Living Income Reference Price for Vanilla from Uganda and Madagascar

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ABSTRACT

Vanilla has received increasing attention by the global public in recent years. On-going high vanilla prices, vanilla theft, and quality problems from vanilla beans harvested before full maturity have brought vanilla repeatedly to the headlines. This is a consequence of the extreme boom-and-bust cycles experienced by the natural vanilla market with long periods of excess supply, low prices and concerns about farmer poverty, and short periods of tight supply with excessive high prices but resulting vanilla bean quality shortages. A "living income reference price" for vanilla has been put forward as one reference tool to help stakeholders work towards a more stable vanilla market which would in term help both, stabilize the supply of high-quality vanilla and support vanilla farmers´ livelihoods.

This report presents a study to establish Living Income Reference Prices (LIRP) for vanilla from Madagascar and Uganda, based on a methodology recently developed by Fairtrade International to determine minimum price levels that would enable the equivalent of a living wage (called a living income) for smallholder farmers of different agricultural commodities. The study analyses the costs of a decent standard of living, as well as the costs of sustainable production for vanilla farmers in both countries. The living income reference price is calculated as the minimum price needed for smallholder vanilla farmers to earn sufficient net income to afford a decent standard of living, assuming that they have a large enough farm to be "fully employed" growing vanilla and have implemented good agricultural practices leading to adequate productivity and quality.

In order to estimate the benchmarks of living income and to establish the minimum "professional" productivity conditions in both countries, 250 interviews were conducted with smallholder vanilla farmers in both Uganda and Madagascar. The interviews were supplemented with focus group discussions, market surveys and stakeholder reviews. Moreover, a realistic sustainable vanilla productivity level that can be achieved by farmers implementing good agricultural practices, and a "full employment" farm size was defined in consultation with vanilla farmers, cooperatives, and both local and international buyers. Throughout the project, stakeholder feedback was systematically taken into account and integrated into the research process.

This report provides insights into the farm economics and context of vanilla farmers in Madagascar and Uganda, which are needed for calculating the minimum required farmgate price for vanilla farmers to earn sufficient return for a decent standard of living.

Household sizes, levels of livelihood diversification, food self-sufficiency and costs of living differ substantially between the two countries, as well as vanilla production and its surrounding market conditions. The costs of a decent living were estimated at 5750€ (per household per year) in Madagascar and at 7297€ in Uganda, respectively. Productivity benchmarks indicating sustainable target yields for vanilla were established at 350 kg/ha for Madagascar and 500 kg/ha for Uganda, as in Uganda two vanilla harvest are possible a year. To achieve a living income, an average vanilla farming household would need a minimum farmgate price of 15.6€ to 16.6€ per kg of green vanilla.

Fairtrade International would like to thank Ben & Jerry's for their contribution to this research

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1. Background

Vanilla is an orchid, which requires shadow and is grown in agroforestry systems. The same botanical vanilla species (*Vanilla planifolia*) is cultivated in Madagascar and Uganda with a distance of around 3,500 km between the two vanilla growing regions. Madagascar is by-far the world´s largest vanilla producer. Here, an estimated 70,000 to 80,000 vanilla farmers produce around 80% of the world´s premium vanilla (1500-1800 metric tonnes). Uganda is currently the world´s fourth biggest producer (FAOstat 2019), accounting for around 5% of global vanilla production with exports of 23 metric tonnes in 2018 (MAAIF 2019).

Madagascar is among the 10 poorest countries globally and Uganda ranks on place 27 (IMF 2019). Consequently, many vanilla farmers in both countries are poor and face ample risks, ranging from price instability to extreme climate patterns.

Vanilla has attracted increasing attention from the global public in recent years. Prices higher than silver and reports on theft and crime in the media brought vanilla frequently to the headlines. This is part of the extreme volatility experienced on the vanilla market, where prices fluctuate heavily in cycles of boom and bust, often influenced by cyclones in Madagascar (Brown 2009), which can significantly impact vanilla harvests. In recent years, global demand and speculation by non-vanilla actors have likewise contributed to increased vanilla prices.

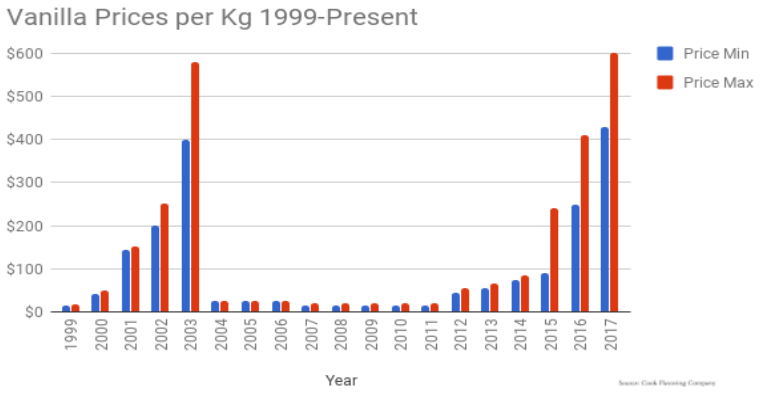


Figure 1: Global vanilla prices 1999-2017. Source: Cook´s Vanilla 2017

Over the past five years, export vanilla prices have remained remarkably high (Figure 1) , including at the farm gate, which has benefited farmers. However, when farm gate prices are high, vanilla becomes extremely valuable in the context of the main producing origins, which creates serious problems with quality as farmers are pressured to harvest immature vanilla in response to theft concerns. During the low-price period between 2005 and 2015 when there

was sufficient supply on the market, quality was high but many producers in the main origins of Madagascar and secondary origins like Uganda experienced low incomes and seasonal food insecurity due to small parcels, relatively low productivity, and the low farmgate prices received.

In recent years, vanilla stakeholders have been collaborating to try and address the problems of quality and sustainability. For example, the Sustainable Vanilla Initiative[1] (SVI) was started in 2016 as a voluntary industry initiative to contribute to increasing the supply of sustainable vanilla, improve the livelihoods of vanilla farmers, and to address the crisis in the quality of vanilla. A major challenge for the vanilla market is the extreme price volatility, which is compounded by such low prices during the "bust" face of the market that farmers outside of the primary origin of Madagascar remove their vines and/or switch to alternative crops, e.g. in Uganda to coffee or cocoa. SVI members believe that stronger alternative countries of origin, such as Uganda, would help stabilize the overall market, which would benefit producers – including in Madagascar - by reducing the extreme price swings and improving the consistency of quality and, therefore, the potential to grow the market for natural vanilla. As natural vanilla only serves about 2% of the total vanilla flavour market, there is considerable potential for growth.

Fairtrade International has recently developed a model to establish the price for a specific crop from a specific region that is needed for an average farmer household with a "full-employment farm size" and an adequate productivity level to earn a living income from the sales of that crop. This so-called Living Income Reference Price (LIRP) is an essential part of Fairtrade's Living Income Strategy, which serves as a tool for raising awareness on income gaps and provides guidance to producers, traders and governments on sustainable pricing as a critical lever for achieving living incomes.

To help inform the debate and strategies about the minimum market conditions required to support a sustainable livelihood for vanilla producers, as well as what would be needed to grow stronger alternative origins, Fairtrade International has commissioned research into the economic conditions of vanilla farming households in the main vanilla producing country

[1] The SVI is a voluntary sustainability initiative uniting consumer goods manufacturer, global flavor/ fragrance companies, international vanilla bean traders and cooperatives. SVI members represent over 70% of worldwide vanilla bean purchases and have focused so-far on Madagascar, whereas Uganda is being developed as a second origin.

Madagascar and an alternative origin Uganda, with the objective to establish Living Income Reference Prices for vanilla from these countries, in collaboration with key stakeholders, i.e., vanilla farmers, farmer groups and the vanilla industry.

This case study contributes to the development of a standardized methodology for establishing Living Income Reference Prices with a broad applicability across commodities and farmer realities by Fairtrade International, in support of its ambition to enable sustainable livelihoods of farmers.

When implemented, the reference price should support smallholder farmers in achieving sustainable livelihoods by earning a sufficient return to cover the cost of a decent standard of living when certain baseline conditions are met. Sustainable prices, such as the LIRP, are believed to contribute to a market stabilisation and increases in sustainable vanilla production. Likewise, the establishment of a LIRP for vanilla could empower local farmer organisations to negotiate suitable prices in the long run.

However, the present study does not represent every vanilla farmer in both countries and the situation for impoverished vanilla farmers might look different than the data presented in this report. Many of the sampled vanilla farmers are Fairtrade certified. In fact, there are indices showing critical differences between certified/contracted farmers compared to "average farmers" such as benefits due to contrcat partners and prices received (Hänke et al. 2018). Therefore, we also tried to include a share of ~25% non-certified vanilla farmers in this study.

2. Methodological approach

The frame for the present vanilla study was to define the values for 4 key parameters needed to establish a Living Income Reference Price: (i) cost of a decent standard of living, (ii) sustainable yields, (iii) full employment farm size and (iv) cost of sustainable production in both countries. To do this, 6 weeks of data collection through household (HH) surveys took place in Uganda and Madagascar, market surveys were conducted, 6 focus group discussion were conducted, and a continuous validation of research findings accompanied the research process. This process comprised of intermediary milestones and feedbacks, i.e. progress presentations and regular communication with affected actors such as farmers, farmer groups, cooperatives, researchers, NGOs and members of the SVI. Throughout the project, data was sense-checked and feedback by relevant stakeholders was systematically recorded and taken into account.

2.a Living Income

A commonly accepted methodology for establishing Living Wage (LW) and Living Income (LI) benchmarks is based on the calculation of the cost of ”decent living”, also known as the “Anker methodology” (Anker and Anker, 2017). Living Income is defined as sufficient income generated by a household to afford a decent standard of living for all household members. Elements of a decent standard of living include food, water, housing, education, healthcare, transportation, clothing and other essential needs, including a provision of 5% for unexpected events. LW and LI serve as reference points to set wages in the case of hired labour (LW) or target incomes for self-employed smallholder farmers (LI). In Uganda as well as in Madagascar, vanilla farmers are self-employed smallholder farmers, suggesting that the LI framework is most relevant.

2.b Fairtrade´s reference price model

In 2017, Fairtrade International developed its Living Income Reference Price (LIRP) model as an integral part of its holistic roadmap towards living incomes. The basic principle behind Fairtrade´s LIRP is the question: What price do farmers under a viable, “full employment” farm size and sustainable production regimes need to reach a living income? In the LIRP, value of self-produced food is deducted from the costs of living (as it reduces the food expenditures for the household).

Key variables of the Fairtrade’s Living Income Reference price model include:

(i.) Sustainable yields:

Adequate productivity levels are based on feasible yields when implementing sustainable agricultural practices. The idea is to base the reference price model around a level of productivity that is realistically achievable for farmers who have implemented the recommended good agricultural practices (e.g. not demo farm productivity).

(ii.) “Full Employment Farm Size”/ Viable land area

Fairtrade follows the principle that self-employed farmers working full-time on their farms should be able to make a living income from their farm proceedings, provided there is a formal market for the goods produced. In order to establish a full-employment farm size, the labour intensity of the main cash crop is leading, whereas potential other crops on the farm are assumed to absorb the available household labour during the low labour seasons of the main crop. Because of the real-world high variability in farm size and diversification, the Fairtrade living

income reference price is based on a maximum vanilla area that can be managed primarily through family labour, that is a full employment vanilla farm size.

(iii.) Cost of Sustainable Production:

The costs associated with producing sustainable yields should reflect an adequate farm investment. Hence, the costs of production are calculated based on the investment needed to reach sustainable yields, considering fully employed, non-remunerated, household labour. Additional hired labour needs are factored in at a living wages.

Per se the LIRP covers a living income for the vanilla farming households and a living wage for hired workers on smallholder farms. The corresponding formula for Fairtrade´s LIRP is:

$$\text{Living Income Reference Price} = \frac{\text{cost of decent living} + \text{cost of sustainable production}}{\text{viable land area} * \text{sustainable yields}}$$

2.c Sampling and Methods

The questionnaires, the sampling design and the implementation were designed by the author of this study. However, in both Uganda and Madagascar, one sub-consultant and 7 research assistants supported the data collection, respectively.

2.c.a. Sampling design and study regions

In Uganda, vanilla farmers were sampled from an umbrella vanilla cooperative: the Rwenzori Farmers' Cooperative Union (RFCU). RFCU unites 12 cooperatives and around 920 farmers.[2] All 12 cooperatives and its farmers are distributed over 3 districts and 30 subcountys in central-western Uganda, bordering the Democratic Republic of Congo (see Figure 2). The region lies directly on the equator, Kasese (south-west) represents a lowland partly in a valley, the terrain in Bundibygo and Ntorko (north) is hilly, which also includes the Rwenzori mountains(west). In all three districts most of the rural inhabitants are farmers and cultivate various subsistence crops. However, vanilla, coffee, cocoa, tea and cotton are also common cash crops in the region.

We received farmer lists of RFCU headquarters but found that they were not up to date. After contacting most of the 12 individual cooperatives, we partly updated the number of farmers in the cooperatives (see Appendix 1) but could not access all of them. Likewise, we also found many new farmers, that is, growing but not yet harvesting vanilla as vanilla can only be

[2] This number is an estimation.

harvested after 3 years. Likewise, some of the farmers left the cooperative and others were not accessible.

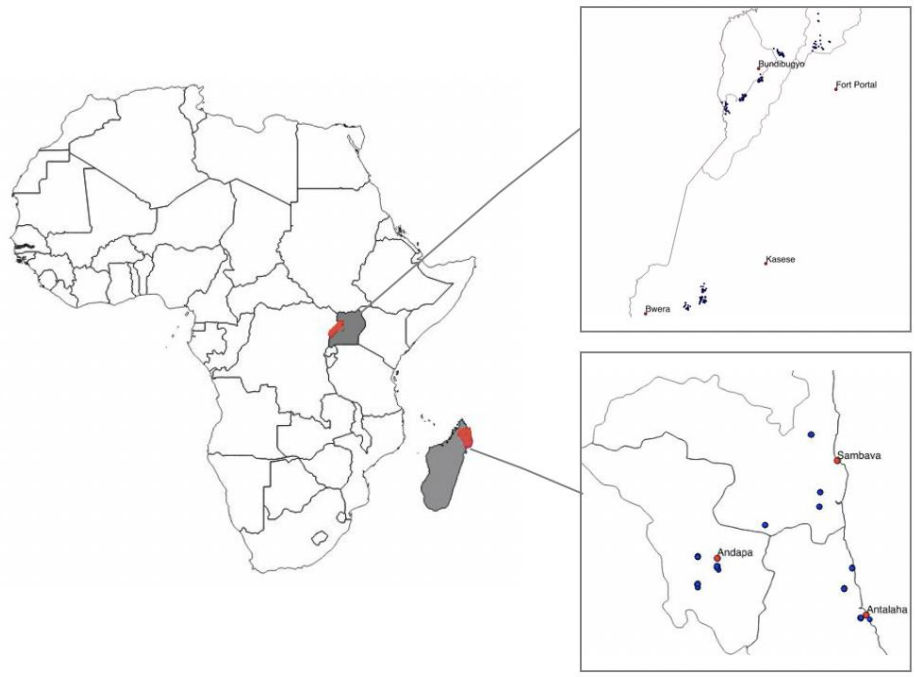


Figure 2: Map of the study regions in Madagascar and Uganda

We sampled 4 cooperatives in the Bundibuygo district, 1 in Ntorko and 4 in Kasese as we wanted to sample the different districts to the same extent. The Ntoroko district has only one vanilla cooperative. Due to the difficulties explained above (non-accessibility, members leaving the cooperative, members who did not harvest yet) our sampling design did not work out completely as initially planned. In fact, vanilla farmers in Bundibygo were proportionally oversampled as Kasese has the highest number of vanilla farmers in all RFCU cooperatives (see Appendix 1). After choosing 9 from the 12 cooperatives, the farmers were randomly selected from the member lists we received. Hence, the sampling design is a stratified random sample which led to a total of 248 farmers.

In Madagascar, vanilla cultivation mainly takes place in the north-eastern SAVA region. The SAVA region is by-far the largest vanilla producing area in the world. The vanilla growing region consists of the littoral (east), intermediate zone (east-centre) and mountainous zone (west). The Sambava and Antalaha districts lie chiefly in the littoral - intermediate zone, while the Andapa district is mainly in the mountainous zone (see Figure 2). As the Andapa region

(west) is around 500m above sea level, it has a different climate than the littoral zone (east). Here, vanilla -and other crops- reach its maturity ~4 weeks later than in the littoral zone.

In our sample, we tried to balance the different geographical vanilla growing districts equally. Therefore, 4 villages in the Antalaha district were chosen, 4 in Sambava and 4 in Andapa, respectively, leading to a total of 12 villages. From the 12 villages, 7 have Fairtrade vanilla cooperatives.

In the other villages (non-Fairtrade cooperatives), we sampled from village associations' list that usually exist in villages were vanilla farmers live. From Fairtrade cooperatives as well as non-Fairtrade associations, we randomly selected farmers from member´s lists. Every 3rd farmer was chosen from these lists so that we could sample proportionally to members in these farmer´s organizations. In Madagascar, this led to a total sample of 252 vanilla farmers. In both countries 10% of the sampled farmers are non-vanilla farmers. They were included as a control group in order to estimate the value that vanilla brings to local livelihoods as compared to non-vanilla farmers.

2.c.b Pilot phase

Prior to conducting the household survey, pilot phases took place in Uganda and Madagascar. The questionnaire design was a process involving local experts in Madagascar and agricultural extension officers in Uganda, who helped to adapt the questionnaire to the local context. The process was supported by local assistants who translated the questionnaire into local dialects. This was particularly relevant in Uganda where 43 different languages are commonly spoken (Ethnologue 2005). After establishing a first draft of the questionnaire, one week of data collection took place in each country, feedback by the respondents and enumerators was received and incorporated into the final questionnaire.

Data collection was done through the use of tablets using the freely available Kobo Collect Application (see https://www.kobotoolbox.org/). All research assistants received 5 days of training on its use and could contribute to the interface structure and design.

2.c.c Questionnaire design and structure

Most of the questions in the questionnaire addressed the entire household. Therefore, we tried to conduct -whenever possible- the interview together with the father and mother of the household as both have different knowledge and information. For example, in Uganda male HH members usually have little knowledge on markets, prices and food costs, but they know better when they engaged hired labourers, or the time spent for guarding of vanilla fields.

If questions on agricultural production, production costs, expenditure or income were surveyed, the questions addressed the entire year of 2018. See Appendix 2 for the questionnaire sections. In order to estimate the accuracy of respondents´ self-reported field sizes, 10% of the agricultural fields were measured through GPS devices by the research team. The fields were randomly selected.

2.c.d. Market surveys on prices and local units

In each district (3 in Uganda, 3 in Madagascar), market surveys were conducted. Prices for the most common crops were surveyed in local units and local units were converted into kg through self-measurements with scales. Each local unit was measured 3 times and subsequently converted to an average value. Additionally, vendors and farmers were asked about price fluctuations, min. and max. prices throughout the year (see Appendix 3).

2.c.e. Focus groups

A total of 6 focus group discussions were complemented (3 in each district Uganda, 3 in each district in Madagascar). In every focus group discussion, a total of 8 people were invited based on the following criterion: vanilla farmers with at least 5 years of experience, half of the participants male, half of them female, and they should live constantly in their villages. Cooperative executives usually assisted the discussions. During the focus groups, a maximal manageable vanilla field size by the households was discussed as well as a maximal reasonable feasible yield. Likewise, findings from individual HH surveys was sense-checked and feedback received. This was particularly important to understand the local context and to validate our research findings. Other key questions discussed were: the costs of living, cost of housing, schooling, health, transportation and food expenditures incl. seasonality.

2.c.f. Limitations of this study

Time for planning, designing, conducting the study, analysing the data and writing the present report were 7 months in total. This is a short time span given the complex reality of vanilla farming and the livelihoods of vanilla farmers. Extensive experience of the author in conducting research in Madagascar on vanilla and great support in Uganda through Catholic Relief Services (CRS) and other partners contributed to a successful accomplishment of this study.

However, the present study does not represent every vanilla farmer in both countries and the situation for impoverished vanilla farmers might look different than the data presented in this report. Many of the farmers sampled for this study are certified. In fact, there are indices showing critical differences between farmers in certification and/or contracts compared to "average farmers" such as benefits due to buyers and prices received (Hänke et al. 2018). Also, farmers who are not members of a cooperative and sell their vanilla on the spot market, are more likely to sell their vanilla immature (Hänke et al. 2018). As many farmers sampled for this survey are certified, selling mature vanilla is most likely a precondition of these cooperatives. Thus, the situation might not reflect the situation of other vanilla farmers. Therefore, we also included non-certified vanilla farmers.

Another important point is that we could not include very remotely living vanilla farmers due to a lack of time and budget. In north-eastern Madagascar all roads except the highways Sambava-Andapa, Sambava-Antalaha and Sambava-Vohémar are dirt roads, which are difficult to drive during the rainy season, the period the surveys were conducted for this study. In Madagascar some vanilla farmers live in very remote areas, that are only accessible through pirogues and/or several days of walking. However, infrastructure in Uganda is much better developed than in Madagascar.

Intercropping is common in both countries and the proportions of each crops were, therefore, estimated through proportional allocation of stones. One field consist of 10 stones and the farmers allocated a number of stones for a given crop. This is an estimation and was not technically measured *in situ*.

Most presented data are average values along with standard errors (mean $\pm$ standard error) to show the variances around the mean values presented. This should allow readers an interpretation of the deviations around the average values.

3.Results

3.1. Living Income benchmark

A. Demographics

(i.) Uganda

Table 1: Household characteristics of Ugandan vanilla farming households

Per household	Mean	St. Error
Adults total (>18 years)	3.23	0.14
Male (%)	47.78	
Female (%)	52.22	
Non-adults total (<18 years)	3.40	0.13
Male (%)	51.73	
Female (%)	48.27	
Total household size	**6.62**	**0.21**

The average household (HH) size in Uganda is 6.6 ± 0.21 (Mean ± Standard Error) consisting of 3.2 adults and 3.4 children, respectively. 52% of adults are female compared to 47.8% of males. Regarding non-adults, there are slightly more males (51.7%) than females (48.3%).

(ii.) Madagascar

Table 2: Household characteristics of Malagasy vanilla farming households

Per household	Mean	St. error
Adults total (>18 years)	2.37	0.07
Male (%)	52.2	
Female (%)	47.8	
Non-adults total (<18 years)	1.84	0.12
Male (%)	48.9	
Female (%)	51.1	
Total household size	**4.22**[3]	**0.19**

The average household (HH) size in Madagascar is 4.2 ± 0.19 consisting of 2.4 adults and 1.8 children, respectively. 47.8% of adults are male compared to 52.8 % of males. Regarding non-adults, there are slightly more females (51.1%) than males (51.1%).

[3] Some stakeholders questioned the HH size of 4.2 persons in this study when preliminary results of this study were presented. However, the largest survey ever conducted in the region (Hänke et al. 2018) found an average HH size of 4.74 ± 0.61, which is roughly in line with this study. Also, vanilla farming HHs who are certified, have significantly larger HH sizes than non-certified HHs indicating a selection bias (Hänke et al. 2018). Other factors leading to decreasing HH size over time may be immigration by farmers from other areas and social change. That is, younger people tend to establish their own HHs leading to a higher number of- but smaller average sizes of households (cf. INSTAT 2014).

B. Cost of decent living for an average household

Living Income is defined as sufficient income generated by a household to afford a decent standard of living for all household members. Components of a decent standard of living include food, water, housing, education, healthcare, transport, clothing and a provision for unexpected events. The methodology is based on Anker and Anker (2017, see below for more details).

Below, data on each of the variables is presented, based on data collected through HH questionnaires, market surveys and focus group discussions, and partly on secondary data.

(i) Model diet

The model diet is based on low-cost nutritious food which is in line with recommendations by the FAO/WHO on consumption of calories, carbohydrates, proteins, fats, fruits and vegetables. Anker and Anker (2017) provide two Excel tools[4] in which edible grams, nutritional data, local food prices and household composition including activity level, age and gender are incorporated. Given the fact, that many of the sampled adults are farmers, their kcal requirements are higher than those of non-agricultural workers (Anker and Anker 2017, Biesalski et al. 2017). Data on nutrition, i.e. carbohydrates, calories, proteins, fat contents and edible weights of all food items were taken from the United States Department of Agriculture Food Composition Database (USDA 2019).

The food items in Anker´s model diet can be adapted so that they correspond to local food habits and preferences. Frequency of consumption of food, subsistence crops planted and its prices throughout the year are presented in Figure 6, Figure 9, Appendix 4-7, respectively. However, for the model diet, additional data from focus group discussions is included. These involve (i.) costs for meat, fish, oil and sugar, and (ii.) price fluctuations and seasonality of food crops throughout the year. Moreover, data collected on local markets on food prices was crosschecked in focus group discussions. The food data was entered into the tool by Anker and Anker (2017) along with socio-demographic charatcteristics of the HH (HH size, age, gender, activity level), based on own HH surveys, and the model caclulates the average costs of a model diet per household per day.

[4] The tools are for free and can be found at: https://www.elgaronline.com

i. Uganda

Local food habits are presented in Appendix 8 for Ugandan vanilla farmers and prices for the local food items are presented in Appendix 4-7.

For a typical Ugandan vanilla farming HH (0.39 adults sedentary, 0.47 adults in moderate activity and 2.46 in vigorous activity plus 3.4 children at a moderate activity level), an average household member needs 2003 kcal per day.

Table 3: Model diet for Ugandan vanilla farmers

Food group	Food item	Edible grams	Cost per day/person in UGX	Cost per day/person in €[5]	Comment
Cereals and grains	Maize	100	123	0.03	4 times a week
	Millet	25	82	0.02	Once a week
	Sorghum	20	41	0.01	Once a week
Roots and tubers	Cassava	150	82	0.02	5 times a week
	Yams	30	41	0.01	Once a week
Starchy fruit / vegetable	Plantains	200	164	0.04	Every day
Pulses, legumes, beans	Beans	80	247	0.06	4 times a week
	Groundnuts	60	288	0.07	3 times a week
Dairy	Milk		206	0.05	For kids one glass per day
Eggs	Chicken Eggs	50	534	0.13	
Meats & Fish	Beef	70	557	0.23	2 times a week
	Chicken	10	164	0.04	Once a week
	Fish	80	721	0.27	2 times a week
Green leafy vegetables	Dodo	60	82	0.02	2 times a week
	Cassava leaves	50	41	0.01	2 times a week
Other vegetables	Onion	51	41	0.01	2 times a week
	Tomato	52	123	0.03	2 times a week
Fruits	Mango	60	82	0.02	3 times a week
	Banana	50	41	0.01	3 times a week
Oils & fats	Vegetable oil	57	123	0.03	Every day
Total cost of model diet excluding additional costs indicated below				3782 UGX	0.92 €
Percentage added for salt, spices, sauces, and condiments				*1%*	
Percentage for spoilage & waste				*5%*	
Percentage added for variety				*10%*	
Total cost of model diet including additional costs indicated below (UGX)				5231 UGX	1.27€
Cost of model diet per family per day				**35 096 UGX**	**8.52€**

[5] Exchange rate during the survey 1€= 4113 UGX (Ugandan Shillings)

In the vanilla growing areas in western Uganda, cassava and plantain are almost daily consumed food crops (see Appendix 8) as well as the cheapest food sources (see Appendix 3). They contain high levels of carbohydrates but are poor in proteins, fats, vitamins and minerals (USDA 2019). Therefore, the food diet was slightly adapted so that the food diet becomes more diverse and healthier based on recommendations by the FAO /WHO. Cassava and plantain are still included with a substantial share of consumption as well as beans, given their low prices and local abundance.

As illustrated in Appendix 8, local vanilla farmers barely eat cereals. A key adaptation for the model diet in Table 3 was that maize, and smaller amounts of sorghum and millet are included in the food diet, which are sometimes planted as cash crops, bought in smaller quantities, and locally available (see Figure 7 and Appendix 3). These cereals include crucial micronutrients, vegetable fats and proteins (USDA 2019). Also, they are easier to store and, therefore, decrease food spoilage. The equatorial climate in the Ugandan study region makes food spoilage common and fridges are rare. Only 0.4 % of the sampled HHs possess a fridge. However, sorghum and millet are relatively expensive compared to maize and were, therefore, added in small quantities to the model diet (around 1 dish per week). Likewise, amounts of vegetables and fruits was increased in the model diet to meet recommendations by the FAO/WHO.

Percentage added for salt, sauces and condiments was put as low as 1% of additional costs. Local sauses consumed are often based on tomatoes and onions, which are already included as vegetables. Likewise, consumption of groundnuts is fairly high in the model diet as it is commonly used for a local sauce ”*Binyebwa”*, which is eaten along with plantain and meat or fish. Groundnuts are a rich source for unsaturated fatty acids and proteins (USDA 2019). Prepared cereals are uncommon in the region and rice is a luxury product, eaten mainly during festivities. Fish, chicken and beef are commonly eaten and were the also largest expenditure class for food in 2018 (see Appendix 9).

Total food costs in the model diet sum up to 1.27€ per person, that is, for an average HH of 6.7 persons 8.52€ taking into account gender, age and activity levels of all HH members,

i. Madagascar

With regard to nutrition and food availability, the context in Madagascar is different than in Uganda. Food availability is seasonal due to only one rainy season. Moreover, lean seasons are common in Madagascar lasting usually from January to April meaning that food savings are scarce, farmers rely on food purchases and food prices increase on local markets (see Appendix 4-7). Local farmers rarely stock rice to prepare for the lean season as production is often insufficient (FAO & WFP 2015).

Local vanilla farmers are smallholders and grow rice, cassava and yams roots, few fruits and vegetables. Most vegetables and pulses are generally purchased in semi-urban markets and most livestock products except chicken and fish are imported from other regions (Kunz 2018). Northeastern Madagascar is largely isolated from the rest of the island and transportation is expensive due to a weak infrastructure. Consequently, food prices are higher than in other parts of Madagascar.

For the case of Malagasy vanilla farmers, food habits are presented in Appendix 11 and average prices for the local food items are presented in Appendix 4-7. As there are less children in an average Malagasy household compared to Uganda, the average kcal required per person is similar with 2010 kcal/person (based on activity level of each HH member).

As illustrated in Appendix 11, Malagasy vanilla farmers eat rice daily (many eat rice 3 times a day) and rice causes the highest expenditures for food (Appendix 12). An average Malagasy eats 120-130 kg of rice per year (Madamaginze 2018, FAO 2004), translating into 328-356 grams per day. Rice is theoretically a nutritious food source but only when the entire grain including its hull is consumed (USDA 2019). However, in Madagascar, the hull is cracked and only the white seed is eaten. Consequently, rice seeds lose important minerals and vitamins, and the white rice seed contains almost exclusively carbohydrates (USDA 2019). This often leads to physical underdevelopments and diseases in rural Madagascar as the food diet is unbalanced and far too much centred on carbohydrates leading to protein and vitamin deficits (Golden et al. 2019, USAID 2018, Schlecht & Hänke *forthcoming*).

Therefore, in the model diet, the rice consumption is reduced to 100 grams per day/person in order to establish a healthy and nutritious diet. This would mean that rice is only eaten 2-3 times a week. Tuber roots and fruits are cheap and locally available (see Appendix 4-13). Moreover,

tuber roots can be harvested throughout the year and don´t depend as much on rain as annual plants (e.g. rice, maize, beans). In addition, vegetable and animal protein consumption are slightly increased in the model diet to satisfy WHO/FAO recommendations. Percentage added for sauces was put on 1%, the lowest option according to Anker & Anker (2017). Despite the fact that Madagascar is a so-called the "spices island", spices are in fact rarely used in local dishes. Only oil, salt and *Sakay*, a chilly sauce consisting of chillies, garlic, vinegar and ginger are commonly added in small quantities.

Table 4: Model diet for Malagasy vanilla farmers

Food group	Food item	Grams per day	Cost per day/person in Ariary	Cost per day/person in €[6]	Comment
Cereals and grains	Maize	25	95	0.02	4 times a week
	Rice	25	212	0.05	2-3 times a weelk
Roots and tubers	Cassava	150	115	0.03	4 times a week
	Yams	50	215	0.05	Once a week
Starchy fruit /	Plantains	200	538	0.13	4 times a week
Pulses, legumes, beans	Beans	80	380	0.09	3 times a week
	Groundnuts	60	238	0.06	3 times a week
Dairy	Milk	200	200	0.05	For children one glass per day
Eggs	Chicken eggs	50	1136	0.28	
Meats & Fish	Beef	30	674	0.17	2 times a week
	Chicken	10	294	0.07	Once a week
	Fish	30	633	0.16	2 times a week
Green leafy vegetables	Bred	60	42	0.01	5 times a week
	Cassava	50	56	0.01	2 times a week
Other vegetables	Onion	51	142	0.03	3 times a week
	Tomato	52	379	0.09	3 times a week
Fruits	Mango	60	51	0.01	3 times a week
	Banana	50	90	0.02	3 times a week
Oils & fats	Vegetable oil	57	398	0.10	Every day
Total cost of model diet excluding additional costs indicated				5887 Ar	1.45 €
Percentage added for salt, spices, sauces, and condiments				*1%*	
Percentage for spoilage & waste				*3%*	
Percentage added for variety				*10%*	
Total cost of model diet including additional costs indicated				68614 Ar	1.69 €
Total model diet per family per day				**28948 Ar**	**7.13 €**

The model diet leads to daily costs of 7.13€ per average household or 1.69€ per person. Thus, for a total year the costs sum up to 2597.2€ per Malagasy household.

[6] Exchange rate during the survey 1€= 4060 Malagasy Ariary

(ii) Housing

Contrary to other poverty lines, the Anker method accounts for detailed measures of non-food costs. Housing costs are estimated by summing up estimates of the costs of rent for an appropriate home or a rental equivalent. In fact, in both Uganda and Madagascar housing rentals are rather uncommon in rural areas. Instead, farmers build their own houses or inherit them. Sometimes workers are engaged to support house construction. However, e.g. in Madagascar there is increasing immigration of other ethnic groups due to the vanilla boom who sometimes rent houses, according to respondents.

In both countries, housing conditions are generally poor, even though housing standards in Uganda are better than in Madagascar (see Table 5). In Madagascar, there are rarely separate rooms for kids and adults, many houses are huts made of wooden sticks and fibres. Some of the houses´ roofs are made of plant material, which has to be renewed every year. However, a gradual improvement of housing conditions was observed during fieldwork. The housing conditions are compared between Madagascar and Uganda in Table 5.

Table 5: Housing conditions in Uganda and Madagascar

House feature	Material/Asset	Uganda (%)	Madagascar (%)
Floor	Clay	71.0	2.2
	Cement	24.2	28.3
	Wood	3.6	63.2
Electricity	Yes	71.8	83.4
	No	28.2	16.6
Electricity Source	Solar panel	72.2	83.5
	From neighbours	3.6	1.5
	Electricity grid	2.0	0.0
Energy source for cooking	Wood	92.7	87.3
	Charcoal	4.4	12.7
	Electricity/Gas	0.0	0.0
Latrine	Yes/No	95/5	71/29
	Covered with walls/shelter	66.9	9.2
	Clay	16.9	0.6
	Hole in the ground	8.9	53.3
	Wood	5.7	18.7
	Porcelain	0.4	0.6

71% of the Ugandan farmers and 83.5% of the Malagasy farmers have an electricity source at home mainly through solar panels (72.2% and 83.5%, respectively). Wood and charcoal are the only energy sources used for cooking in both countries. This makes a separate cooking area particularly important as smoke and gases lead to respiratory diseases and lung cancer, predominantly if people live, sleep and cook in the same rooms (WHO 2019).

In Uganda, the latrines are mainly open spaces covered with walls/shelter (66.9%), clay (16.9%) and only 0.4% of respondents possess porcelain toilets. In Madagascar, 71.1% of farmers have a latrine; however, 42% share the latrine with neighbours. More than 20% of sampled Malagasy farmers practice open defecation. Many diseases are transmitted that way in Madagascar, i.e., typhus, cholera and other diarrheal diseases (UNICEF 2011). Almost none of the latrines fulfil hygienic standards satisfying criterion by the Millennium Development Goals (UN 2019). Neither in Uganda (24.2%) nor in Madagascar (28.3%) floors are frequently cemented. Housing conditions of an average vanilla farmer both in Uganda and Madagascar are thus not in line with international minimum standards (Anker and Anker 2017).

So as to estimate housing costs (rent and utilities) in both countries, international minimum standards of housing conditions were presented to focus group participants. Data for housing costs were collected in 6 focus groups discussions in each of the different districts (3 in Uganda, 3 in Madagascar). Costs for a decent house include the following (Anker and Anker 2017):

i. separate rooms for children and adults, that is, 3 separate rooms for an average HH (depending on HH size)
ii. each room with at least $9m^2$
iii. a safe roof, so that no water can penetrate
iv. air ventilation
v. a cemented floor
vi. concrete walls (wood can be mixed with cement or clay)
vii. a separate cooking area
viii. outside porcelain or improved latrine
ix. access to water and electricity
x. maintenance/reparation costs

Questions discussed with focus group participants were: How much would it take to build such a house, how long would it last and/or what would be a renting equivalent?

Figure 3: Examples of houses of Malagasy vanilla farmers in non-acceptable (left), medium acceptable (middle) and idealistic houses in line with international minimum standards (right). Source: own photos

ii. Uganda

The reality of housing conditions in Uganda is described in Table 5. Among each of the focus group discussions, there was at least one person who recently build a house in line with the presented characteristics above. Those were mainly better-off vanilla farmers benefitting from the on-going vanilla boom and its high prices. Still, focus group participants found it easier to discuss a renting equivalent. As no water pipes are locally available, improved fountains that are kept safe and clean were suggested by the focus group participants. Also, the water can be purified at very low costs either through solar water disinfection or heating (WHO 2019).

In Uganda, the renting equivalent was estimated at 600,000UGX/year for such a model house, which would lead to an average cost of 7,200,000 (1748.9€), per year.

The variance of the price range was low in all 3 different Ugandan districts (500,000- 700,000 UGX/year).

ii. Madagascar

Also in Madagascar some of the focus group participants constructed houses in line with the housings standard described above. Participants agreed that the construction for a similar house would costs 70,000,000- 90,000,000 Ariary (~17,000€ - 22,000€) and would last for around 40-50 years. However, focus group participants agreed that a rental equivalent is more realistic as few farmers are able to build a similar house and/or lack experience in estimating the costs. A rental equivalent, however, would me more expensive than just construction costs for a house, particularly when it is furnished. Local farmers estimated the rental equivalent to 650, 000 Ariary (145.6€-169.9€) per month, on average. The variances in all three districts were low (600,000- 700,000 Ariary) indicating good estimates by respondents.

Hence, the annual housing costs were established at 1,926€/year.

(iii) Electricity

As solar panels are the most common source of electricity in both the sampled Ugandan and Malagasy region, the costs for solar panels, its maintenance and the time span it can be used was discussed in focus group discussions. Most of the focus group discussion participants possess solar panels and could provide good estimates.

iii. Uganda

89.5% of the surveyed HHs have a mobile phone, 83% a radio and 9.2% a TV. These items together with lighting are regionally the main consumers of electricity. In order to produce enough energy for the listed items, solar panels can be bought locally for 300,000 – 1,500,000 UGX (900,000 UGX (218.6€)), on average. The more expensive the solar panel, the more powerful it is, and the more electronic items the HH usually possesses. However, most solar panels are low-quality Chinese fabrications and both, key informants and farmers confirmed that they last for around 3 years only. Consequently, the average costs per solar panel and HH (900,000 UGX/3 years) lead to costs of 72.9€ per year.

iii. Madagascar

Contrary to Uganda, only 44% of the sampled Malagasy farmers possess a mobile phone. However, this number might be limited by network availability. Still, 41 % of the farmers possess a TV and 93% a radio. In Table 5 we saw that 83.4% of the Malagasy farmers have a solar panel but solar panels are expensive in the SAVA region of Madagascar (see also Figure 3 left). A solar panel producing 450 Watts, a battery of 300 Amph and a converter can be locally bought for 4,000,000 Ariary (988€) and will have to be renewed after 3 years. Another example mentioned was a solar panel for 5,000,000 (1,235€) Ariary, which lasted 4 years. These costs translate into an average cost of 111,110 Ariary per month (27.4€) or 328.8€
per year.

(iv) Education

Education is an international human right (UNESCO 2019) and the Anker methodology assumes that every child has the right to complete at least secondary school.

Even though schooling conditions are underdeveloped in both countries, schooling conditions, schooling success, and general educational levels -particularly for adults- are higher in Uganda

than in Madagascar (compare UNICEF 2019a, UNICEF 2019b). However, schooling fees in Uganda are much higher than in Madagascar (Glick and Sahn 2006, UNESCO 2016).

Uganda has kept the British schooling system including primary, secondary and tertiary school. Madagascar has kept the French schooling system consisting of pre-, primary and lower- and upper secondary school. In both countries, there is lack of equipment, teachers are insufficiently trained, and particularly in Madagascar, many parents have to support local schools due to a lack of governmental funds (UNICEF 2017). Because of the weak quality of governmental schools, public schools are on the rise in many parts of rural Africa (UN 2017). In both Uganda and Madagascar, there are public as well as private schools and private schools are generally considered better than governmental schools as teachers get better salaries and are more motivated than in public schools, according to respondents.

iv. Uganda

In Uganda, the schooling fees differ substantially from school to school and place to place. Also, schooling costs depend on the class pupil are visiting (usually the higher the class the higher the school fees). In addition to schooling fees, there are development funds, obligatory school clothes, equipment (mathematical sets, pens, books) and excursions to be paid by parents. However, these fees don´t include food costs that otherwise would have to be deducted from the model diet (Anker & Anker 2017).

Schooling costs up to secondary school per child per year were collected by HH surveys and subsequently summed up per HH (Anker & Anker 2017). Table 6 below shows (i.) the average number of children per HH visiting a particular school and the average costs per year for the given school. The results were post-checked in focus group discussions and were confirmed to be realistic by participants.

Table 6: Expenses for education per household per year in Uganda

School	Number of kids in average household	St error	Average costs (€) /year	Factored (costs* number of school kids in average household)
Primary school	2.1	0.1	229.7	482.6
Secondary school	0.8	0.1	428.0	322.3
Total	**2.9**	**0.2**		**804.89**

Each HH has an average of 2.9 ± 0.2 children visiting school, mainly in primary school (2.1 and secondary school (0.8). Consequently, total education costs per HH sum up to 804.9€ per year, on average.

iv. Madagascar

Even though Madagascar has made progress in terms of literacy and schooling rates in the past decade, schools remain mainly underdeveloped and the governmental support is weak, particularly in rural areas (UNICEF 2017). Secondary schools are often far away from villages where vanilla farmers live. Teachers are irregularly paid, parent´s support is often necessary, and corruption is common in all school types[7]. In the vanilla growing region of the SAVA, parents often take care of the teacher´s vanilla plantations as they are often farmers at the same time.

In Madagascar there is the primary school (école primaire), lower secondary school (*Collège d'Enseignement Générale*), a secondary school (*Brevet d'Étude Primaire Complémentaire*), and upper secondary school (*Lycée*). Here, fees barely differ. Moreover, expenses for school are low and include school fees, FRAM[8], school shirts, books and pencils and sometimes transportation, even though >95% of pupil in this sample walk to school. School fees don´t include food costs.

Table 7: Expenses for education per household per year in Madagascar

School	Number of kids in average household	St error	Average costs (€) /year	Factored (costs* number of school kids in average household)
Primary school	0.9	0.1	37.9	34.1
Secondary school	0.3	0.2	37.9	11.3
Total	**1.2**	**0.1**		**45.4**

Each HH has an average of 1.2 ± 0.1 children visiting school. Both analysis (primary & secondary school) showed average expenses of 37.9± 2.9€, leading to an average cost of 45.4€ per household per year.

[7] Many parents complain about "unofficial fees" to be paid to teachers and school directors, which are not included in the model. These costs can be high according to respondents (> than schooling costs).
[8] FRAM is abbreviation for *Fikambanan'ny ray aman-drenin'ny mpianatra* , "the association of the parents of pupils"

(v) Healthcare

Due to the tropical-equatorial climate and partly inappropriate hygienic conditions in both regions, dangerous diseases such as malaria, dengue, typhus and cholera are common. Moreover, fountains - the most common water source- are often contaminated with pathogenic bacteria. However, public health facilities in Uganda are generally better, and governmental funding's higher in than in Madagascar (World Bank 2019b).

Expenses for health care are all private and were surveyed through HH surveys for each HH member. The costs include professional health treatments, medicine expenses and transportation costs.

v. Uganda

Health treatments are fairly expensive in Uganda. On average, each HH member visits 2.5 times a health centre, doctor or pharmacy per year leading to an average cost of 43.5€ per person per year. Expenses for elderlies and children are higher than for age classes 14 to 50 years old.
Consequently, for an average HH size of 6.6 members, health expenses sum up to 287.3€ ± 72.1€ per HH per year, on average.

v. Madagascar

In the SAVA region of Madagascar, diarrheal diseases, malaria and typhus cause most damage and lead to a particular high child and mother mortality rate (INSTAT 2014, Meekers and Yukich 2016). Sanitation and health facilities are poor in Madagascar, with insufficient number and training of employees, a lack of equipment and low numbers of trained doctors (Centre de Recherches 2013). In Madagascar, many farmers use traditional medicine due to long distances to public health facilities and lower costs compared to western medicine (ibid).
On average, each HH member visits 1.7 times a health centre, doctor or pharmacy per year leading to an average cost of 21.1€ per person per year [9].
Consequently, for an average HH size of 4.2 members, health expenses sum up to 88.9€ ± 1.4€ per HH per year, on average.

[9] The number was post-checked with local key informants and confirmed to be realistic if public/western medicine is used instead of traditional medicine.

(vi) Clothing

Data on clothing costs were collected in focus group discussions. Costs were separately discussed by gender for children and adults. School clothes were included under educational expenses above as they are obligatory and have uniform costs. Clothes for adults include clothes for on-farm work, daily clothes and clothes for festivities. In both countries, proper dresses e.g. for visiting churches on Sundays are socio-culturally essential.

vi. Uganda

Table 8: Expenses for clothing in Uganda per household per year

	Costs in € (mean)	Number of persons in average household	Sum
Adult	115.4	3.2	372.3
Children	66.8	3.4	226.9
		Total	**599.2**

Expenditures for clothing are higher for adults (115.4€) than for kids (66.8€), and higher for women than for men. For a typical household with 6.6 persons, total costs for clothes sum up to 599.2€ per year.

vi. Madagascar

Table 9: Expenses for Clothing in Madagascar per household per year

	Costs in € (mean)	Number of persons in average household	Sum
Adult	52.6	2.4	126.24
Children	64.7	1.8	116.46
		Total	**242.7**

Expenditures for clothing are higher for children (64.7€) than for adults (52.6€), and generally higher for females than for males. Total costs for clothes sum up to 242.7 € per average household per year, considering the HH size of 4.2 persons.

(vi) Transportation

All transportation costs are based on individual HH surveys and were post-checked in focus groups. Transportation costs include commuting to markets for buying/selling food and vanilla and visiting relatives. Transportation of children to school and to doctors are included in school and health expenses, respectively, as we explored during the pilot phase that this was easier to estimate for respondents.

vi, Uganda

In Uganda, 14.9% of Ugandan vanilla farmers possess a motorbike and 10.9% a bicycle. 84.7% of the surveyed farmers in Uganda walk to their vanilla plots, 1.6% use a motorbike and 0.8% a bicycle, respectively. Almost all children walk to their schools. The closest market/town is on average 3.3 km away from home. To sell their vanilla, farmers travel, on average, 1.5 km. However, the farmers sampled for this study are members of cooperatives which often have trading centres close-by or sell vanilla together with neighbouring vanilla farmers *in-situ.*

Yet, total transportation costs are low as private bush-taxis are most commonly used, which cost ~2-3€ per roundtrip for a distance of ~10 km. Due to the lack of food storage and fridges, local farmers visit markets frequently (5.09 $\pm$ 0.24 times a month). The average transportation costs sum up to 17.5€ per month leading to 210€ per year per HH.

vi. Madagascar

In Madagascar, 14.0 % of vanilla farmers possess a motorbike and 21.6% a bicycle. However, 95% of the surveyed farmers walk to their vanilla plots, 0.8% use a motorbike and 4% a bicycle, respectively. Almost all children walk to their schools even though secondary schools are often far away from home (>5 km). The closest market/town is on average 9.5 km away from home and farmers visit these markets 4.8 times a month, on average. To sell their vanilla, farmers travel 0.4 km, on average. Many of the vanilla farmers sell their vanilla in their own villages or close-by. Thus, in Madagascar total transportation costs are relatively low. Likewise, in Madagascar bush-taxis are most commonly used, leading to an average cost of 76.2€ per HH per year.

(vii) Communication

Communication with family relatives, social networks and to receive information on vanilla prices and markets is essential for vanilla farmers. Data for telephone/communication costs were discussed in focus group discussions.

vii. Uganda

89.5% of the surveyed HHs have a mobile phone and the mobile phone grid is well established in the region. Telephone and mobile data costs are generally cheaper in Uganda than in

Madagascar. 30,000 - 50,000 UGX were defined as an average cost for regional farmers per month and HH. Extrapolated to a year, the costs sum up to 117€/year for a HH.

vii. Madagascar

43.8% of the respondents have a mobile phone and communication is relatively expensive in Madagascar. On average, communication expenses were estimated at 58,750 Ariary/month converting into 14.3€ per month, and hence to 171.1€/year.

(viii) Margin for unexpected events

In the Anker methodology, a small margin for unforeseen events is provided. This margin should ensure sustainability and help workers avoid getting into a poverty trap or debt cycle (Anker and Anker 2017). Therefore, a margin (5%) of the sum of the variables above (i.-vi) was added to both total living income estimates.

(ix) Total Living Income per year

ix. Uganda

Taking into the account all variables from above (i.-vii.), total living income for an average sampled HH in Uganda sums up to 7297.1 € per year, translating into 3.03 € per person per day considering the HH size of 6.6 persons.

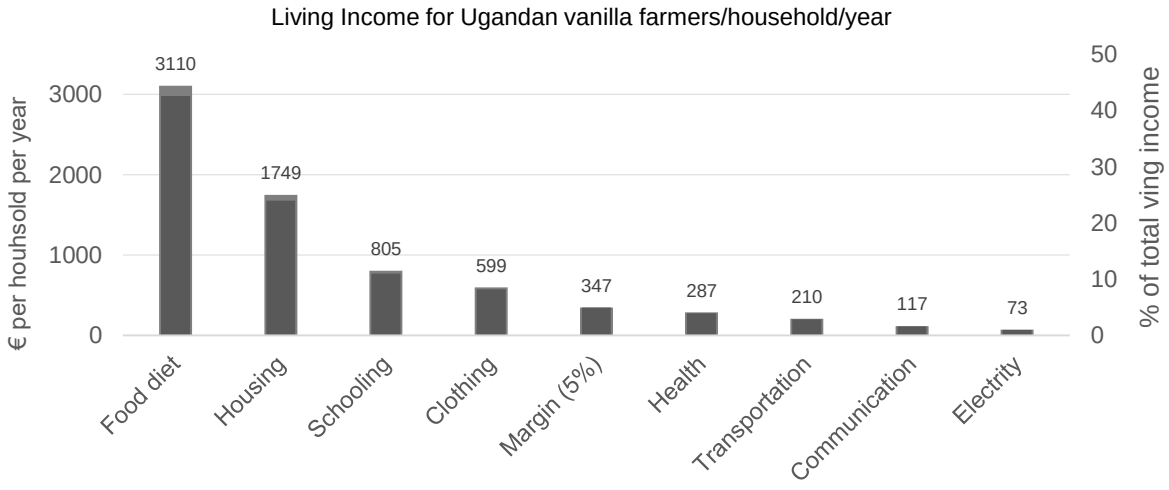


Figure 4: Composition of Living Income of Ugandan vanilla farmers per household and year

ix. Madagascar

Taking into account the benchmarks for a decent living for Malagasy vanilla farmers, total living income sums up to 5750.5€ per HH per year, or 3.75€ per person per day (HH size 4.2 persons).

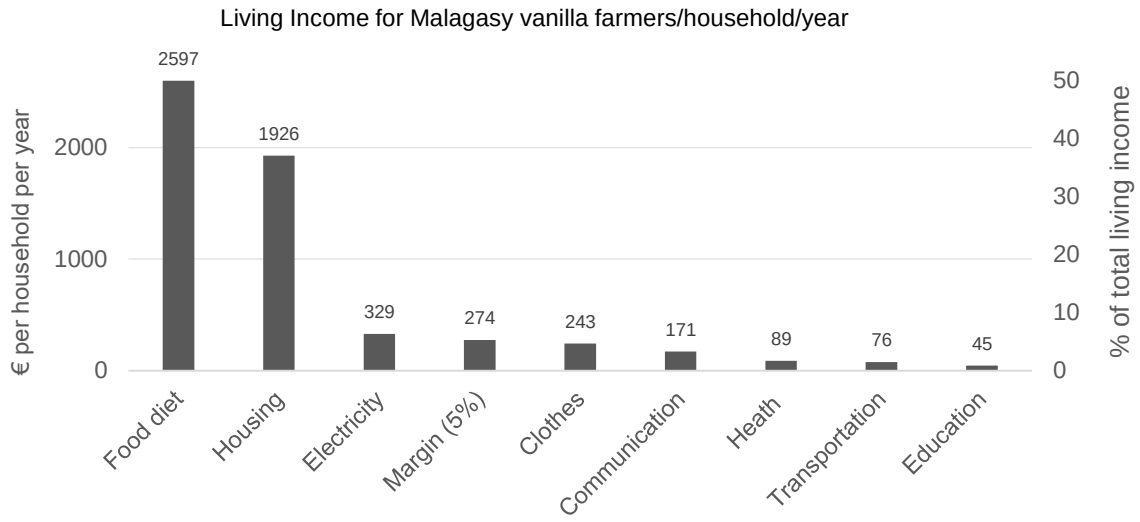


Figure 5: Composition of Living Income of Malagasy vanilla farmers per household and year

C. Value of self-produced food

All home-consumed subsistence crops and livestock in 2018 were surveyed per HH and subsequently converted into cash units.

(i.) Uganda

Table 10: Cash value of subsistence crops produced by Ugandan vanilla farmers

Crop	% of farmers cultivating crop	Average value per year in €	St. Error
Avocado	29.0	2.7	1.1
Beans	75.8	76.5	13.0
Cassava	87.9	51.8	5.6
Leafy vegetables	9.3	0.1	0.2
Groundnuts	21.4	20.1	9.5
Irish potato	5.6	0.9	1.4
Maize	28.6	46.8	28.1
Plantain	95.6	480.5	71.3
Sweet potato	22.6	3.9	1.7
Tomato	4.4	3.9	9.5
Yams	2.0	0.2	0.6
Total		**687.4**	**109.5**

Plantain (480.5€), beans (76.5€), cassava (51.8€) and maize (46.8€) generate most cash value, on average, indicating large quantities harvested. However, the standard errors, particularly for plantain, are relatively high representing significant differences between the vanilla farmers sampled. Many other crops provide little value, on average, partly because of (i.) low quantities harvested, (ii.) low prices particularly for fruits and vegetables and (iii.) they are cultivated by few farmers leading to low average values. Production costs for subsistence crops are very

low, agricultural inputs are rarely used, seeds are self-produced and engagement of hired labourers is uncommon. Thus, most input consists of household labour. The total value of self-produced food was 687.4€ ±109.5€ per average HH in 2018.

Table 11: Value of a. self-consumed, and b. sold livestock by Ugandan farmers

Livestock class	a. Self-consumed		b. Sold	
	Mean €	**St error**	**Mean €**	**St error**
Chicken	24.49	25.07	81.24	25.94
Goats	21.51	22.25	75.56	4.38
Other Poultry	0.67	1.40	1.52	0.44
Pigs	2.33	2.52	21.97	2.77
Cows	-	-	31.86	15.69
Total	49.01	51.24	212.16	49.22

On average, 2.7 chicken and 0.47 goats were home consumed in 2018 converting into a cash value of 24.5€ and 21.5€, respectively. However, other self-produced livestock classes were less commonly consumed. The standard errors indicate substantial differences in livestock home consumption by the vanilla farmers sampled.

On average, 9.0 chicken were sold for a total value of 81.24€ and 1.7 goats were sold for an average total value of 75.56€. As well as for home consumption, other livestock classes were rather uncommonly sold in 2018.

(ii.) Madagascar

Table 12: Cash value of subsistence crops produced by Malagasy vanilla farmers

Crop	% of farmers cultivating crop	Value €
Avocado	4.17	1.3
Banana	33.33	14.2
Beans	12.50	8.2
Bred	10.65	1.6
Cassava	15.74	4.3
Coffee	5.09	6.9
Cucumber	5.09	2.1
Maize	9.72	10.7
Peanuts	1.39	0.7
Rice	94.44	306.8
Sweet potato	3.24	0.8
Yams	6.02	1.2
Total		**358.7**

For this analysis hill rice and irrigated rice were combined and the value of self-consumed rice is highest (306.8€). Other import crops were bananas (14.2€), maize (10.7€) and beans (8.2€), on average.

Table 13: Value of a. self-consumed and b. sold livestock by Malagasy farmer

Livestock class	a. Self-consumed		b. Sold	
	mean	St. error	Mean €	St. error
Chicken	18.99	0.42	13.1	0.7
Other Poultry	10.08	1.24	13.6	2.4
Pigs	2.50	0.00	2.8	3.2
Cows (zebu)	24.06	0.93	3.1	3.2
Total	**55.63**	**2.59**	**32.6**	**9.4**

54.4% of Malagasy farmers possess livestock. Most common are chickens (42.4 %), followed by zebus (22.5%), pigs (10.1%), and other poultry (18.1%), respectively.

Chickens that were self-consumed (18.99€) convert to more cash value than income generated through sales (13.1€), on average. Zebu cattle is rarely sold in the region and mainly eaten during festivities. In general, livestock husbandry is weakly developed in north-eastern Madagascar; zebu cattle and other small ruminants are often imported from other Malagasy regions (Kunz 2018).

The total value of self-consumed livestock in 2018 was 55.6€, on average, and the income generated through sales 32.6€, respectively.

D. Conclusion: Cost of decent living minus value of self-consumed food

In Fairtrade's LIRP model the value of self-produced food is deducted from the cost of decent living.

(i.) Uganda

The total costs of living were estimated at 7297.1€ per year or per day per person this translates into 3.03€ considering the HH size of 6.6 persons. Total value of self-consumed food was 736.4€ (subsistence crops + livestock). Thus, the total costs of decent living is 6,560.7€ per HH per year.

(ii.) Madagascar

The total costs of living income were estimated at 5750.5€ per HH per year or 3.75€ per person per day (considering the HH size of 4.2 persons). Value of self-consumed food was

413€ (self-produced food + livestock). The total costs of decent living is 5337€ per household per year.

3.2. Actual farm size and full employment farm size

a. Land distribution / crop diversification / typical farm model

Farmers were asked which crops they plant on their fields, how many agricultural fields they farm and designated 10 beans proportionally to the different crops on each field. That is, one field was divided into 10 beans leading to an accuracy of 10%.

(i.) Uganda

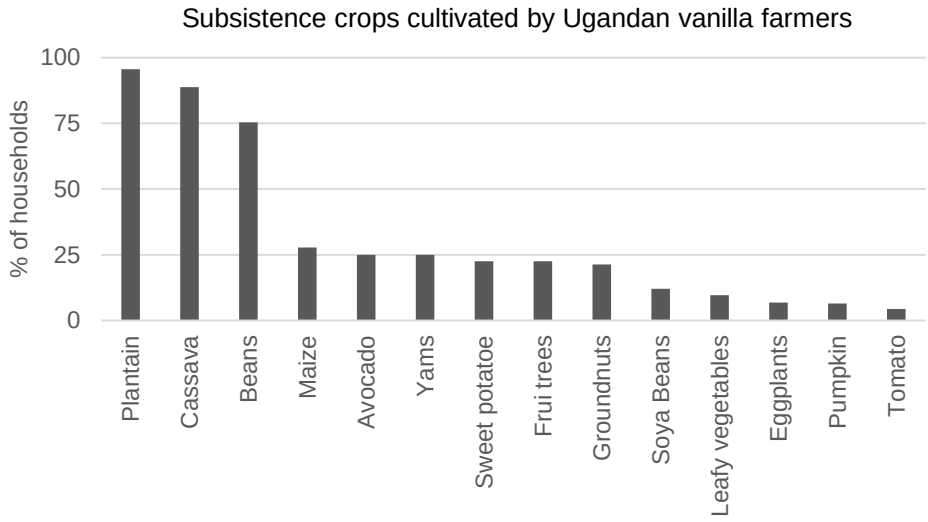


Figure 6: Subsistence crops cultivated by Ugandan vanilla farmers

Ugandan vanilla farmers cultivate, on average, 4.7 different subsistence crops. In the vanilla growing region of Uganda, plantain[10] (95.6%), cassava (88.7%) and beans (75.4%) are the most commonly cultivated subsistence crops. Maize (27.8%), avocado (25%), yams (25.0%) and sweet potato (22.6%) are also common as well as fruit trees (22.6%), mainly mango and jackfruit. Vegetables, however, are less common: 9.7% of the farmers grow green leafy vegetables, mainly *dodo*[11] *and* cassava leaves. Eggplants, pumpkin and tomatoes are only grown by 6.9% - 4.4% of farmers.

[10] In western Uganda a plantain variety locally called *Matooke* is mainly cultivated but many different varieties are common; the same is true for bananas.
[11] *Dodo*, locally often referred to as spinach, belongs to *Amaranthaceae* and is commonly added in small quantities to side dishes.

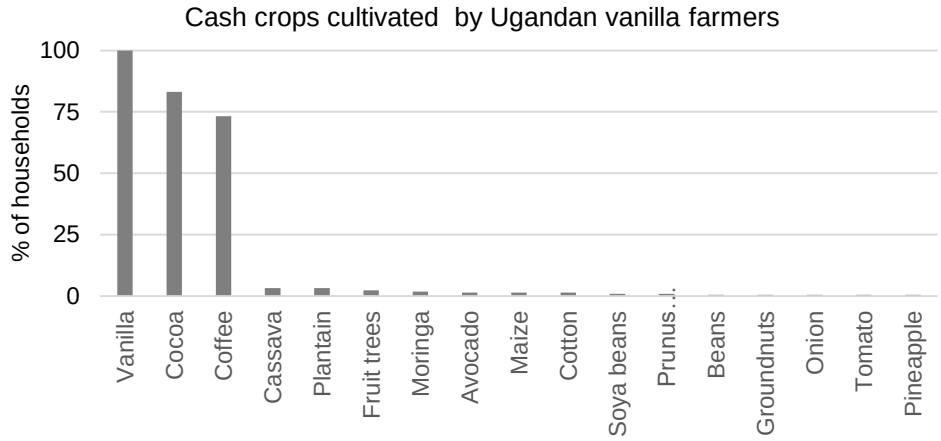


Figure 7: Cash crops cultivated by Ugandan vanilla farmers

Ugandan vanilla farmers cultivate, on average, 2.6 different cash crops. Many vanilla farmers also plant cocoa (83.2%) and coffee (73.2%). However, all other cash crops are cited by less than 4% of farmers as cash crops.

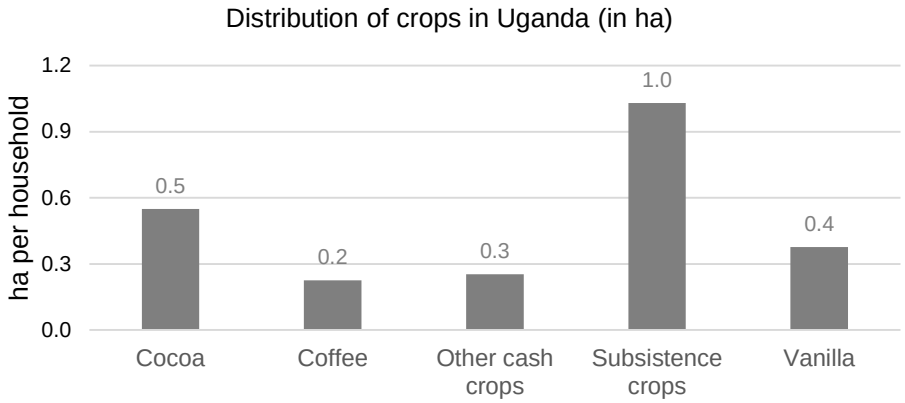


Figure 8: Land sizes distribution of different crops of Ugandan vanilla farmers

On average, sampled Ugandan vanilla farmers have a total of 2.8 $\pm$ 0.1 of agricultural fields. Each field has an average size of 0.8 hectares (ha) $\pm$ 0.1 ha summing up to a total land size of 2.3 ha $\pm$ 0.1 ha per household. Figure 8 shows the land sizes dedicated for subsistence crops (summed), cocoa, vanilla, coffee and other cash crops.

Most of the agricultural fields is used by subsistence crops (1.0 ha in sum), mainly plantain, cassava and beans. Cocoa covers 0.5 ha and coffee 0.2 ha, respectively. Vanilla covers 0.4 ha, on average. “Other cash crops” (0.3 ha) include cotton, soya beans, sugar cane and palm oil.

(ii.) Madagascar

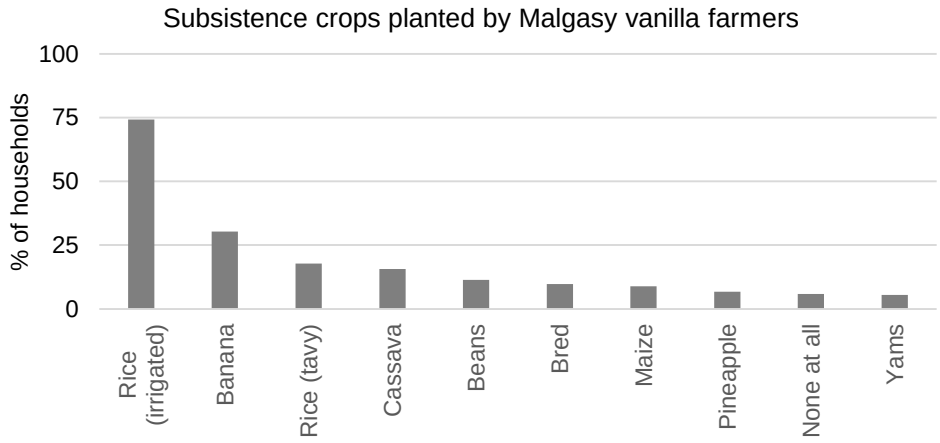


Figure 9: Subsistence crops cultivated by Malagasy vanilla farmers

Malagasy vanilla farmers cultivate 1.9 different subsistence crops, on average. The most common subsistence crop is irrigated lowland rice (74.3%), followed by bananas (30.1%). Hill rice in *tavy* systems, is planted by 17.8% of respondents[12]. Cassava (15.6%), beans (11.4%) and bred (*Acmella oleracea*, 9.7%) are less common. Six percent of the vanilla farmers plant no subsistence crops at all.


Figure 10: Irrigated rice in the Andapa region (left) and hill rice cultivation (right), Source: Annemarie Wurz

Sampled Malagasy vanilla farmers plant, on average, 1.8 of cash crops. Coffee (30.2%) and cloves (13.7%) are relatively common. All other cash crops are planted by less than 7.5% of respondents (Figure 11).

[12] *Tavy* is a slash-and-burn shifting cultivation practice and among the main sources of deforestation in north eastern Madagascar (Zaehringer et al. 2017). Still, the yields of *Tavy* rice (hill) is only around ¼ [th] of irrigated rice.

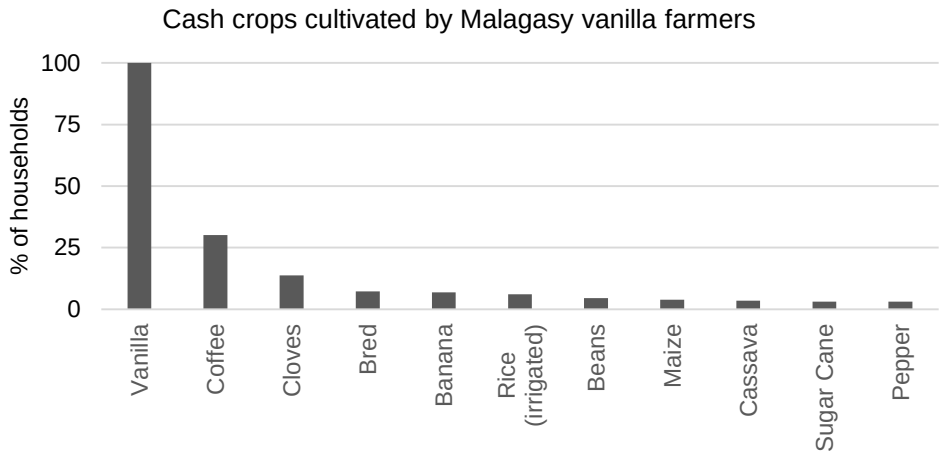


Figure 11: Cash crops cultivated by Malagasy vanilla farmers

The sampled vanilla farmers in Madagascar possess, on average, 2.08 ± 0.06 agricultural fields whereas each field has a size of 0.91 ha ± 0.06 ha, leading to a total land area of 1.89 ha ± 0.12 ha.

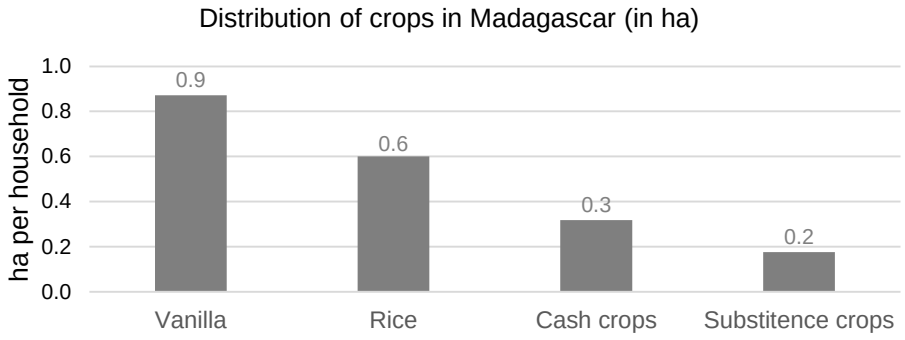


Figure 12: Land size distribution of different crops of Malagasy vanilla farmers

Most agricultural land is covered by vanilla agroforestry systems (0.9 ha), followed by rice (0.6 ha). "Other cash crops" include coffee (0.1 ha), cocoa (0.1 ha) and cloves (0.1 ha); 0.3 ha in sum. Subsistence crops - other than rice - cover in sum only 0.2 ha.

b. "Full Employment" vanilla farm size and land used for other crops

A critical component of this study was to establish a full employment farm size benchmark based the available labour in each HH. This is not to be mistaken as a recommendation to farmers to grow only vanilla; instead this is a critical assumption to establishing a reference price. Because of the real-world high variability in farm size and diversification, the Fairtrade

living income reference price is based on a maximum vanilla area that can be managed primarily through family labour, that is a full employment vanilla farm size. The idea is that if farmers grow vanilla on a smaller area of land, the reference price covers a proportionate share of the living income relative to the full-employment vanilla farm.

In individual interviews vanilla farmers were asked what the maximum farm size would be that they can manage with their own household labour. Vanilla has labour peaks over the year, i.e. vanilla farmers hand-pollinate every single vanilla flower. Labour for pollination is rarely outsourced as flowers have to be pollinated within a short period of time which largely coincides for all vanilla farmers. Therefore, available household labour for pollination is among the main limiting factors for the maximum manageable vanilla area, along with securing the vanilla fields given the current high theft pressure.

Subsequently, assumptions on full employment farm size were discussed in focus group discussion including cooperative leaders, together with different stakeholders and experts, as well as the vanilla industry grouped through the SVI by means of video conferences and a presentation at their General Assembly.

In addition to household labour occupation, the results of this survey showed that "available land to increase vanilla production" was commonly cited as a limiting factor to extend the vanilla area in both countries, indicating that there is land scarcity. For the model, we looked at what crops farmers could give up to achieve a full employment vanilla area. It would be most realistic to transform cocoa or coffee plantations, which also grow in agroforestry systems and require shadow as well as vanilla. Other fields, e.g. subsistence crops, are unrealistic as immediate vanilla plantations since for a successful vanilla plantation trees are necessary as both tutor and shadow trees.

Coffee prices have crashed to a historical low level (FAO 2019). Consequently, the transformation of coffee plantations is currently the most obvious transformation option for this model. Accordingly, field sizes, labour requirements and generated income from coffee are reduced in the LIRP model.

(i.) Uganda

The maximum feasible vanilla area a Ugandan farmer household can manage is 0.8 ha. This was suggested by farmers and confirmed by cooperatives and vanilla companies as a realistic estimation. The main limiting factor for Ugandan vanilla farmers is available HH labour for pollination but currently also for securing the fields (see also d. Labour requirements for vanilla and other crops in 2018). Currently, the average vanilla farm size is 0.4 ha (see Figure 8) but many farmers are enlarging their vanilla plots due to high vanilla prices (own survey data) at the expense of coffee land.

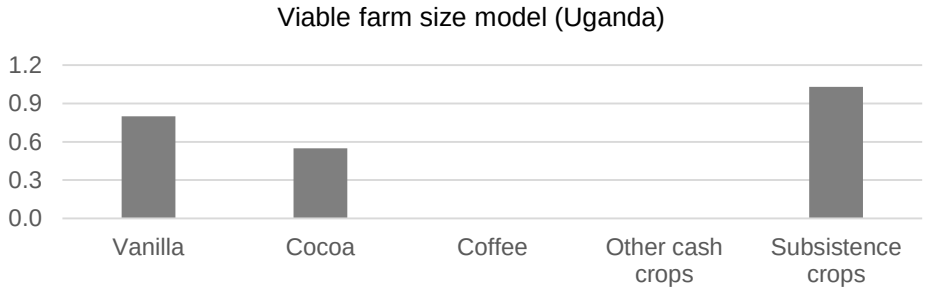


Figure 13: Viable farm size model, crop distribution in Uganda

For this model, we assume Ugandan vanilla farmers would switch from coffee and "other cash crops" to reach the full employment farm size of 0.8 ha. Subsistence crops and cocoa remain unchanged as full employment on the vanilla plot still has labour time available outside of the vanilla peak labour needs to care for these other crops.

(ii.) Madagascar

Malagasy vanilla farmers estimated the full employment farm size at 1.0 ha. This was likewise confirmed by cooperative heads and SVI members as a realistic maximal manageable area by a typical household. As in Uganda, limiting factors are available HH labour for pollination and currently for securing the fields. Presently, the average vanilla farm size is 0.9 ha (see Figure 12).

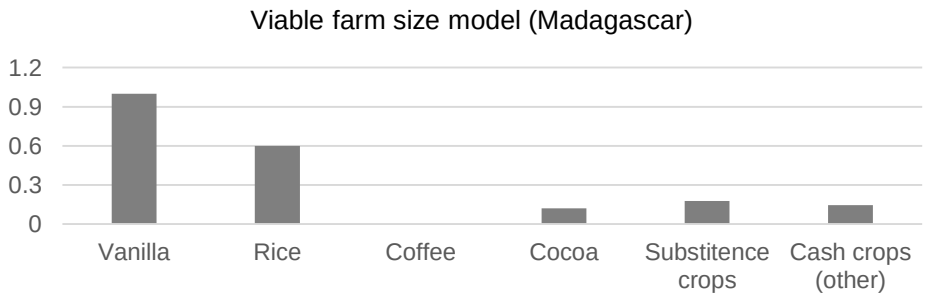


Figure 14: Viable farm size model, crop distribution in Madagascar

c. Household labour availability (FTE) and occupation

(i.) Uganda

Concerning the adult Ugandan population, more females (76.4%) than males (61.2%) work full time on the farm. Yet, more males work part-time on the farm (16.2%), outside the farm (11.6%) or still visit school (11.1%). Looking at non-adults, most household members visit school (75.8% of males and 76.7% of females, respectively) and many non-adult HH members are too young for school, i.e., below 6 years old. The full time equivalent (FTE) is 3.15 persons.

(ii.) Madagascar

Concerning adult HH members, more males (73.7%) work full time on the farm compared to females (47.3%) in Madagascar. On the contrary, more females (33.3%) than males (11.4%) work only part time on the farm or outside of the farm (13.5% of females; 7.6% of males).
Looking at the non-adults, more males than females work full or part-time on the farm. Quite the reverse, more females visit school (66.8%) than males (59.6%).
The FTE is 2.06 persons.

d. Labour requirements for vanilla and other crops in 2018

(i.) Uganda

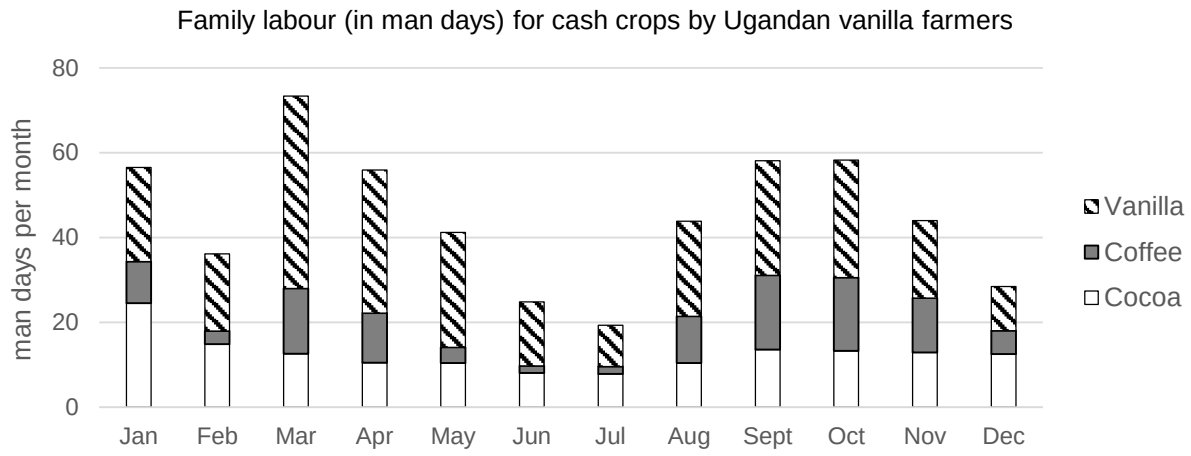


Figure 15: Family labour (in man days) for cash crops by Ugandan vanilla farmers over the year in 2018 (man days were multiplied with the number of household members who contribute)

Vanilla dominates farmer´s family labour throughout the year, however, they have different phases. Labour peaks for vanilla occur between March-May and August-November.

September-November clash with labour needs for cocoa and coffee. As illustrated above, Ugandan vanilla farmers harvest twice a year vanilla compared to only once in Madagascar.

Below, we look more precisely at which vanilla-related activities are practiced over the year.

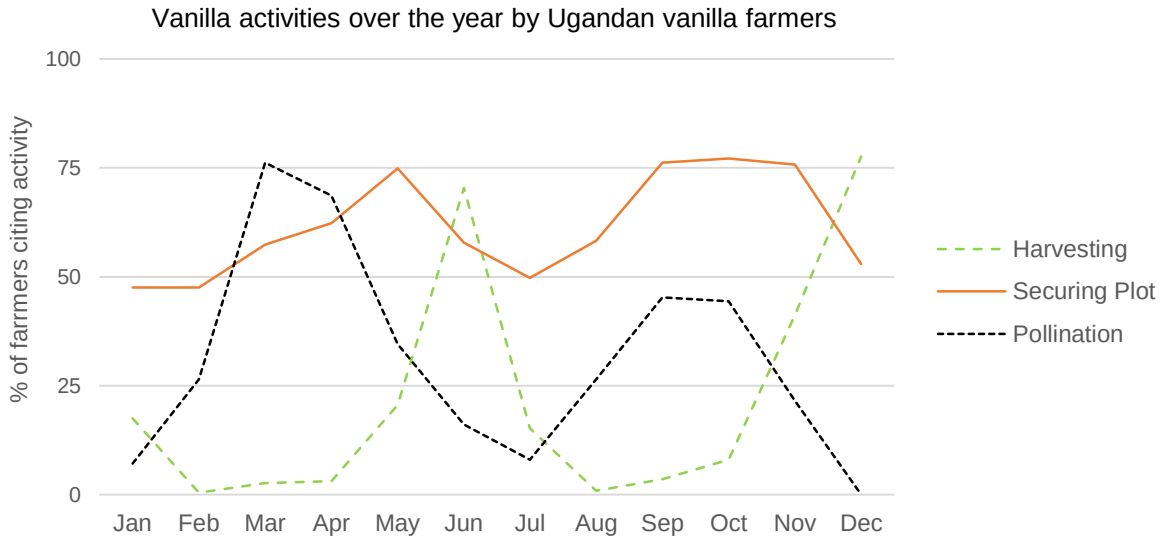


Figure 16: Distribution of agricultural activities (vanilla) over the year in Uganda

As we see in Figure 15 and Figure 16, the agricultural activities conducted by Ugandan vanilla farmers have different peaks.

Vanilla takes around 9 months to ripen (Havkin-Frenkel and Belanger 2011). Consequently, the flowers are pollinated 9 months before harvest, i.e. in March/April and in September/ October (compare Figure 15 and Figure 16). The flowers of the vanilla plant open for some days only, usually when there is sun and mainly in the morning (Havkin-Frenkel and Belanger 2011). Every flower is pollinated by hand as the naturally vanilla pollinating bee from the *Melipona* genus, originating from Mexico, has never been introduced in other parts of the world successfully. Also, its pollination rate is insufficient for vanilla production on an agricultural scale (Rodolphe et al. 2011). Accordingly, pollination is among the most labour-intense activities (see Figure 16). The month of March, in which vanilla is pollinated to be harvested in December is the labour peak (see Figure 15). Pollination requires skills and experience by the farmer. Harvesting is mainly done between May-June and October-December indicating that many farmers harvest their vanilla prematurely.

Given the current high prices of vanilla, securing the vanilla plots is also an exceptional labour-intense activity (Figure 16), particularly before the harvest seasons, i.e., in May and September-

November before the main harvest. Some farmers sleep on their fields for several weeks, others arm themselves (63.9%), engage security guards (27.8%), build fences, install traps on their fields or buy dogs (see Figure 17).

Figure 17: Vanilla fields that are fenced (left) and security dogs on vanilla plots (middle) in Uganda (Source : own photos). Right: Traps being installed on vanilla fields in Madagascar (Source: Johannes Osewold)

Apart from the farm activities -from a chronological perspective- in the following section we will also look at who does the different activities, i.e. male/female HH members, community members or hired labourers.

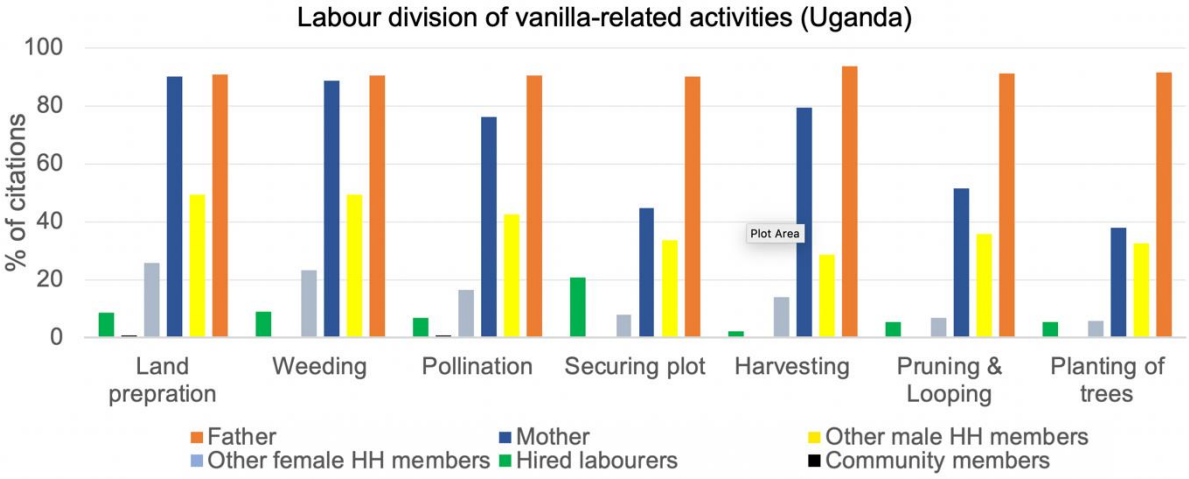


Figure 18: Labour division of vanilla-related activities in Uganda

Particularly planting of trees, pruning & looping and securing of the plot is mainly done by the father of the HH. However, mothers contribute to all activities, particularly to land preparation, weeding and harvesting. Land preparation, weeding, pollination and harvesting are more or less done equally by the mother & father. While many vanilla-related activities are equally done by the mother and the father of the HH, "other male HH members" contribute more commonly than "other female HH members" to vanilla related labour (see Figure 18).

Hired labourers are mainly engaged by farmers for securing the plots (by 20.7% of farmers) and to a smaller degree for land preparation (8.6%), weeding (9.1%), pollination (6.9%), harvesting (2.4%), pruning & looping (5.5%) and planting of trees (5.4%). Support by community members is uncommon: ~1% of respondents cite their support for land preparation and ~1% to pollination, respectively.

(ii.) Madagascar

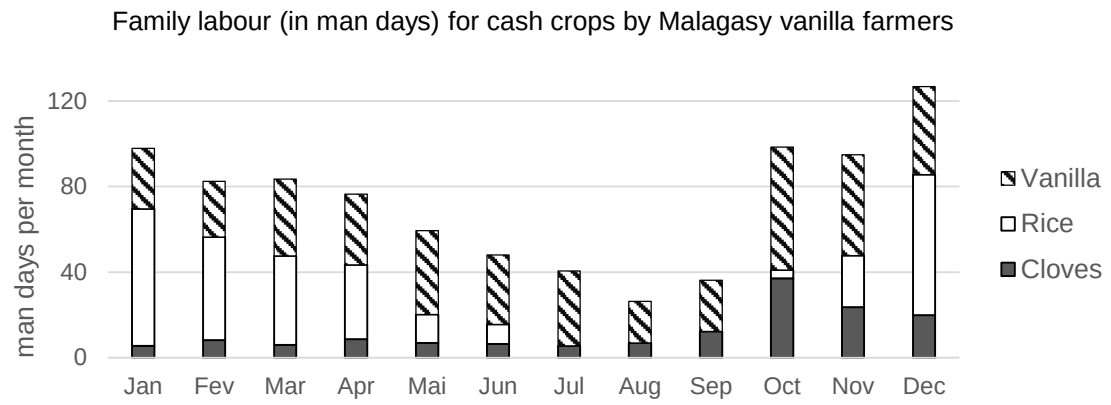


Figure 19: Family labour (in man days) for cash crops by Malagasy vanilla farmers over the year in 2018 (man days were multiplied with the number of household members who contribute)

In Madagascar, vanilla dominates HH´s family labour in October and November and has another peak between March-July. December-March overlap with labour needs for rice. Labour for rice increase gradually from November-January and remains high from February-April. Cloves, a less important cash crop, demands less labour and is harvested around October-November. In Figure 20 we will look more precisely at which vanilla-related activities are practiced over the year.

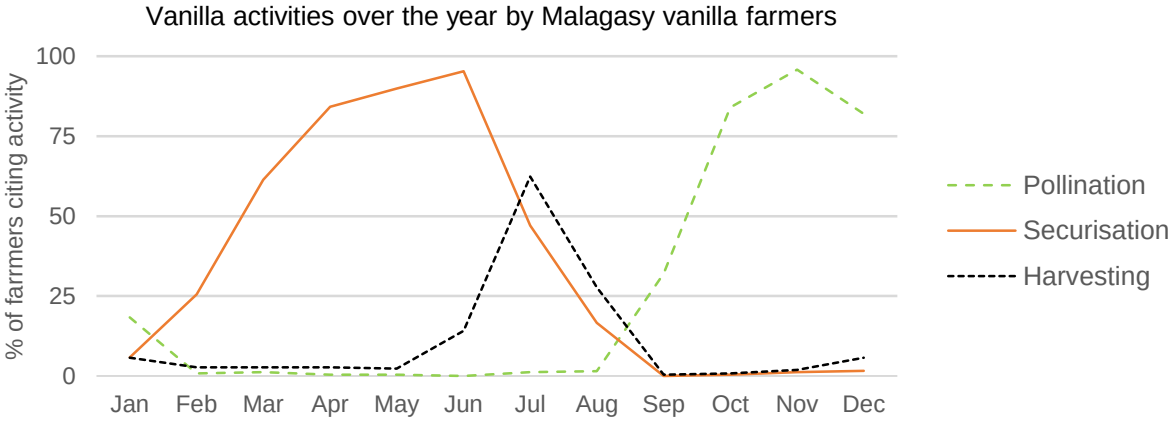


Figure 20: Distribution of agricultural activities (Vanilla) over the year in Madagascar

In Madagascar, pollination occurs at the end of the dry season with its peak between October-December. As well as in Uganda, vanilla needs 9 months to ripen from pollination to harvest.

However, in Madagascar only one vanilla harvest per year is possible. Harvesting is mainly done between June-August, depending on the geographical region. The Antalaha and Sambava districts are predominantly in the littoral and intermediate zone, while the western Andapa district is mostly in the mountainous zone. The Andapa region is around 500 m above sea level and has a different climate than the littoral zone. Therefore, the maturity as well as the harvest dates for green vanilla differ here. 25% of the sampled farmers start securing the fields already in February and continually increase guarding their fields from March (61.4%) until June (95.4%), just before harvesting.

Some farmers arm themselves as a response to theft (27.9%), harvest vanilla premature (14.7%), hire guards (8.9%) or install traps on their fields (see Figure 17).

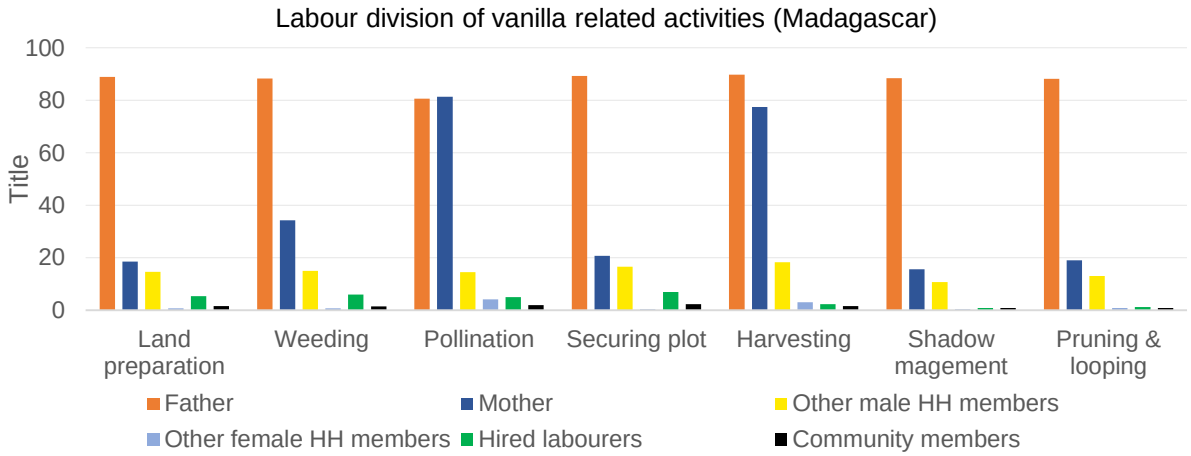


Figure 21: Labour division of vanilla-related activities in Madagascar

In Madagascar, many vanilla-related activities are done by the father and "other male HH members". Pollination is done equally by the father and mother; mothers also contribute substantially to harvesting. However, land preparation, weeding, shadow management/planting of trees are largely done by the father of the HH. Other male HH members contribute particularly to harvesting, securing the plot and weeding. Hired labourers, however, are currently rarely engaged. Mainly for guarding of the fields (6.9%), weeding (6.0%), land preparation (5.4%) and pollination (5%).

e. Labour requirements for viable vanilla farm size

We asked respondents what their household labour distribution would look like if they would farm exclusively vanilla, i.e. on a full-employment vanilla farm size.

Figure 22 and Figure 23 show what the labour distribution would look like on a viable farm size throughout the year as compared to the labour distribution in 2018, based on actual vanilla farm sizes and production.

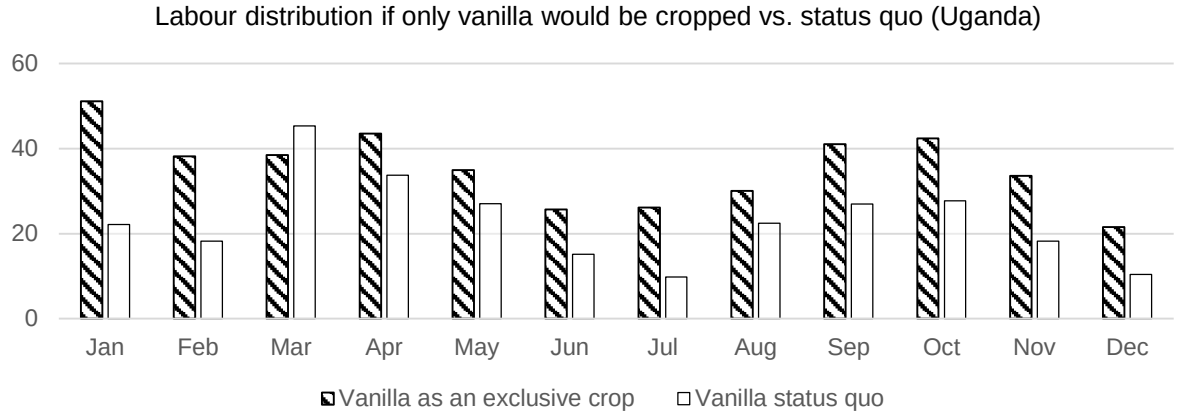


Figure 22: Distribution of family labour (in man days) in viable farm size model compared to the labour distribution in 2018 (Uganda).

Vanilla has labour peaks (pollination, harvesting, currently securing the fields) and even when the maximal labour by a HH would be used for vanilla, a vanilla farm would not be a full employment farm size during the entire year. However, if vanilla would be planted exclusively, there would be additional labour needs for vanilla to be able to farm the size 0.8 ha. Total man days used for vanilla are ~twice as high per year than compared to "status quo" in Figure 22, suggesting around a twofold increase in labour dedicated to vanilla, which is in line with the suggested farm size increase from 0.4 to 0.8 ha.

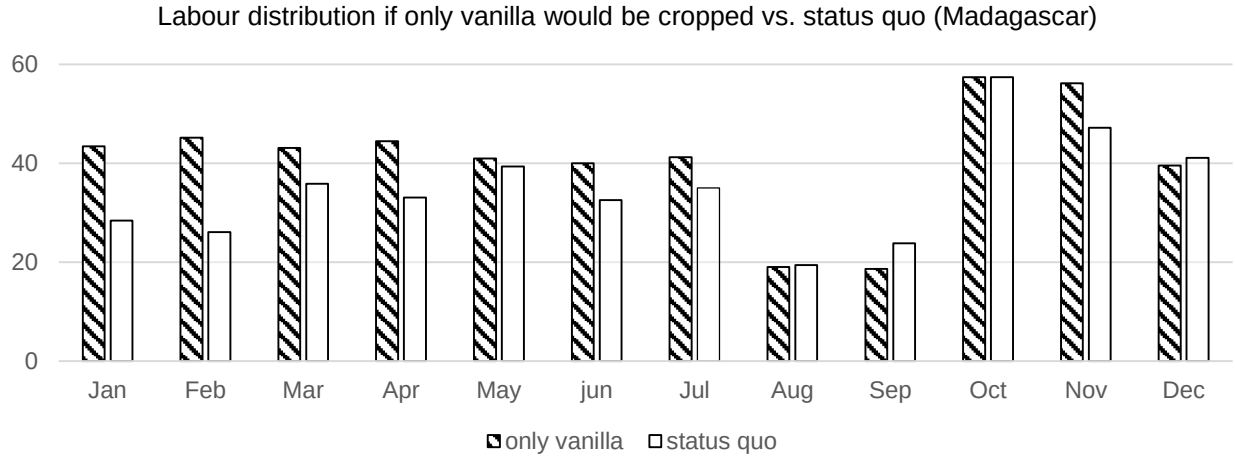


Figure 23: Distribution of family labour (in man days) in viable farm size model compared to the labour distribution in 2018 (Madagascar).

If Malagasy vanilla farmers would exclusively crop vanilla, less labour increases would be needed compared to Uganda. This is because the average farm size (0.9 ha) is already close to the viable, target farm size of 1.0 ha. The average increase in labour would be between 10-20%.

In fact, full employment farm sizes have become reality for many Malagasy vanilla farmers, particularly in the Littoral (eastern SAVA region), where farmers increasingly rely exclusively on vanilla income.

f. Conclusion full employment farm size and labour

If vanilla farmers in both Uganda and Madagascar increase their vanilla field sizes to the target "full employment" field sizes, the field sizes and labour requirements will go in exchange for other fields, most likely coffee.

(i.) Uganda

In Uganda the viable vanilla field size was established at 0.8 ha for the living income reference price model. In order to realize this vanilla area, current coffee and other cash crops would likely be sacrificed, whereas the more profitable cocoa farm area as well as subsistence crops would remain stable. The labour currently invested for coffee would go into the vanilla so as to be able to manage a viable farm size (compare Figure 19 & Figure 22).

This scenario reflects the reality on the ground. In fact, coffee is increasingly abandoned in the area and -according to respondents- does not perform well when intercropped with vanilla. Vanilla could also be intercropped with cocoa as it has similar labour peaks (see Figure 15) and has shown promising results in other countries (Hernandez-Hernandez 2011, Borbolla-Pérez et al. 2017). Compared to Madagascar, less land could be managed as there are higher labour requirements due to two vanilla harvests in Uganda.

(ii.) Madagascar

In Madagascar the viable field size is 1.0 ha for the reference price model. This would be a marginal change to the current farming settings. Coffee would likely be abandoned, while rice, cloves and subsistence crops remain stable. The additional labour requirements for vanilla could come from the transformed coffee farms.

3.3. Sustainable yields

In focus group discussion, farmers estimated and discussed what would be the maximum of vanilla that they can produce on the viable farm size presented above, by implementing the recommended good agricultural practices and density of vines. The time frame discussed was

5 years in order to account for specific events, i.e. cyclones in Madagascar or droughts in Uganda, events that occur occasionally in both countries. For vanilla production and the months in which it was sold in 2018, see Appendix 15.

a. Maximal feasible yields

Agronomic research has shown that vanilla vines can produce around 0.5 kg/year. If a recommended spacing of 3m*3 m is kept by the farmer, this would lead to 1,100 plants/ha and to a production of >500 kg per year. However, only 1% of farmers in both Uganda and Madagascar meet that target productivity, often due to risk aversion behaviour by farmers. In both Uganda and Madagascar, many farmers are afraid of theft and price instability, which limits investments into vanilla farms. Investments needed include replanting of vanilla vines, maintenance of existing vines, active planting of tutor and shadow trees, shadow management and no over-pollination of vanilla flowers. However, the "full employment farm size" has become reality for individual farmers in the SAVA region in Madagascar, particularly in the Littoral and some farmers have reached the target productivity and beyond (see Appendix 19).

(i). Uganda

In Uganda, vanilla farmers estimated that they can produce 400kg on the viable farm size of 0.8 ha (500 kg/ha). This was confirmed as a reasonable assumption by cooperative and vanilla companies through the review process. The yields are based on two harvest a year, a "big" one around December and a "small" one around June (see Appendix 16). Yet, the average harvest in 2018 was only 65.3 kg on an average vanilla plot of 0.4 ha (163.3/kg/ha[13]). However, the variation was large (see Appendix 17).

(ii.) Madagascar

In Madagascar, farmers estimated a maximal feasible field size of 1 ha leading to a harvest of 350 kg green vanilla. This was likewise confirmed as realistic target productivity by different stakeholders. Farmers agreed that in good years, more might be feasible. However, there is a high probability that the region is hit every 4-5 years by cyclones, which would destroy at least parts of the harvests. Looking at the difference in harvests to Uganda, it has to be considered that in Madagascar there is only one vanilla harvest per year.

[13] Concerning the self-reported vanilla harvests in both countries, these may be underreported as vanilla farmers often practice side-selling. That is, parts of the green vanilla could be sold prematurely and another share through a cooperative, which does not accept prematurely harvested green vanilla, and/or farmers may sell vanilla in other periods due to immediate cash needs.

The average harvests, however, was only 49.2 kg of green vanilla on an average farm size of 0.9 ha. Likewise, the variation in harvest was large (see Appendix 19).

The differences in vanilla (target) harvests between the two countries reflect the realities on the ground. In Uganda farmers tend to plant vanilla intensively along with plantain/banana and fruit trees, whereas in Madagascar farmers tend to plant vanilla much less intensively vanilla in agroforestry systems within the forests.

b. Other farm-income when considering a typical, diversified full employment farm size

As shown above, this (simplified) farm model assumed that the increased vanilla farm size would come from the transformation of coffee to vanilla plots in both countries. Value of self-produced food remains stable in both countries.

(i.) Uganda

In Uganda vanilla farmers would lose income from coffee (239.0€, on average) and "other cash crops" (5.3€, on average). Net income from cocoa (998.7€) and livestock (212.2€) would remain stable. Thus, other farm-income sums up to 1210.9€ when considering a viable vanilla farm size.

(ii.) Madagascar

In Madagascar, an average vanilla framer would lose income from coffee (27.3). Average income from cloves (42.7€), rice (70.2€), livestock (32.6€), would remain stable.
Thus, "other farm-income" sums up to 149.8€.

c. Conclusion: total target vanilla yields from viable vanilla plot size and estimated income from other crops in typical farm model

(i.) Uganda

The target yield in Uganda is 400 kg of green vanilla, whereas other farm-income, mainly cocoa, is 1201.9€, on average.

(ii.) Madagascar

In Madagascar, the target vanilla yield is 350kg of green vanilla produced on 1.0 ha. Other farm-income is, on average, 149.8€ mainly cloves and rice.

3.4. Cost of Sustainable production

Vanilla is a plant that is "organic by default" (cf. Brownell 2011) and mainly involves costs for hired labourers and some equipment, such as vanilla lianas, knives, bags and security equipment, i.e., torches and batteries. All agricultural activities are done manually, and no agricultural inputs are used, such as fertilizer or pesticides.

a. Description of different cost items

The survey and particularly the focus group discussions showed a twofold trend. The hired labour expenses for securing the vanilla plots are currently high and were the main production costs for vanilla. On the other hand, relatively few farmers currently engage labourers at all as many farmers have been victims of theft and don´t allow non-family members to enter their fields. Some reported to have been victims of theft through hired labourers, some also through own family members.

Many farmers confirmed that in low-price phases they would engage more frequently hired labour for pollination and harvesting, that is, if vanilla prices would be lower they would more frequently engage labourers as there would be less theft pressure.

(i.) Uganda

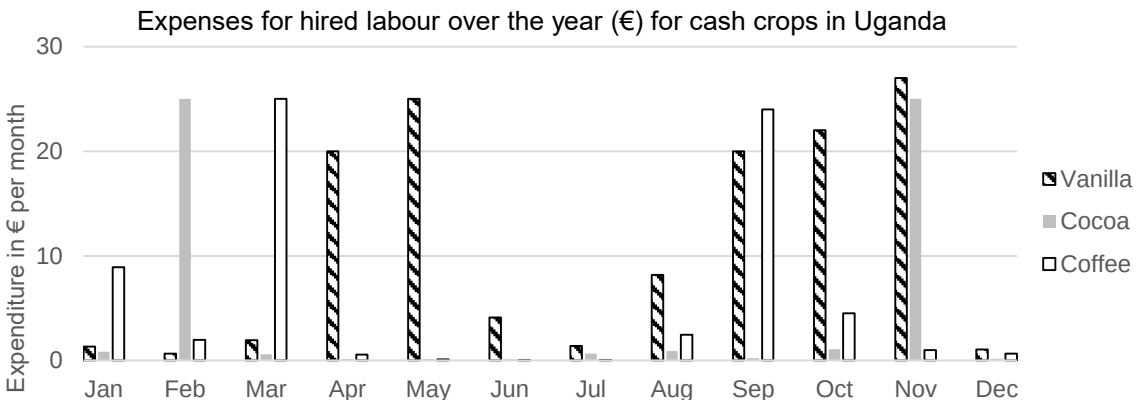


Figure 24: Expenses for hired labour for cash crops in Uganda

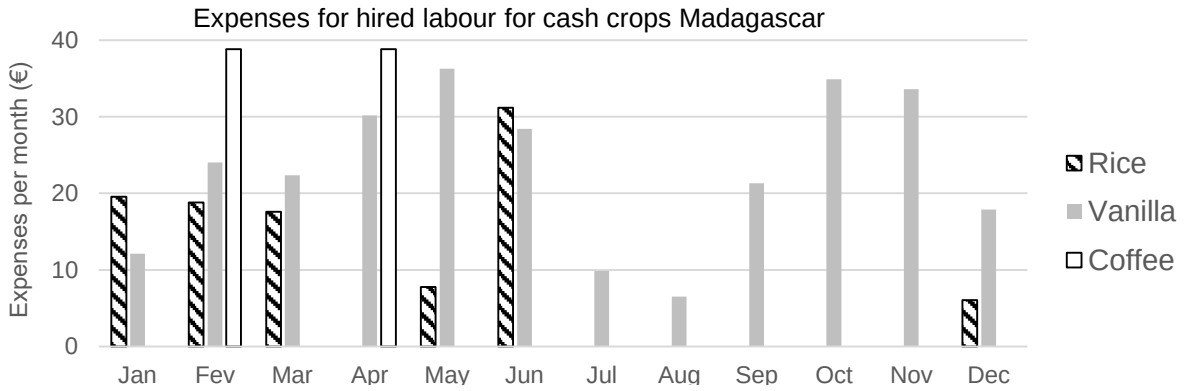
43% of surveyed vanilla farmers engage hired labour for cash crops in general, while 26% also engage labourers for vanilla. >1% of the surveyed farmers engage labourers for subsistence crops. As illustrated in Figure 18, hired workers are often engaged for guarding of vanilla fields and in Figure 24 we see that the months in which labourers are engaged are the months before the harvests in April-May and September-November.

Regarding vanilla, the hired labour costs sum up to 132.6€ ± 57.0€ for the year of 2018

Figure 24). Considering that the average vanilla plot has a size of 0.4 ha (see Figure 8), costs for hired labour translate to 349.0€ ± 151.5€ per ha of vanilla, correspondingly. However, hired labourers are not paid in living wages, labourers receive ~1.4€ per man day, on average.
Hired labourers for coffee and cocoa are mainly engaged during harvests and sum up to 54.8€ for cocoa and 55.7€ for coffee in 2018. Considering that the average field size of cocoa is 0.55 ha and 0.23 ha for coffee (see Figure 8), hired-labour costs sum up to 122.8€ for cocoa and 242.3€ for coffee. However, the variances were large as some farmers only have cocoa, others only have coffee, and many abandoned their coffee plantations around the time of this survey[14].

Other listed equipment costs by Ugandan vanilla framers are vanilla lianas, knives, silon bags for transportation and security equipment, i.e. torches and batteries summing up to 69.9€ per year per HH. Chemical inputs or fertilizer were not cited by any respondents.

(ii.) Madagascar



[14] Coffee prices crashed early 2019 and many farmers converted their plots or sell their plantations' harvest in advances to low prices, similar to what in Madagascar´s vanilla market is known as "*Contrat de fleurs*", i.e. getting credit and/or selling the harvest before it is harvested. However, this also means that the coffee farmers don ´t invest labour in their coffee plantations for a certain time.

Figure 25: Expenses for hired labour for cash crops in Madagascar

Local vanilla farmers barely engage hired labourers for cash crops other than vanilla and rice. Concerning vanilla, hired labourers are mainly engaged during the months where danger of theft is current (Feb-May, cf. Figure 20 & Figure 25) and partly for pollination (Sep-Nov, see Figure 25). Yearly hired labour costs for vanilla sum up to 288.0€ for an average farm size of 0.9 ha, that is, 310.74€ per ha. Hired labourers are not paid in living wages, labourers receive, on average, 2.3€ per man-day in Madagascar. Other (non-labour) expenses are in sum 29.1€ ± 17.8€, mainly vanilla lianas/vines and material for guarding the fields such as torches and batteries. No agricultural inputs were cited.

b. Analysis of security costs for LIRP

If vanilla prices drop to LIRP level, the labour costs for securing the plots would most likely reduce. However, other costs would remain stable or increase in order to meet the target productivity. As illustrated, the largest cost item is labour for securing the field. We assume that other costs remain stable as for a viable farm size more household labour is available as coffee is abandoned, and security costs decrease.

(i.) Uganda

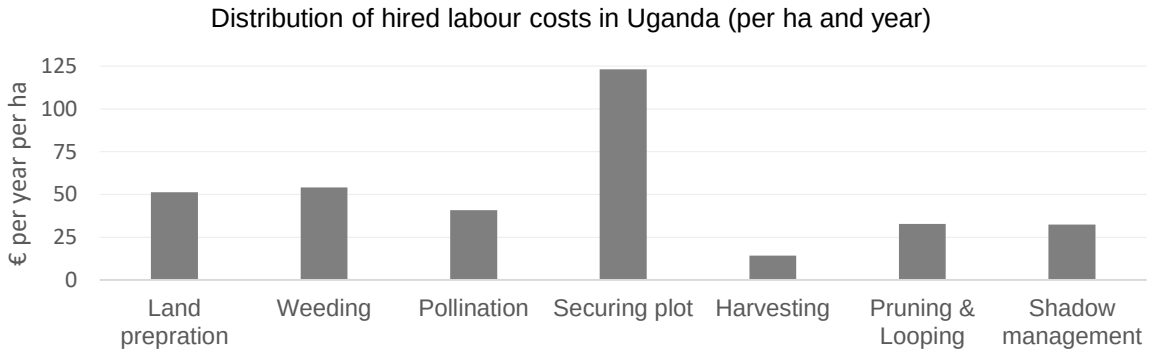


Figure 26: Distribution of hired labour costs in Uganda per ha in 2018

35% of all hired labour costs are paid for securing the fields (123€, on average, converted to ha). We are assuming that security costs would decrease by 50% if vanilla price would drop to a LIRP level. That is, total hired labour costs per ha would be 287.4€/ha. As illustrated above, labourers receive ~1.4€ per day, on average.

(ii.) Madagascar

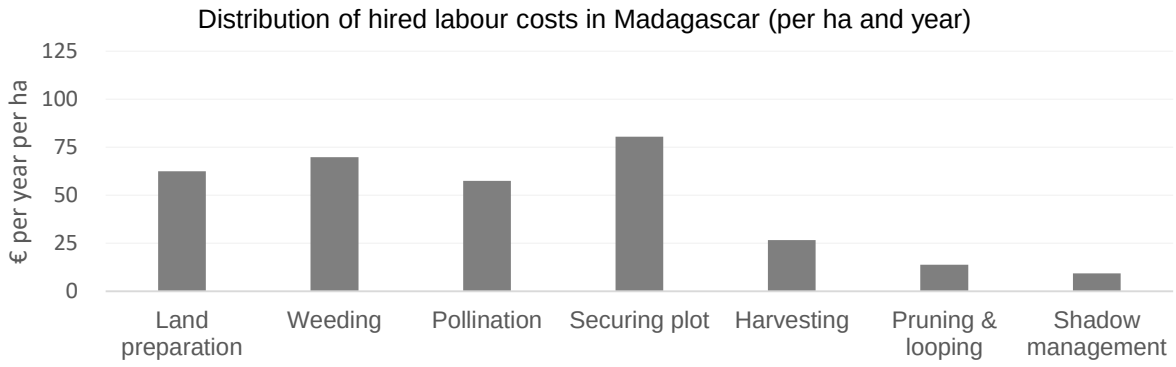


Figure 27: Distribution of hired labour costs in Madagascar per ha in in 2018

In Madagascar, 26% of all hired labour costs are expensed for securing the plot (80€, on average). We assume that security costs decrease by 50% and all other cost remain stable.
That is, total hired labour costs sum up to 279.8€ per year per ha. Hired labourers receive, on average, 2.3€ per man-day.

c. Living Wage and cost of hired labour

For the calculation of living wages, we use data by Guzi and Kahanec (2017) for Uganda and wageindicator.org (2019) for Madagascar. The LW in Madagascar is an averaged value from the ranges presented by wageindicator.org (2019).

(i.) Uganda

The LW for a typical family in Uganda at 3.7€ per day (Guzi and Kahanec 2017). However, on average, hired labourers received only 1.4€ per day in 2018. Converting the hired labour costs presented above into LW, the hired labour costs convert into 922.4€ per ha of vanilla per year.

(ii.) Madagascar

LW is estimated at 4.4€ for a typical HH (wageindicator.org 2019). However, in Madagascar, hired labourers received only 2.3€ per man day in 2018, on average.
If hired labour costs are converted into living wages, hired labour costs sum up to 594.5€ per ha of vanilla per year.

d. Conclusion: Total cost of vanilla production per hectare, when living wages are paid and realistic security expenses

(i.) Uganda

Hired labour paid at living wages is 922.4€ + additional equipment (174.8€) = 1097.2€ per ha per year. **Thus, the yearly production costs for a target productivity and viable farm size (0.8 ha) are 877.7€ per year.**

(ii.) Madagascar

Hired labour per ha per year paid at living wages is 594.5€ + additional equipment (32.3€) = 626.8€ per ha per year. **Thus, the yearly production costs for a target productivity and viable farm size of 1.0 ha are 626.8€ per ha per year.**

The difference in production costs in both countries can be explained by two harvests in Uganda contrary to a single one in Madagascar. Also, as there are fewer vanilla farmers in Uganda, e.g. vanilla lianas and other material is scarce and more expensive than in Madagascar.

3.5. Overview and LIRP calculations

As a summary of selected data presented before, Table 14 summarizes key variables that will be used in the final LIRP models.

Table 14: Summary of key variables for LIRP models in Uganda and Madagascar

Variable*	**Uganda**	**Madagascar**
Farm size total (ha)	2.4	2.08
Vanilla (ha)	0.4	0.9
Full employment vanilla farm size (ha)	*0.8*	*1.0*
Hired labour/year (without living wages)/ha	349.3€	310.7€
Other production costs (equipment)/ha	174.8€	32.3€
Hired labour at living wages /ha/year	*922.4€*	*594.5€*
Production costs (incl. living wages)/ha/year	*1097.1€*	*626.8€*
Farm gate price green vanilla in 2018 (€)	50.4	38.2
Vanilla yields (kg /green/2018)	65.3	49.2
Max. feasible yield per ha of green vanilla (kg)	*500*	*350*
Net income from other farm sources	*1210.9*	*149.8*
Value of self-consumed food	*736.4*	*413.0*
Household size	6.6	4.2
Living income benchmark (per household and year)	*7 297€ / year*	*5 751€/year*
*Extreme poverty line (1.9$/person/day)***	*3090€ / year*	*1592€/year*

** in italic & grey background= model estimations*
** Power Purchasing Parity (PPP) exchange rates applied based on IPC (2011)

3.5.a Price models in relation to poverty line and LIRP in Uganda

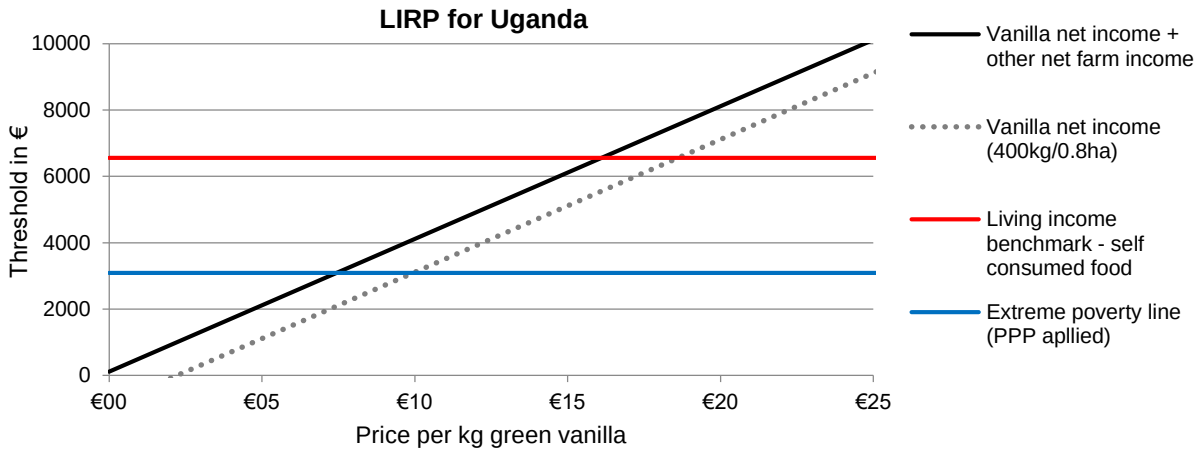


Figure 28: Reference Price for target productivity of Ugandan vanilla farmers

Figure 28 illustrates the price needed for vanilla farmers in Uganda in relation to living income and poverty line (PPP applied), when the target productivity of 400 kg of green vanilla is achieved on 0.8 ha. As the model shows, a price of 9.9€ allows farmers to reach the poverty line level, and a price of 18.6€ to reach living income if we consider vanilla net income only. **However, if we consider vanilla net income & other net farm income (1210.9€), a price of 7.7€ is needed to reach the poverty line level, and a price of 15.6€ (17.2$) to reach living income.**

3.5.b Price models in relation to poverty line and LIRP in Madagascar

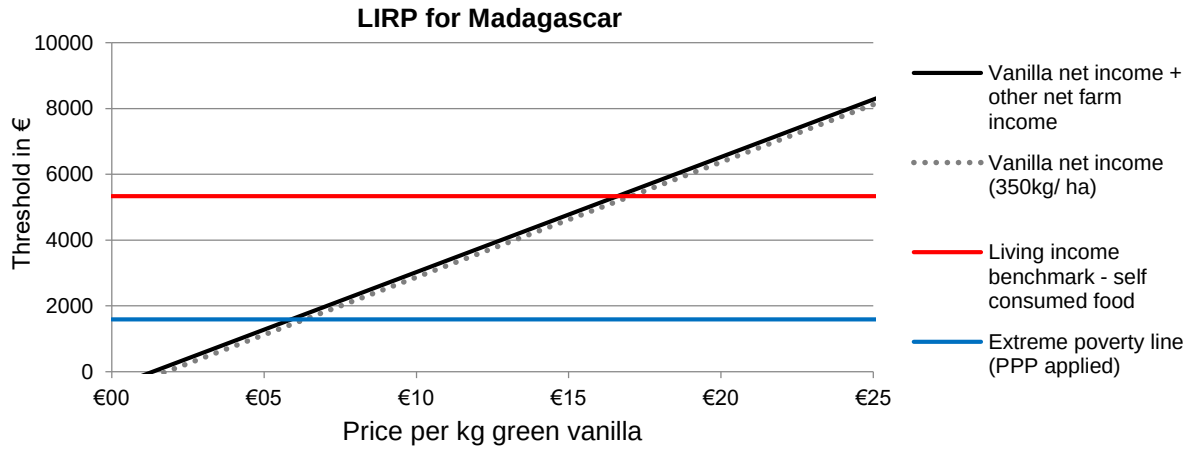


Figure 29: Reference Price for target productivity of Malagasy vanilla farmers

Figure 29 displays the priced needed for Malagasy vanilla farmers to achieve LI and poverty line (PPP applied) when the target productivity of 350 kg green vanilla is accomplished.

Looking at net income from vanilla only, a price of 6.3€ would be needed to be on the poverty line level and a price of 17.0€ to reach living income. **If we consider vanilla net-income and other net farm income (of 150€), there is marginal difference: a price of 5.9€ is needed to reach poverty line and 16.6€ (18.4$) to reach living income.**

7. Discussion and Conclusion

This report highlighted that the context of vanilla farming and the livelihoods of Ugandan and Malagasy vanilla farmers are distinctive. Ugandan vanilla farmers have diversified farms, multiple income sources and are largely food self-sufficient. The data presented for Malagasy vanilla farmers show the opposite. The livelihood diversification of Malagasy vanilla farmers is weak, food self- sufficiency low and vanilla farmers increasingly rely on vanilla proceedings for their livelihoods. In Madagascar, an average vanilla farmer grows only 1.9 subsistence crops and 1.8 cash crops compared to 4.7 subsistence crops and 2.6 cash crops in Uganda.

However, farmers in both countries cultivate similar crops, currently receive high vanilla prices and face high theft pressure. Also, the analysis shows that - even though there are differences in vanilla target productions, living income and HH sizes - the LIRP for both countries is fairly similar. In the following we will briefly discuss the findings presented above.

7.1 Living Income

Living income was estimated at 3.03€ per person per day in Uganda and 3.75€ in Madagascar, respectively. This is roughly in line with other findings, for Madagascar rather in the higher living income ranges (Wageindicator 2019). When deducting the value of self-consumed food, the costs of a decent living convert to 2.5€ (Uganda) and 3.5€ in Madagascar, respectively.
However, comparisons particularly for Madagascar are tricky as most databases and reports only differentiate between rural/urban areas. In Madagascar, rural areas are geographically, economically and ethnically very different. The SAVA region is the most isolated on the island making all transportation expensive. Furthermore, due to high vanilla prices, there is a regional inflation and a lot of cash circulating. As the data for this study is based on original data from 2019, inflation is accounted for in relation to vanilla prices in this year, but the living costs are likely to change in the future if vanilla prices fall. Therefore, living incomes studies should be continually updated and can be based on key indicators, such as food costs (Anker & Anker 2017).

Education is expensive in Uganda and an average vanilla farmer has around 3 children visiting school. Other, non-food costs are proportionally higher in Uganda to Madagascar due to larger HH sizes. Even if Malagasy households are smaller than Ugandan households, the living costs are higher for Malagasy vanilla farmers than for Ugandans on a per person rate. It is the food prices that contribute most to the costs of living and food costs are higher in Madagascar than in Uganda. In Madagascar, this is amplified through low land dedicated to subsistence crops (Figure 12), low production of subsistence crops (Table 10), low food self-sufficiency (Appendix 13) and fairly high food expenditures, both looking at the actual food expenditure data from 2018 (Appendix 12) and the model diet (Table 4).

Even though Madagascar is among the top per capita rice consumers globally, and the large share of the population are farmers (World Bank 2015) it is far from being food self-sufficient and a lot of food, particularly rice, is in fact imported (FAOstat 2019). As Madagascar is an island, far from the African continent, and its infrastructure is weak, all imports and transportation are expensive supporting the high food costs in the model diet. On the contrary, the Ugandan Rwenzori area has a vibrant trade with the Democratic Republic of Congo, Ruanda and other areas.

In view of the value of self-produced food by Ugandan vanilla farmers (687.4€, see Table 10), value of self-consumed livestock (49.01€, see Table 11) and total food expenditures (1004.4€, see Appendix 9), the cash value of consumed food in 2018 sums up to 1740.8€ ± 257.9€. Hence, the model diet in Table 4 differs to 1370€ to the sampled costs in 2018. The main reason is that local farmers don´t have a sufficiently healthy & diverse diet, which is line with recommendations by the FAO/WHO that would be more expensive. Instead the cheapest food sources are most frequently eaten, which are not nutritious and weakly diversified, however. Also, the quantities of food intake may not be sufficient. In fact, malnutrition is common in the area, particularly among children, and many regional inhabitants are stunted or suffer from other physical underdevelopments (Tumwine and Barugahare 2002, FAO 2010, Biondi et al. 2011, WFP 2019).

For the case of Madagascar, the picture looks different. Looking at the value of self-produced food (357.9€, see Table 12), value of self-consumed livestock (55.63€, see Table 13) and total food expenditures (811.7€, see Appendix 12), the cash value of consumed food sums up to 1224.4€. Hence, the model diet (2597.2€) is ~ twice as high as the sampled costs in 2018. The

reason is that food costs for a healthy diet are more expensive and farmers are far from having a diverse and healthy diet that is in line with recommendations by FAO/WHO.

Despite a huge regional agricultural potential of the SAVA region and a lot of vanilla cash currently circulating, the nutritional status of many Malagasy vanilla farming HHs is in fact alarming. Many local people are underweighted and their Body Mass Indexes indicate a chronic energy deficiency (CREAM 2013, USAID 2018). Even though north-eastern Madagascar displays a better picture than other regions in the country, malnutrition is common in the area. 40 - 60% of the children suffer from anaemia, underweight, stunting and "low height for age" as there is an unbalanced food diet and insufficient food quantity and quality (WFP 2016, USAID 2018). Low-cost nutritious foods -other than rice-, however, is inadequately integrated into the regional kitchen culture. One of the reasons is the weak infrastructure -isolating northeastern Madagascar from other parts – and the lack of fridges and food storages; food rots quickly in the tropical climate. Considering the disadvantages mentioned, rice has obvious advantages for the farmers as stable crop.

As illustrated, subsistence crops are insufficiently planted and weakly diversified by Malagasy vanilla farmers (see Figure 9). Consequently, many local people don't have a diverse diet as only locally produced food, particularly rice, is commonly eaten (see Appendix 11).

Another key finding through the focus groups was that many Malagasy vanilla farmers (particularly in the Littoral) confirmed findings from the HH surveys, i.e., that they are increasingly abandoning subsistence crops as they demand too much labour and are not paying off compared to vanilla. Thus, many farmers expect that vanilla prices will remain high, which may bring them in a vulnerable situation if vanilla prices fall again.

7.2 Price scenarios and production costs

If vanilla prices decrease and most likely so does theft pressure, production costs will likely decrease in relation to vanilla price. However, in the price models in Figure 28 & Figure 29, production costs contribute only a marginal difference to the LIRP *vis à vis* living income and the high value of vanilla. Given the biology and farming systems of vanilla, production costs are generally low, particularly compared to other agroforestry commodities, e.g. coffee and cocoa. If production costs would in- or decrease by 500€, the LIRP would change only ~ ± 1€.

7.3 Feasible production /farm size

Agronomic research has shown that vanilla vines can produce around 0.5 kg/year. If a recommended spacing of 3m*3 m is kept by the farmer, this would lead to 1,100 plants/ha and to a production of >500 kg per year. Thus, the estimation by farmers in both origins seems reasonable and was confirmed by vanilla exporters and traders. However, only 1% of farmers in both Uganda and Madagascar are able to meet that target productivity partly because they don´t have a full employment vanilla farm size, but also due to risk aversion behaviour by farmers. In both Uganda and Madagascar, many farmers are afraid of theft and price instability, which limits investments into vanilla farms. Investments needed include replanting of vanilla vines, maintenance of existing vines, active planting of tutor and shadow trees, shadow management and no over-pollination of vanilla flowers. On a country wide level, a better governance of market control, means to control theft, security and traceability are urgently needed if vanilla farmers are to invest more into their farms. However, the "full employment farm size" has become reality for individual farmers in the SAVA region in Madagascar, particularly in the Littoral and some farmers have reached the target productivity and beyond (see Appendix 19).

Limiting factors to increase to increase production in both countries are available labour for pollination, land expansion, lack of access to resources such as finances for land & and land preparation, and technical assistance for good agricultural practices. There is quite a run for land, and we observe that agriculture moves increasingly into marginal areas. In Uganda vanilla is partly cultivated without proper shadow management, i.e., trees.

Figure 30: Marginal agricultural land in the Bundibuygo district in Uganda

7.4 Impact of LIRP on farmer livelihoods and the vanilla market

In the past decades, vanilla farmers have globally experienced a boom-and-bust cycle, which - in high price phases- can lead to interim investments in their farms but also to a risk-aversion behaviour by the farmers in the long run. Uncertainty hinders sustainable, long-term investments. As illustrated in Appendix 16 and Appendix 18, the average vanilla farmer reported to produce only 49 kg (Madagascar) - 65 kg (Uganda) of vanilla and, consequently, is far from the poverty line and particularly from living income. A minimum price would help farmers to plan their assets and labour around an assured market, reduce uncertainty, which in turn might lead to higher investments and increases in sustainable vanilla production.

Vanilla is a risky crop and, therefore, an exclusive vanilla farm model should not be promoted. Scientific evidence shows that livelihood diversification improves well-being of smallholder farmers (Ellis 1998, Barrett et al. 2001) and increases their resilience to cope with shocks (Hänke and Barkmann 2017, Pelletier et al. 2016). Likewise, a vanilla farm will never be a full employment farm throughout the year as there are labour peaks and other crops can be planted along with vanilla. Consequently, other crops are accounted for in the farm models (see Figure 28 & Figure 29). The suggested farm models were supported by many different stakeholders and -as we found during stakeholder reviews- the present minimum price analysis is generally regarded as a credible data source.

A key question by many stakeholders is how the LIRP could be implemented on the ground. Therefore, the development of the vanilla market in the past 5 years requires a closer look. In fact, the vanilla market has seen dramatic changes in recent years. At one time, vanilla farmers were characterized as impoverished farmers who depend on many middlemen and received only small shares of the retail vanilla price. However, many exporters and flavour houses are increasingly sourcing vanilla directly from farmers and have established complex trading outposts and made long term investments and commitments to creating value close to the vanilla producers, particularly in Madagascar (Hänke et al. 2018). Among the motivations are social and environmental standards that require traceability, which are increasingly demanded by western consumers. In non-integrated value chains, such social & environmental standards are difficult to fulfil, and traceability is almost impossible. While the majority of vanilla farmers in Madagascar still rely on the spot market, estimations show that around 19% of all vanilla farmers in Madagascar are already in contracts and/or certifications with exporters or traders integrating them vertically into the vanilla value chain. The number of vertically integrated

farmers is increasing and represents a good opportunity to negotiate the LIRP with contracted farmers as a first step. With contracted farmers as the first target group, this could be stepwise extended to non-contracted farmers. Most likely there will also be spill-over effects to the spot-market.

In Uganda, a minimum price for vanilla will also be crucial to keep vanilla attractive for farmers as they often switched to other crops when prices fall, e.g. cocoa and coffee. As we saw, many Ugandan vanilla farmers also grow other cash crops. A key finding from the focus group discussions in Uganda was that many farmers start investing in other crops when vanilla prices fall below 50 000 UGX (~12.5€) (see Appendix 22 for a short analysis at what price vanilla can compete with other crops).

REFERENCES

Anker, R., and M. Anker. 2017. *Living wages around the world: Manual for measurement*. Edward Elgar Publishing.

Barrett, C. ., T. Reardon, and P. Webb. 2001. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy* 26(4):315–331.

Biesalski, H. K., A. Drewnowski, J. T. Dwyer, J. J. Strain, P. Weber, and M. Eggersdorfer. 2017. *Sustainable nutrition in a changing world*. Springer, Heidelberg

Biondi, D., W. Kipp, G. S. Jhangri, A. Alibhai, T. Rubaale, and L. D. Saunders. 2011. Risk factors and trends in childhood stunting in a district in Western Uganda. *Journal of Tropical Pediatrics* 57(1):24–33.

Borbolla-Pérez, V., L. G. Iglesias-Andreu, M. Luna-Rodríguez, and P. Octavio-Aguilar. 2017. Perceptions regarding the challenges and constraints faced by smallholder farmers of vanilla in Mexico. *Environment, Development and Sustainability* 19(6):2421–2441.

Brown, M. L. 2009. Madagascar's Cyclone Vulnerability and the Global Vanilla Economy. In Jones, Eric C. and. Murphy, Arthur , D editors *The political economy of hazards and disasters* pp. 247:264. AltaMira Press, Lanham

Brownell, R. J. 2011. Fair Trade – The Future of Vanilla? Pages 107–116 *in* D. Havkin-Frenkel and F. C. Belanger, editors. *Handbook of Vanilla Science and Technology*. Wiley-Blackwell, Sussex, UK.

CREAM. 2013. *Monographie de la Région Sava*. Centre de recherches, d'etudes et d'appui a l'analyse economique à Madagascar, Antananarivo.

Ellis, F. 1998. Household strategies and rural livelihood diversification Household Strategies and Rural Livelihood Diversification. *The Journal of Development Studies* 351:1–38.

Ethnologue. 2005. Languages of Uganda. URL: https://web.archive.org/web/20050514130844/http://www.ethnologue.com/show_country.asp?name=uganda.

Fairtrade International. 2017. *Fairtrade Living Income Strategy*. Bonn, Germany URL:https://files.fairtrade.net/2017-10-23_Fairtrade_Living_Income_strategy_EN.pdf

FAO. 2004. Madagascar. Rice is life. Proceedings of the FAO Rice Conference. URL: http://www.fao.org/3/a-y5682e.pdf

FAO. 2010. *Uganda Nutrition Profile. FAO: Nutrition and Consumer Protection Division*:1–66. URL: http://www.fao.org/3/aq011e/aq011e.pdf

FAO. 2019. Coffee (ICO Composite Price) and Cocoa (ICCO monthly price). 66. URL: http://www.fao.org/economic/est/est-commodities/coffee-cocoa/en/

FAOstat. 2019.Vanilla. Crop Production. URL: http://www.fao.org/faostat/en/#search/vanilla.

Glick, P., and D. E. Sahn. 2006. The demand for primary schooling in Madagascar: Price, quality, and the choice between public and private providers. *Journal of Development Economics* 79(1):118–145.

Golden, C. D., B. Vaitla, L. Ravaoliny, M. A. Vonona, E. G. Anjaranirina, H. J. Randriamady, R. P. Glahn, S. E. Guth, L. C. Fernald, and S. S. Myers. 2019. Seasonal trends of nutrient intake in rainforest communities of north-eastern Madagascar. *Public Health Nutrition*:1–10.

Guzi, M., and M. Kahanec. 2017. Estimating Living Wage Globally:1–18. URL: https://wageindicator.org/documents/publicationslist/publications-2018/living-wage_english_20181221.pdf

Hänke, H., and J. Barkmann. 2017. Insurance function of livestock: farmer´s coping capacity with crop failure in south-western Madagascar. *World Development 96:264-275* .URL: https://doi.org/10.1016/j.worlddev.2017.03.011

Hänke, H., J. Barkmann, L. Blum, Y. Franke, D. A. Martin, J. Nienss, K. Osen, V. Uruena, A. S. Whiterspoon, and A. Wurz. 2018a. *Socio-economic, land use and value chain perspectives on vanilla farming in the SAVA Region (north-eastern Madagascar): The Diversity Turn Baseline Study (DTBS).* Göttingen. URL: https://www.researchgate.net/publication/329268603_Socio-economic_land_use_and_value_chain_perspectives_on_vanilla_farming_in_the_SAVA_Region_north-eastern_Madagascar_The_Diversity_Turn_Baseline_Study_DTBS_July_2019_Edition

Havkin-Frenkel, D., and F. C. Belanger. 2011. *Handbook of vanilla science and technology*. Wiley Online Library.

Hernandez-Hernandez, J. 2011. Mexican Vanilla Production. Pages 3–25 *in* D. Havkin-Frenkel and F. C. Belanger, editors. *Handbook of Vanilla Science and Technology*. Wiley-Blackwell.

Iarivony, R., V. R. Rabeza, M. Barrère, and M. Soumaila. 2005. Madagascar: Demographic and Health Survey 2003-2004 Key Findings. *Childhood A Global Journal Of Child Research*:1–34.

IMF. 2019. World Economic Outlook Database. URL: https://www.imf.org/external/pubs/ft/weo/2019/01/weodata/index.aspx.

INSTAT. 2014. *Enquête nationale sur le suivi des objectifs du millénaire pour le développement à Madagascar. 2012-2013 Étude Nationale. Objectif 4: Réduire la mortalité des enfants de moins de cinq ans*. URL :

https://madagascar.unfpa.org/fr/publications/enqu%C3%AAte-nationale-sur-le-suivi-des-objectifs-du-mill%C3%A9naire-pour-le-d%C3%A9veloppement-%C3%A0

IPC (2011). ICP 2011 results Excel data file. International Comparison Program, World Bank. URL: http://pubdocs.worldbank.org/en/108821487172249299/2011-International-Comparison-Program-results.xlsx

Kunz, S. 2018. Beitrag der Tierhaltung zur Diversifizierung des Einkommens der ländlichen Bevölkerung in der SAVA-Region Madagaskars. Master Thesis. Univeristy of Witzenhausen/Kassel.

MAAIF (2019). Declaration Of Vanilla Harvesting Dates. Minsitry of Agriculture, Animal Husbandry and Fishery of Uganda. URL: https://www.mediacentre.go.ug/media/declaration-vanilla-harvesting-dates

Madamagazine (2018). The grain of life-rice cultivation in Madagascar. URL: https://www.madamagazine.com/en/das-korn-des-lebens-reisanbau-auf-madagaskar/

Meekers, D., and J. O. Yukich. 2016. The association between household bed net ownership and all-cause child mortality in Madagascar. *Malaria Journal* 15(1)1:13.

Pelletier, B., G. M. Hickey, K. L. Bothi, and A. Mude. 2016. Linking rural livelihood resilience and food security : an international challenge. *Food Security* 08(3):469:476.

Rodolphe, G., B. Séverine, G. Michel, and B. Pascale. 2011. Biodiversity and evolution in the Vanilla genus. Page *The dynamical processes of biodiversity-case studies of evolution and spatial distribution*. Intechopen. URL: https://www.intechopen.com/books/the-dynamical-processes-of-biodiversity-case-studies-of-evolution-and-spatial-distribution/biodiversity-and-evolution-in-the-vanilla-genus

Tumwine, J. K., and W. Barugahare. 2002. Nutrition status of children in Kasese district at the Uganda-Congo border. *Journal of East African Medicine* 79(8)427:34.

UN. 2017. Private schools gain a foothold in Africa. https://www.un.org/africarenewal/magazine/august-november-2017/private-schools-gain-foothold-africa.

UNESCO. 2016. *National Education Accounts Report Uganda. Working Document*. URL: http://uis.unesco.org/sites/default/files/uganda_nea_report-2016-en.pdf

UNESCO. 2019. Right to education. URL: https://en.unesco.org/themes/right-to-education.

UNICEF. 2011. *Humanitarian action update: Madagascar*. URL: http://www.unicef.org/hac2011/

UNICEF. 2017. *Madagascar. Annual Report 2017*. URL:

https://www.unicef.org/about/annualreport/files/Madagascar_2017_COAR.pdf

UNICEF. 2019. Education and Literacy. Uganda. URL: http://uis.unesco.org/country/UG.

USAID. 2018. *Madagascar : Nutrition Profile*. URL: https://www.usaid.gov/sites/default/files/documents/1864/Madagascar-Nutrition-Profile-Mar2018-508.pdf

USDA. 2019. USDA Food Composition Databases. URL: https://ndb.nal.usda.gov/ndb/search/list?home=true.

WFP. 2016. *Fill the Nutrient Gap Madagascar : Full Report.* *URL:* https://docs.wfp.org/api/documents/837cea77cbe0487d923644497b754ec4/download/?iframe

WFP. 2019 Uganda Country Brief, January 2019. URL: *Full Report.* URL: https://docs.wfp.org/api/documents/837cea77cbe0487d923644497b754ec4/download/?iframe

WHO. 2019. Household air pollution and health. URL: https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health.

WHO. 2019. Household air pollution and health. URL: https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health.

World Bank. 2015. *Madagascar - Systematic country diagnostic*. Washington D.C. URL: http://documents.worldbank.org/curated/en/743291468188936832/pdf/99197-CAS-P151721-IDA-SecM2015-0168-IFC-SAecM2015-0123-Box393189B-OUO-9.pdf

World Bank. 2019a. The International Poverty Line. URL: http://www.worldbank.org/en/programs/icp/brief/poverty-line.

World Bank. 2019b. World Bank Indicator Database. URL: https://databank.worldbank.org/reports.aspx?source=2&series=SI.POV.NAHC&country=.

Zaehringer, J. G., G. Schwilch, O. R. Andriamihaja, B. Ramamonjisoa, and P. Messerli. 2017. Remote sensing combined with social-ecological data: The importance of diverse land uses for ecosystem service provision in north-eastern Madagascar. *Ecosystem Services* 25:140–152.

APPENDIX

Appendix 1: Cooperatives and number of vanilla farmers in Rwenzori Farmer´s Cooperative Union

Districts	Cooperative	RFCU list (number of farmers)
Kasese	Balimi Farmers Cooperative Society	61
Kasese	Bukonzo Farmers Cooperative Society	49
Bundibugyo	Bunyangole Farmers Cooperative Society	69
Kasese	Bwera Farmers Cooperative Society	72
Bundibugyo	Izahura Farmers Cooperative Society	96
Kasese	Kasimire Organic Farmers Cooperative Society	60
Ntorko	Karugutu Farmers Cooperative Society	78
Bundibugyo	Kisongo Farmers Cooperative Society	57
Bundibugyo	Kityo Farmers Cooperative Society	83
Kasese	Kyondo Kyaburingira Farmers Cooperative Society	89
Kasese	Kyondo- Kisinga Farmers Cooperative Society	132
Kasese	Mubuku Farmers Cooperative Society	73
	Total	**919**

Appendix 2: Sections of the questionnaire

1. Socio-demographics, education and activity of all household members
   a. Household composition (age, gender)
   b. Education
   c. Occupation
   d. Agricultural activity level

2. Agriculture, production & land sizes (subsistence and cash crops)
   a. List of all cultivated crops
   b. Crop production
   c. Land sizes and distribution of crops

3. Labour and production costs (subsistence and cash crops)
   a. Family labour for crops, divided into household members and activities
   b. Hired labourers (months, man-days and expenditures, divided into different activities)
   c. Costs for equipment and agricultural inputs

4. Income generated through cash crops

a. Based on cash crops mentioned in 2b., volumes and prices received
b. Costs of production, marketing, limitations to increase production, theft

5. Vanilla preparation and markets
   a. Vanilla theft and means to avoid it
   b. Vanilla curing
   c. In which months is vanilla sold for which price to whom?
   d. Membership in associations/cooperatives/other farmer groups

6. Livestock
   a. Possession of livestock
   b. Home consumption of livestock
   c. Sale of livestock

7. Food consumption and expenditure
   a. Consumption of food
   b. Food self-sufficiency
   c. Expenditures on food (months in different foods are bought and expenditures per week)

8. Expenses for education and healthcare
   a. Number of kids still visiting school
   b. Expenditures per year on schooling and other fees
   c. Frequency of doctoral visits per year per HH member
   d. Expenditure per HH member per year

9. Housing and living standards
   a. Material used for walls at home
   b. Material used for floors
   c. Material used for roofs
   d. Latrine/toilet/sanitation standards
   e. Electricity
   f. House structure (space for adults & kids)
   g. Energy sources for coking at home
   h. Possession of assets

10. Transportation
   a. Frequency of market visits
   b. Distance to markets
   c. Expenditures for transportation

Appendix 3: Prices at local markets in Uganda (in UGX)

	Market Bundibuygo region				Market Ntoroko region				Market Kasese region				
Crop	**Piece/ bunch**	**silon bag**	**Basin**	**Kg**	**piece/ bunch**	**silon bag**	**Basin**	**Kg**	**piee**	**silon bag**	**Basin**	**Kg**	**Total average**
Avocado	500						10000		300				
Beans				3600				3000				2600	30667
Cabbage	2000				1000				1000				
Cacao				6000				6500				6800	6433
Cassava				1000				750			10000		
Coffee				4000			25000					4500	2833
Cotton								1800				1800	1200
Eggplants	200						10000				20000		
Groundnuts				5000				5000				4000	4667
Irish Potato			15000				12000				18000		
Leafy vegetables	1000				500				500				
Maize		60000						1000				1500	833
Plantain	20000				15000				20000				
Millet				4000				6000				4000	4666
Moringa				10000				1000				7000	6000
Onion	1000					200000		3000		200000			
Passionfruit		160000								300000			
Peas								2000				3000	1667
pillari	500							1000	1000				
Pineapple	2000				3000				2000				
Prunus africana				10000				15000				10000	11667
Pumpkin	2000				3000				3000				
rice				4000				3000				4000	3667
Sorghum				2500				2000				2000	21667
soya_beans				5000				2000				3500	3500
Sugar_cane	2000				1000				1500				
sweet_potato			10000								15000		
tomato			50000			10000					25000		
vanilla				200000	500			200000				220000	2067
Yams	3000				2500						15000		

Appendix 4: Minimum and Maximum prices in the littoral of northeastern Madagascar (Marojala)

	Prix min						Dans quel mois	Prix max						Dans quel moins
Culture	Kapoky	Kg	paquet	Piéce	autre:	prix autre		en Kapoky	paquet	En Kg	en Piéce	autre:	prix	
Ananas				500			11-12				5000			1
Arachides	200						5-6	2000						4
Avocat					5 pièces	500	2					2 pièces	500	4-5
Bananes					regine	6000	12-5					regine	15000	6-11
Bred_Anana					paquet	200	1-3					paquet	200	4-12
Choux														
Cacao						4000	5-12						10000	1-4
Coco						1500	5-12						2000	1-4
Cocombre				500			1-3						2000-3000	4-12
Café				4000			4-12						6000	1-3
Fruit de pain					2 pieces	2500	3						4000	2
Gingimbre		3000					6-8			12000				12-1
Girofle										20000				10
Haricot	1500							1500						
Igname_Majôla				500-1000			5-12							
Jackfruit				500			10-12							
Litchi					pannier (10-15 kg)	5000	12						40000	11 & 1
Maïs	400						4	500						10
Mangue					5 pièces	200	12					5 pièces	500	12-1
Manioc					pannier	7000								
Onion					feullies vertes	1000								
Orange					5 pièces	500	4-5					5 pièces	1000-3000	6-3
Patate_douce														
Pois	1000						4-6							
Poivre noire		5000					6		16000					12
Poivre verte		3000					6		6000					12
Riz_	500						10-1	800-1000						2-9
Tomate														
Vanille verte		160000					7							
Vanille noire	600 000						10		120000					1-2

Appendix 5: Minimum and Maximum prices in the mid-highlands of northeastern Madagascar (Antanamangotroka)

	Prix min							Prix max						
Culture	Kapoky	Kg	paquet	Piéce	autre:	prix autre	Dans quel mois	en Kapoky	paquet	En Kg	en Piéce	autre:	prix	Dans quel moins
Ananas				2000			12-01				4000			2
Arachides														
Avocat				200			04-05				500			07-08
Bananes				3pièces/200			12-01				200			02-11
Bred_Anana			200				02-05		500					09-11
Choux				2500			05-06				5000			07-04
Cacao														
Coco														
Cocombre				500			04-05				2000			06-03
Café	1500						07-09	2500						10-08
Fruit de pain														
Gingimbre		2500					03-05			12000				06-02
Girofle														
Haricot	1000						05-02	2000						03-04
Igname_Majôla				2000			04-11				2000			04-11
Jackfruit				1000			02-05				2000			06-01
Litchi					3000Ar pannier de 12kg		12-01					20000Ar pannier de 12kg		02-11
Maïs	600						03-05	600						03-05
Mangue														
Manioc				3pièce/2000			8							
Onion														
Orange														
Patate_douce														
Poids														
Poivre														
Riz_					15000Ar/daba		05-06 et 10-11					20000Ar/daba		07-09 et 12-04
Tomate														
Vanille		200000					8							

Appendix 6:Minimum and Maximum prices in the littoral of northeastern Madagascar (Ampanakana)

Culture	Prix min						Dans quel mois	Prix max						Dans quel moins
	Kapoky	Kg	paquet	Piéce	autre:	prix autre		en Kapoky	paquet	En Kg	en Piéce	autre:	prix	
Ananas				2000			12-01				3500			2
Arachides														
Avocat				300			04-05				500			07-08
Bananes				2pièces/200			12-02				200			02-11
Bred_Anana			200				03-04		500					09-11
Choux				3500			05-06				5000			07-04
Cacao														
Coco														
Cocombre				500			04-05				2000			06-03
Café	1000						07-09	3000						10-08
Fruit de pain														
Gingimbre		2500					03-05			12000				06-02
Girofle														
Haricot	1000						05-02	2000						03-04
Igname_Majôla				2000			04-11				2000			04-11
Jackfruit				1000			02-05				2000			06-01
Litchi					4000Ar pannier de 12kg		12-01					15000Ar pannier de 12kg		02-11
Maïs	600						03-05	600						03-05
Mangue														
Manioc				4pièce/2000			8							
Onion														
Orange														
Patate_douce														
Poids														
Poivre		3000					6		6000					12
Riz_					13000Ar/daba		05-06 et 10-11					20000Ar/daba		07-09 et 12-04
Tomate														
Vanille		200000					8							

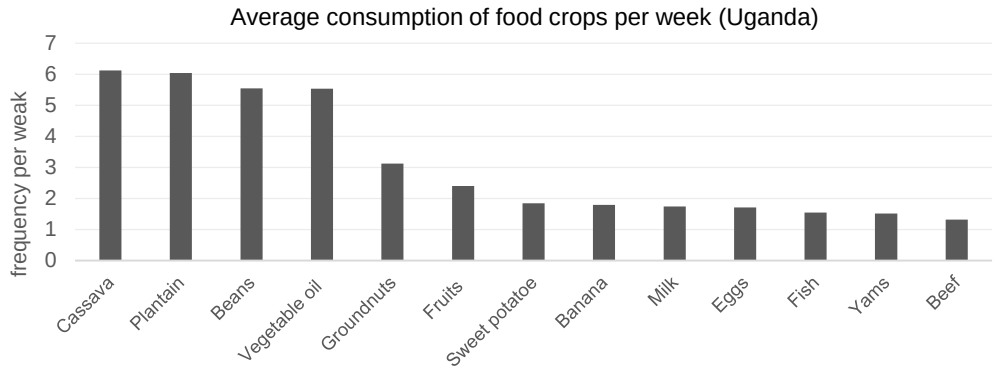
Appendix 7: Food consumption and expenditures

Sampled farmers were asked how many times per week or month they eat the different food sources over the year. Values were averaged for all months and converted to consumption per week.

Subsequently, farmers were asked in which months throughout the year they buy the different food sources and how much the spent for it per week or month. Subsequently, the months in which respondents buy the respective food sources were summed into expenditure per year.

a. Uganda

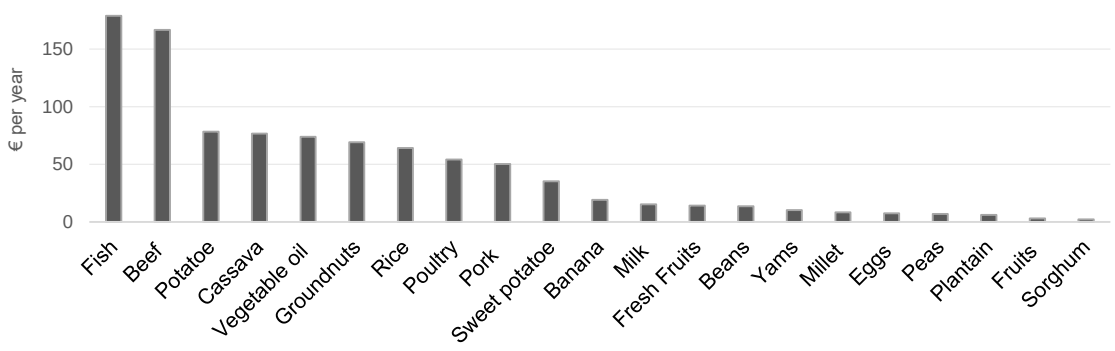
Appendix 8: Consumption of food items per week by Ugandan vanilla farmers



Cassava, plantain, beans and vegetable oil are eaten almost every day by the Ugandan HHs. Groundnuts are used for a local sauce "*Bundib yega*" which is often eaten along with plantain and fish or meat. Fruits (banana, jackfruit, passion fruit and mangos) are regularly eaten. However, vegetables are rather uncommon.

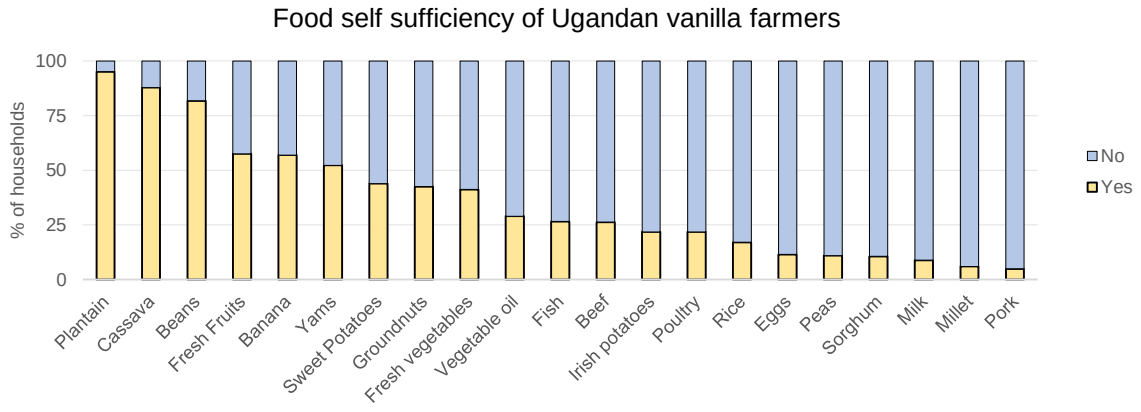
In the following section, we will look at food expenditures by Ugandan vanilla farmers.

Appendix 9: Expenditures on food (per year and household) in Uganda



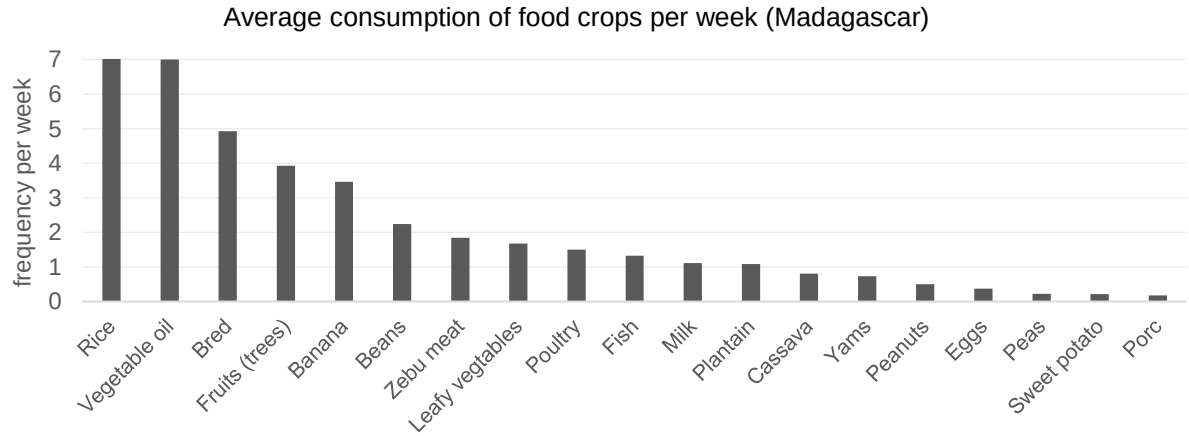
Most food expenditures per year are on fish (178€) and beef (167€). Potatoes (78€) vegetable oil (73€) and groundnuts (69€) also represent important food expenditures. Total food expenditures sum up to 1 004.4€ ± 97.2€ per household per year, on average.

Appendix 10: Food self-sufficiency of Ugandan vanilla farmers



The sampled Ugandan vanilla farmers are largely self-sufficient on food that they regularly eat (compare Appendix 8 and Appendix 10). Ugandan farmers are particularly food self-sufficient on plantain (95.1%), cassava (87.8%), beans (81.8%), fresh fruits (57.6%) and banana (56.9%). Concerning fish (26.5%), beef (26.2%), poultry (21.8%) the picture looks contrary. Those items were also the main food expenditures (see Appendix 9).

Appendix 11: Consumption of food items per week by Malagasy vanilla farmers

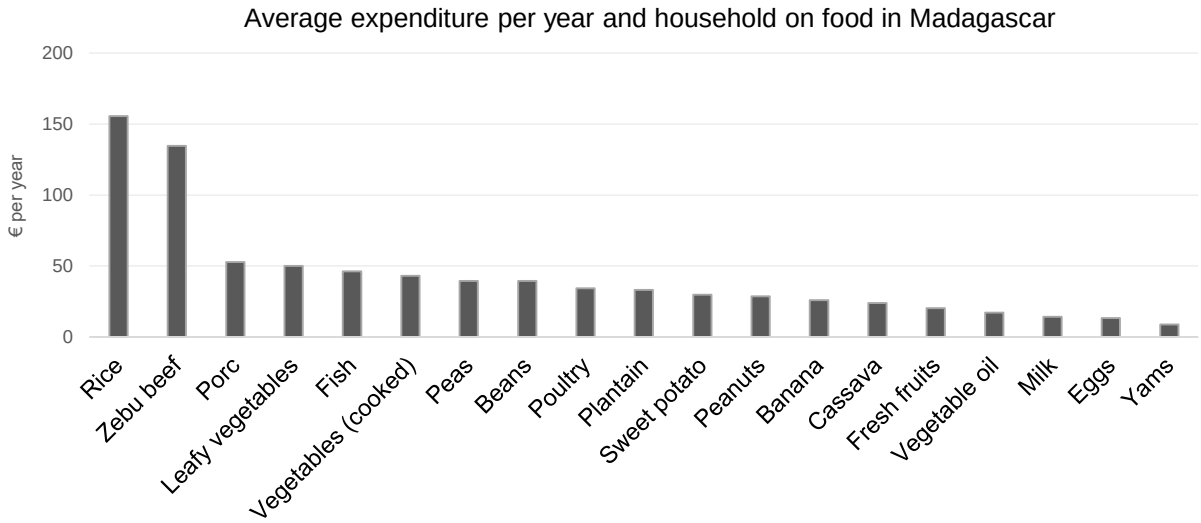


Malagasy vanilla farming HHs eat rice and vegetable oil on a daily basis. Also common are *bred* (5 times a week), fruits (from trees), banana, beans and leafy vegetables, mainly cassava leaves. Yet, *bred* is usually added on top of rice dishes in very small quantities. However, animal products such as milk and eggs are rarely eaten. Out of all animal protein sources zebu

meat is most common (1.8 times a week), poultry (1.5 times a week), Fish (1.4 times a week), and pork less than once per week.

There was little variance between the 3 different districts sampled in Madagascar.

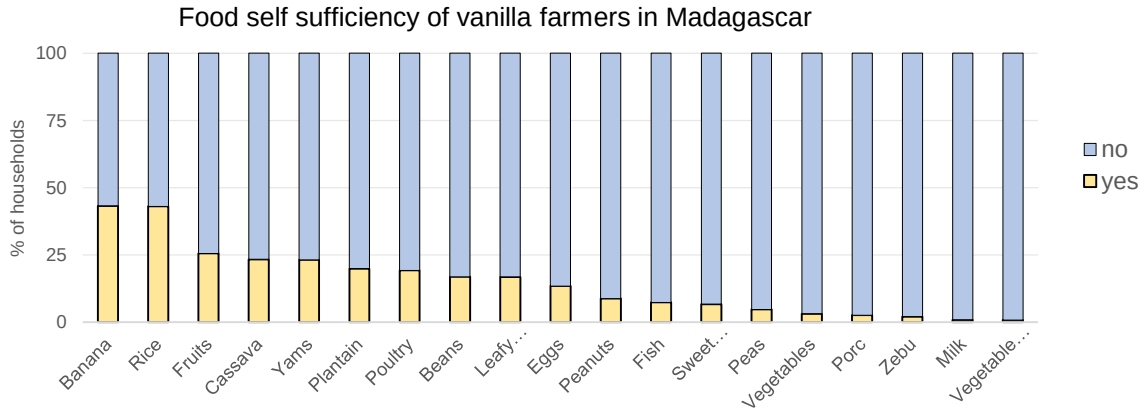
Appendix 12: Expenditures on food (per year and household) in Madagascar



Malagasy vanilla farming HHs spent most cash on rice in 2018 (155.6 €, on average). In fact, a large share of the local population eats 3 times a day rice, a rice soup as breakfast and rice as main- or side dish for lunch and dinner. Zebu meat is the 2nd highest expenditure class and zebu meat is regionally expensive (~5€/kg, see below). Local farmers commonly spent smaller shares on leafy vegetables (bred and cassava leaves), fish, beans, poultry and others.

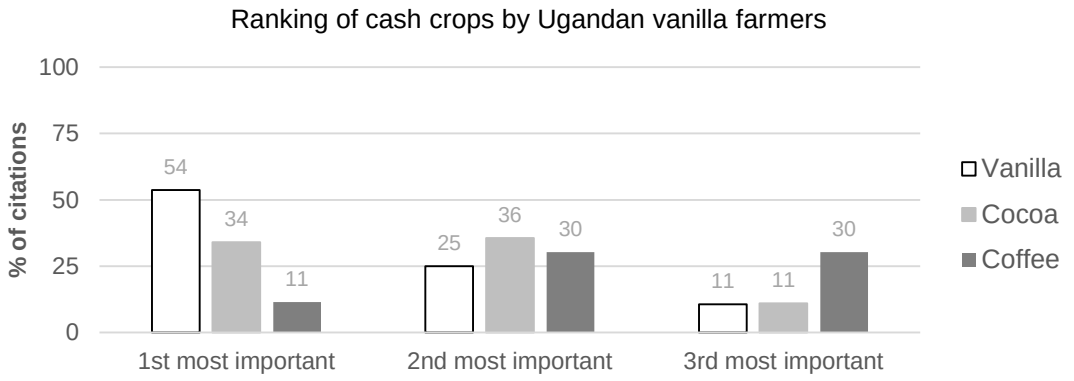
Total food expenditures per year and HH sum up to 811.7€, on average.

Appendix 13: Food self-sufficiency of Malagasy vanilla farmers

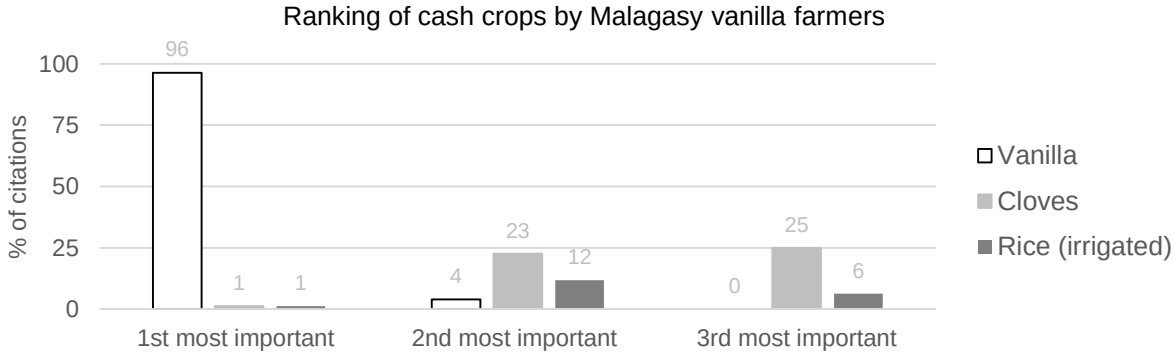


Few Malagasy vanilla farmers sampled are food self-sufficient. 43% are self-sufficient on bananas and rice, and 26% on fruits. However, the percentage of food self-sufficient HHs for all other food items is less than 25%.

Appendix 14: Ranking of cash crops by vanilla farmers in Uganda and Madagascar



Vanilla farmers were asked which cash crops their most important income sources are. 54% cite vanilla as most important and 25% as 2nd most important, respectively. Cocoa is the 2nd most important cash crop in general, often cited as 1st (34%) or 2nd (36%) most important cash crop. Coffee, however, is less important[15], only 11% cite it as most important cash crops, 30% as 2nd and 30% as 3rd, respectively.



96% of the sampled Malagasy farmers cite vanilla as the most important income source. Cloves (23%) and irrigated rice (12%) are regularly cited as 2nd or 3rd most important income source. Coffee, however, is not among the top 3 important cash crops.

[15] However, there are huge differences between the three different districts sampled. Coffee is more common in the Kasese region and cocoa in Bundibugyo and Ntorko, respectively. Also, coffee prices crashed in recent years and many vanilla farmers abandoned coffee, meaning that they have coffee plots but currently not farmed or rented out. Some are also transformed to vanilla plantations.

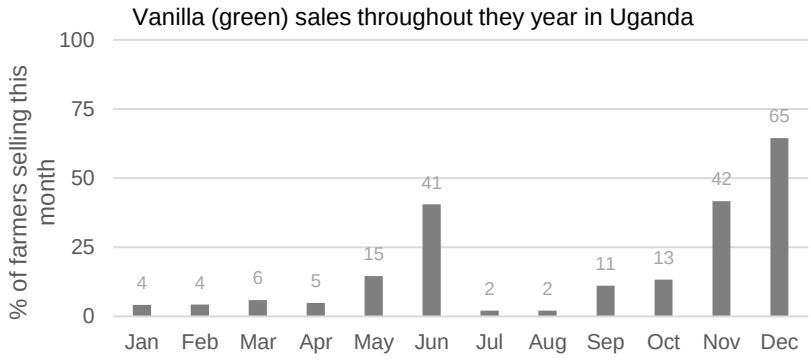
Appendix 15: Vanilla sales, production and theft

Vanilla farmers were asked how much vanilla they produced on their farm, in which month they sold their vanilla and to which price. Multiple answers were possible.

(i.) Uganda

The average production per HH in 2018 was 65.3kg green vanilla on an average size of 0.4 ha, which were sold to an average price of 50.2€ for green vanilla[16]. This translates into an average harvest of 163.3 kg/ha. However, as shown in Appendix 17, the variation is large. Almost 100% of vanilla is sold as green vanilla, < 1% of farmers cure vanilla themselves.

Appendix 16: Vanilla sales (green) over the year in Uganda in 2018



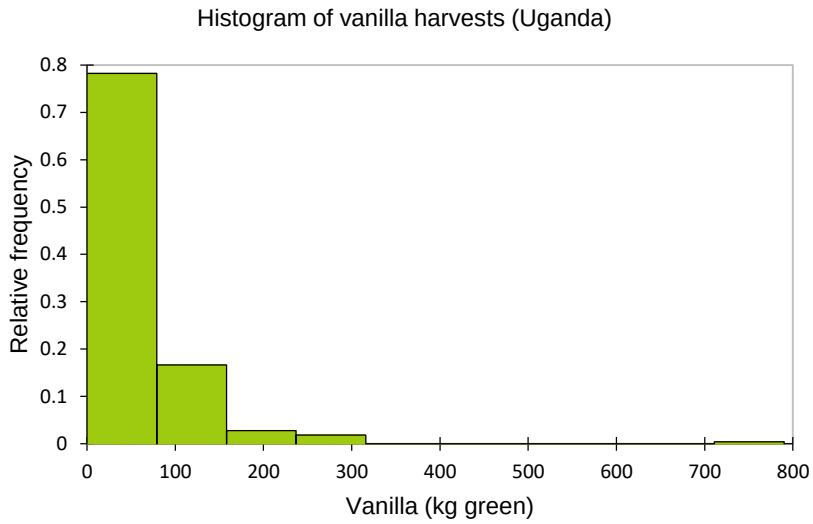
In Uganda there are two vanilla harvests, locally referred to as "mini season" (June) and "big season" (December). However, as we see above, farmers also tend to sell vanilla premature. According to farmers, there is a market for every vanilla quality the whole year long. The key reason for premature sales is fear of theft but also immediate needs for cash. Premature sales occur predominantly in the "big season", 66% of farmers sell at least some immature vanilla between September-November.

86% of farmers reported that vanilla was stolen from their fields. On average, 22 kg were stolen[17]. Also, entire vanilla vines are stolen in Uganda.

[16]18% of vanilla farmers who are members in RFCU cooperative did not harvest yet and were excluded from analysis. Vanilla starts to produce beans after 3 years indicating that many farmers only recently started to grow vanilla.

[17] This number might be overestimated due to expectations towards the research team by vanilla farmers.

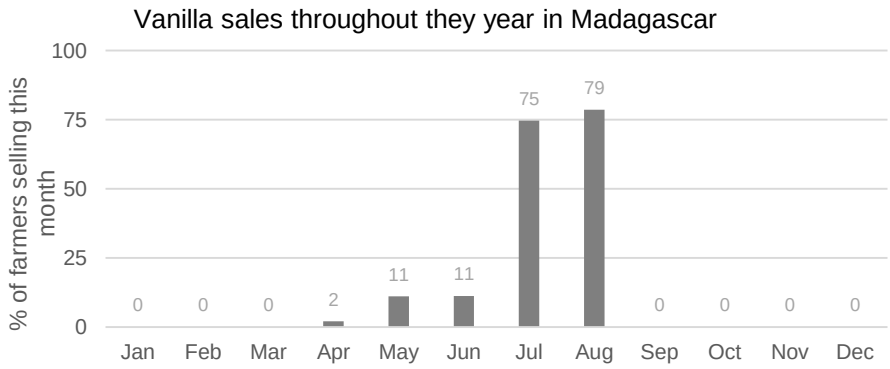
Appendix 17: Distribution of vanilla harvests per household in 2018 in Uganda on average farm size of 0.4 ha



(ii.) Madagascar

In Madagascar, the average production per farm and HH was 49.2 kg of green vanilla in 2018, which were sold to an average price of 38.2 €. The average harvest was 54.7 kg/ ha considering that in Madagascar only one harvest per year is possible. As in Uganda, the harvest data showed large variations (Appendix 19). 11.6% of the sampled farmers also cure some vanilla, but only in small quantities. Farmers repeatedly stated that they gave up on vanilla curing as prices for green vanilla are high and there is a danger of theft if vanilla is kept home for long time.

Appendix 18: Vanilla sales (green) throughout the year in Madagascar in 2018



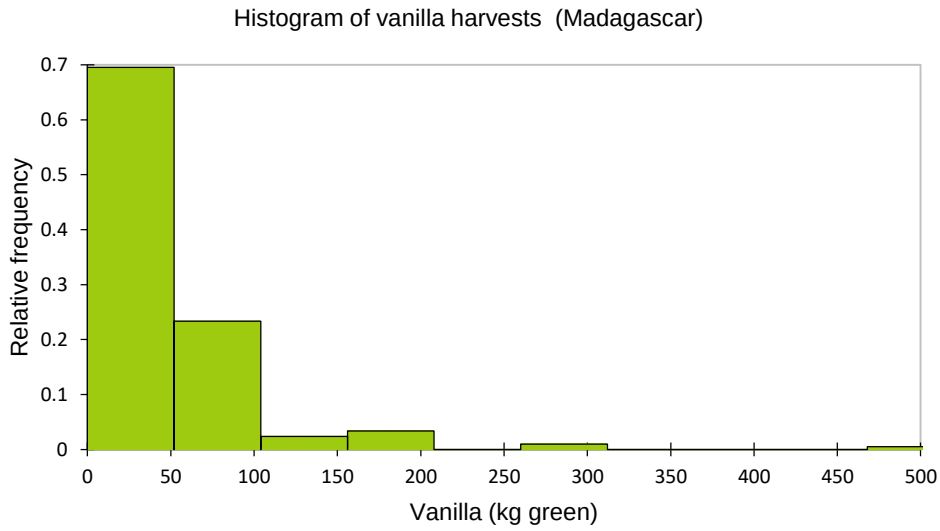
Contrary to Uganda, there are official vanilla harvest dates in Madagascar[18]. The official harvest start dates/market openings in 2018 were the 15th of July in the littoral zone (eastern Sambava

[18] The author was informed that for this year´s vanilla campaign (June 2019), harvest dates are to be implemented in Uganda. At the time of this survey (April-May 2019), this was not yet the case.

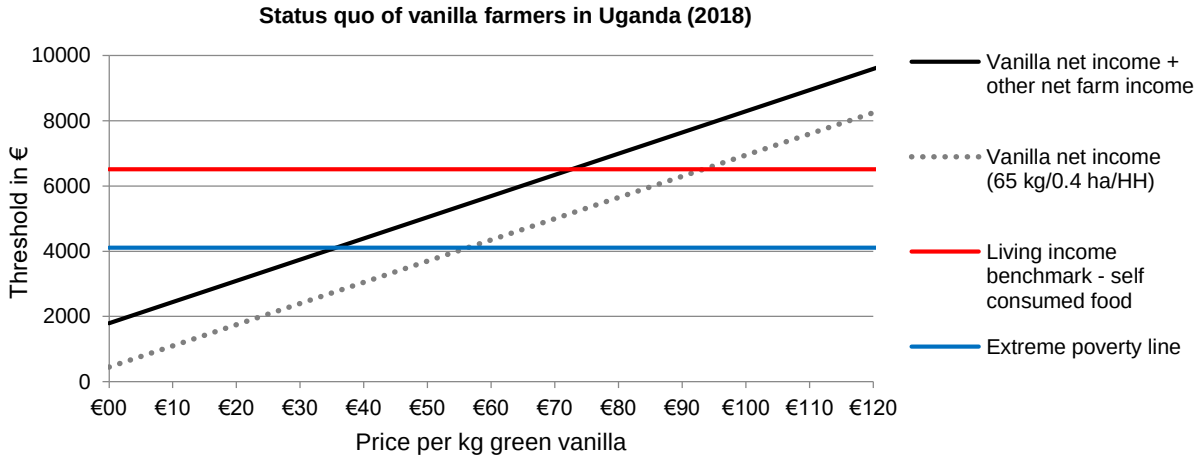
& Antalaha), the 30th of July for the intermediate zone (western Sambava & Antalaha) and the 19th of August for the mountainous zone (Andapa). It is forbidden by law to trade vanilla before the governmental fixed dates. However, as we see above, some farmers sell their vanilla before. Premature sales occur in May (11%) and June (11%). Given the fact that many of the sampled farmers are cooperative members, sale of mature vanilla is most likely obligatory. However, the number of-premature sales from non-cooperative farmer members is far higher (Hänke et al. 2018 & own observation).

38.4% of sampled farmers reported that vanilla was stolen from their fields. On average, 26 kg were estimated to have been stolen.

Appendix 19: Distribution of vanilla harvests per household in 2018 Madagascar on average farm size of 0.9 ha



Appendix 20: Status quo of vanilla farmers in 2018 in relation to poverty line and living income

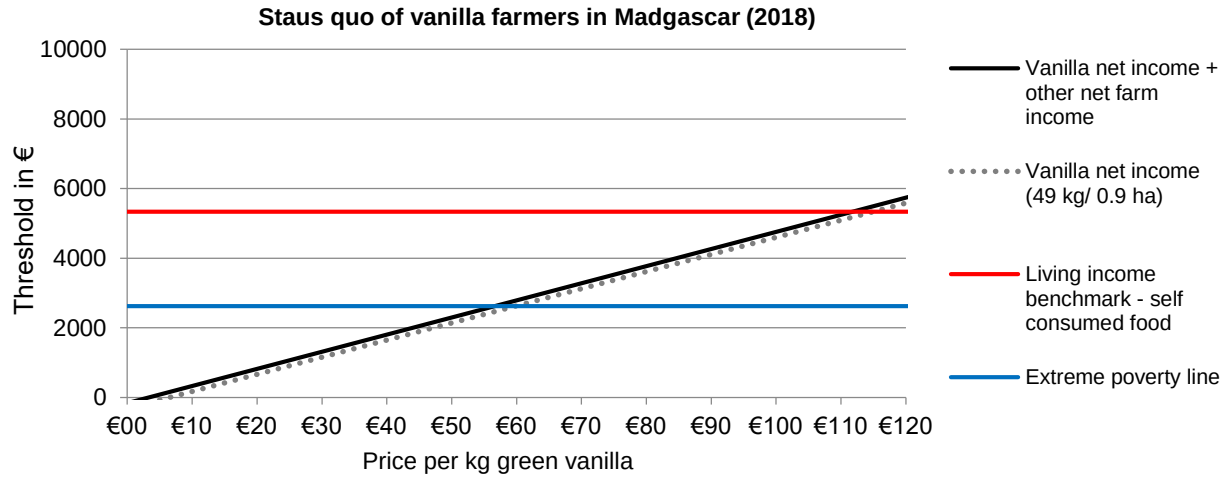


The chart above illustrates the situation for an average Ugandan vanilla farmer in 2018, with an average vanilla land size of 0.4 ha and an average harvest of 65 kg of green vanilla. The refence points relate farm income to international poverty line (1.95$ per person per day) and living income (minus the value of self-produced food).

As we see above, the average farmer is currently far from the poverty line and in particular to living income. When only taking into account vanilla net income (income minus all production costs), Ugandan vanilla farmers are still below the international poverty line even with current vanilla prices of 50.4 € per kg green vanilla. A price of around 55€ per kg green would be needed to be beyond the poverty line, and a price of ~90€ to reach living income.

Considering that Ugandan vanilla farmers also generated 1455€ of other on-farm cash value - a price of ~35€/kg green would allow them to be on the poverty line level and ~70€ to reach living income (considering production costs for "other" cash crops). This model represents the *status quo* in 2018.

Appendix 21: Average vanilla income in Madagascar in relation to international poverty line and living income in 2018



The chart above illustrates the reality for an average Malagasy vanilla farmer in 2018, i.e., with an average farm size of 0.9 ha and an average production of 49.2 kg of green vanilla.

For the case of Malagasy vanilla farmers, farm income-other than vanilla- is low (see Table 14) and makes almost no difference to the price needed to reach the two reference benchmarks. Likewise, the value of self-produced food that is deducted from living income, is low (see Table 10). If we consider vanilla net income only, the farmers would need a price of 57.5 € per kg green to reach the poverty line level, and 112.5€ per kg green to reach living income.

Appendix 22: Minimum market conditions for vanilla to continue to be attractive in Uganda

Another question raised by many stakeholders was about the minimum market price needed for current vanilla farmers in Uganda to continue expanding vanilla. The hypothesis is that the vanilla market would be more stable – therefore benefiting both farmers and vanilla quality – if there was a better balance of production origins and an alternative origin like Uganda could grow back to its historic 400 to 500 mt. Uganda vanilla farmers removed most of the production following the 2004 market crash, clearly showing that prices after that crash were not sustainable in Uganda.

To answer this question, we looked at the relative net income per ha of vanilla relative to coffee and cocoa (the two primary cash crops) across the range of prices seen in the last 5 years. For current vanilla producers (.4ha in vanilla, 65k/ha), vanilla would be more attractive than coffee and cocoa at between 10€ and 15€ per kg of green vanilla, depending on the market of cocoa and coffee.