13.2]	6.5 [3.1 - 13.1]	42.4 [32.8 - 52.6]	4.5 [2.2 - 9.2]	15.1 [9.2 - 23.7]	74.6 [66.4 - 81.4]
Southern	91.5 [86.8 - 94.7]	9.5 [5.3 - 16.7]	5.4 [2.9 - 9.8]	11.7 [7.3 - 18.3]	1.0 [0.2 - 4.2]	12.7 [7.8 - 20.2]	52.0 [40.5 - 63.3]
Central highland	98.0 [94.0 - 99.3]	19.6 [9.7 - 35.6]	17.1 [7.2 - 35.4]	38.4 [24.6 - 54.5]	3.2 [0.5 - 17.4]	34.2 [18.4 - 54.6]	67.14 [47.1 - 82.4]
Large farming plain	98.0 [94.0 - 99.4]	14.7 [9.2 - 22.8]	10.5 [6.3 - 17.0]	44.6 [33.4 - 56.3]	6.8 [3.5 - 13.1]	20.1 [13.6 - 28.9]	61.0. [52.5 - 68.8]
Southern Highlands	95.9 [87.8 - 98.7]	17.8 [11.2 - 27.3]	13.0 [7.4 - 21.9]	29.2 [20.4 - 40.1]	6.1 [2.6 - 13.5]	26.0 [16.9 - 37.8]	59.5 [46.7 - 71.1]
Total	**97.1 [95.7 - 98.0]**	**18.6 [15.3 - 22.5]**	**13.3 [10.4 - 17.0]**	**33.6 [29.8 - 37.7]**	**6.5 [4.5 - 9.4]**	**20.0 [16.2 - 24.3]**	**60.8 [56.3 - 65.0]**

** Significant difference noted between the livelihoods zones using Pearson: Uncorrected chi^2

In all livelihood zones the consumption of grains/roots and tubers are high and above 90% of children.

For legumes and nuts, the Western followed by the Southern zone had the lowest proportion of children who have eaten from this food group and is below 10 percent.

For dairy products the Southern followed by the western zone had the lowest proportion of children and again is below 10 percent.

For the ***consumption of "flesh food" the difference between livelihood zones is significant*** with the lowest proportion seen in southern zone at 11.7 percent compared to 29.2 percent in the southern highland which has the second lowest proportion of children who have eaten flesh food. Interestingly, these are the zones with the highest proportion of agro-pastoralist as seen in chapter 4.

For vitamin A rich foods the difference is significant with the lowest proportion of children seen in South-Western followed by the southern zone, which corresponds to the zones with the lowest crop variety cultivated as seen in chapter 5. The percentage of children consuming other fruits and vegetables showed somewhat lower variability by livelihood zone than consumption of other food groups.

Responsive feeding practices

Although responsive feeding practices is not one of the eight key indicators, optimal complementary feeding depends not only on what is fed, but also on how, when, where and by whom the child is fed. Therefore responsive feeding is an important element of optimal complementary feeding as stated in the guiding principles of complementary feeding[132].

Table 47 - Proportion of children 6-23 months who are encourage or helped to eat, by livelihood zone

	Child helped to eat**		Child encouraged to eat	
	% and CI	Denominator	% and CI	Denominator
MF cyclone east coast	66.5 [57.8 - 74.2]	79	65.8 [54.4 - 75.7]	79
HF cyclone east coast	64.0 [56.3 - 71.1]	190	52.1 [43.5 - 60.5]	190
West- Southwestern	68.9 [54.1 - 80.6]	63	90.2 [77.2 - 96.1]	63
Western	61.8 [52.5 - 70.4]	204	80.5 [73.2 - 86.2]	204
Southern	51.0 [42.7 - 59.3]	181	57.4 [48.5 - 65.8]	181
Central highland	77.4 [59.9 - 88.7]	52	89.3 [77.3 - 95.4]	52
Large farming plain	61.4 [52.9 - 69.3]	133	66.8 [55.3 - 76.7]	133
Southern Highlands	69.0 [59.1 - 77.5]	95	84.7 [75.6 - 90.8]	95
Madagascar	**64.6 [60.8 - 68.1]**	**997**	**70.7 [67.3 - 74.2]**	**997**

In the total sample, 64.6 percent (60.8 - 68.1, 95 percent C.I.) of children are reportedly helped to eat and 70.7 percent (67.3 - 74.2, 95 percent C.I.) of children encouraged to eat. Both indicators ***showed significant variation between the livelihood zones*** (helped to eat: *p=0.0477;* encouraged to eat: *p=0.0000*). With regards to helping to eat, the lowest proportion was seen in southern zone with only 51 percent of children helped to eat but for encouragement. The lowest is in the high frequency cyclone east coast with 52.1 percent of children encouraged to eat followed by southern zone (57.4 percent).

No difference was noted by maternal education or wealth index with regards to helping children to eat. However significant difference is noted for encouraging children by maternal education and wealth index (*p=0.0000* and; *p=0.000* respectively).

[132] PAHO/WHO. (2002). Guiding principles for complementary feeding of the breastfed child. Washington DC, Pan American Health Organization/World Health Organization.

Fig. 86 - Proportion of children 6-23.9 months of age encouraged to eat by maternal education

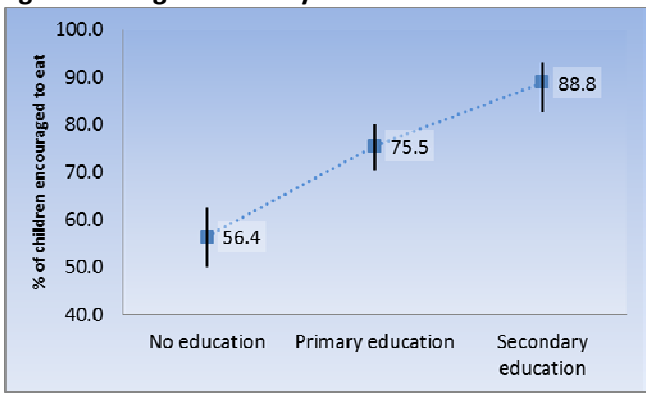
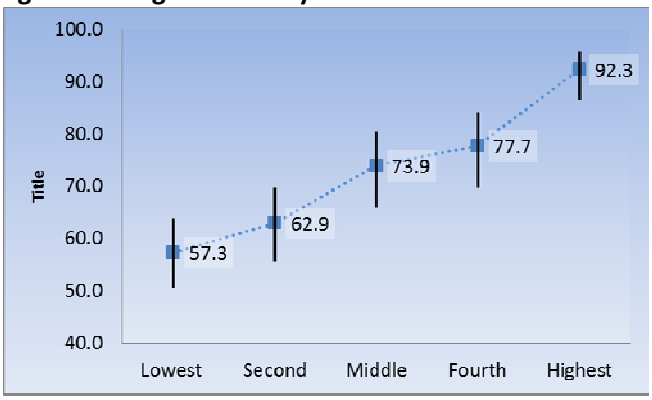


Fig. 87 - Proportion of children 6-23.9 months of age encouraged to eat by wealth index



However when maternal education and encouraging children to eat is explored taking into account wealth index the association is less evident, with a crude odds ratio at 1.89 (1.54-2.3, 95 percent C.I.) compared to a crude odds ratio 1.53 (1.21- 1.95, 95 percent CI) when you take wealth into account, suggesting that poor household may not have as much time to spend encouraging children to eat.

No difference was noted between boys and girls with regards to responsive feeding.

11.0 HEALTHY ENVIRNOMENT AND CARE SEEKING BEHAVIOUR[133]

As seen in chapter 9, the odds of a child suffering from acute malnutrition is 64 percent times higher if the child was sick in the two weeks before the survey: in total, 44 percent of children were sick during this time period with the lowest proportion in the central highlands and the highest in the southern zone where twice as many children were sick.

Considering this relationship between child morbidity and acute malnutrition, it is important to look at the characteristics of children sick in the two weeks prior to the survey as well as the health care seeking behaviour for these children.

11.1. Child health

Disease incidence and health care seeking behaviour for children

In total, **44 percent (42.2 - 45.8, 95 percent CI)** of children were sick in the two weeks prior to the survey with a significant variation among the livelihood zones. The lowest proportion is seen in the central highland compared to the Southern zone where twice as many children were sick in the 2 weeks prior to the survey (p =0.000). These incidences are higher than those reported in the latest DHS. However this is probably due to seasonal variation since the DHS was conducted between November 2008 and August 2009 and the current assessment was conducted in August/ September 2010.

Treatment was sought for only 26 percent of sick children, with a significant difference seen by livelihood zones with the highest level seen in the large farming plains, 44.5 percent compared to only 11.3 percent in south western zone (p =0.0000).

Fig. 88 - Proportion of children sick in the 2 weeks prior to the survey

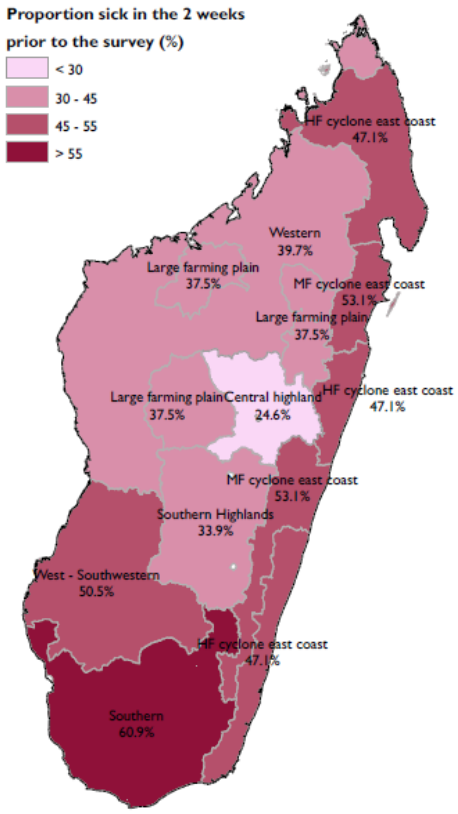
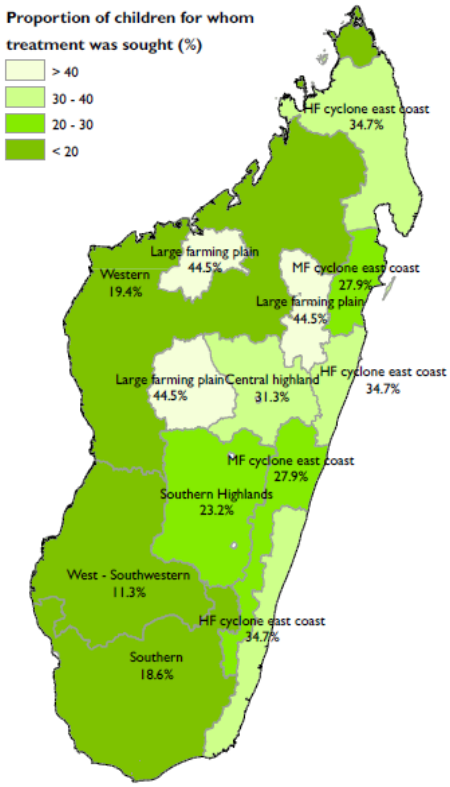


Fig. 89 - Proportion for whom treatment was sought



[133] Chapter developed by UNICEF Madagascar

Table 47 looks at the distribution of the major causes of under-five deaths in Madagascar.

Table 48 - The percentage of children under-5 who had symptoms of acute respiratory infection (ARI), diarrhea or a fever in the two weeks preceding the survey - by background characteristics

	Percentage of children under 5 suffering from an illness in the 2 weeks prior to the survey				
	Fever	% treatment sought	diarrhoea	% treatment sought	Acute respiratory infection *
MF cyclone east coast	24.1 [20.4 - 28.3]	24.7 [16.2 - 35.8]	19.2 [16.0 - 22.9]	28.6 [19.7 - 39.4]	14.8 [11.7 - 18.6]
HF cyclone east coast	18.0 [16.1 - 20.0]	33.8 [28.1 - 40.1]	13.6 [11.8 - 15.5]	34.0 [27.9 - 40.7]	11.7 [9.9 - 13.8]
West-Southwestern	22.2 [15.2 - 31.2]	7.1 [2.9 - 16.2]	16.1 [10.7 - 23.4]	15.7 [5.3 - 37.9]	12.2 [8.5 - 17.3]
Western	16.1 [13.23 -	19.5 [13.6 - 27.1]	10.0 [7.8 - 12.9]	16.9 [10.8 - 25.5]	10.4 [8.1 - 13.2]
Southern	29.5 [25.6 - 33.6]	17.2 [12.5 - 23.3]	19.4 [16.3 - 22.9]	18.6 [13.0 - 25.7]	12.5 [9.2 - 16.9]
Central highland	12.1 [8.9 - 16.2]	30.5 [20.4 - 42.9]	7.0 [5.0 - 9.6]	30.3 [18.2 - 46.0]	3.2 [2.0 - 5.0]
Large farming plain	18.0 [14.6 - 21.9]	41.0 [33.0 - 49.4]	9.3 [7.4 - 11.5]	41.1 [31.57 - 51.24]	5.6 [4.2 - 7.4]
Southern Highlands	15.7 [12.4 - 19.6]	24.4 [16.5 - 34.4]	7.6 [6.1 - 9.6]	17.5 [10.4 - 27.7]	7.9 [6.0 - 10.3]
Total	**19.5 [18.1 - 20.9]**	**24.5 [21.8 - 27.5]**	**12.8 [11.8 - 13.9]**	**25.0 [21.9 - 28.3]**	**10.0 [9.0 - 11.1]**

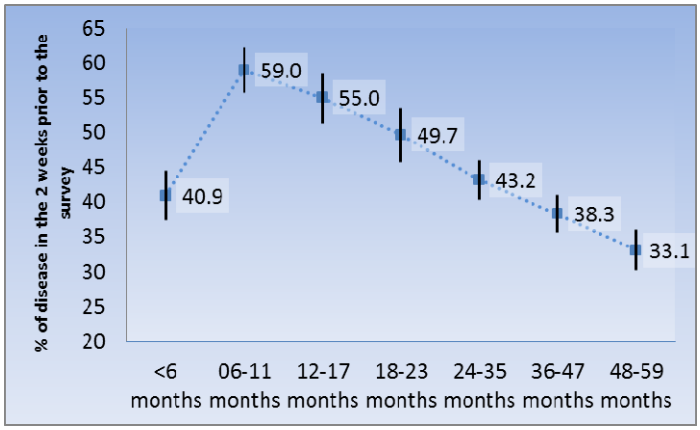
*Acute respiratory infection defined as cough in the last 2 weeks and rapid breathing as reported by the mother

As would be expected significant difference in morbidity is seen among the different livelihood zones, with fever more prevalent in the southern zone, acute respiratory infection more prevalent in the medium frequency cyclone affected east coast stratum and diarrhea incidence at the same high level in both zone.

As would be expected, a significant difference in the incidence of illness is seen by age group ***with children 6-17 months of age the most affected*** (p =0.000), since this corresponds to the age group for the introduction of complementary food, exploration of the environment and maturation of the immune system.

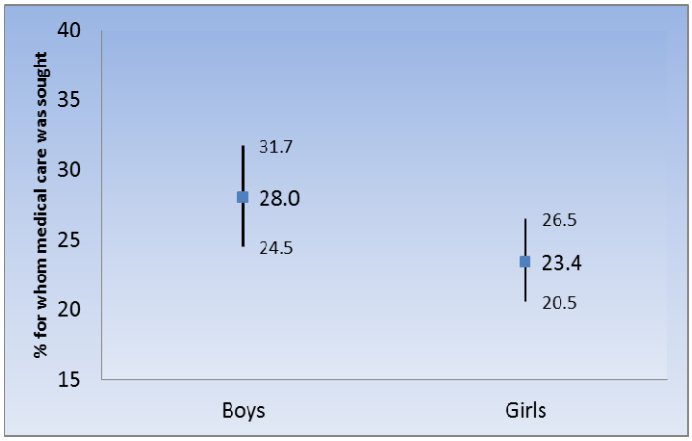
For care seeking behavior, a significant difference is seen with ***younger children more likely to be seen by a health provider*** (p =0.02).

Fig. 90 - Morbidity in the 2 weeks prior to survey by age group



For sex, no difference in the incidence of illness is seen, however ***treatment was sought significantly more for boys than for girls*** (28 percent compared to 23 percent, (p =0.02). The association is seen when you take, maternal education, wealth and child age into account. Once again, suggesting that in Madagascar, boys are "treated" differently to girls irrespective of maternal education and household wealth.

Fig. 91 - Health seeking behaviour by child sex



A significant difference is seen by wealth index with children from households in the lowest and second lowest wealth quintile more likely to have sick children compared to the richer quintiles. From the third quintile onwards, wealth does not seem to have an impact on the probability of being sick (p =0.0000 and only a very weak evidence that maternal education has an impact on the probability that their child is sick (p =0.0673).

Fig. 92 - Morbidity in the 2 weeks prior to the survey by wealth index

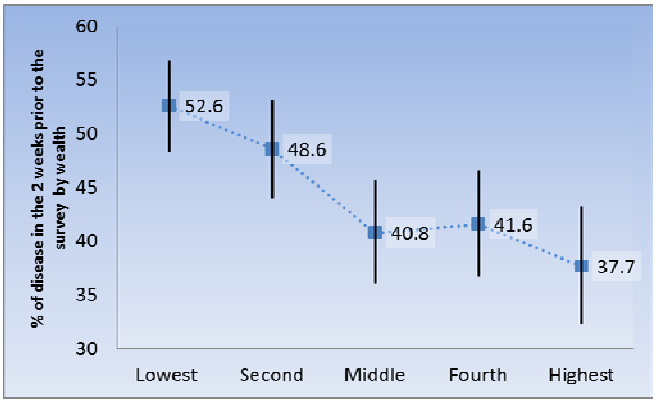
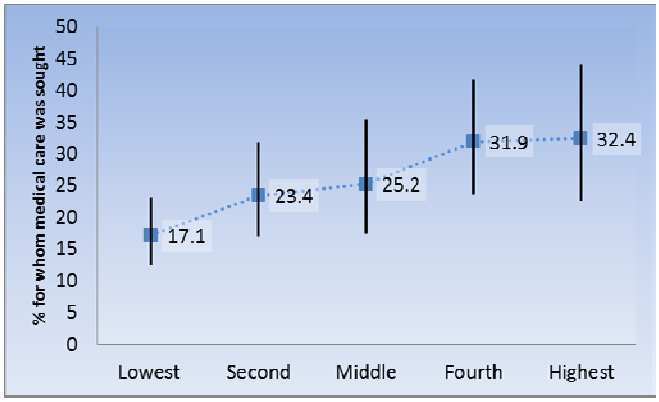


Fig. 93 - Health seeking behavior by wealth index



The ***proportion of children for whom treatment was sought, increases with increasing wealth index*** (p =0.02). In contrast, no significant difference was seen by maternal education (p =0.25) and only a weak evidence was seen for distance from health center (p =0.05), although this may be as a result of medical help sought at community level health posts and pharmacies as well as the small sample size.

Preventative treatment for children

Considering the link between child health and acute malnutrition, it is important to look at preventative measures taken to improve the health of children

A significant difference is seen for all preventative treatment by livelihood zones, with the highest level seen in central high lands and the lowest in the southern zone.

For all preventative treatment, ***a significant difference is seen among distances from the health center*** with a divide seen between distance less than three hours from health center and distance above three hours.

Maternal education has an impact on preventative treatment ***with children from women with no education less likely to receive preventative treatment***.

The same is true for wealth index with ***the lowest and second lowest quintile less likely to receive preventative treatment for their children*** compared to the richer quintiles. Interestingly, although a difference is seen between sick boys and girls with regards to seeking of treatment, no difference is seen between the sexes for preventative treatment.

Table 49 - Preventative treatment by background characteristic

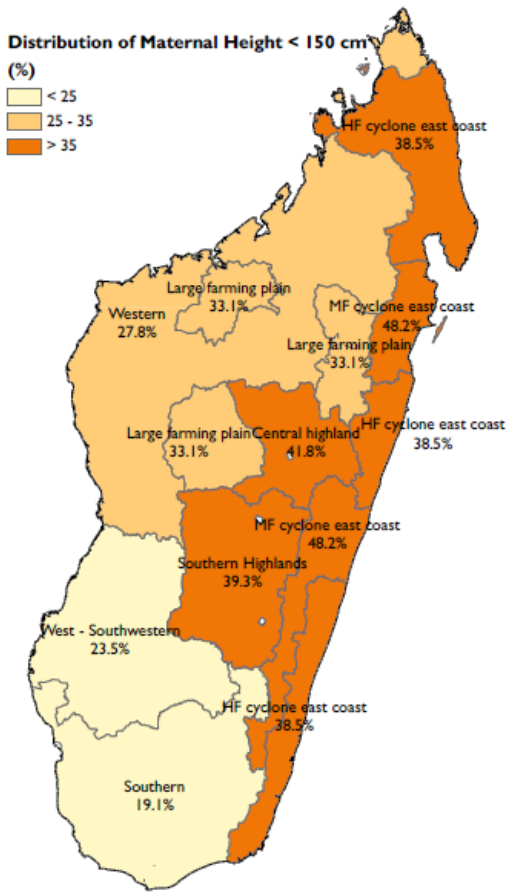
	Vitamin A supplementation of children 11-59 months [95% CI]	Denominator	De-worming of children 17-59 months [95% CI]	Denominator	Measles vaccination of children 9-59 months [95% CI]	Denominator
Livelihood zones						
MF cyclone east coast	90.2 [83.7 - 94.4]	198	75.1 [69.2 - 80.1]	566	83.2 [75.8 - 88.6]	208
HF cyclone east coast	83 [77.6 - 87.3]	586	72.2 [68.8 - 75.4]	1650	84.1 [80.0 - 87.4]	596
West- South western	55.8 [40.3 - 70.2]	207	58.5 [48.3 - 68.0]	480	61.3 [43.1 - 76.8]	211
Western	68.7 [60.5 - 76.0]	527	52.2 [45.0 - 59.2]	1069	71.4 [63.4 - 78.2]	540
Southern	50.2 [40.4 - 60.1]	512	49.6 [43.1 - 56.1]	1347	59.2 [48.3 - 69.3]	520
Central highland	90.8 [82.5 - 95.3]	135	91.6 [88.1 - 94.2]	51	97.1 [90.5 - 99.2]	146
Large farming plain	78.8 [70.0 - 85.6]	312	79.1 [72.9 - 84.2]	945	75.8 [67.1 - 82.8]	323
Southern Highlands	85.2 [78.0 - 90.4]	255	87.5 [83.6 - 90.6]	823	88.7 [82.4 - 92.9]	263
Maternal education						
No education	68.5 [62.2 - 74.2]	898	60.8 [55.3 - 66.1]	749	66.8 [60.5 - 72.5]	912
Primary education	80.74 [77.14 - 83.9]	1193	71.7 [67.6 - 75.5]	990	84.2 [81.1 - 86.7]	1242
Secondary education	87.5 [81.9 - 91.5]	383	82.4 [73.8 - 88.5]	313	90.7 [86.1 - 93.8]	394
Distance from household to health centre						
<1h	80.7 [76.6 - 84.2]	1192	74.65 [70.2 - 78.7]	1015	86.6 [83.2 - 89.4]	1229
1-3h	73.2 [66.9 - 78.6]	1094	65.1 [59.6 - 70.2]	924	72.5 [67.0 - 77.4]	1114
3-6h	54.8 [41.9 - 67.1]	254	49.2 [38.5 - 60.1]	211	57.7 [42.9 - 71.2]	261
>6h	47.4 [34.4 - 60.7]	58	59.1 [39.4 - 76.2]	45	46.6 [32.7 - 61.1]	58
Wealth quintile						
Lowest	69.8 [64.4 - 74.8]	743	66.1 [60.5 - 71.2]	627	70.9 [65.4 - 75.7]	763
Second	71.3 [65.1 - 76.9]	625	66.5 [60.8 - 71.8]	540	71.6 [65.7 - 76.7]	640
Middle	78.6 [72.6 - 83.6]	515	70.0 [62.8 - 75.63]	428	82.5 [77.8 - 86.3]	536
Fourth	82.5 [77.3 - 86.7]	472	77.8 [72.0 - 82.6]	386	87.4 [83.1 - 90.7]	479
Highest	90.8 [86.3 – 94.0]	359	82.1 [75.4 - 87.3]	304	93.0 [89.3 - 95.5]	369
Total	**77.1 [74.0 - 79.9]**	**2732**	**79.3 [76.2 - 82.2]**	**1985**	**79.5 [76.7-82.1]**	**2807**

11.2. Low birth weight and maternal health

Maternal health seeking behaviour

Considering the link between maternal size and stunting it is important to look at the maternal characteristic and health care seeking behaviour during pregnancy with the aim of improving birth outcomes in the short term and break the inter-generational cycle of malnutrition. In total **34.9 percent of mothers were less than 150cm**, as with stunting, a significant variation is seen by livelihood zones (p=0.000).

Fig. 94 - -Distribution of maternal height by livelihood zone



For each child alive during the survey, the mother was asked if she received antenatal care by a health care professional, took iron folic acid during the pregnancy as well as post-partum vitamin A supplement. Considering this was asked only of living children, the presented results are likely to be over-estimation of the true levels.

In total, for 90.3 percent of pregnancies, ***antenatal care by a health professional was sought with a significant difference seen among the livelihood zones*** (p=0.000), with the lowest level seen in the medium frequency cyclone east coast. The World health Organization, recommends that at a pregnant women attends four or more antenatal visits, in the latest DHS only 46.3 percent of women in rural Madagascar attended four or more antenatal visits during their last pregnancy.

For iron-folic acid, ***61.8 percent stated that they took iron folic acid during their pregnancy, with significant difference among livelihood zones*** and the lowest level seen in the southern zone (p=0.000). The World health Organization for countries with high level of anaemia among women of child bearing age, systematic supplementation of iron folic acid for at least 90 days during pregnancy. Considering that this recommendation applies to Madagascar where 36.2 percent of women 15 to 49 years of age are anaemic, it is concerning that the latest DHS found that only 6.7 percent of women took the recommended 90 days of iron folic acid during their last pregnancy.

The same pattern is seen for post-partum vitamin A supplementation where only 47.7 percent of pregnancies were followed by ***post-partum vitamin A supplementation with a significant variation by livelihood zones*** (p=0.031) . The lowest seen is once again seen in the southern zone.

Fig. 95 - Proportion of women who attended antenatal care by health professional

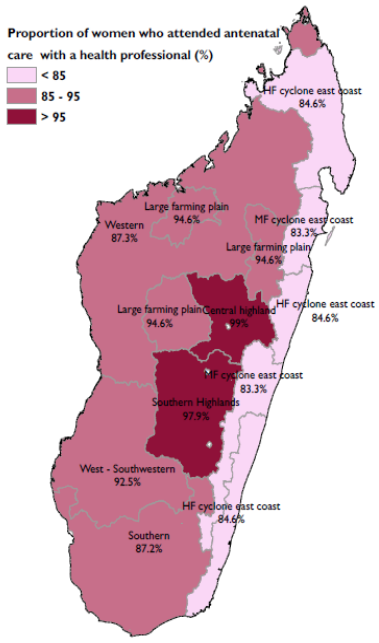


Fig. 96 - Proportion of women who received iron folic acid during their pregnancy

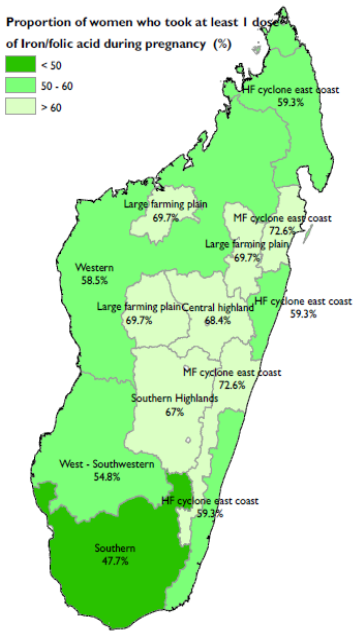
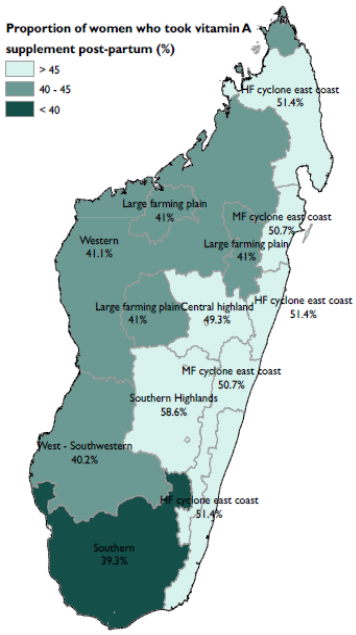
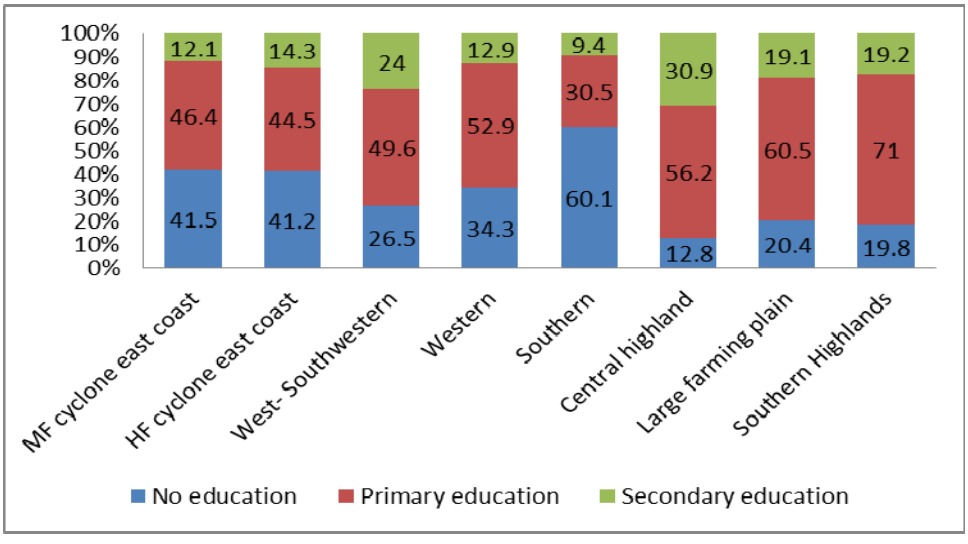


Fig. 97 - Proportion of women who received post-partum vitamin A



Considering the importance of maternal education, the distribution of maternal education by livelihood zones was carried out, showing the highest proportion of un-educated women in the Southern zone

Fig. 98 - Maternal education level by livelihood zone

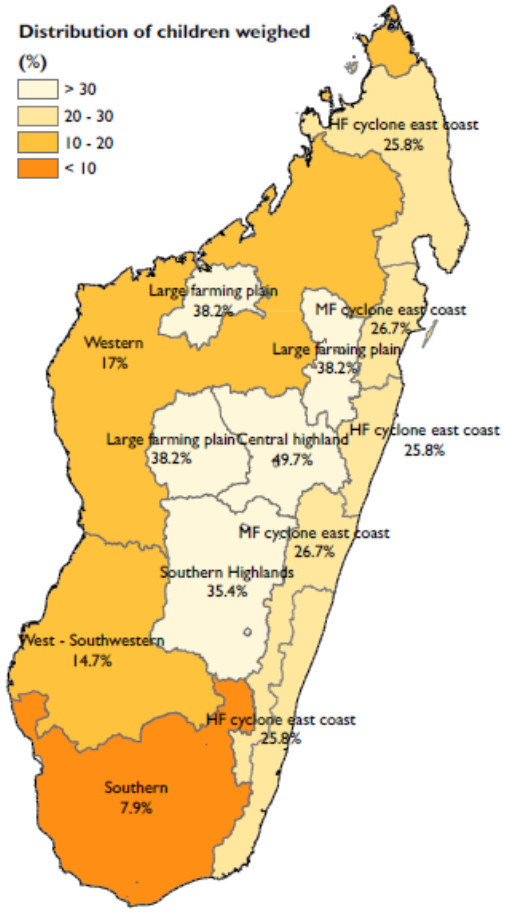


Weighed at birth

Considering the association between low birth weight and stunting it is interesting to explore the prevalence of low birth weight by background characteristics.

As presented at the right, only 26 percent (23.8 - 28.6, 95 percent CI) of children were weighed at birth but the prevalence differs ***significantly by livelihood zone*** (*p* =0.000). We find the lowest proportion of new-borns weighed in the Southern zone where less that 10 percent were reportedly weighed (for details see table 114 Annex V).

Fig. 99 - Distribution of neonates weighed at birth by livelihood zone



There is also a ***significantly higher proportion of children weighed by increase in maternal education*** (*p* =0.0000) and ***wealth index*** (*p* =0.000).

Fig. 100 - Proportion of children weighed at birth by wealth index

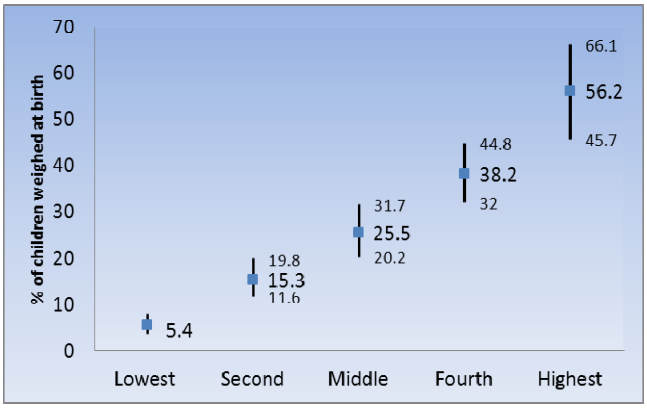
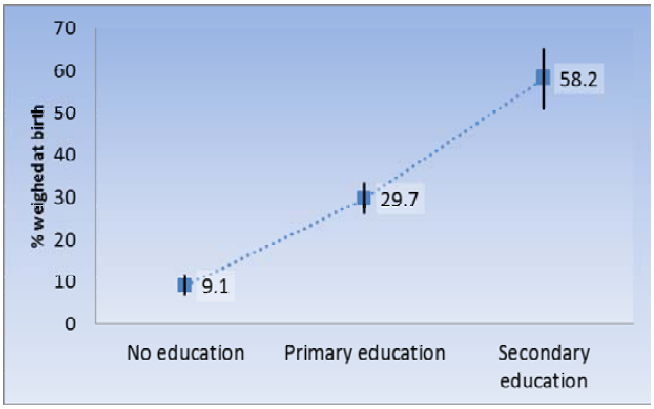


Fig. 101 - Proportion of children weighed at birth by maternal education



The association between maternal education and a neonates weighed at birth continues to exist when you take household wealth into account, however the association it is weaker in the wealthier quintile, from an odds ratio of 1.9 in the richest quintile to 3.1 in the poorest quintile.

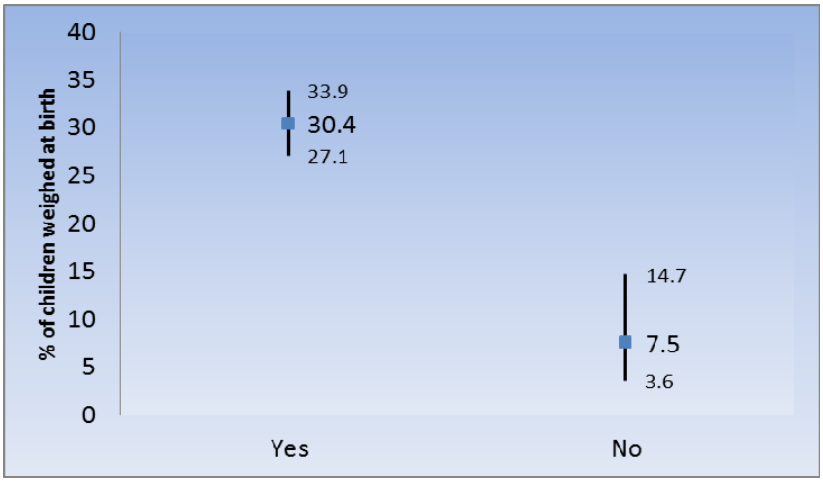
Table 50 - Association between maternal education and birth weight by wealth quintile.

	Odds Ratio	95% CI	p*
Lowest	3.19	(1.97 – 5.15)	0.0000
Second	2.92	(2.07 – 4.10)	0.0000
Middle	2.21	(1.61 – 3.03)	0.0000
Fourth	2.04	(1.54 – 2.69)	0.0000
Highest	1.94	(1.39 – 2.69)	0.0001

** Statistical test*

Children of ***mother who sought antenatal care from a health profession were four nearly times more likely to have been weighed at birth*** (*p* = 0.000). No difference is seen between the sexes.

Fig. 102 - Proportion of children weighed at birth if the mother had antenatal classes with a health professional.



Low birth weight

Considering that only 26 percent children where weighed at birth, mothers were also asked their perception of their child size at birth. In total, 13.5 percent of children with a reported birth weight were of low birth weight babies (<2.5kg), regarding perception, 39.8 percent stated that their babies were smaller than average at birth.

It is important to note that birth weight (or perception of birth size) was asked only for children alive at the time of the survey, therefore the incidence of low birth weight is likely to be an underestimation of the true incidence since infants' with a low birth weight have a higher mortality risk and may have died prior to the survey[134].

[134]Ashworth A (1998), Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. *European Journal of Clinical Nutrition 52(S1):34–42.*

Table 51 - Prevalence of low birth weight and perception of birth size of living children by livelihood zone

	birth weight <2.5kg	Denominator	Perceived bigger than average size	Perceived of average size	Perceived smaller than average	Denominator
Livelihood zone						
MF cyclone east coast	14.49 [9.682,21.12]	150	34.73 [19.14,54.45]	31.78 [18.29,49.23]	33.49 [20.2,50.04]	1039
HF cyclone east coast	26.97 [11.92,50.17]	928	15.88 [9.985,24.32]	40.98 [31.64,51.01]	43.14 [32.73,54.21]	4825
West-Southwestern	8.652 [3.334,20.64]	86	37.76 [17.87,62.85]	22.39 [12.05,37.79]	39.85 [20.4,63.14]	1235
Western	10.76 [7.008,16.17]	288	32.17 [23.52,42.25]	16.66 [11.93,22.79]	51.17 [39.77,62.45]	2451
Southern	10.46 [5.652,18.57]	136	32.55 [22.26,44.85]	14.75 [7.963,25.7]	52.7 [38.35,66.62]	3612
Central highland	6.93 [3.715,12.56]	531	57.38 [41.1,72.2]	23.77 [12.23,41.1]	18.85 [13.15,26.29]	1160
Large farming planes	8.97 [6.019,13.17]	643	34.21 [24.49,45.45]	34.18 [23.1,47.31]	31.61 [21.75,43.45]	2150
Southern Highlands	5.964 [3.016,11.45]	613	31.14 [20.92,43.6]	42.38 [31.13,54.47]	26.48 [18.62,36.2]	1878
Maternal height						
<150cm	13.5 [10.54,17.13]	665	25.5 [23.35,27.78]	32.74 [30.29,35.28]	41.76 [39.42,44.15]	2580
>150cm	9.972 [8.322,11.91]	1390	34.96 [32.94,37.04]	30.53 [28.46,32.68]	34.51 [32.87,36.19]	5495
Total	13.55 [7.774,22.56]	3375	31.33 [26.6,36.48]	28.87 [24.71,33.43]	39.8 [34.78,45.04]	18348

A significant difference in the proportion of children born with a low birth weight was noted with the highest level seen in the east coast zone (p =0.0024).

No difference in the proportion of living children who were born with a low birth weight was seen between boys and girls and by maternal educational level or by wealth index.

There is some evidence that maternal height has an impact on birth weight, with 13.6 percent of living children born with a birth weight less than 2.5 kg from mothers with a height under 150 cm (p =0.05).

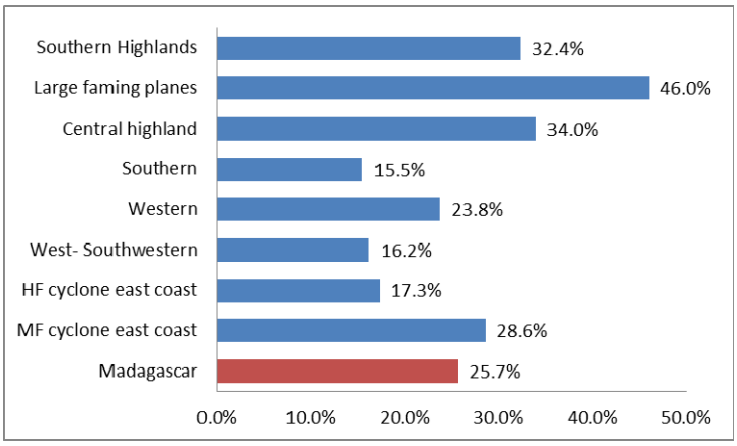
11.3. Health access

Community health services and perceptions

A quarter of all communities interviewed had a health centre in their Fokontany (either public or private). However there is a large disparity by livelihood zones with highest levels seen in the large farming plains (46 percent) and the lowest in the Southern zone (15.5 percent).

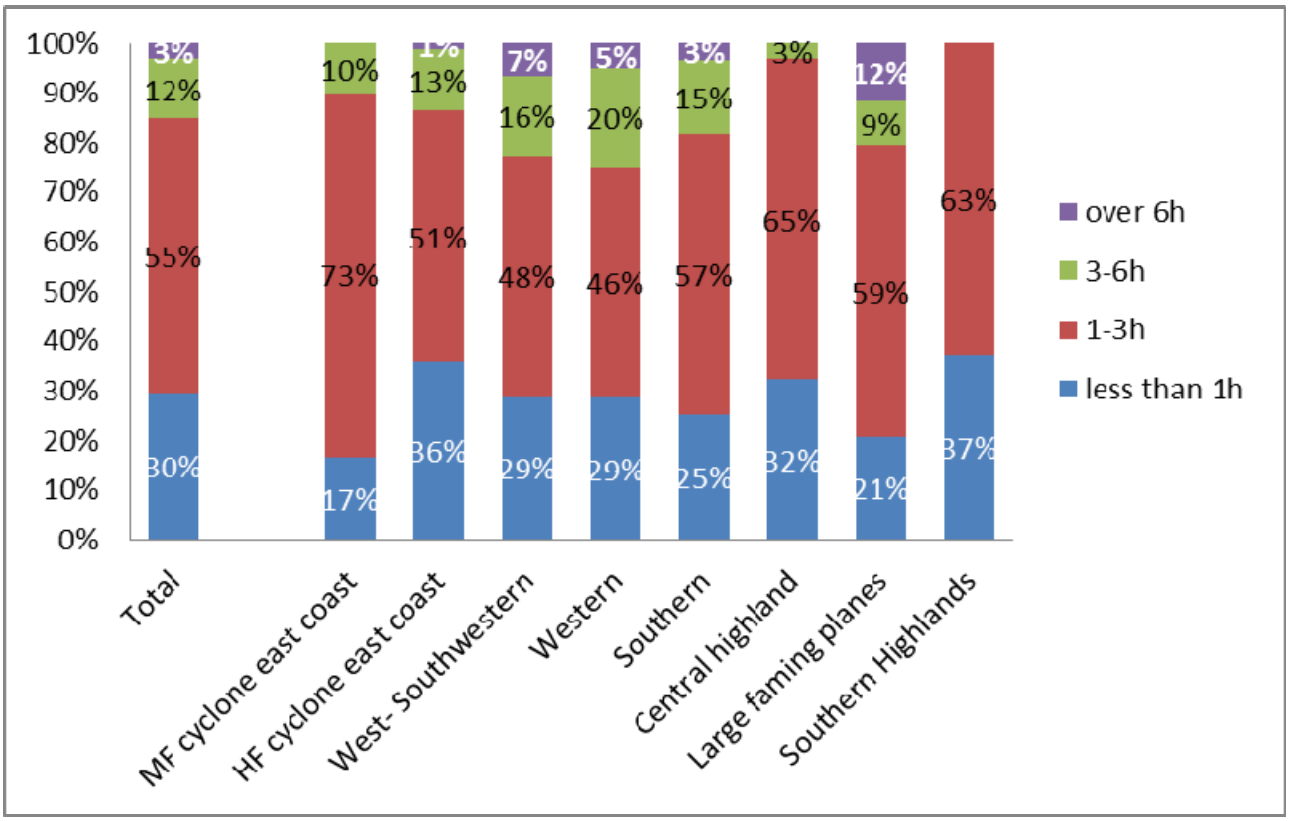
Of those without a health centre in their community, for just over half (55 percent) the health centre is situated one to three hours from the Fokontany and three percent are over six hours from the health centre.

Fig. 103 - Proportion of communities with a health centre in their Fokontany



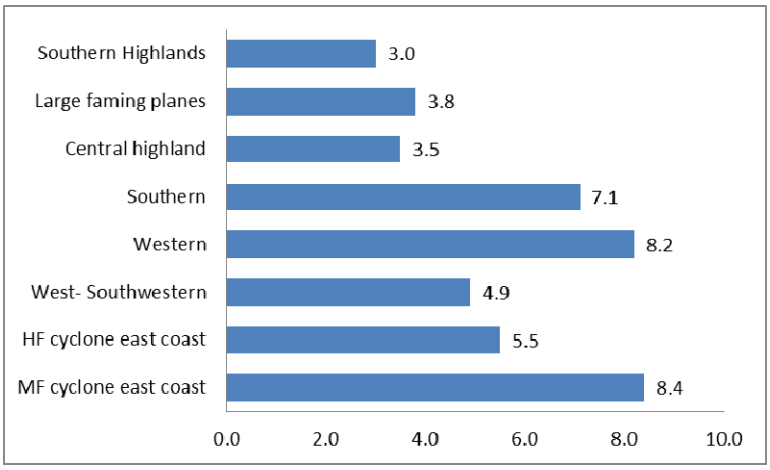
Once again a large disparity is seen by livelihood zones, with the southern highlands having the best physical access to health centres.

Fig. 104 - Distance of health centre from Fokontany by livelihood zone



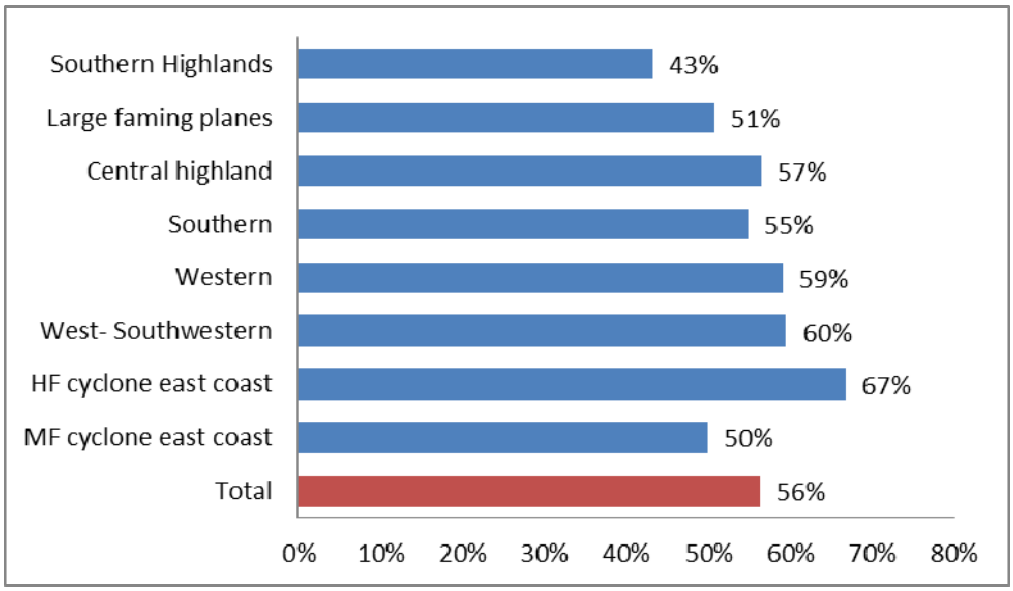
Fokontany level health centres provide basic, primary level health care, for more complicated treatment such as the in-patient treatment of severe acute malnutrition with medical complications, referral to district level health hospitals is necessary. A great disparity regarding mean time required to reach the district level exist by livelihood zones, with the highest mean time see in the Medium and high frequency cyclone east coast (eight hours) compared to the highlands with an average of 3.5h

Fig. 105 - Average time in hours required to reach the district from the Fokontany



This is associated with a difference in transport cost to reach the district from the Fokontany, with the lowest cost in the southern and central highlands (average cost of 3000 Ariary) and the highest cost in the West-South western and Western zones where the cost of transport is twice as much at 6000 Ariary.

Fig. 106 - Proportion of health centres in which treatment payment in required



Transport cost is not the only cost, over half (56 percent) of the communities stated that they had to pay at the their health centre with the highest level seen in high frequency cyclone east coast (67 percent) and the lowest in the Southern Highlands (41 percent).

Chapter 4 looks at household expenditure, and it can be seen that three percent of household expenditure is on medicine with 39 percent of households who stated that they noticed an increase in their expenditure on health.

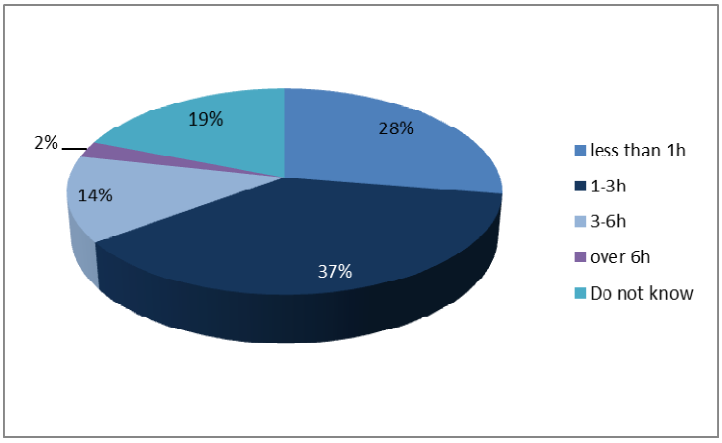
Indeed when the communities were asked about the main barriers of their community for not frequenting the health centre. The main reason evoked by all the livelihood zones was lack of money except for Southern where distance of health centre was also evoked.

Community health and nutrition services and perceptions

Of the 544 communities interviewed, 322 (59 percent) reported having a community nutrition sites in their Fokontany, 97 percent of which were the SEECALINE (PNNC) sites and the remaining three percent are GRET (Nutrimad) sites.

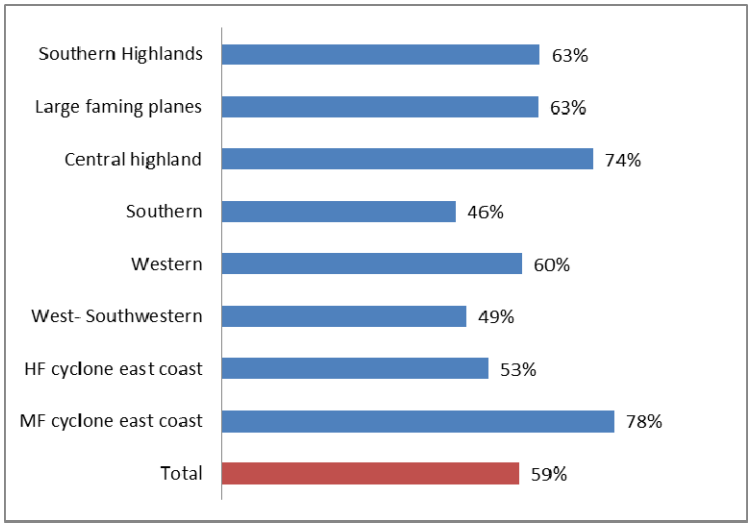
Of those without a nutrition community site in their community, the majority are one to three hours from the Fokontany.

Fig. 107 - Distance of nutrition community site from Fokontany



The presence of community sites varies by livelihood zone, from 46 percent in the Southern zone to 78 percent in the Medium Frequency Cyclone east coast. It is not possible to compare malnutrition levels in communities with a nutrition site and communities without, since the SEECALINE sites are purposefully placed in vulnerable communities.

Fig. 108 - Presence of a nutrition community site in the Fokontany



Community perception of nutrition related issues

In order to ascertain the perception of acute malnutrition and stunting in the community, two questions were asked in the community based questionnaire;

1) *Do you think there are many thin children in your community? If yes, do you view this as a problem?*
2) *Do you think there are many short children in your community? If yes, do you think this is a problem?*

For wasting, 67 percent of community stated that they have a lot of thin children in their community of which 93 percent considered it problematic. However, for stunting, only 40 percent of community stated that they had a lot of short children in their community and 81 percent of which stated that this is a problem.

As would be expected the perception of malnutrition varies by livelihood zone. For wasting this varies from 89 percent in the West South Western zone and 88 percent in the Southern zone to 38 percent in the central zone, this distribution follows well the distribution of acute malnutrition. However for stunting, the stratum which has some of the highest level of stunting has the lowest awareness of stunting in their community.

Fig. 109 - Prevalence of global acute malnutrition

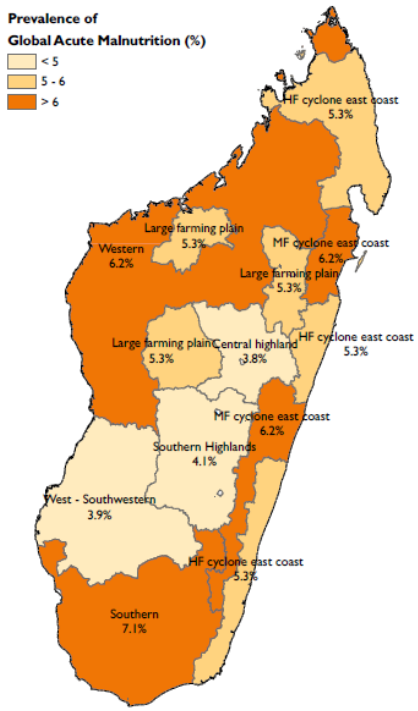


Fig. 110 - Perception of wasting

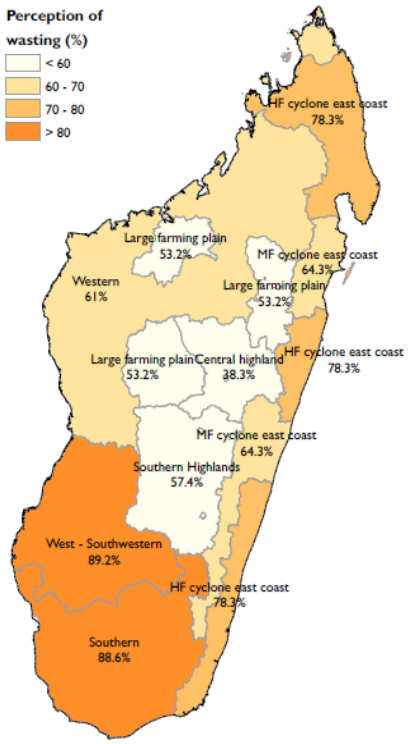


Fig. 111 - Prevalence of stunting

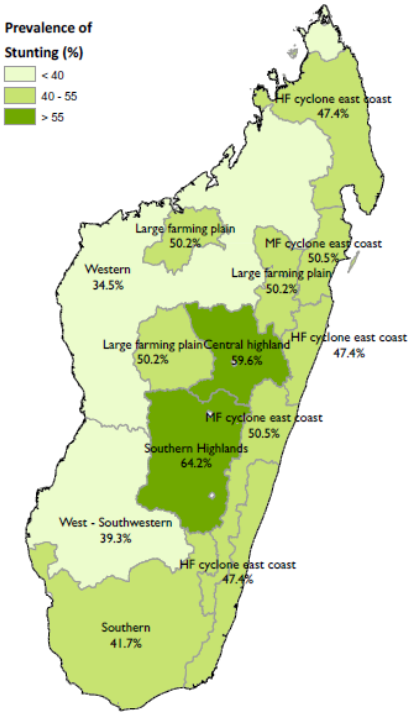
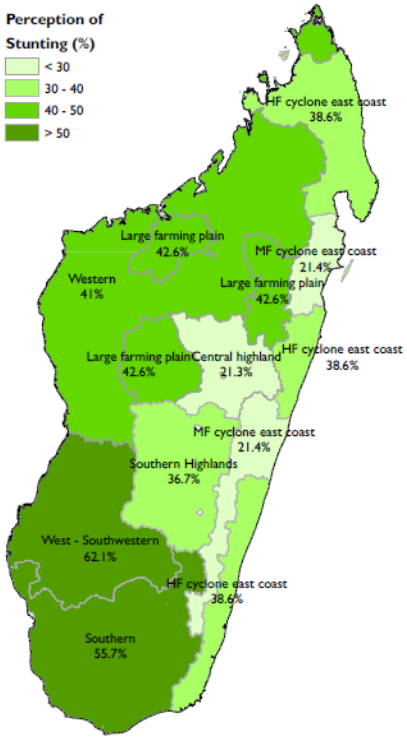


Fig. 112 - Perception of stunting



11.4. Water and sanitation

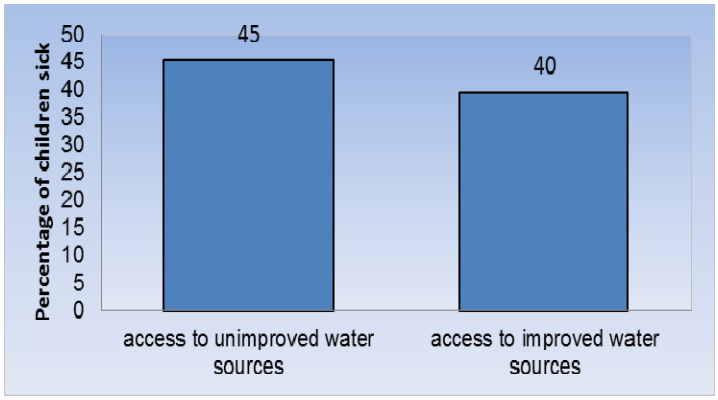
Access to improved water source[135]

Since the survey took place in the dry season, further analysis was carried using this data. However information on access to water was obtained for the rainy season in order to look at seasonality in water access.

No link was found between access to improved water source and acute malnutrition. However as highlighted in the conceptual framework, poor water and sanitation environment contributes to acute malnutrition via an increase in morbidity.

Indeed a significant association was found between child morbidity in the two weeks prior to the survey and access to improved water source (p =0.04).

Fig. 113 – Morbidity in the two weeks prior to survey and access to water source



Access to an improved safe water remains low with only 26 percent (22.9 - 29.4, 95 percent CI) of households having access to an improved water source in the dry season, increasing slightly to 27.7 percent (24.5 - 31.2, 95 percent CI) in the rainy season with a significant difference among livelihood zones (p=0.000, for dry season access) and the lowest access seen in the Southern. The main source of water in all the livelihood zones was surface water (from lakes, rivers and streams). In the West/South-western, large farming plains and the Southern zones, water from the well is also common. Water from tap (public or private) was more likely in the central highlands and the large farming plains.

These finding are slightly lower than the values found in the latest JMP where 29 percent of rural households is reported to have access to improved water source, however it remains within the confidence interval range, therefore we can suspect that no improvement in access to an improved water sources has been noted since 2008.

[135]The definition for improved water source and sanitation was aligned to the Joint Monitoring Programme for Water Supply and Sanitation (JMP)- update 2010 (for Madagascar, data from 2008 was used).

Fig. 114 - Percentage of households with access to improved water source during the dry season

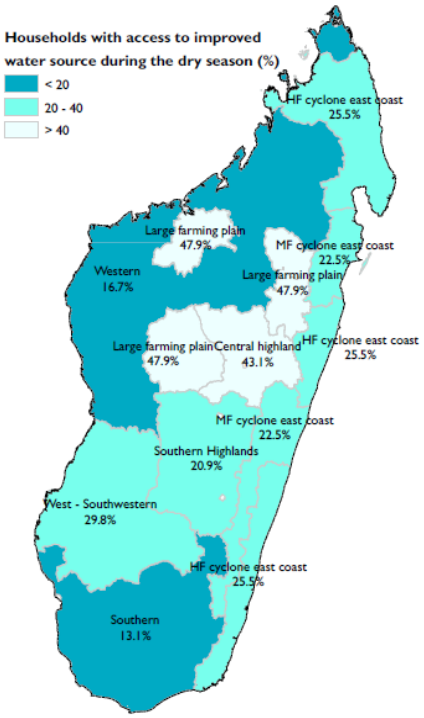
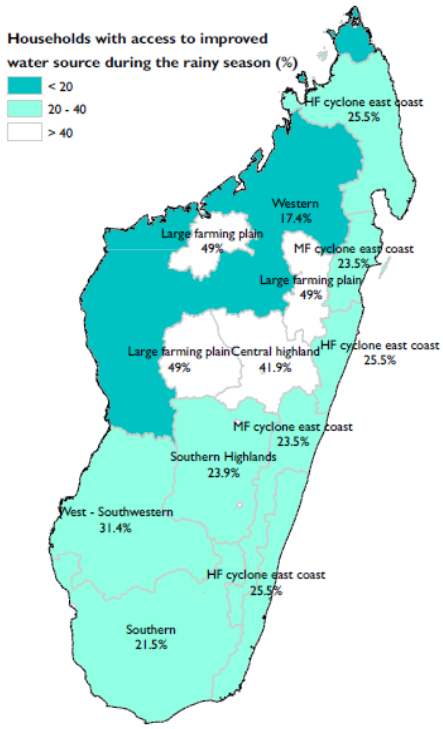


Fig. 115 - Percentage of households with access to improved water source during the rainy season



Overall no difference is noted in access to improved water source between seasons except for the southern zone where access to improved water sources increases from 13.1 percent (7.8 – 21.0; 95 percent CI) in the dry season to 21.5 percent (14.8 – 30.2; 95 percent CI) during the rainy season. However, communities reported periods where access to water (improved or unimproved) was difficult as summarised in the table below.

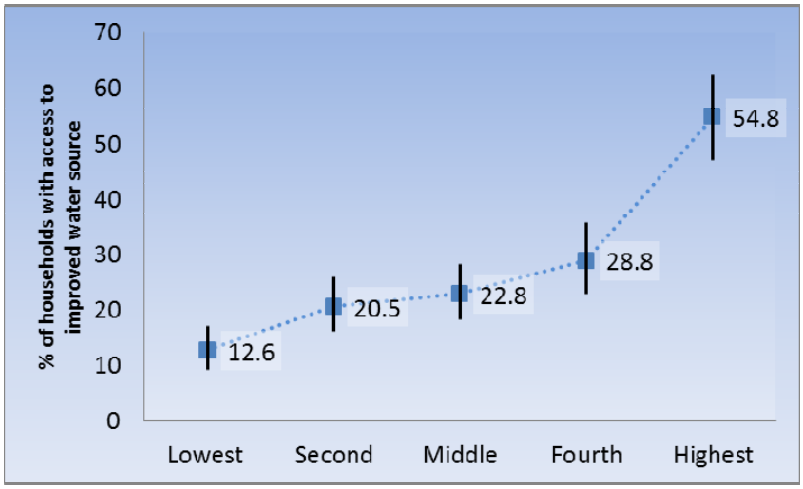
Table 52 - Periods of difficulties in physical access of water by livelihood zones

Cluster	Mean	Jan	Feb	Mar	Apr	Mai	Jun	Jul	Aug	Sep	Oct	Nov	Dec
MF cyclone east coast	3.4												
HF cyclone east coast	2.9												
West- South western	2.0												
Western	3.6												
Southern	3.1												
Central highland	3.5												
Large farming planes	2.5												
Southern Highlands	1.6												

White : No difficulty ; Green : less than 10 % of Fokontany had difficulties ; Yellow : 10 -20% of Fokontany had difficulties; Orange : 20 -40 % of Fokontany had difficulties; Red: > 40% Fokontany had difficulties

For wealth index, there is a significant and linear increase in the proportion who have access to an improved water source by wealth quintile (p=0.000 for dry season access), however it is important to note that access to safe water is one of the indicators in the construction of the wealth index.

Fig. 116 - Access to improved water source by wealth index



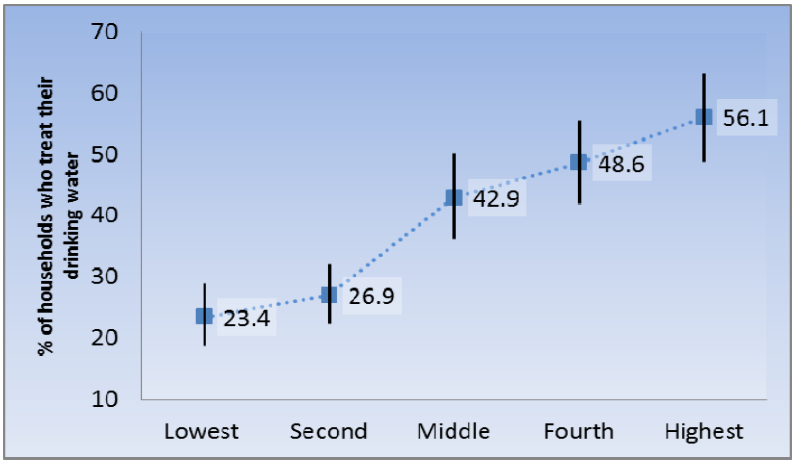
Treatment of drinking water from a non-improved water source is recommended. In all 37.6 percent (34.2 – 41.1 ; 95 percent CI) of households reported that they treated their drinking water, with significant differences among livelihood zones (p=0.000), and the lowest levels seen in the southern zone[136].

Table 53 - Percentage of households that treat their drinking water by livelihood zone

	% households who treat their drinking water	95% CI	Denominator
MF cyclone east	59.3	[45.9 - 71.4]	170
HF cyclone east	44.6	[38.1 - 51.3]	516
West- Southwestern	15.9	[9.1 - 26.4]	176
Western	48.2	[39.1 - 57.5]	495
Southern	11.7	[7.9 - 17.0]	410
Central highland	48.6	[34.3 - 63.2]	127
Large faming plain	16.3	[11.5 - 22.5]	303
Southern Highlands	37.6	[31.0 - 44.7]	220
Total	**37.6**	**[34.2 - 41.1]**	**2366**

The majority of households (92 percent) who stated that they treat their drinking water used the boiling method, followed by addition of Sur'Eau (six percent), a smaller proportion used filter (one percent). The highest use of Sur'Eau is seen in the Southern zone, followed by the Large Farming Plains and HF cyclone east coast.

Fig. 117 - Household water treatment by wealth index



A significant difference in households who treat their drinking water is noted by wealth quintiles with a distinct difference between the first two quintiles and the three richer quintiles (p=0.000). So it is only the poorest that are less likely to treat their drinking water.

[136]It is important to note that information on quality of treatment methods was not assessed so it is not known if the households appropriately treated then drinking water to ensure water safety.

Access to improved sanitation[137]

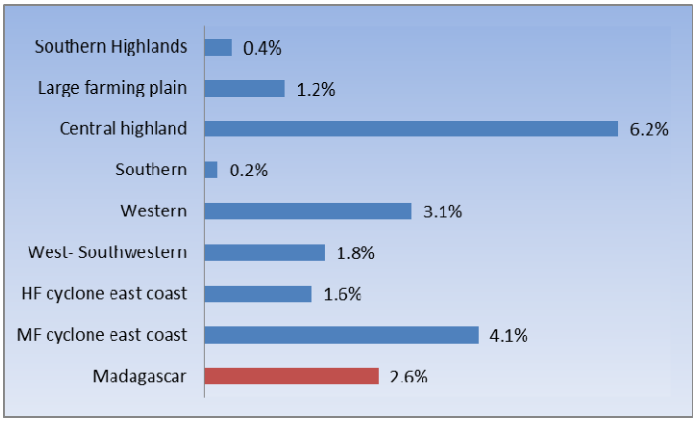
Table 54 - Availability of improved sanitation by wealth index

	% households with access to improved	95% CI	Denominator
Lowest	0.4	[0.1 - 1.6]	602
Second	0.3	[0.0 - 1.9]	539
Middle	1.0	[0.3 - 3.9]	439
Fourth	2.8	[1.1 - 7.2]	412
Highest	7.5	[4.6 - 12.0]	350
Total	**2.1**	**[1.4 - 3.3]**	**2393**

Household access to improved sanitation is extremely low with only 2.6 percent of households who reported having access to an improved sanitation.

The highest access is seen in the central highland and the Medium frequency Cyclonic east coast zone. Worryingly, 58.2 percent of households stated that they practice open air defecation and 93 percent of Fokontany stated that open air defecation was practiced in their Fokontany. Poor use of improved sanitation remains an important public health problem across all of Madagascar.

Fig. 118 - Access to improved sanitation by livelihood zone



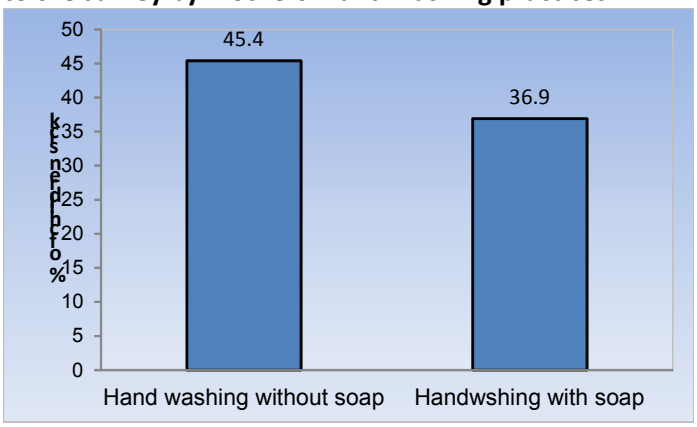
There seems to be an increase in access to improved sanitation by wealth index however the sample size is too small to look if this is statistically different.

Hand washing habits

No associating was found between maternal hand washing and acute malnutrition. However, as highlighted by the conceptual framework, recent ***child morbidity is significantly higher among children from mother who do not wash their hands*** with soap after using the latrine (p=0.002).

Only 21.7 percent of women reported using soap to wash their hands following latrine use, with a high variability between the livelihood zone (p=0.000). The central highlands zone had the highest proportion of women who wash their hands with soap (43.2 percent) and the southern has the lowest (10.5 percent).

Fig. 119 - Percentage of children sick in the 2 weeks prior to the survey by mothers' hand washing practices



[137] Although the JMP indicators were used these data are not comparable as the definition of rural and urban differs

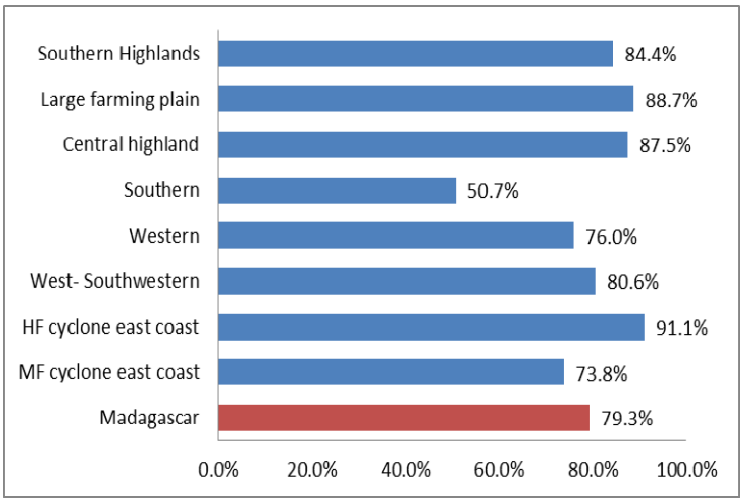
Table 55 - Hand washing by mothers after latrine use

	% women who was their hands with soap after latrine	95% CI	Denominator
Livelihood zone			
MF cyclone east	15.2	[9.613,23.21]	167
HF cyclone east	19.6	[15.21,24.92]	487
West-	14.6	[9.173,22.86]	166
Western	13.9	[9.839,19.38]	458
Southern	11.7	[8.008,16.7]	359
Central	51.8	[37.52,65.86]	122
Large farming	18.2	[13.04,24.76]	291
Southern	24.2	[17.91,31.87]	211
Total	**21.7**	**[18.86,24.9]**	**2261**

Not surprising soap usages is higher in communes in which soap is available to purchase (20.1 percent compared to 8.1 percent). The vast majority of communities stated that they have soap commercially available except for the southern zones where only half (51 percent) of the Fokontany stated they have commercial access to soap.

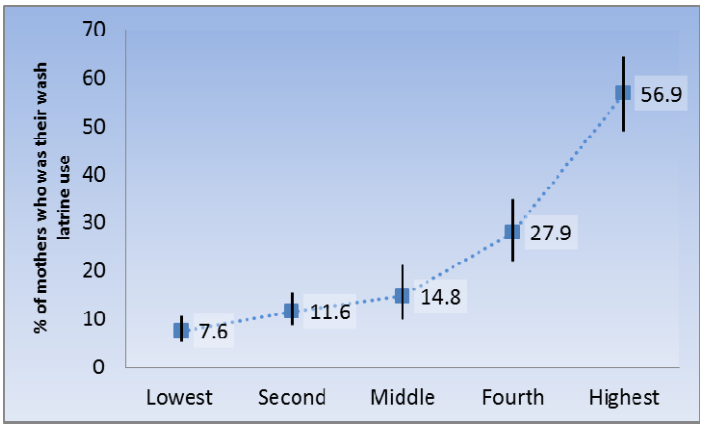
Fig. 120 – Percentage of mothers who wash their hands after latrine use by availability of soap in the Fokontany

Fig. 121 - Fokontany with commercial access to soap



Significantly more mothers from wealthier households washed their hands compared to mothers from poor households, with a distinct divide between the first four quintiles and the riches. These results tie in with the finding from chapter 4 where an estimated six percent of household income is spent on soap, making soap a luxury item in the Malagasy context.

Fig. 122 - Percentage of mothers who was their wash hands after latrine use by wealth quintile



12.0 RECOMMENDATIONS[138]

12.1. Improving food demand and supply

With over 80 percent of the rural population employed in agriculture, low farm productivity is among the leading causes of poverty and food insecurity in Madagascar.

Boost national and household agricultural production (in quantity and quality) - Provide incentives (i.e., subsidized fertilizers and seeds) and technical extension assistance to subsistence farmers and improve land tenure structure through wide implementation of the National Land Tenure programme). Promote access to credit; improve water management.

Invest in transport infrastructure, road construction/repairs and market facilities - to link areas of high agricultural potential with deficit areas.

Develop a dynamic market system - Develop a national market price information system and develop market chains linking producers with potential buyers.

Improve post-harvest handling - Strengthen the capacity of farmer associations/organizations to improve storage techniques, fight against pests and improve food processing technology.

Promote natural resource management - Watershed protection, conservation agriculture, reforestation, bush fire control.

12.2. Investing in human and social capital

Implement social protection programmes to combat widespread poverty - Support productive safety nets targeting the most food insecure through community asset creation programmes.

Strengthen policies that promote education - The country needs to pursue: free and compulsory primary education for all; re-introduction of adult-literacy programmes, especially for women; parenting education to encourage behaviour change; the opportunity to attract children to school and feed them there by implementing/extending school canteen projects in food insecure areas.

12.3. Coping with shocks/disasters

Improve the resilience of households and communities in risk areas - Ensure appropriate preparedness and response mechanisms to emergency food and nutrition insecurity by assessing needs, prepositioning emergency food stocks and updating and reviewing contingency plans.

12.4. Tackling acute malnutrition

Concentrating on activities that reduce the risk of disease will contribute to the reduction in acute malnutrition.

Manage acute malnutrition - Continue the integration and expansion of the integrated management of acute malnutrition into routine activities at the health centre/ community level. Improve surveillance and early warning systems for the early detection of a worsening nutritional situation for rapid deployment disaster reduction strategies.

Concentrate on programmes to promote exclusive breast feeding - Ensure that there is a continual focus on the promotion of exclusive breastfeeding for children under 6 months via community-based

[138] Chapter developed by WFP Madagascar and UNICEF Madagascar

behavior change programs and the use of different communication channels (mass media, inclusion in school curriculum, inclusion of the private sector).

Improve access to health care for children- through community-based management of childhood diseases and promotion of preventative vaccination programmes via communication strategies designed for women with a low education levels.

Improve access to safe water – Activities to improve access to safe water, including promoting adequate water treatment methods help reduce childhood illness and subsequently acute malnutrition.

Facilitate access to soap at the Fokontany level – Activities to improve access to soap at the Fokontany level to help in the promotion of hand washing.

12.5. Activities to tackle stunting

Reinforcing activities which improve the health and nutrition status of teenagers and women of child bearing age will reduce the prevalence of low birth weight and small stature among women to cut stunting.

Improve the dietary intake of children aged 6-23 months –Promote appropriate complementary feeding including dietary diversity, with particular focus on the use of local products via community-based behaviour change programmes.

Reduce the risk of teenage pregnancies – Activities which delay the first pregnancy until after 20 years will reduce the proportion of short women[139,140]and the risk of a low birth weight infant.

Improve iron folic acid supplementation of pregnant and lactating women – Promote the full course of iron folic acid by pregnant and lactating women, thereby reducing the risk of low birth weight.

Improve the attendance of the full antenatal classes – Ensure all pregnant women attend the recommended four antenatal classes and have access to the minimum range of interventions during the antenatal classes in order to reduce the risk of low birth weight.

Integrate nutrition counselling into agricultural activates –To ensure that vulnerable households consume the foods they produce.

Promote the use and benefits of home gardens– To increase household access and utilization of micronutrient rich foods.

[139]Casanueva E et al 2006. Adolescents with adequate birth weight newborns diminish energy expenditure and cease growth. J Nutr 136: 2498-2501

[140]Rah JH, Christian P, Shamim AA, Arju UT, Labrique AB, Rashid M. Pregnancy and lactation hinder growth and nutritional status of adolescent girls in rural Bangladesh. J Nutr. 2008;138:1505-11.

ANNEXES

Annex I: Sampling and Analysis

In order to have a representative sample by region and livelihood zone, a two-stage cluster sampling was applied.

First stage

The number of clusters per region was calculated based on the required sample size to determine malnutrition and food security by region (details on sample size calculation are reported below). A minimum of 25 clusters per region was set.

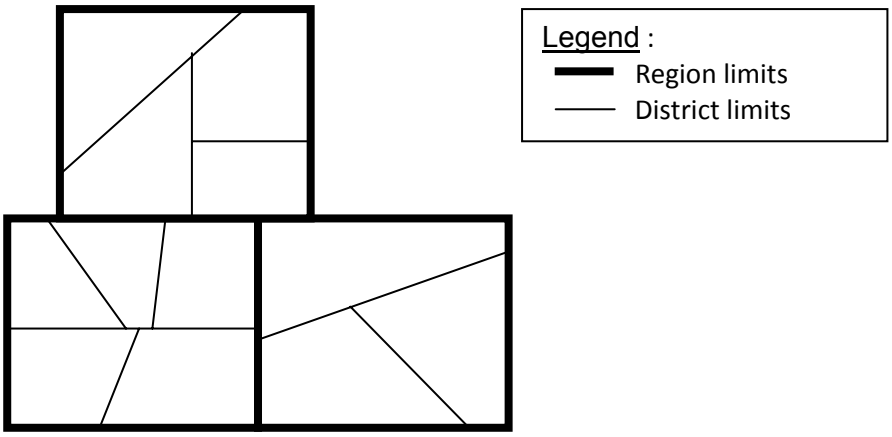
Since the Fokontany is the smallest administrative unit with population data available, this was established as the administrative unit from which clusters were selected. A list of all Fokontany and their estimated population was obtained from INSTAT.Urban communities as defined by the latest DHS-IV were not included in the sampling frame.

Using this list and the livelihood zones, 176 segments were defined corresponding to both the regions and the livelihood zones. The number of clusters in each of the 176 segments was determined based on the population per segment weighted from the total regional population (see table XX).

For each segment, the Fokontany and their population were introduced into ENA[141] and the required number of cluster per segment was selected using "probability proportional to population size" (PPS) sampling technique. This process was repeated for each of the 176 segments. The methodology is illustrated in the diagram below.

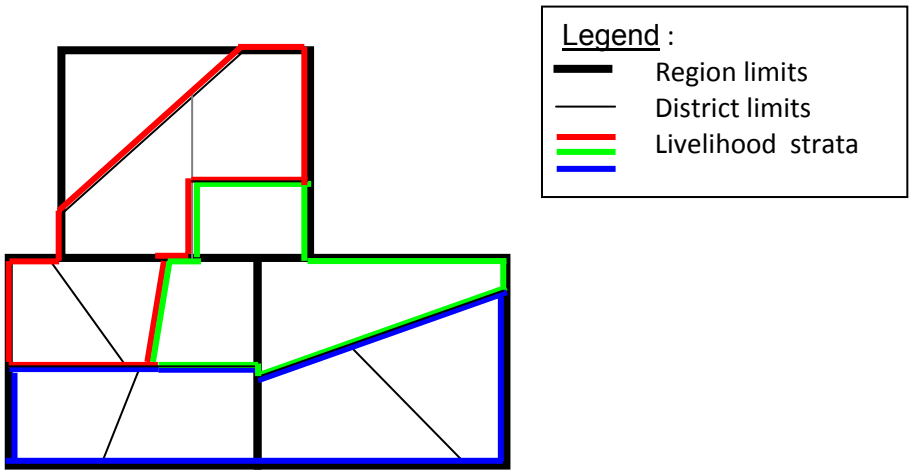
Fig. 123 – Illustration of the methodology for cluster selection by region taking into a livelihood zones

a) Administrative boundaries

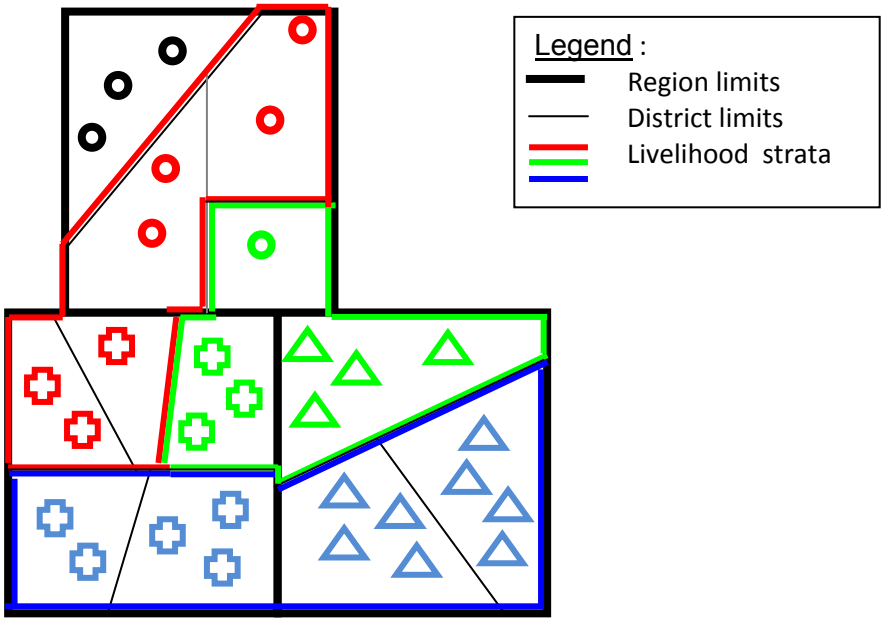


[141] http://www.nutrisurvey.net/ena/ena.html

b) step 1: Division into livelihood zones

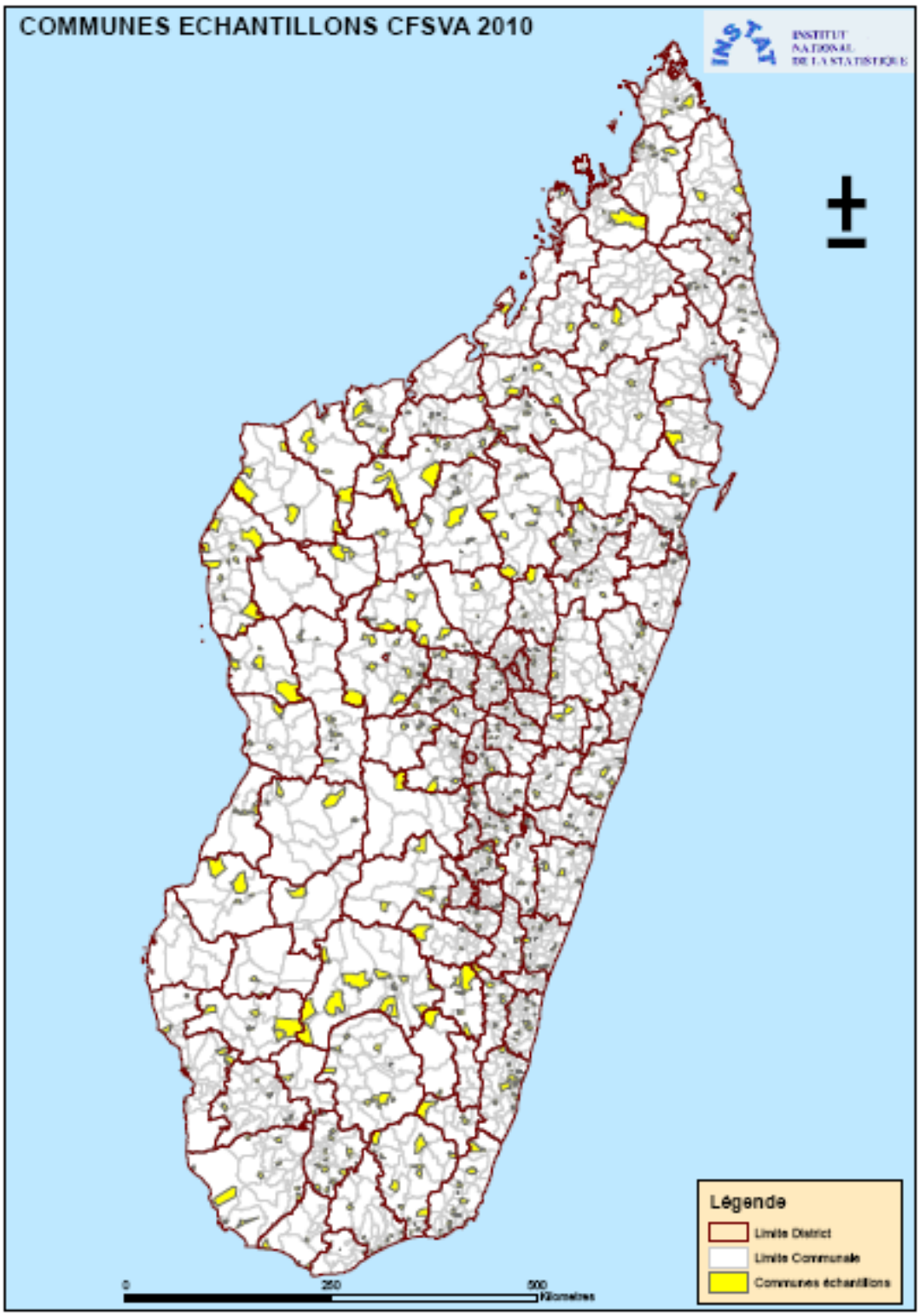


c) Step 2: Cluster sampling within each region



In total, 606 clusters were selected across the 22 regions and distributed in the 8 Livelihood zones. The distribution is shown in the map below

Fig. 124 – Map of the selected clusters



Thirty-three clusters out of the 606 selected were not visited due to bad weather or insecurity. The table below shows the actual number of clusters visited during the field work by livelihood zone.

Table 56 - Clusters actually visited by livelihood zone and region

Region	Population by LHZ									numbre clusters by LHZ								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
ALAOTRA MANGORO	85714	-	-	-	-	264121	636202	-	986037	2					8	15		25
AMORON'I MANIA	-	-	-	-	-	-	-	686509	686509								26	26
ANALAMANGA	-	-	-	-	-	1660653	-	-	1660653						26			26
ANALANJIROFO	732687	237601	-	-	-	-	-	-	970288	21	4							25
ANDROY	-	-	-	-	705007	-	-	-	705007					28				28
ANOSY	-	243517	-	-	383901	-	-	-	627418		14			19				33
ATSIMO ANDREFANA	-	-	328354	-	785723	-	-	-	1114077			7		19				26
ATSIMO ATSINANANA	166842	644534	-	-	51314	-	-	-	862690	3	23			1				27
ATSINANANA	419189	504930	-	-	-	-	-	-	924119	9	16							25
BETSIBOKA	-	-	-	281760	-	-	-	-	281760				25					25
BOENY	-	-	-	163587	-	-	374351	-	537938				6			19		25
BONGOLAVA	-	-	-	-	-	-	439041	-	439041							26		26
DIANA		390288	-	162077	-	-	-	-	552365		19		9					28
HAUTE MATSIATRA	-	-	-	-	-	-	-	949819	949819								25	25
IHOROMBE	-	-	195224	-	104569	-	-	-	299793			18		7				25
ITASY	-	-	-	-	-	292712	410757	-	703469						10	15		25
MELAKY	-	-	-	277990	-	-	-	-	277990				25					25
MENABE	-	-	323675	244711	-	-	-	-	568386			14	12					25
SAVA	-	941505	-	-	-	-	-	-	941505		25							25
SOFIA	-	-	-	1197409	-	-	-	-	1197409				25					25
VAKINANKARATRA	-	-	-	-	-	431454	-	1031719	1463173						8		18	26
VATOVAVY FITOVINANY	558469	801247	-	-	-	-	-	-	1359716	7	20							27
Madagascar	**1962901**	**3763622**	**847253**	**2327534**	**2030514**	**2648940**	**1860351**	**2668047**	**18109162**	**41**	**121**	**39**	**103**	**74**	**52**	**75**	**69**	**573**

Second stage:

The secondary sample unit was the household as defined by INSTAT.[142] Within the selected clusters, households were selected from an exhaustive of households using systematic random sampling.

For the anthropometric data, the households' number (as defined by the sample size calculation) was selected using a calculated interval sampling (i.e. from a Fokontany with 200 households, 20 households were selected using a sample interval of 10). The households for the food security survey were sampled from the larger list of households already selected for the anthropometric survey. This was done using an independently calculated interval sampling (i.e. from the 20 households selected for anthropometric data, 5 households were selected for food security and health data using a sample interval of 4).

Sample Size Calculation

The sample size for the household level survey (food security) was calculated using the formula with a relative error of 95 percent:

$$\textbf{Sample size} = 1.96^2 \times \frac{p \times (1-p)}{d^2} \times [\text{DEFF}]$$

Where:
p = food security level
d =minimum acceptable precision level (confidence level)
DEFF = Design effect

To estimate food security level, information from the 2005 CFSVA was used adjusted to the current situation using the 2009 crop assessment.[143]

The sample size for the anthropometric survey (malnutrition on children under 5) was calculated using the formula with a relative error of 95 percent:

$$\textbf{Number of children needed} = 1.96^2 \times \frac{p \times (1-p)}{d^2} \times [\text{DEFF}]$$

Where:
p = nutrition status prevalence
d =minimum acceptable precision level
DEFF = Design effect

For the nutrition status prevalence, the country was divided into 3 prevalence rates for global underweight (weight-for-age <-2 z-score using WHO standards) and for global acute malnutrition (weight-for-height<-2 z-score using WHO standards).The prevalence for each region was estimated using a combination of sources including: i) routine growth monitoring data from the PNNC, ii) the recent baseline study from SALOHI, iii) the latest DHS-IV, iv) information on recent emergencies and nutrition crisis.

The design effect was set at 2.5 based on SMART surveys carried out in Madagascar. Precision level was set at 3 percent of global acute malnutrition and 5 percent for underweight.

Although children under 5 are the sampling unit for measuring malnutrition, the household was selected within the clusters. Therefore, it was necessary to convert the number of children required into the number of households using the following formula:

$$\textbf{N}_{hh} = \textbf{N}_{ch}/(a*b*(1-c))$$

Where:
Nhh = final number of households
Nch = number of children needed
a = average household size → 5.5 based on DHS-IV data
b = proportion of under-5s in total population → 18 percent based on DHS-IV data
c = proportion of households absent/refusing (non-response) →10 percent based on previous surveys.

Sample Size Calculation

Data analysis was conducted using STATA and SPSS.

For the nutrition section, ENA software was used for calculation of malnutrition prevalence. Adjusted chi squared was used to compare categorical data, unless stated otherwise.

[142] One (or more) people living under the same roof or different roofs, but sharing the main mails and respecting the authority of the same person (the head of the household)

[143] http://documents.wfp.org/stellent/groups/public/documents/ena/wfp108512.pdf

Annex II: Indicators used for the Food Security and Nutrition analysis

Malnutrition indicators

All indicators of malnutrition are in z-scores based on the WHO standards 2006 for all children less than 5 year of age

- Global acute malnutrition (GAM) is defined as -2 z-scores weight for height and/or oedema.
- Severe acute malnutrition (GAM) is defined as -3 z-scores weight for height and/or oedema.
- Global stunting is defined as -2 z-scores height for age.
- Severe stunting is defined as -3 z-scores height for age.
- Global Underweight is defined as -2 z-scores weight-for-age.
- Sever Underweight is defined as -2 z-scores weight-for-age.

Infant feeding practices

To assess infant and young child practices, the 8 key indicators as defined by the November 2007 consensus meeting on "Indicators for assessing infant and young child feeding practices" were used.[144]

Early initiation of breastfeeding:

Proportion of living children born in the last 23.9 months who were put to the breast within one hour of birth[145] calculated as:

$$\frac{\text{Living children born in the last 23.9 months who were put to the breast within one hour of birth}}{\text{Children born in the last 23.9 months}}$$

Exclusive breastfeeding under 6 months:

Proportion of infants 0-5.9 months of age who are fed exclusively with breastmilk[146] calculated as:

$$\frac{\text{Infants 0-5.9 months of age who received only breastmilk during the previous day}}{\text{Infants 0-5.9 months of age}}$$

Continued breastfeeding at 1 year:

Proportion of children 12 – 15.9 months of age who are fed breastmilk

$$\frac{\text{Children 12-15.9 months of age who received breastmilk during the previous day}}{\text{Children 12-15.9 months of age}}$$

Introduction of solid, semi-solid or soft foods:

Proportion of infants 6-8.9 months of age who receive solid, semi-solid or soft foods

$$\frac{\text{Infants 6-8.9 months of age who received solid, semi-solid or soft foods during the previous day}}{\text{Infants 6-8.9 months of age}}$$

[144] WHO Indicators for assessing infant and young child feeding practices Conclusions of a consensus meeting November 2007

[145] This indicator is usually for living and deceased infants; however for this survey only living children were included in the sample therefore it is probably an overestimation of true prevalence assuming children who are not breastfed within the 1h are more likely to die.

[146] This indicator shows current status based on recall of the previous day and therefore includes only living infants. Using the previous day recall period will cause the proportion of exclusively breastfed infants to be overestimated, as some infants who are given other liquids irregularly may not have received them in the day before the survey.

Minimum dietary diversity:

Proportion of children 6-23.9 months of age who receive foods from 4 or more food groups[147].

Children 6-23.9 mo of age who received foods from ≥ 4 food groups during the previous day
Children 6-23.9 months of age

Minimum meal frequency:

Proportion of breastfed and non-breastfed children 6-23.9 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for nonbreastfed children) the minimum number of times or more[148].The indicator is calculated from the following two fractions:

Breastfed children 6-23.9 months of age who received solid, semi-solid or soft foods the minimum number of times or more during the previous day
Breastfed children 6-23.9 months of age

and

Non-breastfed children 6-23.9 months of age who received solid, semi-solid or soft foods or milk feeds the minimum number of times or more during the previous day
Non-breastfed children 6-23.9 months of age

Minimum acceptable diet:

Proportion of children 6-23.9 months of age who receive a minimum acceptable diet (apart from breastmilk).This composite indicator will be calculated from the following two fractions:

Breastfed children 6-23.9 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day
Breastfed children 6-23.9 months of age

and

Non-breastfed children 6-23.9 months of age who received at least 2 milk feedings and had at least the minimum dietary diversity and the minimum meal frequency during the previous day
Non-breastfed children 6-23.9 months of age

Consumption of iron-rich or iron-fortified foods:

Proportion of children 6-23.9 months of age who receive an iron-rich food or iron-fortified food that is specially designed for infants and young children, or that is fortified in the home.

Children 6-23.9 months of age who received an iron-rich food
or a food that was specially designed for infants and young children and was fortified with iron,
or a food that was fortified in the home with a product that included iron during the previous day
Children 6-23.9 months of age

[147]**The 7 food groups** are (1) grains, roots and tubers, (2) legumes and nuts (3) dairy products, (milk, yoghurt, cheese) (4)flesh foods (meat, fish, poultry and liver/organ meats) (5) eggs, (6) vitamin A rich fruits and vegetables (7) other fruits and vegetables.
[148]**Minimum frequency** is defined as: i) 2 items for breastfed infants 6-8.9 months; ii) 3 items for breastfed children 9-23.9 months; iii) 4 items for non-breastfed children 6-23.9 months.

Water and sanitation indicators

Water and Sanitation indicators were derived from the Joint Monitoring Programme for Water Supply and Sanitation[149]. The definition used for an improved sanitation facility is one that hygienically separates human excreta from human contact. And for an improved drinking-water source, one that by the nature of its construction adequately protects the source from outside contamination, in particular with faecal matter; therefore the following categories were used.

Food Consumption Score (FCS)

Households were asked to report the frequency with which a list of food items was consumed. The list included: *1) rice, 2) maize, 3) sorghum, 4) other cereals, 5) cassava, 6) roots/other tubers (i.e., igname, sweet potatoes, etc.), 7) beans/peas, 8) vegetables (including leaves), 9) fruits, 10) flesh meat, 11) poultry/eggs, 12) fish, 13) sugar and sugar products, 14) oil/fats/butter, 15) milk/yogurt.*

Food consumption scores (FCS) were computed to reflect the diversity, the frequency (number of days per week) and the nutritional value of the food items consumed by households. FCS is a standardized frequency weighted diet diversity score. Diet diversity is correlated with nutrient adequacy, children's and women's anthropometry and socio-economic status.[150]The indicator is therefore considered as a good proxy of food access and nutrition intake.

FCS is computed by grouping together the food items for which consumption was assessed over a seven-day recall period. The frequency represents the number of days an item from each food group was consumed, with a range from 0 (never) to 7 (every day). A weight is assigned to each food group representing its nutritional importance. All food groups and weights are presented in the following table. The FCS is the sum across food groups of the product of frequency by weight.[151]

[149]WHO/UNICEF. Progress on Sanitation and Drinking-water: 2010 Update. WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2010

[150] Ruel M. 2003. Operationalizing Dietary Diversity: A Review of Measurement Issues and Research Priorities. *Journal of Nutrition* 133 (11 suppl. 2) 3911S-3926S.

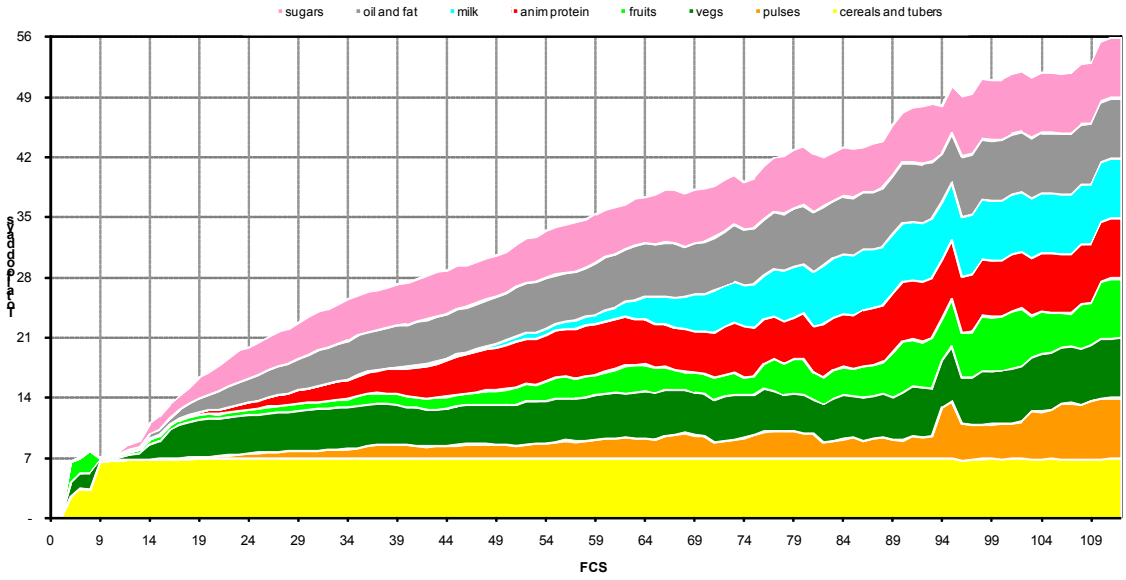
[151] Quantities are not included in the FCS. Only food items consumed as a substantial meal during the seven-day recall period were recorded. However, it is possible that some food items consumed in small quantities are recorded. This may lead to an over-estimation of the FCS.

Table 57 - Food items, groups and weights for calculation of FCS

	Food Items	Food Group	Weight
1.	Cereals: corn, wheat, sorghum, rice, bread; Roots and tubers: manioc, sweet potatoes; Banana	**Staples**	2
2.	Pulses: peanuts, beans	**Pulses**	3
3.	Vegetables:including green leafy vegetables, shoots	**Vegetables**	1
4.	Fruits	**Fruits**	1
5.	Animal Proteins: fish, meat, eggs	**Meat & fish**	4
6.	Milk & milk products	**Milk**	4
7.	Oil and fats	**Oil**	0.5
8.	Sugar	**Sugar**	0.5

FCS is a continuous variable. To facilitate the interpretation, two thresholds (21 and 35) are used to distinguish consumption level. The thresholds define three groups: poor consumption (≤ 21); borderline consumption (> 21 and ≤ 35); and acceptable consumption (> 35). The chart below describes the increase in the diet by the FCS values.

Fig. 125 – Increase of the diet by FCS values



Reduced Coping Strategy Index (CSI)

The table below summarizes the coping strategies and the severity weights used to compute the reduced coping strategies index (CSI).

Table 58 - Coping strategies and severity weights

Coping strategies	Severity weights
Eating less preferred/less expensive foods	1
Borrowing food/relying on help from friends/relatives	2
Limiting portion size at mealtime	1
Limiting adult intake in order for small children to eat	3
Reducing number of meals per day	1

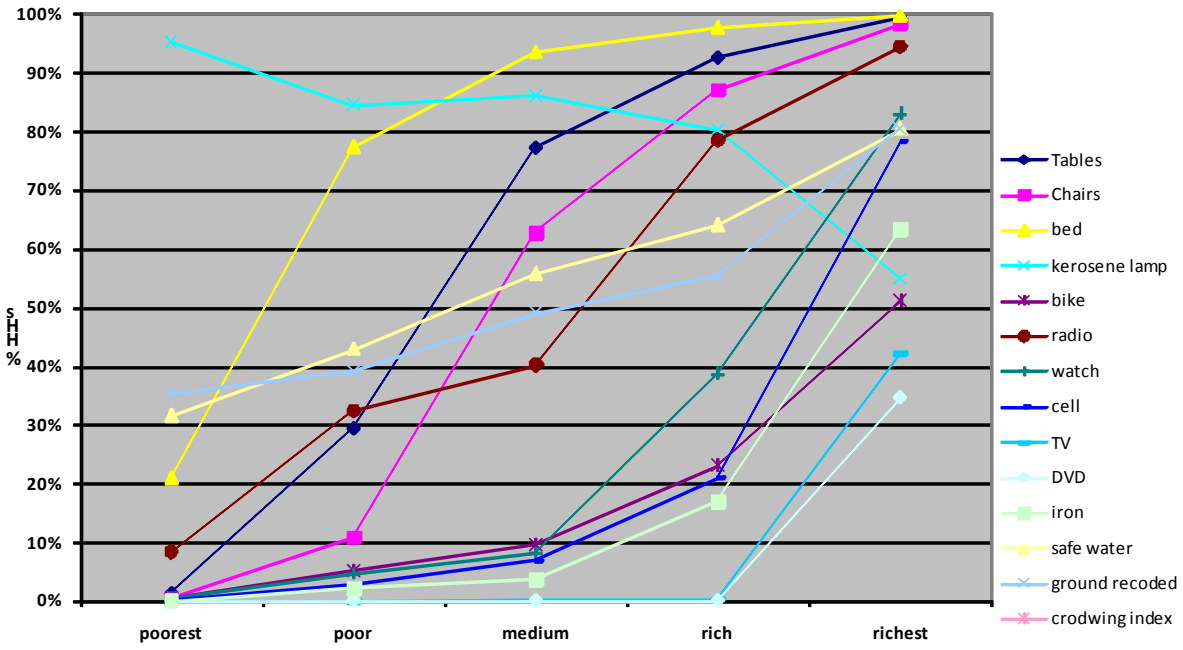
Research demonstrated that reduced CSI reflects food insecurity nearly as well as the full or context-specific CSI. Even if the CSI does not have a cut off like the food consumption score, its average can be used to compare groups and identify those who are more exposed to stress – in order words who engage more frequently in stressful coping mechanisms. Methodological details for the computation of reduced CSI can be found in the "Coping Strategy Index: Field Methods Manual" 2nd Edition, 2008.

Wealth index

A principal components analysis (PCA) was conducted on wealth-related variables to compute a household Wealth Index (WI) as proxy measure of wealth. After careful screening and taking into consideration the Malagasy context, the following variables were used to compute WI: ownership of at least one table, chair, bed, kerosene lamp, bike, radio, watch, mobile phone, TV, DVD, iron, type of flooring (cover versus no cover), crowding index, safe water (improved source and/or treated). The first component was selected to represent a proxy measure of wealth; it conserved 31.6 percent of the total variance. Wealth quintiles were derived from WI, ranging from the poorest to the wealthiest.

The chart below represents the relationship between the variables included in the WI and the index itself. Except for kerosene lamp, more common among the poorest and poor, the ownership of the assets increases as wealth increases. In particular, DVD and TV are owned only by the richest.

Fig. 126 – Asset ownership by wealth quintiles (% HHs)



Food Security Classification

As mentioned in the text, a food insecurity classification has been identified by combining four food access indicators: wealth index, food consumption score, coping strategy index and per capita monthly expenditures. Through a Principal Component Analysis (PCA) and a Cluster Analysis (CA) four three homogeneous clusters have been identified:[152] *food insecure*, 35.2 percent of the total sample, *vulnerable* (47.9 percent) and *food secure* (16.9 percent).

Even if "three" was the optimal number of cluster suggested by the software, a higher number of clusters was explored in order to see if other meaningful partitions were present in the structure of data. After a careful observation of the profiles, it was decided to adopt the three-partition suggested by the software.

[152] Analysis conducted with ADDAWIN (available at http://cidoc.iuav.it/~silvio/addawin_en.html). The software allows the identification of the optimal number of clusters.

Table 59 – food insecure, vulnerable and food secure: description

	Total per capita exp (*)	% HHs in the poorest expenditure quintile	Mean FCS	% poor consumption HHs	reduced CSI	% HHs in the poorest wealth quintile
food insecure	11,298	30%	28.5	25%	27.1	35%
Vulnerable	13,998	19%	36.3	6%	7.5	15%
food secure	42,226	1%	57.3	1%	9.5	1%

Variant of the Standardized Precipitation Index (SPI)

In order to evaluate whether drought occurred in a season, the seasonal total amount is usually compared to a reference value (normally a medium or long term average). The comparison used here is the difference between the total rainfall for a given season and the long term average seasonal total, scaled by the standard deviation of the average seasonal total.

Z sson = (R sson – R avg) / Std Dev

In this way, differences from the mean are compared to the typical scale of interannual variation. This is a simpler variant of the Standardized Precipitation Index (SPI), a widely used (and increasingly taken as a standard) parameter for evaluation of rainfall deficits over varying time scales. Negative (positive) values denote below (above) average seasonal rainfall. A common qualitative description is as follows:

-0.75 and +0.75:	near normal
-0.75 to -1.25:	mild drought
-1.25 to 2.00:	moderate drought
-2.00 to -3.00:	severe drought
< -3.00:	extreme drought

WRSI and Madagascar Model Details

Rainfall is monitored from the beginning of the season and each time sptep the rainfall is compared to the water requirements of the crop. Deficits are added throughout the season and at the end a numerical inderx (water rsourses satisfaction index, WRSO) is defined as:

WRSI = 100 – (Total Deficit / Total Crop Requirement)

This WRSI is 100 for seasons with an optimal water supply (no deficits) and would be 0 for no rainfall. In practice, values below 50 are indicative of complete crop failure. The model is tuned to crop types by using tables of seasonal water requirements published by FAO for specific crops. In this way, the behaviour of crops with higher water requirements (maize) is accounted for and differentiated to some degree from those of less water demanding crops (such as cassava).

The water requirements of a crop are defined as proportional to a parameter known as **Potential EvapoTranspiration** (ETp) which is a measure of the water demand imposed by the environment (through its temperature, amount of sunshine, degree of humidity, etc,); therefore a semi-arid climate (hot, sunny, windy and dry) will have a much higher ETp than a temperate climate (cool, cloudier, humid) and hence a given crop planted in a semi-arid climate will require a lot more water than a similar crop planted in a temperate climate. Water requirements are lowest at planting time, increase steadily to reach a peak in the approach to maturity (during the crop flowering and grain filling period for cereals) and decrease again as the crop ends its development.

Given the existence of the required data as gridded datasets (rainfall, ETp, maximum soil water holding capacity) the model can be run and its outputs produced as grids to be displayed as maps.

For irrigated crops or any crop that does not rely on local rainfall and in particular in the case of Madagascar for paddy rice, the above approach is only possible with a detailed knowledge of the amounts of water supplied to the crop by irrigation. Mapping the crop's performance would also require detailed

maps of which areas are occupied by paddy rice (e.g. from detailed land cover/land use information) which is not readily available.

This model was run for Madagascar for a standard maize crop and for a standard cassava crop. The rainfall data used as input is from the same source as in the "rainfall dristribution and variability". The ETp data used were long term averages mapped at the same resolution and originating from USGS. The calculations also requires an estimate of the maximum water amount a soil can hold – this is derived from the FAO Soil Map of the World and is available from the Global Ecological Database (http://www.ngdc.noaa.gov/ecosys/cdroms/reynolds/reynolds/reynolds.htm).

Crop calendars for Madagascar were analysed in order to identify a suitable crop calendar for cassava. This is required as cassava was not included in the application that runs the model. A development cycle length for cassava of 210 days (7 months) was adopted as the best compromise across the 10 listed agroecological zones. The development cycle was divided in an initial stage (post planting) of 20 days, an intermediate (development) stage of 40 days, a mid season stage (peak) of 90 days and a late stage of 60 days.

Water requirements for both crops were found in Allen et al (1998), better known as FAO publication 56 ("Crop evapotranspiration – Guidelines for computing crop water requirements"). Cassava has a lower water demand than maize throughout its development period : according to FAO56, at its peak a cassava crop demands 80 percent of the local ETp values while maize requires 120 percent. For Madagascar, peak crop season ETp is between 130 to 160mm/month, hence a cassava crop under typical conditions requires 50 to 60mm less per month than maize.

It should be noted that besides requiring more water, maize is also far more sensitive to water stress than most other (cereal and tuber) crops, particularly during its flowering and grain filling stages. This means that for the same degree of water supply deficit, maize will suffer a larger decrease in final yield than another cereal crop grown under similar circumstances.

Occurrence of significant impacts on crop production are evaluated by deriving the magnitude and frequency of deviations of WRSI from a reference value, its medium term median value. Deviations from the median are related to qualitative drought levels as such :

Mild drought:	WRSI within 80-90 percent of the median
Moderate drought:	WRSI within 70-80 percent of the median
Severe drought:	WRSI below 70 percent of the median

The WRSI model was run for each season in the record (1995-1996 to 2009-2010). From the set of seasonal outputs, the long term median was derived and the ratios of the median derived for each season. This set was then converted into frequencies of occurrence.

Annex III: Correlations between key indicators - Wealth, Expenditures, Income Consumption, CSI

The table below reports the correlation coefficients (Pearson's) between key indicators used in the analysis: FCS, WI, total per capita expenditure, reduced CSI and per capita income.

Table 60 – correlation between FCS, WI, expenditures, income and CSI

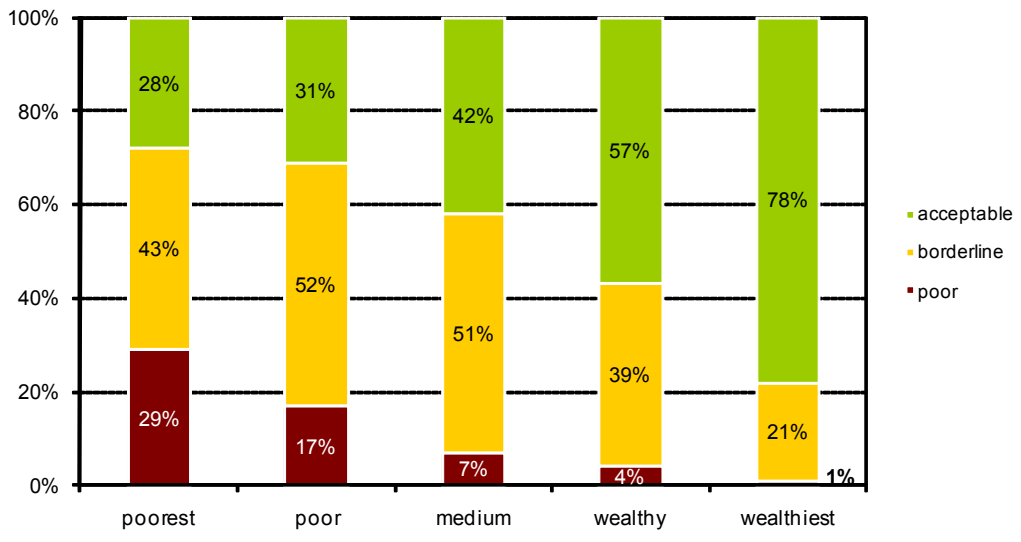
		FCS	Wealth Index	Total expenditure per capita	Reduced CSI	Total per capita income
FCS	Pearson Corr.	1	.497**	.413**	-.274**	.224**
	N	4173	4138	4173	4138	4150
Wealth Index	Pearson Corr.	.497**	1	.389**	-.286**	.315**
	N	4138	4154	4154	4111	4123
Total expenditure per capita	Pearson Corr.	.413**	.389**	1	-.154**	.318**
	N	4173	4154	4192	4143	4157
Reduced CSI	Pearson Corr.	-.274**	-.286**	-.154**	1	-.150**
	N	4138	4111	4143	4143	4123
Total per capita income	Pearson Corr.	.224**	.315**	.318**	-.150**	1
	N	4150	4123	4157	4123	4157

(**) = Correlation is significant at the 0.01 level (2-tailed)

All the correlations are statistically significant at p<0.001. As expected, a positive association is found between the FCS, the WI, the total per capita expenditures and total per capita income; a negative association is found between the CSI and the other indicators.

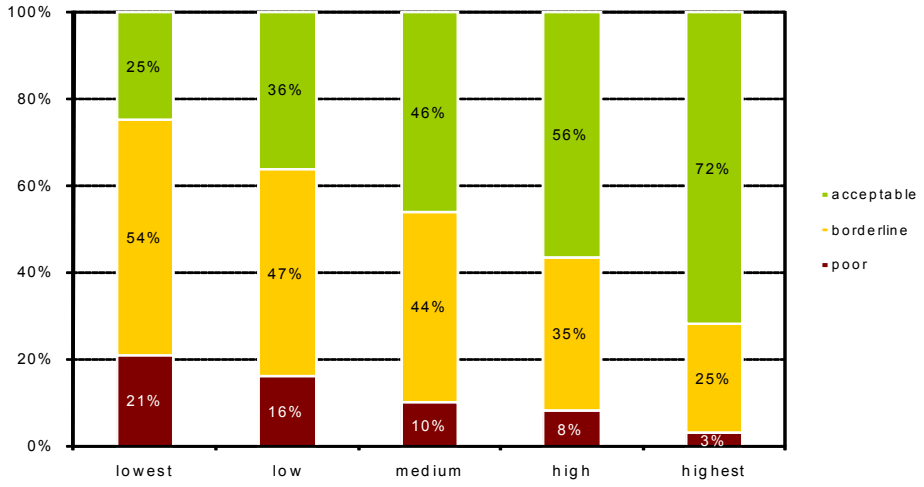
A positive strong linear correlation is found between the WI and the FCS (Pearson Corr = 0.497; p < 0.001). As consequence, the prevalence of poor consumption decreases progressively as long as wealth increases. Poor food consumption prevalence is as high as 29 percent among the poorest households (ie. poorest quintile); it is 17 percent among the poor households (second lowest quintile); seven percent among the medium; and only four and one percent among the wealth and the wealthiest households.

Fig. 128 – Food Consumption Groups by Wealth Quintiles



A positive strong linear correlation is found between the total per capita expenditures and the FCS (Pearson Corr = 0.413; p < 0.001).Therefore, the prevalence of poor consumption is higher in the lower quintiles and decreases in the higher quintiles. Poor consumption households are 21 percent in the quintile with by the lowest expenditures; it is 16 percent in the second lowest quintile; 10 percent among the medium; eight percent among the high expenditure quintile and only three percent in the quintile with the highest expenditures.

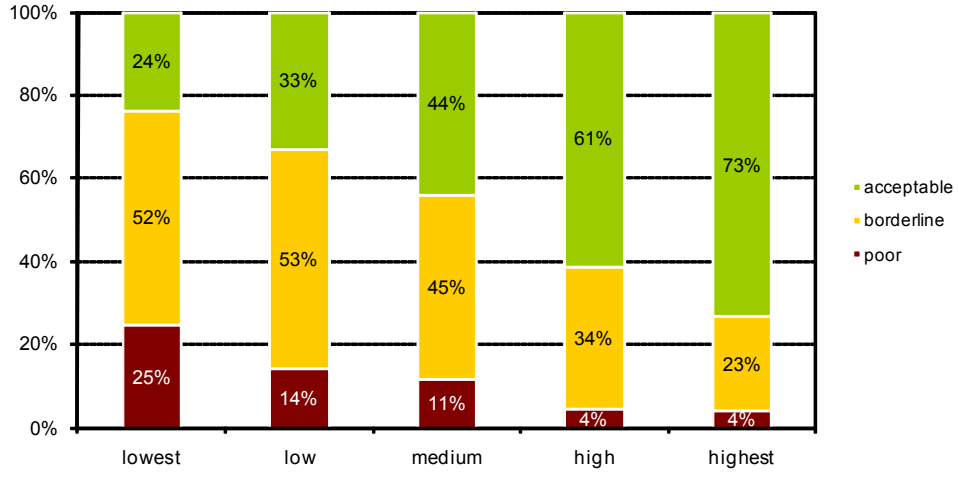
Fig. 129 – Food Consumption Groups by Total Per Capita Expenditures Quintiles



A negative medium/strong linear correlation is found between the reduced CSI and the FCS (Pearson Correlation = -0.274; p < 0.001).The poor consumption households have a mean CSI of 24; the borderline score 15.1 and the acceptable 12.2.

A positive linear correlation is found between the total per capita income and the FCS (Pearson Correlation =.318; p< 0.001). Poor consumption prevalence is higher in the lower income quintiles and decreases as long as income increases. Poor consumption households are 25 percent in the lowest income quintile; it is 14 percent in the second lowest quintile; 11 percent among the medium; four percent among the high and the highest income quintiles.

Fig. 130 – Food Consumption Groups by Total Per Capita Income Quintiles



Annex IV: Tables on Food Security by region and livelihood zones

Table 61 –Income groups by region (percentage of households)

	INCOME GROUPS									
	small farmers	medium/big farmers	informal labourers	pub. salaried/remittances	casual labourers	agropastorals	fisherfolks	Priv. salaried	other act	agric. labourers
Analamanga	6.6%	5.8%	24.0%	5.8%	14.9%	8.3%	.0%	12.4%	14.0%	8.3%
Vakinakaratra	7.1%	11.8%	32.3%	2.4%	17.3%	22.8%	.0%	3.9%	1.6%	.8%
Itasy	16.7%	17.3%	14.2%	2.5%	47.5%	.6%	1.2%	.0%	.0%	.0%
Bongolava	28.1%	43.1%	7.5%	3.1%	5.0%	10.6%	.6%	.0%	1.3%	.6%
Haute Matsiatra	25.0%	12.5%	21.5%	7.6%	11.8%	17.4%	2.1%	.7%	.0%	1.4%
Amoron i Mania	14.5%	4.8%	37.1%	2.4%	21.8%	13.7%	.0%	3.2%	2.4%	.0%
Vatovavy Fitovinany	31.1%	11.3%	16.2%	4.1%	24.8%	.0%	4.5%	1.4%	5.9%	.9%
Ihorombe	12.1%	50.3%	9.7%	3.6%	13.3%	3.6%	.0%	3.0%	.6%	3.6%
Atsimo Atsinanana	9.7%	24.0%	18.3%	2.9%	33.1%	1.1%	1.1%	.6%	7.4%	1.7%
Atsinanana	11.8%	33.5%	20.8%	6.1%	12.7%	3.3%	4.2%	4.7%	2.8%	.0%
Analanjirofo	25.4%	28.0%	12.7%	2.1%	20.8%	1.7%	3.8%	2.1%	2.5%	.8%
Alaotra Mangoro	6.2%	16.8%	24.2%	4.3%	21.1%	4.3%	6.8%	1.2%	14.3%	.6%
Boeny	23.7%	20.1%	20.1%	2.6%	12.9%	6.7%	8.2%	1.5%	3.6%	.5%
Sofia	25.1%	33.8%	19.6%	1.4%	9.6%	2.7%	1.4%	.5%	5.9%	.0%
Betsiboka	9.5%	20.0%	29.5%	2.9%	7.1%	2.4%	1.9%	2.9%	21.9%	1.9%
Melaky	8.8%	19.2%	18.1%	6.0%	9.3%	12.1%	12.6%	1.6%	11.0%	1.1%
Atsimo Andrefana	42.3%	2.6%	12.2%	2.0%	11.2%	12.8%	7.1%	.5%	6.1%	3.1%
Androy	12.3%	11.2%	20.8%	10.4%	17.5%	23.0%	1.5%	.7%	.7%	1.9%
Anosy	19.0%	20.9%	22.4%	9.1%	8.4%	.8%	1.5%	7.6%	9.1%	1.1%
Menabe	27.9%	27.9%	8.4%	7.0%	5.1%	6.5%	6.0%	3.3%	7.0%	.9%
Diana	21.6%	17.4%	11.6%	9.5%	2.6%	1.1%	3.7%	8.4%	23.2%	1.1%
Sava	22.3%	27.9%	28.5%	6.1%	11.2%	1.1%	2.2%	.6%	.0%	.0%
Rural Madagascar	**19.6%**	**19.1%**	**20.2%**	**4.5%**	**16.0%**	**7.3%**	**2.8%**	**3.2%**	**5.7%**	**1.6%**

Table 62 - Income groups by livelihood zone (percentage of households)

	LIVELIHOOD GROUPS									
	small farmers	medium/big farmers	informal labourers	pub. salaried/remittances	casual labourers	agropastorals	fisherfolks	priv salaried	other act	agric. labourers
MF Cyclone Eastern Coast	25.6%	22.8%	12.0%	3.6%	23.0%	2.1%	2.2%	2.6%	5.5%	.5%
HF Cyclone Eastern Coast	19.1%	24.3%	22.0%	5.4%	16.0%	.9%	3.9%	2.3%	5.3%	.8%
West-SouthWestern	33.3%	25.0%	11.7%	5.3%	9.0%	3.9%	.9%	2.6%	6.5%	1.9%
Western	22.0%	27.7%	19.3%	3.1%	8.3%	4.3%	4.0%	1.8%	9.0%	.4%
Southern	24.2%	10.8%	16.1%	6.5%	12.8%	15.4%	4.9%	2.5%	4.2%	2.7%
Central Highlands	9.1%	5.4%	25.7%	5.2%	18.7%	10.2%	.2%	8.9%	10.4%	6.1%
Large Farming Plains	18.8%	27.7%	15.0%	1.8%	22.1%	5.8%	4.3%	.6%	3.4%	.5%
Southern Highlands	15.8%	11.8%	28.2%	4.2%	16.7%	18.1%	.7%	2.9%	1.1%	.5%
Rural Madagascar	**19.6%**	**19.1%**	**20.2%**	**4.5%**	**16.0%**	**7.3%**	**2.8%**	**3.2%**	**5.7%**	**1.6%**

Table 63 – Share of expenditure on specific items out of the total expenditures by region (means)

	rice	cereals	tubers	pulses	fruits	meat	oil	milk	sugar	threshing	soap	fuel	water	alcohol	transport	med. consultatio	medicines	trad. med. consultatio	trad medicines	clothes	.	. housing	labour	debts	education	events	veterinary	seeds	fertilizers	tractor
Analama	29.0	2.1	2.2	3.2	5.4	8.4	4.7	1.3	5.4	.1	5.1	2.3	.2	3.4	1.7	.2	3.8	.0	.0	4.2	1.0	1.8	1.9	.5	5.8	3.8	.4	1.4	.8	.0
Vakinaka	27.2	3.5	5.0	1.6	5.1	8.8	4.3	.4	6.8	.7	4.1	2.4	.0	3.8	1.7	.1	1.7	.0	.1	4.7	1.1	1.6	2.3	2.9	1.9	5.8	.8	.4	1.1	.0
Itasy	42.7	.0	.4	.3	4.5	9.9	7.8	.1	7.0	.3	7.8	2.1	.0	.5	.2	.1	1.9	.0	.0	10.4	.0	.1	.3	.0	1.6	1.8	.0	.0	.2	.0
Bongolava	32.7	1.1	6.9	2.8	3.5	9.4	4.7	.8	4.0	.9	4.0	.2	.1	3.3	3.3	.1	1.8	.0	.0	3.8	.7	1.8	2.7	2.1	3.4	5.3	.2	.2	.2	.0
Haute	44.2	.8	12.0	2.6	8.0	3.4	3.0	.3	2.8	.1	2.8	.0	.2	2.0	1.7	.2	1.4	.0	.0	5.0	1.5	.9	.5	1.2	2.0	2.5	.3	.2	.5	.0
Amoron i	37.2	4.1	1.9	3.3	3.8	8.7	3.7	.8	5.7	.1	3.9	3.8	.3	3.7	2.7	.1	.8	.0	.1	3.2	.2	1.2	.5	2.5	1.9	4.4	.8	.5	.1	.0
Vatovav	44.1	.1	2.0	1.0	1.9	3.0	6.9	.0	9.9	.2	7.0	.1	.0	4.0	.4	.2	3.2	.1	.1	11.3	.1	.0	.0	.2	.7	.4	.0	2.6	.0	.4
Ihorombe	48.5	.9	7.7	2.1	3.0	4.7	2.7	.2	2.1	.3	4.3	1.4	.5	2.5	2.2	.4	2.0	.1	.1	3.3	2.2	1.1	1.2	2.3	.6	2.8	.4	.3	.1	.0
Atsimo	37.1	.1	12.2	1.4	2.5	3.7	4.0	.2	8.7	.0	4.3	.7	.0	7.3	.0	.1	3.7	.3	.1	3.0	.1	.3	.3	1.3	2.9	5.4	.0	.2	.0	.0
Atsinanan	34.4	.7	3.0	3.0	5.1	7.9	8.8	.4	5.0	.0	5.1	1.3	.0	5.5	.8	.1	3.4	.0	.2	6.5	.2	.5	3.7	1.1	.3	.5	.1	2.6	.0	.0
Analanjir	32.3	.9	1.4	3.8	4.7	5.9	6.1	.1	6.8	.4	7.2	5.0	.1	4.6	2.3	.3	2.7	.0	.3	4.9	.2	.3	1.5	1.0	2.4	4.4	.6	.0	.0	.0
Alaotra	30.7	.4	1.2	2.0	7.0	9.3	5.7	.6	5.3	1.0	6.0	1.9	.0	3.7	4.2	.2	1.9	.1	.0	7.9	.8	2.0	2.7	3.1	1.0	.7	.5	.0	.0	.1
Boeny	29.8	.8	3.7	3.0	3.8	13.2	6.4	1.1	5.0	.0	6.4	2.8	.4	3.9	1.4	.6	3.9	.0	.1	6.1	2.6	.6	.3	2.1	.7	.5	.5	.4	.0	.0
Sofia	21.1	.9	1.0	2.7	2.8	10.3	9.9	.1	6.8	.2	13.7	2.9	.2	.4	.2	1.0	6.6	.0	.7	15.8	.1	.2	.2	1.1	.5	.5	.2	.0	.0	.0
Betsiboka	26.1	1.0	2.0	4.4	6.1	11.8	5.4	.6	7.1	.2	6.6	1.1	.6	4.8	1.5	.5	4.4	.1	.1	6.5	1.8	.5	1.4	1.1	.7	2.3	.8	.3	.0	.1
Melaky	21.6	1.1	2.3	1.1	4.3	14.8	6.1	.1	8.5	.4	9.9	.6	.0	6.1	1.8	.8	3.4	.6	.4	7.9	1.2	.2	.8	.7	.8	4.3	.0	.1	.0	.0
Atsimo	14.0	10.5	42.9	.6	2.0	1.8	.6	.0	1.8	.1	2.7	3.2	.3	2.8	.3	.2	2.3	.4	.1	4.9	.1	.0	.0	4.9	.8	1.9	.0	.8	.0	.0
Androv	7.0	4.7	31.4	1.8	1.2	1.1	.9	.2	3.5	.0	3.8	5.6	6.3	3.3	1.8	2.8	3.0	2.4	.0	2.0	1.2	1.0	.6	3.0	1.1	7.9	.8	1.5	.0	.1
Anosy	30.4	2.4	18.0	3.4	3.3	5.0	2.4	.4	1.5	.0	3.9	3.1	1.9	3.0	2.0	1.9	2.8	.2	.1	4.5	.8	.1	.1	3.0	1.1	4.0	.3	.3	.0	.2
Menabe	29.4	2.9	6.6	2.9	3.9	9.2	4.6	.7	4.2	.3	5.3	1.9	.2	4.1	2.7	1.6	2.7	.4	.1	5.9	1.1	.5	1.9	2.5	1.9	1.8	.1	.2	.0	.0
Diana	42.5	3.6	2.7	2.4	3.2	8.2	4.0	.9	2.6	.5	4.6	7.7	.3	5.2	2.0	.6	1.0	.1	.1	2.8	.1	.7	.1	.8	2.7	.2	.0	.1	.0	.2
Sava	39.4	1.3	1.7	3.6	3.4	4.9	3.6	.3	3.5	.0	3.9	6.0	.0	1.1	7.0	.5	3.7	.1	.1	6.0	.0	.0	.9	1.4	4.1	3.1	.0	.3	.1	.0
Rural Mad	**31.6**	**2.2**	**7.7**	**2.4**	**4.0**	**6.9**	**5.0**	**.4**	**5.4**	**.2**	**5.6**	**2.7**	**.4**	**3.4**	**1.8**	**.5**	**3.0**	**.2**	**.1**	**6.3**	**.6**	**.7**	**1.1**	**1.7**	**2.0**	**2.9**	**.3**	**.7**	**.2**	**.0**

Table 64 - share of expenditure on specific items out of the total expenditures by livelihood zone (means)

	rice	cereals	tubers	pulses	fruits	meat	oil	milk	sugar	threshing	soap	fuel	water	alcohol	transport	med. consultation	medicines	trad. med. consultation	trad medicines	clothes	. equipment	. housing	labour	debts	education	events	veterinary	seeds	fertilizers	tractor
MF Cyclone East	35.5	.5	2.2	2.9	3.5	6.1	6.6	.2	6.6	.3	6.6	3.2	.0	5.5	1.6	.2	2.7	.0	.2	6.1	.2	.3	1.6	.8	1.3	3.1	.4	1.4	.0	.3
HF Cyclone East	38.5	1.1	4.9	2.5	3.5	5.1	5.4	.3	6.0	.1	5.0	3.1	.1	3.7	2.4	.3	3.4	.1	.1	6.6	.1	.3	1.0	1.1	2.3	2.2	.0	1.0	.0	.0
WS Western	32.5	2.7	17.8	2.2	3.9	5.6	2.4	.3	3.0	.2	4.2	2.9	.4	3.2	2.3	.9	2.1	.3	.0	4.6	1.1	.3	.5	2.6	1.2	2.0	.1	.7	.0	.0
Western	25.2	1.3	2.0	2.7	3.6	10.6	7.9	.4	6.5	.3	10.6	2.6	.3	2.2	.9	.9	5.0	.1	.5	11.4	.5	.3	.7	1.2	.8	1.3	.2	.1	.0	.0
Southern	14.1	8.1	34.1	1.5	1.7	2.0	.9	.2	2.3	.0	3.4	3.6	2.8	3.1	1.3	1.5	2.6	1.0	.1	3.7	.7	.5	.3	4.2	1.0	4.3	.4	.7	.0	.1
Central Hlands	31.4	1.7	2.9	2.6	5.3	8.6	4.9	1.0	5.7	.3	5.2	2.3	.1	3.1	1.7	.1	3.1	.0	.0	4.7	.8	1.4	1.9	.8	4.1	3.7	.5	1.0	.9	.0
L. Farming Plain	33.1	.7	3.6	2.2	4.4	10.6	6.2	.7	5.1	.4	6.0	1.6	.1	3.1	1.8	.3	2.4	.0	.0	7.1	1.2	.9	1.2	1.9	2.1	2.6	.3	.2	.1	.0
Southern Hlands	35.1	3.1	6.0	2.4	5.6	7.0	3.8	.4	5.2	.3	3.6	2.1	.1	3.2	1.9	.2	1.5	.0	.1	4.5	1.1	1.4	1.2	2.3	2.1	4.2	.6	.3	.4	.0
Rural Mada	**31.6**	**2.2**	**7.7**	**2.4**	**4.0**	**6.9**	**5.0**	**.4**	**5.4**	**.2**	**5.6**	**2.7**	**.4**	**3.4**	**1.8**	**.5**	**3.0**	**.2**	**.1**	**6.3**	**.6**	**.7**	**1.1**	**1.7**	**2.0**	**2.9**	**.3**	**.7**	**.2**	**.0**

Table 65 – Household perception of expenditure trends by region (percentage of households)

	2009-2010 food expenditure			2009-2010 energy expenditure			2009-2010 health expenditure			2009-2010 education expenditure			2009-2010 agricultural expenditure		
	increased	decreased	same	increased	decreased	same	increased	decreased	same	increased	decreased	same	increased	decreased	same
Analamanga	63.9%	19.7%	16.4%	17.2%	4.9%	77.9%	29.5%	25.4%	45.1%	81.5%	2.5%	16.0%	45.6%	2.2%	52.2%
Vakinakaratra	53.8%	20.5%	25.8%	43.9%	17.4%	38.6%	28.2%	29.0%	42.7%	64.6%	3.7%	31.7%	51.6%	4.8%	43.7%
Itasy	76.1%	9.8%	14.1%	2.5%	1.2%	96.3%	33.7%	58.3%	8.0%	55.4%	3.0%	41.6%	70.9%	2.6%	26.5%
Bongolava	64.4%	12.9%	22.7%	27.6%	7.4%	65.0%	34.4%	19.0%	46.6%	64.0%	.0%	36.0%	58.6%	10.2%	31.2%
Haute Matsiatra	63.9%	24.3%	11.8%	33.3%	32.6%	34.0%	30.6%	47.2%	22.2%	76.7%	6.8%	16.5%	37.8%	28.3%	33.9%
Amoron i Mania	57.9%	22.2%	19.8%	23.8%	4.8%	71.4%	34.9%	29.4%	35.7%	46.8%	7.6%	45.6%	36.0%	16.0%	48.0%
Vatovavy Fitovinany	46.4%	47.3%	6.3%	41.4%	45.0%	13.5%	48.2%	33.8%	18.0%	58.3%	24.4%	17.3%	51.4%	21.9%	26.7%
Ihorombe	86.7%	4.8%	8.5%	72.1%	9.1%	18.8%	50.9%	18.8%	30.3%	38.8%	3.0%	58.2%	64.2%	6.2%	29.6%
Atsimo Atsinanana	50.9%	21.1%	28.0%	11.4%	16.0%	72.6%	39.4%	5.7%	54.9%	44.7%	1.8%	53.5%	6.8%	2.7%	90.5%
Atsinanana	72.7%	20.5%	6.8%	72.6%	3.2%	24.2%	30.7%	11.0%	58.3%	83.9%	.7%	15.3%	51.1%	2.8%	46.1%
Analanjirofo	45.3%	31.8%	22.9%	39.8%	29.2%	30.9%	28.5%	48.9%	22.6%	71.6%	7.4%	20.9%	38.1%	32.4%	29.5%
Alaotra Mangoro	81.5%	6.8%	11.7%	16.7%	1.2%	82.1%	33.3%	13.0%	53.7%	34.3%	1.0%	64.6%	15.9%	5.3%	78.8%
Boeny	69.7%	16.2%	14.1%	23.7%	4.0%	72.2%	53.0%	20.2%	26.8%	71.9%	5.2%	22.9%	81.6%	7.0%	11.4%
Sofia	43.2%	9.0%	47.7%	27.8%	4.0%	68.2%	47.1%	3.6%	49.3%	81.8%	1.3%	16.9%	62.5%	1.4%	36.1%
Betsiboka	71.1%	5.7%	23.2%	40.8%	1.9%	57.3%	52.6%	11.4%	36.0%	62.2%	7.2%	30.6%	54.7%	6.1%	39.2%
Melaky	51.9%	8.3%	39.8%	27.1%	5.5%	67.4%	33.7%	18.8%	47.5%	28.6%	9.5%	61.9%	12.2%	4.1%	83.7%
Atsimo Andrefana	94.8%	.5%	4.6%	60.8%	.5%	38.7%	65.5%	6.2%	28.4%	81.7%	.0%	18.3%	84.3%	1.3%	14.5%
Androy	55.5%	21.5%	23.0%	31.8%	23.4%	44.9%	44.2%	27.0%	28.8%	24.2%	34.9%	40.9%	43.9%	28.2%	27.8%
Anosy	45.5%	39.0%	15.5%	36.7%	33.3%	29.9%	45.1%	37.5%	17.4%	58.6%	23.3%	18.1%	23.8%	33.7%	42.5%
Menabe	76.6%	13.6%	9.8%	59.8%	7.5%	32.7%	40.0%	25.1%	34.9%	53.1%	6.2%	40.8%	41.5%	7.1%	51.4%
Diana	65.6%	13.8%	20.6%	49.2%	10.6%	40.2%	35.3%	42.4%	22.3%	77.6%	4.1%	18.4%	57.9%	18.7%	23.4%
Sava	72.1%	11.7%	16.2%	29.6%	6.7%	63.7%	36.3%	48.6%	15.1%	84.1%	6.3%	9.5%	76.4%	5.4%	18.2%
Rural Madagascar	**62.1%**	**19.4%**	**18.5%**	**36.1%**	**13.8%**	**50.2%**	**39.0%**	**27.5%**	**33.5%**	**67.0%**	**6.8%**	**26.1%**	**51.3%**	**11.2%**	**37.4%**

Table 66 - Household perception of expenditure trends by livelihood zone (percentage of households)

	2009-2010 food expenditure			2009-2010 energy expenditure			2009-2010 health expenditure			2009-2010 education expenditure			2009-2010 agricultural expenditure		
	increased	decreased	same	increased	decreased	same	increased	decreased	same	increased	decreased	same	increased	decreased	same
MF Cyclone EastC.	50.9%	30.8%	18.2%	41.3%	24.2%	34.6%	35.1%	34.2%	30.6%	68.3%	6.9%	24.9%	44.1%	24.1%	31.9%
HF Cyclone East C.	60.8%	26.1%	13.1%	41.9%	20.2%	37.8%	38.5%	32.9%	28.5%	72.3%	9.4%	18.3%	49.0%	11.1%	40.0%
WS Western	89.5%	4.9%	5.7%	62.9%	5.2%	31.9%	54.0%	16.5%	29.5%	48.2%	3.9%	47.9%	58.8%	5.1%	36.1%
Western	51.6%	10.7%	37.7%	32.4%	4.8%	62.8%	43.8%	12.0%	44.3%	72.1%	3.0%	25.0%	54.3%	4.0%	41.7%
Southern	71.0%	14.3%	14.7%	46.7%	13.8%	39.5%	53.5%	18.7%	27.8%	50.2%	20.8%	29.0%	59.7%	17.9%	22.5%
Central Hlands	64.7%	18.1%	17.2%	19.2%	9.2%	71.6%	27.7%	31.8%	40.5%	74.3%	2.3%	23.3%	48.7%	2.4%	48.9%
L. Farming Plains	72.0%	11.3%	16.7%	18.7%	4.5%	76.8%	41.3%	26.5%	32.2%	56.9%	3.2%	39.9%	65.5%	6.6%	27.8%
Southern Hlands	58.0%	22.4%	19.6%	35.6%	16.3%	48.1%	31.8%	34.3%	33.8%	66.3%	5.8%	27.9%	43.1%	16.0%	40.9%
Rural Madagascar	**62.1%**	**19.4%**	**18.5%**	**36.1%**	**13.8%**	**50.2%**	**39.0%**	**27.5%**	**33.5%**	**67.0%**	**6.8%**	**26.1%**	**51.3%**	**11.2%**	**37.4%**

Table 67 – Percentage of households by main crop cultivated (by region)

	Main crop																					
	Rice 1st season	Rice 2nd season	Rice tanety	rice jeby	maize	manioc	Sweet potatoes	beans	arachids	lentils	peas	potatoes	soja	voanjobory	Sugarcane	letchis	coffe	sunflowers	vanilla	pepper	onion	other
Analamanga	53.3%	40.0%	.0%	.0%	1.1%	3.3%	.0%	2.2%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Vakinakaratra	89.6%	.8%	2.4%	.0%	1.6%	.8%	.0%	.0%	.0%	.0%	.0%	.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	4.0%
Itasy	80.4%	.0%	.0%	.0%	2.0%	10.1%	.7%	2.7%	1.4%	.0%	.7%	1.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.7%
Bongolava	65.2%	26.5%	3.9%	3.9%	.6%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Haute Matsiatra	59.2%	16.2%	.0%	.0%	.8%	13.1%	5.4%	2.3%	1.5%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	1.5%
Amoron i Mania	22.0%	67.0%	.0%	.0%	2.0%	5.0%	.0%	2.0%	1.0%	.0%	.0%	1.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Vatovavy Fitovinany	34.1%	59.0%	4.9%	.0%	.0%	2.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Ihorombe	43.6%	47.4%	.0%	.0%	2.3%	6.0%	.0%	.0%	.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Atsimo Atsinanana	9.3%	70.0%	2.0%	.0%	.0%	17.3%	.0%	.7%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.7%	.0%	.0%	.0%	.0%	.0%
Atsinanana	82.8%	11.6%	3.0%	.0%	1.0%	1.0%	.5%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Analanjirofo	66.3%	10.2%	22.4%	.0%	.0%	1.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Alaotra Mangoro	10.0%	67.7%	10.0%	.0%	3.1%	6.9%	.0%	.8%	.0%	.0%	.0%	.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.8%
Boeny	43.0%	31.5%	.0%	18.1%	6.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	1.3%
Sofia	9.8%	84.9%	.0%	.0%	1.5%	1.0%	1.0%	.0%	.5%	.0%	.0%	.0%	.0%	.0%	.5%	.0%	.0%	.0%	.0%	.0%	.5%	.5%
Betsiboka	30.2%	60.4%	6.7%	.7%	.0%	1.3%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.7%
Melaky	82.9%	3.6%	5.0%	3.6%	.7%	2.9%	.0%	.0%	.7%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.7%
Atsimo Andrefana	38.5%	.0%	.0%	.0%	13.8%	46.2%	.0%	.0%	.8%	.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Androy	13.7%	.0%	.4%	.0%	10.6%	67.0%	6.6%	.0%	1.3%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%
Anosy	35.5%	.0%	.0%	.0%	7.2%	45.2%	8.4%	.0%	.6%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	3.0%	.0%
Menabe	65.7%	13.7%	1.1%	.0%	5.1%	6.3%	.6%	1.7%	.6%	1.7%	1.7%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	1.7%
Diana	14.0%	80.4%	.0%	.0%	2.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.9%	.0%	.0%	.0%	.0%	1.9%
Sava	80.5%	7.1%	3.2%	.6%	.0%	1.3%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.6%	.0%	.0%	.0%	5.8%	.0%	.0%	.6%
Rural Mada	**50.8%**	**29.9%**	**3.2%**	**.7%**	**2.4%**	**9.4%**	**.9%**	**.6%**	**.4%**	**.1%**	**.1%**	**.2%**	**.0%**	**.0%**	**.1%**	**.0%**	**.0%**	**.0%**	**.4%**	**.0%**	**.1%**	**.7%**

Table 68- Percentage of households by main crop cultivated (by livelihood zone)

	Main crop																					
	Rice 1st season	Rice 2nd season	Rice tanety	rice jeby	maize	manioc	Sweet potatoes	beans	arachids	lentils	peas	potatoes	soja	voanjobory	Sugarcane	letchis	coffe	sunflowers	vanilla	pepper	onion	other
MF Cydone EastC.	62.1%	18.9%	17.8%	.0%	.0%	1.1%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
HF Cydone EastC.	51.3%	36.8%	2.0%	.2%	.8%	6.3%	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.2%	.0%	.1%	.0%	1.6%	.0%	.1%	.3%
WS Western	64.5%	15.3%	.0%	.0%	4.8%	12.3%	.4%	.0%	1.6%	.0%	1.1%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%
Western	27.9%	63.5%	1.5%	1.0%	1.6%	1.0%	.6%	.4%	.4%	.4%	.0%	.0%	.0%	.0%	.3%	.0%	.2%	.0%	.0%	.0%	.3%	1.0%
Southern	18.5%	4.0%	.5%	.0%	12.5%	57.7%	4.5%	.3%	.7%	.4%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.7%	.2%
Central Hlands	65.8%	27.5%	.1%	.0%	.7%	3.4%	.2%	1.4%	.0%	.0%	.0%	.5%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.3%
L. Farming Plains	55.4%	25.0%	2.0%	6.3%	3.7%	4.1%	.0%	1.4%	.6%	.0%	.3%	.8%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.4%
Southern Hlands	61.0%	22.5%	1.4%	.0%	1.7%	6.2%	1.9%	1.3%	.8%	.0%	.0%	.2%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	2.9%
Rural Mada	**50.8%**	**29.9%**	**3.2%**	**.7%**	**2.4%**	**9.4%**	**.9%**	**.6%**	**.4%**	**.1%**	**.1%**	**.2%**	**.0%**	**.0%**	**.1%**	**.0%**	**.0%**	**.0%**	**.4%**	**.0%**	**.1%**	**.7%**

Table 69 - Crop distribution by region (percentage of crops out of the total crops cultivated)

	Riz 1ere saison	Riz 2ieme saison	Riz tanety	riz jeby	mais	manioc	patate douce	haricot	arachide	lentille	pois du cap	pomme de terre	soja	voanjobory	canne a sucre	letchis	cafe	girofle	vanille	poivre	oignon
Analamanga	13.5%	11.5%	0.3%	0.0%	5.9%	24.2%	13.0%	20.0%	3.1%	0.0%	0.0%	2.5%	0.3%	5.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
Vakinakaratra	22.0%	1.8%	2.2%	0.2%	21.4%	14.6%	14.2%	6.7%	1.8%	0.0%	0.0%	12.6%	1.1%	1.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%
Itasy	31.2%	0.0%	0.5%	0.0%	16.4%	27.9%	4.8%	5.2%	6.0%	0.0%	0.2%	5.5%	0.0%	1.9%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Bongolava	15.7%	21.5%	3.1%	3.0%	17.3%	20.1%	0.2%	2.3%	10.6%	0.0%	0.0%	0.0%	0.0%	6.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Haute Matsiatra	19.2%	5.9%	0.0%	0.0%	9.0%	24.1%	14.9%	12.3%	7.3%	0.0%	0.0%	1.5%	1.9%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Amoron i Mania	5.5%	17.0%	0.0%	0.0%	14.0%	19.8%	17.7%	16.3%	3.9%	0.0%	0.0%	3.4%	0.2%	1.4%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Vatovavy Fitovinany	11.9%	27.6%	2.8%	0.0%	0.3%	30.6%	7.7%	1.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	2.2%	12.5%	0.7%	0.5%	1.2%	0.0%
Ihorombe	20.8%	25.8%	0.0%	0.0%	6.3%	26.8%	5.8%	5.1%	5.8%	0.3%	0.3%	0.0%	0.5%	1.5%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Atsimo Atsinanana	16.9%	27.5%	1.5%	0.2%	1.3%	29.2%	10.1%	1.3%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.4%	7.4%	2.1%	0.2%	0.4%	0.0%
Atsinanana	22.4%	22.0%	3.6%	0.0%	8.9%	23.0%	3.6%	0.3%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	5.0%	5.4%	4.0%	0.7%	0.1%	0.5%	0.0%
Analanjirofo	18.0%	14.3%	14.8%	0.0%	2.3%	22.7%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%	7.3%	2.2%	9.7%	3.0%	0.0%	0.0%
Alaotra Mangoro	5.6%	25.0%	6.4%	0.0%	13.5%	21.8%	2.9%	9.8%	4.4%	0.0%	0.0%	0.2%	0.0%	1.0%	5.4%	0.0%	3.4%	0.0%	0.0%	0.0%	0.5%
Boeny	19.0%	19.0%	0.6%	16.7%	18.1%	11.1%	6.1%	0.3%	7.9%	0.0%	0.0%	0.0%	0.0%	0.3%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
Sofia	3.9%	35.9%	0.0%	0.2%	22.9%	14.6%	1.4%	2.1%	5.1%	0.2%	2.9%	0.0%	0.0%	0.2%	6.2%	0.0%	0.4%	0.0%	0.0%	0.0%	3.9%
Betsiboka	12.1%	25.3%	6.2%	0.8%	16.8%	22.9%	1.5%	1.8%	5.7%	0.0%	0.5%	0.0%	0.0%	2.1%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
Melaky	37.8%	3.5%	2.5%	2.9%	18.7%	30.2%	0.0%	0.3%	1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Atsimo Andrefana	14.2%	11.4%	0.0%	0.0%	11.7%	32.8%	14.5%	0.0%	5.1%	4.6%	2.0%	0.0%	0.0%	2.8%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%
Androy	5.8%	0.0%	0.2%	0.0%	22.0%	36.8%	18.2%	0.2%	12.4%	0.2%	0.0%	0.0%	0.0%	4.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Anosy	20.9%	5.5%	0.0%	0.2%	11.2%	32.3%	17.8%	0.7%	3.6%	0.0%	0.0%	0.0%	0.0%	1.9%	0.5%	1.0%	3.3%	0.0%	0.0%	0.0%	1.2%
Menabe	29.1%	18.4%	0.9%	0.0%	16.7%	13.7%	5.6%	4.1%	6.3%	2.2%	2.4%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Diana	8.4%	49.2%	0.0%	0.0%	12.8%	14.0%	3.4%	3.9%	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	0.6%	3.9%	0.0%	2.2%	0.0%	0.0%
Sava	**27.1%**	**14.2%**	**4.3%**	**0.4%**	**2.5%**	**17.7%**	**1.9%**	**4.5%**	**1.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**1.6%**	**0.0%**	**6.2%**	**0.6%**	**17.9%**	**0.0%**	**0.0%**

Table 70 – Crop distribution by livelihood zone (percentage of crops out of the total crops cultivated)

	Riz 1ere saison	Riz 2ieme saison	Riz tanety	riz jeby	mais	manioc	patate douce	haricot	arachide	lentille	pois du cap	pomme de terre	soja	voanjobory	canne a sucre	letchis	cafe	girofle	vanille	poivre	oignon
MF Cyclone EastC.	17.6%	17.3%	11.2%	.0%	2.4%	24.4%	5.8%	.6%	.0%	.0%	.0%	.2%	.0%	.0%	3.1%	5.3%	4.3%	5.8%	1.0%	.9%	.0%
HF Cyclone East C.	20.3%	23.0%	2.6%	.2%	4.1%	24.2%	5.1%	1.7%	.0%	.0%	.0%	.5%	.0%	.0%	1.3%	2.2%	7.4%	1.1%	6.2%	.1%	.0%
WS Western	26.3%	25.0%	.0%	.0%	5.9%	24.9%	3.1%	1.1%	.8%	.0%	1.9%	7.1%	.2%	2.3%	.5%	.0%	.0%	.0%	.0%	.0%	.8%
Western	11.9%	28.1%	1.1%	.9%	21.5%	16.8%	2.0%	2.7%	.6%	.0%	1.8%	4.6%	.0%	.3%	4.5%	.1%	.4%	.0%	.3%	.0%	2.5%
Southern	8.9%	4.4%	.2%	.0%	17.8%	34.2%	18.7%	1.1%	2.4%	.0%	1.0%	7.9%	.0%	3.1%	.1%	.0%	.0%	.0%	.0%	.0%	.3%
Central Hlands	17.2%	8.3%	.2%	.0%	9.6%	23.5%	13.9%	14.9%	.0%	5.5%	.0%	2.4%	.3%	3.7%	.2%	.0%	.1%	.0%	.0%	.0%	.2%
L. Farming Plains	19.1%	15.8%	2.3%	4.7%	18.7%	19.0%	1.7%	3.8%	.0%	1.3%	.1%	9.0%	.0%	3.4%	.8%	.0%	.2%	.0%	.0%	.0%	.2%
Southern Hlands	**16.8%**	**7.4%**	**1.4%**	**.1%**	**15.8%**	**18.3%**	**14.4%**	**11.1%**	**.0%**	**6.4%**	**.0%**	**4.5%**	**1.2%**	**2.3%**	**.2%**	**.0%**	**.0%**	**.1%**	**.0%**	**.0%**	**.0%**

Table 71 – Practice of agriculture - land tenure and land sufficiency by region (percentage of households)

	Farming in 09 10 season?	land ownership						Sufficient land?
		landowner	Tenant of land	Share cropping	Borrowed land	Land wages	other	
Analamanga	74%	77.6%	1.3%	17.1%	3.9%	.0%	.0%	29%
Vakinakaratra	95%	83.3%	2.4%	4.0%	10.3%	.0%	.0%	31%
Itasy	91%	84.9%	14.4%	.7%	.0%	.0%	.0%	9%
Bongolava	94%	86.5%	8.4%	.6%	4.5%	.0%	.0%	56%
Haute Matsiatra	90%	88.4%	4.7%	.8%	6.2%	.0%	.0%	24%
Amoron i Mania	79%	85.9%	2.0%	7.1%	5.1%	.0%	.0%	37%
Vatovavy Fitovinany	93%	86.4%	.5%	.5%	12.6%	.0%	.0%	43%
Ihorombe	81%	85.0%	4.5%	5.3%	5.3%	.0%	.0%	12%
Atsimo Atsinanana	86%	89.7%	.7%	1.4%	8.2%	.0%	.0%	21%
Atsinanana	91%	89.7%	6.2%	1.0%	3.1%	.0%	.0%	18%
Analanjirofo	87%	78.8%	8.1%	1.0%	11.1%	.0%	1.0%	24%
Alaotra Mangoro	80%	72.3%	10.0%	12.3%	5.4%	.0%	.0%	23%
Boeny	76%	61.2%	21.1%	12.2%	4.8%	.0%	.7%	24%
Sofia	93%	73.6%	13.2%	2.0%	11.2%	.0%	.0%	24%
Betsiboka	71%	81.4%	12.1%	4.3%	2.1%	.0%	.0%	33%
Melaky	77%	83.5%	5.5%	5.5%	5.5%	.0%	.0%	27%
Atsimo Andrefana	67%	88.6%	1.6%	3.3%	6.5%	.0%	.0%	23%
Androy	83%	88.4%	.9%	2.2%	8.4%	.0%	.0%	56%
Anosy	63%	75.2%	1.8%	6.1%	17.0%	.0%	.0%	43%
Menabe	81%	82.1%	9.0%	7.1%	1.9%	.0%	.0%	20%
Diana	56%	53.3%	29.3%	12.0%	4.0%	.0%	1.3%	26%
Sava	86%	76.2%	6.0%	10.6%	7.3%	.0%	.0%	22%
Rural Madagascar	**83%**	**81.7%**	**6.1%**	**4.7%**	**7.4%**	**.0%**	**.1%**	**28%**

Table 72 - Practice of agriculture - land tenure and land sufficiency by livelihood zone (percentage of households)

	Farming in 09 10 season? (variable for regression)	land ownership						Sufficient land?
		landowner	Tenant of land	Share cropping	Borrowed land	Land wages	other	
MF Cyclone Eastern Coast	91%	84.6%	3.8%	.6%	10.4%	.0%	.6%	27%
HF Cyclone Eastern Coast	83%	82.2%	5.6%	4.4%	7.7%	.0%	.1%	28%
West-SouthWestern	76%	80.3%	5.6%	6.7%	7.4%	.0%	.0%	23%
Western	84%	74.7%	12.9%	3.7%	8.7%	.0%	.0%	25%
Southern	71%	87.4%	1.2%	3.0%	8.4%	.0%	.0%	36%
Central Highlands	80%	77.1%	2.8%	12.8%	7.3%	.0%	.0%	24%
Large Farming Plains	85%	75.4%	15.3%	6.0%	3.1%	.0%	.2%	31%
Southern Highlands	89%	88.8%	3.0%	2.5%	5.7%	.0%	.0%	33%
Rural Madagascar	**83%**	**81.7%**	**6.1%**	**4.7%**	**7.4%**	**.0%**	**.1%**	**28%**

Table 73 – Crop variety (mean) and irrigation (percentage of households) by region

	crops number (mean)	share land irrigated				
		no irrigation	up to 25% of land	up to 50%	up to 75%	up to 100%
Analamanga	3.06	4.4%	21.1%	46.7%	15.6%	12.2%
Vakinakaratra	4.30	.0%	46.0%	41.1%	10.5%	2.4%
Itasy	2.69	2.7%	48.0%	29.1%	12.8%	7.4%
Bongolava	3.95	1.3%	20.0%	38.1%	32.3%	8.4%
Haute Matsiatra	3.46	12.6%	8.7%	29.9%	33.9%	15.0%
Amoron i Mania	3.46	71.9%	10.1%	12.4%	1.1%	4.5%
Vatovavy Fitovinany	2.71	.0%	3.4%	18.7%	20.7%	57.1%
Ihorombe	2.41	6.8%	7.5%	51.9%	21.1%	12.8%
Atsimo Atsinanana	2.79	8.6%	27.3%	41.0%	13.7%	9.4%
Atsinanana	3.61	2.3%	14.4%	62.6%	16.1%	4.6%
Analanjirofo	3.50	10.1%	14.1%	48.3%	15.4%	12.1%
Alaotra Mangoro	2.70	31.3%	18.3%	19.1%	14.8%	16.5%
Boeny	1.83	12.5%	.8%	13.3%	8.6%	64.8%
Sofia	2.39	7.5%	2.0%	38.5%	26.5%	25.5%
Betsiboka	1.89	17.7%	2.7%	23.8%	23.1%	32.7%
Melaky	1.75	8.0%	2.2%	27.0%	29.9%	32.8%
Atsimo Andrefana	1.82	4.3%	.0%	.0%	6.4%	89.4%
Androy	2.31	64.3%	10.8%	17.3%	5.9%	1.6%
Anosy	1.68	38.6%	20.5%	32.3%	3.9%	4.7%
Menabe	2.16	22.9%	3.1%	20.6%	13.0%	40.5%
Diana	1.11	57.9%	.0%	1.9%	5.6%	34.6%
Sava	3.01	7.2%	27.0%	23.7%	20.4%	21.7%
Rural Madagascar	**2.83**	**12.6%**	**17.0%**	**32.8%**	**16.9%**	**20.6%**

Table 74 - Crop variety (mean) and irrigation (percentage of households) by livelihood zone

	crops number (mean)	share land irrigated				
		no irrigation	up to 25% of land	up to 50%	up to 75%	up to 100%
MF Cyclone Eastern Coast	3.58	5.1%	12.2%	47.0%	18.0%	17.7%
HF Cyclone Eastern Coast	2.64	10.8%	16.9%	29.4%	16.1%	26.7%
West-SouthWestern	2.05	11.4%	3.2%	19.5%	14.1%	51.8%
Western	2.14	11.5%	2.1%	33.1%	24.8%	28.5%
Southern	1.96	48.4%	9.4%	21.9%	5.7%	14.5%
Central Highlands	3.28	3.8%	29.1%	41.8%	15.0%	10.2%
Large Farming Plains	2.76	6.5%	26.5%	23.4%	17.3%	26.3%
Southern Highlands	3.75	20.8%	23.1%	33.1%	16.7%	6.3%
Rural Madagascar	**2.83**	**12.6%**	**17.0%**	**32.8%**	**16.9%**	**20.6%**

Table 75 – Percentage of households who reported short harvest of rice (1st and 2nd season) - maize and manioc by region

	short harvest rice 1st season	short harvest rice 2nd season	short harvest maize	short harvest manioc
Analamanga	2%	0%	33%	1%
Vakinakaratra	3%	0%	22%	11%
Itasy	3%	.	16%	1%
Bongolava	17%	4%	39%	3%
Haute Matsiatra	3%	4%	10%	3%
Amoron i Mania	0%	1%	18%	8%
Vatovavy Fitovinany	30%	29%	50%	15%
Ihorombe	6%	4%	8%	4%
Atsimo Atsinanana	35%	18%	33%	13%
Atsinanana	20%	7%	55%	1%
Analanjirofo	1%	4%	22%	3%
Alaotra Mangoro	10%	10%	35%	13%
Boeny	12%	8%	12%	30%
Sofia	20%	4%	6%	3%
Betsiboka	4%	3%	13%	6%
Melaky	3%	0%	5%	5%
Atsimo Andrefana	25%	50%	57%	28%
Androy	48%	.	63%	34%
Anosy	26%	27%	43%	17%
Menabe	10%	10%	17%	15%
Diana	0%	10%	21%	18%
Sava	14%	27%	8%	1%
Rural Madagascar	**11%**	**12%**	**25%**	**9%**

Table 76 - Percentage of households who reported short harvest of rice (1st and 2nd season) - maize and manioc by livelihood zone

	short harvest rice 1st season	short harvest rice 2nd season	short harvest maize	short harvest manioc
MF Cyclone Eastern Coast	13%	14%	32%	5%
HF Cyclone Eastern Coast	19%	19%	42%	9%
West-SouthWestern	17%	21%	18%	6%
Western	10%	5%	9%	6%
Southern	22%	27%	55%	31%
Central Highlands	4%	0%	35%	4%
Large Farming Plains	9%	6%	28%	8%
Southern Highlands	3%	2%	14%	5%
Rural Madagascar	**11%**	**12%**	**25%**	**9%**

Table 77 – Relative contribution of different food sources to the total current consumption (means) by region

	production (%)	exchange (%)	borrows (%)	gifts (%)	purchase (%)	hunting (%)	credit (%)	begging (%)	Food aid (%)
Analamanga	27.1	.0	.0	.0	72.9	.0	.0	.0	.0
Vakinakaratra	22.9	.0	.1	2.2	71.1	2.2	.0	.0	.0
Itasy	28.0	.0	.0	.9	71.1	.0	.0	.0	.0
Bongolava	35.2	.1	.0	.4	63.1	1.2	.0	.0	.0
Haute Matsiatra	40.7	.2	.3	.2	58.1	.3	.0	.0	.0
Amoron i Mania	28.8	.0	.0	2.2	68.1	.9	.0	.0	.0
Vatovavy Fitovinany	30.0	.0	.0	6.9	62.0	.8	.0	.0	.0
Ihorombe	19.2	.4	.0	2.5	74.5	3.2	.0	.0	.2
Atsimo Atsinanana	31.6	.0	.0	.7	62.2	4.9	.0	.0	.0
Atsinanana	32.0	.6	.1	.8	64.3	.6	.0	.0	1.0
Analanjirofo	31.8	.1	.0	1.8	64.7	1.2	.0	.0	.4
Alaotra Mangoro	25.2	.4	.0	1.6	67.6	3.0	.0	.0	.1
Boeny	20.0	.0	.1	1.8	75.7	1.8	.2	.0	.3
Sofia	45.0	.0	.0	4.0	49.5	1.5	.0	.0	.0
Betsiboka	24.5	.0	.1	1.3	71.5	2.5	.0	.0	.0
Melaky	22.8	.0	.0	1.4	65.2	9.9	.2	.0	.5
Atsimo Andrefana	9.8	.6	1.2	1.8	79.6	6.1	.0	1.0	.0
Androy	23.5	.0	.0	5.9	55.9	14.7	.0	.0	.1
Anosy	16.7	.0	.4	4.1	73.1	5.0	.4	.0	.4
Menabe	15.4	.8	.0	2.0	76.3	4.9	.0	.2	.0
Diana	15.3	.0	.1	.5	83.1	.2	.0	.0	.3
Sava	33.3	.2	.0	.1	64.6	1.0	.0	.0	.9
Rural Madagascar	**27.5**	**.1**	**.1**	**2.0**	**67.2**	**2.4**	**.0**	**.1**	**.2**

Table 78 - Relative contribution of different food sources to the total current consumption (means) by livelihood zone

	production (%)	exchange (%)	borrows (%)	gifts (%)	purchase (%)	hunting (%)	credit (%)	begging (%)	Food aid (%)
MF Cyclone Eastern C.	34.5	.4	.0	2.9	60.1	1.3	.0	.0	.4
HF Cyclone Eastern C.	27.1	.1	.0	1.9	68.4	1.7	.0	.0	.5
West-SouthWestern	14.5	.7	.0	1.4	81.1	2.1	.0	.1	.1
Western	34.4	.0	.0	2.8	59.7	2.9	.1	.0	.1
Southern	16.5	.3	.8	4.1	67.7	9.6	.1	.6	.2
Central Highlands	25.7	.0	.0	.4	72.8	.7	.0	.0	.0
Large Farming Plains	26.6	.1	.1	1.3	70.1	1.4	.0	.0	.1
Southern Highlands	31.7	.1	.1	1.6	65.0	1.0	.0	.0	.0
Rural Madagascar	**27.5**	**.1**	**.1**	**2.0**	**67.2**	**2.4**	**.0**	**.1**	**.2**

Table 79 – Percentage of households classified as net producers / net consumers by region

	NET PRODUCER / NET CONSUMER on rice			NET PRODUCER / NET CONSUMER on mais			NET PRODUCER / NET CONSUMER on manioc		
	net consumer (deficit)	balance	net producer (surplus)	net consumer (deficit)	balance	net producer (surplus)	net consumer (deficit)	balance	net producer (surplus)
Analamanga	49.4%	1.2%	49.4%	52.4%	23.8%	23.8%	53.2%	11.4%	35.4%
Vakinakaratra	57.5%	5.0%	37.5%	43.5%	7.8%	48.7%	42.7%	12.0%	45.3%
Itasy	39.7%	6.1%	54.2%	14.5%	38.2%	47.3%	10.7%	68.8%	20.5%
Bongolava	19.0%	14.4%	66.7%	4.3%	63.8%	31.9%	15.6%	64.9%	19.5%
Haute Matsiatra	51.4%	11.0%	37.6%	20.5%	51.3%	28.2%	25.0%	41.3%	33.7%
Amoron i Mania	61.8%	.0%	38.2%	50.8%	27.9%	21.3%	60.7%	11.9%	27.4%
Vatovavy Fitovinany	71.6%	1.5%	26.9%	.0%	100.0%	.0%	61.5%	14.0%	24.6%
Ihorombe	72.4%	6.5%	21.1%	28.0%	68.0%	4.0%	46.7%	40.0%	13.3%
Atsimo Atsinanana	75.9%	2.2%	21.9%	.0%	.0%	100.0%	64.4%	10.4%	25.2%
Atsinanana	52.2%	1.6%	46.2%	12.1%	25.8%	62.1%	32.3%	32.9%	34.8%
Analanjirofo	60.1%	1.0%	38.9%	11.1%	44.4%	44.4%	4.6%	22.9%	72.6%
Alaotra Mangoro	38.1%	.9%	61.1%	1.9%	48.1%	50.0%	11.9%	39.3%	48.8%
Boeny	41.7%	4.3%	54.0%	31.1%	18.0%	50.8%	27.8%	27.8%	44.4%
Sofia	31.4%	27.7%	40.8%	28.3%	48.1%	23.6%	26.8%	39.4%	33.8%
Betsiboka	42.5%	11.0%	46.6%	19.0%	36.5%	44.4%	29.4%	25.9%	44.7%
Melaky	54.5%	.7%	44.8%	22.8%	21.1%	56.1%	27.5%	15.4%	57.1%
Atsimo Andrefana	42.9%	10.2%	46.9%	82.1%	10.3%	7.7%	89.3%	2.7%	8.0%
Androy	63.2%	21.1%	15.8%	62.3%	30.4%	7.2%	86.7%	.0%	13.3%
Anosy	61.2%	1.2%	37.6%	37.5%	31.3%	31.3%	76.0%	.8%	23.3%
Menabe	35.9%	6.9%	57.2%	35.1%	19.5%	45.5%	61.7%	6.7%	31.7%
Diana	62.0%	10.0%	28.0%	22.7%	18.2%	59.1%	47.6%	14.3%	38.1%
Sava	70.2%	3.3%	26.5%	.0%	38.5%	61.5%	25.0%	34.1%	40.9%
Rural Madagascar	**53.6%**	**6.2%**	**40.2%**	**34.3%**	**27.9%**	**37.8%**	**44.0%**	**22.3%**	**33.7%**

Table 80 - Percentage of households classified as net producers / net consumers by livelihood zone

	NET PRODUCER / NET CONSUMER on rice			NET PRODUCER / NET CONSUMER on mais			NET PRODUCER / NET CONSUMER on manioc		
	net consumer (deficit)	balance	net producer (surplus)	net consumer (deficit)	balance	net producer (surplus)	net consumer (deficit)	balance	net producer (surplus)
MF Cyclone Eastern Coast	61.0%	.6%	38.4%	9.8%	50.3%	39.9%	23.0%	27.4%	49.6%
HF Cyclone Eastern Coast	67.7%	2.9%	29.5%	12.6%	25.5%	61.9%	47.7%	17.9%	34.4%
West-South Western	47.5%	7.4%	45.1%	62.7%	25.8%	11.5%	70.8%	12.0%	17.2%
Western	38.1%	19.5%	42.5%	25.4%	39.4%	35.2%	29.7%	30.7%	39.7%
Southern	55.8%	8.1%	36.1%	65.2%	21.2%	13.6%	85.2%	5.2%	9.6%
Central Highlands	50.9%	2.0%	47.1%	42.8%	16.7%	40.5%	46.0%	22.0%	32.0%
Large Farming Plains	30.2%	8.5%	61.3%	13.3%	40.0%	46.7%	11.6%	55.3%	33.1%
Southern Highlands	56.0%	6.2%	37.8%	42.3%	21.0%	36.6%	40.1%	22.7%	37.1%
Rural Madagascar	**53.6%**	**6.2%**	**40.2%**	**34.3%**	**27.9%**	**37.8%**	**44.0%**	**22.3%**	**33.7%**

Table 81 – Average weekly consumption of various food items / groups by region

	rice	maize	sorghum	cereals	cassava	tuber	pea	vegetable	fruit	meat	poultry	fish	sugar	oil	milk
Analamanga	7.0	0.5	0.1	1.6	2.9	1	1.8	5.7	1.6	1.6	0.7	1.1	6.2	5.7	1.2
Vakinakaratra	7.0	2.3	0.0	2.1	3.6	1.2	0.9	4.7	0.5	1.2	0.3	2.2	6.1	5.5	0.7
Itasy	7.0	0.7	0.0	0.0	4.3	0.2	0.4	6.3	0.0	0.7	0.0	0.4	5.1	5.0	0.0
Bongolava	7.0	0.5	0.0	0.2	3.8	0.0	1.0	4.4	1.2	1.1	0.5	2.2	5.1	6.2	0.7
Haute Matsiatra	6.9	0.5	0.0	0.2	4.7	1.6	1.4	5.6	1.0	0.6	0.3	0.5	5.4	3.3	0.1
Amoron i Mania	7.0	0.6	0.2	1.7	3.9	2.5	1.1	5.0	0.8	1.4	0.5	0.8	4.8	4.9	0.8
Vatovavy Fitovinany	6.4	0.0	0.1	0.5	6.1	0.9	0.3	3.2	1.9	0.3	0.4	0.7	2.8	2.8	0.0
Ihorombe	6.9	0.7	0.0	0.4	5.2	0.8	1.8	5.4	1.6	1.7	0.4	1.6	4.1	4.7	0.5
Atsimo Atsinanana	6.7	0.1	0.0	0.4	5.4	2.1	0.4	5.3	0.7	0.4	0.2	1.5	3.4	2.8	0.2
Atsinanana	7.0	0.1	0.0	0.8	5.0	0.1	0.6	4.6	1.5	0.5	0.1	1.8	5.2	6.1	0.4
Analanjirofo	7.0	0.1	0.0	0.7	4.4	0.2	1.0	3.5	1.5	0.5	0.0	1.7	4.6	3.5	0.1
Alaotra Mangoro	7.0	0.2	0.0	0.8	2.2	0.4	0.7	4.5	1.7	0.9	0.5	1.8	4.1	4.5	0.5
Boeny	6.9	0.5	0.0	0.4	1.4	1.7	1.2	3.9	2.1	1.2	0.2	2.9	4.4	5.1	0.7
Sofia	6.8	1.6	0.0	0.0	1.2	0.4	1.0	5.0	0.6	0.3	0.0	1.5	2.5	2.4	0.0
Betsiboka	6.9	0.5	0.0	0.8	1.6	0.4	1.4	4.8	1.9	1.2	0.4	2.0	5.1	4.5	0.4
Melaky	7.0	0.4	0.0	0.3	1.9	0.3	0.3	3.6	2.0	0.8	0.2	4.2	4.2	3.9	0.2
Atsimo Andrefana	2.0	1.4	0.0	0.1	5.6	1.0	0.3	1.3	0.3	0.2	0.0	0.5	2.4	0.6	0.1
Androy	1.0	0.6	0.0	0.2	6.0	1.1	1.1	3.7	1.2	0.5	0.1	0.1	1.1	0.9	0.6
Anosy	3.7	0.5	0.0	0.3	5.8	1.3	1.5	4.0	0.4	1.0	0.2	0.9	1.2	2.6	0.4
Menabe	6.7	1.1	0.0	1.1	3.7	0.9	2.4	5.0	1.3	1.2	0.3	2.8	4.6	4.8	0.5
Diana	6.8	0.4	0.0	2.7	1.0	0.7	1.4	2.9	1.8	1.3	0.2	1.8	1.8	2.8	0.8
Sava	7.0	0.3	0.0	0.4	2.5	0.3	1.4	4.3	0.6	0.4	0.3	0.9	2.5	2.1	0.2
Rural Madagascar	**6.2**	**0.7**	**0.0**	**0.8**	**3.9**	**0.9**	**1.0**	**4.4**	**1.1**	**0.8**	**0.3**	**1.3**	**4.0**	**3.7**	**0.4**

Table 82 – Average weekly consumption of various food items / groups by livelihood zone

	rice	maize	sorghum	cereals	cassava	tuber	pea	vegetable	fruit	meat	poultry	fish	sugar	oil	milk
MF Cyclone EastC.	6.9	0.1	0.0	0.5	5.2	0.4	0.7	3.8	1.6	0.4	0.1	1.4	3.9	3.8	0.2
HF Cyclone EastC.	6.6	0.2	0.0	0.7	4.1	0.7	0.9	4.0	1.2	0.5	0.2	1.3	3.2	3.2	0.2
W-S Western	5.6	0.9	0.0	0.5	4.9	0.5	1.6	4.2	1.1	1.2	0.2	1.2	4.5	3.2	0.4
Western	6.9	1.1	0.0	0.6	1.6	0.5	1.1	4.6	1.1	0.7	0.2	2.2	3.3	3.3	0.2
Southern	1.8	1.1	0.0	0.1	5.7	1.3	0.8	2.8	0.6	0.5	0.1	0.5	1.4	1.0	0.3
Central Highlands	7.0	0.5	0.1	1.5	3.3	1.0	1.4	5.5	1.2	1.3	0.5	1.2	6.0	5.3	1.0
L Farming Plains	7.0	0.6	0.0	0.3	2.9	0.6	0.9	4.8	1.2	1.1	0.3	1.8	4.8	5.6	0.5
Southern Hlands	7.0	1.5	0.1	1.3	4.0	1.5	1.2	5.1	0.8	1.1	0.4	1.3	5.5	4.7	0.5
Rural Madagascar	**6.2**	**0.7**	**0.0**	**0.8**	**3.9**	**0.9**	**1.0**	**4.4**	**1.1**	**0.8**	**0.3**	**1.3**	**4.0**	**3.7**	**0.4**

Table 83 – Food consumption score (mean) - Coping Strategy Index (mean) and Food Security Classification (percentage of households) by region

	FCS	Reduced Coping Strategy Index	Food Security CLASSIFICATION		
			food insecure	vulnerable	food secure
Analamanga	50.17	13.7	16.0%	41.2%	42.9%
Vakinakaratra	44.54	12.6	20.6%	57.3%	22.1%
Itasy	31.43	3.9	3.7%	92.0%	4.3%
Bongolava	44.77	9.1	11.1%	59.3%	29.6%
Haute Matsiatra	35.16	18.2	52.8%	34.5%	12.7%
Amoron i Mania	41.33	7.6	13.6%	68.8%	17.6%
Vatovavy Fitovinany	28.17	15.5	47.3%	51.4%	1.4%
Ihorombe	46.80	13.9	22.1%	44.8%	33.1%
Atsimo Atsinanana	33.61	23.2	71.3%	21.6%	7.0%
Atsinanana	38.26	15.2	30.5%	55.2%	14.3%
Analanjirofo	35.30	8.5	13.6%	76.7%	9.7%
Alaotra Mangoro	40.72	5.1	9.3%	73.9%	16.8%
Boeny	47.03	5.5	8.1%	64.1%	27.8%
Sofia	31.95	19.5	65.9%	30.4%	3.7%
Betsiboka	44.22	9.9	22.9%	57.6%	19.5%
Melaky	44.91	8.0	12.8%	73.2%	14.0%
Atsimo Andrefana	20.90	25.9	75.9%	17.4%	6.7%
Androy	27.13	21.0	63.4%	26.5%	10.1%
Anosy	34.27	20.4	53.4%	26.7%	19.8%
Menabe	49.02	15.3	29.2%	42.9%	27.8%
Diana	40.63	18.7	31.6%	23.6%	44.8%
Sava	32.01	14.6	34.9%	53.1%	12.0%
Rural Madagascar	**37.12**	**14.8**	**35.2%**	**47.9%**	**16.9%**

Table 84 - Food consumption score (mean) - Coping Strategy Index (mean) and Food Security Classification (percentage of households) by region

	FCS	Reduced Coping Strategy Index	Food Security CLASSIFICATION		
			food insecure	vulnerable	food secure
MF Cyclone Eastern Coast	33.76	11.7	26.4%	65.8%	7.8%
HF Cyclone Eastern Coast	33.76	16.9	42.6%	44.2%	13.3%
West-SouthWestern	38.64	16.3	40.9%	32.3%	26.7%
Western	38.15	15.6	44.7%	42.6%	12.7%
Southern	25.73	24.0	68.0%	22.8%	9.2%
Central Highlands	46.25	12.4	16.6%	50.9%	32.5%
Large Farming Plains	41.84	6.7	9.1%	69.2%	21.7%
Southern Highlands	40.84	12.6	27.7%	53.7%	18.5%
Rural Madagascar	**37.12**	**14.8**	**35.2%**	**47.9%**	**16.9%**

Table 85 - Months where it is particularly challenging to access food or have enough cash (percentage of households by region)

	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	July 10
Analamanga	4%	15%	20%	21%	36%	62%	61%	24%	6%	0%	0%	0%
Vakinakaratra	12%	22%	34%	32%	29%	46%	52%	10%	2%	1%	1%	3%
Itasy	22%	55%	52%	34%	17%	24%	27%	17%	1%	1%	3%	6%
Bongolava	7%	17%	23%	13%	12%	17%	22%	23%	5%	1%	4%	10%
Haute Matsiatra	5%	18%	27%	42%	53%	36%	17%	10%	6%	3%	1%	3%
Amoron i Mania	10%	14%	12%	17%	15%	23%	21%	6%	4%	5%	5%	9%
Vatovavy Fitovinany	6%	17%	13%	6%	2%	5%	3%	9%	35%	4%	1%	7%
Ihorombe	36%	59%	70%	60%	45%	28%	22%	14%	5%	3%	2%	4%
Atsimo Atsinanana	20%	50%	58%	44%	22%	19%	27%	47%	53%	16%	8%	10%
Atsinanana	11%	32%	55%	40%	7%	6%	11%	17%	15%	4%	3%	8%
Analanjirofo	5%	25%	23%	12%	4%	11%	12%	24%	20%	4%	3%	5%
Alaotra Mangoro	2%	9%	12%	10%	11%	23%	36%	53%	19%	2%	3%	1%
Boeny	1%	1%	2%	2%	3%	9%	55%	16%	6%	3%	6%	1%
Sofia	2%	2%	2%	4%	8%	21%	52%	57%	14%	3%	2%	3%
Betsiboka	3%	7%	3%	4%	7%	16%	37%	48%	8%	4%	2%	2%
Melaky	1%	3%	3%	4%	3%	16%	38%	29%	13%	2%	1%	5%
Atsimo Andrefana	77%	82%	84%	79%	66%	59%	63%	52%	38%	40%	51%	70%
Androy	48%	58%	56%	60%	60%	55%	45%	37%	34%	34%	35%	40%
Anosy	20%	38%	38%	33%	27%	25%	22%	18%	16%	17%	21%	29%
Menabe	16%	21%	27%	12%	9%	29%	50%	30%	17%	5%	4%	8%
Diana	8%	9%	7%	7%	9%	18%	46%	42%	25%	13%	10%	8%
Sava	2%	18%	27%	9%	3%	6%	12%	47%	56%	6%	4%	3%
Rural Mada	**15%**	**27%**	**31%**	**26%**	**22%**	**27%**	**34%**	**28%**	**19%**	**8%**	**8%**	**11%**

Table 86 – Months where it is particularly challenging to access food or have enough cash (percentage of households by region)

	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	July 10
MF Cyclone EastC.	8%	27%	31%	22%	5%	9%	11%	23%	24%	3%	2%	6%
HF Cyclone East C.	8%	26%	31%	18%	8%	11%	16%	29%	37%	8%	5%	8%
WS Western	44%	55%	60%	44%	37%	34%	43%	31%	15%	8%	9%	24%
Western	3%	4%	4%	5%	8%	21%	48%	47%	14%	4%	3%	4%
Southern	57%	65%	68%	67%	57%	51%	49%	40%	34%	37%	44%	53%
Central Hlands	6%	22%	28%	26%	33%	59%	59%	23%	5%	1%	1%	1%
L. Farming Plains	9%	19%	20%	13%	10%	16%	36%	21%	6%	2%	4%	5%
Southern Hlands	10%	19%	26%	30%	33%	32%	28%	8%	3%	3%	2%	5%
Rural Mada	**15%**	**27%**	**31%**	**26%**	**22%**	**27%**	**34%**	**28%**	**19%**	**8%**	**8%**	**11%**

Annex V: Tables on Nutritional Status by Region and Livelihood Zone

Table 87 – Prevalence of acute malnutrition in children under-five years by region

Region	Prevalence of global malnutrition (<-2 z-score and/or oedema)	95% Confidence interval	Prevalence of severe malnutrition (<-3 z-score and/or oedema)	95% Confidence interval	Denominator (n)
Alaotra Mangoro	5.1	(3.2 - 8.0)	1.0	(0.32 – 3.12)	395
Amoron'Mania	3.5	(2.1 - 5.7)	0.0	(0.00 - 0.00)	436
Analamanga	3.3	(1.7 - 6.2)	0.0	(0.00 - 0.00)	370
Analanjirofo	2.6	(1.1 - 5.8)	0.0	(0.00 - 0.00)	348
Androy	5.4	(3.8 - 7.5)	0.26	(0.07 – 1.00)	768
Anosy	5.7	(4.2 - 7.8)	1.38	(0.77 – 2.46)	659
Atsimo Andrefana	8.1	(6.0 - 10.8)	1.45	(0.66 – 3.17)	629
Atsimo Atsinanana	5.4	(3.8 - 7.6)	0.50	(0.19 – 1.29)	800
Atsinanana	3.3	(1.8 - 6.0)	0.48	(0.13 – 1.74)	418
Betsiboka	5.5	(3.5 - 8.4)	0.78	(0.19 – 3.18)	393
Boeni	5.1	(3.5 - 7.3)	0.46	(0.12 – 1.76)	437
Bongolava	5.5	(3.9 - 7.6)	0.89	(0.35 – 2.22)	572
Diana	7.6	(4.9 - 11.4)	1.37	(0.55 – 3.38)	295
Haute Matsiatra	3.6	(2.3 - 5.6)	0.0	(0.00 - 0.00)	532
Ihorombe	4.7	(2.8 - 7.6)	0.25	(0.03 – 1.76)	410
Itasy	5.3	(3.2 - 8.5)	0.79	(0.26 – 2.35)	382
Melaky	5.4	(3.7 - 7.9)	0.27	(0.04 – 1.95)	431
Menabe	2.6	(1.2 - 5.5)	0.0	(0.00 - 0.00)	431
Sava	1.9	(1.0 - 3.8)	0.32	(0.05 – 2.16)	314
Sofia	7.6	(5.2 - 11.1)	1.68	(0.81 – 3.47)	361
Vakinakaratra	4.5	(2.4 - 8.0)	0.0	(0.00 - 0.00)	452
Vatovavy	8.8	(6.5 - 11.8)	0.82	(0.41 – 1.64)	735
Rural Madagascar	**5.4**	**(4.8 - 6.0)**	**0.65**	**(0.48 – 0.86)**	**10 568**

Table 88 – Prevalence of acute malnutrition in children under-five years by livelihood zone

Region	Prevalence of global malnutrition (<-2 z-score and/or oedema)	95% Confidence interval	Prevalence of severe malnutrition (<-3 z-score and/or oedema)	95% Confidence interval	Denominator (n)
MF cyclone east	6.2	[4.3 - 9.0]	0.31	[0.10 - 0.95]	788
HF cyclone east coast	5.3	[4.3 - 6.5]	0.70	[0.43 - 1.10]	2311
West- Southwestern	3.9	[2.3 - 6.7]	0.09	[0.01 - 0.64]	614
Western	6.2	[4.8 - 7.9]	1.10	[0.61 - 2.00]	1518
Southern	7.1	[5.7 - 8.9]	1.21	[0.6 - 2.29]	1790
Central highland	3.8	[2.5 - 5.7]	0.22	[0.07 - 0.66]	762
Large faming plain	5.3	[4.2 - 6.7]	0.55	[0.26 - 1.17]	1382
Southern Highlands	4.1	[2.9 - 5.9]	0.30	[0.11 - 0.78]	1179

Table 1– Prevalence of stunting in children under-five years by region

Region	Prevalence of stunting (<-2 z-score)	95% Confidence interval	Prevalence of severe stunting (<-3 z-score)	95% Confidence interval	Denominator (n)
Alaotra Mangoro	55.1	(48.2 - 61.8)	20.6	(14.7 - 28.2)	395
Amoron'Mania	61.3	(55.4 - 66.8)	28.3	(22.1 - 35.4)	436
Analamanga	53.4	(44.8 - 61.8)	21.8	(15.8 - 9.3)	370
Analanjirofo	48.1	(42.2 - 54.0)	17.9	(13.6 - 23.1)	348
Androy	46.7	(41.2 - 52.2)	15.8	(13.0 - 19.0)	768
Anosy	47.4	(42.5 - 52.2)	16.5	(12.8 - 20.9)	659
Atsimo Andrefana	37.5	(31.7 - 43.6)	13.5	(10.5 - 17.3)	629
Atsimo Atsinanana	49.9	(44.5 - 55.2)	20.1	(16.9 - 23.7)	800
Atsinanana	52.9	(47.3 - 58.5)	20.2	(15.0 - 26.7)	418
Betsiboka	44.3	(39.0 - 49.7)	19.1	(14.7 - 24.4)	393
Boeni	40.3	(35.1 - 45.7)	14.0	(11.1 - 17.5)	437
Bongolava	52.6	(46.7 - 58.4)	19.8	(16.3 - 23.8)	572
Diana	27.7	(20.7 - 36.0)	6.2	(3.9 - 9.8)	295
Haute Matsiatra	61.2	(53.6 - 68.3)	26.3	(20.7 - 32.9)	532
Ihorombe	41.6	(36.6 - 46.9)	9.1	(6.1 - 13.3)	410
Itasy	60.6	(54.0 - 66.8)	26.3	(22.3 - 30.7)	382
Melaky	28.3	(23.1 - 34.1)	6.7	(4.7 - 9.3)	431
Menabe	40.2	(35.2 - 45.5)	11.1	(7.5 - 16.0)	431
Sava	46.9	(42.0 - 51.9)	16.2	(12.4 - 20.9)	314
Sofia	34.1	(27.0 - 41.9)	6.5	(6.5 - 11.3)	361
Vakinakaratra	71.1	(65.6 - 76.0)	34.4	(28.7 - 40.6)	452
Vatovavy Fitovinany	47.7	(42.7 - 52.8)	18.2	(15.5 - 21.5)	735
Rural Madagascar	**48.7**	**(47.1 – 50.3)**	**18.8**	**(17.7 – 20.0)**	**10 568**

Table 90 – Prevalence of stunting in children under-five years by livelihood zone

	Prevalence of stunting (<-2 z-score)	95% Confidence interval	Prevalence of severe stunting (<-3 z-score)	95% Confidence interval	Denominator (n)
MF cyclone east	50.5	[45.3 - 55.8]	20.4	[17.1 - 24.2]	783
HF cyclone east coast	47.4	[45.0 - 49.8]	17.8	[16.0 - 19.8]	2275
West- Southwestern	39.3	[34.1 - 44.7]	10.4	[7.1 - 15.0]	613
Western	34.5	[30.7 - 38.6]	9.0	[7.0 - 11.5]	1517
Southern	41.7	[37.8 - 45.8]	14.2	[12.2 - 16.4]	1769
Central highland	59.6	[53.6 - 65.3]	25.7	[20.7 - 31.4]	765
Large faming plain	50.2	[46.3 - 53.8]	19.7	[17.3 - 22.4]	1374
Southern Highlands	64.2	[60.4 - 67.9]	30.4	[27.1 - 34.0]	1178

Table 91 – Prevalence of underweight in children under-five years by region

Region	Prevalence of underweight (<-2 z-score)	95% Confidence interval	Prevalence of severe underweight (<-3 z-score)	95% Confidence interval	Denominator (n)
Alaotra Mangoro	32.4	(25.7 - 39.9)	8.4	(4.8 - 14.1)	395
Amoron'Mania	35.9	(29.1 - 43.3)	7.9	(5.2 - 11.9)	436
Analamanga	31.8	(24.3 - 40.3)	7.3	(4.8 - 11.0)	370
Analanjirofo	25.1	(20.4 - 30.4)	4.3	(2.5 - 7.3)	348
Androy	26.9	(23.1 - 31.0)	4.9	(3.4 - 6.9)	768
Anosy	24.5	(21.1 - 28.3)	6.0	(4.5 - 8.1)	659
Atsimo Andrefana	26.9	(22.4 - 32.0)	7.3	(4.9 - 10.6)	629
Atsimo Atsinanana	26.7	(22.7 - 31.1)	6.4	(4.4 - 9.2)	800
Atsinanana	25.4	(18.9 - 33.1)	6.5	(3.1 - 13.1)	418
Betsiboka	30.5	(25.6 - 36.0)	7.4	(4.9 - 11.0)	393
Boeni	23.5	(19.0 - 28.7)	6.0	(3.9 - 9.3)	437
Bongolava	27.9	(23.8 - 32.4)	6.0	(4.1 - 8.7)	572
Diana	17.8	(13.4 - 23.3)	3.8	(2.1 - 6.8)	295
Haute Matsiatra	33.6	(27.1 - 41.9)	8.7	(5.8 - 13.0)	532
Ihorombe	19.3	(15.3 - 23.9)	3.0	(1.4 - 6.2)	410
Itasy	36.2	(31.3 - 41.5)	8.2	(5.5 - 12.1)	382
Melaky	17.6	(13.7 - 22.3)	3.2	(1.9 - 5.3)	431
Menabe	20.4	(16.7 - 24.7)	2.6	(1.3 - 5.1)	431
Sava	23.2	(17.3 - 30.2)	4.2	(2.4 - 7.1)	314
Sofia	20.5	(16.2 - 25.7)	3.9	(2.3 - 6.4)	361
Vakinakaratra	41.6	(36.5 - 46.8)	10.5	(7.8 - 13.8)	452
Vatovavy Fitovinany	33.2	(28.0 - 38.9)	8.5	(6.4 - 11.1)	735
Rural Madagascar	**27.9**	**(25.8 – 30.1)**	**6.5**	**(5.5 – 7.7)**	**10 568**

Table 22 – Prevalence of underweight in children under-five years by livelihood zone

	Prevalence of underweight (<-2 z-score)	95% Confidence interval	Prevalence of severe underweight (<-3 z-score)	95% Confidence interval	Denominator (n)
MF cyclone east	30.8	[25.8 - 36.4]	8.5	[6.2 - 11.6]	792
HF cyclone east coast	26.5	[24.2 - 29.1]	6.0	[4.9 - 7.4]	2313
West- Southwestern	20.1	[17.1 - 23.4]	3.1	[1.9 - 4.8]	619
Western	20.6	[18.1 - 23.4]	4.4	[3.4 - 5.7]	1541
Southern	27.0	[24.0 - 30.2]	6.4	[4.8 - 8.5]	1787
Central highland	33.4	[28.5 - 38.7]	7.7	[5.8 - 10.2]	763
Large faming plain	29.9	[26.9 - 33.2]	6.9	[5.5 - 8.6]	1386
Southern Highlands	38.0	[34.1 - 42.1]	9.8	[8.0 - 12.0]	1182

Table 93 – Children born in the last 23.9 months who were put to the breast within one hour of birth by region

	% infants born in the last 23.9 months	95% Confidence interval	Denominator
Alaotra Mangoro	63.83	[52.26 - 73.99]	47
Amoron'Mania	85.11	[69.78 - 93.39]	47
Analamanga	62.5	[46.02 - 76.52]	32
Analanjirofo	42.86	[33.24 - 53.05]	35
Androy	51.24	[36.62 - 65.65]	122
Anosy	78.49	[70.31 - 84.91]	93
Atsimo Andrefana	6.55	[2.634 - 15.4]	63
Atsimo Atsinanana	47.62	[35.07 - 60.47]	85
Atsinanana	85.11	[68 - 93.89]	49
Betsiboka	42.47	[28.31 - 57.98]	73
Boeni	42.42	[28.97 - 57.1]	66
Bongolava	57.89	[42.53 - 71.87]	57
Diana	47.37	[28.41 - 67.12]	40
Haute Matsiatra	97.78	[86.33 - 99.67]	46
Ihorombe	69.23	[59.43 - 77.56]	56
Itasy	51.35	[31.97 - 70.33]	37
Melaky	34.78	[20.75 - 52.07]	48
Menabe	27.27	[17.49 - 39.88]	66
Sava	55.88	[40.38 - 70.32]	34
Sofia	78.13	[68.61 - 85.37]	65
Vakinakaratra	61.9	[47.44 - 74.52]	42
Vatovavy Fitovinany	67.95	[56.19 - 77.8]	78
Rural Madagascar	**56.76**	**[52.89 - 60.56]**	**1281**

Table 94 – Children born in the last 23.9 months who were put to the breast within one hour of birth by Livelihood zone

	% infants born in the last 23.9 months	95% Confidence interval	Denominator
MF cyclone east coast	60.5	[50.9 - 69.4]	92
HF cyclone east coast	62.0	[54.5 - 69.0]	256
West- South Western	29.9	[18.5 - 44.6]	88
Western	56.7	[47.8 - 65.2]	243
Southern	39.0	[29.1 - 49.9]	243
Central highland	65.1	[52.5 - 76.0]	70
Large faming plain	50.6	[42.0 - 59.2]	166
Southern Highlands	78.7	[68.4 - 86.4]	123

Table 95 – Proportion of infants 0-5.9 months of age who are fed exclusively with breast milk by region

	%infants	95% Confidence interval	Denominator
Alaotra	90.91	[59.59 -	11
Amoron'Ma	100	-	12
Analamanga	100	-	7
Analanjirofo	88.89	[45.03 -	9
Androy	54.55	[33.96 -	33
Anosy	57.14	[35.14 -	21
Atsimo	63.16	[41.23 -	20
Atsimo	70.83	[48.14 -	24
Atsinanana	75	[35.6 -	9
Betsiboka	85.71	[57.62 -	14
Boeni	81.25	[56.02 -	16
Bongolava	62.5	[25.74 -	8
Diana	77.78	[44.79 -	9
Haute	83.33	[53.32 -	12
Ihorombe	86.67	[63.28 -	17
Itasy	100	-	9
Melaky	27.78	[15.62 -	18
Menabe	69.57	[42.78 -	23
Sava	88.89	[48.48 -	9
Sofia	81.25	[46.33 -	16
Vakinakarat	76.92	[38.77 -	13
Vatovavy	92.86	[62.17 -	14
Rural	**74.1**	**[70.47 -**	**336**

Table 96 – Proportion of infants 0-5.9 months of age who are fed exclusively with breast milk by livelihood zone.

	%infants 0-5.9 months	95% Confidence interval	Denominator
MF cyclone east coast	86.0	[54.8 - 96.9]	15
HF cyclone east coast	72.6	[61.3 - 81.7]	72
West-Southwestern	60.9	[33.0 - 83.1]	26
Western	66.5	[50.8 - 79.2]	70
Southern	57.1	[43.2 - 70.0]	69
Central highland	88.0	[46.5 - 98.4]	17
Large farming plain	87.1	[71.2 - 94.8]	35
Southern Highlands	86.9	[69.7 - 95.0]	32

Table 97 – Proportion of children 12-15.9 months who continue to breastfeed at 1 year old by livelihood zone

	% infants 12 – 15.9 months	95% Confidence Interval	Denominator
MF cyclone east coast	100	-	24
HF cyclone east coast	94.4	[83.3 - 98.3]	50
West- Southwestern	100	-	13
Western	89.4	[72.5 - 96.4]	57
Southern	89.8	[75.2 - 96.2]	31
Central highland	98.4	[87.4 - 99.8]	10
Large faming plain	96.8	[79.8 - 99.5]	32
Southern Highlands	100	-	28
Rural Madagascar	**95.8**	**[92.4 - 97.7]**	**95.8**

Table 98 – Proportion of infants 6-8.9 months of age who received solid, semi-solid or soft foods by Livelihood zone.

	% infants 6- 8.9 months	95% Confidence Interval	Denominator
MF cyclone east coast	86.0	[51.0 - 97.3]	11
HF cyclone east coast	90.4	[73.1 - 97.0]	30
West- Southwestern	100	100	10
Western	76.4	[56.1 - 89.1]	37
Southern	100	100	16
Central highland	97.5	[81.8 - 99.7]	8
Large faming plain	90.1	[73.7 - 96.8]	33
Southern Highlands	96.1	[75.7 - 99.5]	22
Rural Madagascar	**91.0**	**[84.9 - 94.8]**	**167**

Table 99 – Proportion of children 6-23.9 months of age who receive foods from 4 or more food groups by region

	% infants 6-23.9 months	95% Confidence Interval	Denominator
Alaotra Mangoro	8.108	[2.561 - 22.85]	37
Amoron'Mania	19.44	[10.57 - 33.01]	36
Analamanga	26.92	[11.98 - 49.93]	26
Analanjirofo	0	-	29
Androy	2.062	[.4822 - 8.38]	97
Anosy	13.7	[7.941 - 22.6]	73
Atsimo Andrefana	0	-	43
Atsimo Atsinanana	7.692	[3.709 - 15.27]	65
Atsinanana	14.29	[6.368 - 29]	42
Betsiboka	10.94	[5.537 - 20.46]	64
Boeni	7.547	[2.988 - 17.79]	53
Bongolava	19.64	[8.821 - 38.18]	56
Diana	27.03	[14.29 - 45.13]	37
Haute Matsiatra	22.22	[11.97 - 37.52]	36
Ihorombe	24.44	[13.45 - 40.25]	45
Itasy	0	-	30
Melaky	3.636	[.9282 - 13.19]	55
Menabe	34.69	[21.37 - 50.95]	49
Sava	12	[3.846 - 31.74]	25
Sofia	9.091	[3.401 - 22.12]	55
Vakinakaratra	3.333	[.4746 - 19.96]	30
Vatovavy Fitovinany	33.82	[19.37 - 52.1]	68
Rural Madagascar	14.4	[11.5 - 17.8]	1051

Table 100 – Proportion of children 6-23.9 months of age who receive foods from 4 or more food groups by livelihood zone.

Livelihood zones	% children	95% Confidence Interval	Denominator
MF cyclone east coast	19.3	[8.6 - 37.8]	83
HF cyclone east coast	16.2	[10.6 - 23.9]	207
West- Southwestern	23.2	[12.7 - 38.6]	68
Western	11.4	[6.9 - 18.3]	216
Southern	5.56	[3.1 - 9.7]	186
Central highland	19.9	[9.0 - 38.2]	54
Large farming plain	11.6	[6.2 - 20.6]	140
Southern Highlands	14.3	[8.9 - 22.1]	97

Table 101 – Proportion of children 6-23 months (breastfed and non-breastfed) who received food the minimum number of time by region

	% infants 6-23 months	95% Confidence Interval	Denominator
Alaotra Mangoro	64.86	[50.67 - 76.84]	37
Amoron'Mania	88.57	[76.29 - 94.92]	35
Analamanga	88.46	[69.12 - 96.33]	26
Analanjirofo	85.19	[72.32 - 92.68]	27
Androy	41.3	[30.48 - 53.04]	92
Anosy	47.89	[37.27 - 58.7]	71
Atsimo Andrefana	24.39	[13.69 - 39.61]	41
Atsimo Atsinanana	86.67	[77.38 - 92.51]	60
Atsinanana	60.98	[42.32 - 76.89]	41
Betsiboka	71.43	[59.63 - 80.88]	63
Boeni	68.00	[51.46 - 80.98]	50
Bongolava	72.55	[56.33 - 84.41]	51
Diana	75.76	[59.53 - 86.91]	33
Haute Matsiatra	93.94	[77.71 - 98.57]	33
Ihorombe	74.42	[62.08 - 83.79]	43
Itasy	86.67	[74.41 - 93.56]	30
Melaky	80.77	[65.75 - 90.19]	52
Menabe	77.27	[59.33 - 88.8]	44
Sava	96	[75.56 - 99.47]	25
Sofia	79.25	[66.3 - 88.11]	53
Vakinakaratra	86.67	[70.21 - 94.72]	30
Vatovavy Fitovinany	71.43	[57.43 - 82.24]	63
Rural Madagascar	**73.0**	**[69.5 - 76.3]**	**1 000**

Table 102 – Proportion of children 6-23 months who received food the minimum number of time by livelihood zone

	Breastfed children		Non breastfed children		All children	
	% of children	Denominator	% of children	Denominator	% of children	Denominator
MF cyclone east coast	82.1	67	19.5	12	72.7	79
HF cyclone east coast	84.2	164	43.6	31	77.2	195
West- Southwestern	89.4	53	10.5	13	70.6	66
Western	86.3	163	56.1	44	77.5	207
Southern	49.8	126	2.16	54	33.1	180
Central highland	99.1	43	21.9	11	87.5	54
Large farming plain	80.3	114	31.7	21	73.0	135
Southern Highlands	90.3	90	38.4	5	86.8	95
Madagascar	**83.4**	**820**	**28.2**	**191**	**73.0**	**1011**

Table 103 – Proportion of children 6-23.9 months of age who received the minimum acceptable diet by region (breast-fed and non-breastfed).

	% infants 6-23 months	95% Confidence Interval	Denominator
Alaotra Mangoro	8.108	[2.56 - 22.86]	37
Amoron'Mania	20	[10.96 - 33.67]	35
Analamanga	19.23	[8.675 - 37.37]	26
Analanjirofo	0	-	27
Androy	1.087	[.1443 - 7.713]	92
Anosy	7.042	[2.967 - 15.8]	71
Atsimo Andrefana	0	-	41
Atsimo Atsinanana	8.333	[4.037 - 16.42]	60
Atsinanana	14.63	[6.555 - 29.52]	41
Betsiboka	9.524	[4.67 - 18.44]	63
Boeni	8	[3.176 - 18.73]	50
Bongolava	9.804	[4.485 - 20.1]	51
Diana	27.27	[13.84 - 46.67]	33
Haute Matsiatra	24.24	[12.92 - 40.84]	33
Ihorombe	23.26	[12.31 - 39.54]	43
Itasy	0	-	30
Melaky	0	-	52
Menabe	31.82	[18.41 - 49.12]	44
Sava	12	[3.846 - 31.74]	25
Sofia	9.434	[3.549 - 22.77]	53
Vakinakaratra	3.333	[.4744 - 19.96]	30
Vatovavy Fitovinany	28.57	[16.5 - 44.75]	63
Rural Madagascar	**12.3**	**[9.8 - 15.3]**	**1008**

Table 104 – Proportion of children 6-23.9 months of age who received the minimum acceptable diet by livelihood zone.

	Breastfed children		Non breastfed children		All children	
	% of children (95% CI)	Denominator	% of children (95% CI)	Denominator	% of children (95% CI)	Denominator
MF cyclone east coast	17.1 [7.7 - 33.8]	67	19.5 [5.7 - 49.3]	12	17.4 [7.6 - 35.1]	79
HF cyclone east coast	11.5 [6.6 - 19.5]	164	30.0 [15.7 - 49.7]	31	14.4 [9.6 - 21.1]	195
West- Southwestern	22.1 [11.3 - 38.8]	53	10.5 [2.3 - 38.2]	13	19.3 [10.3 - 33.4]	66
Western	9.4 [5.4 - 15.9]	163	16.8 [6.5 - 37.0]	44	11.2 [6.6 - 18.4]	207
Southern	4.3 [1.9 - 9.7]	126	0.9 [0.1 - 6.7]	54	3.1 [1.4 - 6.8]	180
Central highland	16.7 [7.4 - 33.5]	43	0	11	14.2] [6.4 - 28.5]	54
Large farming plain	7.8 [4.2 - 14.1]	112	6.1 [1.4 - 22.7]	21	7.5 [4.3 - 13.0]	133
Southern Highlands	13.7	90	38.4	4	14.5	94

Table 105 – Proportion of children 6-23 months who are encourage or helped to eat by region

	Child helped to eat [95% Confidence interval]	Child encouraged to eat [95% Confidence interval]	Denominator (n)
Alaotra Mangoro	55.88 [36.35 - 73.75]	58.82 [39.95 - 75.42]	37
Amoron'Mania	77.14 [59.64 - 88.52]	91.43 [72.77 - 97.71]	35
Analamanga	88.46 [69.11 - 96.33]	100	26
Analanjirofo	68.97 [55.62 - 79.76]	79.31 [56.4 - 91.91]	27
Androy	52.63 [42.33 - 62.72]	66.32 [53.05 - 77.43]	92
Anosy	50.7 [38.25 - 63.07]	57.75 [45.18 - 69.38]	71
Atsimo Andrefana	45.24 [31.29 - 59.97]	47.62 [33.31 - 62.33]	41
Atsimo Atsinanana	58.33 [45.16 - 70.42]	23.33 [15.1 - 34.25]	60
Atsinanana	60.53 [44.14 - 74.85]	68.42 [53.38 - 80.39]	41
Betsiboka	64.06 [50.01 - 76.06]	65.6 [49.33 - 78.92]	63
Boeni	68.63 [56.49 - 78.66]	62.75 [46.69 - 76.4]	50
Bongolava	61.54 [48.37 - 73.21]	84.62 [64.79 - 94.27]	51
Diana	63.64 [46.66 - 77.78]	84.85 [69.08 - 93.35]	33
Haute Matsiatra	62.86 [46.61 - 76.64]	74.29 [56.4 - 86.58]	33
Ihorombe	94.87 [81.01 - 98.77]	92.31 [78.76 - 97.49]	43
Itasy	53.33 [34.86 - 70.94]	50 [30.19 - 69.81]	30
Melaky	87.04 [70.97 - 94.86]	72.22 [57.74 - 83.19]	52
Menabe	72.73 [62.01 - 81.33]	81.82 [68.23 - 90.41]	44
Sava	84 [64.6 - 93.79]	52 [32.99 - 70.45]	25
Sofia	51.02 [36.87 - 65.01]	89.8 [77.89 - 95.65]	53
Vakinakaratra	63.33 [45.35 - 78.24]	83.33 [67.07 - 92.47]	30
Vatovavy Fitovinany	61.9 [50.15 - 72.41]	61.9 [47.45 - 74.52]	63
Rural Madagascar	**64.6** **[60.8 - 68.1]**	**70.7** **[67.3 - 74.2]**	**997**

Table 106 – Proportion of children 6-23 months who are encourage or helped to eat - by livelihood zone

	Child helped to eat**		Child encouraged to eat	
	% children 6-23 months [95%Confidence Interval]	Denominator	% children 6-23 months [95%Confidence Interval]	Denominator
MF cyclone east coast	66.5 [57.8 - 74.2]	79	65.8 [54.4 - 75.7]	79
HF cyclone east coast	64.0 [56.3 - 71.1]	190	52.1 [43.5 - 60.5]	190
West- Southwestern	68.9 [54.1 - 80.6]	63	90.2 [77.2 - 96.1]	63
Western	61.8 [52.5 - 70.4]	204	80.5 [73.2 - 86.2]	204
Southern	51.0 [42.7 - 59.3]	181	57.4 [48.5 - 65.8]	181
Central highland	77.4 [59.9 - 88.7]	52	89.3 [77.3 - 95.4]	52
Large farming plain	61.4 [52.9 - 69.3]	133	66.8 [55.3 - 76.7]	133
Southern Highlands	69.0 [59.1 - 77.5]	95	84.7 [75.6 - 90.8]	95

Table 107 – Incidence of disease in the 2 weeks prior to the survey and health seeking behavior by region

	Sick in the last 2 weeks	95% Confidence Interval	% treated at health centre	95% Confidence Interval	Denominator
Alaotra Mangoro	21.5	[16.19 - 27.97]	41.3	[26.76 - 57.54]	46
Amoron'Mania	36.63	[31.13 - 42.5]	33.33	[20.1 - 49.84]	87
Analamanga	22.02	[17.47 - 27.36]	42.86	[29.85 - 56.94]	56
Analanjirofo	49.16	[43.26 - 55.08]	7.767	[4.256 - 13.76]	103
Androy	58.36	[52.39 - 64.1]	13.31	[8.613 - 20.01]	308
Anosy	49.02	[42.85 - 55.22]	20.59	[13.23 - 30.6]	204
Atsimo Andrefana	67.66	[62.41 - 72.51]	18.15	[12.19 - 26.16]	314
Atsimo Atsinanana	47.57	[42.87 - 52.32]	23.94	[15.8 - 34.55]	188
Atsinanana	45.05	[39.41 - 50.82]	35.64	[26.33 - 46.19]	101
Betsiboka	37.93	[29.63 - 47.00]	18.48	[10.52 - 30.4]	92
Boeni	52.95	[44.46 - 61.29]	43.21	[32.76 - 54.31]	162
Bongolava	36.78	[30.58 - 43.45]	43.86	[33.05 - 55.29]	114
Diana	42.18	[34.65 - 50.09]	28.07	[16.79 - 43.01]	57
Haute Matsiatra	23.21	[18.31 - 28.95]	35.29	[18.73 - 56.35]	34
Ihorombe	44.77	[39.97 - 49.67]	10.14	[5.61 - 17.66]	69
Itasy	30.34	[25.42 - 35.77]	36.51	[23.81 - 51.41]	63
Melaky	38.81	[29.39 - 49.13]	33.93	[25.11 - 44.03]	112
Menabe	30.68	[22.19 - 40.72]	13.92	[6.771 - 26.49]	79
Sava	50	[41.8 - 58.2]	48.19	[37.08 - 59.49]	83
Sofia	38.52	[31.83 - 45.69]	9.524	[4.527 - 18.94]	63
Vakinakaratra	37.25	[31.41 - 43.48]	13.56	[7.955 - 22.16]	118
Vatovavy	53.22	[49.18 - 57.23]	42.28	[34.47 - 50.49]	246
Rural Madagascar	44.0	[42.2 - 45.8]	25.8	[23.3 - 28.6]	

Table 108 – Incidence of disease in the 2 weeks prior to the survey and health seeking behavior by livelihood

	Sick in the last 2 weeks	95% Confidence Interval	% treated at health centre	95% Confidence Interval	Denominator
MF cyclone east coast	53.1	[49.37,56.81]	28.0	[19.96,37.77]	794
HF cyclone east coast	47.2	[44.39,50.12]	34.9	[29.82,40.26]	2250
West- Southwestern	50.5	[39.4,61.61]	11.3	[4.817,24.12]	653
Western	39.74	[35.31,44.35]	19.4	[14.17,26.07]	1593
Southern	60.9	[56.83,64.74]	18.6	[13.84,24.53]	1898
Central highland	24.6	[20.65,29.02]	31.31	[22.82,41.28]	786
Large farming plain	37.6	[32.95,42.53]	44.54	[37.04,52.31]	1395
Southern Highlands	33.9	[30.08,37.94]	23.18	[16.43,31.64]	1212

Table 109 – Child Preventative treatment by region

	Vitamin A supplementation of children 11-59 months	Denominator	De-worming of children 17-59 months [95% CI]	Denominator	Measles vaccination of children 9-59 months	Denominator
Alaotra Mangoro	89.89 [81.32 - 94.78]	89	88.36 [60.96 - 87.68]	65	76.92 [60.96 - 87.68]	91
Amoron'Mania	97 [91.68 - 98.96]	101	89.61 [85.22 - 92.81]	73	85.58 [72.26 - 93.11]	105
Analamanga	88.89 [75.61 - 95.38]	54	93.45 [89.32 - 96.06]	39	98.48 [90.06 - 99.79]	66
Analanjirofo	95.45 [88.94 - 98.21]	90	79.31 [71.24 - 85.57]	65	90.32 [82.02 - 95.03]	95
Androy	65.6 [57.04 - 73.25]	250	63.09 [54.24 - 71.14]	182	65.87 [56.3 - 74.3]	252
Anosy	83.94 [77.62 - 88.73]	193	55.62 [46.09 - 64.76]	140	87.18 [79.33 - 92.34]	195
Atsimo Andrefana	21.23 [14.06 - 30.76]	154	39.67 [32.39 - 47.43]	112	42.67 [27.75 - 59.05]	152
Atsimo Atsinanana	87.83 [79.54 - 93.05]	194	77.02 [71.03 - 82.08]	141	75.63 [67.73 - 82.11]	203
Atsinanana	88.57 [76.99 - 94.72]	110	61.1 [55.18 - 66.7]	80	88.07 [77.65 - 94.01]	113
Betsiboka	63.23 [45.8 - 77.77]	155	62.23 [48.38 - 74.34]	113	47.8 [35.47 - 60.4]	159
Boeni	58.06 [46.29 - 68.99]	125	55.67 [45.47 - 65.42]	91	55.56 [42.82 - 67.6]	127
Bongolava	95.88 [89.8 - 98.4]	97	90.79 [85.73 - 94.17]	70	91.35 [84.65 - 95.28]	104
Diana	75 [62.64 - 84.3]	102	71.2 [60.82 - 79.76]	74	86.81 [78.87 - 92.07]	99
Haute Matsiatra	86.46 [75.17 - 93.09]	101	88.76 [83.41 - 92.53]	73	95.92 [87.73 - 98.72]	103
Ihorombe	87.04 [77.62 - 92.85]	115	64.44 [56.65 - 71.53]	84	89.66 [81.54 - 94.45]	123
Itasy	90.32 [79.74 - 95.68]	93	85.21 [77.08 - 90.8]	68	96.77 [91.06 - 98.88]	93
Melaky	74.62 [65.41 - 82.04]	133	63.77 [50.55 - 75.2]	97	71.01 [57.61 - 81.54]	141
Menabe	75.74 [63.63 - 84.77]	138	67.32 [55.35 - 77.39]	100	71.74 [59.58 - 81.39]	140
Sava	72 [52.51 - 85.67]	78	78.02 [70.84 - 83.83]	57	79.73 [67.72 - 88.06]	76
Sofia	66.4 [51.79 - 78.43]	126	45.34 [34.09 - 57.1]	92	76.8 [62.31 - 86.89]	127
Vakinakaratra	79.49 [66.44 - 88.35]	78	85.82 [78.39 - 90.99]	57	86.25 [75.49 - 92.74]	80
Vatovavy Fitovinany	87.1 [79.74 - 92.05]	156	74.48 [68.32 - 79.79]	113	81.48 [73.33 - 87.57]	163
Madagascar	**77.1 [74.0 - 79.9]**	**2732**	**79.3 [76.2 - 82.2]**	**1985**	**79.5 [76.7-82.1]**	**2807**

Table 110 – Child Preventative treatment by livelihood zone

	Vitamin A supplementation of children 11-59 months	Denominator	De-worming of children 17-59 months [95% CI]	Denominator	Measles vaccination of children 9-59 months	Denominator
MF cyclone east coast	90.2 [83.7 - 94.4]	198	75.1 [69.2 - 80.1]	566	83.2 [75.8 - 88.6]	208
HF cyclone east coast	83 [77.6 - 87.3]	586	72.2 [68.8 - 75.4]	1650	84.1 [80.0 - 87.4]	596
West- Southwestern	55.8 [40.3 - 70.2]	207	58.5 [48.3 - 68.0]	480	61.3 [43.1 - 76.8]	211
Western	68.7 [60.5 - 76.0]	527	52.2 [45.0 - 59.2]	1069	71.4 [63.4 - 78.2]	540
Southern	50.2 [40.4 - 60.1]	512	49.6 [43.1 - 56.1]	1347	59.2 [48.3 - 69.3]	520
Central highland	90.8 [82.5 - 95.3]	135	91.6 [88.1 - 94.2]	51	97.1 [90.5 - 99.2]	146
Large farming plain	78.8 [70.0 - 85.6]	312	79.1 [72.9 - 84.2]	945	75.8 [67.1 - 82.8]	323
Southern Highlands	85.2 [78.0 - 90.4]	255	87.5 [83.6 - 90.6]	823	88.7 [82.4 - 92.9]	263

Table 111 – Maternal health seeking behaviour by region

	% pregnant women who attended antenatal care by a health professional [95% CI]	% pregnant women who took iron folic acid during their pregnancy [95% CI]	% pregnant women who received postpartum vitamin A supplementation [95% CI]	Denominator
Alaotra Mangoro	93.4 [83.05 - 97.61]	69.16 [57.78 - 78.61]	40.19 [30.77 - 50.39]	107
Amoron'Mania	93.4 [87.44 - 96.64]	53.77 [39.01 - 67.9]	53.85 [41.32 - 65.91]	104
Analamanga	94.2 [86.68 - 97.59]	75 [55.73 - 87.73]	61.76 [45.05 - 76.1]	68
Analanjirofo	87.23 [72.76 - 94.59]	80.85 [66.99 - 89.78]	50 [34.87 - 65.13]	94
Androy	63.96 [51.35 - 74.91]	48.65 [40.38 - 56.99]	35.14 [25.35 - 46.36]	223
Anosy	74.74 [64.3 - 82.93]	55.49 [45.94 - 64.66]	56.15 [46.67 - 65.2]	187
Atsimo Andrefana	46 [32.4 - 60.22]	41.33 [27.96 - 56.12]	34.67 [22.6 - 49.09]	158
Atsimo Atsinanana	63.16 [53.14 - 72.16]	61.45 [52.56 - 69.63]	23.66 [15.48 - 34.39]	186
Atsinanana	84.03 [69.85 - 92.28]	74.56 [61.32 - 84.42]	74.56 [62.01 - 84.04]	119
Betsiboka	83.24 [70.81 - 91.04]	56.4 [39.65 - 71.8]	41.52 [32.24 - 51.44]	171
Boeni	83.09 [71.87 - 90.43]	65.91 [53.83 - 76.22]	30.6 [22.17 - 40.55]	135
Bongolava	92.8 [82.66 - 97.21]	70.49 [56.87 - 81.23]	48.8 [38.53 - 59.17]	125
Diana	94.12 [84.33 - 97.94]	82.35 [68.9 - 90.77]	65.91 [52.48 - 77.19]	94
Haute Matsiatra	76.85 [63.46 - 86.39]	83.02 [72.62 - 90.01]	75 [65.19 - 82.77]	102
Ihorombe	6.667 [2.978 - 14.25]	60.17 [47.45 - 71.65]	60.5 [48.18 - 71.62]	128
Itasy	100	70 [54.79 - 81.8]	39 [27.8 - 51.5]	100
Melaky	71.83 [55.79 - 83.75]	56.25 [43.95 - 67.83]	29.08 [19.51 - 40.95]	143
Menabe	78.43 [63.34 - 88.44]	67.32 [56.53 - 76.54]	33.56 [23.87 - 44.85]	151
Sava	77.63 [63.94 - 87.17]	37.33 [23.65 - 53.4]	42.11 [26.2 - 59.84]	78
Sofia	72.66 [57.42 - 83.97]	56.12 [42.6 - 68.78]	41.61 [28.9 - 55.54]	138
Vakinakaratra	93.33 [85.2 - 97.15]	61.11 [48.9 - 72.07]	39.33 [26.19 - 54.21]	89
Vatovavy Fitovinany	76.36 [64.43 - 85.21]	57.93 [45.73 - 69.23]	59.39 [46.52 - 71.1]	166
Madagascar	**90.34 [88.43 - 91.96]**	**61.82 [58.55 - 64.98]**	**47.65 [44.32 - 50.99]**	**2849**

Table 112 – Maternal health seeking behavior by livelihood and vulnerability status

	% pregnant women who attended antenatal care by a health professional [95% CI]	% pregnant women who took iron folic acid during their pregnancy [95% CI]	% pregnant women who received postpartum vitamin A supplementation [95% CI]	Denominator
MF cyclone east coast	83.34 [71.11 - 91.05]	72.58 [61.1 - 81.69]	50.69 [39.46 - 61.85]	208
HF cyclone east coast	84.65 [79.48 - 88.7]	59.3 [52.59 - 65.69]	51.44 [44.26 - 58.56]	571
West- Southwestern	92.46 [87.25 - 95.65]	54.81 [40.2 - 68.63]	40.17 [30.67 - 50.48]	218
Western	87.32 [81.12 - 91.69]	58.48 [50.31 - 66.21]	41.13 [33.36 - 49.36]	576
Southern	87.16 [82.14 - 90.93]	47.71 [39.44 - 56.11]	39.34 [30.85 - 48.53]	484
Central highland	99.03 [93.61 - 99.86]	68.36 [55.36 - 79.01]	49.34 [36.57 - 62.2]	156
Large faming planes	94.63 [89.93 - 97.2]	69.65 [62.59 - 75.88]	40.95 [35.19 - 46.97]	369
Southern Highlands	97.86 [95.28 - 99.04]	67.01 [58.48 - 74.55]	58.55 [49.9 - 66.7]	267

Table 113 - Distribution of maternal height below 150cm by region

	% of mothers with a height <150cm	95% Confidence	Denominator
Alaotra Mangoro	37.29	[31.82 - 43.11]	354
Amoron'Mania	35.7	[30.11 - 41.7]	409
Analamanga	34.57	[27.08 - 42.92]	350
Analanjirofo	41.24	[34.86 - 47.92]	291
Androy	17.52	[12.86 - 23.41]	508
Anosy	25.21	[20.58 - 30.48]	480
Atsimo Andrefana	18.11	[15.15 - 21.5]	370
Atsimo Atsinanana	40.16	[34.41 - 46.2]	610
Atsinanana			
Betsiboka	37.39	[31.9 - 43.23]	353
Boeni	19.67	[15.75 - 24.29]	366
Bongolava	34.21	[27.7 - 41.38]	532
Diana	19.13	[14.3 - 25.12]	230
Haute Matsiatra	29.83	[25 - 35.15]	295
Ihorombe	28.53	[21.03 - 37.43]	319
Itasy	36.57	[29.97 - 43.72]	350
Melaky	20.06	[16.37 - 24.34]	314
Menabe	21.53	[16.33 - 27.83]	367
Sava	33.2	[26.32 - 40.89]	253
Sofia	29.09	[22.48 - 36.73]	330
Vakinakaratra	45.95	[38.9 - 53.16]	407
Vatovavy Fitovinany	49.04	[43.42 - 54.68]	622
Madagascar	**34.9**	**[33.1 - 36.7]**	**5070**

Table 114 - Distribution of maternal height below 150cm by livelihood zone

	% of mothers weight a height <150cm	95% Confidence	Denominator
MF cyclone east coast	48.2	[41.9 - 54.5]	431
HF cyclone east coast	38.5	[36.0 - 43.1]	1159
West- Southwestern	23.5	[18.9 - 28.9]	325
Western	27.8	[24.0 - 31.9]	813
Southern	19.1	[16.0 - 22.6]	698
Central highland	41.8	[37.1 - 46.7]	406
Large faming plain	33.1	[28.0 - 38.5]	715
Southern Highlands	39.3	[34.5 - 44.3]	523

Table 115 – Proportion of children weighed at birth and prevalence of low birth weight by livelihood zone

	% of living children weighed at birth	95% Confidence Interval	Denominator	birth weight <2.5kg	95% Confidence Interval	Denominator
Alaotra Mangoro	39.29	[28.49 - 51.26]	397	14.29	[7.776 - 24.78]	147
Amoron'Mania	40.9	[29.12 - 53.83]	445	12.03	[7.487 - 18.76]	158
Analamanga	58.93	[45.2 - 71.4]	375	9.05	[6.193 - 13.04]	221
Analanjirofo	29.97	[20.61 - 41.36]	347	18.18	[11.87 - 26.82]	77
Androy	9.693	[5.126 - 17.58]	815	8.955	[4.209 - 18.04]	67
Anosy	15.16	[10.1 - 22.12]	673	12.62	[7.585 - 20.27]	103
Atsimo Andrefana	5.663	[3.157 - 9.956]	671	12.82	[5.305 - 27.85]	39
Atsimo Atsinanana	7.116	[3.501 - 13.92]	801	5.172	[1.594 - 15.52]	58
Atsinanana	45.53	[37.53 - 53.77]	369	20.35	[13.52 - 29.45]	172
Betsiboka	23.59	[14.31 - 36.34]	407	7.609	[3.33 - 16.45]	92
Boeni	27.46	[18.82 - 38.2]	437	11.97	[7.438 - 18.69]	117
Bongolava	39.58	[29.89 - 50.16]	566	13	[7.832 - 20.82]	223
Diana	59.07	[46.86 - 70.26]	259	14	[8.815 - 21.52]	150
Haute Matsiatra	34.19	[23.99 - 46.1]	468	7.801	[4.471 - 13.27]	141
Ihorombe	25.69	[17.89 - 35.42]	436	10.77	[3.226 - 30.41]	65
Itasy	50.13	[39.53 - 60.72]	385	8.854	[5.24 - 14.58]	192
Melaky	16.23	[9.583 - 26.15]	382	9.859	[4.649 - 19.7]	71
Menabe	11.64	[6.72 - 19.42]	438	8.333	[3.969 - 16.66]	48
Sava	34.33	[22.32 - 48.76]	300	16.82	[11.72 - 23.55]	107
Sofia	12.53	[7.53 - 20.14]	367	10.87	[3.201 - 31.02]	46
Vakinakaratra	28.6	[21.38 - 37.11]	451	13.18	[7.585 - 21.92]	129
Vatovavy Fitovinany	19.65	[11.99 - 30.49]	733	11.76	[7.198 - 18.65]	119
Rural Madagascar	**26.0**	**[23.8 – 28.6]**	**17809**	**13.55**	**[7.774 - 22.56]**	**3375**

Table 116 – Proportion of children weighed by livelihood zone

	% of living children weighed at birth	95% Confidence Interval	Denominator	birth weight <2.5kg	95% Confidence Interval	Denominator
MF cyclone east coast	26.7	[19.17,35.81]	759	14.49	[9.682 - 21.12]	150
HF cyclone east coast	25.8	[20.85,31.52]	2261	26.97	[11.92 - 50.17]	928
West- Southwestern	14.7	[10.24,20.54]	650	8.652	[3.334 - 20.64]	86
Western	17.0	[12.98,22.05]	1561	10.76	[7.008 - 16.17]	288
Southern	7.9	[5.331,11.46]	1914	10.46	[5.652 - 18.57]	136
Central highland	49.7	[39.93,59.57]	775	6.93	[3.715 - 12.56]	531
Large farming plain	38.2	[31.92,44.95]	1390	8.97	[6.019 - 13.17]	643
Southern Highlands	35.4	[29.2,42.04]	1212	5.964	[3.016 - 11.45]	613

Table 117 – Access to improved water source by season and region

	Dry season		Rainy season		
	% households with access to improved water source	**95% confidence interval**	**% households with access to improved water source**	**95% confidence interval**	**Denominator**
Alaotra Mangoro	18.5	[7.519,38.85]	21.0	[9.266,40.86]	
Amoron'Mania	18.0	[7.62,36.71]	21.8	[10.97,38.66]	
Analamanga	46.4	[28.14,65.73]	44.6	[26.48,64.35]	
Analanjirofo	20.9	[9.65,39.62]	19.8	[9.057,37.87]	
Androy	9.9	[5.133,18.4]	28.6	[18.64,41.3]	
Anosy	26.5	[16.15,40.41]	35.2	[24.39,47.74]	
Atsimo Andrefana	13.9	[5.665,30.31]	12.8	[4.718,30.4]	
Atsimo Atsinanana	15.7	[7.678,29.26]	16.2	[7.434,31.81]	
Atsinanana	27.8	[15.87,43.96]	26.6	[14.76,43.14]	
Betsiboka	23.1	[11.71,40.59]	25.4	[13.46,42.63]	
Boeni	42.0	[25.58,60.43]	44.5	[28.64,61.64]	
Bongolava	50.5	[34.68,66.2]	49.5	[33.8,65.32]	
Diana	46.1	[31.43,61.41]	45.7	[30.52,61.64]	
Haute Matsiatra	18.3	[9.578,32.08]	21.51	[12.1,35.28]	
Ihorombe	37.4	[25.36,51.18]	40.4	[28.39,53.7]	
Itasy	59.5	[43.01,74.08]	59.5	[43.01,74.08]	
Melaky	15.9	[8.415,27.93]	15.6	[8.344,27.36]	
Menabe	23.5	[13.15,38.47]	27.5	[15.5,44.04]	
Sava	20.8	[11.28,35.12]	23.4	[13.27,37.83]	
Sofia	9.7	[3.337,24.95]	8.7	[2.726,24.62]	
Vakinakaratra	27.4	[16,42.78]	28.8	[17.65,43.22]	
Vatovavy Fitovinany	27.1	[15.62,42.81]	27.1	[15.62,42.81]	
Madagascar	**26.0**	**[22.9 - 29.4]**	**27.7**	**[24.5 - 31.2]**	**2405**

Table 118 – Access to improved water source by season and livelihood zone

	Dry season		Rainy season		
	% households with access to improved water source	95% confidence interval	% households with access to improved water source	95% confidence interval	Denominator
MF cyclone east coast	22.5	[13.6 - 35.0]	23.5	[14.0 - 36.5]	170
HF cyclone east coast	25.5	[19.5 - 32.6]	25.5	[19.4 - 32.6]	514
West- Southwestern	29.8	[18.7 - 44.1]	31.4	[19.0 - 47.2]	174
Western	16.7	[11.1 - 24.4]	17.4	[11.6 - 25.3]	499
Southern	13.1	[7.8 - 21.0]	21.5	[14.8 - 30.2]	406
Central highland	43.1	[29.4 - 57.9]	41.9	[28.2 - 56.9]	127
Large faming plain	47.9	[37.5 - 58.5]	49.0	[38.8 - 59.2]	303
Southern Highlands	20.9	[14.0 - 30.0]	23.9	[17.0 - 32.5]	221

Table 119 – Percentage of households who treat their drinking water by region

	% households who treat their drinking water	95% Confidence interval	Denominator
Alaotra Mangoro	42.0	[31.74,52.95]	
Amoron'Mania	44.8	[34.37,55.85]	
Analamanga	66.07	[48.2,80.3]	
Analanjirofo	80.2	[62.7,90.74]	
Androy	11.3	[7.161,17.33]	
Anosy	19.1	[12.88,27.48]	
Atsimo Andrefana	7.6	[3.29,16.7]	
Atsimo Atsinanana	61.5	[50.1,71.74]	
Atsinanana	69.7	[60.64,77.49]	
Betsiboka	19.4	[10.87,32.22]	
Boeni	5.9	[2.413,13.64]	
Bongolava	26.2	[17.09,37.98]	
Diana	20.7	[12.74,31.69]	
Haute Matsiatra	42.3	[33.87,51.4]	
Ihorombe	20.2	[12.83,30.33]	
Itasy	5.06	[2.04,12.02]	
Melaky	22.2	[15.03,31.57]	
Menabe	17.4	[10.91,26.57]	
Sava	26.0	[16.19,38.92]	
Sofia	74.2	[63.4,82.67]	
Vakinakaratra	21.92	[12.6,35.35]	
Vatovavy Fitovinany	34.3	[23.76,46.82]	
Madagascar	**37.6**	**[34.19 - 41.08]**	**2366**

Table 120 – Percentage of households who treat their drinking water by livelihood zone

	% households who treat their drinking	95% Confidence interval	Denominator
MF cyclone east coast	59.3	[45.92 - 71.38]	170
HF cyclone east coast	44.6	[38.06 - 51.32]	516
West- Southwestern	15.9	[9.1 - 26.43]	176
Western	48.2	[39.09 - 57.51]	495
Southern	11.7	[7.93 - 16.97]	410
Central highland	48.6	[34.26 - 63.18]	127
Large faming plain	16.3	[11.55 - 22.54]	303
Southern Highlands	37.6	[30.99 - 44.67]	220

Table 121 – Availability of improved sanitation by region

	% households with access to improved sanitation	95% Confidence interval	Denominator
Alaotra Mangoro	2.5	[0.656,8.848]	
Amoron'Mania	1.3	[0.1755,8.752]	
Analamanga	5.5	[1.636,16.68]	
Analanjirofo	0	-	
Androy	0	-	
Anosy	1.2	[.3116,4.761]	
Atsimo Andrefana	0	-	
Atsimo Atsinanana	0	-	
Atsinanana	0	-	
Betsiboka	8.2	[3.329,18.85]	
Boeni	3.3	[0.73,14.05]	
Bongolava	1.0	[0.1451,6.319]	
Diana	5.5	[2.293,12.53]	
Haute Matsiatra	0	-	
Ihorombe	1.01	[0.13,7.24]	
Itasy	1.3	[0.1832,8.221]	
Melaky	0	-	
Menabe	4.4	[1.114,15.69]	
Sava	3.9	[1.358,10.66]	
Sofia	0.8	[0.1,5.3]	
Vakinakaratra	4.1	[0.98,15.67]	
Vatovavy Fitovinany	5.4	[1.552,17.28]	
Madagascar	2.2	[1.414,3.332]	

Table 122 – Availability of improved sanitation by livelihood zone

	% households with access to improved sanitation	95% Confidence interval	Denominator
MF cyclone east coast	4.1	[1.0 - 15.9]	170
HF cyclone east coast	1.6	[0.8 - 3.2]	500
West- Southwestern	1.8	[0.4 - 8.7]	175
Western	3.1	[1.5 - 6.1]	439
Southern	0.2	[0.0 - 1.4]	406
Central highland	6.2	[2.5 - 14.6]	126
Large farming plain	1.2	[0.4 - 3.4]	302
Southern Highlands	0.4	[0.1 - 2.7]	221

Table 123 – Hand washing by mothers after latrine use by region

	% women who was their hands with soap after latrine use	95% Confidence interval	Denominator
Alaotra Mangoro	14.1	[6.301,28.62]	
Amoron'Mania	49.3	[36.99,61.72]	
Analamanga	75.0	[59.96,85.74]	
Analanjirofo	18.1	[8.235,35.16]	
Androy	17.9	[11.77,26.16]	
Anosy	26.2	[19.92,33.57]	
Atsimo Andrefana	0.95	[.1354,6.382]	
Atsimo Atsinanana	6.7	[3.095,14.16]	
Atsinanana	23.1	[14.72,34.27]	
Betsiboka	25.2	[15.41,38.37]	
Boeni	28.2	[17.63,41.84]	
Bongolava	16.8	[10.87,25.14]	
Diana	55.4	[41.77,68.3]	
Haute Matsiatra	15.4	[8.519,26.2]	
Ihorombe	30.4	[19.72,43.79]	
Itasy	6.7	[2.523,16.47]	
Melaky	18.8	[12.11,27.88]	
Menabe	9.2	[4.961,16.31]	
Sava	17.3	[9.643,29.18]	
Sofia	2.7	[0.8736,7.783]	
Vakinakaratra	8.7	[3.45,20.24]	
Vatovavy Fitovinany	14.7	[8.901,23.39]	
Madagascar	**21.7**	**[18.86 - 24.9]**	**2261**

Table 124 – Hand washing by mothers after latrine use by livelihood zone

	% women who was their hands with soap after latrine use	**95% Confidence interval**	**Denominator**
MF cyclone east coast	15.2	[9.613 - 23.21]	167
HF cyclone east coast	19.6	[15.21 - 24.92]	487
West- Southwestern	14.6	[9.173 - 22.86]	166
Western	13.9	[9.839 - 19.38]	458
Southern	11.7	[8.008 - 16.7]	359
Central highland	51.8	[37.52 - 65.86]	122
Large faming plain	18.2	[13.04 - 24.76]	291
Southern Highlands	24.2	[17.91 - 31.87]	211