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Participatory research to support sustainable land management on the Mahafaly Plateau in south-western Madagascar

Characteristics of rural markets
in the Mahafaly Plateau region
Analysis of market monitoring
data from 2013 and 2014



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Electronic appendix

The electronic appendix to this report contains three Microsoft Excel files with the following content:

- Summary statistics: tables depicting statistics on raw data and four-week averages for all crops, livestock products and alimentary plants surveyed as well as supplementary tables on unit conversions for crops and livestock category definitions
- Crop diagrams: diagrams of seasonal price fluctuations for all crops surveyed
- Livestock diagrams: diagrams of seasonal price fluctuations as well as diagrams with prices according to age class for all livestock types surveyed

Introduction

For villagers on the Mahafaly Plateau local markets are the most important channels for marketing their agricultural products and purchasing goods for consumption. Thus, a market analysis provides information on the constraints and opportunities faced by the rural households.

We monitored market prices for crops, alimentary plants and fruits as well as livestock products on five markets in the Mahafaly Plateau region over a period of 2 years (2013 & 2014) in at least 2-weekly intervals. We analyse the data to answer the following questions:

1. Which livestock, crop and alimentary plants products are available on the markets?
2. Which factors influence the availability and prices of these products on the different markets?

Among the factors influencing product availability and prices, we pay particular attention to seasonality, differences between markets and price shocks. Verification interviews with the market monitors or other key persons helped us to validate results on causes of price developments on a qualitative basis. This is the second report showing results from the monitoring in 2013 and 2014 (see report Characteristics of rural markets in the Mahafaly Plateau region - Analysis of market monitoring data from 2013). The monitoring continued in 2015 and 2016 with the same methodology.

Methods

We monitored prices from mid-January 2013 to mid-January 2015 on five markets in the Mahafaly Plateau region. The five markets were identified as central for different regions for the northern transect of the SuLaMa study area through a network analysis of Village Baseline Survey data. The network analysis was carried out with information on markets visited by people from different villages and using the software Ucinet. We selected in the littoral region the neighbouring markets of Efoetse and Marofijery, and on the plateau the markets of Andremba and Itomboina. In 2014 the market in Marofijery was replaced by the neighbouring market in Ankilibory, since the market in Marofijery was partly given up. In addition to those markets of local importance, we selected Ambatry as one market of regional importance since people from the littoral, the plateau as well as from Masiaboay and Beantake mentioned to visit this place.

The currency of all recordings is Madagascar Ariary (MGA; 1 € = 3,250 MGA: 4th September 2014, 1 € = 3,564 MGA: 17th July 2015, www.oanda.com). For each market place, we engaged a local inhabitant of the village as a market monitor, who received the local half day salary for assistance for each monitored data set (3,000-4,000 MGA). He visited the market days at least in intervals of 2 weeks (in many cases even in weekly intervals) and recorded prices of available products. We predefined a list of products, but the market monitor could add other crops, livestock categories or local fruits if they occurred on the market. In order to keep the disturbance on the market and transaction costs for the monitors low, he recorded always the first price given by the seller of the product. There might be deviations from the actual selling price since bargaining is possible on the market. The market monitors usually started recording prices around 8.00am to 8.30am. At this time, the market for crops and other products is fully opened, while transactions especially on the livestock market may take place earlier (as early as 4.00am).

The monitored data was checked from the market monitors' notebooks at monthly intervals and then entered into excel files. The full data set was organized in weekly intervals. For each product, a standard unit was defined and conversions of sold units were carried out based on weighings of local crops. For some products, e.g. melons and pumpkins, a price range was recorded by the monitor due to the different sizes of pieces. Here, we worked with the mean price calculated from the price range. In order to carry out comparative analyses of prices, we calculated the mean price in moving 4 weeks intervals for the whole time period.

We recorded market data for 27 different crops grown in the Mahafaly Plateau region. The range of crops comprises manioc (dried and fresh), sweet potatoes, maize, tomatoes, as well as different kinds of beans, bulb vegetables, melons, and pumpkins. We used standard statistical methods in R to test for differences between markets and seasons in the crop data. Differences were tested using Kruskal-Wallis test and a post-hoc Dunnett's multiple comparison test since for the majority of analysed data the homogeneity of variances required for the standard ANOVA was not given according to the Levene test of variances. For testing differences between seasons in crop price data, we defined the harvest season and the lean season according to the cropping calendar (Agriculture fact sheet from WP 2) for the study region. Table 1 depicts the harvest and lean seasons for the different crops. The lean season takes place at the end and the beginning of the monitored years. Thus, we used four different datasets with an equal number of weeks, one representing the lean season 2012/2013, two for 2013/2014 and one for the lean season 2014/2015. As many crops were traded only seasonally, a meaningful statistical analysis was only possible for the most frequently occurring crops.

Table 1 Harvesting and lean seasons for different crops (calendar weeks)

| Crop | 2013/2014 | | | 2014/2015 | | |
|-----------------------|---------------|----------------|---------------|---------------|----------------|---------------|
| | Lean season 1 | Harvest season | Lean season 2 | Lean season 1 | Harvest season | Lean season 2 |
| Maize | 3-9 | 12-20 | 49-3 | 2 - 8 | 12 - 20 | 48 - 2 |
| Manioc | 3-9 | 27-35 | 49-3 | 2 - 8 | 27 - 35 | 48 - 2 |
| Lojy and other | 3-9 | 14-22 | 49-3 | 2 - 8 | 14 - 22 | 48 - 2 |

We recorded price information for livestock and livestock products for zebu, sheep and goats on five markets in the Mahafaly Plateau region. Among the recorded items are milk and meat, as well as live animals in 72 categories for zebu and 44 categories for sheep and goats respectively. The categories of live animals are based on age and body condition, and for females also on reproductive performance. For adult sheep and goats, animals are classified according mainly to their life age (2 to 8 years), while younger animals are classified finer in age categories of 6 months or less. The same applies to bulls and castrated zebu as well as charrette zebu (konda). Older zebu females are classified according to the number of their parturitions. Please see the electronic appendix for the detailed classification.

During the data analysis for 2013, the market monitors were asked to give feedback to the diagrams showing the crop and livestock data they recorded. Questions were posed on phenomena visible in the diagrams (e.g. periods of especially high prices, comparisons between different market places).

This exercise allowed us to cross-check findings from the data with personal experiences of the monitors, and we collected information on possible sources of price differences and fluctuations. The information from these exercises is reported in separate sections in the results. Most respondents understood the logic of the diagrams and were able to make comparisons between seasonal prices and different markets. Most of them also understood the market logic, i.e. the influence of number of sellers (supply) and number of buyers (demand) on prices.

Results

Market network analysis

The result of the network analysis of data on visited markets from the Village Baseline Survey (figure 1) clearly distinguishes markets according to the village of origin of their visitors and the relative importance of the market. Without any information on the geographic location of villages, the network reproduced more or less a regional map, indicating the littoral region as distinct from the plateau region with the most important regional centres to the right side of the network, i.e. eastern side of the Mahafaly Plateau region.

In the littoral region, the network depicts four markets (Efoetse, Marofijery, Ankilibory, and Beheloke) of similar importance, while Ankilimivony is mentioned less often. In the Plateau region, Itomboina is the most important market, which is visited by inhabitants from nearly all villages nearby as well as from some littoral villages and villages from Beantake and Masiaboay. Surprisingly, the market in Beroy is visited by inhabitants from littoral and plateau villages equally. In Beantake and Masiaboay communes, the most important markets are Masiaboay centre, Ampasindava and Beahitse. However, as the markets of Betioky and Ambatry with larger importance are situated nearby, inhabitants from the single villages visit these markets as well.

Based on this information and needs of the project, we chose to monitor the markets of Efoetse and Marofijery in the littoral region, Itomboina and Andremba in the plateau region, as well as Ambatry as a market with greater centrality and regional importance. Although the network does not depict trade relations (i.e. transport and resale of goods and services), we can assume that traders travel between the littoral region and Itomboina, between Itomboina and Andremba, as well as between the regional centers Betioky/Ambatry and Itomboina.

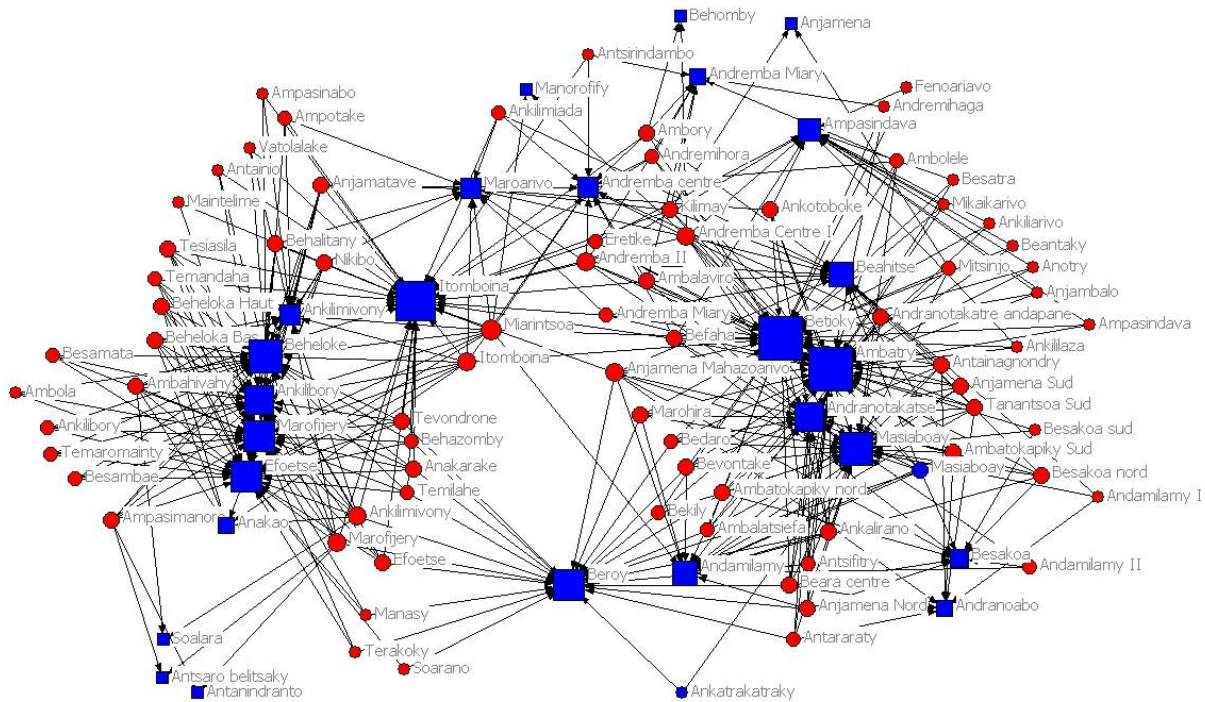


Figure 1 Network of markets in the Mahafaly region

Note: Villages are shown in red, markets in blue, the size of the square indicates the relative importance of the market (i.e. relative number of records from villages)

Crops

We recorded market data for 19 different crops grown in the Mahafaly Plateau region. The range of crops comprises manioc (dried and fresh), sweet potatoes, maize, tomatoes, as well as different kinds of beans, melons, and pumpkins.

Availability

Most observations for crops in the moving 4 week intervals were made for maize, rice, Lojy beans (cowpea) and peanuts (without shell) which occurred on average in 80 to 100 % of all intervals and markets (table 2). Dried manioc occurred less on the markets in Efoetse, Itomboina and Marofijery/Ankilibory (60 – 72 %) in 2014 compared to the year 2013. Antsamby beans (mungbeans), garlic and onions were also common on the markets. Other products, e.g. pumpkins and melons, were only seasonally or occasionally available. The availability was lowest for the grains sorghum and millet, but in 2014 they seem to be present more often compared to 2013. Furthermore, sweet potatoes were with an overall presence of 46 % nearly equally common in both observation years.

Markets also differ in the availability of crops. The widest and most constant range of products is offered in Ambatry followed by Efoetse and Marofijery/Ankilibory. Some products were present only in one market (see Voatavo (pumpkin), Akondro (banana) or fresh Kapiky (peanut)).

Table 2 Availability and prices for agricultural crops on the different markets in 2013 and 2014 based on moving 4-weekly means

| Category | Crop | Unit | Market | 2013 | | | | | 2014 | | | | |
|-----------------|--------------------------------|---------------------|-----------------------|------------------|-----|------|------|--------|------------------|------|------|------|--------|
| | | | | Availability (%) | Min | Max | Mean | Median | Availability (%) | Min | Max | Mean | StdDev |
| Beans | Tsaramaso (beans) | MGA/kg ¹ | Efoetse | | | | | | 20 | 800 | 900 | 840 | 55 |
| | | | Marofijery/Ankilibory | | | | | | 28 | 600 | 800 | 657 | 98 |
| | | | Ambatry | | | | | | 64 | 500 | 800 | 680 | 116 |
| | Lojy (cowpea) | MGA/kg | Efoetse | 92 | 150 | 600 | 324 | 300 | 92 | 200 | 600 | 351 | 106 |
| | | | Marofijery/Ankilibory | 100 | 200 | 500 | 337 | 300 | 80 | 217 | 500 | 330 | 80 |
| | | | Itomboina | 100 | 213 | 500 | 289 | 267 | 96 | 200 | 475 | 334 | 76 |
| | | | Andremba | 100 | 175 | 575 | 290 | 300 | 100 | 200 | 450 | 305 | 76 |
| | Antake (hyacinth-bean) | MGA/kg | Ambatry | 96 | 200 | 633 | 317 | 308 | 96 | 225 | 750 | 334 | 115 |
| | | | Efoetse | 32 | 100 | 300 | 250 | 300 | 16 | 300 | 300 | 300 | 0 |
| | | | Marofijery/Ankilibory | 32 | 225 | 300 | 257 | 250 | 40 | 225 | 300 | 264 | 29 |
| | | | Itomboina | 48 | 143 | 250 | 188 | 184 | 72 | 193 | 270 | 218 | 27 |
| | Antsamby (mungbean) | MGA/kg | Andremba | 48 | 200 | 250 | 206 | 200 | 52 | 200 | 250 | 222 | 23 |
| | | | Ambatry | 56 | 250 | 475 | 345 | 338 | 52 | 250 | 450 | 342 | 61 |
| | | | Efoetse | 72 | 300 | 1000 | 617 | 700 | 44 | 288 | 800 | 373 | 150 |
| | | | Marofijery/Ankilibory | 52 | 267 | 1250 | 464 | 475 | 76 | 300 | 800 | 516 | 152 |
| | Antsabim-bazaha (rice-bean) | MGA/kg | Itomboina | 80 | 257 | 500 | 355 | 338 | 80 | 350 | 800 | 499 | 124 |
| | | | Andremba | 60 | 250 | 1000 | 358 | 300 | 76 | 300 | 1000 | 496 | 205 |
| | | | Ambatry | 96 | 300 | 883 | 450 | 421 | 96 | 325 | 1000 | 472 | 135 |
| | | | Efoetse | 24 | 280 | 450 | 366 | 350 | 24 | 400 | 700 | 500 | 155 |
| | Voanjobory (bambara groundnut) | MGA/kg | Marofijery/Ankilibory | 0 | | | | | 16 | 250 | 400 | 325 | 87 |
| | | | Itomboina | 36 | 200 | 350 | 256 | 200 | 40 | 400 | 1000 | 620 | 184 |
| | | | Andremba | 8 | 300 | 300 | 300 | 300 | 16 | 400 | 400 | 400 | 0 |
| | | | Ambatry | 68 | 250 | 475 | 362 | 350 | 64 | 400 | 600 | 484 | 66 |
| Bulb vegetables | Tongolo fotsy (garlic) | MGA/kg | Efoetse | 24 | 400 | 500 | 467 | 500 | 28 | 400 | 800 | 579 | 135 |
| | | MGA/kg | Marofijery/Ankilibory | 0 | | | | | 8 | 400 | 400 | 400 | 0 |
| | | MGA/kg | Itomboina | 16 | 250 | 300 | 275 | 275 | 8 | 200 | 200 | 200 | 0 |
| | | MGA/kg | Andremba | 28 | 200 | 350 | 257 | 250 | 4 | 400 | 400 | 400 | 0 |
| | Tongolo fotsy (garlic) | MGA/piece | Ambatry | 92 | 88 | 533 | 356 | 367 | 92 | 200 | 500 | 331 | 78 |
| | | | Efoetse | | | | | | 80 | 1900 | 4000 | 3025 | 515 |
| | | | Marofijery/Ankilibory | | | | | | 60 | 100 | 200 | 136 | 39 |
| | | | Itomboina | | | | | | 80 | 50 | 150 | 93 | 29 |
| | Tongolo fotsy (garlic) | MGA/piece | Andremba | | | | | | 24 | 44 | 100 | 76 | 25 |

| | | | | | | | | | | | | | |
|-------------------|----------------------|----------------------|-----------------------|-----|-----|------|-----|-----|-----|------|------|------|-----|
| | Tongolo (onion) | MGA/kg | Ambatry | | | | | | 72 | 600 | 2000 | 1109 | 438 |
| | | MGA/kg | Efoetse | | | | | | 92 | 650 | 2500 | 1274 | 482 |
| | | MGA/kg | Marofijery/Ankilibory | | | | | | 72 | 800 | 2000 | 1279 | 438 |
| | | MGA/tas | Itomboina | | | | | | 68 | 100 | 200 | 106 | 24 |
| | | MGA/tas | Andremba | | | | | | 44 | 100 | 200 | 161 | 44 |
| | | MGA/kg | Ambatry | | | | | | 68 | 400 | 717 | 524 | 95 |
| Fruits | Voasary (orange) | MGA/tas ² | Itomboina | | | | | | 16 | 200 | 200 | 200 | 0 |
| | | | Andremba | | | | | | 36 | 100 | 200 | 124 | 38 |
| | | | Ambatry | | | | | | 72 | 150 | 317 | 251 | 56 |
| | Akondro (banana) | MGA/tas | Ambatry | | | | | | 80 | 150 | 300 | 211 | 43 |
| | | | | | | | | | | | | | |
| Grains | Fresh corn | MGA/piece | Efoetse | | | | | | 16 | 100 | 100 | 100 | 0 |
| | | | Marofijery/Ankilibory | | | | | | 28 | 100 | 200 | 143 | 45 |
| | | | Itomboina | | | | | | 16 | 125 | 217 | 179 | 40 |
| | | | Andremba | | | | | | 12 | 100 | 150 | 125 | 25 |
| | | | Ambatry | | | | | | 64 | 75 | 300 | 187 | 84 |
| | Bajiry (millet) | MGA/kp | Efoetse | 44 | 225 | 400 | 281 | 275 | 28 | 200 | 250 | 240 | 19 |
| | | | Marofijery/Ankilibory | 24 | 250 | 250 | 250 | 250 | 48 | 200 | 400 | 288 | 60 |
| | | | Itomboina | 8 | 400 | 400 | 400 | 400 | 8 | 400 | 400 | 400 | 0 |
| | | | Andremba | 0 | | | | | | | | | |
| | | | Ambatry | 8 | 300 | 300 | 300 | 300 | | | | | |
| | Rice | MGA/kp | Efoetse | | | | | | 96 | 400 | 488 | 432 | 28 |
| | | | Marofijery/Ankilibory | | | | | | 92 | 400 | 450 | 430 | 23 |
| | | | Itomboina | | | | | | 96 | 390 | 450 | 417 | 23 |
| | | | Andremba | | | | | | 100 | 400 | 463 | 423 | 25 |
| | | | Ambatry | | | | | | 96 | 350 | 450 | 398 | 43 |
| | Ampemba (sorghum) | MGA/kp | Efoetse | | | | | | 16 | 220 | 223 | 222 | 2 |
| | | | Marofijery/Ankilibory | | | | | | 16 | 200 | 230 | 215 | 17 |
| | | | Ambatry | 12 | 300 | 1000 | 533 | 300 | 4 | 1000 | 1000 | 1000 | 0 |
| | Tsako (maize) | MGA/kp | Efoetse | 92 | 200 | 500 | 287 | 250 | 96 | 197 | 300 | 247 | 28 |
| | | | Marofijery/Ankilibory | 96 | 193 | 467 | 269 | 250 | 92 | 200 | 350 | 243 | 30 |
| | | | Itomboina | 100 | 177 | 290 | 217 | 210 | 96 | 175 | 342 | 241 | 49 |
| | | | Andremba | 100 | 167 | 350 | 220 | 217 | 100 | 170 | 450 | 238 | 63 |
| | | | Ambatry | 96 | 200 | 500 | 294 | 250 | 92 | 150 | 475 | 238 | 72 |
| Pumpkins & Melons | Voatavo (pumpkin) | MGA/piece | Itomboina | | | | | | 8 | 2000 | 2000 | 2000 | 0 |

| | | | | | | | | | | | | | |
|-------|-----------------------------------|-----------------------|-----|-----|------|------|------|----|-----|------|-----|-----|--|
| | | Ambatry | 8 | 400 | 400 | 400 | 400 | | | | | | |
| | Mody (pumpkin) | MGA/piece Efoetse | | | | | | 16 | 200 | 225 | 209 | 12 | |
| | | Marofijery/Ankilibory | | | | | | 28 | 100 | 400 | 175 | 114 | |
| | | Andremba | | | | | | 16 | 25 | 117 | 83 | 40 | |
| | | Ambatry | 44 | 100 | 475 | 243 | 300 | 80 | 25 | 200 | 135 | 41 | |
| | Taboara (pumpkin) | MGA/piece Efoetse | 28 | 525 | 1600 | 883 | 725 | 48 | 450 | 1367 | 860 | 312 | |
| | | Marofijery/Ankilibory | 32 | 800 | 1500 | 1267 | 1275 | 48 | 383 | 1000 | 669 | 193 | |
| | | Itomboina | 52 | 317 | 950 | 463 | 383 | 44 | 500 | 700 | 630 | 59 | |
| | | Andremba | 32 | 200 | 500 | 381 | 425 | 40 | 200 | 450 | 338 | 74 | |
| | | Ambatry | 80 | 283 | 750 | 449 | 400 | 92 | 250 | 675 | 356 | 124 | |
| | Voantango (sugar melon) | MGA/piece Efoetse | 16 | 250 | 300 | 275 | 275 | 36 | 400 | 1200 | 724 | 268 | |
| | | Marofijery/Ankilibory | 20 | 533 | 800 | 647 | 650 | 20 | 300 | 367 | 343 | 28 | |
| | | Itomboina | 32 | 208 | 583 | 403 | 446 | 32 | 150 | 513 | 321 | 161 | |
| | | Andremba | 20 | 500 | 800 | 625 | 600 | 24 | 233 | 500 | 318 | 104 | |
| | | Ambatry | 32 | 350 | 533 | 429 | 400 | 24 | 275 | 400 | 328 | 43 | |
| | Kiseny (sugar melon) | MGA/tas Efoetse | 0 | | | | | 16 | 200 | 200 | 200 | 0 | |
| | | Marofijery/Ankilibory | 16 | 100 | 100 | 100 | 100 | 28 | 100 | 200 | 157 | 45 | |
| | | Itomboina | 64 | 100 | 100 | 100 | 100 | 40 | 100 | 100 | 100 | 0 | |
| | | Andremba | 36 | 50 | 100 | 92 | 100 | 20 | 100 | 100 | 100 | 0 | |
| | | Ambatry | 32 | 100 | 200 | 125 | 100 | 56 | 100 | 100 | 100 | 0 | |
| | Vamanga/ Voazavo (water melon) | MGA/piece Efoetse | 24 | 383 | 500 | 442 | 446 | 36 | 200 | 1000 | 487 | 304 | |
| | | Marofijery/Ankilibory | 24 | 500 | 650 | 546 | 525 | 28 | 300 | 600 | 445 | 98 | |
| | | Itomboina | 32 | 167 | 450 | 315 | 333 | 32 | 200 | 250 | 225 | 27 | |
| | | Andremba | 16 | 350 | 400 | 375 | 375 | 24 | 233 | 400 | 314 | 72 | |
| | | Ambatry | 36 | 475 | 900 | 606 | 550 | 36 | 200 | 700 | 357 | 146 | |
| Roots | Balahazo (manioc dried) | MGA/kg Efoetse | 84 | 500 | 1000 | 738 | 700 | 72 | 600 | 950 | 838 | 86 | |
| | | Marofijery/Ankilibory | 80 | 650 | 900 | 749 | 738 | 72 | 767 | 1000 | 880 | 55 | |
| | | Itomboina | 100 | 493 | 1515 | 904 | 742 | 60 | 200 | 600 | 500 | 156 | |
| | | Andremba | 72 | 325 | 1515 | 740 | 606 | 80 | 200 | 600 | 315 | 160 | |
| | | Ambatry | 88 | 475 | 1515 | 1011 | 1009 | 96 | 100 | 600 | 383 | 179 | |
| | Balahazo (manioc fresh) | MGA/tas Efoetse | 16 | 606 | 700 | 651 | 649 | 8 | 400 | 400 | 400 | 0 | |
| | | Marofijery/Ankilibory | 28 | 500 | 1515 | 1030 | 1008 | 8 | 400 | 400 | 400 | 0 | |
| | | Itomboina | 60 | 500 | 1212 | 668 | 549 | 36 | 400 | 1000 | 500 | 212 | |
| | | Andremba | 8 | 303 | 303 | 303 | 303 | | | | | | |
| | | Ambatry | 96 | 303 | 1515 | 675 | 606 | 88 | 300 | 800 | 555 | 157 | |

| | | | | | | | | | | | | | |
|--------|----------------------------------|-----------|-----------------------|----|-----|------|-----|------|----|-----|------|-----|-----|
| Others | Bele (sweet potatoes) | MGA/tas | Efoetse | 24 | 400 | 1000 | 775 | 850 | 20 | 850 | 1000 | 947 | 62 |
| | | | Marofijery/Ankilibory | 48 | 400 | 1000 | 910 | 1000 | 36 | 400 | 1000 | 867 | 265 |
| | | | Itomboina | 64 | 300 | 1000 | 652 | 700 | 64 | 400 | 1500 | 840 | 342 |
| | | | Andremba | 64 | 267 | 725 | 426 | 400 | 56 | 300 | 400 | 375 | 38 |
| | | | Ambatry | 56 | 200 | 417 | 357 | 379 | 56 | 250 | 817 | 492 | 218 |
| | Kapiky (peanut dried) | MGA/kp | Efoetse | 60 | 183 | 200 | 198 | 200 | 36 | 100 | 200 | 169 | 43 |
| | | | Marofijery/Ankilibory | 84 | 150 | 200 | 186 | 200 | 48 | 150 | 200 | 172 | 20 |
| | | | Itomboina | 88 | 90 | 200 | 136 | 143 | 92 | 100 | 200 | 169 | 27 |
| | | | Andremba | 76 | 87 | 200 | 130 | 133 | 68 | 100 | 200 | 133 | 28 |
| | | | Ambatry | 64 | 100 | 325 | 219 | 267 | | | | | |
| | Kapiky (peanut fresh) | MGA/kp | Ambatry | | | | | | 64 | 125 | 300 | 213 | 68 |
| | Kapiky (peanut without shell) | MGA/kp | Efoetse | | | | | | 96 | 500 | 800 | 669 | 87 |
| | | | Marofijery/Ankilibory | | | | | | 84 | 500 | 700 | 616 | 88 |
| | | | Itomboina | | | | | | 80 | 600 | 800 | 752 | 74 |
| | | | Andremba | | | | | | 88 | 400 | 800 | 658 | 151 |
| | | | Ambatry | | | | | | 88 | 300 | 750 | 527 | 152 |
| | Fary (sugar cane) | MGA/piece | Efoetse | | | | | | 20 | 200 | 500 | 320 | 130 |
| | | | Marofijery/Ankilibory | | | | | | 20 | 100 | 100 | 100 | 0 |
| | | | Itomboina | | | | | | 36 | 100 | 600 | 494 | 170 |
| | | | Andremba | | | | | | 16 | 200 | 500 | 350 | 173 |
| | | | Ambatry | | | | | | 84 | 250 | 725 | 452 | 161 |
| | Sweet potato leaves | MGA/tas | Efoetse | | | | | | 8 | 100 | 100 | 100 | 0 |
| | | | Marofijery/Ankilibory | | | | | | 12 | 200 | 200 | 200 | 0 |
| | | | Itomboina | | | | | | 16 | 92 | 100 | 96 | 5 |
| | | | Ambatry | | | | | | 16 | 100 | 100 | 100 | 0 |
| | Voatabia (tomatoes) | MGA/tas | Efoetse | 28 | 100 | 250 | 167 | 150 | 36 | 100 | 200 | 139 | 49 |
| | | | Marofijery/Ankilibory | 32 | 100 | 200 | 150 | 150 | 40 | 100 | 200 | 170 | 48 |
| | | | Itomboina | 72 | 100 | 150 | 141 | 150 | 16 | 100 | 200 | 138 | 48 |
| | | | Andremba | 48 | 100 | 275 | 196 | 200 | 20 | 100 | 100 | 100 | 0 |
| | | | Ambatry | 76 | 200 | 333 | 225 | 200 | 92 | 100 | 300 | 186 | 57 |

Note: Prices in MGA, ¹: kp = kapoaka, a tin cup with content 0.39 l, ²: pile (tas): local unit with weight of approx. 0.66 kg

Price seasonality

Figure 2 shows the price development for lojy beans for all markets in the study area. The prices are lowest during the harvesting season in June/July and highest in the lean season in December/January. Similar patterns can be observed for other crops as well.

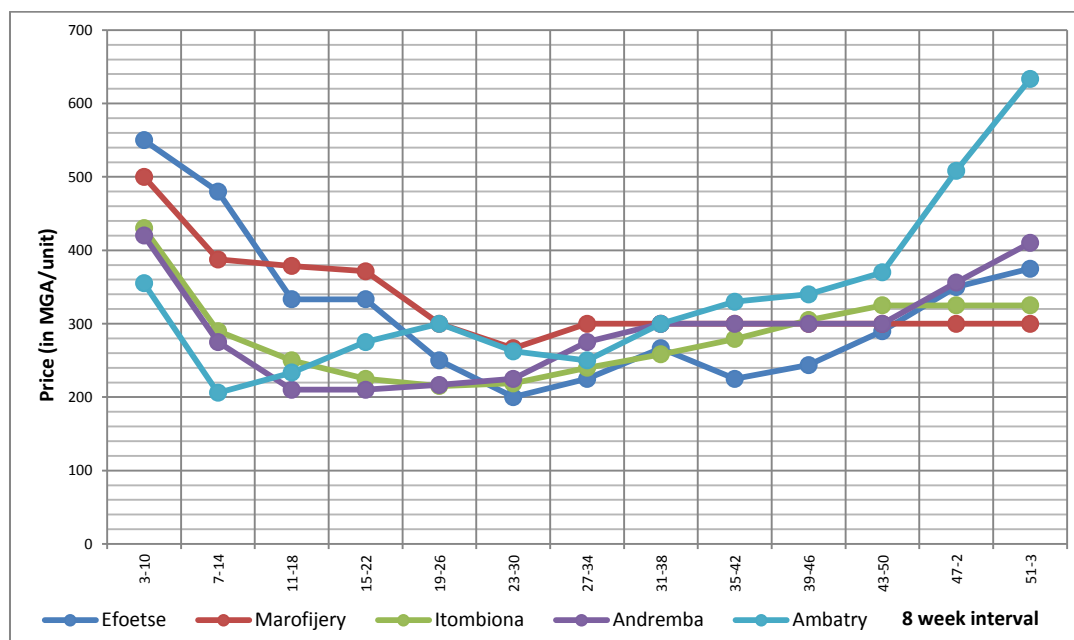


Figure 2 Seasonal price development for 1 kapoaka (0.39 l) of lojy beans in 2013

For a closer analysis, we compared price differences for the harvest and the two lean seasons for all crops for 2013 (table 3). For crops with a high number of observations, the Mann-Whitney test could be applied, confirming that there are differences between harvest and lean season prices for maize, lojy and antsamby beans. However, for maize the difference between harvest and lean season 1 is not significant, while also the samples for the two lean seasons for lojy beans differed.

For 2014, we compared price differences for the harvest and the two lean seasons for all crops (table 3) using the Kruskal-Wallis test. The results also confirmed that there are differences between harvest and lean season prices for maize, dried cassava, peanut without shell, bambara groundnut, cowpea and mungbeans. Prices for all these crops are lower in the harvest season compared to the lean seasons. However, this trend can also be seen for other crops, but is statistically not significant or the number of observations is too low.

Table 3 Seasonal price differences for agricultural crops in harvest and lean seasons in 2013 [in MGA/standard unit]

| Category | Crop | Harvest season | | | | Lean season 1 | | | | Lean season 2 | | | |
|-------------------|--------------------------------|----------------|-----|------|------------------|---------------|-----|------|------------------|---------------|------|------|------------------|
| | | Obs | Min | Max | Mean | Obs | Min | Max | Mean | Obs | Min | Max | Mean |
| Main crops | Maize | 26 | 150 | 350 | 233 (a) | 24 | 150 | 600 | 275 (a) | 24 | 200 | 550 | 335 (b) |
| | Cassava (dried) | 26 | 300 | 712 | 580 | 27 | 400 | 1515 | 704 | 19 | 700 | 1515 | 1187 |
| | Cassava (fresh) | 13 | 454 | 1515 | 879 | 6 | 303 | 606 | 556 | 5 | 1515 | 1515 | 1515 |
| | Sweet potatoes | 23 | 300 | 1000 | 574 | 0 | | | | 0 | | | |
| Beans | Bambara groundnut (voanjobory) | 2 | 225 | 225 | 225 | 6 | 88 | 500 | 244 | 9 | 400 | 600 | 500 |
| | Cowpea (lojy) | 30 | 150 | 400 | 285 (a) | 21 | 180 | 700 | 466 (b) | 21 | 300 | 800 | 395 (c) |
| | Hyacinth bean (antake) | 0 | | | | 1 | 300 | 300 | 300 | 15 | 200 | 400 | 273 |
| | Mungbean (antsamby) | 26 | 200 | 400 | 300 (a) | 17 | 300 | 1300 | 659 (b) | 11 | 500 | 1000 | 732 (b) |
| | Rice bean (antsambim-bazaha) | 6 | 200 | 350 | 272 | 1 | 400 | 400 | 400 | 0 | | | |
| Melons & Pumpkins | Voatavo | 0 | | | | 0 | | | | 0 | | | |
| | Mody | 0 | | | | 5 | 300 | 600 | 440 | 0 | | | |
| | Taboara | 24 | 200 | 1500 | 613 | 5 | 400 | 600 | 500 | 3 | 700 | 800 | 750 |
| | Voantango | 11 | 175 | 900 | 398 | 13 | 300 | 800 | 596 | 0 | | | |
| | Kiseny | 12 | 50 | 100 | 96 | 0 | | | | 0 | | | |
| | Vamanga(voazavo) | 9 | 150 | 500 | 297 | 14 | 300 | 800 | 489 | 5 | 500 | 1000 | 760 |
| Grains | Millet (bajiry) | 11 | 200 | 300 | 250 | 1 | 400 | 400 | 400 | 3 | 300 | 300 | 300 |
| | Peanut with shells | 28 | 60 | 200 | 135 | 6 | 100 | 200 | 133 | 5 | 150 | 200 | 180 |
| Others | Sorgum (Ampemba) | 0 | | | | 0 | | | | 2 | 1000 | 1000 | 1000 |
| | Tomatoes | 4 | 100 | 200 | 175 | 5 | 200 | 400 | 280 | 5 | 150 | 200 | 180 |

Note: prices in MGA; statistically tested distributions highlighted with fat letters; letters in brackets indicate groups significantly different at 5 % level, please see table 2 for units

Price differences between markets

As illustrated by figure 2 and table 5 there are price differences between the markets during the observation period. The visual interpretation of graphs shows that price differences are low between the two neighbouring markets Efoetse and Marofijery, which take also place on two subsequent days. Price information seems to penetrate also fairly well between Andremba and Itomboina, where travel distances are also relatively short, while the price development in Ambatry does not follow closely the pattern of the four local markets.

As shown in table 5, prices are lowest on the plateau markets Itomboina and Andremba for most products occurring at intermediate and high frequencies, while prices are especially high in the littoral region (Efoetse and Marofijery/Ankilibory) at the beginning of the observation period, and in Ambatry at the end of the observation period. The only exception to this pattern are prices for dried cassava, which are lowest and most stable throughout the observation period in the littoral region.

With Mann-Whitney tests (for data from 2013) and Kruskal-Wallis tests (for data from 2014), price differences between markets are found, although the statistically significant group memberships are influenced by large differences in variances between the price distributions, and the composition of groups was not stable across analysed crops.

Table 4 Seasonal price differences for agricultural crops in harvest and lean seasons in 2014 [in MGA/standard unit]

| Category | Crop | Harvest season | | | | Lean season 1 | | | | Lean season 2 | | | |
|------------|--------------------------------|----------------|-----|------|----------------|---------------|-----|------|----------------|---------------|-----|-----|----------------|
| | | Obs | Min | Max | Mean | Obs | Min | Max | Mean | Obs | Min | Max | Mean |
| Main crops | Maize | 30 | 150 | 300 | 210 (a) | 20 | 200 | 550 | 338 (b) | 19 | 150 | 350 | 267 (c) |
| | Cassava (dried) | 28 | 100 | 1000 | 434 (a) | 20 | 500 | 1000 | 688 (b) | 11 | 600 | 900 | 727 (b) |
| | Cassava (fresh) | 7 | 300 | 550 | 379 | 7 | 400 | 1000 | 529 | 1 | 750 | 750 | 750 |
| Beans | Cowpea (lojy) | 28 | 200 | 400 | 288 (a) | 20 | 200 | 800 | 453 (b) | 18 | 350 | 700 | 423 (b) |
| | Mungbean (antsamby) | 25 | 200 | 500 | 368 (a) | 10 | 300 | 1000 | 660 (b) | 13 | 500 | 800 | 680 (b) |
| | Bambara groundnut (voanjobory) | 4 | 200 | 250 | 225 (a) | 7 | 300 | 600 | 450 (b) | 1 | 350 | 350 | 350 |
| Melons & | Mody | 9 | 50 | 200 | 105 | 2 | 100 | 150 | 125 | 0 | | | |
| Pumpkins | Taboara | 19 | 200 | 2000 | 618 | 5 | 300 | 500 | 400 | 1 | 650 | 650 | 650 |
| | Voantango | 16 | 150 | 1000 | 384 | 5 | 300 | 1200 | 610 | 0 | | | |
| | Kiseny | 14 | 100 | 200 | 121 | 2 | 100 | 100 | 100 | 0 | | | |
| | Vamanga (voazavo) | 19 | 200 | 500 | 305 | 6 | 250 | 1000 | 525 | 0 | | | |
| Others | Kapiky (peanut dried) | 22 | 100 | 200 | 138 | 3 | 150 | 200 | 183 | 1 | 150 | 150 | 150 |
| | Kapiky (peanut without shell) | 20 | 300 | 800 | 527 (a) | 15 | 450 | 800 | 633 (a) | 15 | 600 | 800 | 743 (b) |
| | Tomatoes | 6 | 150 | 400 | 225 | 2 | 200 | 250 | 225 | 4 | 200 | 250 | 212 |

Note: prices in MGA; statistically tested distributions highlighted with fat letters; letters in brackets indicate groups significantly different at 5 % level, please see table 2 for units

Table 5 Availability and prices for agricultural crops based on weekly data in 2013 and 2014

| Category | Crop | Unit | Market | 2013 | | | 2014 | | | | | |
|----------|--------------------------------|----------------------|-----------------------|------------------|-----|------|----------------------|------------------|-----|------|--------------------|--------|
| | | | | Availability (%) | Min | Max | Mean | Availability (%) | Min | Max | Mean | StdDev |
| Beans | Tsaramaso (beans) | MGA/kp ¹ | Efoetse | | | | | 4 | 800 | 900 | 825 | 50 |
| | | | Marofijery/Ankilibory | | | | | 4 | 600 | 800 | 650 | 100 |
| | | | Ambatry | | | | | 18 | 500 | 800 | 658 | 129 |
| | Lojy (cowpea) | MGA/kp | Efoetse | 34 | 100 | 700 | 315 ^(a) | 32 | 200 | 600 | 350 | 105 |
| | | | Marofijery/Ankilibory | 33 | 200 | 500 | 341 ^(b) | 29 | 200 | 700 | 341 | 115 |
| | | | Itomboina | 34 | 175 | 500 | 290 ^(a) | 34 | 200 | 500 | 343 | 78 |
| | | | Andremba | 42 | 150 | 700 | 301 ^(a) | 44 | 200 | 500 | 311 | 87 |
| | | | Ambatry | 31 | 150 | 800 | 340 ^(a,b) | 30 | 200 | 800 | 336 | 136 |
| | Antake (hyacinth-bean) | MGA/kp | Efoetse | 6 | 100 | 300 | 267 | 2 | 300 | 300 | 300 | 0 |
| | | | Marofijery/Ankilibory | 8 | 200 | 300 | 250 | 9 | 200 | 300 | 261 | 33 |
| | | | Itomboina | 14 | 130 | 250 | 187 | 22 | 180 | 290 | 219 | 29 |
| | | | Andremba | 20 | 200 | 250 | 205 | 18 | 200 | 250 | 228 | 26 |
| | | | Ambatry | 15 | 200 | 500 | 343 | 14 | 250 | 500 | 354 | 82 |
| | Antsamby (mungbean) | MGA/kp | Efoetse | 19 | 300 | 1000 | 666 ^(a) | 17 | 200 | 800 | 356 ^(a) | 131 |
| | | | Marofijery/Ankilibory | 16 | 250 | 1300 | 491 ^(b,d) | 21 | 300 | 800 | 517 ^(b) | 140 |
| | | | Itomboina | 22 | 220 | 600 | 348 ^(b,c) | 21 | 300 | 800 | 520 ^(b) | 146 |
| | | | Andremba | 18 | 200 | 1000 | 344 ^(c) | 27 | 300 | 1000 | 476 | 192 |
| | | | Ambatry | 30 | 300 | 1000 | 485 ^(d) | 27 | 300 | 1000 | 469 | 130 |
| | Antsabim-bazaha (rice-bean) | MGA/kp | Efoetse | 4 | 280 | 450 | 358 | 4 | 400 | 700 | 550 | 173 |
| | | | Marofijery/Ankilibory | 0 | | | | 2 | 250 | 400 | 325 | 106 |
| | | | Itomboina | 5 | 200 | 350 | 250 | 7 | 400 | 1000 | 614 | 212 |
| | | | Andremba | 1 | 300 | 300 | 300 | 3 | 400 | 400 | 400 | 0 |
| | | | Ambatry | 15 | 250 | 500 | 370 | 15 | 400 | 600 | 477 | 62 |
| Fruits | Voasary (orange) | MGA/tas ² | Itomboina | | | | | 2 | 200 | 200 | 200 | 0 |
| | | | Andremba | | | | | 10 | 100 | 200 | 120 ^(b) | 42 |
| | | | Ambatry | | | | | 22 | 150 | 400 | 255 ^(a) | 72 |
| | Akondro (banana) | MGA/tas | Ambatry | | | | | 21 | 150 | 300 | 207 | 51 |
| Grains | Fresh corn | MGA/piece | Efoetse | | | | | 2 | 100 | 100 | 100 | 0 |
| | | | Marofijery/Ankilibory | | | | | 5 | 100 | 200 | 140 | 55 |
| | | | Itomboina | | | | | 5 | 100 | 250 | 180 | 57 |
| | | | Andremba | | | | | 4 | 100 | 200 | 125 | 50 |

| | | | | | | | | | | | | |
|-------------------|----------------------------|-----------|-----------------------|-----------|------------|------------|----------------------------|-----------|------------|-------------|--------------------------|------------|
| | | | Ambatry | | | | | 14 | 75 | 300 | 209 | 86 |
| | Bajiry (millet) | MGA/kp | Efoetse | 11 | 200 | 400 | 277 | 11 | 200 | 250 | 245 | 15 |
| | | | Marofijery/Ankilibory | 7 | 250 | 250 | 250 | 11 | 200 | 400 | 277 | 52 |
| | | | Itomboina | 1 | 400 | 400 | 400 | 1 | 400 | 400 | 400 | |
| | | | Andremba | 0 | | | | 0 | | | | |
| | | | Ambatry | 2 | 300 | 300 | 300 | 0 | | | | |
| | Rice | MGA/kp | Efoetse | | | | | 38 | 400 | 500 | 433^(b) | 31 |
| | | | Marofijery/Ankilibory | | | | | 32 | 400 | 450 | 431^(b) | 25 |
| | | | Itomboina | | | | | 35 | 380 | 450 | 420 | 25 |
| | | | Andremba | | | | | 44 | 400 | 500 | 424^(b) | 27 |
| | | | Ambatry | | | | | 30 | 350 | 450 | 396^(a) | 44 |
| | Ampemba (sorghum) | MGA/kp | Efoetse | | | | | 4 | 220 | 230 | 223 | 5 |
| | | | Marofijery/Ankilibory | | | | | 2 | 200 | 230 | 215 | 21 |
| | | | Ambatry | 4 | 300 | 1000 | 650 | 1 | 1000 | 1000 | 1000 | |
| | Tsako (maize) | MGA/kp | Efoetse | 33 | 180 | 500 | 292^(a) | 42 | 190 | 300 | 247 | 32 |
| | | | Marofijery/Ankilibory | 33 | 180 | 600 | 270^(a) | 33 | 200 | 350 | 242 | 31 |
| | | | Itomboina | 34 | 106 | 300 | 217^(b) | 35 | 150 | 350 | 245 | 56 |
| | | | Andremba | 40 | 150 | 500 | 235^(b,c) | 46 | 150 | 500 | 245 | 79 |
| | | | Ambatry | 31 | 180 | 600 | 307^(a) | 26 | 150 | 550 | 237 | 81 |
| Pumpkins & Melons | Voatavo (pumpkin) | MGA/piece | Itomboina | | | | | 1 | 2000 | 2000 | 2000 | |
| | | | Ambatry | 1 | 400 | 400 | 400 | | | | | |
| | Mody (pumpkin) | MGA/piece | Efoetse | | | | | 3 | 200 | 225 | 208 | 14 |
| | | | Marofijery/Ankilibory | | | | | 5 | 100 | 400 | 170 | 129 |
| | | | Andremba | | | | | 4 | 25 | 200 | 94 | 77 |
| | | | Ambatry | 11 | 100 | 600 | 318 | 25 | 25 | 300 | 136 | 68 |
| | Taboara (pumpkin) | MGA/piece | Efoetse | 7 | 450 | 1700 | 907 | 13 | 400 | 2000 | 908^(b) | 450 |
| | | | Marofijery/Ankilibory | 9 | 800 | 1500 | 1300 | 9 | 350 | 1000 | 606^(b) | 210 |
| | | | Itomboina | 13 | 200 | 950 | 435 | 11 | 300 | 1000 | 641^(b) | 169 |
| | | | Andremba | 7 | 200 | 500 | 386 | 15 | 200 | 500 | 347^(a) | 92 |
| | | | Ambatry | 22 | 200 | 800 | 457 | 28 | 250 | 700 | 339^(a) | 121 |
| | | | Efoetse | 2 | 250 | 300 | 275 | 10 | 400 | 1200 | 690 | 331 |
| | Voantango (sugar melon) | MGA/piece | Marofijery/Ankilibory | 5 | 300 | 900 | 620 | 6 | 300 | 400 | 350 | 55 |
| | | | Itomboina | 11 | 175 | 700 | 416 | 8 | 150 | 600 | 397 | 155 |
| | | | Andremba | 7 | 500 | 800 | 629 | 8 | 200 | 600 | 313 | 136 |
| | | | Ambatry | 9 | 300 | 600 | 450 | 6 | 250 | 400 | 317 | 52 |
| | | | Efoetse | 0 | | | | 3 | 200 | 200 | 200 | 0 |
| | Kiseny | MGA/tas | Efoetse | | | | | | | | | |

| | | | | | | | | | | | | |
|--------|-----------------------------------|-----------|-----------------------|----|-----|------|----------------------|----|-----|------|---------------------|-----|
| | (sugar melon) | | Marofijery/Ankilibory | 4 | 100 | 100 | 100 | 5 | 100 | 200 | 160 | 55 |
| | | | Itomboina | 17 | 100 | 100 | 100 | 10 | 100 | 100 | 100 | 0 |
| | | | Andremba | 10 | 50 | 100 | 95 | 6 | 100 | 100 | 100 | 0 |
| | | | Ambatry | 5 | 100 | 200 | 120 | 17 | 100 | 100 | 100 | 0 |
| | Vamanga/ Voazavo (water melon) | MGA/piece | Efoetse | 6 | 350 | 500 | 433 | 8 | 200 | 1000 | 431 | 249 |
| | | | Marofijery/Ankilibory | 7 | 400 | 800 | 550 | 8 | 300 | 600 | 450 ^(b) | 93 |
| | | | Itomboina | 11 | 150 | 550 | 325 | 6 | 200 | 250 | 225 ^(a) | 27 |
| | | | Andremba | 4 | 200 | 500 | 375 | 7 | 200 | 500 | 300 | 115 |
| | | | Ambatry | 13 | 400 | 1000 | 600 | 10 | 200 | 700 | 350 | 151 |
| Root | Balahazo (cassava dried) | MGA/kg | Efoetse | 34 | 500 | 1000 | 753 | 26 | 600 | 1000 | 858 ^(b) | 103 |
| | | | Marofijery/Ankilibory | 27 | 600 | 900 | 754 | 24 | 700 | 1000 | 871 ^(b) | 62 |
| | | | Itomboina | 33 | 380 | 1515 | 886 | 15 | 200 | 600 | 487 ^(a) | 181 |
| | | | Andremba | 32 | 300 | 1515 | 828 | 31 | 200 | 600 | 348 ^(a) | 186 |
| | | | Ambatry | 28 | 400 | 1515 | 929 | 29 | 100 | 600 | 355 ^(a) | 196 |
| | Balahazo (cassava fresh) | MGA/tas | Efoetse | 5 | 606 | 700 | 644 | 1 | 400 | 400 | 400 | |
| | | | Marofijery/Ankilibory | 6 | 500 | 1515 | 1025 | 1 | 400 | 400 | 400 | |
| | | | Itomboina | 15 | 378 | 1212 | 670 | 7 | 400 | 1000 | 486 | 227 |
| | | | Andremba | 1 | 303 | 303 | 303 | | | | | |
| | | | Ambatry | 33 | 303 | 1515 | 711 | 26 | 300 | 1000 | 552 | 182 |
| | Bele (sweet potatoes) | MGA/tas | Efoetse | | | | | 5 | 800 | 1000 | 940 ^(b) | 89 |
| | | | Marofijery/Ankilibory | | | | | 7 | 400 | 1000 | 914 ^(b) | 227 |
| | | | Itomboina | | | | | 16 | 400 | 2000 | 875 ^(b) | 412 |
| | | | Andremba | | | | | 21 | 200 | 400 | 376 ^(a) | 62 |
| | | | Ambatry | | | | | 17 | 250 | 1000 | 482 ^(a) | 254 |
| Others | Voanjobory (bambara groundnut) | MGA/kp | Efoetse | 5 | 400 | 500 | 480 | 7 | 400 | 800 | 557 | 181 |
| | | | Marofijery/Ankilibory | 0 | 0 | 0 | 0 | 1 | 400 | 400 | 400 | |
| | | | Itomboina | 2 | 250 | 300 | 275 | 1 | 200 | 200 | 200 | |
| | | | Andremba | 7 | 200 | 400 | 293 | 1 | 400 | 400 | 400 | |
| | | | Ambatry | 28 | 88 | 600 | 374 | 27 | 200 | 500 | 333 | 82 |
| | Kapiky (peanut dried) | MGA/kp | Efoetse | 16 | 150 | 200 | 197 ^(a) | 10 | 100 | 200 | 180 | 42 |
| | | | Marofijery/Ankilibory | 25 | 150 | 200 | 182 ^(a) | 16 | 150 | 200 | 172 | 26 |
| | | | Itomboina | 23 | 80 | 200 | 131 ^(b,c) | 25 | 100 | 200 | 173 | 29 |
| | | | Andremba | 24 | 60 | 200 | 125 ^(b) | 27 | 100 | 200 | 126 | 29 |
| | Kapiky (peanut fresh) | MGA/kp | Ambatry | 18 | 100 | 350 | 208 ^(a,c) | 18 | 100 | 300 | 208 | 71 |
| | Kapiky | MGA/kp | Efoetse | | | | | 30 | 500 | 800 | 653 ^(bd) | 93 |

| | | | | | | | | | | | | | | | | | |
|------------------------|-----------|--|--|--|--|--|--|--|--|--|--|-----------------------|----|-----|------|---------------------|-----|
| (peanut without shell) | | | | | | | | | | | | Marofijery/Ankilibory | 28 | 500 | 800 | 614 ^(d) | 97 |
| | | | | | | | | | | | | Itomboina | 25 | 600 | 800 | 752 ^(c) | 81 |
| | | | | | | | | | | | | Andremba | 36 | 400 | 800 | 656 ^(bd) | 158 |
| | | | | | | | | | | | | Ambatry | 27 | 300 | 750 | 531 ^(ad) | 154 |
| Fary (sugar cane) | MGA/piece | | | | | | | | | | | Efoetse | 3 | 200 | 500 | 333 | 153 |
| | | | | | | | | | | | | Marofijery/Ankilibory | 4 | 100 | 100 | 100 ^(b) | 0 |
| | | | | | | | | | | | | Itomboina | 8 | 100 | 600 | 525 ^(a) | 175 |
| | | | | | | | | | | | | Andremba | 2 | 200 | 500 | 350 | 212 |
| Sweet potato leaves | MGA/tas | | | | | | | | | | | Ambatry | 25 | 200 | 750 | 442 | 164 |
| | | | | | | | | | | | | Efoetse | 6 | 400 | 1000 | 700 | 1 |
| | | | | | | | | | | | | Marofijery/Ankilibory | 10 | 400 | 1000 | 931 | 3 |
| | | | | | | | | | | | | Itomboina | 20 | 300 | 1000 | 630 | 5 |
| | | | | | | | | | | | | Andremba | 24 | 100 | 1000 | 450 | |
| Voatabia (tomatoes) | MGA/tas | | | | | | | | | | | Ambatry | 16 | 200 | 450 | 359 | 3 |
| | | | | | | | | | | | | Efoetse | 10 | 100 | 300 | 170 (a,c) | 7 |
| | | | | | | | | | | | | Marofijery/Ankilibory | 7 | 100 | 200 | 143 (a,c) | 11 |
| | | | | | | | | | | | | Itomboina | 17 | 100 | 150 | 143 (a,c) | 4 |
| | | | | | | | | | | | | Andremba | 17 | 100 | 400 | 206 (a,b) | 4 |
| | | | | | | | | | | | | Ambatry | 19 | 200 | 400 | 232 (b) | 25 |
| | | | | | | | | | | | | | | | | | |

Note: Prices in MGA; statistically tested distributions highlighted with fat letters; letters in brackets indicate groups significantly different at 5 % level, please see table 2 for units)

Price shocks

Strong rises and declines are visible especially in lean season prices for several crops but not consistently in all markets. For example, there is a strong increase in lojy beans and maize prices in Efoetse between week 4 and 6, i.e. end of January 2013. Similar increases in maize prices are observed for Marofijery/Ankilibory, while the prices in Andremba and Itomboina remain relatively constant at that time. A similar pattern is visible in week 1 (beginning of January 2014) for lojy beans, maize and sorghum prices in Ambatry and in week 2 (January 2014) for lojy beans and maize prices in Andremba, while prices for maize and lojy beans remain relatively constant in Efoetse. There is also a strong increase in cowpea, mungbean and maize prices in Ambatry and for mungbeans and maize on Andremba market in January 2014. Similar increases are following in Efoetse for cowpea and on Itomboina market for mungbeans in February.

Thus, we can observe localised shocks for several products, which are most likely associated with rainfall. When the rain comes, people like to start sowing immediately on their fields, which increases strongly the demand for seeds. The explanation further substantiated since we observe this pattern only for crops which are sown as they are sold on the market. We do not observe increases in prices for cassava or melons and pumpkins, for which the relation between harvested parts and seeds is not direct.

Appraisal of results for 2013 by market monitors

The respondents confirmed the seasonal variations of availability and prices between harvest and lean seasons. In addition, differences in climatic conditions (especially occurrence of rainfall) lead to variations in sowing and harvesting periods and thus in comparative prices between markets. The respondents also traced seasonal fluctuations of prices to single events, e.g. traders from other villages visiting the market, or high prices on the central market in Toliara. While some price differences between markets corresponded to their experience (e.g. for lojy beans), others (e.g. price differences for cassava between Itomboina vs. Andremba and Itomboina vs. Efoetse/Marofijery/Ankilibory) were contrary to their personal observations.

Respondents also confirmed the occurrence of price shocks for maize and lojy beans after rainfall events. In addition, they named the supply of lojy beans and maize by the World Food Programme as an important cause for decreasing/not further rising prices in April 2013 and December 2013. We directly asked for the effect of a thunderstorm in April 2013 on prices: While in Efoetse, Marofijery, Itomboina and Andremba respondents could not remember any effect of this storm on prices, the respondent in Ambatry stated a strong effect.

Apart from explaining parts of the influences and shocks on prices, respondents confirmed the different demand and supply chains of the markets they are familiar with: While the markets in Efoetse and Marofijery/Ankilibory are visited by traders from Toliara and Itampolo, traders and farmers from Betioky and the Onilahy region frequent the markets on the plateau. The trade activities between the littoral zone and Itomboina are especially strong, but with apparently loose intensity in the lean seasons due to security problems (malaso).

Livestock products

Availability

Table 6 depicts the availability of different categories of goats and sheep as sums over the five markets as moving four week averages. The total number of recordings is slightly lower for sheep

than for goats. Recordings are highest among the female categories, however, for them also more categories were available. When leaving aside male kids, more recordings are available for castrated goats and sheep in comparison to billy-goats and rams. Among goats, vibine goats are most widely available, while castrated goats have the most recordings among the 2 year olds. Among sheep, most recordings occur for vantone sheep (1 year old) and tongaline sheep (4 months to 1 year). The sale recordings drop very much with higher age of the animals.

Regarding differences between the markets, most recordings were done in Ambatry and Marofijery/Ankilibory, while least animals are available in Andremba (the total number of recordings reaches only a quarter of the entries of other markets). Goats are available less frequently on the plateau, while for the other markets the availability of goats and sheep does not differ much. In addition, animals in age classes from six to eight years were not recorded on the plateau. For sheep, even the 5 year age class is completely missing.

Table 7 shows the availability of zebu in the different categories. Males are available as bulls, trained charrette-zebus (konda) or castrated males. From two year old zebus, most males are available as bulls, while the differences level out in the higher age categories. Males are recorded up to an age of 13 years, while females recorded in categories with up to 8 calves born. The age of these females can be up to 16 years. Among all categories of males, most recordings occur in the age class 2 years while young bulls are slightly more often available as sakany or temboay. Bulls can still be castrated at a young age and trained as charrette zebus; thus the distinction between categories in the young age classes is still flexible. Females are most often sold as temboay, sakany and tamana.

There are strong differences between the availability of zebus on the different markets. While Ambatry offers the most constant availability of zebus in total, only 11 and 2 recordings occurred in total in Andremba in 2013 and 2014, respectively.

Table 6 Availability of goats and sheep categories separated by gender

| Category | Category description | Goats | | | | | | Sheep | | | | | |
|-----------------------|---------------------------------|-------------|------------|------------|-------------|------------|------------|-------------|------------|------------|-------------|------------|------------|
| | | 2013 | | | 2014 | | | 2013 | | | 2014 | | |
| | | Castrated | Male | Female | Castrated | Male | Female | Castrated | Male | Female | Castrated | Male | Female |
| Female with kid | Female of any age with kid | | | 85 | - | - | 58 | | | 73 | - | - | 39 |
| Tohetse | Pregnant female | | | 52 | - | - | 56 | | | 59 | - | - | 41 |
| Betsiterake | Female with no parturition | | | 57 | - | - | 86 | | | 47 | - | - | 63 |
| Valoanake | 8 years | 16 | 4 | 4 | 15 | 7 | 28 | 4 | 0 | 0 | 7 | 4 | 23 |
| Fitoanake | 7 years | 25 | 20 | 18 | 21 | 11 | 17 | 25 | 26 | 12 | 14 | 14 | 19 |
| Eneanake | 6 years | 36 | 31 | 22 | 26 | 21 | 28 | 26 | 22 | 22 | 30 | 15 | 24 |
| Limianake | 5 years | 51 | 36 | 39 | 36 | 23 | 37 | 42 | 36 | 29 | 32 | 26 | 30 |
| Efatsanake | 4 years | 40 | 43 | 40 | 43 | 34 | 49 | 38 | 41 | 42 | 53 | 30 | 32 |
| Teloanake | 3 years | 74 | 47 | 56 | 62 | 50 | 54 | 52 | 39 | 38 | 57 | 45 | 46 |
| Roanake | 2 years | 80 | 45 | 51 | 82 | 57 | 56 | 56 | 45 | 53 | 66 | 63 | 44 |
| Raikanake | 1-2 years | 72 | 46 | 51 | 67 | 59 | 46 | 74 | 48 | 54 | 51 | 45 | 44 |
| Tamana | Female 1-2 years | | | 69 | - | - | 88 | | | 61 | - | - | 77 |
| Vantone | 1 year | 27 | 93 | 91 | 66 | 91 | 36 | 4 | 86 | 95 | 50 | 83 | 44 |
| Antonone | 8 months to 1 year and 6 months | | 30 | 19 | 40 | 33 | 43 | | 49 | 28 | 32 | 39 | 25 |
| Vibine | 6 months to 1 year and 2 months | | 100 | 100 | 70 | 91 | 95 | | 66 | 84 | 43 | 85 | 92 |
| Tongaline | 4 months to 1 year | | 92 | 88 | 58 | 79 | 72 | | 69 | 92 | 44 | 59 | 66 |
| Gorogan | 2-6 months | | 26 | 17 | 19 | 40 | 35 | | 19 | 26 | 13 | 28 | 39 |
| Solaloha | 3-9 months | | 58 | 49 | 9 | 42 | 31 | | 55 | 55 | 20 | 39 | 27 |
| Malita | New born to 3 months | | 12 | 5 | 2 | 6 | 4 | | 3 | 5 | 0 | 5 | 4 |
| Total category | | 421 | 683 | 913 | 601 | 637 | 919 | 321 | 604 | 875 | 505 | 576 | 779 |
| Total animal | | 2017 | | | 2157 | | | 1800 | | | 1860 | | |

Notes: Figures are sums over 5 markets from moving four week averages; 125 recordings would represent full availability on all five markets)

Table 7 Availability of zebu categories in 2014 separated by gender

| Category | Category description | 2013 | | | | 2014 | | | |
|--------------------------|---------------------------------|--------------|------------|------------|--------|--------------|------------|------------|------------|
| | | Male (bulls) | Konda | Castrated | Female | Male (bulls) | Konda | Castrated | Female |
| Female with kid | Female of any age with kid | | | | 30 | - | - | - | 17 |
| Tohetse | Pregnant female | | | | 28 | - | - | - | 22 |
| Betsiterake | Female with no parturition | | | | 57 | - | - | - | 44 |
| Renen'aombe valoanake | 8 parturitions | | | | | - | - | - | 3 |
| Renen'aombe fitoanake | 7 parturitions | | | | 21 | - | - | - | 5 |
| Renen'aombe enenake | 6 parturitions | | | | 19 | - | - | - | 9 |
| Renen'aombe limianake | 5 parturitions | | | | 23 | - | - | - | 16 |
| Renen'aombe efatsanake | 4 parturitions | | | | 37 | - | - | - | 20 |
| Renen'aombe teloanake | 3 parturitions | | | | 29 | - | - | - | 18 |
| Renen'aombe roanake | 2 parturitions | | | | 31 | - | - | - | 32 |
| Renen'aombe raikanake | 1 parturition | | | | 27 | - | - | - | 13 |
| Tamana | 1-2 years, good body condition | | | | 72 | - | - | - | 69 |
| Foloteloamby ay | 13 years | 6 | 10 | 7 | | 0 | 5 | 0 | - |
| Foloroamby ay | 12 years | 6 | 12 | 9 | | 3 | 7 | 8 | - |
| Foloraikamby ay | 11 years | 8 | 14 | 14 | | 5 | 12 | 18 | - |
| Foloay | 10 years | 18 | 22 | 18 | | 10 | 11 | 13 | - |
| Siviay | 9 years | 21 | 13 | 16 | | 13 | 10 | 14 | - |
| Valoay | 8 years | 18 | 28 | 23 | | 12 | 15 | 15 | - |
| Fitoay | 7 years | 21 | 29 | 31 | | 15 | 16 | 16 | - |
| Enenay | 6 years | 23 | 28 | 24 | | 17 | 23 | 18 | - |
| Limiaay | 5 years | 23 | 36 | 34 | | 18 | 25 | 21 | - |
| Efatsay | 4 years | 36 | 37 | 35 | | 22 | 32 | 37 | - |
| Teloay | 3 years | 62 | 51 | 43 | 32 | 47 | 46 | 45 | 30 |
| Roay | 2 years | 70 | 53 | 49 | 52 | 40 | 60 | 36 | 52 |
| Sakany | 1 year and 6-11 months | 71 | 41 | 21 | 73 | 59 | 38 | 42 | 51 |
| Temboay | 1 year and 0-6 months | 79 | 28 | 23 | 78 | 63 | 51 | 52 | 66 |
| Raiay | 1 year | 0 | 2 | 4 | | - | - | 13 | - |
| Drotsy | | | | | | 17 | 17 | 10 | 19 |
| Gorogan | 7 months to 1 year and 3 months | 51 | 3 | 12 | 42 | 36 | 9 | 16 | 17 |
| Solaloha | 5 months to 1 year | 28 | 1 | 4 | 11 | 20 | 10 | 10 | 4 |
| Malita | New born up to 4 months | 11 | 0 | 0 | 9 | 2 | 1 | 0 | 4 |
| Total in category | | 552 | 408 | 367 | | 399 | 388 | 384 | 243 |

Notes: figures represent sums over 5 markets from moving four weeks averages; 125 recordings would represent full availability on all five markets

Price according to age class

The fine recording of age classes for different animals allows a comparison of prices between different animal categories. Figure 3 shows the price development through the age classes for male and female sheep for the five different markets. Prices for male sheep range from 10,000 MGA for small gorogan sheep up to 70,000 MGA for 8 year olds. A nearly linear increase in prices is visible with increasing age, while there is no drop in price for comparably old sheep. Similar developments (sometimes with increasing variation of data in the higher age classes) are visible for male goats and zebu as well. The price for females ranges from 10,000 MGA to 90,000 MGA, whereas older age classes in Ambatry are responsible for the maximum range. An increase in prices is visible at young age classes of females up to tamana and stabilizing in older age classes. Similar tendencies are visible for other female goats and zebu as well.

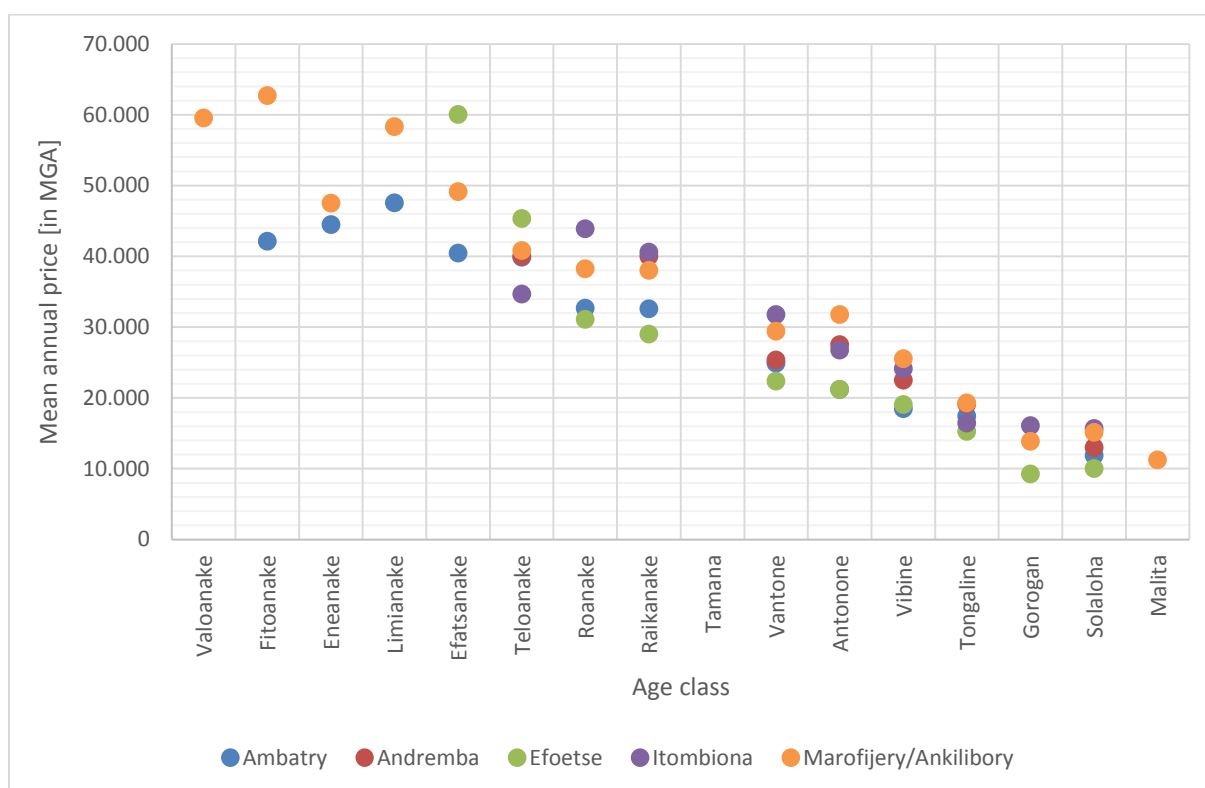


Figure 3 Annual mean prices for male sheep in 2014 according to age categories (youngest age categories at the right side)

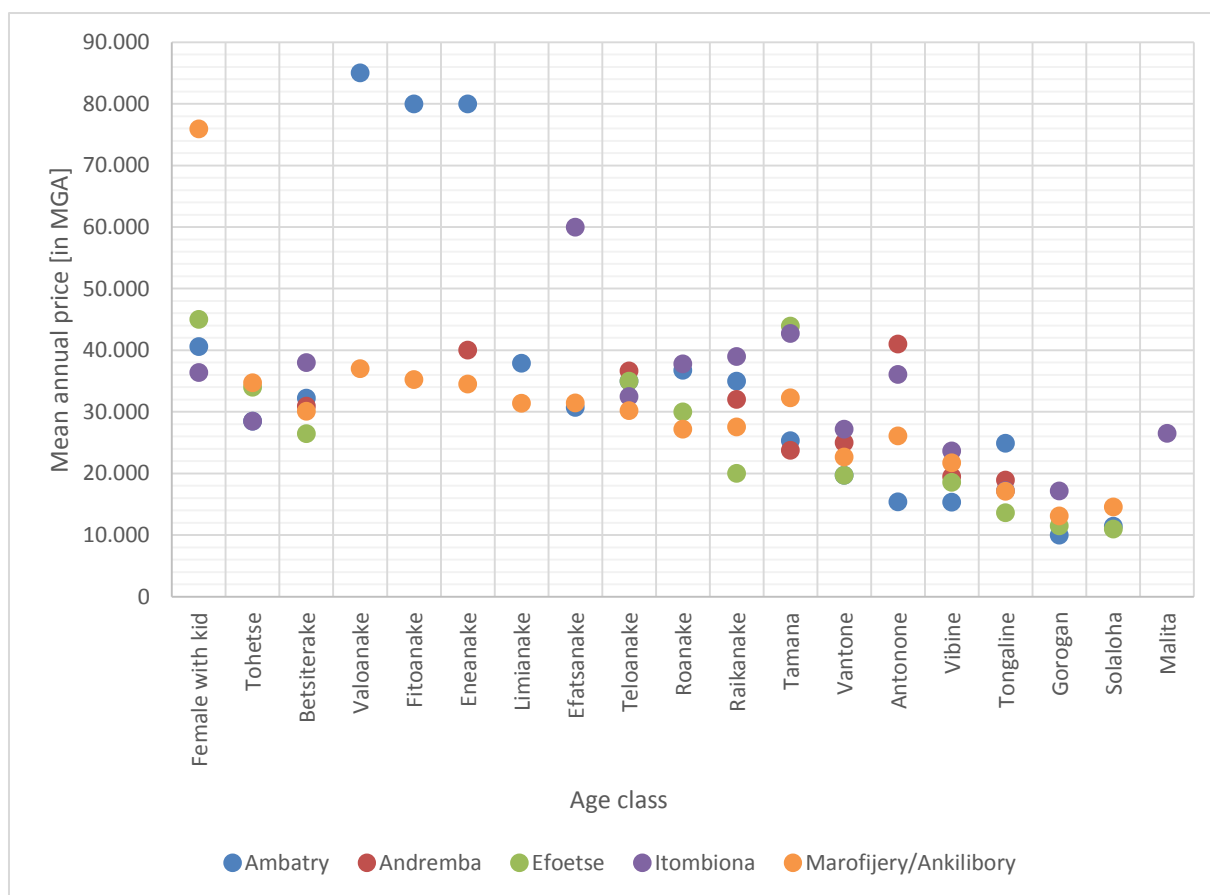


Figure 4 Annual mean prices for female sheep in 2014 according to age categories (youngest age categories at the right side)

Price seasonality

Seasonal price differences for live animals are not as pronounced as for crops. While a slight trend to higher prices in July/August is visible for goats and sheep, seasonal price differences for zebus are nearly absent in the graphs. The diagrams in figure 5 and 6 show the development for female sheep (Vibine) and female zebu (Tamana) in 2014 (see more diagrams in file 'DiaLiveStock_Price_Development_20160214'). Prices tend to be higher between week 30 and 45 for female sheep, but the trend cannot be seen for other livestock categories. That prices tend to be higher in the harvest season, which can be explained with increased demand due to the upcoming festivities and investments of earnings from harvest sales. The tendency is especially visible for Efoetse, Marofijery/Ankilibory and Itombiona, while the trend is not equally clear for Ambatry. The development for the female zebu does not show this trend. Low observation numbers further complicate the analysis for most livestock categories.

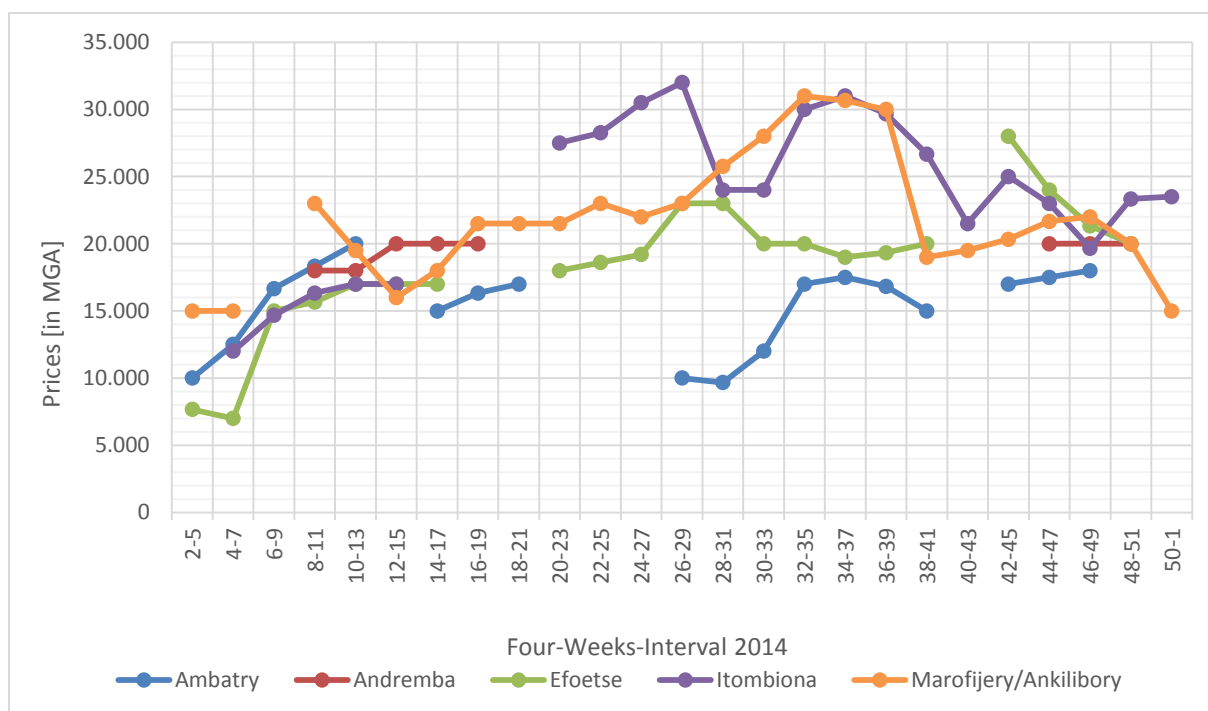


Figure 5 Seasonal price development for female sheep (Vibine) in 2014

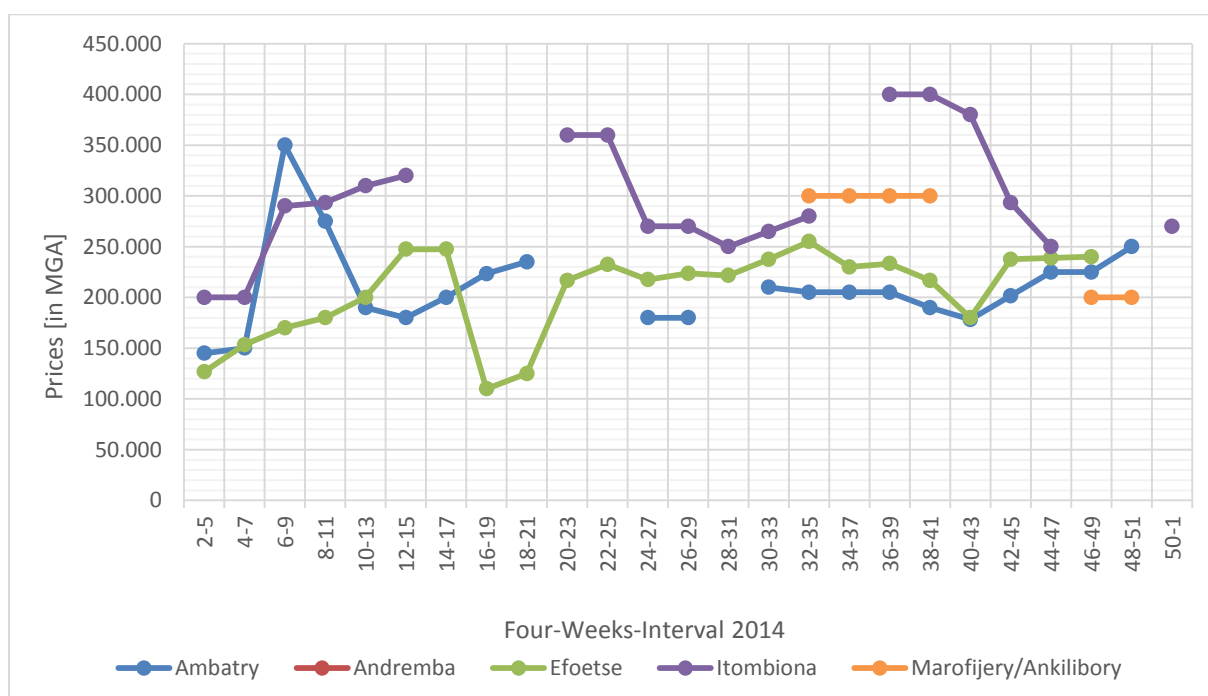


Figure 6 Seasonal price development for female zebu (Tamana) in 2014

Price differences between the markets

The five monitored markets differ in the availability of live animals, as well as in prices. Most recordings for nearly all categories of livestock were done in Ambatry, while far least recordings are available for Andremba. Mean prices for most livestock categories are highest in Ambatry for castrated, female and konda zebus in the older age categories, although other markets have less comparable observations. Male zebus are more expensive in Efoetse for older age classes. Younger livestock categories showed same mean price development. In general, price development for zebu

seems linear with higher prices for older ages. Goats and sheep show a similar linear trend, but without a clear distinction between the markets. Castrated goats and sheep as well as female sheep seem to be more expensive in Ambatry.

We did not apply statistical tests to evaluate differences between markets since values are relatively close and it is unlikely to find systematic differences over several livestock categories.

Appraisal of results of 2013 by market monitors

As for the crops, market monitors or other key persons in the market villages were asked for their thoughts on diagrams with monitored data. Besides seasonal developments, we discussed diagrams displaying the price development over age classes similar to figure 3 and 4.

Regarding seasonality, all respondents confirmed that prices for goats and sheep are higher in the harvest season as people sell their harvest and invest the cash in small stock. In addition, at that time animals are slaughtered in social events. Harvest failure (*kere*) corresponds with very low prices of animals. For the respondents, it was understandable that zebus do not show the strong fluctuations since most people do not earn enough cash with their harvest to invest directly in zebus. “Collecting” zebus for social events is a longer-term project.

Regarding the price developments over age classes, respondents emphasised that body condition does influence the price more strongly than age. For female animals, they confirmed that tamana achieve particularly high prices since this animal category is defined by good body condition. The steady rise of prices over age classes for male animals was not confirmed, but rather body condition (fatness) said to be the main determinant. Apart from body condition and age, the price for zebus is positively influenced by colour (particularly red) and big horns. Big horns seem to play a larger role among the Mahafaly ethnic group around Ambatry.

The respondents saw differences between the markets particularly regarding the availability of animals. Itomboina is well known in the study region as a livestock market since buyers come from the Onilahy region. It was confirmed that the livestock market in Andremba is not very lively. Apparently, livestock resellers (“patrons”) coming from outside the region to the local markets are potent livestock buyers especially in the lean season period and influence the livestock prices positively by their presence.

Prices for milk and meat

Besides live animals, milk and meat are sold on the monitored markets. Table 8 depicts summary statistics of milk and meat prices. For 2013, the price for zebu and goat milk ranges from 100 to 300 MGA, but has a stable mean and median around 200 MGA. For 2014, the price for zebu and goat milk ranges from 150 to 450 MGA, thus is slightly higher than in 2013. Sheep milk occurred only three times on the market in Itomboina in 2013, but is otherwise taboo to be consumed among the Mahafaly and Tanalana ethnic groups.

Sheep, goat and zebu meat are sold by butchers on the markets with goat meat occurring most frequently. Sheep meat occurred in Ambatry as often as goat meat, but only seldom on the markets of Itomboina and Andremba, respectively. This can be explained with the less widespread distribution of sheep on the plateau. In the littoral region, sheep meat occurred less often in comparison to goat meat. The meat prices are nearly the same for all livestock types and range between 2,000 and 6,000 MGA per kg for all markets.

Table 8 Availability and prices for milk and meat on the monitored markets in 2014

| Item | Market | Unit | N | Min | Max | 2013 | | N | Min | Max | 2014 | |
|---------------|-----------------------|------------------------|----|-------|-------|--------------|--------|----|-------|-------|-------|---------|
| | | | | | | Mean | Median | | | | Mean | Std.Dev |
| Meat of goat | Efoetse | MGA/kg | 34 | 3,500 | 4,500 | 4,000 | 4,000 | 20 | 4,000 | 4,000 | 4,000 | |
| | Marofijery/Ankilibory | MGA/kg | 29 | 3,000 | 4,000 | 3,793 | 4,000 | 28 | 3,000 | 4,000 | 3,832 | 272 |
| | Itomboina | MGA/kg | 33 | 2,500 | 6,000 | 5,273 | 5,500 | 20 | 4,500 | 5,000 | 4,975 | 112 |
| | Andremba | MGA/piece ¹ | 25 | | | ¹ | | 19 | | | | |
| | Ambatry | MGA/kg | 33 | 3,000 | 6,000 | 4,961 | 5,000 | 22 | 3,000 | 5,000 | 4,159 | 473 |
| Meat of sheep | Efoetse | MGA/kg | 16 | 4,000 | 4,000 | 4,000 | 4,000 | 3 | 4,000 | 4,000 | 4,000 | |
| | Marofijery/Ankilibory | MGA/kg | 4 | 3,000 | 4,000 | 3,625 | 3,750 | 3 | 2,500 | 3,500 | 3,167 | 577 |
| | Itomboina | MGA/kg | 1 | 4,000 | 4,000 | 4,000 | 4,000 | 2 | 5,000 | 5,000 | 5,000 | |
| | Andremba | MGA/piece ¹ | | | | | | 1 | | | | |
| | Ambatry | MGA/kg | 31 | 3,000 | 6,000 | 4,952 | 5,000 | 22 | 3,000 | 5,000 | 4,023 | 326 |
| Meat of zebu | Efoetse | MGA/kg | 25 | 3,000 | 4,000 | 3,700 | 4,000 | 21 | 4,000 | 4,000 | 4,000 | |
| | Marofijery/Ankilibory | MGA/kg | 8 | 2,800 | 4,000 | 3,725 | 4,000 | 6 | 3,500 | 4,000 | 3,917 | 204 |
| | Itomboina | MGA/kg | 22 | 2,000 | 4,000 | 3,177 | 3,500 | 14 | 2,500 | 3,600 | 3,050 | 268 |
| | Andremba | MGA/piece ¹ | 2 | 2,000 | 2,000 | 2,000 | 2,000 | 2 | | | | |
| | Ambatry | MGA/kg | 31 | 4,000 | 6,000 | 4,468 | 4,000 | 20 | 4,000 | 4,500 | 4,100 | 205 |
| Milk of goats | Efoetse | MGA/kp | 37 | 200 | 300 | 218 | 200 | 28 | 200 | 300 | 225 | 44 |
| | Marofijery/Ankilibory | MGA/kp | 23 | 100 | 200 | 191 | 200 | 30 | 200 | 300 | 210 | 31 |
| | Itomboina | MGA/kp | 18 | 100 | 600 | 228 | 200 | 13 | 200 | 200 | 200 | 0 |
| | Andremba | MGA/kp | 14 | 100 | 200 | 157 | 200 | 16 | 150 | 200 | 175 | 26 |
| | Ambatry | MGA/kp | 4 | 133 | 166 | 158 | 166 | 0 | | | | |
| Milk of sheep | Efoetse | MGA/kp | 0 | | | | | 0 | | | | |
| | Marofijery/Ankilibory | MGA/kp | 0 | | | | | 0 | | | | |
| | Itomboina | MGA/kp | 3 | 150 | 200 | 183 | 200 | 0 | | | | |
| | Andremba | MGA/kp | 0 | | | | | 0 | | | | |
| | Ambatry | MGA/kp | 0 | | | | | 0 | | | | |
| Milk of zebu | Efoetse | MGA/kp | 10 | 200 | 200 | 200 | 200 | 5 | 200 | 200 | 200 | 0 |
| | Marofijery/Ankilibory | MGA/kp | 6 | 200 | 200 | 200 | 200 | 0 | | | | |
| | Itomboina | MGA/kp | 10 | 150 | 200 | 160 | 150 | 11 | 150 | 200 | 195 | 15 |
| | Andremba | MGA/kp | 16 | 100 | 200 | 163 | 150 | 16 | 150 | 200 | 169 | 25 |
| | Ambatry | MGA/kp | 15 | 200 | 350 | 257 | 250 | 20 | 150 | 450 | 334 | 88 |

¹ Statistics not calculated as conversion of diverse units not possible

Alimentary plants

For inhabitants of the Mahafaly Plateau region, alimentary plants are an important supplement of the diet. While some fruits enhance the daily food supply during their availability, especially tubers are an inferior substitute for cassava and rice during the lean season.

Availability

A list of 43 alimentary plants derived from the Household Baseline Survey data was proposed for monitoring of prices. However, only some of them actually occurred on the markets during the observation period 2013 (21) and again in 2014 (19). Furthermore, many of them are traded infrequently and only on one or two markets. Thus, for the other alimentary plants, we can assume that they are not traded regularly on the markets and that nearly no market prices exist. Table 9 depicts availability and prices of alimentary plants on the monitored markets.

Among the most frequently occurring alimentary plants are baboky (yam), kily (tamarind fruits), lamonty, manga (mangoes), ovy ala (yam) and tsinefo fruits. For 2013, the widest range of products is offered in Ambatry, followed by Marofijery/Ankilibory, while least alimentary plants are recorded for the market in Efoetse. For 2014, the widest range of products is offered in Itomboina (14 observations), followed by Ambatry and Andremba (11, respectively), Marofijery/Ankilibory (9), while least alimentary plants are recorded for the market in Efoetse (5). While some fruits like mangoes, the fruits of raketa (*Opuntia* spp.) and tsinefo are clearly available only seasonally, other fruits (e.g. tamarind fruits) and tubers (e.g. yam species, e.g. baboky, ovy ala) are offered on the markets all year round.

Table 9 Availability and prices of alimentary plants on the monitored markets

| Plant | Market | Unit | 2013 | | | | | 2014 | | | | |
|---------------|-----------------------|-----------|------|-----|-----|------|--------|------|-----|-----|------|----------|
| | | | Obs. | Min | Max | Mean | Median | Obs. | Min | Max | Mean | Std.Dev. |
| Angily | Itomboina | MGA/piece | | | | | | 2 | 200 | 200 | 200 | 0 |
| Baboky | Ambatry | MGA/piece | 24 | 100 | 400 | 208 | 200 | 25 | 150 | 300 | 202 | 44 |
| | Andremba | | 1 | 100 | 100 | 100 | 100 | | | | | |
| | Itomboina | | 25 | 100 | 250 | 158 | 150 | 21 | 100 | 200 | 171 | 46 |
| | Marofijery/Ankilibory | | 1 | 200 | 200 | 200 | 200 | | | | | |
| Felempasy | Andremba | MGA/kp | 1 | 150 | 150 | 150 | 150 | | | | | |
| | Marofijery/Ankilibory | | 1 | 150 | 150 | 150 | 150 | | | | | |
| Giseny | Ambatry | MGA/piece | 3 | 200 | 250 | 217 | 200 | | | | | |
| Guava (goavy) | Ambatry | MGA/tas | 20 | 100 | 250 | 160 | 200 | 15 | 100 | 200 | 143 | 37 |
| Katro | Andremba | MGA/tas | | | | | | 1 | 100 | 100 | 100 | 0 |
| Kily | Ambatry | MGA/kg | 20 | 100 | 400 | 177 | 175 | 13 | 100 | 175 | 125 | 35 |
| | Andremba | | | | | | | 3 | 100 | 100 | 100 | 0 |
| | Itomboina | | 26 | 50 | 200 | 138 | 150 | 17 | 100 | 200 | 158 | 24 |
| Kiseny | Ambatry | MGA/tas | 3 | 100 | 100 | 100 | 100 | 12 | 100 | 100 | 100 | 0 |
| | Andremba | | 8 | 50 | 100 | 94 | 100 | 4 | 100 | 100 | 100 | 0 |
| | Itomboina | | 2 | 100 | 100 | 100 | 100 | 9 | 100 | 100 | 100 | 0 |
| | Marofijery/Ankilibory | | | | | | | 3 | 100 | 200 | 167 | 58 |
| Lalangy | Marofijery/Ankilibory | MGA/kp | 4 | 20 | 200 | 130 | 150 | | | | | |
| Lamonty | Ambatry | MGA/kp | 16 | 50 | 200 | 116 | 100 | 14 | 50 | 100 | 96 | 13 |

| | | | | | | | | | | | | |
|--------------|-----------------------|-----------|----|-----|-----|-----|-----|----|-----|-----|-----|-----|
| | Andremba | | | | | | | 3 | 50 | 50 | 50 | 0 |
| | Efoetse | | | | | | | 2 | 100 | 200 | 150 | 71 |
| | Itomboina | | | | | | | 15 | 50 | 100 | 59 | 18 |
| | Marofijery/Ankilibory | | | | | | | 12 | 100 | 200 | 158 | 42 |
| Langolora | Andremba | MGA/kp | 1 | 50 | 50 | 50 | 50 | | | | | |
| Manga | Ambatry | MGA/tas | 11 | 100 | 200 | 136 | 100 | 7 | 100 | 100 | 100 | 0 |
| | Andremba | | | | | | | 8 | 100 | 200 | 138 | 52 |
| | Efoetse | | | | | | | 3 | 200 | 200 | 200 | 0 |
| | Itomboina | | | | | | | 13 | 100 | 200 | 138 | 51 |
| | Marofijery/Ankilibory | | | | | | | 9 | 200 | 200 | 200 | 0 |
| Moky | Efoetse | MGA/piece | | | | | | 2 | 100 | 200 | 150 | 71 |
| | Marofijery/Ankilibory | | | | | | | 3 | 100 | 100 | 100 | 0 |
| Notsoke mena | Andremba | MGA/tas | | | | | | 3 | 100 | 100 | 100 | 0 |
| | Itomboina | | | | | | | 2 | 100 | 100 | 100 | 0 |
| Ovy ala | Andremba | MGA/piece | 13 | 200 | 200 | 200 | 200 | 2 | 200 | 200 | 200 | 0 |
| | Itomboina | | 30 | 150 | 300 | 197 | 200 | 21 | 100 | 300 | 226 | 56 |
| Paky | Itomboina | MGA/kp | | | | | | 10 | 400 | 400 | 400 | 0 |
| Raketa | Ambatry | MGA/tas | 6 | 50 | 100 | 92 | 100 | 4 | 100 | 100 | 100 | 0 |
| | Andremba | | 5 | 50 | 100 | 90 | 100 | 1 | 100 | 100 | 100 | 0 |
| | Efoetse | | 7 | 100 | 200 | 129 | 100 | | | | | |
| | Itomboina | | | | | | | 5 | 100 | 100 | 100 | 0 |
| | Marofijery/Ankilibory | | 3 | 100 | 200 | 133 | 100 | 5 | 100 | 100 | 100 | 0 |
| Sakoa | Ambatry | MGA/kp | 9 | 250 | 400 | 328 | 300 | 21 | 300 | 800 | 483 | 153 |
| | Andremba | | | | | | | 2 | 400 | 400 | 400 | 0 |
| | Itomboina | | 11 | 400 | 450 | 405 | 400 | 9 | 200 | 400 | 378 | 67 |
| Samangy | Marofijery/Ankilibory | MGA/kp | 2 | 100 | 100 | 100 | 100 | | | | | |
| Sele | Ambatry | MGA/kp | | | | | | 10 | 100 | 100 | 100 | 0 |
| | Itomboina | | 8 | 100 | 100 | 100 | 100 | 2 | 100 | 100 | 100 | 0 |
| | Marofijery/Ankilibory | | | | | | | 3 | 200 | 200 | 200 | 0 |
| Selempasy | Ambatry | MGA/kp | 2 | 150 | 200 | 175 | 175 | | | | | |
| | Andremba | | 1 | 100 | 100 | 100 | 100 | 3 | 100 | 100 | 100 | 0 |
| | Efoetse | | | | | | | 1 | 100 | 100 | 100 | 0 |
| | Marofijery/Ankilibory | | 1 | 200 | 200 | 200 | 200 | 8 | 150 | 200 | 175 | 27 |
| Tsinefo | Ambatry | MGA/kp | 10 | 100 | 100 | 100 | 100 | 17 | 100 | 100 | 100 | 0 |
| | Andremba | | 5 | 50 | 100 | 70 | 50 | 3 | 50 | 50 | 50 | 0 |
| | Efoetse | | 8 | 100 | 100 | 100 | 100 | | | | | |
| | Itomboina | | 19 | 20 | 50 | 36 | 30 | 11 | 10 | 100 | 42 | 31 |
| | Marofijery/Ankilibory | | 6 | 100 | 200 | 117 | 100 | 19 | 100 | 200 | 118 | 38 |
| Tsingilo | Efoetse | MGA/kp | 4 | 100 | 100 | 100 | 100 | | | | | |
| | Marofijery/Ankilibory | | 2 | 100 | 100 | 100 | 100 | | | | | |
| Tsotsoky | Ambatry | MGA/piece | | | | | | 1 | 20 | 20 | 20 | 0 |
| | Efoetse | | 1 | 100 | 100 | 100 | 100 | 10 | 40 | 100 | 94 | 19 |
| | Itomboina | | 2 | 50 | 100 | 75 | 75 | 4 | 50 | 100 | 88 | 25 |
| | Marofijery/Ankilibory | | 2 | 100 | 100 | 100 | 100 | | | | | |
| Velay | Ambatry | MGA/piece | 2 | 150 | 200 | 175 | 175 | | | | | |
| Voatany | Marofijery/Ankilibory | MGA/piece | 2 | 100 | 150 | 125 | 125 | 5 | 100 | 200 | 130 | 45 |

Price seasonality

As noted above, especially fruits are only seasonally available on the markets. For the products occurring regularly on the market, seasonal differences in prices might be caused by (1) seasonally changing quality and available quantities of the product or by (2) seasonally changing demands and willingness to pay for the product from consumers. However, price seasonality is hard to corroborate, since effects may differ between products and only in few cases data for two or more markets are available (see diagrams in file 'Dia_AlimCrops_20160207'). For example, prices for baboky in Ambatry rose at the beginning of 2013 to 300-400 MGA/piece and at the beginning of 2014 to 250-300 MGA/piece while they were lower (100-150 MGA/piece) in July-October. However, similar data from Itomboina did not show any systematic price changes. The data for Tsinefo shows high prices before week 25 (100-200 MGA/kg) and then prices suddenly decreasing on markets in Marofijery/Ankilibory and Itomboina (25-100 MGA/kg) in 2014. Contrary, prices in Ambatry are not changing over the year. These patterns mirror more or less the crop price dynamics.

For tamarind fruits (kily), prices in Ambatry are highest in September-December (approx. 200 MGA/kg) compared to 120-150 MGA/kg in February 2013. A similar trend with later peak prices (in November/December) is visible in the tamarind fruit price recordings for Itomboina. For this product, the source of price changes is most likely a seasonally changing quality, as fruits become full ripe in the last quarter of the year.

Price differences between markets

Differences in prices for alimentary plants between the monitored markets are not observable due to data limitations.

Discussion

Methods

We observed market prices for local products on five markets in the Mahafaly Plateau region over one year. No other price information of similar detail from the same region with which our results can be compared is available to us.

The recorded data and thus the results may be influenced by the methods of data collection. Prices are not fixed or officially recorded, thus they are a result of bargaining between buyers and sellers on the local markets. Consequently, actually achieved prices per unit are likely to vary between different transactions, according to exchanged amounts as well as during the course of the market day. In addition, there might be variations according to unobserved characteristics, e.g. for crops according to quality.

In the monitoring we did not record results of transactions but expected prices by the sellers of products in a similar time window on each market day. Thus, there might be some deviation between recorded expected prices and actually achieved prices through transactions. In addition, we recorded data just for a limited amount of sellers, which does not allow the calculation of an average price per market day. The price differences are likely to be fairly low for products with relatively stable prices and frequent transactions, but there might be considerable deviations for products with high price

volatility. In general, we can expect actual prices to be somewhat lower than the recorded prices in our data.

Crops

The market data for different crops revealed the seasonality as an important factor influencing the availability and prices. Regarding availability, only staple food crops were found on nearly every market in the region, while other crops, e.g. a broad variety of pumpkins and melons as well as some bean species, were only available seasonally or occasionally. These results can be traced to the harvesting seasons of the different crops. For staple foods, prices were found to vary strongly according to the season, with prices being highest in the lean season (planting and growing season) while prices dropped in the harvest season. Thus, seasonal effects were highly visible in the data.

We observed differences between the markets regarding the availability and prices as well. Ambatry as a regional market offers a broader and more constant range of crops compared to the four local markets. Regarding price differences, we found in tendency lower prices on the plateau compared to the two littoral markets and Ambatry. This may be related to a comparably higher crop production and lower infrastructural access to plateau villages compared to Ambatry (which is located close to the RN 10) and the two littoral villages (where transport to the regional centre Tulear is comparably easier through waterways and the road running parallel to the sea shore).

In a detailed comparison of prices between Andremba vs. Itomboina and Itomboina vs. Ambatry we observed systematic differences. While in the harvest season the prices in the more remote market (Andremba or Itomboina, respectively) were lower than in the more central market (Itomboina or Ambatry), the pattern was reversed in the lean season. Interplay between transport costs and relative supply and demand is the most likely explanation for this pattern. In the harvest season there is abundant supply of crops in the remote market as each farmer tries to sell crops to generate cash. Traders use the relative abundance of crops to negotiate lower prices which also pay off the transport costs to the more central markets. In contrast, in the lean season, there is a comparably high demand of staple food crops in the remote village since smallholders whose subsistence stock is finished try to buy crops on the market. Traders bringing staple food from more central villages or local villagers having stocked products offer only a scarce supply of products. This leads to comparably high prices in the remote villages. For beans and maize, prices in the lean season increase heavily after rainfall events since households looking for seeds are willing to pay very high prices.

Feedback interviews with the market monitors on price diagrams confirmed these relationships, especially the effects of seasonality and seed demand. According to these local observations, interventions of the World Food Programme by food for work schemes caused food prices to fall during lean times.

Livestock products

Prices for live animals were recorded in locally used very fine categories, specifying gender, age, and reproductive stage of the animal: For example, zebu prices were recorded in 72 categories. However, we did not observe the body condition of sold animals, which causes unexplained variation in the data.

In contrast to crop prices, the influence of seasonality on prices of live animals is rather low. For zebus, no influence is visible, while for female sheep and goats somewhat higher prices can be observed in the harvest season especially on the littoral markets of Efoetse and Marofijery/Ankilibory. Thus, if any seasonality can be stated, it runs contrary to the pattern of crop prices, which are lowest during the harvest season. The pattern can be explained with increased demand for small stock as after the harvest season people invest cash earned from arable farming activities in livestock and the festivity season in August/September, where livestock is exchanged and consumed in larger quantities. This pattern was confirmed in the feedback interviews with market monitors. The “festivity effect” is not visible for zebus, although they are a main status symbol and highly valued gift. In addition, we found no systematic influence of the seasonally variable body condition of animals on the price. Although animals tend to be fatter at the end of the rainy season and thinnest at the end of the dry season, we did not observe price differences which can be related to that effect.

A well visible influence on the animal price in the data regardless of its body condition is the age of the animal. It is possible to evaluate this effect in detail due to the many age categories distinguished in the data. Contrary to common expectations, for most markets (except Ambatry) the price for male animals increases nearly linearly with higher age of the animal. Feedback interviews could not confirm this relationship. Part of this effect can be explained with increasing body weight and horn size with age especially for zebus. For female animals, the price remains in general stable once they have reached the reproduction age, but, again, we do not observe systematically decreasing prices with increasing age.

We observed differences between the markets regarding the availability of livestock as well as slight tendencies regarding price differences. The highest presence of livestock was observed on the market of Ambatry, while animals were available only occasionally in Andremba. In addition, animals of higher age categories (more than 7-8 years for zebus and 4-5 years for goats and sheep) were not available on the plateau markets of Andremba and Itomboina, although the categories were known to the market monitors. Possible reasons might be a generally lower availability of older animals in this region, cultural constraints in the sale, or a preference of home slaughter of older animals. Mean price differences were only observed as tendencies since the overall variation in prices would override differences in statistical tests. For most animal categories, prices were highest for Ambatry and partly for Itomboina, while mean prices were lower for most animal categories (except young goats and sheep) on the littoral markets of Efoetse and Marofijery/Ankilibory.

Alimentary plants

Despite the price recording was proposed for more than 40 different alimentary plants, only half of them actually occurred during the observation period on the markets. Thus, a wide range of alimentary plants is not traded on the markets although evidence of the household baseline data suggests that they are consumed. For the traded plants, the majority of them only occur occasionally or seasonally, which is the case especially for fruits with seasonal harvesting times. Only tamarind fruits and yam species are found regularly on some markets.

We could not sufficiently corroborate seasonal price variations and price differences between markets due to insufficient data points, however, seasonal quality and available quantity changes as well as changes in consumer demand may influence price developments. Nevertheless, the data suggests that price developments depend on the specific plant concerned, its seasonal dynamics and valuation

by the customers. The price dynamics for a seasonally available fruit like mango are certainly different from the price of yam tubers, which serve as lean season food and are an inferior replacement for cassava and rice.

In sum, the evidence from the market monitoring for alimentary plants underlines that consumable forest products are predominantly home consumed and have only a limited importance as traded goods. If existing, the marketing chains for most of those products are short and largely driven by local availability and demand.

Determinants of availability and prices

The market monitoring data of 2013 and 2014 shows availability and price dynamics which are typical for rural markets. Although the basic forces of supply and demand are crucial for shaping prices on the markets, we found for agricultural crops strong seasonal price changes and price differences between the markets which can be explained by remoteness/centrality of markets in combination with varying transport costs. The pattern is consistent with an outflow of agricultural products during the harvest season and an inflow of the same products during the lean season. According to the data, seed supply is a problem in the study area, since prices for seeds rise dramatically when it rains. The markets for livestock products exhibit less seasonality and less price differences between markets. Interestingly, the price for comparably old animals does not drop significantly. In detail, findings regarding seasonality and price differences between age classes are consistent with the function of livestock as savings in households.

Viewed together over all three product classes (crops, livestock and alimentary plants), the most important factors for explaining availability and price fluctuations are (1) seasonality of land use, (2) infrastructural deficits resulting in a high cost of transport and (3) consumer preferences, resulting from the logic of farm-households relying partly on subsistence, and from other socio-cultural factors. An important factor, though not observable in the data, is the influence of precipitation and thus harvest quantity on the level of prices. According to information from local people, prices for agricultural products in drought years are generally higher than in years with abundant rain and a good harvest. As in 2013 and 2014 the harvest was rather moderate or low, the observed prices are likely to be rather high in a cross-year comparison. However, this point can be only investigated through a longer term monitoring of market data.

Despite the market monitoring data reveals important patterns of rural markets in the Mahafaly Plateau region, it cannot provide a full market analysis and the findings remain partly incomplete. Important questions left out here, which constitute potential for further studies, are (1) marketing chains resulting from trader activities and their strategic decisions, (2) the question of storage especially of cassava, which influences significantly seasonal price changes of the most important crop and is strategically done by traders in the villages, and (3) the influence of the overall precipitation and the quantity of harvest on yearly prices.

Findings in a nutshell

- We observed market data for crops, livestock and alimentary plants on five different markets in the Mahafaly region.

Main results of crop price monitoring

- Basic agricultural products are constantly available on all markets, while other products are available only seasonally or occasionally. The range of products offered is higher in more central markets.
- Markets for agricultural crops are strongly seasonal. Prices are low in the harvest season and high in the lean season, which can be explained by seasonal variations of supply and demand. The onset of rain is a shock for prices of maize and beans, since a strong increase in demand for seeds occurs.
- Remoteness/centrality of the market influences prices through transport costs and the forces of relative supply and demand. Thus, prices for agricultural products in remote villages are lower than in more central villages in the harvest season, while prices in remote villages are higher than in more central villages in the lean season.

Main results of livestock prices

- Prices for livestock products were recorded in very fine categories, specifying gender, age and reproductive stage of the animal. E.g. zebu prices were recorded in 72 categories by the market monitors.
- The most often sold animals are older calves (vibine or vantone for sheep and goats, temboay for zebu) while old animals occur less often on the market. Animals above 3-4 years among goats and sheep and above 7-8 years for zebu occur less often on the plateau markets, with especially few animals being available on the market in Andremba.
- Prices for male animals increase with the age of the animal, while for female animals prices remain constant through their life time period once they reached a productive age. According to local information body condition is the most important determinant of livestock prices.
- Seasonality is also present on livestock markets. Prices for small stock are higher in the harvest season but lower in the lean season. This pattern is caused by increased investment of cash in livestock and consumption in social events which occur predominantly in this season.

Main results for prices of alimentary plants

- Although price recording was proposed for more than 40 plants only half of them actually occurred on the markets during the observation period. This underlines that consumable forest products are predominantly used for subsistence but have only limited importance as traded products.
- Among the most frequently occurring products are tamarind fruits and yam species, while fruits like mangos and fruits of *Opuntia spec.* are only seasonally available.
- Due to a lack of data, we cannot prove seasonal price differences and price differences between the markets; however, price dynamics differ most likely according to the nature of the product and consumer valuations.

Determinants of availability and prices

- Basically, market forces of supply and demand influence price fluctuations in the study area. Thus, extremely distorted markets for some products are unlikely.
- Other important factors influencing prices are (1) the seasonality of supply, especially for agricultural crops, (2) high transport costs due to infrastructural deficits, and (3) consumer

preferences from rural, partly subsistence farm-households. The high demand for seeds after rain events in the lean season causes price shocks.

- A factor with significant influence on the price level for products during the year is according to local information the amount of precipitation and thus the quantity of the harvest. However, as the observation period covers only one year (2013/beginning of 2014) in which the harvest was moderate, cross-year comparisons are not possible and the factor remains unobserved.
- Further potential for studies in market analysis is seen in the analysis of marketing chains, trader's strategic behaviour, and storage of agricultural products.

