

C:AVA

Cassava: Adding Value for Africa



Market opportunities for cassava in Malawi

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Executive summary

The Bill and Melinda Gates Foundation (BMGF) commissioned the Natural Resources Institute of the University of Greenwich (NRI) to carry out market research to assess the full range of market opportunities for cassava-based products in Malawi with a view to prioritising promising sub-sectors for future investment which is the subject of the present report.

There have been drastic changes in the Malawian economy, with the decline of the tobacco industry, devaluation of the Malawian Kwacha (MK), along with severe shortages in foreign exchange over the past two years, negatively impacting many businesses in Malawi. Cassava which has always been taken as a food security crop, is once again finding itself in the limelight, as, with this background, it has not been too difficult to stimulate awareness on its potential as a partial substitute to wheat flour and corn starch. Also, with the visit to Malawi in September 2012 by the Nigerian president to promote trade between the two countries and share experience on the Nigerian Presidential Cassava Initiative, there also had a positive impact on further raising expectations of the value of cassava.

Since 2009, supported through the Bill and Melinda Gates Funded project (Cassava Adding Value for Africa; C: AVA) led by NRI, two distinct cassava value chains producing high quality cassava flour (HQCF) have been promoted in Malawi - one using sun-drying methods, the other using artificial drying technology (flash drying). In January this year, Universal Industries Ltd., Malawi, had technical support with the commissioning, installation and testing of the machinery and HQCF processing plant. This represents the first commercial scale cassava processing plant in Malawi promising year round supply of cassava flour to end-users, requiring a continuous supply of raw materials potentially involving small holder farmers. Despite this initial achievement, the supply of raw materials at a competitive price, volumes, quality, and with any degree of reliability is posing a serious challenge. How well these issues can be overcome, will, to a large extent, determine the development of various promising cassava subsectors identified by this market study and summarised below.

In the medium term, the team identifies HQCF distributed through rural and urban outlets, inclusion by medium and large bakeries, biscuit companies, packaging companies and textile companies as a having potential for growth, substituting hard and soft wheat, and for the latter two sectors, maize starch. This will stimulate a theoretical demand for ~55,000t fresh cassava roots (see Table 9 for more detail). Aside supply challenges, the realisation of meeting this demand will also depend on the cost of wheat flour and, indirectly, on the dynamics of MK exchange rate, the awareness of HQCF use and the capacity to reach a large number of scattered micro-enterprises. Another promising subsector is that of cassava chips or grits by inclusion by poultry feed companies (and to a much lesser extent aquafeed industries). The substitute in this case is maize. This market will stimulate a theoretical demand for ~10,000t fresh cassava roots from farmers. Meeting this demand will depend on cost efficient drying of required volumes as well as successful outcomes of commercial trials that need to be carried out with feed and poultry companies. A conservative estimate for the combined market potential across promising subsectors is 65,000t fresh cassava roots, potentially involving 6,500 smallholder farmers. It is envisaged that meeting these market opportunities for HQCF and chips/grits will involve SME processors supplied by both commercial large scale and small-scale farmers. Technical support along all stages of the value chain will be required for these sectors under

CAVA II owing to the lack of awareness by some end-users on how to use the product, as well as unfamiliarity with HQCF process technology, quality management by smaller operators, development of inclusive supply chain models involving smallholder farmers, and the need for technical backstopping commercial farmers who traditionally have not grown cassava.

Our assessment of the market opportunities for cassava-based products also highlighted a range of sub-sectors that appear to have limited potential in the short to medium-term. In Malawi, there has not been discussion for making the inclusion of HQCF in wheat flour mandatory. This might be due to the failures of these attempts in Nigeria. Millers would need sufficient incentives to be willing to include HQCF on voluntary basis. While the inclusion of HQCF would allow them significant cost and foreign exchange savings due to the dramatic raise of the imported wheat price following the recent devaluation of the local currency, millers would need immediate regular supply of large volumes (about 5,000 t/yr) of consistent quality HQCF. Other, non-promising sectors identified were sugar syrup in the beverage and confectionary industry. For the beverage sector, no significant local demand exists. For confectionaries, the current demand level of 5000t fresh root equivalent cannot justify the required processing plant investment. The substitute in this case is sugar/sugar-maize based syrup. Long-term markets with large potential demand (4 million litres) were also identified which included ethanol for inclusion in petrol, potable ethanol and industrial alcohol, and ethanol for household cooking and heating. With respect to household cooking and heating, the economics of cassava-based ethanol do not look favourable.

During the 2010 market studies also involving identification of potential investors in cassava processing, a key factor for potential investors was Forex's availability. Other though less important motivations may be political (with the Malawi Growth and Development Strategy) and social (including the threat of the social Duty Waiver for imported wheat flour for biscuits being withdrawn). From early conversations with potential investors in HQCF processing, the main concern however was feasibility – return on capital, raw material supply, cost of processing, and the market price offered by different subsectors. The next step therefore for the C:AVA Malawi team is to conduct investment studies in order to provide reasonable assurance that the selected products and sub-sectors are viable business propositions that can in addition demonstrate benefit for smallholder farmers. This final study will form the basis of the development of the CAVA II proposal for Malawi.

1. Introduction

1.1. Background

Cassava Adding Value for Africa (C:AVA) is a project funded by the Bill and Melinda Gates Foundation (BMGF), coordinated by the Natural Resource Institute (NRI) of the University of Greenwich in UK and implemented in partnership with several African institutes.

The original work-plan for the C:AVA project was designed around providing support for development of market opportunities for High Quality Cassava Flour (HQCF) in five African countries: Nigeria, Ghana, Tanzania, Uganda and Malawi.

BMGF has recently commissioned NRI to carry out additional market research to assess the full range of market opportunities for cassava-based products in Malawi with a view to prioritising promising sub-sectors for future investment by the BGMF. The present report presents the results of this exercise and its hoped that its findings may contribute to the development of C:AVA II.

Interviews were arranged with different stakeholders during a field mission carried out between 4 March and 14 March 2013. The team consisted of Dr Diego Naziri (Mission Leader & Market Economist), Louise Abayomi (C:AVA Malawi Coordinator & Food Technologist), Vito Sandifolo (C:AVA Malawi Country Manager & Agronomist), and Vincent Kaitano (C:AVA Business Development Adviser & Agricultural Economist).

The cassava products and potential applications assessed by the study were:

- High Quality Cassava Flour (HQCF) as replacement of wheat flour (by bakery, biscuit, confectionary, plywood and aquafeed industries) and maize starch (by packaging and textile industries)
- Cassava starch as replacement of maize starch (by confectionary and meat processing industries)
- Dry cassava (chips or grits) as replacement of maize (by animal feed and traditional beer industries) and malted barley (by clear beer industry)
- Cassava-based sugar syrups as replacement of refined sugar or non-cassava-based syrups (by beverage and confectionary industries)
- Cassava-based ethanol as replacement of non-cassava based ethanol (by petrol, spirits and other industries) and kerosene & firewood (for household cooking and heating).

1.2. Objective of the assignment

The aim of this study is to assess the potential demand for a range of processed cassava products and identify options for future investments in cassava value chains. Different market segments have been researched to estimate their size and quantify the opportunity for inclusion of cassava products. Based on the indicative production costs of the different cassava products and on an estimation of the likely buying price the end-users will pay, it was possible to understand how cassava can be attractive for the different market segments and set realistic achievable targets in medium term.

1.3. Structure of the report

The present report unfolds as follows. The next section presents a range of background information about cassava production and commercialization in Malawi. Section 3 investigates the different market segments for HQCF as partial replacement of wheat flour or complete replacement of maize starch. Section 4 shows the opportunity for cassava starch and section 5 for dry cassava chips or grits. Section 6 and 7 presents the findings about the opportunities for cassava-based syrups and ethanol, respectively. Finally, the last sections schematically summarize and draw the main conclusions about the size of the different market opportunities in the longer term and set sensible targets achievable in the medium-term, i.e., in the timeframe of a possible C:AVA II.

1.4. Acknowledgments

In Malawi the team visited milling companies, food distributors, HQCF processors, biscuit manufacturers, beverage companies, feed mills, poultry farms, fish farms, one packaging factory, one ethanol plant, one meat processor, one textile manufacturer, NGOs, service providers, academics and donors. The authors acknowledge the generosity of time and opinions that were offered without exception by the people interviewed; a full list is given in Annex 1.

This study is an output from a research project funded by the Bill and Melinda Gates Foundation (BMGF) for the benefit of developing countries. The views expressed in this paper are those of the authors and do not necessarily reflect the views or policies of BMGF.

1.5. Acronyms

ADD	Agricultural Development Division
AMPU	Autonomous Mobile Processing Unit
BMGF	Bill and Melinda Gates Foundation
C:AVA	Cassava: Adding Value for Africa
C.R.	Conversion Ratio
CMBL	Carlsberg Malawi Brewery Limited
CML	Carlsberg Malawi Limited
DADTCO	Dutch Agricultural Development and Trading Company
DVHS	David Whitehead & Sons
FCR	Feed Conversion Rate
HFS	High Fructose Syrup
HQCF	High Quality Cassava Flour
IITA	International Institute of Tropical Agriculture
MDL	Malawi Distilleries Limited
MK	Malawian Kwacha
NRI	Natural Resources Institute of the University of Greenwich
PIM	Packaging Industry Malawi
SARRNET	Southern Africa Root Crops Research Network
SBA	Starch-based Adhesives
SBL	Southern Bottlers Malawi Limited
SME	Small and Medium Sized Enterprise
TAPP	Trustees of Agricultural Promotion Programme
UNDP	United Nations Development Programme
MK	Malawian Kwacha
US\$	US dollar
ha	Hectare
t	Tonne
kg	Kilogram

EXCHANGE RATES (March 2013)

MK 390 to US\$

2. Cassava production and commercialization in Malawi

2.1. Cassava production

2.1.1. Historical background

Cassava was introduced into Malawi as early as the 1800's. For a long time cassava has been looked upon as an inferior crop to maize. Both the colonial and post-colonial governments up to the 1990's encouraged the planting of maize as the staple food for subsistence farmers. This policy preference was because maize is much easier to dry and store than cassava, surpluses could be sold more easily on the international market and the majority of the Malawian population preferred maize as its main staple food. Just as importantly, higher yielding maize varieties are easier to introduce than cassava, which is propagated from stem cuttings that do not store well and are costly to cut and handle. Vegetative reproduction also means the rate of multiplication of new, improved cassava varieties is slow. In areas of surplus production, transportation of the tubers to deficient cassava eating areas has proved to be difficult to achieve because once harvested, cassava starts to deteriorate after 48 hours. Internationally, far less research and development has been devoted to cassava than to rice, maize and wheat and has received considerably less emphasis in genetic improvement and biotechnology (Kambewa & Nyembe, 2011). During the colonial and post-colonial periods, only a few of the warmer areas along the Lake Malawi shore (Nkhata Bay and Nkhotakota) continued to grow cassava as its main food source.

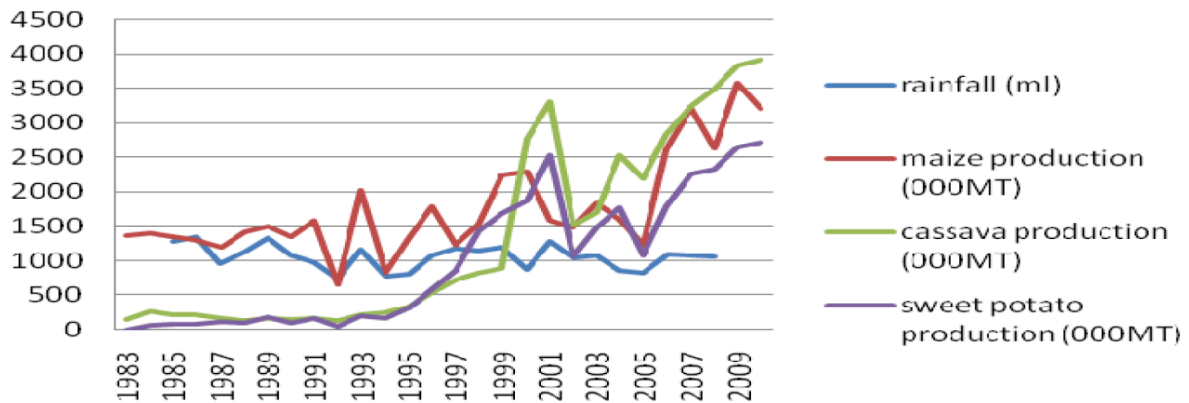
However, since the serious drought in 1991/92, the growing of cassava by smallholder farmers has been on the increase. This increase has been assisted by the introduction of improved higher yielding and more disease resistant cassava varieties by IITA/SARRNET. Cassava has proved to be drought tolerant, has the potential of providing a high level of dietary calories, readily adapts to a wide range of agro-ecological conditions, is very efficient at utilizing mineral reserves of infertile soils, withstands climatic variations, is very flexible over its time of planting and harvesting and is a very prolific producer of starch. A study by the Ministry of Agriculture with the Agricultural Policy Research Unit at Bunda College (2010) carried out a comparative analysis, which showed that cassava was the best smallholder food crop for competitiveness, food security, employment, household income, environmentally sustainability, drought tolerance with new technology freely available.

2.1.2 Trend in cassava production

Figure 1 is a graphical representation of trend in cassava production over a 17 year period, compared to other selected staple crops.

The country experienced droughts in 1991/92, 1993/94, 2000/01, and 2004/05 seasons (Kambewa, 2010). In all the drought years, the country faced a maize deficit of over 1 million tonnes which had to be met through relief support and use of alternative foods sourced locally by households. Erratic rainfall and drought (less than 1,000 mm of rain) was a major factor leading to drop in maize production. For example, in the 1991/92 and 1993/94 seasons the country had about 777 mm of rainfall while in 2000/01 and 2004/05 the country had less than 900 mm of rainfall (Kambewa, 2010).

Figure 1: Rainfall and production of cassava, maize and sweet potato (1983-2009)



Source: Kambewa (2010)

In 1991/92 season, the country produced about 65,700 tonnes of maize against a national agricultural requirement of over 2 million tonnes. Drought struck again in 1993/94 when the country produced 818,999 tonnes of maize and in 2000/01 and 2001/02 when the country produced 1.6 and 1.5 million tonnes of maize respectively. In 2004/05, the country produced 1.2 million tonnes of maize (MoAFS, 2010).

While most crops experienced decline in production during 1992/93 -2001/02 period, the roots and tubers registered remarkable growth in production. Cassava production increased from 534,549 tonnes in 1993 to 3,201,051 tonnes in 2001/02 (MoAFS Crop Estimates, 2000 in Mataya, *et.al*, 2001). This is attributed to government's crop diversification and promotion policy of drought resistant crops, maize production having been affected by unpredictable and precarious environmental factors and the rise in prices of inputs (SARRNET, 2003; SARRNET, 2008).

Even though cassava (and sweet potato) witnessed a drop in production in the 2002/03 season, the annual production of cassava has been higher than the maize one since the year 2000/01 and it is still nowadays. The repercussions of the 2001/02 drought might have influenced farmers to increase cassava and sweet potato production in order to avert hunger.

2.1.3. Main production areas

Malawi is divided into eight Agricultural Development Divisions (ADDs) based on agro ecological zones, namely: Shire Valley, Blantyre, Machinga, Lilongwe, Kasungu, Salima, Mzuzu and Karonga. With the exception of Shire Valley, ADDs share names with one of the districts but they cover more districts. Figure 2 presents the location of the eight ADDs in Malawi.

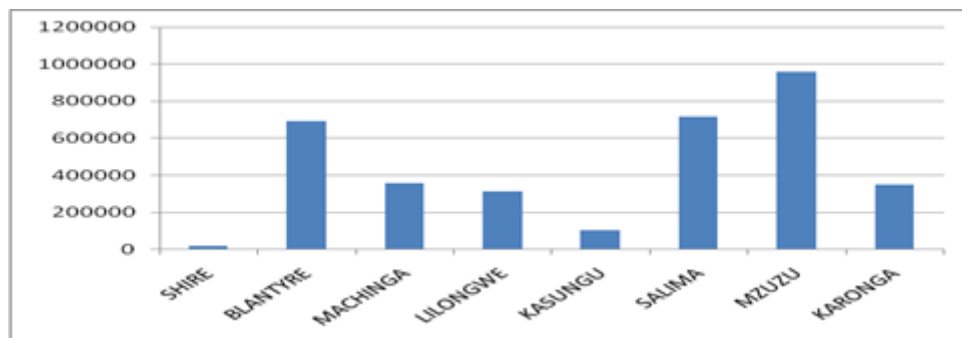
Figures from the 8 ADDs indicate that cassava is grown in all the ADDs, albeit some produce comparatively higher cassava than others depending on topography, weather patterns and whether cassava is a staple food, as shown in Figure 3.

Figure 2: Map of the Agriculture Development Division (ADD) in Malawi



Source: IFDC (2002)

Fig.3: Cassava production estimates by ADDs in 2008/08 (tonnes)



Source: Ministry of Agriculture and Food Security (2010)

Figure 3 shows that Salima and Mzuzu ADDs are the highest cassava producing ADDs in the country followed by Blantyre ADD coming third as a cassava producer. Cassava production per capita gives a better picture of likely surplus above the requirement for household food security and this statistic shows that Mzuzu retains first position but Karonga is in second place and Salima has relatively lower cassava production per capita. Blantyre ADD is still the third highest producer on a per capita basis but the difference between Blantyre and Mzuzu is more marked (Hillocks, 2010).

Table 1 shows crop production estimates broken down by district and it is evident that Nkhotakota and Nkhata Bay produce the highest tonnage of cassava (699,589 and 587,617 tonnes, respectively) than in any of the other districts. Despite maize being the staple food in much of Mzimba District, it is nevertheless the third highest cassava producing district in Malawi (305,000MT). Mulanje (234,375MT) and Thyolo (198,261MT) districts are the largest cassava producers in Blantyre ADD (close to the recently installed flash dryer location at Njuli) and Zomba District (182,850MT) in Machinga ADD is a significant cassava producer too.

Table 1: Cassava production by district within ADDs in 2008

ADD/Districts	Production MT	ADD/Districts	Production MT
BLANTYRE ADD		KASUNGU ADD	
Phalombe	66,615	Dowa	5,873
Thyolo	198,261	Ntchisi	37,766
Mulanje	234,375	Mchinji	60,181
Blantyre	40,006	ADD TOTAL	103,820
Chiradzulu	43,230	MZUZU ADD	
Mwanza	78,032	Rumphi	65,586
Neno	31,756	Nkhata Bay	587,617
ADD TOTAL	692,275	Mzimba	305,000
MACHINGA ADD		Likoma [island]	1.115
Balaka	16,031	ADD TOTAL	959,318
Zomba	182,850	KARONGA ADD	
Mangochi	106,770	Chitipa	75,442
Machinga	51,560	Karonga	276,567
ADD TOTAL	357,211	ADD TOTAL	352,009
SALIMA ADD		SHIRE VALLEY ADD	
Nkhotakota	699,589	Chikwawa	14,421
Salima	17,802	Nsanje	6,978
ADD TOTAL	717,391	ADD TOTAL	21,399
LILONGWE ADD			
Ntchetu	44,047		
Dedza	114,007		
Lilongwe	155,771		
ADD TOTAL	313,825		
		NATIONAL TOTAL	3,517,248

Source: ADD (2008)

2.1.4. Production system

In Malawi October to January is the peak cassava production period. Most cassava is planted around the same period as when it is harvested. In most areas the planting occurs between November and March. Cassava is propagated by cutting the stem into sections, and planting these cuttings on the onset of the rainy season. Most farmers do not apply fertilizer to cassava. The main cultivation practices after planting are weeding and ridging up of the crop. Very little mechanisation is practiced in Malawi with land preparation, planting, weeding and harvesting undertaken by hand. Little storage is required for the crop as roots are harvested, as and when required, for either family consumption or for marketing.

The bitter and sweet varieties normally mature from eight months to ten months but some varieties can take up to two years. The bitter type is grown mainly for fermented flour meal in traditional cassava growing areas. In most other parts of the country, where maize is regarded as the staple food, sweet varieties are grown. In areas where fresh roots can be easily sold in urban areas, sweet varieties are preferred. Bitter varieties tend to be higher yielding than sweet varieties. Although there has been an increase in cassava production, most of the farmers still tend to cultivate local low yielding disease susceptible varieties. Improved high yielding varieties are available but, besides the issue of shortage of planting material, they are not preferred by producers due to their lower dry matter content. On research plots, using new improved disease resistant high yielding varieties and applying fertilizer yields can be as high as 30 tonnes/ha. Even higher yields have been obtained on estate farms where irrigation has been used during the dry season.

2.2. Cassava commercialization

2.2.1. Farm sales

The peak harvest period is the same for marketing because of the perishability of the fresh cassava roots. A number of factors dictate when farmers harvest their cassava. Farmers view delayed harvesting as the better way of storing cassava roots for future use while at the same time keeping the stems viable for planting during the rainy season (freshly cut stems are more productive because they sprout faster than stored stems). Cassava prices tend to be relatively high during the lean maize season (November to March) enticing farmers to sell at that time for better prices. Some farmers, especially those who intercrop cassava with maize (common in the southern region) start to harvest from July to August in order to start preparing their fields for the next crop. Other farmers sell their cassava before the rainy season because they use the money to buy inputs, especially maize seed and fertilizer. Cassava that is harvested later in the season often has bigger root sizes that fetch relatively higher prices. Farmers usually sell cassava fresh at harvesting time, which explains the concurrence of peak production and marketing seasons. Growers experience seasonal variation in cassava sales with peak volumes in October to February. During the cassava lean months (March to June), some farmers do not sell cassava at all, especially in non-cassava consuming districts. In Nkhata-Bay, Nkhotakota, and Mulanje, households usually store dried chips for home consumption which are milled into flour or sold to help households meet other needs. Peak period cassava sales vary slightly across regions. In the southern and central regions rains start around October/November. Before this period the cassava season activity starts to increase as farmers harvest to prepare for the next season. In the northern region, rains normally start around

November/December which is the same period farmers harvest cassava to replant the fields. Traders often buy the entire cassava field and meet the costs for harvesting and transportation. Whatever traders leave behind either due to small sizes or damages during harvesting is used for household consumption either in fresh form, chips, or flour. The proportion of cassava that farmers sell also varies with amount of maize in the market. In times of lean maize production, some farmers sell more cassava to benefit from good market prices and buy maize (if available) while others sell less cassava to keep some for household consumption (Kambewa, 2010).

2.2.2. Trade flows and seasonality

There is significant trade in cassava although there is no reliable data to quantify the scale and volumes of the trade. There is no accurate indication of the proportion of Malawi's cassava that is traded fresh or dried, or the amount that is for own consumption. It is reported that the proportion of cassava that farmers sell varies with the least proportion of about 30% reported in Nkhata-Bay. In Lilongwe, Kasungu, and Zomba Districts farmers reported that they sell almost all their cassava except for a very small proportion (less than 10%) for household consumption (Kambewa, 2010). However a comprehensive record of data about the use of cassava at national level is non-existent for the time being. This basic data on cassava production and trade is vital if Malawi is to monitor and encourage investment to add value to cassava.

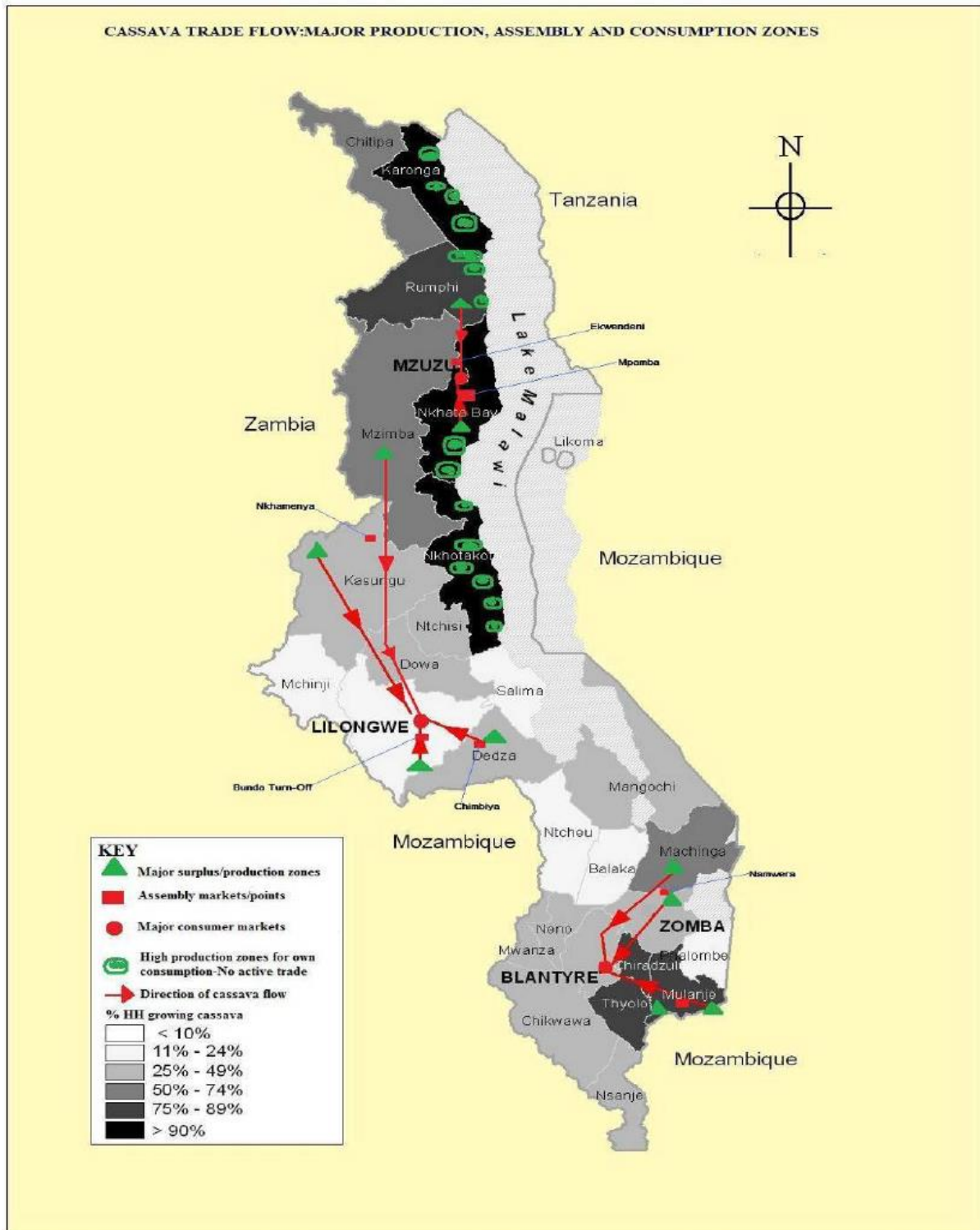
In absence of reliable data, unpacking trends in cassava commercialization process and its determinants (driving forces) may be difficult. It would require a better understanding of the relative importance of cassava as a commercial and subsistence crop since population growth and demographic changes, among other factors, tend to affect commercialization of subsistence agriculture. As a starting point, this section provides a glimpse on trade flows, seasonality, and price trends.

Population growth and urbanization influence demand for cassava products. Most cassava and cassava products are sold in urban centers rendering Mzuzu, Lilongwe, and Blantyre as the major consumption markets. Zomba city and Kasungu district are rapidly growing into consumption markets while at the same time they serve as major supply zones to Lilongwe and Blantyre respectively. Urbanization has contributed to the increase in the one-way flow of cassava (especially fresh) from rural to urban centers. As Figure 4 shows, major flows originate from the major production zones in rural areas and towns including Rumphu, Mzimba, Nkhata-Bay, Kasungu, NkhotaKota, Dedza, Thyolo, Machinga, Mulanje, Chiradzulu, and the outskirts of the cities including Mitundu and Chiwamba in Lilongwe, Chingale in Zomba, Mdeka in Blantyre among others. Cassava also comes from Mozambique through Mulanje and Dedza into Malawi. In the traditional cassava consuming districts (Nkhata-Bay, Nkhotakota, Mulanje) there has been an increase in the production of sweet varieties for sale.

The flow of cassava to the major consumption markets shows seasonal patterns. The peak period for cassava marketing falls from November to February in Blantyre and Lilongwe markets. This is the period when Malawi experiences lean maize supplies at the household and market levels. The season in the major market starts around September to October with small amounts that increase to moderate with peak periods in later months. The season in the major markets is thus extended because of the overlap of the seasons in major supply zones. There is a limited amount of cassava

trade from April to August, with little to no cassava in the market from May to July, which is the period when maize and sweet potato are generally plentiful.

Figure 4: Cassava trade flows



Source: Kambewa (2010)

Traders selling cassava flour reported that dried chips and flour are sold throughout the year with more volume during the lean maize season when they sometimes sell double the amount of cassava flour. It should be noted that the volume of cassava in the major markets is an accumulation of cassava from different supply zones. Hence, the season at the major markets may start earlier or end later than in the individual supply zones where farmers may be selling relatively less cassava.

The price of maize and cassava are strongly linked. A recent study published by the Michigan State University (MSU, 2010) has shown that nominal prices of maize and cassava have been overlapping over the years. In particular, both maize and cassava prices increase in maize deficit years. In the informal sector, cassava/maize substitution is at peak in drought years when sales volumes for cassava flour, for example, increases between 7 and 11 times depending on the scarcity of maize and consumers substitute up to 50-100% cassava flour in making the traditional dish of *nsima* (the maize-based staple food in Malawi). Even in good maize years, cassava prices increase by 10 to 20% in December to February when some households run short of maize before the next harvest. In drought years, prices for cassava flour more than doubles depending on the scarcity of maize on the market. Unless a dedicated production system to supply roots for industrial use is established, this remains a potential threat to achieving the goal of a year round supply of cassava raw material for would-be large-scale investors in the cassava sector (MSU, 2010).

2.3. Key cassava products and markets

A number of products from cassava are used both in the food and non-food industry which define the major value chains arising from cassava. In the food sector, cassava is consumed in different forms and the most common products include *nsima*, raw or boiled cassava, and leaves. In the non-food sector the major products are High Quality Cassava Flour (HQCF) and starch.

It is possible to identify several primary uses of fresh cassava roots (Figure 5). These are presented in the following sections.

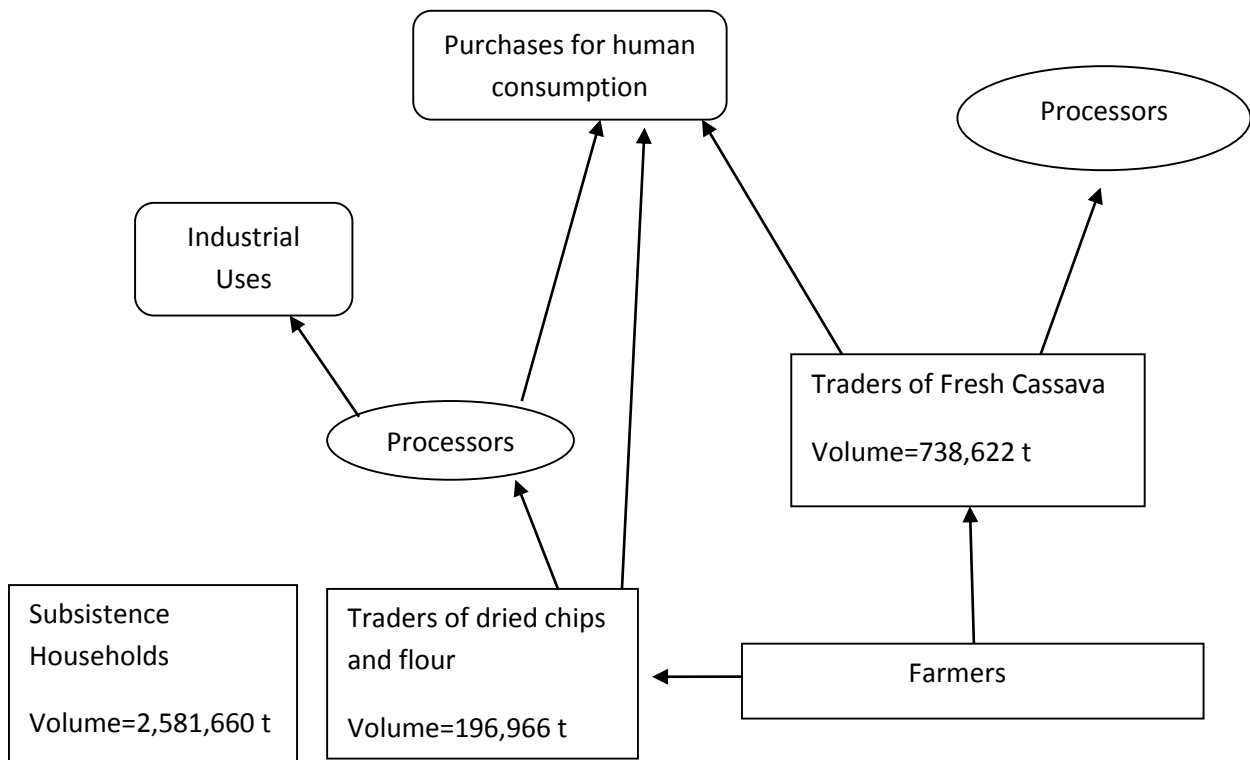
2.3.1. Farm households consumption

A majority of the households eat the cassava they grow. As previously mentioned, this varies by regions with the cassava belt having a majority of the farmers consuming a bulk of their cassava and selling a surplus. These can consume up to 90% of their cassava (Kambewa & Nyembe, 2011). Increase is dependent on population growth and not new consumers based on changes on tastes and preferences. This is especially prevalent in the northern Malawi. The smallholder farmers from non-cassava belt have not increased area of growing cassava for own consumption. Rather these have increased the growing of cassava for sale.

For cassava consumption, it is important to make distinction of cassava types. Cassava grown in Malawi can be either sweet or bitter. In the cassava belts, bitter cassava is more commonly grown compared to sweet cassava. This is the case because unlike the sweet type, the bitter cassava stores better i.e. thieves and monkeys do not attack it (Chiwona-Karltun, 2004). From the bitter cassava, flour is produced through a fermentation process and the flour is called *kondowole*. *Kondowole* is processed as follows: after digging, the roots are washed, peeled and washed again before being

soaked for three to four days to allow the fermentation process to take place. Thereafter, it is washed and dried. The dried cassava is crushed then milled or pounded and thereafter sieved.

Figure 5: Use of fresh cassava in Malawi



Source: adapted from Kambewa & Nyembe (2011)

Note: The total cassava production figure is based on the 2008 crop estimate from the Ministry of Agriculture of 3,517,248 tonnes. IITA/SARRNET (2010) estimates that out of the total, 26.6% is sold of which 80% is sold as fresh cassava (representing about 21% of total production) and 20% as processed cassava (representing about 5% of total production). However, as previously discussed, these figures are hardly reliable and should be considered as an indication only.

Non-fermented cassava flour is formed from dried cassava chips also known as *makaka*. In this case after cassava is dug, it is peeled and thereafter dried. The dried chips are sold as such and it is up to the consumer to further process them into cassava flour through crushing and further milling, as it is the case with *kondowole*. In some cases, the *makaka* are boiled and eaten. This food is common especially in southern Malawi districts and it is a hunger crop.

Cassava flours from *kondowole* or *makaka* are direct competitors to maize flour. While *makaka* is dominant in the south, *kondowole* is dominant in the lakeshore areas of central and northern

Malawi (Kambewa & Nyembe, 2011). Increasingly though, cassava flour is mixed with maize flour especially in the non-cassava belt areas of southern Malawi. In the cassava belt areas, it is common to find people using cassava flour to make their *nsima*. In the non-cassava belt, when it is used as a staple food it is mainly during the hunger period. Thus when maize fails or maize stocks are low during the lean season, cassava is used as an alternative source of food. In this case, cassava flour is usually mixed with maize flour to prepare *nsima*. Thus cassava is used to allow the maize reserve to last for a longer period (SARNNET, 2008).

2.3.2. Fresh marketed cassava

Fresh-marketed cassava is the largest trade channel of cassava in much of Malawi. IITA/SARNNET (2010) carried out a study on fresh cassava value chains for several southern African countries including Malawi, Zambia, Mozambique, Angola and South Africa. It was reported that in Malawi, fresh cassava is predominantly sold in fresh form targeting the informal markets for food security. The buyers eat it raw or they buy fresh cassava to boil at home. It is mainly used as a substitute for bread to be consumed together with tea or it is eaten as a snack. Although the growth potential in this channel is not likely to be large it is likely that, with population growth, the demand for fresh cassava will increase. Moreover, if the price of bread continues to increase in the future, many consumers are likely to switch to cassava in substituting bread.

2.3.3. Cassava-based prepared foods

Cassava based foods are various in Malawi. These are found both in the informal and formal sectors. Cassava-based prepared foods in this case exclude home-prepared dishes such as boiling and *kondowole* discussed above. Rather they represent food processed specifically for sale.

In the informal sector, cassava is mainly boiled to be sold as a snack at market places. This is sold to workers in the morning or afternoon (SARNNET, 2010). In rural areas *makaka* flour is often mixed with wheat flour for the preparation of mandazi. Furthermore, in some markets in Mzuzu and Kasungu, fresh cassava is also fried as chips to be eaten as a snack. This snack competes with chips made from Irish potato which is common throughout the country. In this case, cassava chips are cheaper than chips from Irish potatoes and thus offer an opportunity for the poor to eat 'chips' (Kambewa & Nyembe, 2011).

In the formal sector, it was observed that several biscuit manufacturers use a small proportion of *makaka* flour for the cheaper biscuits. This has been triggered by a continuous increase in wheat prices. However, the manufacturing industries prefer dried cassava chips of higher quality than is locally in the markets. First, the traditional peeling methods leave some rinds on the tuber. Secondly they prefer mechanically chipped cassava as drying is more uniform. A group of smallholder farmers in Zomba operating under a community based organization CMRTE (Chinangwa ndi Mbatata Roots and Tubers Enterprises) has been processing cassava for manufacturing industries in Blantyre. In 2010, the group managed to sell 30 tonnes of cassava chips to Crest Limited and Universal Industries amounting to MK 510,000 (US\$ 3,669 at 2010 exchange rate). They sold their product at a premium price of MK 15 to MK 18 per kilogram compared to MK 4 per kilogram other farmers sell at the local market.

A local entrepreneur also based in Zomba and belonging to CMRTE by the name Alongolere Enterprise processes *kondowole* for selling in supermarkets in Zomba and Blantyre. The enterprise

buys cassava chips from CMRTE members which are further processed into cassava flour and packaged for sale in supermarkets. In 2011, about 2,000 packs of 5 kg were sold through the supermarkets.

2.3.4. Industrial uses

There are two cassava-based industrial products in Malawi: High Quality Cassava Flour (HQCF) and cassava starch.

As mentioned above, a considerable amount of dry cassava roots and chips are converted into traditional flour (perhaps 200,000 t per annum as indicated by Kambewa and Nyembe, 2011). However, this would not be classed as HQCF as it has not been processed according to the specifications, i.e., it would be dried slowly, giving rise to fermentation and contains a considerable amount of extraneous matter, it would not have been milled to the required particle size or have been sieved, and it may well contain residual cyanide levels above regulatory minimum levels. As previously seen, this “low quality” cassava flour is widely traded and used as a staple food; it competes with maize flour as one of the two main staples in the country. As the drying process is simple and quality standards are low, this traditional cassava flour can be traded cheaply.

High Quality Cassava Flour (HQCF) is prepared from peeled and grated cassava, that has been de-watered, dried to 10-12% moisture content, milled and screened to give a fine flour capable of passing through a 0.25mm sieve. HQCF typically contains >90% starch but is not pure starch as it contains a certain percentage of fibre and traces of protein and fat. HQCF is so called to distinguish it from the many traditional cassava flours which are typically off white in colour, have a fermented smell and taste, and coarsely ground. Unlike the traditional products, HQCF is ideal as a partial substitute for wheat flour in bakery products and a complete substitute for starch in starch-based paperboard adhesives (SBA). Furthermore, its properties make it a potential substitute for starch in textile applications and suitable to be used as a binder in fish pellets.

In Malawi HQCF production has been introduced and supported by the C:AVA project funded by the BMGF and coordinated by NRI. HQCF is produced by two methods: sundried or artificially dried.

Sundried HQCF production started in the 2010/11 season. There are six active processors of sundried HQCF in Malawi: three processing groups (in Mulanje, Zomba and Salima) and three SMEs (in Nkhotakota). In the first season 18.6 t of HQCF were produced. The following year the production was 128.4 t and last year 303 t. It was observed that increasingly rural bakeries and mandazi makers are using HQCF to mix with wheat flour in bread and mandazi making in ratios ranging from 10% to 50% depending on the product to be produced (personal communication, Daniel Sandifolo, Manager CMRTE).

In February 2013 a first flash drier for the production of HQCF has been installed in Malawi by the largest biscuit company, Universal Industries, with the financial and technical support of BMGF and NRI. The flash drier has a processing capacity of 2.5 t/day HQCF (translating into an installed capacity of 750 t/year if operating one shift per day or 1,500 t/y if operating two shifts). The expected production in the first 12 months is projected at about 460 t. The roots' catchment area is within a 100 km radius. As better discussed in the following sections, Universal will initially target the HQCF requirement of Packaging Industries Malawi (PIM) and use the remaining flour as a substitute of

wheat flour in the biscuit lines. Universal Industries is also considering investing in a second flash drier and exploring the option to support the establishment of new processors that would supply cassava wet mash from areas outside the current catchment area.

Tables 2 and 3 present an estimation of the production costs and margins for both sundried and artificially dried HQCF.

Table 2: Production cost of sun-dried HQCF

Production costs per tonne HQCF	MK/t HQCF	US\$/t HQCF
Root supply (4t of FCR @ 15,000 MK/t)	60,000	154
Peeling, washing, drying	14,400	37
Labour for grater and presser	2,000	5
Fuel	3,500	9
Transport to Mill/electricity	1,000	3
Milling&screening	10,000	26
Bagging	1,800	5
Transport to end-user	1,000	3
Total direct costs per ton HQCF	93,700	240
Depreciation	1,000	3
Supervision and administrative expenses	9,370	24
Contingency & other costs (10%)	10,407	27
Total overhead	20,777	53
Total production cost per ton HQCF	114,477	294
Selling price	180,000	462
Margin	65,523	168
Margin (%)	57%	57%

As far as starch is concerned, in Malawi there are two SMEs processing cassava starch: Masinda Starch in NkhotaKota and Matsimbe Starch around Lilongwe. Until recently Masinda was a regular supplier of PIM while Matsimbe, supported by the Ngo Trustees of Agricultural Promotion Programme (TAPP), supplies meat processing companies. The volume produced by these companies is very small. For instance Matsimbe Starch has the capacity to process three tonnes of fresh roots per day for a maximum of three days a week. Taking into account the seven months down time due to the difficulties in syndrying, this translates into less than 40 tonnes of starch produced per year.

Table 3: Production cost of artificially dried HQCF

Production costs per tonne HQCF	MK/t HQCF	US\$/t HQCF
Root supply (4t of FCR @ 15,000 MK/t)	60,000	154
Peeling	3,159	8
Washing	1,092	3
Crushing	1,133	3
Dewatering	465	1
Drying	24,633	63
Milling&screening	980	3
Bagging	13,920	36
Transport to end-user	2,100	5
Total direct costs per ton HQCF	107,481	276
Depreciation	5,296	14
Supervision and administrative expenses	10,748	28
Contingency & other costs (10%)	12,353	32
Total overhead	28,396	73
Total production cost per ton HQCF	135,878	348
Selling price	210,000	538
Margin	74,122	190
Margin (%)	35%	35%

3. Market opportunities for HQCF

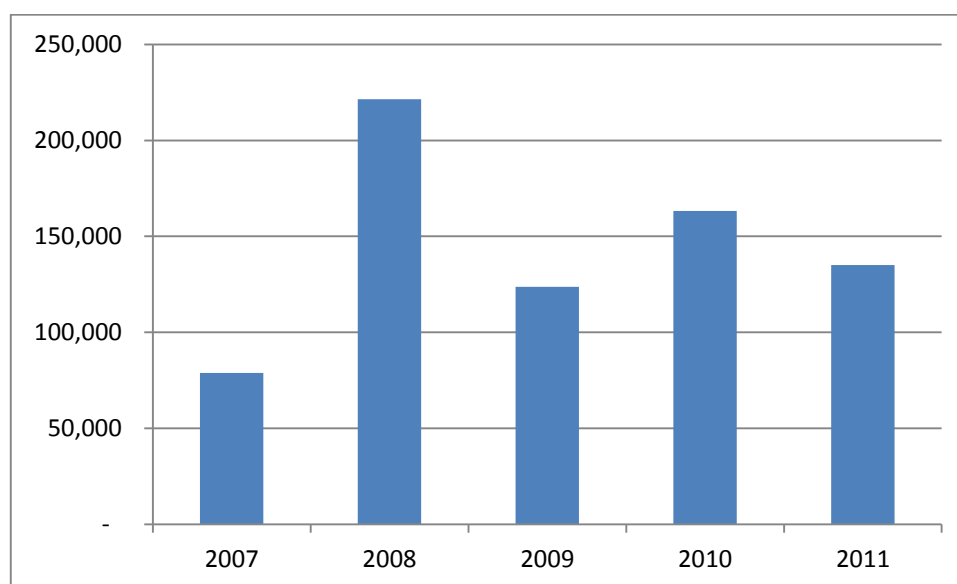
HQCF is a partial substitute of wheat flour and a complete substitute of maize starch in several industries. The following sections present the opportunities of HQCF in the different market segments.

3.1 Wheat import and flour production

HQCF is a partial substitute of wheat flour in several applications. Thus it is important to have a good understanding of the wheat flour's market in order to estimate the potentials of HQCF. Currently, Malawi imports almost all its wheat and wheat flour since its climate and water resources are not favourable for obtaining good wheat yields. It is estimated the domestic wheat production between 2007 and 2010 ranged between just 2,400 and 4,600 t per annum.

Malawi has only two companies that mill wheat, Bakhresa in Blantyre and Capital Foods in Lilongwe. Both companies have been expanding their installed capacity over the last few years in the expectation that consumption of wheat flour would grow significantly in the near future (for instance in 2011 Bakhresa doubled its wheat milling capacity to 500 t per day). However, as will be discussed later, the milling sector has been negatively affected by the devaluation of the Kwacha in 2012, making the import of wheat significantly more expensive and reducing the demand of wheat flour. As shown in Figure 6 annual wheat imports between 2007 and 2011 fluctuated between 80,000 and 220,000 t per annum. Interviews with Bakhresa, importing 70% to 80% of total wheat in the country, and other key-informants indicated that the current import of wheat is about 120,000 to 140,000 t.

Figure 6: Import of wheat between 2007 and 2011 (tonnes)



Source: ITC Trademap database

Wheat is imported mainly from the USA, Canada and Australia, and comes through the port of Nacala and Beira by either rail or road. The millers tend to import the cheaper soft wheat themselves and then purchase the hard wheat from USAID funded “Food for Peace” PL 480 Programme. The importance of PL480, which is likely to come to an end next year, is that allows the millers to import cheaper soft wheat and then combine it with the harder PL480 wheat to create better quality flour for the bakers.

Currently, the import of wheat grain does not incur import duties or taxes. Conversely, 20% import duty and 16.5% VAT apply to the import of flour for reselling. However, flour used for manufacturing is exempted and it is believed that biscuit manufacturers import cheaper soft wheat flour. Universal Industries, the largest biscuit manufacturer in Malawi with a 40%-60% market share, indicates to import about 5,000 t of wheat flour, mainly from Turkey since this is cheaper than purchasing locally from the millers. Furthermore, millers produce two types of flour, for bread making and confectionery, and they do not yet process flour specifically for biscuit manufacturers. Price considerations and unavailability of dedicated flour may explain why some manufacturers prefer to import flour specifically milled for biscuits. An overall amount of about 10,000 t of wheat flour per year is estimated to be imported directly by the biscuits manufacturers.

In the past Bakhresa and Capital Foods used to export wheat flour, in particular to Mozambique, Zambia and Zimbabwe. In 2009, the volume of wheat export was estimated at about 5,000 t per annum. However, recently, Bakhresa established a wheat mill in Mozambique and no export is likely to occur.

The wheat flour balance sheet is presented in Table 4. It is assumed that 130,000 t of wheat are imported and milled into 100,000 t of flour. By assuming that 10,000 t of wheat flour are imported by biscuit manufacturers and no exports occur, the total annual consumption of wheat flour can be estimated at about 110,000 t.

Table 4: Wheat flour balance sheet in Malawi, 2012

	Grain (t/year)	Flour (t/year)
Wheat grain imported	130,000	
Flour from imported grain (at 75% efficiency)		100,000
Wheat flour imported		10,000
Wheat flour exported		0
Total consumption		110,000

Most wheat flour is sold directly by the two mills to medium and large bakeries for bread making and other products such as scones and cakes. It is estimated that they absorb about half of the flour distributed by Bakhresa and Capital Foods (50,000 t per annum). The other half is sold wholesale through intermediaries, the most important of them being RAB Processors. RAB has an extensive network of about 80 outlets in rural areas where Bakhresa flour is sold either directly or through other intermediaries to small bakeries (not having the volumes required to be supplied directly by

the millers), restaurants, micro-processors and households for the manufacturing of bread, cakes, scones and mandazi. It is estimated that RAB sells about 35,000 t of wheat flour through its rural outlets (according to the World Bank about 80% of the population in Malawi resides in rural areas). The remaining 15,000 t are sold to urban outlets. It was indicated that about 40% of wheat flour consumed in Malawi is for the manufacture of mandazi (this share is apparently considerably higher in rural areas than in major cities). This would translate in about 40,000 tonnes of wheat flour used for mandazi, i.e. 80% of wheat flour distributed through rural and urban outlets. The market segmentation of wheat flour is provided in Table 5. These are just estimates but it gives an indication of the relevance of the different market sectors.

Table 5: Estimated wheat flour market segmentation

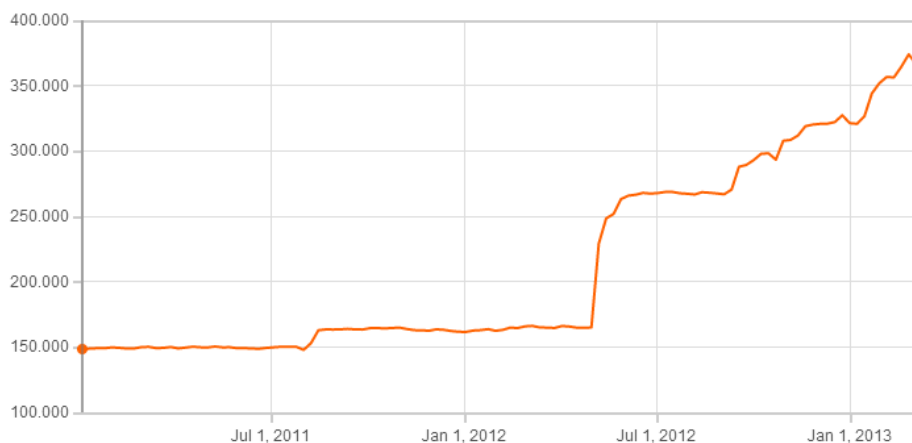
Market segment	Tonnage (t)
Large bakeries	50,000
Rural outlets	35,000
Urban outlets	15,000
Biscuits	10,000
Total	110,000

3.2. Market segments for HQCF as partial substitute of wheat flour

3.2.1. Millers

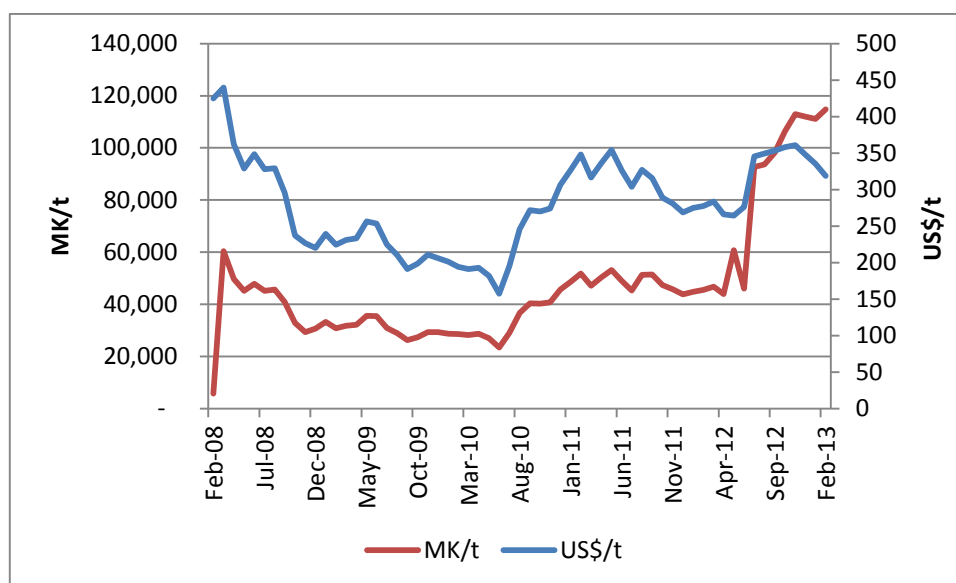
The devaluation of the Kwacha that occurred over the last year (Figure 7) had a strong impact on the production cost of wheat flour. The Figure 8 shows the trend in international wheat price over the last 5 years expressed in US\$ and Kwacha.

Figure 7: Exchange rate US\$:MK – January 2011 to March 2013



Source: www.oanda.com

Figure 8: International price of wheat expressed in US\$ and MK



Note: Wheat, No.1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico

Source: author's elaboration based on ITC trade statistics and Oanda exchange rates

Besides the imported wheat grain, other costs of wheat flour are denominated in foreign exchange; these include transport costs, port administration and handling. It is estimated that about 80% of flour production costs are denominated in foreign exchange (Sergeant, 2009).

While the production costs of unbagged wheat flour were estimated at about USD 510 per tonne in 2009 (Sergeant, 2009) it is estimated that in 2012 they were about US\$ 610. However, in Kwacha terms the increase was dramatic, with production costs of unbagged flour rising from MK 82,000 to 238,000 per tonne in just 3 years (+190%).

So far in Malawi, unlike in Nigeria, there has not been discussion for making the inclusion of HQCF in wheat flour mandatory.¹ In fact until the intervention of the C:AVA project the production of HQCF was negligible and mandatory inclusion, whose enforcement requires consistent supply of large volumes, only becomes a serious option when there is significant investment in artificial dryers. As such, the millers have to find sufficient incentives to opt for the inclusion on voluntary basis. Malawi's wheat milling companies appear to be receptive to the idea of incorporating HQCF with their wheat flour. Obviously the main driver would be the possibility of substantial cost savings. As previously seen the production cost of artificially dried HQCF is estimated at about 136,000 MK/t offering enough room for its profitable inclusion in wheat flour even when taking into account the transport costs. Moreover, the interviews indicated that, even though the cost savings would not be significant, the possibility of saving foreign exchange would be very attractive per se. Other benefits

¹ In Nigeria, despite the fact that a policy for mandatory inclusion has been introduced, this could not be enforced due to several factors including difficulties to ensure consistent supply of quality roots, inefficient drying technologies, disagreement about mechanism for price setting, lack of trust between the different stakeholders and challenges in the detection of cassava inclusion in wheat flour.

are that if millers would assist producers of HQCF, they might be able to improve their negotiation position with national authorities to get a larger allocation of foreign exchange and, by making a contribution to improve the purchasing power of rural communities (producers of cassava), it will positively impact on the sales of wheat flour.

On the other hand the millers raised some concerns, including the awareness that there is not sufficient production of HQCF in Malawi to meet even a minimal part of their potential demand. Moreover there are concerns about the capacity to regularly supply consistent quality HQCF and that the choice of HQCF inclusion might affect their market reputation.² As such, the two millers would like to act in unison in order to avoid that one company might claim the other's flour to be of inferior quality.

The potential demand of millers can be estimated at about 5,000 t per annum (assuming a 5% inclusion rate). If inclusion of small quantities of HQCF does not affect quality, then millers should pay the HQCF the same as their cost of processing wheat into (unbagged) flour, i.e. about 238,000 MK/t.

Since the production of artificially dried HQCF is still scarce and, as we will see in the following sections, the price that millers may be willing to pay for HQCF is not as high as other markets that would be the main target of potentially newly installed flash driers, the wheat milling market is to be considered as a long-term goal, which can only be realised when these amounts of HQCF can be assured.

3.2.2. Medium and large bakeries

In Malawi there are a number of large bakeries that own several factories, such as Bakers Holdings, Mother Holdings and Royal Products. In addition the mills directly supply a wide range of medium bakeries. The wheat flour requirement of these bakeries represents a large opportunity for HQCF. It is estimated that large and medium bakeries consume about 50,000 t of wheat flour per annum. Normally it is assumed that HQCF can be incorporated at levels of ~7% without adverse effects on loaf quality. Above this level the volume of the loaf is visibly reduced and the texture of the bread has a heavy cake like texture due to the absence of gluten in HQCF. Furthermore shelf-life will reduce from 7-10 days to about 4 days due to the hygroscopic nature of HQCF that encourages mould growth. However, bakery improvers are available that allow 20% incorporation of HQCF with a 7-8 day shelf-life. By assuming a conservative estimate of 7% inclusion rate these market segment would offer a potential for using about 3,500 t of HQCF a year.

Large bakeries are buying wheat flour at about 290,000 MK/t (delivered). It is assumed that the bakers would be interested in using HQCF only if it reduces the cost of their bread process. Assuming that they will be attracted by paying HQCF at 75% of wheat flour's price, this would translate into a price of 218,000 KW/t of HQCF. Since these bakeries purchase between 2 and 5 t of wheat a day, their demand could be met only by HQCF produced by means of a flash drier. Again, if our production cost estimates for artificially dried HQCF are correct, there should be enough room for profitably selling HQCF to these end-users. However it is obvious that it would be much easier to target them having the HQCF already incorporated by the millers in composite bread flour.

² In Nigeria, quality of artificially dried HQCF has been found in most cases quite disappointing.

3.2.3. Rural and urban outlets

A large amount of wheat flour is distributed by rural and urban wholesale outlets, with the former outweighing the latter. In rural areas flour is used in particular for the manufacturing of a range of simple snacks such as scones, buns, donuts and mandazi.³ Most of the micro-enterprises that prepare these snacks buy the flour in small amounts, sometimes several times per day, from the rural retail markets. Mandazi is by far the most common snack prepared with wheat flour. As previously mentioned it is estimated that about 80% of wheat flour distributed through rural and urban outlets is used for the preparation of mandazi. It is common practise to mix some *makaka* flour in the preparation of mandazi. During the interviews it has been indicated that wheat/HQCF composite flour is unlikely to be successful in the rural areas because cultural issues make each manufacturer willing to mix the wheat and cassava flour according to his specific taste and preferences. However, RAB Processors is selling ready-mix mandazi flour (with 15% of *makaka* flour) in the urban markets but it has been reported that the volumes are extremely small.

In the preparation of mandazi it is possible to replace considerably more wheat flour than in bread making: HQCF can be successfully included at a level higher than 40%. However, taking into account that the remaining 20% of wheat distributed through outlets is used for preparations other than mandazi for which a lower inclusion rate is advisable (but still higher than in bread) it is safer to assume a more conservative inclusion rate of 30%. This would translate in a potential demand of 15,000 t of HQCF per annum.

Because of the higher transport costs RAB Processors is currently selling wheat flour in rural areas at higher price than in the major cities (wholesale price of 275,000 and 250,000 MK/t, respectively). It is assumed that HQCF would be attractive if sold at 75% of wheat flour price (206,000 and 188,000 MK/t in the rural and urban areas, respectively) and this appears to be doable for producers of both artificially dried and sundried HQCF. However it is clear that only a small part of this demand could be met by small-scale processors of sundried HQCF only. It is interesting that during the interview RAB Processors expressed its interest in distributing HQCF through its network of rural outlets even though this would add some extra cost for the transport of HQCF to the outlets and then to the rural end-users.

In consideration of the fact that a considerable amount of wheat flour is bought at retail level in rural areas for the preparation of snack, in particular mandazi, by micro-enterprises, an alternative strategy that offers a sizable opportunity consists in targeting these market segment directly. In fact, due to the transport costs and the presence of an additional actor in the chain, wheat flour purchased in small amount by retailers in rural areas is significantly more expensive than in any other outlet. During the visit the prices of wheat flour were found ranging between 300 and 350 MK/Kg and offering an opportunity for the sale of HQCF at about 225 to 260 MK/Kg (75% of wheat flour price). This represents a very interesting opportunities for the processors of sundried HQCF that can sell their product in the surrounding areas at a very attractive price (Sergeant, 2009). This is the main marketing strategy currently promoted by C:AVA in rural areas. While sales to rural retailers and end-users offer the best economic return a challenge consists in reaching a plethora of

³ Mandazi are made using flour, baking powder, eggs, sugar and milk. The ingredients are mixed together and then small portions of the batter are fried in oil.

micro outlets and processors that are scattered by nature and hence offering little opportunities for scaling up.

3.2.4. Biscuits

There are five main biscuit manufacturers in Malawi; Universal Industries, Cresta, Bakeman's Confectioneries, RAB processors and Baked Lines. The first four companies are based in Blantyre whilst the fifth, Baked Lines is based in Lilongwe. All companies use some *makaka* flour in their cheapest lines because it is much cheaper than wheat flour.

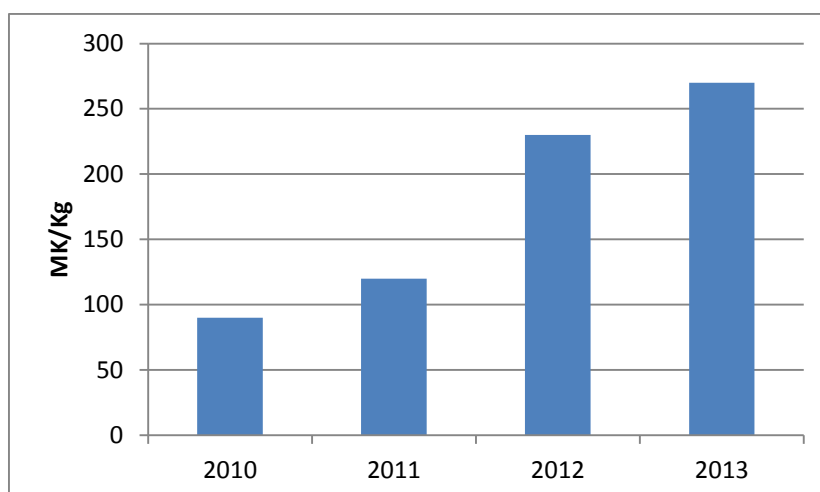
It is estimated that biscuit companies use about 12,000 t of flour per year, consisting of about 10 to 11,000 t of imported wheat flour and 1 to 2,000 t of *makaka* flour. Because the processing of HQCF is more costly and requires greater technical skill, it is assumed that it cannot compete with traditional cassava flour used for cheaper biscuits (RAB processors is currently selling *makaka* flour to other biscuit companies at 90,000 MK/t). Thus it is assumed that the use of cheaper *makaka* flour will continue in the lower quality biscuits.

Normally it is indicated that in the manufacture of biscuits it should be possible to substitute up to 35% of wheat flour with HQCF. However, due to some machinability problems that may arise, in the medium term, a replacement of 25% is more feasible. In total, by assuming wheat consumption of biscuit manufacturers at 10,000 t per annum, this indicates a market opportunity of 3,500 t per annum in the longer term and 2,500 t per annum in the medium term. However, it has to be taken into account that Universal Industries is the largest producer of biscuits and they have recently (in February 2013) installed a flash drier for the production of HQCF. Universal imports about 5,000 t of wheat flour a year and it would offer a theoretical opportunity of using 1,250 t of HQCF in its biscuits. The flash drier has an installed capacity of 2.5 t of HQCF per day if working one shift per day and the double of it when operating two shifts per day. When operating at full capacity it is expected that it will produce about 1,500 t of HQCF a year. Part of this HQCF will be in sold to the packaging industries (see later) and the rest will suffice to cover all their medium-term requirements. As such the untapped demand of the biscuit sector for HQCF is 1,250 in the medium-term and 2,250 t in the longer term.

The current price biscuit manufacturers are paying for their imported wheat flour is MK 270,000 per tonne. This is cheaper than the price they would pay for locally milled flour. Furthermore with imported flour they benefit of 180 day credit instead of the 14 day credit offered by the local millers. Like the price of wheat grain, the price of imported wheat flour has increased tremendously as a consequence of the recent devaluation of the Kwacha (see Figure 9).

The partial substitution of imported wheat flour with HQCF would allow saving in foreign exchange. And this would be a first incentive to use it. However, apart from it, biscuit companies would be interested in cost savings. As such 75% of wheat flour would be a reasonable price for HQCF. At current prices this would translate in about 200,000 MK/t. Again this price seems to offer enough opportunity for make the production of HQCF attractive. Moreover, due to the biscuit manufacturers' habit of using traditional cassava flour, there is already a good understanding that it can be successfully incorporated. This should facilitate the uptake of HQCF by this industry.

Figure 9: Landed price of wheat flour imported by biscuit manufacturers



Source: ITC Trademap database

3.2.5. Plywood

It would be possible to use HQCF in the plywood industry for the production of glue. In Malawi there is only one major company, Raiply in the northern part of the country. Whilst it was not possible to visit them, it has been indicated that they had already been met in the past. Raiply is currently using in the order of 200 to 300kg/day of cheap ingredients as binder, namely *makaka* flour and low quality or expired wheat flour. It is assumed that HQCF cannot compete with these cheap raw materials and as such, the plywood sector does not seem to offer concrete market potential for HQCF in the short to medium term.

3.2.6. Aquafeed

HQCF can be used as a binder for fish pellets in order to limit its crumbling. Some trials have been already conducted in Malawi and they have proved successful. It has been indicated that an inclusion rate of 1.5% performs well.

In Malawi, the production of farmed fish can be estimated at about 2,000 t per annum, almost exclusively tilapia. This is considerable lower than the capture fisheries from the Lake Malawi (around 65,000-70,000 t/y) but it has been growing over the last few years. It is estimated the potential fish demand of Malawian consumers can be around 100,000 t per annum.

About 1,000 t a year is produced by smallholders mostly in small pond farms set within mixed agriculture farms. These ponds are usually fertilized and no supplementary feed is provided. The remaining 1,000 t is produced by one large farm, Maldeco Aquaculture. This company currently farms fish in cages in the Lake but it is progressively switching to earthen ponds. Currently there are apparently no mid-size fish farms in Malawi.

It is assumed that the feed conversion rate in Maldeco is quite poor, at about 3.5:1. This translates in a current demand of about 3,500 t of feed per annum. If the HQCF is incorporated at commercial

level at a 1.5% rate, Maldeco would offer a potential demand of about 50 t per year. However, in the expectations of increasing the production of aquafeed for internal use and possibly sale, Maldeco has recently signed a contract with the National Association of HQCF processors for 120 t of sun dried HQCF per annum (10 t/month). No consignment has been delivered for the time being. The agreed price is 150,000 MK/t but it is likely that some room for higher pricing exists. However this opportunity seems more likely to be met by processors of sundried HQCF only rather than the ones potentially equipped with a flash drier.

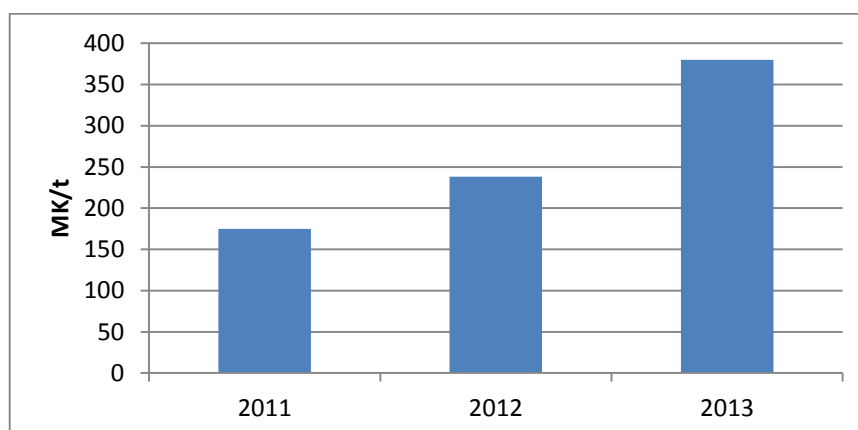
Another large high technology fish farm, Chambo Fisheries, has been established in the surroundings of Blantyre but, due to several technical problems, this is not currently operational. Its installed capacity is about 800 t of fish a year. It has been indicated that the production will progressively start in the coming months. However, this company will use molasses as binder and it does not look interested in switching to HQCF.

3.3. Maize starch import

There is no production of maize starch in the country and all the demand is currently met by imports, mainly from South Africa. Even though most, if not all, companies importing maize starch have applied and benefitted from a custom rebate that allows them to import the starch free of duty and taxes, this is extremely costly for the end-users. In the past, in order to save foreign exchange a few companies have made some attempts to source some locally produced product to use in their manufacturing process. For instance, until recently Packaging Industries Malawi (PIM, the major packaging industry in Malawi) used to buy some cassava starch from Masinda Starch and David Whitehead & Sons (DVHS, the only textile company in Malawi) tried to use *makaka* flour. However, both attempts failed: in the former case the starch company has not been able to ensure consistent supplies; in the latter case there were serious quality issues.

The interest in replacing imported starch with locally produced material has become more compelling following the devaluation of the Kwacha. While in dollar terms the price of imported starch has been quite stable over the last few years, the price that local companies are paying in Kwacha terms has seen an impressive growth as shown in Figure 10.

Figure 10: Landed price of imported maize starch in Malawi



Currently, in Malawi, the major users of maize starch are the packaging, textile and biscuit companies. The first two will be dealt more extensively in the following sections. As far as the biscuit companies are concerned they use the maize starch for the preparation of the biscuit's cream filling. It has been indicated that Universal Industries uses about 120 t of maize starch and RAB Processors about 12 t per annum. HQCF can completely replace maize starch in the packaging and textile industries but it is not suitable as replacement of starch in the manufacture of biscuits.

3.4. Market segments for HQCF as substitute of maize starch

3.4.1. Packaging industry

HQCF can completely replace maize starch in the manufacturing of packaging material. This is potentially a small but highly lucrative market. Unfortunately previous donor driven projects had discouraged the Malawian paperboard industry and created the impression that HQCF could never be used in paperboard glues. To boost investor and end-user confidence in HQCF as a substitute for maize starch in paperboard adhesives, NRI and University of Malawi undertook industrial trials of HQCF-based adhesive formulations at PIM (part of the NAMPAK group) in October 2010. Representatives of the Universal Industries, at that time considering investing in a flash drier for the production of HQCF, participated in these trials and a report of the successful outcome of the trials was circulated to the management of both Universal Industries and PIM. It was agreed that when Universal's HQCF factory becomes operational C:AVA would run a demonstration and optimisation trial with HQCF at PIM in Malawi (planned for August 2013).

PIM currently imports about 360 t of native maize starch per annum as major ingredient for an improved Bauer type paperboard adhesive. The cost of last consignment of starch was 370,000 MK/t. It could be argued that they should pay a similar price for HQCF. This is clearly the most lucrative market for HQCF and Universal Industries is likely to supply it entirely, at least in the short to medium term. Another packaging company, Flexible packaging, is also importing limited volumes of maize starch but the team didn't have the opportunity to visit it and the volumes of starch used are unknown.

3.4.2. Textile industry

HQCF can completely replace maize starch in the manufacturing of yarn and fabric. David Whitehead & Sons (DVHS) is the only textile company in Malawi. DVHS have had unpleasant experiences with *makaka* flour in the past. Major problems were due to the hot paste viscosity, lack of stability and high fibre levels. This disrupted its confidence in using locally sourced material. However, upon discussion with the team, the manufacturer manager could appreciate the fact that HQCF and *makaka* flour are not the same product. DVHS is keen to run a factory trial using HQCF and this is likely to be done next year if they resume processing yarn again.

Maize starch is used in the process of dyeing and as yarn thickener in order to reduce breakages during the weaving. Due to recent challenges in the supply of cotton DVHS has temporarily suspended the spinning and weaving and it is currently using starch exclusively for the dyeing process (about 12 t per annum). As a yarn thickener, DVHS typically used about 240 t of maize starch a year. However, at the time of the visit, the company was upgrading its production line in order to

double the installed capacity for weaving. It is expected that at the end of the year DVHS will restart the spinning and weaving and it is estimated that it will require about 500 t of maize starch per year. As previously mentioned the replacement of maize starch offers the best opportunity for HQCF to fetch a very attractive price.

4. Market opportunities for cassava starch

As previously discussed there are applications where native maize starch cannot be replaced by HQCF. However it would be possible to replace currently imported maize starch used by the confectionery and meat processing industries with locally produced cassava starch. As previously mentioned, the current annual volume of starch produced by the two SMEs manufacturing cassava starch is likely to be less than 80 t per annum.

4.1. Market segments for cassava starch

4.1.1. Confectionery industry

As already mentioned Universal Industries and RAB Processors use for the biscuit's cream filling about 120 t and 12 t of maize starch per annum, respectively. It can be assumed that the overall demand of maize starch by the confectionary industry is below 200 t a year. This is a potentially attractive market however it should be taken into account that large companies such as Universal Industries require a consistency in supply of quality starch that these small local starch processors are not able to guarantee (as already experience by PIM when it attempted to buy some local cassava starch).

4.1.2. Processed meat industry

Manufacturers of processed meat use starch as binder and filler in sausages, poloni, smoked ham and other meat products. There are two major companies in Malawi: Kapani Processed Meat Ltd and Ori Processed Meat Ltd. Being attracted by the possibility of cost and foreign exchange savings, both companies switched from imported maize starch to locally produced cassava starch. The process was not straightforward and difficulties due to quality inconsistency were encountered. However, following some rejections of the consignments, apparently the quality of the cassava starch considerably improved and currently the two companies purchase from Matsimbe Starch about 1 t of cassava starch a month each. As such, the overall demand of cassava starch by the local meat processing industry is estimated at about 25 t per annum. For the time being, this demand is already met.

5. Market opportunities for dry cassava chips and/or grits

Dry cassava can substitute cereal grains in several industrial applications. In Malawi two market segments have been identified where cassava can replace maize, namely in animal feed and in the manufacturing of traditional beer. Furthermore cassava can replace malted barley in the production of clear beer. The following sections present the findings of our study.

5.1. Market segments for dry cassava chips and/or grits as substitute of maize

5.1.1. Animal feed

Table 6 shows the size of livestock population in Malawi in 2012.

Table 6: Livestock population in Malawi in 2012

Livestock	Heads
ALL CATTLE	1,110,560
<i>Beef cattle</i>	1,060,221
<i>Dairy cattle</i>	50,339
GOATS	4,442,907
SHEEP	228,649
ALL PIGS	2,160,670
<i>Indigenous pigs</i>	1,924,773
<i>Small scale exotic pigs</i>	222,553
<i>Commercial exotic pigs</i>	13,344
ALL CHICKENS	43,836,919
<i>Indigenous chickens</i>	21,683,889
<i>Broilers</i>	16,627,188
<i>Layers</i>	5,635,298
BLACK AUSTRALORP	725,711
RABBITS	1,022,864
GUINEA FOWLS	1,350,585
TURKEY	145,486
GUINEA PIGS	170,721
DOVES/PIGEONS	2,560,964
DUCKS	1,014,869

Source: Ministry of Agriculture

It is estimated that in Malawi about 95% of commercial feed is for poultry. The rest is for pig, dairy cattle and the emerging fish industry.

Dried cassava can be used in the production of compound animal feed and this is a common practice in Latin America, South East Asia and Europe. However in Africa, while cassava inclusion in animal feed is not a novelty, it has never been consistently used in large volumes due to the prevalent role

of cassava as a staple food. Furthermore cassava is often more expensive than the grains used in the traditional cereal-based rations.

In the animal feed industry cassava can be used as a replacement for maize as a source of energy. The results found in literature, in terms of its feeding value, nutritional problems encountered, biological responses and productive performances of animals fed with cassava products, have exhibited wide variability. The variations, apart from being caused by the varying types of the tested cassava, are due to differences in species, types and development stage of the animals, level of production and ecological conditions. In addition, the form, and composition of diets, level and types of supplementation are additional factors contributing to these conflicting results. Accordingly, the literature presents contradictory findings regarding what products can be used, how they can be fed, and how much cassava product can successfully be fed to each type of animal.

Cassava roots are an excellent source of carbohydrates but the protein and vitamin content is very poor. It is important to correctly balance cassava based diets for all nutrients to appropriately satisfy the needs of each class of animal. Therefore there is need to supplement the cassava products with protein, amino acids, fat, minerals and vitamins at higher levels than when using cereal-based diets. Typically, protein rich ingredients used as supplements are soymeal, fishmeal and groundnut cake.

Cassava is usually in the form of dried root chips or chunks which are milled into powder (meal or flour) before incorporation into compound feed. Cassava is manually sliced in chips of different sizes but recently simple machines have been developed for chipping cassava roots. The need to peel the root for the use of cassava in animal feed is controversial.

The most common way for drying chips and chunks is by sun-drying. However, when the weather conditions are not favourable, artificial drying is possible by simple batch dryers often used for drying grains on farm.

An alternative cassava product than can be used in animal feed is the grit. Grits are produced by grating the washed unpeeled roots to produce a mash. The mash is then dewatered to form a cake that will be spread thinly and allowed to sundry. One of the advantages of grits in poultry is that they do not need to be milled (and hence lower losses due to dust) and can be supplied directly to the birds without need of pelletization. Moreover they present a relatively uniform particle size and dry quicker.

In Malawi the production of dry cassava, either *makaka* or *kondowale*, is common in the rural setting. While they are important staple foods it is challenging to procure large volumes of these dry products for commercial use. For instance, RAB Processors indicates that they struggle to purchase the volume of *makaka* required for their line of cheap biscuits. Moreover even though unmilled *makaka* is quite cheap (20to 30 MK/Kg delivered) its availability is irregular and the quality is variable.

The feed industry in Malawi has proved to be either not aware of the possibility to use cassava or complain about its unavailability. Moreover the perception of toxicity due to the presence of cyanide in the root is a source of concern.

Makaka, as currently produced, is unlikely to meet the requirements of the commercial feed industry in terms of both quantity and quality. Rather, a commercially oriented production of dry

cassava would be required. This can be either in the form of mini-chips or grits. Table 7 and 8 present an estimation of the production cost of sundried mini-chips and grits. In both cases, it has been assumed that peeling the roots is required.

Table 7: Estimated cost of production of sundried minichips

Production costs per tonne peeled mini chips	MK/t HQCF	US\$/t HQCF
Root supply (3t of FCR @ 15,000 MK/t)	45,000	115
Peeling, washing, drying	10,800	28
Labour for chipping	500	1
Fuel	2,100	5
Bagging	1,800	5
Transport to end-user	1,000	3
Total direct costs per ton mini chips	61,200	157
Depreciation	1,000	3
Supervision and administrative expenses	6,120	16
Contingency & other costs (10%)	6,832	18
Total overhead	13,952	36
Total production cost per ton mini chips	75,152	193
Margin (30%)	22,546	58
Selling price	97,698	251

Table 8: Estimated cost of production of sundried grits

Production costs per tonne grits	MK/t HQCF	US\$/t HQCF
Root supply (4t of FCR @ 15,000 MK/t)	60,000	154
Peeling, washing, drying	14,400	37
Labour for grater and presser	2,000	5
Fuel	3,500	9
Bagging	1,800	5
Transport to end-user	1,000	3
Total direct costs per ton HQCF	82,700	212
Depreciation	1,000	3
Supervision and administrative expenses	8,270	21
Contingency & other costs (10%)	9,197	24
Total overhead	18,467	47
Total production cost per ton grits	101,167	259
Margin (30%)	30,350	78
Selling price	131,517	337

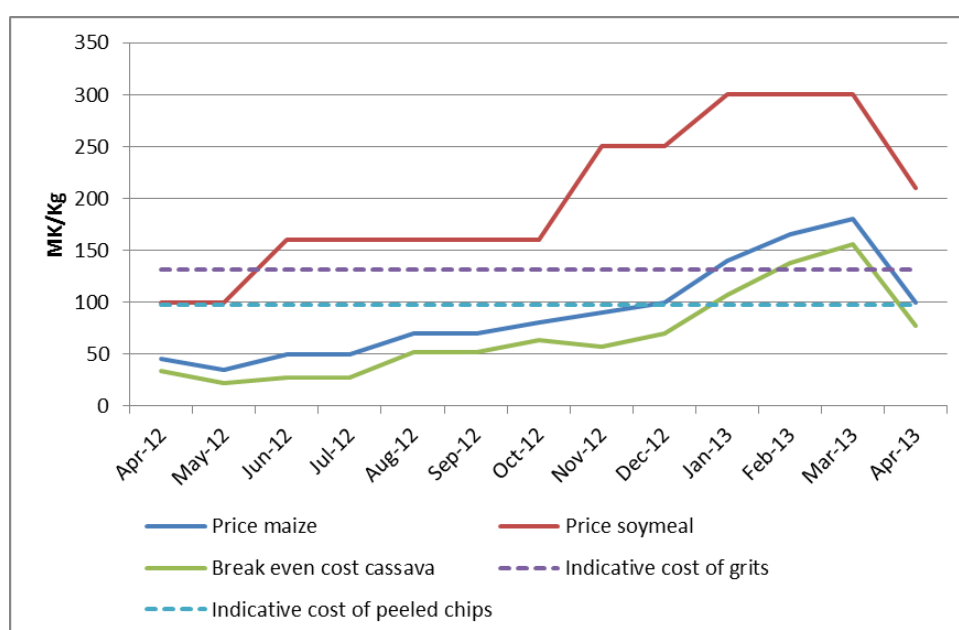
5.1.1.1. Poultry feed

It is estimated that the overall demand of commercial poultry feed is about 120,000 t per annum. About 70% (~85,000 t) of this demand is met by large scale fully integrated poultry farms such as Central Poultry Ltd, Protofeed Ltd, and Southern Poultry Ltd. These companies use 60% to 70% of their manufactured feed for internal use and sell the rest on the market. They have sufficient working capital to purchase the overall annual requirement of maize at harvesting time when the maize prices are at their lowest. They often store the maize themselves or pay a fee to local warehouses for fumigation and storing. Cassava chips or grits are unlikely to be competitive with maize purchased in such a way unless maize price during the harvesting season will substantially increase (as occurred during the current year with price of maize in April still as high as 100-100 MK/t). For instance, one of these large companies has indicated that the average cost of maize they purchased over the last 12 months, including interests and storing fee, has been just 90,000 MK/t (mainly bought in May/June).

However, the remaining 30% (~35,000 t) of the commercial poultry feed is produced by small and medium scale feed mills. They do not have the capacity to purchase all the required maize when its price is at its lowest, and they procure maize throughout the year. The implication is that they found themselves paying extremely high prices for maize in the lean season. This represents an interesting opportunity for the inclusion of cassava. It is expected that cassava would be used opportunistically at the time when the price of maize is at its highest.

Assuming that 1,000 kg of maize would be replaced by 830 kg of dry cassava and an additional 170 kg of soybean (the two rations would be equivalent in terms of protein content), and taking into account the variability of the price of different ingredients over the course of the year (in this case the last 13 months, April 2012 to April 2013), the Figure 11 indicates a three month window where an opportunity exists for using cassava chips as replacement of maize savings (January to March, i.e. the months when cassava chips cost less than the break-even cost of cassava – representing the cost of cassava that would make the cassava-based ration as expensive as the maize-based one).

Figure 11: Price of maize and its potential substitutes in poultry feed



The use of grits, due to their higher production costs, seems profitable only over two months (February and March). Assuming that the production of poultry feed is constant over the year, that the average poultry ration contains 50% of maize and that 83% of maize is substituted by cassava, the small and medium scale feed mills may absorb about 3,500 tonnes of cassava chips or 2,500 tonnes of cassava grits per year. However, to grasp this opportunity depends on successful outcomes of commercial trials to be carried out with feed and poultry companies. Furthermore, cost efficient simple drying technologies (e.g. by bin dryers) should be developed and adopted since the months where cassava inclusion appears to be economically viable are in the rainy season when sundrying is not feasible. Artificial drying will add some cost whose impact on the sustainability of this opportunity had to be assessed. On the other hand, in case trials provide evidence that inclusion of unpeeled chips is doable, the production cost of the chips will decrease offering better potentials for inclusion of cassava in the rations.

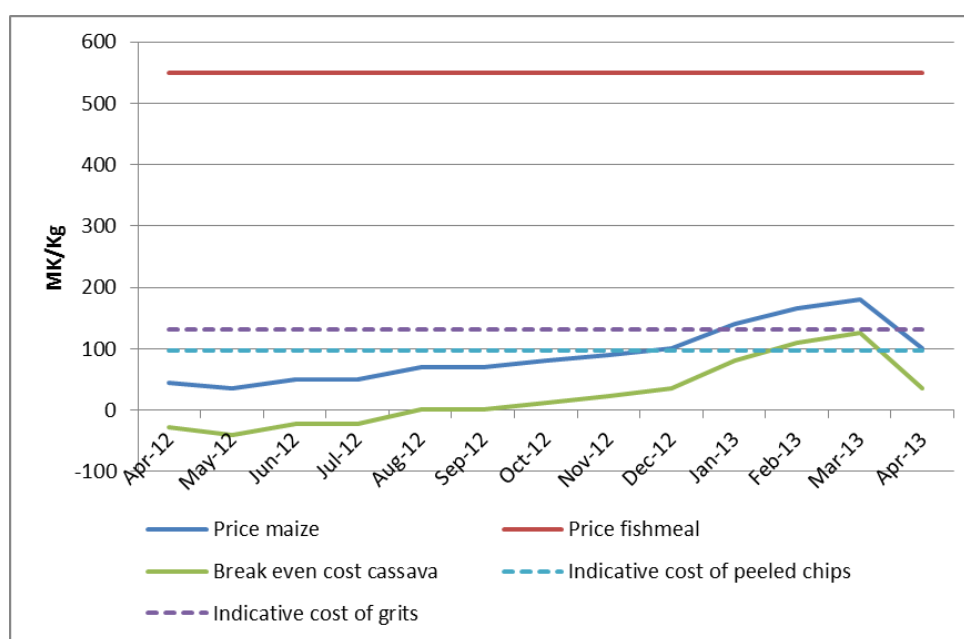
5.1.1.2. Aquafeed

As previously mentioned it appears that in Malawi only two companies have the capacity to produce significant amount of aquafeed: Maldeco Aquaculture and Chambo Fisheries. It is estimated that Maldeco manufacture about 3,500 t of sinking pellets per annum, almost exclusively for internal use. Chambo fisheries is not yet in operation but it is expected that it will require about 1,000 t of sinking pellets per year soon, i.e., when fully operational (FCR estimated at about 1.25). Negligible volumes of fish pellets are produced by few feed companies and none of them is currently producing floating pellets where the use of cassava seems to positively contribute to their floatability. As such the possibility for cassava to completely or partially substitute of maize as source of energy lays exclusively on economic considerations.

It is assumed that Maldeco pellets contain about 50% of maize while during the interviews the representatives of Chambo Fisheries reported a much lower maize inclusion rate (about 6%). This translates in an overall use of maize in fish feed of about 1,800 t a year. Alike for poultry feed, the substitution of maize with cassava would require higher inclusion of protein-rich ingredient to compensate for the cassava's lower protein content. We assume that 1,000 kg of maize would be replaced by 870 kg of dry cassava and an additional 130 kg of fishmeal (again, the two rations would be equivalent in terms of protein content). By doing so we expect that about 87% of maize could be substituted by cassava, i.e., about 1,550 t per annum.

However, this interesting possibility appears to be largely precluded by the extremely high cost of fishmeal (reported to have been fairly stable over the course of last year at about 550 MK/kg). In fact, even though both companies buy (or will buy) maize throughout the year, Figure 12 shows that there seem to be only two months (February and March) where the substitution of maize with cassava chips would lead to cost savings (this require that the cassava chips cost less than the break-even cost of cassava, i.e. the cost of cassava that would make the cassava-based ration as expensive as the maize-based one). Conversely, the replacement of maize with cassava grits does not appear to be economically viable at any given time of the year. Assuming that the production of aquafeed is constant over the year, the aquaculture sector seems to offer a potential to absorb about 250 t of cassava chips per year. However this opportunity is very much dependent on successful outcomes of commercial trials to be carried out in conjunction with the aquaculture enterprises. Moreover, like poultry feed, the additional costs of artificially drying has to be fully assessed.

Figure 12: Price of maize and its potential substitutes in aquafeed



5.1.2. Traditional beer

In Malawi huge volumes of traditional beer are produced and consumed, particularly in rural areas. Besides a large number of small, scattered and informal village level producers of opaque beer, only one company produces and commercializes significant volume of this product: Chibuku, part of the SAB-Miller group. Chibuku produces about 25 to 30 million litres per annum. This beer, marketed as a Chibuku *Shake Shake* (because you have to shake it before you drink it), is made by fermenting a feedstock made of 90% maize and 10% sorghum. About 5,000 tonnes of maize are annually brewed by Chibuku. Even though appreciated in the rural setting, this traditional beer is a low quality product where cassava can easily replace maize once possibilities of cost savings are proved. The Quality Manager of Chibuku has shown his interest in any opportunities to reduce the cost of the raw material. He is very much aware of the possibility to use cassava and even he considered to carry out some trials using *kondowale* (even though this statement shows the lack of fully understanding of the challenges in using a partially fermented product in the brewing process it proves the genuine interest in considering cassava as potential substitute of maize). Unlike maize, the use of sorghum is required to give the demanded flavour and viscosity and its substitution doesn't appear to be an option.

It has been mentioned that cassava would never fully replace maize and, by assuming a 50% substitution, an opportunity to use about 2,500 tonnes of dry cassava seems to exist. A part the concerns expressed about future availability of consistent volume of maize, the main driver for cassava inclusion would be again the opportunity for cost saving. Chibuku purchases most of its maize requirement in June when the grains are properly dried and the prices are low. As such the company is not exposed to the seasonal price fluctuations. During the interview it was reported that the average price of delivered maize in year 2012 has been about 65,000 MK/t (to which a 20,000 MK/t should be added to cover the milling costs). However, the current production costs of cassava chips and grits, as previously presented, do not seem to offer room for cost savings in the short to medium term, even assuming that there would not be need to mill the grits. Nevertheless, this

picture might be altered if the price of maize at harvest time will be significantly higher than in the last few years for which official statistics exist. This is extremely difficult to predict even though, during the current year, prices of maize have shown sign of increase.

5.2. Market opportunities for dry cassava chips and/or grits in clear beer

Officially opened in 1968, Carlsberg Malawi Brewery Limited (CMBL), now part of Carlsberg Malawi Limited (CML), was the first Carlsberg brewery outside Denmark. It is the only state-of-the-art brewing and beer packaging facility in Malawi and is capable of producing 38 million litres of beer per year. It is estimated that CMBL has about 95% of clear beer market share, the rest covered by imports. CMBL commercializes several brands (*Carlsberg Green, Carlsberg Light, Carlsberg Classic, Carlsberg Elephant, Carlsberg Special Brew, Carlsberg Stout* and the local brew *Kuche Kuche*), some produced by brewing 100% imported malted barley and some produced by fermentation of barley and some domestically produced adjuncts (up to 30%). The most common adjuncts used are rice, sorghum, brown sugar and maize. The use of locally produced raw material is seen with interest by the company in order to lower the cost of raw material and save foreign exchange.

Currently, the company is installing specific equipment that would allow the production of beer with higher inclusion of adjuncts. The company is contemplating launching a new product made by fermenting sorghum only and their target would be to capture about 5% to 10% of the market. Like sorghum, the inclusion of cassava (at any sensible rate) as a fermentable feedstock would require the development and launch of a new product, "cassava beer", rather than occurring in currently commercialized brands. This is similar to what done by SAB-Miller in October 2011 when, attracted by the tax rebate offered by the government for beer produced with local raw material, it introduced the brand *Impala* in Northern Mozambique. *Impala* is a lager containing 70% cassava and 30% malted barley. In the first 12 months of production, *Impala* sales were 9 million bottles (50,000 hectolitres) which equates with 2.7% of the domestic beer market. In Mozambique, cassava is processed into wet-cake (~40% moisture) in the village using mobile processing units known as AMPU (developed by DADTCO) and transported to the brewery.

Interview with the Chief Brewer at CMBL allowed a better understanding of the company strategy for future procurement of raw material. While there appear to be a strong interest in increasing the use of locally produced raw material, the current focus seems to be pretty much on sorghum only. However, an interest in assessing the potential of cassava in dry form has been expressed and the C:AVA team will follow up this by supplying samples for carrying out initial laboratory trials.

By assuming that the cassava beer would take over 5% to 10% of the domestic market and that its inclusion rate would be between 50% to 70%, in the medium term an opportunity to supply 200 to 500 t of dry cassava per annum to CMBL may exist.

In case laboratory and commercial trials for consumer's acceptability were successful, CMBL would explore the possibility to apply to the Malawian Innovation Challenge Fund established by UNDP (total budget of US\$ 8 million for expected 15-16 projects). This fund will offer matching grants over the period 2013-2016 to promote the development of inclusive business models and, in particular, to support the additional cost of involving small scale producers in new value chains.

6. Market opportunities for sugar syrups

Starch from cassava roots or other carbohydrate sources such as maize can be hydrolysed using enzymes to form glucose syrup. Glucose syrup is actually a mixture of malto-dextrins of varying chain lengths. Glucose syrup is actually not particularly sweet when compared to sucrose but has applications in the food and beverage industries as a thickener used to give products body. Glucose syrup can be further refined to produce pure glucose for use as a sweetener. Alternatively the syrup can be treated with glucosyltransferase to form high fructose syrup (HFS). HFS has the advantage of intense sweetness at low concentrations and is favoured for carbonated drinks such as Coca-Cola. The basic conversion yields a syrup containing 42% fructose, 55% glucose and 3% dextrin's which has many applications but is not of the right sweetness for use in beverages. HFS-42 can be further refined for industrial purposes to produce 90% fructose syrup which is then blended with HFS42 to produce HFS-55 (55% fructose, 41% glucose & 4% dextrin's) for sale to the beverage industries. HFS55 has the correct sweetness is stable, extremely soluble in water and thus has considerable advantages as a replacement for sucrose. It can also be used in bakery products, confectionary, soft ice-cream and other dairy products.

Malawi is a net exporter of sugar produced exclusively from processing of sugarcane. Between 2007 and 2011 export of sugar ranged between 80,000 and 270,000 t per annum (ITC Trademap database, 2013) while import volumes were negligible. In Malawi there are no companies producing sweeteners and the demand is fully met by import. Import of sweeteners over the period 2007-2011 was in the range of 500 to 1,000 t per annum, mainly from South Africa and India (ITC Trademap database, 2013).

6.1. Market segments for sugar syrup

In Malawi the vast majority of refined sugar used at industrial level is demanded by the beverage and confectionary industry. The following sections provide a more in depth analysis of these market segments.

6.1.1. Beverage

Southern Bottlers Malawi Limited (SBL), part of the CML group, is the only major producers of soft drinks in the country. It produces water and soft drinks for retail and also owns the Coca-Cola franchise in Malawi which enables them to bottle leading brands such as *Coca-Cola*, *Fanta* and *Sprite*. Universal Industries commercializes a range of soft drinks under the brand *Fruity* but these are made from imported pre-mixes to which just water is added before bottling.

During the interview, representatives of CML reported that they use exclusively refined sugar. Their current demand is about 1,200 t per annum. This would offer a theoretical demand for about 6,000 tonnes of fresh cassava. Some interest in using HFS as replacement of sugar was shown in the recent past as HFS would have allowed cost savings and less dependence on sugar for which they sometimes face some difficulties to ensure a regular supply during the lean season (sugarcane is crashed for around 6 months per year). It was reported that the internal acceptability test did not provide satisfactory results: it seems that the Malawian consumer is very much sensitive to sweeteners' taste and shows a clear preference for beverage produced with sugar. Moreover the

replacement would not have brought the economic benefits that were expected. As such the idea to switch to HFS has been abandoned for the time being. It was reported that SBL has never considered entering into the production of sweeteners but it would have relied on imports.

In conclusion, the beverage industry in Malawi does not appear to offer opportunities for cassava processing in the short to medium term. Even in the longer term it is unlikely that HFS will replace refined sugar in this industry.

6.1.2. Confectionary

Besides SBL, Universal Industries and RAB Processors are the main users of sugar at industrial level. This is used for the manufacture of confectionary. Currently Universal Industries uses about 2,000 t of sugar a year while RAB processors about 1,800 t. The overall demand of sugar from this market can be estimated at about 4,500 t per annum. This would offer a theoretical demand for about 22,500 tonnes of fresh cassava roots.

The current demand of the sweetener required for the confectionary industry, namely glucose syrup, was estimated at about 600 t per annum, equivalent to around 2,750 tonnes of fresh cassava. Universal Industries is by far the main user of imported glucose syrup representing about 80% of this demand. The remaining 20% is roughly equally shared between RAB Processors and a plethora of small bakeries and confectionary manufacturers. In the past Universal Industries used to blend higher volumes of glucose with sugar for its applications but, following the Kwacha devaluation, the imported glucose became more expensive than domestically produced sugar (currently price of delivered sugar is about MK 315,000 per tonne while the price of imported glucose syrup increased from MK 155,000 to 325,000 per tonne over the course of the last 12 months).

These volumes would not be large enough to justify such a large investment as required to competitively manufacture glucose syrup in Malawi. Therefore the processing of cassava roots into glucose syrup could be justified only if export driven. While the assessment of this opportunity is beyond the scope of the present study, it should be mentioned that successfully penetrating neighbouring countries could result extremely challenging due to the proximity to South Africa.

7. Market opportunities for ethanol

There are two main companies that produce ethanol in Malawi: Press Cane in the southern region and Ethco in the central region. Both belong to Press Corporation. As raw material they are both using molasses, by-product of the sole sugarcane processing company in Malawi, ILLOVO Sugar Ltd.

Ethco annually produces about 8 million litres of ethanol, Press Cane about 12 million litres. While Press Cane sells all its production to fuel companies to blend it with imported fuel, Ethco sells ethanol to Malawi Distilleries Limited (MDL) for the production of spirits, to fuel companies for fuel blending (20% of its production, that is not food-grade) and to neighbouring countries as industrial alcohol. As such the current volume of ethanol used by the fuel industry is estimated at about 13.5 million litres while the remaining 6.5 million litres are used as potable or industrial alcohol, either domestically or abroad.

Even though the sugar industry is expected to further expand in the coming years, including by the ingress of new entrants, the ethanol industry is concerned that the increase in the available amount of molasses is not going to keep the pace with the growing ethanol industry. As such Press Corporation is considering an investment in a crushing plant to process sugarcane directly (yet the operations will not start before 3-4 years). However, for the sake of diversification (and not economic profitability where sugarcane and its by-product will always be more efficient for ethanol production) there appear to be an interest in exploring other potential raw material, including cassava even though concerns about this option exist, above all with regard to low yields and unreliability of supplies. However it is unlikely that any cassava-based ethanol will be produced in the short to medium term.

7.1. Market segments for ethanol

7.1.1. Fuel industry

It is estimated that Malawi imports about 120 million litres of unblended fuel per year. The volume of imported fuel has been increasing a steady pace over the last years. Malawi has adopted a policy to make mandatory inclusion of ethanol in fuel at a 20% blending rate (E20). This translates in an actual demand of about 24 million litres of ethanol per year. As previously mentioned the current production of ethanol for the fuel industry is estimated at about 13.5 million litres, leaving a demand of about 10 million litres a year untapped. As such, at time of shortage, the fuel companies are allowed to include less ethanol (10%) or even to sell unblended fuel.

In consideration of the untapped current demand and the growing fuel consumption in the country, and taking into consideration information received during the interviews, we can assume that the current production of ethanol for the fuel industry can easily double in the medium term. As such additional 13.5 million litres of ethanol could be produced in the country. This will hardly come from cassava only and we believe that a reasonable assumption would be that about 20% of this additional volume is obtained from cassava roots. This would create an opportunity for processing about 19,000 tonnes of fresh cassava roots a year (C.R. 7:1).

7.1.2. Potable and industrial alcohol

Besides fuel blending, ethanol produced in Malawi is used as potable or industrial alcohol, either domestically or in neighbouring countries.

Malawi Distilleries Limited (MDL), part of the CML group, is a leading producer, distributor and marketer of spirits in Malawi. MDL produces various leading brands including *Malawi Gin, Premier Brandy, Three Barrels Brandy, Powers* and *Kadansana*. It also distributes world class brands of whiskies and wines such as *Johnny Walker, J&B, Grants* and the *KWV* range of wines. The market of spirits is expanding and, in the last years, it has contributed to decrease the volumes of ethanol available for the export market.

It has been reported that the export market is represented mainly by Mozambique, Zambia and Uganda, where ethanol is mainly used for industrial purposes. Over the last years the volumes exported have witnessed a severe contraction mainly due to the fact that the amount of ethanol currently produced in the country cannot meet the domestic demand. However, it has been reported that these export market would be available to resume their imports to previous levels if enough volumes were available.

Even though these market segments would deserve a more in depth analysis we can assume that the current volume of ethanol for these segments may double in the medium term leaving room for additional 6.5 million litres. Based on the same assumptions used in the previous section this opportunity would create a demand for 9,000 tonnes of FCR.

7.1.3. Household cooking and heating

We did not have the possibility to really investigate this market. However, two elements make us think that this does not represent a concrete opportunity in the short to medium term. Firstly, UNDP carried out a feasibility study for the use of ethanol as a household cooking fuel in Malawi in the year 2007 and the findings show that it could not be economically justified. Secondly, it was mentioned that one company tried this venture using *jatropha* as fermentable feedstock but the results were unsatisfactory and the plant had to be closed. Even though we acknowledge that further investigation is required we do not see a real opportunity in the short to medium term.

8. Summary of market opportunities

The following table schematically presents the opportunities for cassava products identified by the present study.

Table 9: Summary of potential demand for cassava-based products

Market segment	Competing ingredient	Current / potential annual demand for cassava-based products			Medium-term potential in fresh roots equivalents (t/yr)	Comments
		Current market (t/yr)	Theoretical demand (t/yr)	Achievable medium-term demand (t/yr)		
HQCF inclusion by large millers	Hard/soft wheat flour	0	5,000 ⁴	0	0	It would require either enforcing a mandatory inclusion or reassuring the two millers that sufficient HQCF volumes are available
HQCF inclusion by medium and large bakeries	Hard/soft wheat flour	Very limited	3,500	3,500	14,000	Depends directly on cost of wheat flour and, indirectly, on the dynamic of MK exchange rate. Moreover on the ability to supply large volumes of HQCF
HQCF distributed through rural and urban outlets	Hard/soft wheat flour	Very limited	15,000	7,500	30,000	Depends on the awareness of HQCF use and the capacity to reach a large number of scattered micro-enterprises (primarily mandazi makers)
HQCF inclusion by biscuit companies	Soft wheat flour	Started in Feb 2013	3,500	2,500	5,000	Estimated demand includes the requirement of Universal Industries that will be fully tapped once the recently installed flash drier will operate at full capacity
HQCF inclusion by plywood companies	<i>Makaka</i> and low quality wheat flour	0	0	0	0	HQCF not competitive with currently used ingredients.
HQCF inclusion by aquafeed companies	Cellulose or other binders	0	120	120	480	HQCF as binder. Maldeco has already issued purchasing orders to HQCF processing groups and SMEs but no consignment so far

⁴ This figure cannot be summed up with the others since upstream inclusion of HQCF in composite flour by large millers would lower the demand for voluntary inclusion of HQCF by large bakeries and rural/urban outlets.

HQCF inclusion by packaging companies	Maize starch	0	360	360	1,440	Estimated demand consists of the requirement of PIM that will be fully tapped by the flash drier recently installed by Universal Industries once the demonstration and optimisation trials are carried out
HQCF inclusion by textile companies	Maize starch	0	500	500	2,000	Depends on successful trials
TOTAL HQCF		Very limited	22,910	14,410	52,920	
Cassava starch inclusion in confectionary	Maize starch	0	200	200	1,000	It requires consistent supplies
Cassava starch inclusion by meat processors	Maize starch	25	25	25	125	This demand is already met by the cassava starch processor
TOTAL starch		25	225	225	1,125	
Cassava chips/grits inclusion by poultry feed companies	Maize	0	3,500	3,500	10,500	Estimated demand of chips. Alternatively 2,500 t of grits (10,000 t of fresh roots). Depends on cost efficient drying technology and successful outcomes of commercial trials to be carried out with feed and poultry companies
Cassava chips/grits inclusion by aquafeed companies	Maize	0	250	250	750	Dry cassava as source of energy. Estimated demand of chips. Depends on cost efficient drying technology and successful outcomes of commercial trials to be carried out with aquaculture enterprises. Use of grits is not economically viable
Cassava chips/grits inclusion in traditional beer	Maize	0	2,500	0	0	At current prices, dry cassava does not seem to offer room for cost savings
Cassava chips inclusion in clear beer	Malted barley	0	200-500	200-500	600-1,500	Depends on successful outcomes of consumer acceptability test
TOTAL cassava chips/grits		0	6,450-6,750	3,950-4,250	11,850-12,750	
Sugar syrup in beverage industry	Sugar	0	0	0	0	In the long-term demand might raise but rather unlikely
Sugar syrup in confectionary industry	Sugar/maize-based syrup	0	5,100	0	0	Volume not large enough to justify such a large investment. Need to explore regional demand to justify large investment
TOTAL sugar syrup		0	5,100	0	0	

Ethanol inclusion in petrol	Petrol	0	2.7 million litres	0	0	Opportunities exist but not in the short to medium term.
Ethanol potable and industrial alcohol	Molasses-based ethanol	0	1.3 million litres	0	0	Opportunities exist but not in the short to medium term.
Ethanol inclusion in household cooking and heating	Kerosene & firewood	0	0	0	0	The economics of cassava-based ethanol do not look favourable. Past attempts failed
TOTAL ethanol		0	4,0 million l.	0	0	
TOTAL cassava-based products					~65,000	

9. Conclusions

The aim of this study was to assess the potential demand for a range of processed cassava products. Different market segments have been studied to estimate their size, quantify the opportunity for inclusion of cassava products and set realistic achievable medium term targets.

HQCF seems to offer the largest opportunity by far. The overall theoretical longer-term demand can be estimated at about 23,000 tonnes per annum while the medium term target can be set at about 14,500 tonnes (53,000 tonnes FCR equivalent).

In Malawi, there has not been discussion for making the inclusion of HQCF in wheat flour mandatory. This might be due to the failures of these attempts in Nigeria. As such, the millers have to find sufficient incentives to be willing to include HQCF on voluntary basis. While the inclusion of HQCF would allow them significant cost and foreign exchange savings due to the dramatic raise of the imported wheat price following the recent devaluation of the local currency, the millers would need immediate regular supply of large volumes (about 5,000 t/yr) of consistent quality HQCF. While this might be considered as a long-term goal, it is not envisaged to happen in the next few years. In fact the current volumes of HQCF are extremely limited (and non-existent until few years ago) and potentially newly installed flash driers are likely to target downstream demand where highest prices can be fetched.

Large scale bakeries offer a potential for using about 3,500 t of HQCF a year (14,000 tonnes FCR equivalent), by assuming a conservative estimate of 7% inclusion rate in bread making. It appears that it would be possible to meet this demand in the medium-term thanks to the cost savings opportunities that HQCF inclusion offers. However, this would require the ability to consistently supply large volumes of HQCF that can be guaranteed only by means of flash dryers.

The distribution of HQCF through urban and rural outlets seems to offer the largest prospect. A large amount of wheat flour is distributed by these outlets for the manufacturing of a range of simple snacks (e.g., scones, buns, donuts and mandazi), mainly by micro-enterprises. The HQCF inclusion would be facilitated by several factors, such as the higher price of wheat flour in rural areas (where the largest volumes of wheat flour are sold to those microprocessors), the highest potential inclusion rate of HQCF in these snacks, reluctance to use ready-mix composite flour and established familiarity with blending wheat flour with traditional cassava flour. Overall this market opportunity has been estimated at 15,000 tonnes per annum. However, although sales to rural retailers and end-users offer the best economic return, a challenge consists in reaching a plethora of micro outlets and processors that are scattered by nature and hence offering little opportunities for scaling up. As such a prudent medium-term target can be set at 7,500 tonnes (30,000 tonnes FCR equivalent). However, it is likely that only a small part of this demand could be met by small-scale processors of sundried HQCF only.

Biscuit companies offer a market opportunity of 3,500 t of HQCF per annum in the longer term and 2,500 t (10,000 tonnes FCR equivalent) per annum in the medium term. However, when the flash drier recently installed by Universal Industries will be fully operational the untapped demand is likely to decrease to about 2,250 t per annum in the longer term and 1,250 t (5,000 tonnes FCR equivalent) in the medium-term.

The replacement of maize starch offers the best opportunity for HQCF to fetch a very attractive price. The two industries using the vast majority of imported maize starch are the packaging and textile ones. The former offers an immediate opportunity for 360 tonnes of HQCF per annum (1,440 tonnes FCR equivalent) but it is likely that this demand will be soon met by the HQCF produced by Universal Industries. The latter can absorb about 500 tonnes of HQCF (2,000 tonnes FCR equivalent) a year, subject to successful industrial trials.

Finally, HQCF can be used as a binder in aquafeed and as a base for adhesives in the manufacture of plywood. The former provides an immediate opportunity for about 120 tonnes per annum (480 tonnes FCR equivalent) that will be soon met by sun-dried HQCF produced by CMRTE. The latter does not offer any opportunities in the short to medium term because HQCF cannot compete with the cheap raw materials currently used by this industry.

Apart from HQCF, the market seems to offer interesting opportunities for dry cassava, either in form of chips or grits. These cassava products can replace either maize in animal feed and in the manufacturing of traditional beer or malted barley in the production of clear beer. The total medium-term opportunity for dry cassava has been estimated at about 4,000 tonnes a year (12,000 tonnes FCR equivalent).

The poultry feed industry represents about 95% of animal feed production in Malawi. This market segment may offer sizeable opportunities for the inclusion of cassava in the formulations. On the one hand, a considerable share of market is domain of large integrated poultry farms able to purchase the overall annual requirement of maize at harvesting time when the maize prices are at their lowest. Unless the price of maize will substantially increase in the coming years they are unlikely to benefit of any cost savings from cassava inclusion. On the other hand, about 35,000 tonnes of commercial poultry feed are produced by small and medium scale feed mills that do not have the financial capacity to purchase all the required maize when its price is at its lowest and have to procure it throughout the year. The implication is that they found themselves paying extremely high prices for maize in the lean season. This represents an interesting opportunity for the inclusion of cassava (estimated at 3,500 tonnes of dry cassava per annum, equivalent to 10,500 t FCR) although it is expected that cassava would be used only opportunistically at the time when the price of maize is at its highest. However, this opportunity depends on successful outcomes of commercial trials to be carried out with feed and poultry companies. Furthermore, cost efficient simple drying technologies should be developed and adopted since the months where cassava inclusion appears to be economically viable are in the rainy season when sun drying is not feasible. Artificial drying will add some cost whose impact on the sustainability of this opportunity had to be assessed. On the other hand, in case trials provide evidence that inclusion of unpeeled chips is doable, the production cost of the chips will decrease offering better potentials for inclusion of cassava in the poultry diet.

The aquafeed industry can offer opportunities for about 250 tonnes of cassava chips per annum (750 tonnes FCR equivalent). Nevertheless, likewise for poultry feed, the manufacturers are likely to opportunistically switch to cassava only at the time of the year when the price of maize is at its peak, i.e. at the time when sun drying would be a challenge.

As far as the traditional beer market segment is concerned, the potential demand has been assessed at 2,500 tonnes per annum (7,500 tonnes FCR equivalent) but this does not seem to offer opportunities in the short to medium term. The only large company in the country is able to

purchase most of its maize requirement when its price is low. As such the company is not exposed to seasonal price fluctuations and the use of cassava chips and grits would not give immediate opportunities for cost savings.

The use of dry cassava in the manufacture of clear beer does seem to offer some medium-term opportunities. Carlsberg Malawi Brewery Limited, the only state-of-the-art brewing company in Malawi, appears to have a strong interest in increasing the use of locally produced raw material. Even though the current focus seems to be pretty much on sorghum only, the company has expressed an interest in assessing the potential of cassava. The inclusion of cassava as a fermentable feedstock would require a fairly long process for the development and launch of a new product rather than occurring in currently commercialized brands. In case laboratory and commercial trials for consumer's acceptability were successful, in the medium term an opportunity to supply 200 to 500 t of dry cassava (600-1,000 tonnes FCR equivalent) per annum may exist. Financial incentives provided by the government, similarly to the ones provided by the Government of Mozambique to stimulate the use of locally sourced raw material, would increase this opportunity's likelihood to materialize

The opportunities for cassava starch appear limited. Two industries can be targeted: confectionary and meat processing. The former can offer an opportunity for about 200 tonnes of starch per annum (1,000 tonnes FCR equivalent), the latter for 25 tonnes (125 tonnes FCR equivalent). However, the demand from the meat processing companies is already met by local cassava starch processors.

The market demand for sugar syrup does not seem sizeable enough to justify an investment. The beverage industry, in spite of an initial interest, has given this option up due to lack of consumer's acceptability and insufficient cost savings. The confectionary industry may offer a long-term opportunity for about 5,100 tonnes of HFS per annum but this volume is not sufficient to set up a plant able to competitively manufacture glucose syrup in Malawi. Therefore the processing of cassava roots into glucose syrup could be justified only if export driven. The feasibility of this option would require an *ad hoc* study.

The market of ethanol does not offer opportunities in the short to medium term. In Malawi the ethanol industry uses the by-product from the sugarcane processing. The industry is considering investments in plants for directly crashing the sugarcane. However, for the sake of diversification (and not economic profitability) there appear to be an interest in exploring other potential raw material, including cassava even though concerns about this option exist, above all with regard to low yields and unreliability of supplies. However, despite the potential large demand for petrol blending and potable & industrial alcohol - estimated at about 28,000 tonnes of fresh cassava per annum - it is extremely unlikely that any cassava-based ethanol will be produced in the short to medium term.

In order to consider the feasibility of promoting cassava processing in Malawi it is worth stressing two issues. First, in Malawi there is not a strong tradition of commercial cassava farming. The vast majority of traded cassava reaches the final consumer in the fresh form and processing is very minimal and, more often than not, it has been promoted by development interventions. Most cassava roots are consumed by the farmer's household itself and only surplus are sold. This is especially prevalent in the northern Malawi and in the Lake shore where most of traditional cassava farming occurs and where cassava, mainly consumed in the form of *kondowole*, is an important, if

not the most important, staple food. In the southern districts, maize is largely preferred to cassava, and growing volumes of roots are produced for sale. However, in these regions cassava is an important hunger crop to feed the households in case of draught. As such, care should be put in designing mechanisms that are able to ensure regular supply to the factories and, at the same time, to minimize the risk of threatening the food security situation in the country.

Second, this study has assessed, among the other things, the feasibility of substituting maize (in animal feed and traditional beer). These estimations have to be considered with due care. While a strong raise in maize price (as the one recorded in the last few months) might widen some of the identified opportunities, it is important to highlight that, historically, the price of maize and cassava have shown to be strongly linked and that, in particular, both maize and cassava prices increase in maize deficit years. As such any statement about the new opportunities offered by the raising maize prices should be handled with caution. Again, the exclusive reliance on supplies of raw material from small-scale farmers, easily switching from selling to keeping the roots for home consumption or side-selling as soon as new market opportunities emerge, remains a potential threat to achieving the goal of a year round supply of raw material for potentially large-scale investors in cassava processing.

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Annex 1 – List of person met

Date	Name	Sector	Product range	Location	Interviewers	Interviewees
04/03/2013	MoA (Root and Tuber Crops)	Gov. agency	-	Lilongwe	DN, LA, VK, VS	Dr Benesi (Team Leader)
04/03/2013	Trustees of Agriculture Promotion Programme (TAP)	NGO	-	Lilongwe	DN, LA, VK, VS	Winfred Chanza (Project Manager)
04/03/2013	Ndatani Feed	Feed mill	Animal feed	Lilongwe	DN, LA, VK, VS	Donald Kazanga (GM)
04/03/2013	Ndatani Feed	Feed mill	Animal feed	Lilongwe	DN, LA, VK, VS	Isacc Kazanga (MD)
04/03/2013	Dogon Group (RSA)	Consulting firm	Aquaponics	Lilongwe	DN, LA	Dr Hugo Jankowitz
05/03/2013	Bunda college	University	Aquaculture	Lilongwe	DN, LA, VK, VS	Prof Emmanuel Kaunda
05/03/2013	Lilongwe University of Agr. and Nat. Resources	University	Animal science	Lilongwe	DN, LA, VK, VS	Prof Fanny Chigwa
05/03/2013	Kapani Processed Meat	Food industry	Fresh and processed meat	Lilongwe	DN, LA, VK, VS	Peter Phiri (Production Manager)
05/03/2013	Matsimbe Starch	Food industry	Cassava starch	Lilongwe	DN, LA, VK, VS	Hobson Matsimbe (owner's son)
06/03/2013	Central poultry	Poultry production	Poultry, eggs, chicks, feed	Lilongwe	DN, LA, VK, VS	Graham Hendersen (GM)
06/03/2013	Agricultural Commodity Exchange	Trade	Agr. Commodities	Lilongwe	DN, LA, VK	Kenneth Nyirenda (Programme Manager)
06/03/2013	Agricultural Commodity Exchange	Trade	Agr. Commodities	Lilongwe	DN, LA, VK	Peter Pemba (IT Manager)
06/03/2013	Land O' Lakes	Ngo	-	Lilongwe	DN, LA, VK	Amenye Mulwafu-Banda
07/03/2013	UNDP	Intergov. Agency	-	Lilongwe	DN, KA, LA, OH, VK, VS	Cinzia Tecce (Private Sector Dev. Specialist)
07/03/2013	Maldeco Aquaculture Ltd.	Aquaculture	Fish and aquafeed	Mangochi	DN, KA, LA, OH, VK, VS	Dr Daniel Jamu (Aquaculture Manager)
07/03/2013	Maldeco Aquaculture Ltd.	Aquaculture	Fish and aquafeed	Mangochi	DN, KA, LA, OH, VK, VS	Japhet Master (Feed Mill Manager)
07/03/2013	Maldeco Aquaculture Ltd.	Aquaculture	Fish and aquafeed	Mangochi	DN, KA, LA, OH, VK, VS	Yvonne Chipiliro (Chief Commercial Officer)
07/03/2013	CMRTE	Food industry	Sundried HQCF, makaka flour	Zomba	DN, KA, LA, OH, VK, VS	Daniel Sandifolo (Manager)
07/03/2013	CMRTE	Food industry	Sundried HQCF, makaka flour	Zomba	DN, KA, LA, OH, VK, VS	Mphatso Jalasi (marketing)
08/03/2013	Universal Industries	Food industry	Biscuits, HQCF, makaka flour	Blantyre	DN, KA, LA, OH, VK, VS	Navin Kumar (General Manager)
08/03/2013	Universal Industries	Food industry	Biscuits, HQCF, makaka flour	Blantyre	DN, KA, LA, OH, VK, VS	Neffie Mkumba (Quality facilitator)
08/03/2013	Universal Industries	Food industry	Biscuits, HQCF, makaka flour	Blantyre	DN, KA, LA, OH, VK, VS	

08/03/2013	Universal Industries	Food industry	Biscuits, HQCF, makaka flour	Blantyre	DN, KA, LA, OH, VK, VS	(VSO)
08/03/2013	Chibuku (SAB Miller group)	Beverage	Traditional beer	Blantyre	DN, LA, VK	Sam Liwewe (National Quality Manager)
08/03/2013	Carlsberg	Beverage	Clear beer, spirits, soft drinks	Blantyre	DN, LA, VK	Eugenio Tebulo (Head of engineering)
09/03/2013	District Agriculture Development Officer (DADO)	Gov. agency	Cassava production	Mulanje	DN, KA, LA, OH, VK, VS	Chikumbutso Kilembe (C:AVA Desk officer)
11/03/2013	Packaging Industries Malawi (PIM)	Packaging industry	Packaging	Blantyre	DN, LA, VK	Simon A. Itaye (Managing Director)
11/03/2013	Packaging Industries Malawi (PIM)	Packaging industry	Packaging	Blantyre	DN, LA, VK	Gregory Mhango (procurement and Logistics Manager)
11/03/2013	Bakhresa Grain Milling (Malawi) Ltd	Food industry	Wheat mill	Blantyre	DN, LA, VK	Mahesh Josyabhatla (CEO)
11/03/2013	Bakhresa Grain Milling (Malawi) Ltd	Food industry	Wheat mill	Blantyre	DN, LA, VK	Sudhakar Akella (Mill Manager)
11/03/2013	Carlsberg	Beverage	Clear beer, spirits, soft drinks	Blantyre	DN, LA, VK	Bonaventure Nanthuru (Chief Brewer and Production Manager)
11/03/2013	AgriFeeds Ltd	Feed industry	Animal feed (potentially aquafeed)	Blantyre	DN, LA, VK	Renard Kamberembere (Technical Director)
12/03/2013	Chambo Fisheries (former Rift Valley Aquaculture)	Aquaculture	Fish (potentially ethanol pilot plant)	Blantyre	DN, LA, VK	Irfan Bheda (MD)
12/03/2013	Chambo Fisheries (former Rift Valley Aquaculture)	Aquaculture	Fish	Blantyre	DN, LA, VK	Ramon M. Kourie (Technical Director)
12/03/2013	Chambo Fisheries (former Rift Valley Aquaculture)	Aquaculture	Fish	Blantyre	DN, LA, VK	Ion Alexandru Stanilou (Technical Operations Manager)
12/03/2013	David Whitehead & Sons	Textile	Yarn and fabric	Blantyre	DN, LA, VK	Anthony Mpochi
12/03/2013	Rab Processors Ltd	Food industry	Wheat and makaka flour distributor, biscuit, fertilizers	Blantyre	DN, VK	Sai Kiran Josyabhatia (MD)
13/03/2013	Protofeed	Poultry production	Poultry, eggs, chicks, feed	Blantyre	DN, VK	Craig Neilson (General Manager)
13/03/2013	Charles Stewart	Poultry production	Chick, feed, eggs	Blantyre	DN, VK	Mr Phiri (GM)
13/03/2013	Charles Stewart	Poultry production	Chick, feed, eggs	Blantyre	DN, VK	Katherine Stewart (Director)
13/3/2013	Press Cane	Ethanol	Ethanol	Nchalo	DN, VK, LA	Bryson Mkhomawanthu

Note: DN: Diego Naziri; KA: Kola Adebayo; LA: Louise Abayomi; OH: Orin Hasson; VK: Vincent Kaitano; VS: Vito Sandifolo