Status of Cassava (*Manihot Esculenta* Crantz) in Côte d'Ivoire: From Production to Consumption and Evaluation of Technology Adoption

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Abstract

The current state of cassava production and technology level as well as commercialization and consumption aspects were studied in Côte d'Ivoire. The study involved a sample of 570 actors of the value chain randomly selected in three (3) agro ecological regions (south, west and centre). Using a baseline survey questionnaire, 150 producers, 195 transformers and 195 consumers were interviewed. Results showed that farmers and consumers households are in majority led by men (80 and 61%) while transformers households are led by women (81%). Concerning the level of adoption of cassava technologies, it was found that about 35% of cassava growers are aware about the new cassava varieties and more than 80% agreed to use them. The analysis performed in agro ecological regions revealed that traditional varieties are preferred (40 % to 90 %) to improved varieties. Improved varieties, Bocou 1 (10.67%), TMS4 (2)1425 (0.67%) and Bocou 2 (0.67%) are less preferred for cultivation in spite of high yields, food processing or taste qualities, respectively mentioned by farmers. More than 50 % of farmers agreed to adopt the Rapid Seed Multiplication technique. Contrary to the localities of Man (West) and Bonoua (South) where pounded cassava is more consumed (89.29% and 66%), dehydrated cassava (Attieke) food is the most consumed in other localities surveyed. In spite of the high yield of improved varieties and the desire of cassava growers to adopt new cassava technologies,

research and extension services should be reinforced taking into account agro ecological specificities of production, commercialization and consumption.

Keywords: Cassava farming, improved varieties, technology adoption, agro ecological region, Côte d'Ivoire

Introduction

Cassava is the most important crop in Africa by both production weight and value, and it provides a similar source of calories as rice. Its drought-tolerance, resilience on marginal agricultural land, and ability to be stored in the ground up to three years make it an important food security crop for smallholder farmers (IFAD & FAO, 2000; Sayre, Beeching, Cahoon, Egesi, Fauquet, Fellman & Zhang, 2011). Cassava is a staple and also a famine reserve crop and can be an important food source when drought and conflict prevent production of other food crops (Burns, Gleadow, Cliff, Zacarias & Cavagnaro, 2010). An estimated 40% of Africans rely on the crop as a significant source of calories (Nweke, 2004).

Total world cassava use is expected to increase from 172.7 million t to 273 million t in the period 1993-2020 using the International Food Policy Research Institute's (IFPRI's) baseline data. A higher prediction of demand and production growth estimates the 2020 production at 291 million t (Scott, Rosegrant & Ringler, 2000). In both projections cassava use in Africa is equivalent to 62 % of total world production. The sub-Saharan region is one of the most producing parts in Africa. For proof, West Africa produced 80.9 million metric tons of cassava in 2012, accounting for 54.15% of African global production. This is justified by the geographic situation of Nigeria - the world biggest producer (FAO, 2013). In fact, the world production was 278,754 million tonnes in 2016. The part of Africa was 155 398 million tonnes of which 57 855 million were produced by Nigeria, making it the world's largest producer With 4 548 million tonnes, Côte d'Ivoire was the 13rd producer in Africa (FAO, 2017).

In Côte-d'Ivoire, cassava is the second largest food crop after yam. It is grown throughout the country. The southern zone is the area of high production (N'zué, Okoma, Kouakou, Dibi, Zohouri, Essis, & Dansi, 2014). In order to improve cassava production and access to planting material, new varieties developed through research as well as new methods of producing and propagating plant material have been made available to actors in the cassava sector. Farmers have taken up three high-yielding varieties of cassava, known as Bocou1, Bocou2, Bocou3 and TmS4(2)1425 resistant to disease and pests. These varieties can produce 32 to 34 tonnes per hectare per year, compared to less than 20 tonnes per hectare from traditional cassava varieties (N'zué, Zohouri, Djédji & Tahou, 2013). In addition, the rapid seed mutiplication

method has been familiarized (N'zué, Zohouri, Doumbia, Yapi-Gnaoré & Sangaré, 2008).

The current study assesses the adoption of these innovations or technologies by the actors of cassava value chain. It aims at selecting the elite seeds suitable for the specific region and -specific environments of Côte d'Ivoire and also evaluates through the value chain, the current state of production as well as constraints in the dissemination of high quality seeds.

Methodology

Study sites

Six (6) sites (localities) were selected in three (3) agro ecological regions: West (Man), Centre (Bouaké) and South (Dabou, Bingerville and Bonoua) of Côte d'Ivoire for this baseline survey during June 2016. The West region has a mountain climate (with precipitation from 1500 to 2200 mm/year and two seasons: a dry and a rainy). The Centre has an attenuated equatorial transition climate (with precipitation from 1500 to 2200 mm/year and four seasons: two dry and two rainy). The South has an equatorial transition climate (with precipitation from 1300 to 2400 mm/year and four seasons: two dry and two rainy). The criteria of selection of the six sites were the importance of cassava yield, the processing or commercialization and the consumption as well as the level of technology in diffusion. The three (3) treatments sites for technology diffusion located in West (Man), Centre (Bouake) and South (Dabou) regions were compared to two (2) controls sites selected in the South region (Bingerville and Bonoua) where improved varieties are not yet disseminated to farmers. Abidjan was the sixth site surveyed for a high level of cassava consumption.

Introduced technologies

In Côte d'Ivoire, five (5) technologies were developed and introduced in cassava fields by the National Center for Agronomic Research (CNRA) and ANADER (Agence Nationale d'Appui au Développement Rural). These technologies involved four (4) improved varieties (Bocou1, Bocou 2, Bocou 3 and TMS4 (2)1425) and a technology referred as Rapid Seed Multiplication by rationing (RSM).

Data collected and analysis

The study sample of 540 actors composed of 150 producers, 195 transformers and 195 consumers were surveyed by questionnaires. The variables investigated were about socio-demographic characteristics of households (sex, age, origin, education and years of experience), Farm management and cultural practices (varieties cultivated and/or preferred, frequencies of cultivation, farm size, periods and frequency of harvesting,

yields), marketing and processing activity (derived products, markets and prices), the use of new technologies and Cassava consumption level (processed products and frequency of consumption). The analysis was especially based on descriptive statistics. The STATA statistical software was used for data analysis.

Results and discussion

Socio-demographic characteristics of households

Socio-demographic characteristics of households led by actors involved in the cassava value chain were presented in Table 1.

Farmers and consumers' households were in majority led by men (80 and 61%) while transformers households were led by women (81%). On average, heads of farm families (44 years) and transformers (45 years) were younger than consumers (49 years). A high proportion of heads of households were autochthons (58 % of farmers, 76 % of transformers and 66% of consumers), illiterates (43% of farmers; 36% of transformers and 33% of consumers) and married (82% of farmers; 62% of transformers and 69% of consumers). Non-native (31%) were most present in cassava farming than in processing (1%). On average, eight (8) members were found in cassava farm families as well as in transformer's and consumer's families. Five (05) among them worked in production and processing while three (03) in marketing. Producers and processors had approximately the same length of experience (13 and 14 years). Producers combined the two activities of production and marketing (61%) and also the three activities of production, processing and marketing (29%) while processors were specialized in both processing and marketing (44%) or marketing (32%).

The households led by cassava value chain actors are headed by adults men, illiterate with more than ten years of experience in their activities. The analysis revealed similar socio-demographic characteristics of farm families with transformer's families which corroborate with the state of combine function between cassava growers and transformers.

Table 2 : Socio-demographic characteristics of cassava value chain actors interviewed in Côte d'Ivoire

Variables (units)	Modality	Farmers	Transformers	Consumers
Sex (%)	Men	80	18.97	61.54
	Women	20	81.03	38.46
Age (years)	Min	18	19	25
	Max	88	85	96
	Mean	44.23	45.19	48.79
Origin (%)	Autochthons	58.22	76.04	66.49
	Allochthons	10.96	22.92	23.56
	Non native	30.82	1.04	9.95
Education (%)	None	43.24	35.90	32.99
	Primary	29.05	37.95	26.29

	Secondary	23.65	25.13	31.96
	University	4.05	1.03	8.76
Marital status (%)	Married	82.43	61.98	69.27
	Single	13.51	23.96	18.75
	Divorced	0.00	2.08	2.08
	Widower/Widow	4.05	11.98	9.90
Household size (Number)				
Wives	Min	0	0	0
	Max	4	8	8
	Mean	1.07	1.59	1.28
Children	Min	0	1	0
	Max	24	16	18
	Mean	5.30	4.96	4.92
Children solarized	Min	0	0	0
	Max	9	10	10
	Mean	2.92	3.17	2.98
Total	Min	1	2	2
	Max	29	27	30
	Mean	7.80	7.69	7.98
Laborers size (Number)				
Permanent	Min	0	0	-
	Max	16	20	-
	Mean	2.80	2.20	-
Non-permanent	Min	0	0	-
	Max	20	30	-
	Mean	4.00	2.53	-
Total	Min	0	0	-
	Max	21	30	-
	Mean	5.28	3.21	-
Experience (Years)	Min	1	3	-
	Max	50	40	-
	Mean	13.06	14.37	-
Main activity (%)	Production	9.46	-	-
	Trading	-	32.11	-
	Processing	-	7.89	-
	Production, Trading	61.49	9.47	-
	Processing, Trading	-	43.68	-
	Production, Processing, Trading	29.06	6.84	-

Farm characteristics, technology adoption and production

Table 2 shows the situation of cultivated and preferred varieties by farmers in Côte d'Ivoire. The three (3) most cultivated varieties were non-improved (or traditional) varieties Yace (54%), Agba ble (13.33%) and

Essakpel (6.67%), respectively preferred by farmers according to high market demand (38%), good quality for food processing (16%) and the precocity of cycle (8%) of production. The study revealed also that improved varieties were less preferred (Bocou 1 (10.67%), TMS4 (2)1425 (0.67%) and Bocou 2 (0.67%)) for cultivation in spite of high yields, food processing or taste qualities, respectively mentioned by farmers. The global analysis showed that low utilization of improved varieties in cassava farming was probably due to competitiveness of traditional varieties and differences of adaptability between agro ecological regions. The second reason might be the fact that improved varieties were recently released, since 2010.

The analysis within agro ecological regions as shown in Table 3 revealed that the first variety preferred (Yace) is most preferred in the South (Bingerville (90%), Bonoua (50 %) and Dabou (30%)) and the West (Man (36.67%)) regions while the second variety (Agba ble) is preferred in the Centre (Bouake (80 %)) of the country. Within agro ecological regions, it was found that the level of improved varieties cultivated was higher with Bocou 1 (33.33% in Dabou) conversely to TMS4 (2)1425) (3.33% in Man) and Bocou 2 (0% in Dabou). The variety Bocou 3 is not yet cultivated by farmers.

Results on the level of adoption of cassava technologies in Côte d'Ivoire were presented in Table 4. It was found that about 35% of cassava growers were awarded of new cassava varieties and more than 80% agreed to use them. The analysis revealed also that the level of knowledge varied within agro ecological regions. Percentages of knowledge in treatment regions (where technologies were introduced) varied from 21% in the West (Man) to 47% in the Centre (Bouake) and 90% in the South (Dabou) while in control regions (where technologies were not yet introduced), the level varied from 15% in Bingerville to 100% in Bonoua both located in the south region. It was also found that more than 50% of cassava growers agreed to use new varieties. The RSM technique is also well known in treatments regions (23 to 79%) as well as in controls (28 to 100%) where more than 50% of farmers agreed to use it.

There was a large willingness of producers to adopt new varieties but the allocated areas were still weak. The total average area has been 0.74 ha with variation between varieties from Bocou 2 (0.16 ha cultivated in Dabou) to TMS4 (2)1425 (0.87 ha in Man) and Bocou1 (1 ha in Bouake and 0.46 ha in Dabou). The average density of plantation was 769 plants/ha (representing 7.69% of the area) associated with variation from TMS4 (2)1425 (550 plants/ha: 5.5% of the area) to Bocou1 (878 plants/ha: 8.78% of the area) and Bocou2 (881 plants/ha: 8.81% of the area).

This study has revealed that improved varieties were less used for cultivation. Coulibaly, Arinloye, Faye & Abdoulaye, (2014) indicated that varieties Bocou 1, Bocou 2 and Bocou 3 had been taken up by farmers in the

southern and eastern parts of the country. This study showed that, in fact, these varieties were well received by the populations. Their adoption should take longer. The global analysis of technology adoption in cassava farming revealed that non-improved varieties were still cultivated and preferred by farmers. In spite of the great desire of the producers to use new varieties, the level of adoption was still low in practice in different agro ecological regions of Côte d'Ivoire. The reasons of less-utilization of new technologies were due to the Low Yield Dry Matter (LYDM) of new varieties (Bocou 1, Bocou 2 and Bocou 3) and the non-knowledge of TMS4 (2)1425). Awareness on improved varieties and technology for rapid seed multiplication should be reinforced. It has been commonly shown that acceptance of new technology practices take place over time (Nweke, 1994). Adoption was said to be the continued use of innovation after individuals have passed through certain mental processes. The adoption of improved technology was influenced by various factors such as; personal characteristics, traditional believes, institutional and socio economic factors (Suleman, 2012). It could also be explained through different processes such as awareness, interest, evaluation and trial (Suleman 2012 ; Ekong, 2003 ; Agbamu, 2006). Yusuf (2009) found the rate of adoption of improved technologies was higher when the technologies were easy to operate.

Table 3 : Cassava varieties cultivated and preferred by farmers in Côte d'Ivoire

Variety Name	Variety Type	Cultivation (%)	Preference (%)	Reasons of preference
Yace	Traditional	54.00	38.00	High market demand
Agbable	Traditional	13.33	16.00	Food processing
Essakpel	Traditional	6.67	8.00	Precocity cycle
Bocou 1	***Improved***	***6.00***	***10.67***	***High yield***
Akra batchin	Traditional	3.33	8.00	High yield, Food processing
Assuable Tambou	Traditional	3.33	0.67	Taste
Dabou	Traditional	2.67	10.67	Precocity cycle
Zoglo ble	Traditional	2.67	2.00	Food processing
Sans manquer	Traditional	2.00	0.67	-
Vitesse	Traditional	2.00	0.67	High market demand
Bonoua	Traditional	1.33	0.67	Food processing, Taste
TMS	***Improved***	***0.67***	***0.67***	***Food processing***
Manioc doux	Traditional	0.67	0.67	-
Okou	Traditional	0.67	0,67	-
Tetoh	Traditional	0.67	0.67	Taste
Bocou 2	***Improved***	***-***	***0.67***	***High yield, Taste***
Alidja	Traditional	-	0.67	High yield
Mantale	Traditional	-	0.67	High yield, Food processing
Yavo	Traditional	-	0.67	High yield, Colour
You M'bossi	Traditional	-	0.67	Food processing, Taste
Total		100.00	100.00	

Table 4 : Cassava varieties cultivated and preferred in agro-ecological region in Côte d'Ivoire

Agro-Ecological Region	Locality Name	Variety Name	Variety Type	Cultivation (%)	Preference (%)	Reason of utilisation
West	Man[1]	Bocou 1	Improved	-	3.33	High market demand
		TMS	Improved	3.33	3.33	Food processing
		Dabou	Traditional	13.33	53.33	Precocity cycle
		Tetoh	Traditional	3.33	3.33	Taste
		Yace	Traditional	80.00	36.67	High market demand
Centre	Bouake[1]	Bocou 1	Improved	6.67	13.33	Food processing
		Agbable	Traditional	66.67	80.00	Food processing
		Bonoua	Traditional	6.67	-	
		Okou	Traditional	3.33	-	
		Yace	Traditional	3.33	3.33	Food processing
		Zoglo ble	Traditional	13.33	3.33	Food processing
South	Dabou[1]	Bocou 1	Improved	33.33	36.67	High yield
		Bocou 2	Improved	-	3.33	High yield
		Bonoua	Traditional		3.33	Food processing, Taste
		Essakpel	Traditional	23.33	40.00	Precocity cycle
		Manioc doux	Traditional	3.33	-	
		Sans manq.	Traditional	10.00	-	
		Yace	Traditional	30.00	10.00	High yield, Food process.
		Yavo	Traditional	-	3.33	High yield
		You M'Bossi	Traditional	-	3.33	Food processing
South	Bonoua[2]	Akra batchin	Traditional	16.67	40.00	High yield
		Assuable T.	Traditional	16.67	3.33	Taste
		Mantale	Traditional	-	3.33	High yield, Food process.
		Vitesse	Traditional	10.00	3.33	High market demand
		Yace	Traditional	56.67	50.00	High yield
	Bingerville[2]	Alidja	Traditional	-	6.67	High yield
		Yace	Traditional	100.00	90	High market demand
		Zoglo ble	Traditional	-	3.33	Food processing, Precocity

[1] Treatment site where improved cassava varieties were introduced, [2] Control site
Sans manq. = Sans manquer ; AssuableT. = Assuable Tambou

Table 5 : Cassava technologies adoption in agro ecological regions of Côte d'Ivoire

Agro-Ecological Region	Locality Name	Variables (units)	Bocou 1	Bocou 2	Bocou 3	TMS	Pooled	RSM[1]
West	Man	Knowledge technology (%)	-	-	-	-	21.43	79.31
		Agree for utilisation (%)	-	-	-	-	90.00	90.48
		Area (ha)	-	-	-	0.87	0.87	-
		Plants (Number/ha)	-	-	-	550	550	-
		Improved seeds uses (%)	-	-	-	-	3.33	-
		Reason[2] non-use technology	LY	HPW	LYDM	UT	-	UT

Centre	Bouake	Knowledge technology (%)	-	-	-	-	46.67	23.33
		Agree for utilisation (%)	-	-	-	-	56.67	57.14
		Area (ha)	1	-	-	-	1	-
		Plants (Number/ha)	17	-	-	-	17	-
		Improved seeds uses (%)	-	-	-	-	3.33	-
		Reason non-use technology	LYDM	LY	-	-	-	UT
South	Dabou	Knowledge technology (%)	-	-	-	-	89.66	67.86
		Agree for utilisation (%)	-	-	-	-	96.55	78.95
		Area (ha)	0.46	0.16	-	-	0.31	-
		Plants (Number/ha)	1311	881	-	-	1096	-
		Improved seeds uses (%)	-	-	-	-	23.33	-
		Reason non-use technology	-	-	-	UT	-	LL
South	Bonoua	Knowledge technology (%)	-	-	-	-	100.00	100.00
		Agree for utilisation (%)	-	-	-	-	90.00	-
		Area (ha)	-	-	-	-	-	-
		Plants (Number/ha)	-	-	-	-	-	-
		Improved seed uses (%)	-	-	-	-	0	-
		Reason non-use technology	LL	-	-	-	-	-
South	Bingerville	Knowledge technology (%)	-	-	-	-	15.38	27.59
		Agree for utilisation (%)	-	-	-	-	100.00	83.33
		Area (ha)	-	-	-	-	-	-
		Plants (Number/ha)	-	-	-	-	-	-
		Improved seeds uses (%)	-	-	-	-	0	-
		Reason non-use technology	-	-	-	-	-	-
Pooled	-	Knowledge technology (%)	-	-	-	-	34.97	40.43
		Agree for utilisation (%)	-	-	-	-	86.58	81.13
		Area (ha)	1.19	0.16	-	0.87	0.74	-
		Plants (Number/ha)	878.4	881	-	550	769.80	-
		Improved seeds uses (%)	-	-	-	-	6.00	-
		Reason non-use technology	LYDM	LYDM	LYDM	UT	-	UT

[1] RSM = Technology for Rapid Seed Multiplication
[2] LYDM = Low Yield Dry Matter, LL = Lack of Land, LY = Low Yield, UT = Unknown Technology

Current state of cassava production

Basing on data collected during the three (3) past years of cassava production, the current state of production was estimated and results were presented in Table 5.

Estimation showed an average yield of cassava of 16.03 Tons/ha/year with area of cultivation of 1.48 ha per producer. Areas of production varied from 0.33 to 8 ha. The highest yield was observed in the South (20.75 Tons/ha in Bonoua) and the lowest in the Centre (9.63 tons/ha in Bouake) and intermediate values observed in the South (10.61 Tons/ha in Dabou and 11.34 Tons/ha in Bingerville) and in the West (15.17 tons/ha in Man).

With regard to the cassava production, referencing to the average yield (15 and 33 tons/ha) that could be obtained for improved varieties in rural areas (according to CNRA, 2014), the study revealed that the current state of cassava production was low. The landraces were often low yield potential. The level of cassava technology adoption in Côte d'Ivoire was actually low. Therefore, producers should cultivate high yield landraces and new improved varieties and landraces

Table 6 : Cassava average yields in agro ecological regions of Côte d'Ivoire

Agro-Ecological Region	Locality Name	Cropping years[1]	Min area (ha)	Max area (ha)	Mean area (ha)	Number harvests/ year	Number Vehicles[2]/ year	Quantity harvested (Tons/year)	Yield (Tons/ha/ year)
West	Man	2013/2014	0.50	1.50	0.85	13.95	3.52	10.56	12.42
		2014/2015	0.50	1.00	0.75	11.42	3.52	10.56	14.08
		2015/2016	0.50	1.00	0.80	13.61	5.07	15.21	19.01
		Yearly average	0.50	1.17	0.80	12.99	4.04	12.11	15.17
Centre	Bouake[1]	2013/2014	0.25	2.00	0.78	2.00	2.00	6.00	7.69
		2014/2015	0.50	2.00	0.84	2.00	3.50	10.50	12.5
		2015/2016	0.50	2.00	0.72	2.50	2.09	6.27	8.70
		Yearly average	0.42	2.00	0.78	2.17	2.53	7.59	9.63
South	Dabou[1]	2013/2014	0.07	1.50	0.58	6.27	2.23	6.69	11.53
		2014/2015	0.07	2.00	0.67	6.76	2.16	6.48	9.67
		2015/2016	0.09	1.50	0.59	6.50	2.09	6.27	10.62
		Yearly average	0.08	1.67	0.61	6.51	2.16	6.48	10.61
South	Bonoua[2]	2013/2014	0.25	10.00	1.83	1.00	12.70	38.10	20.81
		2014/2015	0.25	8.00	1.52	1.00	10.46	31.38	20.64
		2015/2016	0.50	6.00	1.60	1.00	11.10	33.30	20.81
		Yearly average	0.33	8.00	1.65	1.00	11.42	34.26	20.75
South	Bingerville[2]	2013/2014	1.00	5.00	1.63	3.16	6.58	19.74	12.11
		2014/2015	0.25	5.00	1.85	3.04	5.54	16.62	8.98
		2015/2016	1.00	6.00	2.05	3.62	8.83	26.49	12.92
		Yearly average	0.75	5.33	1.84	3.27	6.98	20.95	11.34
Total	-	2013/2014	0.25	10.00	1.45	5.44	8.04	24.12	16.63
		2014/2015	0.25	8.00	1.39	4.44	6.84	20.52	14.76
		2015/2016	0.50	6.00	1.61	4.35	8.97	26.91	16.71
		Yearly average	0.33	8.00	1.48	4.74	7.95	23.85	16.03

[1] Cropping year (n-1/n) correspond to the period from April of the year before (n-1) to March of the following year (n)

[2] A vehicle of 3 tons is used for the transport of cassava harvested to markets.

Cassava commercialization aspects

The Table 6 presents cassava commercialization aspects in Côte d'Ivoire. The cassava harvesting and marketing was globally permanent (28.26% of farmers) in the year or frequently realized from January to March (25.36%), October to December (18.12%), April to June (15.94%) and July to

September (12.32%). The analysis between localities of agro ecological regions revealed different periods of commercialization. The main markets supply periods were January to March for both localities Man (50%) and Bingerville (40%) and from July to September for Bonoua (50%) while it was permanent for both localities Bouake (51.85%) and Dabou (52%).

Actors involved in the value chain of cassava were composed of transformers (60.32%), wholesalers (17.46%) and retailers (9.52%). The presence of actors who cumulate two (2) functions such as wholesalers-retailers (6.35%), wholesalers-transformers (5.56%) and transformers-retailers (0.79%) was observed. In the value chain, transformers are generally in great proportion except in the localities of Bonoua (wholesalers (63.33%) and wholesalers-transformers (23.33%) and Bouake (retailers (33.33%). Destinations of cassava products are wholesale (40.80%) or retail markets (12%) as well as households (47.20%). Main destinations were wholesale markets in Man (62%) and Bonoua (97.67%) while it was households in Bouake (89.47%), Dabou (89.47%) and Bingerville (86.21%).

Average markets prices were 33.23 F CFA / Kg at the farm gate level and 51.21 F CFA/Kg on wholesales markets for fresh tuber of cassava. Contrary to localities of Bouake and Bonoua where vehicles of 3 tons were often used for cassava commercialization, in the localities of Man, Dabou and Bingerville, bags were used. Due to the unknown weight of bags, estimation of markets prices in these localities was challenging.

Table 7 : Cassava processing and commercialisation characteristics in Côte d'Ivoire

Agro Ecological Region	West	Centre	South			Pooled
Locality	Man	Bouake	Dabou	Bonoua	Bingerville	
Harvests and Markets supply periods[1] (%)						
Permanent	-	51.85	52.00	6.67	33.33	28.26
January to March	50.00	7.41	16.00	13.33	40.00	25.36
April to Jun	46.15	3.70	8.00	13.33	10.00	15.94
July to September	-	-	8.00	50.00	-	12.32
October to December	3.85	37.04	16.00	16.67	16.67	18.12
Actors (%)						
Transformers	66.67	66.67	78.95	-	100	60.32
Wholesalers	-	16.67	-	63.33	-	17.46
Retailers	33.33	-	10.53	-	-	9.52
Wholesaler - retailers	-	-	5.26	23.33	-	6.35
Wholesaler – transformers	-	16.67	-	13.33	-	5.56
Transformers - retailers	-	-	5.26	-	-	0.79
Destinations (%)						
Wholesale markets	62.07	22.22	-	97.67	-	40.80
Retail markets	31.03	-	10.53	-	13.79	12.00
Households	6.90	77.78	89.47	3.33	86.21	47.20

Markets Prices (F CFA/Kg)						
Producer						
Min	10.83	8.33	-	32.55	21.66	26.16
Max	13.75	19.16	-	55.12	30.26	40.31
Mean	12.29	13.74		43.83	25.96	33.23
Wholesaling						
Min	-	-	50.00	31.25	-	39.25
Max	-	15	66.66	72		63.18
Mean		15	58.33	51.62		51.21

Cassava processing and consumption characteristics

The main characteristics of cassava consumption were described in Table 7. Results showed that traditional varieties were most consumed in Côte d'Ivoire. In cassava processing, variety Dabou (15.63%) was mostly used for pounded cassava while Yace was processed as fermented paste (49.45%) or dried cassava (54.31%) for local foods Placali or Attiéké. The study revealed that frequencies of consumption were three times a week for pounded cassava, twice a week for Placali and daily for Attiéké.

The analyses within agro ecological regions showed differences. Contrary to the West region (Man) where variety Dabou was used for pounded cassava, other traditional varieties were used in the Centre (Agba ble (40.74%) in Bouake) and in the South (Akra-batchin (66.66%) in Bonoua and 'Manioc bois rouge' in Abidjan (36.36%) and Bingerville (45%)). It was also found that contrary to the localities of Man and Bonoua where pounded cassava was most consumed (89.29% and 66%), dried cassava (Attiéké) food was the most consumed in other localities surveyed.

This study showed that traditional varieties of cassava were still well consumed in Côte d'Ivoire. The wide type of product consumed was dried cassava or Attiéké and the traditional variety Yace seems to be well adapted and most used by transformers in different agro ecological regions investigated. It is well known that Attiéké was the largest cassava processing product in Côte d'Ivoire (Coulibaly et al., 2014). The adaptability of improved varieties for food processing in dried products like Attiéké should be reinforced. This study did not highlight the problems and challenges prohibiting actors in cassava processing from realizing the expected yield in terms of production thereby affecting their profit. Indeed, the operations involved in Attiéké's production were essentially the same as for gari: peel and wash, chop (in 3-4 cm cubes), crush or grate, drain, sift, granulate, dry and steam. The production process was very long and sometimes tedious, most operations still being done by hand, except for grinding (Coulibaly et al., 2014). On this subject, Ehinmowo & Fatuase (2016) showed, in the case of the adoption of improved cassava processing technologies by women entrepreneur in the south-west of Nigeria, that the high cost of equipment, the

non-availability of the equipment, the difficulty to operate the machines and the lack of knowledge were the major challenges affecting the adoption of the improved cassava processing technologies.

Table 8 : Cassava consumption characteristics in households in Côte d'Ivoire

Agro Ecological Region (*Locality*)	Variety preferred	Frequency (%)	Modality of consumption	Frequency (%)
West (*Man*)				
Pounded cassava	Dabou	89.29	Three times per week	35.71
Fermented paste	Yace	95.83	Three times per week	37.50
Dried cassava	Yace	80.00	Once a week	60.00
Centre (*Bouake*)				
Pounded cassava	Agbable	40.74	Everyday	20.69
Fermented paste	Agbable	44.83	Twice a week	23.33
Dried cassava	Yace	69.23	Everyday	72.41
South				
Abidjan				
Pounded cassava	Manioc bois rouge	36.36	Once a week	27.27
Fermented paste	Yace	80.00	Once a week	50.00
Dried cassava	Yace	86.67	Everyday	88.89
Bingerville				
Pounded cassava	Manioc bois rouge	45.00	Twice a week	28.00
Fermented paste	Yace	66.67	Once a week	21.05
Dried cassava	Yace	90.48	Everyday	37.04
Bonoua				
Pounded cassava	Akra batchin, Mantale	66.66	Everyday	46.67
Fermented paste	Yace	55.56	Twice a week	44.44
Dried cassava	Yace	69.23	Three times a week	38.46
Dabou				
Pounded cassava	You M'Bossi, Bonoua	45.45	Three times per week	21.43
Fermented paste	Yace	40.00	Once a week	23.81
Dried cassava	Yace	25.00	Everyday	65.52
Pooled				
Pounded cassava	Dabou	15.63	Three times per week	20.53
Fermented paste	Yace	49.45	Twice a week	22.86
Dried cassava	Yace	54.31	Everyday	55.37

Conclusion

The current state of cassava production and technology level as well as commercialization and consumption aspects were analyzed in Côte d'Ivoire. The collected data showed that production, commercialization and consumption of traditional varieties are still higher comparatively to improved varieties introduced in agro ecological regions. Basing on high yields of improved varieties and the great desire of cassava growers to adopt new cassava technologies, research and extensions services should be reinforced taking into account sensitization and socio-agro ecological specificities. These

problems need to be addressed in order to increase the level of adoption and to accrue more profits.

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