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Innovation Opportunities in Mango Value Chain in Mali

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Abstract

Mangoes are the most popular fruit produced in Mali with more than 20 varieties. Despite the quality preference for mangoes from Mali, achieving major gains in returns has posed challenges to different actors. This paper assessed the potential economic benefits of the different actors in the mango value chain using participatory appraisal techniques in two regions (Sikasso and Koulikoro). We used “structure, Conduct and Performance” approach to assess the whole value chain of the fruit. Farmers and their organizations, state and para-state institutions were surveyed to capture the constraints and opportunities along the value chain. Our findings indicated that there is high potential for mango production in the country, but producers face storage and conservation constraints. However, mangoes are exported to Europe by sea and air to supply big distribution chains. Processing the mango in the country is a key challenge to the development of the value chain.

Key Words:

Mango, Value Chain Development, Value Chain Analysis, Mali, Intervention strategies

Background

Mali produces fruits including mangoes, green beans, tomatoes, and potatoes that have the advantage of being exported easily. The volume of mangoes produced is estimated at 575 000 tons per year. Mango production is an important socio-economic activity in Mali, providing employment in rural areas and income through exportation.

The agro-ecology and the relatively low cost of labour required by mango enterprises provide the country a comparative advantage in mango production. This advantage is not effectively used by different actors in the mango value chain. This is due to lack of appropriate infrastructure and competencies to overcome the technical, commercial, financial, and legal challenges that should be overcome to develop a viable activity.

The low volumes exported (below 10 percent of production) could be explained on national level by poor transportation and lack of a cool chain. Exportation by sea from Dakar or Conakry should be developed. The low volumes could also be explained by the traceability required for all fresh products at the risk of being denied entry into the European market. Poor funding and lack of irrigation water are also major constraints. Producers, collectors, and exporters face all these constraints.

On the international level, this low volume of exports could be explained by the increasing competition with other mango producers targeting the same markets; technical barriers; and by the high quality standards set by consumers.

Thus, despite its high natural potential in mango production and efforts being made to increase exports, the mango sub-sector in Mali still performs dismally.

Irrigation of mango trees

Because of the importance of mangoes in Mali, producers apply irrigation during dry seasons to promote their growth. Irrigation, combined with organic manure application, ensures good flowering, reduces the production cycle, increases fruiting density, and improves fruit quality. Survey results in Mali have shown that 79 percent of mango producers irrigate their crops; only 21 percent rely entirely on rainfall.

Those who apply irrigation use various water sources. More than 85 percent use wells. Water is brought in a basin around the trees. Irrigation by pumping is not developed in the production areas.

Table: 1. Distribution of surveyed mango producers who practice irrigation (%)

Production zone	Yes					No %
	%	Water source used (%)				
		Simple wells	Ponds/creeks/	Rivers	Equiped wells	
Koulikoro	100	79	4	17	0	0
Kati	82	75	24	0	1	18
Dioïla	100	92	8	0	0	0
Sikasso	85	59	35	0	6	15
Koutiala	23	100	0	0	0	77
Bougouni	66	94	6	0	0	34
Yanfolila	100	100	0	0	0	0
Moyenne ensemble zones	79	85,57	11	2,43	1	21

Other production techniques

Digging holes. This technique is practised by 80 percent of the farmers in the different zones, even though the deepness of holes varies from one zone to another. On average, holes are deeper in Yanfolila and Koulikoro zones (52 and 50 cm respectively), and shallower in Bougouni zone (about 27 cm). The average depth is shallow in Kati, Sikasso, and Bougouni and could be limiting production in those areas. The shallow depth of holes in Sikasso is due to the nature of the soils, which are hard to dig. An average well depth of 50 cm is necessary for the crop to develop well. In Bougouni, farmers do not know the techniques of irrigating mango.

More than 80 percent of producers leave space between mango plants. This distance varies with production zones, from 10 metres in Bougouni and Dioïla zones to 7 in Koulikoro.

In all production zones, fertilisation of mango tree fields is poor. Only 28 percent of the producers surveyed applied organic manure or chemical fertiliser to their crops. Organic manure is more common. Farmers in Koulikoro, Bougouni, and Kati do not apply fertiliser to their mango trees.

Soils

Mangoes are adapted to many soil types be they sandy, loam, or clay, provided they are well drained. However, they should not be heavy and wet. A pH of 5.5-7.5 is preferred. The crop tends to tolerate alkalinity. For good growth, mangoes require rich soils about 3 metres deep and without impermeable layers. Such depths accommodate their extensive root systems and aid in anchoring the tap root. Moderately sloping sites are also recommended to prevent water logging.

Planting and planting materials

- **Propagation:**

Mangoes are propagated either vegetatively or by seed. Seedlings are grown sometimes to produce new cultivars but mainly for use as rootstocks or to reproduce. This process is known as polyembryonic reproduction. In this mode of reproduction, the seed contains more than one embryo and produces true-to-type progeny cultivars. In the monoembryonic mode of reproduction, the seed contains only one embryo. However, this latter mode requires vegetative propagation to retain all of the desired characteristics. It is also known that trees grafted on selected rootstocks remain smaller than the rootstock plants propagated for further grafting/budding, and bear better fruits earlier. The following table provides information on production of rootstock and grafted plants.

Table 2: Production and trade of mango plants

Site	Production of plants			Plants sold	Unit-Price (F.CFA)	Amount (F.CFA)
	Plants planted	Plants that survived	(Survival percentage)			
Sikasso	2 600000	2079382	79	1379434	400	551773 600
Bamako	130000	73926	57	10 811	500	5405500
Koulikoro	10000	53340	More than 100	51840	700	36 288 000
TOTAL	2740000	2206648	80.53	1442 085		593467 100

Source: Rapport journée mangue 2014

For 2 740 000 plants planted, plant producers realised only 2 206 648 plants and sold 1 442 085, or 80.53 percent of those planted. The Sikasso Basin was the highest producer with 94.23 percent followed by Bamako with 3.35 percent and Koulikoro with 2.42 percent.

Besides the soil requirements already mentioned, mangoes require 500–1000 mm of rainfall and an altitude of 0–1200 m. The mango tree grows easily; once well established, it is relatively tolerant to drought, occasional flooding, and poor soil conditions compared to other crops. Irrigation in the first years after planting promotes flushing and suppresses flowering so that tree size increases quickly. Irrigation also makes it possible to intercrop mango with other crops such as papaya, banana, pineapple, or vegetables during the establishment phase. When the trees are big enough to produce a substantial crop, irrigation is stopped, or at least interrupted long enough to impose quiescence, leading to flower initiation.

Constraints to production, productivity, and profitability

The production potential of mango in Mali is estimated at 575 000tons a year (source : Etude PCDA sur la télédétection réalisée en 2009). In 2014, mango production was only 58,769,157 tons, mainly from varieties such as: Amelie, Kent, Keïtt, Julie, Heldon, Mango, Brooks, Valencia, and Spring Fields.

Table 3: Production of mangoes in the three most prominent mango-producing areas in Mali

Site	Production (tons)		
	Expected production	Actual production	Percentage achievement
Sikasso	120 000	39 318,22	33
Bamako	15 000	9 019,997	6013
Koulikoro	18 000	10 430,94	58
TOTAL	153 000	58,769,157	38

Source : enquête statistique IFM-Mali 2014

This table does not include the proportion consumed by the household, the proportion sold by mobile traders, and that wasted in the field. It also excludes factors due to inaccessibility of some production areas and the effect of varieties that are not exported. These factors make the statistics unreliable.

Since the early 1990s, Mali has achieved a spectacular increase in its exports of fresh mangoes, seizing opportunities offered by an increasing market demand in Europe and finding solutions to overcome significant physical hurdles.

Overcoming transport and logistics constraints

High transportation costs made Malian mangoes uncompetitive in the global market. Whereas competitors in Latin America could take advantage of more economic sea freight, Mali's producers were limited to the more expensive air freight option. This reduced their exports and relative position as a mango exporter in West Africa (Table 10).

Historically, Mali relied on Côte d'Ivoire as a link to port facilities. Cotton lint and other products, for example, were exported through the port of Abidjan. In addition to relying on its neighbour's ports, Mali relied on its neighbours' infrastructure to move its export products to the ports. Until the 1990s, the only rail line in Mali with international links was run inefficiently, leading to significantly high prices and delays. This protracted transport constraint was especially detrimental to those Malian agricultural products that have high spoilage and shrinkage rates. A research report (CARANA Corporation 2004) also points out that producers' logistical costs were negatively affected by the cost of the consolidation of goods and poor business practices.

Linking Malian farmers to mango markets

Until recently, European consumers were more likely to eat Indian, Israeli, or Brazilian mangoes than Malian ones. However, since 2001, sea-freighted Malian mangoes produced in the south of the country by small-scale farmers have been successfully exported and retailed in Northern Europe. This achievement was quite significant given the previous failure of similar projects and the overall difficulty in finding investors for exportation of perishables from landlocked countries with poor transport connections like Mali. Exportation of Malian

products is controlled by Ivorian exporters with few returns to the producers on the other side of the border. Despite the high quality of its fresh fruit and vegetables, the high cost of air-freight was impeding expansion of production and export. By establishing a multi-modal shipment system and improving every step of the supply chain, the mango export pilot project confirmed the feasibility and profitability of such innovation.

The case in agro-processing trading

The objective of the Project of Support for the Valorization and Marketing of Agricultural Products (d'Appui à la Valorisation et Commercialisation des Produits Agricoles—PAVCOPA), assisted by the World Bank, was to provide technical support to the Agricultural Trading and Processing Promotion Agency (Agence pour la Promotion des Filières Agricoles-APROFA). This is a non-profit, government-funded agency responsible for providing marketing opportunities for smallholders' agricultural products for local, regional, and international markets.

Innovation opportunities

To promote the mango export campaign in Mali, a two-level operation plan, was designed:

- Upstream, small growers were assisted in developing an efficient supply chain by improving mango quality to adapt the product to the market requirements (production and processing);
- Downstream, a joint venture was established with an Ivorian private operator (with no existing operations in the mango sector or in Mali), to resume the activities of the Sikasso pack-house (that had been closed, having gone bankrupt). This would overcome the transportation bottlenecks by developing sea shipment logistics to connect Sikasso to the importing markets of Northern Europe, through Abidjan (the trading port to Europe).

The initiatives taken in the mango sector in Mali clearly demonstrate that even a physical constraint as immutable as being landlocked can be overcome to some extent through innovative solutions.

In Mali, the entry point was the identification and economic validation of a new transport and logistics arrangement that allowed mangoes to be exported in large volumes and in good condition.

Mali is currently focusing on consolidating and expanding its initial success by strengthening stakeholder involvement and private sector partnerships to ensure growth and sustainability. The Mango Task Force has emerged as the sector's professional organisation, with potential to become a permanent trade/business association capable of handling the new issues facing the horticulture industry in Mali.

Innovation at different nodes of the supply-chain

At the production level (extension and training): Farmers were leaving their mangoes to drop on the ground at maturity; many fruits were damaged this way and were not suitable for marketing especially on international markets. They could not be conserved and packed for shipping. Farmers have been trained on time to cut and how to cut fruits in net, which prevents them from falling on the ground. This technique has increased volumes of trade with European countries.

Intercropping of mango with papaya is another production innovation, where papaya trees are planted between small mango trees. This integrated approach could allow production of 4000 tons of mango and 3000 tons of papaya on a 200-ha field with varieties suited for export and save on costs, notably on irrigation and labour. A modern drip irrigation system was installed with tanks, where fertilisers were mixed with the irrigation water. The energy for pumping irrigation water was generated by solar panels. Trees were pruned every year to keep them small (short stem type); this has increased the density to more than 400 trees per hectare. Trees were planted in the fences to protect the top soil from wind erosion and to create a micro climate favourable for the mango trees. These trees also prevented the wind from damaging the mango flowers thus keeping yields as high as possible.

Currently, yields from existing mango orchards in Mali are declining year by year because: the mango trees are ageing, they are not maintained, and they receive no irrigation or fertiliser application. To remain competitive on the world market, Mali has to invest in new mango orchards as done in Peru, Ivory Coast, Senegal, Ghana, and many other countries in the world.

On the marketing side: Many actions have been undertaken. They include: (i) organising the marketing actors for their active participation in the different steps of the chain, and organising them into cooperatives through training; (ii) training in export standards (sorting and conditioning, quality control); (iii) logistics improvement (identification of transportation sub-contractors, packing to reduce losses, container shipment); (iv) financial arrangements to fund operations (involvement of local banks); and (v) building partnerships with specialised export companies.

These actions have helped the development of a successful agro-business and a rural private sector promotion. The actions carried out under the operation entailing improved practices in production, quality, and commercialisation have benefited mango growers significantly. Rural smallholders have been able to farm their abandoned orchards and raise income through this new form of revenue. They will also see longer-term results such as their ability to respond to market demands by maintaining regular production (volumes and product quality) adapted to the requirements of the market. The impact of the operation also went beyond the initial stakeholders, inspiring the establishment of other partnerships between exporters. Over time, the objective is to develop a 5000-ton operation with a multi-modal shipment system through Senegal, between Bamako and Dakar. This would cut to less than 10 days the transport time of the mangoes to Northern Europe.

As demand for fresh mangoes is rising in Europe, increased production and exportation of mangoes offer great possibilities for Mali to increase the actors' welfare and spur their development. To preserve the quality of the shipped mangoes, they are cooled down to a temperature of 10°C as soon as possible after harvest. Therefore, a packing hall with cold storage facilities must be built near the orchards. This could create full-time as well as part-time jobs. In a country like Mali, where 70 percent of the population depends on agriculture as the primary source of income, advanced knowledge of modern agricultural practices will lead to an

advanced level for all employees. Knowledge transfer will relate to all kinds of modern agricultural practices that are relatively new in Mali. These include drip irrigation techniques, plantation management, pest and disease control, and environmental awareness. Malian mango producers did not anticipate the increasing demand for mangoes in the European market, which was moving from a luxury, niche market to a volume market. Mangoes, like some other tropical fruits such as bananas and pineapples some decades earlier, became a fruit that was in high demand all year round by European customers. In an attempt to increase its mango exports, Mali sought alternatives to air freight that would increase its competitiveness and market share. Mali's landlocked status posed a serious challenge to that effort; however, logistics and transport issues prevented an initial substantive scaling up of exports.

Value chain analysis

Information on national mango production is very limited because few studies have been conducted on the value chain. Production and traded volumes are still poorly controlled.

Actors

Many actors involved in mango trade in Mali are identified. The main ones are: producers, collectors, whole sellers, and exporters.

Producers

Koulikoro and Sikasso regions are the biggest mango-production zones in Mali. Produce from Koulikoro in the vicinity of Bamako District is almost entirely exported by plane; collectors from Mauritania also buy mangoes near their border (e.g. at Siby and, Koulikoro). Produce from Sikasso zone, bordering with Côte d'Ivoire, has for a long time been collected mainly by Ivorian collectors and sent by ship towards Europe by exporters.

Collectors

In practice, exporters are supplied by collectors who use their own means of transportation; they harvest and collect fruits from the orchards to the exporters' shop. They sell mangoes to the exporter after sorting them. The producer does not have a direct relationship with the exporter.

At times the exporter could, depending on the urgency of the need, provide an advance of money to the collectors for him to supply the mangoes quickly. But the amount of money advanced would not buy more than one truck load.

Wholesalers

Wholesale activities occur at the market places where storage facilities exist. These are supply places of traders from neighbouring countries such as Côte d'Ivoire, Mauritanie, and Sénégal, and other local traders.

Exporters

At national level, more than 20 enterprises are grouped into two large associations of mango exporters.

- « Association Malienne des Exportateurs de Fruits et Légumes » (AMEFEL), created by « Centre Malien du Commerce Extérieur », includes more than two-thirds of exporters;
- « Association Professionnelle des Exportateurs de Fruits et Légumes » (APEFEL), created recently; it includes the biggest exporters who use the plane.

These registered enterprises, who are shown in Table 4, have supplied about 80 percent of the total volumes of mangoes exported.

Table 4: List of main mango export enterprises in Mali

N°	Entreprises	Localities	Contacts
1	Flex Mali	Sogoniko- Bamako	DaoudaMalinké Tel. 2209998 Fax : 2209998
2	EtsYaffa et frères	FaladièSokoro- Bamako	AdamaDoumbia Tel. 2210788 Fax : 2218154
3	Mali Primeur	Zone industrielleSotuba- Bamako	ModiboCoulibaly Tel. 2212246 Fax : 2212012
4	Fruitex	Medina Coura rue18 porte 597	Aba Niang Tel. 6744203
5	Primeurs expansion	Lafiabougou-Bamako	AbouTraoré
6	IB Négoce	Niamakoro- Bamako	IssaBagayoko Tel.5179167/ 6746814
7	Soleil vert		
8	Deguessivert		ModiboKonaté Tel. 6483341
9	DiabyDoucouré (Héliathys)	Aéroport de Bamako	Diallo Tel. 6240705 CheickTraoré Tel. 6768465

Since 2007, the number of enterprises and individual mango exporters have increased following state involvement (Direction nationale de la Concurrence), the building of “platforms”, and contacts between French and Malian actors.

These exporters are commercial enterprises with seasonal activities; sometimes the enterprises are side activities. Conditioning equipment exists in Bamako with large capacities especially equipped for shipped mango. The equipment belonged to the entreprise AOM. Also, conditioning equipment made in Israel was installed brand new with cleaning, drying and sorting facilities. The sorting facility is equipped with electronic weighted and maltase drawers. This station has important frigorific equipment comprising a pre-refrigeration chamber and a waiting cool chamber of a 60-ton capacity. However, the volume of mango treated had never gone beyond 20 tons, so the facility it is underutilised. Regarding mangoes shipped by plane from Bamako, the conditioning facilities belonging to individual exporters are habitually limited. Sites are usually not protected, with simple huts to house workers and protect mangoes against the sun.

Table 5: List of mango exporters in Mali

Sr/n	Name of Exporters		Name of Exporters
1	ACM	24	Multichem
2	Agronegoce	25	Nakoba
3	Agropal Sarl	26	Negotrad
4	Bello Mampo	27	Panafricaine Des Fruits
5	Blonba Fruits Sarl	28	Particulier
	<u>Bougouni</u>	29	Sahel Fruits Sarl
6	Societe Fruitiere SA De Bougouni	30	Sahel Fruits Sarl
7	Cooperative	31	Scofles
8	Corfuima SA	32	SCS International
9	Deguess Vert	33	Ste Fruitiere SA Yanfolila
10	Ets Yaffa Et Freres	34	Tam- Fruits
11	Exagri	35	Tem
12	Finkolo AC	36	Univers Kanaga
13	Flex Mali	37	Verger Du Sud
14	Fruitex		Yanfolila
15	Fruitiere Bougouni	38	Societe Fruitiere SA De Yanfolila
16	Fruitiere Du Loto	39	Uscopy
17	Ib Negoce	40	Uscopy (Doussoudiana ET Sibirila)
18	Interneg Sarl		
19	Kabola (Mandela)		
20	Kadiolo		
21	Mali Bio		
22	Mali Primeurs		
23	Mali Yiriden		

Retailers

Retailers in the production zones are supplied by producers (farm gate), although those from urban centres are supplied by whole sellers. Mangoes are always given on credit to retailers based on verbal agreement. They pay back after selling, which may be at the end of the day or end of the week. Retailers are present on the markets and cities to sell mangoes by unit or grasp.

Service providers for mango trading

Mango trade service providers identified are many and varied. They include packaging service providers, transporters, and customers.

Providers of packaging services

They provide bags and other equipment for packaging mangoes. The main enterprises are SOME PAC, SONACO (RCI), Rochette (Sénégal) and European enterprises.

Transporters

There are two types of transportation:

- ✓ Plane transportation covered from Bamako to Paris by Air France, Ethiopian Airlines, Air Algérie, and Royal Air Maroc among others
- ✓ Transportation by sea through MAERSK Mali sa (transportation and transit company) ; ships of OCAB.

Providers of custom services

They cover external trade formalities, custom services, and transportation. SAGA and Continental transit perform this activity. Continental transit has two cold chambers at the airport.

Consumers

Consumers are among the most important actors in the mango value chain. All actions of the other actors help to meet the satisfaction of consumers' needs.

Mango trade

Unlike cereals and other agricultural products, there is a wholesaler direct-supply system with mango producers. Retailers are supplied by whole sellers (in big urban centres) or directly by producers (production zones). The middleman or collector system is used more by exporters. In fact, 85 percent of identified mango exporters are supplied by collectors and 15 percent by producers. More than 80 percent of traders (wholesalers and retailers) are supplied in the production zones at farm gate, local markets, or villages. Volumes purchased by different categories of traders (wholesalers and retailers) per season are shown in Table 5. Average volumes traded in years 2010 are estimated at 53.533 tons. This volume is in net progression, up to 169 tons in recent years. Table 5 shows that mango varieties (local varieties), Beverley and Amélie are the most traded by retailers, accounting for 35 percent of traded volumes. On the other hand, wholesalers purchase mainly varieties such as Beverley, Keitt, Kent, and Brooks with 29 percent of volumes purchased.

Table 5: Estimated average volumes of mango purchased by category of traders and by varieties

Varieties	Retailers		Wholesalers	
	Quantities	% *	Quantities	% *
Amélie	275	15	2160	4
Kent	110	6	10 970	22
Mangos	656	35	3195	6
Valencia	265	14	-	-
Beverley	542	29	15000	29
Keïtt	30	2	13320	25
Brooks	-	-	6030	12
Springfield	-	-	480	1
Smith	-	-	500	1
Total	1878	100	51655	100

Table 6: Purchase prices of mangoes by variety

Varieties	Purchased quantity (tons)	Purchased Price (kg)
Amélie	10185	75
Kent	11598	75
Keïtt	6690	20
Julie	1620	90
Mangos	15016	66
Zill	5367	47
Toba	400	200
Irwin	7813	25
Farima	10000	70
Koyokoyo	10500	25
Wanlassa	7500	100
Brooks	483	20
Valencia	3680	25
Springfield	5600	48
Feu rouge	5250	15
TOTAL	101 702	

More than 50 percent of traders purchase mango volumes between April and June, corresponding to the maturity period of many varieties.

Market prices

Estimation of mango prices faces several difficulties related to measuring instruments. There is no standard instrument for measurement in production zones. Average price variations in the different production zones depend on varieties and weight.

Prices could be as high as 75 CFA/kg for varieties like Mélina and Smith and as low as 23 CFA/kg for variety « feu rouge ». Varieties such as Amélie, Mangos, Julie et Kent are sold at higher prices than the others.

Sale of mangoes

The sale of mangoes poses enormous difficulties that are related to inadequacy of storage infrastructure. This leads to heavy losses to the actors concerned.

The average quantities of traded mangoes by category of traders (retailers, wholesalers) during 2007 are shown in Table 7.

Table 7: Estimation of average traded mango volumes by trader category and variety per kg

Varieties	Retailers		Wholesalers	
	Quantities	% *	Quantities	% *
Amélie	265	15	2000	5
Kent	105	6	10350	25
Mangos	640	37	1654	4
Valencia	230	13	-	-
Américain	20	1	2000	5
Beverley	490	28	13500	32
Keïtt	-	-	5561	14
Brooks	-	-	5660	14
Springfield	-	-	435	1
Smith	-	-	450	1
Total	1750	100	41610	100

Traders who buy varieties such as Springfield, Feu rouge, Irwin, and Amélie et suffer significant losses due to rotting.

Table 8: Estimation of mango volumes sold and losses by variety

Varieties	Purchased Quantities (kg)	Sold Quantities (kg)	Sell Price FCFA/kg	Losses %
Amélie	10185	8447	134	12
Kent	11598	8738	137	9
Keïtt	6690	5118	125	9
Julie	1620	1540	190	1.25
Mangos	15016	10125	120	9
Zill	5367	5213	95	9
Toba	400	290	250	10
Irwin	7813	7197	50	13
Farima	10000	9500	100	15
Koyokoyo	10500	9950	50	8
Wanlassa	7500	7500	250	0
Brooks	483	475	35	2.13
Valencia	3680	3524	50	3
Springfield	5600	4393	117	15
Feu rouge	5250	4462	30	15
TOTAL	101 702	86 472		

From Table 8, the most sold mango varieties are Mangos, Koyokoyo, Farima, Kent, Amélie, Wanlassa, and Irwin. Varieties with higher losses are feu rouge, springfield, Farima, Irwin, Amélie, and Toba.

Trade margins

Trade costs include transportation fees, handling, conditioning, storage, and taxes. These parameters vary from one zone to another. As seen in Table 9, retailers make higher profits than wholesalers per kg of mango sold. But wholesalers have higher revenues because they trade large quantities of mango.

Export

In 1980, Mali was the main mango supplier of Europe with a market share of about 16 percent. The country lost this position many years back and exports have declined to about 1 percent of what they used to be. This is explained mainly by the poor organisation of exporters (HELVETAS, 2002).

In recent years, there has been an increase in mango volumes exported; this could be due to establishment of new mango platforms and creation of private export enterprises.

Table 9: Average budget for retailers and wholesalers

Items	Retailers	Wholesalers
1. Sales		
Average quantity sold (kg)	1750	41610
Average sale price (Fcfa)	90	70
Gross revenue	157500	2912700
2. Expenses		
a. Trade const		
Transportation fees	2480	37732
Conditioning fees	4156	5750
Handling fees	1500	1900
Storage fees	700	1163
Taxes	1700	4950
Total a	10536	51495
b. Financial fees	0	0
Total expenses =a+b	10536	51495
3. Trade margins	146964	2861205
Trade margins per kg	84	69

Table 10: Mango export by ship from Bamako

Exporters	Quantities per country (kg)			Total
	Holland	France	Gabon	
ETS YAFFA ET FRERES	63900	140130		204030
SCS INTERNATIONAL	172800		21760	194560
IB NEGOCE	128000			128000
MALI PRIMEURS	22230	88920		111150
FLEX MALI	21120	64640		85760
BLONBA FRUITS SARL	63360			63360
SAHEL FRUITS SARL	45000			45000
DEGUESS VERT		42880		42880
CORFUIMA SA	42280			42280
TOTAL	558690	336570	21760	917020

Table 11: Mangoes exported by plane from Bamako

EXPORTERS	Quantities Per Country (kg)									TOTAL
	France	HOLLANDE	Espagne	Belgique	LIBYE	GABON	MAROC	ALGERIE	TUNIS	
ETS YAFFA ET FRERES	228298.0	8734.0	0	0	83691.1	1397.5	0	419.0	2509.0	325048.6
FLEX MALI	214295.0	60853.0	13260.0	0	0	23152.0	1455.0	0	0	313015.0
NEGOTRAD	70096.0	7490.0	760.0	1325.0	0	463.0	0	0	0	80134.0
MALI PRIMEURS	41636.0	5874.9	2835.0	26839.0	0	0	0	0	0	77184.9
SAHEL FRUITS SARL	37232.0	0	0	0	684.0	0	0	0	0	37916.0
FRUITIERE BOUGOUNI	35960.0	0	0	0	0	0	0	0	0	35960.0
IB NEGOCE	23760.0	0	0	0	0	2000.0	0	0	0	25760.0
MULTICHEM	16120.0	0	0	0	0	0	0	0	0	16120.0
FRUITEX	13131.0	0	0	0	0	0	0	0	0	13131.0
TAM- FRUITS	9600.0	0	0	0	6590.0	0	0	0	0	16190.0
AGROPAL SARL	11369.0	0	0	0	0	0	0	0	0	11369.0
INTERNEG SARL	9710.0	0	0	0	0	0	0	0	0	9710.0
NAKOBA	4847.0	0	0	0	0	0	0	0	0	4847.0
EXAGRI	0	43807.0	0	0	0	0	0	0	0	4387.0
UNIVERS KANAGA	4180.0	0	0	0	0	0	0	0	0	4180.0
STE FRUITIERE SA YANFOLILA	4189.0	0	0	0	0	0	0	0	0	4189.0
BELLO MAMPO	3289.0	0	0	0	0	0	0	0	0	3289.0
PANAFRICAINE DES FRUITS	3103.0	0	0	0	0	0	0	148.0	0	3251.0
FRUITIERE DU LOTO	5920.0	0	0	0	0	0	0	0	0	5920.0
TOTAL	736735.0	87338.9	16855.0	28164.0	90965.1	27012.5	1455.0	567.0	2509.0	991601.5

Standards required by export markets include levels of pesticides used, phyto-sanitary certificate, biological certificate, and homogeneity certificate.

Trade cost of exported mangoes

Two export cost models have been used for mango trade--one from Sikasso by ship and another from Bamako by plane.

Table 12: Cost paid by exporter from Sikasso using ship

Items	Export cost (FCFA/kg)
Purchase of fruits	152
Cages	93
Conditioning and other fees	60
Misleaneous	62
Rail road + Sea Fret (Rotterdam)	194
Total CAF	561
Arrival transit	7,5
Commission (8%)	56
Total delivery cost to client	624,5
Sale Price	700
Exporter Margin	75,5

Table 13: Cost paid by exporter using plane from Bamako

Items	Export cost (FCFA/kg)
Mango purchased	165
Cage and packing	82.5
conditioning	
- Personal	25.5
- gasoil	1.2
- Electricity	0.9
- location and depreciation	15.1
total conditioning	42.7
Airport transportation	0.7
Depart transit	7.6
FOB cost	298.5
Fret	715
CIF cost	1021.8
Commissions/sales (10%)	140
Arrival transit and transportation	60
General fees (10% FOB)	29.85
Total delivered cost to client	1251.65
Sale Price	1400.00
Margin	148.35

Summary and Conclusion

The mango value chain is promising in Mali because the varieties produced are highly appreciated by external consumers. However, the value chain faces several constraints related to production, trade, and processing.

Proposed solutions to these constraints are:

✓ **At production level**

The main problems at production level include inadequate extension services and organisation of producers, difficulties in selling, and lack of appropriate equipment.

To alleviate these constraints, it is necessary to:

- document technical problems encountered by producers;
- ensure disease control by using phyto-sanitary products regularly;
- ensure organisation of mango producers so that they create cooperatives, unions, and other bodies;
- ensure that producers are trained on planting, improving orchards, maintenance and phyto-sanitary treatment, and harvesting techniques; and
- reduce the production cycle of mango trees and provide mango fruits all year round.

✓ **At trade level**

The main constraints identified at this node of the mango value chain are poor organisation of traders, conservation difficulties, transportation difficulties, storage problems, lack of funding, difficulties with sales, poor quality, and price instability among others. To counter the effects of these constraints,

- effectively organize internal mango trade systems;
- build and renew infrastructure to facilitate transportation and conservation of products;
- establish adequate infrastructure for conservation or storage of products; and
- facilitate access to credit.

✓ **At export level**

Difficulties in accessing transportation by sea, hence the need to use the more costly air transportation, limited cold trucks and lack of conditioning station, failure to honour deadlines and observe regulatory requirements, poor sorting of fruits and packaging, weak organisation of traders, and failure to respect international norms.

Proposed solutions are :

- promote professionalism among actors in exportation;
- explore new markets;
- build cool chain infrastructure ; and
- train actors in different innovations.

✓ **At processing level**

Processing is the weakest link of the value chain. This is the main cause of poor value addition in current production.

Existing processing units have poor financial leverage. Promoting this node is the key to improving the entire mango value chain. Therefore, it is important to:

- have legislative and regulatory measures to encourage traders to invest more in the fruit sector;
- facilitate access to credit ; and
- support groups and training of processors.

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Appendix A: Summary of Findings from FGD

	Production	Post production
Challenges	<ul style="list-style-type: none"> • Finance • Land preparation expensive • lack of water/irrigation facilities • Lack of efficient equipment for land preparation • Poor access to land • Poor access to farm implements (such as cutlass, hoes, boots) • Absence of agro-chemical shops in the communities • Bird control • Rodent control • Lack of combined harvesters for timely harvesting • Difficulty in repaying loan from banks • Climate change is affecting farming so the risk is higher • Lack of information on rice types preferred by consumers • AGRA variety provided by MoFA in 2015 was mixed with other varieties so they mature at different times making harvesting difficult. This caused losses to the farmers. • A disease is affecting the rice few weeks after transplanting and the leaves start wilting 	<ul style="list-style-type: none"> • Over-dried paddy mainly due to delayed harvesting affects grain quality; for example, the percentage of broken rice increases. • Too much rain also affects rice quality by, for example, discolouring the grains. • Termites also affect grain quality on field. • Drying paddy too close to the ground can introduce stones in the rice. • Threshing rice on metal tanks/barrels introduces metal pieces that can only be detected and removed by mills with a special magnet • Lack of destoners, graders, cleaners • lack of sealing/stitching and packaging machine • Lack of weighing scale • Lack of hammer mill hence the processed rice flour needs to be sieved manually to get smoother/smaller particle sizes. • Absence of labels and branding on whole sale packages • High percentage of broken rice.

		<p>Caterers</p> <ul style="list-style-type: none"> • Low volumes of expansion make rice unsuitable for institutional feeding. • Mixing local rice with cheaper imported brands • Relatively higher price • Not always available • Texture of cooked rice deteriorates few hours after cooking.
Coping mechanisms	<ul style="list-style-type: none"> • Set traps for rodents or feed rodents with fried fish mixed with indocid (medicine) • Spread nets on farm to scare away birds 	<ul style="list-style-type: none"> - Engage local artisans to dismantle and study the China mill and fabricate some components locally using thicker metal sheets. Through these, cleaners have been produced, which are currently being used to clean rice seeds before packaging. - Broken brown rice used for processed products and has helped to reduce waste and diversify income sources. - Manual grading and sorting
Interventions required	<ul style="list-style-type: none"> • Combined harvesters for timely rice harvesting • Sealing/stitching machines • Trailers from transporting rice to storage/sales points • Information on consumers preferred rice varieties 	<ul style="list-style-type: none"> • Money to buy larger amounts of rice and store • Expansion of the current storage facility provided by MoFA • Sealing and stitching machine • Hammer mill

		<ul style="list-style-type: none"> • Interventions that will ensure all-year availability of rice
Training needs	<ul style="list-style-type: none"> • Alternative uses of rice stalk and husk e.g. for mushroom production, production of charcoal, macaroni production and as building material. • Proper methods of land preparation • Preparation of organic fertiliser/manure 	<ul style="list-style-type: none"> • Processing rice into pastries and other value-added products • Hygienic way of roasting soybeans to brown evenly • Using moisture detectors to determine the moisture content of paddy rice before milling. • Rice mill has several functions that are not being used for lack of knowledge and skill in its operation. Training is required on how to make maximum use of the mill. • Educating farmers on the right time to harvest and hygienic and appropriate post-harvest handling practices prior to milling • How to extend shelf life of the milled rice and processed products e.g. by controlling pests and rodents • Packaging, including stitching, sealing, labelling, and appropriate packaging material to use • Record keeping, accounting and marketing • Maintenance and repair

		of equipment
Innovation/research opportunity	<ul style="list-style-type: none"> - Conduct detailed consumer study to understand drivers of consumer choices - Conduct research on the disease that causes wilting few weeks after transplanting and identify interventions - Devise innovative ways of bird and rodent control 	<ul style="list-style-type: none"> - Processed rice products are new in Ghana hence there is an opportunity to develop new products and improve quality of existing products - Opportunity to scale up the involvement of local artisans in fabricating rice mills and its vital components - Develop innovative marketing strategy for rice.