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DETERMINANTS OF PROCESSING TIME OF FRESH FRUITS BUNCHES (FFBFFB) AMONG OIL PALM *(Elaeis guneensis)* PROCESSORS IN AKWA IBOM STATE, NIGERIA

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Abstract
The study was designed to assess the determinants of fresh fruits bunches (FFB) of oil palm (Elaeis guneensis) processing time from harvest in Akwa Ibom State, Nigeria. A multi stage sampling technique was used to select 250 processors. Data were collected through the use of questionnaire and analyzed using descriptive and inferential statistics. The result shows that majority (66.4%) of the processors were female and married (67.2%). The result also shows that about 37.3% of the respondents had secondary education with majority (62.4%) of them being sole processors and bought FFB with bunches (64.7%). The results further showed that about 45.6% of the respondents in the study area falls within the age bracket of between 34-50 years with most (52.4%) of them having 11-20 years of business experience with majority of them (62.8%) using family/hired labour. Equally, motorcycle was the most common form of transportation (57.2%) and they used local processing machines, majority (84.2%) were not mill owners with most (68.4%) of them asserting that mills were booked before usage. Results further indicated that 44.5% of respondents were not aware of the adverse effect of their practices on the palm oil quality while about 46.8% did not have knowledge on the extent of processor on oil palm quality. The result of Ordinary Least Square (OLS) regression analysis on factors determining processing time of fresh fruit bunches from harvest reveals that, household heads age, purpose of processing, access to processing mill, source of labour, distance to mill household heads level of education, years of experience, sole processor and purchase status, were significant factors determining processing time of fresh fruit bunches from harvest in the study area. It can be concluded that processing method was still traditional and most of the processors were not aware of the negative effect of their processing practices. The study therefore, recommended for more sophisticated mills in the study area and that intense awareness on these negative practices be carried and premium price place on quality oil palm.
Keywords: Bunch, Fresh, Fruits, Processing and Time.

Introduction

The unfavorable disposition of Nigeria crude palm oil in the global market and its geometrical nose-diving in the Africa's market grading ladder is not only worrisome but a real cause for concern (Enyoh *et al.*, 2017). This situation has persisted since the advent of petroleum exploration despite the efforts of successive government at implementing reformed agricultural policies for acceptability of its product in the global market. This is not unconnected with the status of production and processing which is still in its infancy. Though, extant literature have attributed this trend to the high free fatty acid content build by (bruised fruits and prolonged time of processing from harvest) estimated at between 9 > 15% in the palm oil produced in Nigeria (Marcillo, *et al.*, (2013) but the real culprit could be ignorance and or unsubstantiated believe system of the rural processors on the extraction rate, value and status of palm oil in the global market place viz-a-viz its production system.

Even the current global food inflation situation exacerbated by the ban on palm oil exports by Indonesia as well as Russia's invasion of Ukraine was supposed to be an opportunity for Nigeria because both countries at war are world's sunflower oil producers and international oil buyers are scrambling for its alternatives.

However, the current dwindling level of production and inefficient processing status still makes Nigerian oil palm situation uncertain. It is even on record that most palm oil produced in Nigeria is not good for cooking purposes as they are produced through the fermentation method and has free fatty acid (FFA) content of about 10-30% whereas a lesser amount of 5-7% of free fatty acid (FFA) content is mostly ideal in edible oil (Orewa *et al.,* 2009).

Palm oil processing system in Nigeria is basically traditional while it production relies only on the semi natural grooves (FAOSTAT, 2012). This has snowballed to the lost in dominance by Nigeria in both the international and African market of palm oil. This old-fashioned processing knowledge, apart from being labourious, yield low oil, consume time and deliver comparatively low-quality product (Scott *et al*., 2002; Westby, 2002). Traditional oil palm processing methods according to Westby (2002), maximum extraction rate is about twenty-four percent (24%) while modern extraction methods give about ninety (90) percent. Successive government in Nigeria have tried different policies and programme to fast tract its market dominance for self-reliance and independence, all to no avail or little significance progress. For instance, the Central Bank of Nigeria (CBN), to encourage local production and managed foreign reserves included palm oil as illegitimate for FOREX through the Nigerian inter- bank market. Equally, a duty charge of 35% was slam on crude palm oil (CPO) import to check the importation trend (PIND-pwc.com). The apex Bank launched the Anchor Borrowers' Programme with a single-digits interest rates (9% per annum) on loans to farmers through depositors' banks and other participatory financial institutions. In 2019, the Bank mandated support to corporate bodies and individuals engaged in palm oil production through Oil Palm Growers Association of Nigeria (OPGAN). Any member of the organization with a total land mass of one-hectare (1 Hectare) was entitled to the sum of One Million Two Hundred thousand (N1, 200,000) Naira loan repayable over twenty-five years with a four year monotarium.

Despite these programmes and projects to increase production, the processing system is still in its infancy. These traditional methods added to quick activation of lipase enzymes sequel to bruises sustained from gravitational fall of the FFB increases rate of free fatty acid and reduces oil quality. Whereas it is recommended for the fresh fruit bunches (FFB) to be processed immediately or within 1-4 days after harvest from the field or at least within 48–96 hours after harvest (Owolarafe and Arumughan, 2007). The duration of storage from harvest to when it is processed shows substantial relationship with the free fatty acid (FFA) release rate. This is exacerbated by the processors unsubstantiated believe that the quantity of oil to be produced is a direct function of the FFB fermentation period. Orewa *et al*., (2009) and Ayodele, (2010) confirmed that FFB bunches are kept for about 7-9 days or even more to allow for the fruits to get loosened from bunches after harvest before processing and this causes a build-up of FFA. This is against the 7-9 days recommended standard harvesting and processing period for the observed first ripen fruit. Marcillo, *et al.* (2013) opined that free fatty acid defines the nutritional status, storability and acceptability of the oil and that bunches left on trees for thirty days or more after first ripen fruit is observed will generate more than 12% free fatty acid and will negatively impact on oil quality.

Nigeria palm oil is not competing favourably in the international market. Even within Africa, the country's produce has geometrically been sliding down the market's grading ladder. Extant literatures (Dada, 2007; Marcillo, *et al.,* 2013, Enyoh *et al.,* 2017) have attributed this trend to the high free fatty acid content estimated at between 9 > 15% in the palm oil manufactured in Nigeria. This is against the allowable content of 1- 4%. Dada (2007) reported that only 20% of the overall palm oil production in Nigeria is of high quality and good for consumption because it possesses a high oilien content.

The major cause of these accumulated free fatty acid has been bruises sustained from gravitational fall of FFB (Hadi, Ahmad and Akande; 2014) and ill-time processing period of the FFB from harvest time. The later cause is of more concern

because it is a fall out of the unsubstantiated believe that the quantity of palm oil from FFB is a function of fermentation period of the FFB.

In the Southern States of Nigeria, palm oil processing has become a major source of income, however, with local processing method and according to Taiwo *et al.* (2000), these traditional technologies are low yielding, time consuming, labour intensive and give products of relatively low quality. The methods are not technically efficient which according to Ukpabi (2004) should translate to increase quality and quantity of palm oil from a given quantity of FFB for consumption and trade. Though, these traditional methods are inefficient, but the timing of processing of palm oil from harvest is worst culprit. This has to do with the believe system of the processors. It is against this backdrop that this research is being conducted to find out the determinants of processing time of fresh fruit bunches (FFB) of palm oil from harvest.

The specific objectives are as following to;

i. describe the socio-economic characteristics of the processors.
ii. describe the level of awareness of the local processors of palm oil on the effects of the practices.
iii. examine the factors that determine processing time of the fresh fruit bunches (FFB) of palm oil from harvest.
iv. describe the constraints to proper processing time of fresh fruit bunches (FFB) from harvest.

Materials and Methods

The Study Area

The study was conducted in Akwa Ibom State. The state is positioned within the South-East ecological zone of Nigeria. It has a bearing of latitude 40 32'N and 50 33' N of the equator and Longitude 70 25'E and 50 25' E of the Greenwich meridian. The National Population Commission (NPC, 2006) put the population of Akwa Ibom State as 7,245, 935,746 peoples projected from 2012 with total land mass of 7,081km² (2,734 Sq m). A total of 73% of its people inhabit the rural suburbs with agriculture as their major livelihood jobs. The major crops grown in the study area were plantain, fluted pumpkin, waterleaves and the animals raised were sheep, poultry, grass cutter, goat, cattle, rabbit and artisanal fishing typically done by adepts' fisher-folks living in the coastal zones. The State has six agricultural zones which are: Ikot Ekpene, Abak, Uyo, Eket, Oron and Etinan.

Sampling Techniques

A Multi-stage sampling procedure was used for the selection of the respondents in the study area. Step one involved the random selection of one Local Government Area (LGA) from each of the six (6) Agricultural Zones of Akwa Ibom State. Secondly, five villages were randomly sampled from the LGAs earlier sampled. The final stage, five rural dwellers were randomly selected from each community selected. Two hundred and fifty (250) palm oil processors were selected for the study.

Method of Data Collection

Data were collected through the use of questionnaire which was administered by trained enumerators and the researcher.

Method of Data Analysis

Descriptive and inferential statistical tools were used to analyze the data collected. Descriptive statistics such as frequency count and percentage were used to describe socio-economic characteristics of the respondents, the level of awareness of the local processors on the effects of the practices and the constraints associated with the practice were ascertained using frequencies and percentages. Objective 1, 2 and 4 of the study used frequencies and percentages while the determinants of processing time of the fresh fruit bunches of palm oil from harvest was estimated using regression analysis.

The model was explicitly specified as:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + b_{11}x_{11} + b_{12}x_{12} + b_{13}x_{13} + b_{14}x_{14} + U \quad . \quad . \quad . \quad (1)$$

Where Y = Processing time (Number of days from harvest)
X_1 = Gender (male/ female)
X_2 = Age (Actual number of years of processors)
X_3 = Marital Status (Single, Married, Widow, Widower)

X_4 = Educational level (Number of years spent to acquire education)
X_5 = Experience (Number of years in the processing business)
X_6 = Household Size (Number of persons in the household)
X_7 = Sole (Only) Processor (Sole -1; Combined = 2)
X_8 = Purpose for processing (Household consumption=1, Commercial=2, Combined =3)
X_9 = Accessibility to SSPE mill Yes - 1, No - 0)
X_{10} = Days allowed for fermentation (No. of days FFB are kept after dehusking)
X_{11} = Breed of FFB (local = 1, improve = 2)
X_{12} = Purchase status of FFB (in bunches = 1, striped = 2)
X_{13} = Sources of Labour (Family = 1, hired =2, family/hired = 3, borrowed =4)
X_{14} = Means of transport (Bicycle = 1; Motorcycle = 2, Car = 3, Keke Van = 4)
U = error term

Results and Discussion

Socio-Economic Characteristics of the Respondents

Table 1, shows the distribution of the respondents according to socio-economic characteristics. The results reveals that majority (65.5%) of the oil palm processors were female and 34.5% male. This outcome is in line Frank *et al;* (2018), Gunn (2014) and Ubokudom *et al;* (2017), all said that women participate more in the processing as processors due to excessive time that is consumed during the process and the zeal to be financially independent, since palm oil processing is believed to be lucrative. The result also showed that about 45.6% of the respondents falls within the age bracket of between 34-50 years. This indicates that palm oil processors were still in their youthful and dynamic age (Nwalieji and Ojike, 2018).

The outcomes further showed that bulk of the palm fruit processors were married putting the percentage of married couples at (52.1%), single (11.8%), widows (27.3%) and lastly widowers at (8.2%). This agreed with the findings of Nwalieji and Ojike (2018) that married couples form the bulk processors. In terms of Education, about 37.3% of the respondents attended secondary schools followed by those that attended primary schools (34.5%), 20.0% did not attended any formal education and 8.2% were respondents with certificate greater than secondary school. Frank *et al;* (2017) stated that processors with some level of education are very much open to innovation and Nwalieji and Ojike (2018) agrees that level of education stimulate involvement in agricultural productive undertakings as well as implementation, transmission and finally opt for the adoption.

About 51.8% of the respondents had household of 6-10 persons, followed by those with household ranging from 1-5 (41.8%) and household of 11-15 at (6.4%). This finding implies that palm oil processors had a large household with a mean of 6. The table farther indicates that (49.1%) of the respondents are into processors of oil palm full time, part-time processors amount to (50.9%) which are also into processing as a supportive business with majority of (70%) of the respondents having owned plantation and about 30% did not owned a plantation (Frank *et al;* 2017b).

In respect to plantation owners about 30.9% got the plantation through inheritance, 25.5% got it through leasing, 20.0% through outright purchasing from people, 7.3% got through cooperative form and 6.4% got it through community plantation. The 30% that did not own plantation got their fruit for processing through buying in which majority (56.4%) of the respondent's purchases palm oil as bunches while about 43.6% purchased as strip fruit.

Furthermore, the result of the study shows that about 44.5% of the processors had 11-20 years of experience. On the source of labour used by the respondents, the result revealed that majority (51.8%) of the respondents used a combination of family and hired labour. About 39.1% of the respondents used motorcycle as a means of transportation.

The result further show that about 43.6% of the processors in the study area are still using the local processing equipment while majority (56.4%) used the improved small-scale processing equipment this shows improved and the role of adoption of respondent in the study area is high.

The result further showed that majority (60.0%) of the respondents did not own a mill.

Table 1: Socio - Economic Characteristics of Respondents

Variables (n = 250)	Frequencies	Percentage	Mean
Gender			
Males	84	33.6	
Females	166	66.4	
Total	**250**	**100**	
Age			
< 20	0	0	
21 – 35	49	19.6	
36 – 50	114	45.6	
51 – 65	68	27.2	
>65	19	7.6	
Total	**250**	**100**	
Marital Status			
Single	33	13.2	
Married	168	67.2	
Widow	30	12	
Widower	19	7.6	
Total	**250**	**100**	
Level of Education			
No formal education	12	20	
Primary	48	34.5	
Secondary	141	37.3	
Tertiary	49	8.2	
Total	**250**	**100**	
Household Size			
5 – 10	66	26.4	
10 – 15	158	63.2	
>16	26	10.4	
Total	**250**	**100**	
Solely Processor			
Yes	156	62.4	
No	94	37.6	
Total	**250**	**100**	
Owner of Plantation			
Yes	46	18.4	
No	204	81.6	
Total	**250**	**100**	
Source of Palm Fruits			
Buy as Stripped FFB	48	19.2	
Buy as Bunch FFB	162	64.8	
Both	40	16	
Total	**250**	**100**	
Business Experience			
< 10	50	20	
11- 20	131	52.4	
21-30	32	12.8	
31-40	21	8.4	

Above 41	16	6.4
Total	**250**	**100**
Source of Labour		
Family	40	16
Hired	27	10.8
family/Hired	157	62.8
Borrowed	26	10.4
Total	250	100
Transportation of Palm Fruit		
Head Load	55	22
Bicycle	8	3.2
Motorcycle	143	57.2
Car	12	4.8
Keke Van	32	12.8
Total	**250**	**100**
Type of Mill Used for Processing		
Local processing machines	162	64.8
Small-Scale-Processing-Equipment (SSPE)	72	28.8
Semi-mechanized-integrated (SSPE)	16	6.4
Total	**250**	**100**
Ownership of Processing Mill		
Yes	44	17.6
No	206	82.4
Total	**250**	**100**
Access to Mill		
Borrowed	40	36.4
Hired	70	63.6
Total	**250**	**100**
Availability of Mill		
Readily Available	58	23.2
Not Readily Available	21	8.4
Booking	171	68.4
Total	**250**	**100**

Source: Field Survey, 2023

Level of Awareness of the Processors on the Effects of the Practices

Table 2, shows the level of the awareness of the processors a greater percentage of the respondents were not aware of the negative effect of what they were practicing. About 44.5% of the respondents from the study area were not aware. This must have been due to the unsubstantiated believe and their emphasis on quantity and not quality by the processors. However, 19.1% of the total respondents were aware that their oil palm processing practices had any adverse effect on the oil quality that they produce while about 24.6% believe that there was no need for the information.

They believed that their way and manner of processing of the palm oil is the best and it is also good for every purpose, 11.8% of the respondent seems not to be interested in improve information involving their practices on the processing of oil palm.

When their knowledge extent level was examined, the results shows that about 46.8% of them said they do not know, 24% said they know very little, 18% said that they know to a reasonable extent while 9.6% confirmed that they know of a very great extent the harm of delayed processing to quality of the oil.

Table 2: Level of Awareness of the Processors on the Effects of the Practices

Variables (n = 250)	Frequency	Percentage (%)
Awareness of effect of Practice on palm oil Quality		
Aware	41	19.1
Not aware	159	44.5
Unnecessary	37	24.6
Indifference	13	11.8
Knowledge Extent of the Processors on Palm Oil Quality		
Do not know	117	46.80
Know very little	60	24.0
To a Reasonable Extent	43	18
Great knowledge of it	24	9.6
Total	**250**	**100**

Source: Field Survey, 2023

Determinants of processing time of fresh fruit bunches of oil palm from harvest

Table 3, shows the result of Ordinary Least Square (OLS) regression analysis on factors determining processing time of fresh fruit bunches from harvest. The result reveals that household heads age, purpose of processing, access to processing mill, source of labour, distance to mill for processing, household heads level of education, years of experience, having palm oil processing as a sole occupation (sole processor) and the status of purchase FFB were significant ($P < 0.01$and, $P < 0.1$) factors determining processing time of fresh fruit bunches from harvest in the study area. The adjusted R-square was found to be 31%, implying that 31% of the variation is explained by the independent variables of the model under *ceteris paribus* assumption while the remaining 69% were accounted by other variables that were not included into the model.

The coefficient of household heads age is negative but statistically significant at 1% probability level. This implies that, as household heads age increases, the average processing time of fresh fruit bunches from harvest decreases. The possible reason for this may not be unconnected with the fact that the older palm oil processors have different purposes for FFB processing. Field experience shows that FFB time of process is a factor of what the oil is meant for. Oil meant for home consumption have very short processed period from harvest and those meant for sales have prolonged processed time. Therefore, time of palm oil processing is a function of the purpose for which the oil will be used. This is in line with Tagoe, Dickinson and Apetorgbor (2012) who reported that time of processing affect quality of palm oil processed.

The coefficient of household heads educational status is negative and statistically significant at 10% level indicating that as household heads educational status increases, the average processing time of FFB from harvest decreases. This is so because education is human capacity builder and educated processors knows why the oil palm fruits should be processed when it is still fresh.

The coefficient of household heads years of experience is positive and statistically significant at

10% level. It implies that as household heads years of experience increases, the average processing time of FFB from harvest also increases. This may not be unconnected with the unsubstantiated belief of getting higher quantity of palm oil from prolonged fermentation of the fruits. These experienced processors are after quantity of palm oil produced and may not know about the quality since there is no premium price on quality palm oil.

The coefficient of processors being solely a palm oil processor is negative and statistically significant at 10% level. It implies that being solely a processor reduces the average processing time of FFB from harvest. This is so because they

processors do not have any other additional occupation and must hasten to process so that they can go back to purchase another FFB. As a profit making venture, the processor knows that easy and fast turnaround is paramount to more profit. Therefore, they will not delay the processing of the FFB.

The coefficient of processor purpose of processing is negative and statistically significant at 1% level. It suggests that the purpose of processing of FFB reduces the average processing time of FFB from harvest. Again this is corroborated by Tagoe, Dickinson and Apetorgbor (2012). He stated that time of processing is a function purpose of the oil.

The coefficient of access to SSPE processing mill is negative and statistically significant at 1% level. It implies that ready access to processing mill by a processor reduces the average processing time of FFB from harvest. Field survey showed most of the processors complain of access to readily available mills especially at the peak of the dry season when oil palm gives bumper harvest. It has even reflected as a very serious challenge in the constraint objective.

Table 3: Determinants of Oil Palm FFB Processing Time from Harvest

S/N	Variables	Coefficient	Std. Error	t-ratio	p-value
1	Constant	-1.2499600*	0.65401	−1.911	0.05900
2	Gender	0.0786126	0.12792	0.6146	0.54030
3	Age of processors	-0.99675***	0.07577	-3.5677	0.00030
4	Marital Status	0.0079575	0.08043	1.0630	0.29050
5	Level of Education	-0.0761053*	0.14602	1.9590	0.05310
6	Experience	0.2234900*	0.03963	−1.920	0.05780
7	Actual Household Size	0.0005386	0.08428	−0.2013	0.84090
9	Sole Processor	-0.0266441*	0.12557	1.7800	0.07830
8	Purpose of FFB Processing	-0.274303***	0.07477	-3.6687	0.00024
10	Accessibility to SSPE Mill	-0.99675***	0.19797	-5.0349	<0.00001
11	Fermentation days	0.2834300	0.04199	−0.4324	0.66650
12	Breed of FFB	-0.0237464	0.10720	2.6440	0.00960
13	Purchase status of FFB	1.034510*	0.61147	1.6918	0.09068
14	Sourcing time for Labour	0.091962***	0.06250	0.00861	0.99310
15	Distance to Mill	0.199275***	0.04758	4.18800	<0.0001

Mean dependent var.	1.445455	S.D. dependent var.	0.643761
Sum squared residue	31.14133	S.E. of regression	0.575579
R-squared	0.310617	Adjusted R-squared	0.200609
F-(14, 250)	2.823582	P-value (F)	0.001154
Log-likelihood	86.67629	Akaike criterion	205.3526
Schwarz criterion	248.5603	Hannan-Quinn	222.8779

Note: ***, * significant at 1%, and 10% level respectively. **Source:** Field survey, 2023
Source: Extracted from computed print-out by the Author, 2023

The coefficient of purchase status of FFB is positive and statistically significant at 10% level. It shows that, the state of purchase of oil palm (in bunches or stripped) by a processor increases the average processing time of FFB from harvest. Field survey shows that majority of the palm oil processors purchase the fruits unstripped from bunches and this likely will take time and labour to strip. However, stripped fruits on the other hand is costlier but will take lesser time to process.

Sources of labour coefficient is statistically significant at 1% level and positive. It deduces

that as labour sourcing time increases, the average processing time of FFB from harvest also increases. This may not be unconnected with the tedious work of manual chopping of the FFB, manual de-husking of the fruits and manual separation of the fruits from the chaff, gathering of fire woods, boiling the fruits are labour demanding services.

The coefficient of distance to mill is positive and in line with *apriori* expectation but statistically significant at 1% level. It denotes that, as distance to mill from the processor domain increases the average processing time of FFB from harvest equally increases. A lot of time is needed to convey the fruits to the mill especially with the current high cost in transportation. Most at time the mill must be booked in advance to guarantee timely processing.

Challenges faced by respondents in adhering to proposed processing time

Among the challenges faced by the processors, the most pressing was lack of access to SSPE mechanized mills. This constituted 55.2%. This may not be unconnected with the exorbitant price of this milling machines. Ajani, Onwubuya, and Nwalieji (2012) and Owolarafe, Osunleke, and Oyebamiji, (2007) reported that the price of hydraulic palm oil processing mills is exorbitant. Equally, the belief system of getting more quantity of oil from longer fermented palm fruits constituted 29% while lack of knowledge on the delayed effect on oil quality accounted for 9.7%. Audi (2020), stated that believe system positively affect practice and establishes norms if it persists.

Table 4: Challenges faced by respondents in adhering to proposed processing time

SN	Challenges	Frequency	Percentage
1	Lack of knowledge on the delayed effect on oil quality	42	9.7
2	Lack of Access to SSPE mechanized mills	238	55.2
3	Lack of Labour for timely fruits processing	11	2.6
4	The believe system of fermentation of FFB and quantity of oil	125	29
5	Small capacity of SSPE mill	12	2.8
6	The believe system of fermentation of FFB and quality of oil	3	0.7
		431	100

Source: Computed from field study, 2023

Conclusion and Recommendations

Processors in the study area were mostly women, educated and in their productive age. Processing method was still traditional and most of the processors were not aware of the negative effect of their processing practices. Age, education, years of experience, being solely a palm oil processor, purpose of processing, access to SSPE mills, status of purchase FFB, sourcing time for available labour and distance to mill were some determinants of processing time of FFB from harvest and some of the constraints were: lack of access to SSPE mills, belief system and lack of knowledge of the practice on the effect of oil quality.

It was recommended that, the government and well-meaning individuals should construct more of small-scale processing mill and/or a more sophisticated mill. There is need for good extension awareness to convince them of the need to practice the ideal recommended method that will give good quality. They should be standard of grading of oil and special incentive for those with high quality. The marketing channel needs to be straightened through the use of price differences in oil quality and to also avoid mixture.

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