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A SUSTAINABLE PALM FRUIT VALUE CHAIN MODEL FOR SMALL-SCALE ACTORS IN NIGERIA

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ABSTRACT

This theory's model was driven by the need to empirically establish the possibility of smallholder's in the Nigerian palm fruit value chain to compete with large-scale actors. Thereby, capturing a share of the consumer income which would promote sustainability. To achieve it, a theory submitted. Within this model, nineteen conceptual relationships were proposed to be contributors in the palm fruit value addition chain. A PLS-SEM technique was used to investigate the validity of these relationships. The primary data used for the investigation was surveyed from extension agents in Edo South agro-ecological zone of Edo State Nigeria. First, the article introduced the term Value Chain Theory. Next, it briefly familiarizes the readers with what structural equation modeling is all about, as well as its applications. Subsequently, the document preview literature on the pathways towards modeling a sustainable smallholder's palm fruit's value chain. Afterward, the researcher creates the path model for the drive of the investigation. Following that, the author ensured that the methodological approaches adopted in achieving the investigation were clearly specified. After which the results from the analysis ran were serially outlined and discussed. Last, but not least, the implications for the use of this model was highlighted and conclusion for the study was drawn. Thus, the author commended the robustness of the theory and, afterward, proposed a confirmatory test for the model. It was concluded that the tool exhibits prospects for promoting sustainability in the palm fruit value supply chain if properly adopted.

KEYWORDS: V*alue chain theory, palm-fruits, Nigeria, measurement model, PLS-SEM*

INTRODUCTION

Approximately six decades ago, Nigeria, a predominant sub-region of West Africa, added value to palm fruits by processing them into palm oil (Carrere, 2010), and became the prime producer and exporting hub of palm oil in the world (Hassan et al., 2016). During that period, Nigeria benefited significantly from participating in palm fruit processing activities (Gharleghi and Yin-Fah, 2013). The benefits her country gained from the participation can be seen in Emokaro and Ugbekile (2014); and Ohimain et al., (2014). However, two-decade later, and to date, the country lost its dominant position (Gourichon, 2013) and its security in the sector is still uncertain (Hassan et al., 2016).

Concerns are now raised on the future sustainability of the small-scale sector (Abdul-Quadir et al., 2016; Gunn, 2014 Hassan, et al., 2016). Not only is there a huge supply gap in meeting consumers demands (IndexMundi, 2018), a piece of evidence has revealed that palm oil production in some parts of Nigeria are of low quality (Ohimain et al., 2012; Olorunfemi et al., 2014;). Okonkwo et al., (2012) has alerted that

the high rate of palm oil deterioration, is resulting in low competitiveness in the global market (Gourichon, 2013).

In trying to address sustainable development from a global perspective, while trying to alleviate poverty among small-scale industries and smallholders participating directly, or indirectly, in the global trade, the Value Chain Theory was developed (Kaplinsky and Morris 2001). According to Amarender (2013), a value chain distinctly represents a full life cycle of a product or process, where the chain symbolizes value addition at different stages during the transformation of a raw material into a finished product (Cambridge Institute for Sustainability Leadership (CISL), 2017). A value chain is being derived by analyzing areas where competitive advantage can be attained by the actors in an organization (Ensign, 2001; Institute of Management Accountants, 1996). UNIDO (2011) was able to offer a list of analytical tools for carrying out such analysis where they noted that these tools were the foundation for additional studies. With the aid of such tools, PIND (2011) was able to establish a formal palm fruit value chain model using the Abia State Palm Oil Value Chain Development Project as a basis. Wherein various developmental programmes focusing on sustainability, entrepreneurial and rural development mostly among smallholders in the oil palm regions have adopted the use of the theory as a model for development.

In 2016, it is important to mention that Hassan et al., raised a fundamental question still querying the ability of this group of actors to even compete and capture a share of the remaining value-added income in the country when it is well-known that they are less efficient when compared with their counterparts in the industry. Although they concluded that the reality of achieving a competitive advantage with large-scale processors may seem deceptive, this article attempts to propose a sustainable model that could be used to carry out such assessment as well as to promote their performance.

A model empirically driven by theories and observed data no doubt has been known to be a close approximation to reality. But then again, the main hassles stem from accurately explaining the causal relationships driving these theories with the available data. Where Roberts and Thatcher (2009) have also hinted that paying more attention to the nature and direction of the links between constructs and the indicators embedded within such theories are also significant. Nonetheless, based on the rationale driving the Value Chain Theory, certainly, it is assumed that various elements combine to form an overlaying construct being investigated. In which Wright et al., (2012) were able to explain that, the type of constructs formed as a result of the composite of its dimensions are aggregates constructs, which Hair et al., (2017) later termed composite constructs which are similar to formative measure types.

Formatives related measures are easily assessed by using a partial least squares structural equation modeling (PLS-SEM) approach (Wright et al., 2012). Thus, in order to suggest a sustainable palm fruit value chain model for small-scale actors in Nigeria, a PLS-SEM approach was used to investigate the path model towards attaining a sustainable smallholder's palm fruit value chain (SSPFVC). In attaining this general objective, four value addition stages, as well as fifteen aspects, was proposed to be associated with the palm fruit value chain. These postulations were all assessed if they were significantly associated with adding value to palm fruits. The proposed model was aimed at demonstrating if truly empirical shreds of evidence exists among already proposed conceptual relationships. Subsequent from the investigation, a robust model was suggested towards attaining sustainability in palm fruit value chain of small-scale actors. It was also expected that with the new recommended model, the assessment of the palm fruit value chain would easily be carried out with no difficulty by other researchers in such field. Thus, this will make the model a versatile tool in the already existing body of knowledge in the area. However, for the aforementioned main objective stated above is to be achieved, there was a need to quickly glance through various reviews of works of literature.

REVIEW OF LITERATURES

Value chain concept

The connotation of the concept value chain is relative. Currently, there are a lot of rich pieces of literature that have given both the descriptive and normative definitions of what this concept connotes. But a notable one is that of the Adam et al., (2014; 4) who defined the concept as:

'A business model in which producers and buyers of agricultural products form strategic alliances with other supply chain actors, such as aggregators, processors, distributors, retailers, and consumers, to enhance financial returns through product differentiation that advances social or environmental values. Partners in these business alliances recognize that creating maximum value for their products depends on interdependence, collaboration, and mutual support'.

Within this broad definition of what a value chain entails, "product differentiation" as defined by Philip (1999); Adam and Barham (2011), (Adam, et al., 2014; 4) 'creating maximum value for their products' as explained by Verdin and Tackx (2015; 2) is a key phrase for reflection. With this key phrase in mind, it can be assumed that the concept driving the theory of value chain is undoubtedly created by observable indicators in an environment. Where, Diamantopoulos et al., (2008) have hinted that when attention is given to causes of an outcome, the operationalization of unobserved variables is possible.

Adding value to goods and products causes product differentiations. Value addition is the unobserved indicator which individuals, firms or organizations aspire to attain in order to promote competitiveness and sustainability. Then, one way in which an unobserved variable can be assessed implicitly is through the use of structural equation modeling (SEM) (Hair et al., 2017).

Introduction to structural equation modeling as an assessment tool

Over the years, researchers on strategic management have always appreciated the use of a second-generation statistical technique called the structural equation modeling (Sarstedt et al., 2012), to explain unobserved variables and conceptual theories. The SEM has long been known to be a multivariate statistical analysis method used to analyze structural relationships in order for more evidence to be explained. It is a tool used to show how multiple items indicators are connected to constructs. In which, it likewise shows the relationships that exist between these constructs. The SEM process also uses a combination of both factor analysis and multiple regression analysis to analyze the structural relationship between measured variables and latent constructs (Hair et al., 2017).

Models towards a sustainable small-scale palm fruit value chain

Palm fruits' value chain theory

Gaining a competitive advantage has always been the objective of a firm. In order to identify how a competitive advantage can be attained by the actors in an organization, the analysis of the value chain has long been the adopted practice (Akenbor and Okoye, 2011; Sutarmin and Jatmiko, 2014). PIND (2011) created the palm fruits' value chain map for Nigeria and noted that value is created in the following stages: production, primary processing, aggregation and wholesale, secondary processing, retailing and at the end markets. These stages are the ways in which palm oil actors capture more value in palm fruits.

New and emerging theories for adding value to palm fruits

Hassan et al., (2016) advised on ways a multi-remedial technology should be created for the small-scale palm sector. Brees and Hofstrand (2010); Stark and Stewart, (2011) indicated that the practice of identifying the customers of a product, and what they desire before the commencement of production is an important key to creating value. The foundation for Partnership Initiative of the Niger Delta (PIND),

in 2011 agreed that in order to determine the effect of significant activities influencing value addition, it is vital to assess the outlook of the consumers of the products by knowing what they want and how of an great income can be generated while meeting their demands. After that has been identified, production can then commence. Notwithstanding, during the process of obtaining the harvested fresh fruit bunches (FFB), Azeman, et. al., (2015) maintained that working to produce high-quality palm oil, the free fatty acid (FFA) content is a significant criterion to watch out for. They documented that the ability to maintain low free fatty acid (FFA) content of less than 5 percent for crude palm oil, as well as less than 0.1 percent in the production of refined bleached deodorized oil during the processing of palm fruit significantly increases the value of oil produced. Tagoe et. al., (2012) Zainon Binti Mat Sharif, et al., (2017) showed ways on how smallholders could reduce the FFA content. Tagoe et. al., (2012) also settled that storage of the fruits before processing and the storage length of the oil after processing were aspects to consider when the value is to be maintained.

Conceptual framework

Error! Reference source not found. below shows the author's hypothetical model towards attaining a sustainable palm fruit value chain. By using the review from various literature, the author was able to develop his theory from the one suggested by PIND (2011; 31). The researcher did not just only focus on the palm oil production stage of palm fruit value chain, other stages such as the distribution, wholesaling, and end-user stages of the palm fruit value chain were examined. The other stages were concentrated upon because less focus was given to these areas as compared with the production stage (PwC, 2017).

For this manuscript, the author further conceptualized a smallholder value chain model to be made up of four stages which were the: consumer base identification stage (CBI); upstream processing stage (UPP); downstream processing stage (DP); and the post-processing stage (PPA). The author further proposed fifteen factors which were contributing to the various value addition stages. It was theorized that seeking information about the product market (IATPM) and seeking information about the raw material (IATRM) were factors that have a relationship with CBI. While for the UPP, the author further theorized that Redness promotion of the palm oil or Bleaching and leaching prevention of palm oil (BP), Digestion of palm fruits (DIG), free fatty acid control in palm oil (FFACP), purity maintenance in palm oil (PM), and poison prevention in palm oil (PPP) were factors contributing significantly to the stage. Whereas for DP, it was hypothesized that involvement in activities such as the production of: by-products from Palm Kernel (BPFPK), by-products from palm oil (BPFPO), and by-products from biomass (BPOB) were aspects that could increase the smallholder income if they practice such activities in the downstream processing stages. Finally, the researcher also postulated that for PPA, elements such as: partaking in awareness creation (AC), involvement in creating product identity (PIC), FFA post-processing handling (FFAPPH), and participating indirectly in selling by-products (SOB), and trust building with customers (TB) were all causes of adding value at those stage.

METHODOLOGY

Study area and scope

The study was conducted in Nigeria specifically in Edo State. Edo State in Nigeria was selected for this survey because it is part of the center of fresh fruit bunch processing State within Nigeria (PIND, 2011). Edo State is situated at the mid-south-west region of Nigeria, and this region is popularly known as the forest zone of the country. The State lies roughly between Latitudes 05° 44′ N and 07° 34′N; and Longitude 06° 04′ E and 06° 43′E. At present, Edo State is made-up of eighteen (18) Local Government Area (LGAs), which spread through the three (3) agro-ecological zones (Alufohai et al., 2015). These agro-ecological zones include: Edo South, Edo Central and Edo North and they are delineated along the

Agricultural Development Programme (Emokaro and Dibiah, 2014). Located in the State, is an institution that has played a major role in the improvement of the Oil palm production. This institution is called the Nigeria Institute for Oil Palm Research (NIFOR). It is located in the Edo South agro-ecological zones at the Ovia North-East LGA. Amidst several functions of the institute, the basic objective is to improve Oil palm production where palm oil is its major product (PIND, 2011). Other notable palm oil producers in the State are two major large-scale processors of palm fruits and they include PRESCO and OKOMU oil which are located also at the Edo South agro-ecological zones in the Ikpoba-Okah and Ovia-South West LGAs respectively.

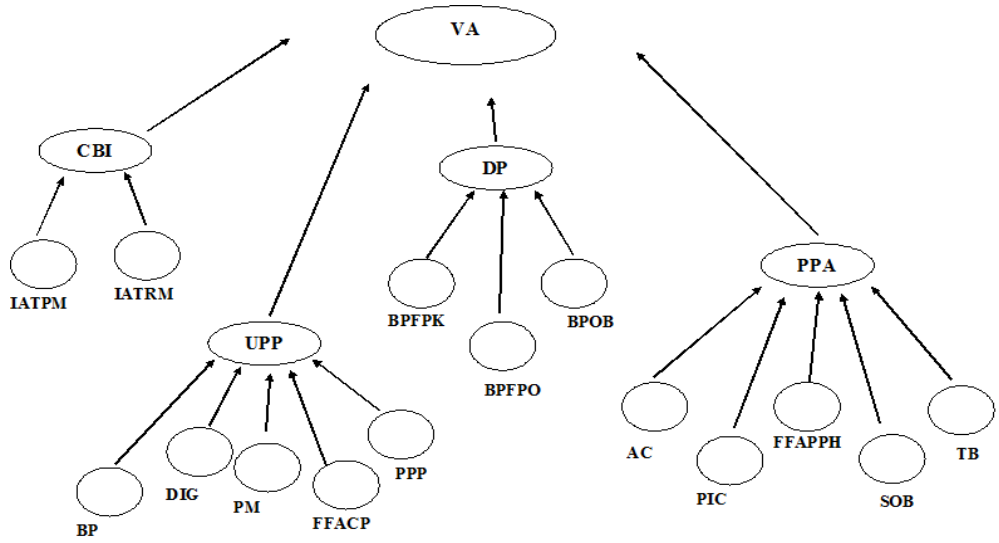

Figure1: Conceptual Framework

The population of the study

The population for the study was extension agents. The view of extension agents towards the palm fruit supply chain was a significant subject matter to be explored upon because the extension agents were assumed to provide researchable information from research institutes directly to the farmers and processors (FMARD, 2016). In Edo State, there are currently 746 extension agents (NAN, 2017).

Sampling procedure

A two-stage sampling method was adopted to purposively select 224 extension agents from Edo South agro-ecological zone for the investigation. Edo South agro-ecological zone was selected for this inquiry because it was assumed for this study that the region has a comparative advantage because of the aforementioned established institutions for palm oil processing when compared with the other regions in the State.

To select the extension agents needed for the investigation, the modus operandi was to use the general Cochran's formula to set a foundation so as to know the required sample size needed for the study. By using the Cochran's formula in which 95 percent confident level and a 5 percent margin of error was held, with the maintenance of the maximum heterogeneity assumption, the recommended sample size derived for the study was approximately 395. In Edo South agro-ecological zone, there are about 491 N-power extension agents (Igbinedion, 2018). In carrying out the research, the cost and respondent's

willingness to participate in the survey were factors considered. In order to address this issue, carrying out a census was opted for a survey, thus this lead to the adoption of a modified Cochran's formula also called the finite population correction (Ajay and Micah, 2014), to establish that 219 respondents was an appropriate size needed for the study were five additional respondents were further added to balance for non-response respondents.

Data instrument

The data instrument for the investigation was a questionnaire. The questionnaire was designed based on the review of various literature. The questionnaire was aimed at assessing nineteen constructs proposed to be associated within the palm fruit value chain (see Figure 1). One of the constructs was related to the term value addition. With four of the other constructs linked to the value addition stages within the palm fruit value chain that most likely causes value addition. Lastly, the remaining fifteen, were connected items closely related to value adding activities that adds value in their corresponding value addition stages to which they are relate to.

The questionnaire was designed to simply solicited respondents' level of agreement on a five-point rating scale that an activity was a value-adding activity that causes value addition in the palm fruit value chain. Forty-five statements were used to achieve this. These statements were manifest items used to form the building blocks needed to measure the various latent constructs in consideration for this investigation. The generation of the statements was done using a face and content validity approach. This method was used because it is easy to adopt (Bolarinwa, 2015). Besides that, the technique simply tends to evaluate the extent to which the observed variables capture the major features of a construct (Hair et al., 2014), were if an important item was omitted, the nature of the concept may be misrepresented (Diamantopoulos et al., 2008).

Nevertheless, as a result of using of these statements, first, four of the statements were used to develop the construct 'seeking information about the product market (IATPM)', while another four was used to develop 'seeking information about the raw material (IATRM)'. From literature reviews (Brees and Hofstrand, 2010; Stark and Stewart, 2011; PIND, 2011), these two developed constructs, concurrently formed the items used to assess the consumer base identification stage (CBI) proposed for the study.

Next, the upstream processing stage (UPP) was another value addition stage that was evaluated using five different latent measures in the study. These latent items used to investigate the UPP stage were obtained from various literatures. The various aspects used to investigate the particular stage were: Redness promotion of the palm oil or bleaching and leaching prevention of palm oil (BP) (Casssiday,2017; Imoisi et al., 2015; Shabdin et al., 2016), Digestion of palm fruits (DIG) (Adetola , et. al., 2014; Owolarafe, et. al., 2007; Zu, et. al., 2012), Free fatty acid control in palm oil (FFACP) (Mensah, 1999); Tagoe, et al., 2012; World Bank, 1986) Purity maintenance in palm oil (PM) (Poku, 2002), and Poison prevention in palm oil (PPP) (Poku, 2002; World Bank, 1986). The building blocks for these unobserved items were three manifest items used to evaluate the construct BP; another four separate obvious assertions used to appraise the construct DIG; three for FFACP; four for PM; and two for PPP. All this statement was all observed variables.

Following the upstream processing stage (UPP) is the downstream processing stage (DP). This stage was appraised from three dormant dimensions. The concealed features used to assess this stage were actors' involvement in the production of: by-products from Palm Kernel (BPFPK); by-products from palm oil (BPFPO); by-products from biomass (BPOB). These components were conversely measured by two different distinct statements respectively. Finally, the last stage reviewed for the investigation was post-processing stage (PPA). The proposition for this stage was for it to be assessed using five latent constructs. The unobserved constructs for evaluating this stage were: awareness creation (AC); creating product identity (PIC), FFA post-processing handling (FFAPPH); participating indirectly in selling by-products (SOB); trust building with customers (TB). These veiled constructs were developed by asking

the respondents to indicate their level of agreement with various observed statements concerning the respective constructs.

Data collection and processing

After the respondents had filled out the questionnaire, the questionnaire was collected and cleaned of errors. This was done with the SPSS 24.0 version. However, before the commencement of data analysis, it is worthy to note that survey data are usually altered by the issues of nonresponses (Rubi, 1987). To address this issue, missing value analysis was carried out. The missing value analysis carried out indicated that the dataset failed the Little's MCAR test (Chi-Square = 3449.451, DF = 3171, Sig. = .000). This indicates that the data were assumed to not be missing completely at random (MCAR). As this also demonstrates that the probability of the data being missing neither depends upon the observed data and unobserved data (Plumpton et al., 2016). Also, it was observed that the missing values were approximately up to 9 percent, and their pattern of missingness was an arbitrary one.

In working to address the issues of missing data, it was further noticed that fourteen respondents had 50% and above of their response's incomplete. Thus, they were removed for the study. This led to having a survey response rate of about 93.75 percent. Having such response rate indicate that the response rate was a good one (Saldivar, 2012). Furthermore, in order to avoid further deletion of cases with incomplete response, the expectation maximization (EM) technique of handling missing data was used to handle the issue of missing values. The EM algorithm was used because it met the assumption that the missing data mechanism may be missing at random (MAR). The EM procedure have various attractive properties. These ranges from being unbiased, efficient and a simple technique. It is a better algorithm than the multiple imputation process because it does not require simulation (Dong and Peng, 2013). Choi et al., (2004) have also shown that parameter estimates from EM algorithms are also reliable with the estimates from the complete data, even with up to 50% of the data missing (Rubin et al. 2007).

The data were further investigated for issues with unengaged responses as well as Skewness and Kurtosis. It was observed that none of the respondents exhibited a zero variance towards all the statements. This, therefore, implies that the Skewness and Kurtosis were within the range of +3.

DATA ANALYTICAL TECHNIQUE

Model specification

The modeling of the path model was done in SmartPls 2.0.M3. The model specification for the study was modeled based on the review of the literature (Hair, et. al., 2014). In order to build the model, Ringle et al., (2014) instruction toward SEM in using SmartPLS was adopted. This path model was created based on the set of related hypotheses proposed from the conceptual framework in ***Error! Reference source not found.***.The model is a formative-formative higher order construct. The model elaborates that the concept value addition (main endogenous variable or third-order construct) is caused by the four stages assumed in the smallholder palm fruit value chain (lower endogenous variables or second-order constructs). Wherein when these stages are expanded, other layers of dimensions (exogenous variables or first-order constructs) are observed to be the causes of these stages.

Prior model estimation

In order for formative-formative models to be estimated, there was a need to first estimate the constructs scores (Hair et. al., 2017). After that was done, a second remodeling of the path model was further been done for the final estimation of indicators weights and loadings; structural model path coefficients; and the resulting R2 values to be derived. Because of this, a two-stage approach for analyzing a higher-order composite was adopted for this study (Hair et al, 2017).

Before running the ordinary PLS iteration algorithm for the first stage estimation, it was ensured that indicator variables which by default were reflective were all reverted to formative for all the indicators

that formed the constructs. This was crucial because the misspecification of formative variables to be reflective variables could lead to Type I error (Diamantopoulos, et. al., 2008). After creating the model by correctly using the recommended method specified by Gaskination's YouTube channel (2017), the first stage was ready to obtain the construct scores (Hair et al. 2017). But before running the ordinary PLS algorithm, it was ensured that the stop criterion was set at 1.0E-7, initial weight held at 1 (Hair et al. 2017). While the factor weighting scheme was selected. The factor weighting scheme was selected since the study was an exploratory one (Ringle et al. 2014). After that, the traditional PLS algorithm was run, with a bootstrapping using 746 subsamples was carried out. This was to obtain the latent variable scores for the constructs and to test the significance of observed indicators in the measurement model.

The derived latent variable scores obtained from the first stage were remodeled in a new structural equation model. A bootstrapping of 5000 samples was used for the second stage. The use of such number of subsamples for the bootstrapping was to derive estimates as if it was the entire extension agents that were being censused in Edo State specifically, and as if the subsamples were representative of Nigeria generally. Lastly, SPSS 24.0 was also used for the diagnosis of the presence of multicollinearity in the constructs. A linear regression was run to get the multicollinearity measures such as the variance inflated factor and the corresponding tolerance values.

RESULTS

Results from the exploration of the proposed model commence by evaluating the quality of the measurement model before that of the structural model.

Measurement model assessment of the sustainable palm fruit value chain model

The evaluation of the relevance of the measurement model was assessed using the ordinary PLS-SEM algorithm, in addition with a bootstrapping of 746 subsamples for the first stage, and 5000 samples for the second step of the two-stage PLS-SEM approach respectively. By using the ordinary PLS-SEM algorithm to generate reliable estimates from the first stage, the stop criterion was reached where the number of iterations reached before iteration converged was 79 iterations. Further assessment of the measurement model was carried out and it is shown below:

Assessment of convergent validity

Findings from the analysis show that the strengths of the path coefficients linking the formative constructs with its corresponding reflective measure were 1.

For this study, the single reflective items used for each analysis was the summarized global items which the constructs aimed to measure (Sarstedt et al., 2012). The redundant analyses output reveal that for all the constructs, convergent validity was fully established for them. This is because the path coefficients between the formative measured constructs and their reflective measured composites showed a strength of more than 0.8 and the variance explained in the reflective endogenous constructs were more than 0.5.

Diagnosis of the presence of multicollinearity among observed indicators

After the convergent validity was attained for the various constructs, the observed indicators which form each latent construct were assessed of multicollinearity issue. Tolerance and the variance inflated factor (VIF) values have long been known to be the measures of collinearity in regression models. They are obtained when the observed indicators are regressed with their corresponding formative latent constructs. The estimates derived for this study were within the range of 0.634 to 0.98 for the tolerance values and 1.02 to 1.578 for the VIF values. It is noteworthy that a tolerance value is a reciprocal of the VIF estimates and vice versa. Thus, it is expected that the lower the tolerance the higher the VIF.

Weight significance (T-values)

The inspection of the results obtained from the assessment of the observed indicators that form the measurement model for the analyzed path model was carried out. The examination of the results obtained from the ordinary PLS-SEM showed that most of the examined indicators within an unobserved exogenous construct, somewhat had equal weights. It was also observed that some indicators also exhibited negatives signs. The negative indicator was because the specific questions were asked in their negative form. To know the significances of the various weights, results from bootstrapping the model by using 800 samples for the first stage and 5000 subsamples for the second stage was carried out. Results obtained from the bootstrapping analysis revealed that the majority (88.8%) of the observed indicators had T-values greater than 2.57 when evaluating using a two-tailed test. This imply that the observed indicators were critically significant at 1 percent probability of error. Furthermore, it was also observed that one of the investigated indicators which is IATPM1 was statistically significant at 5 percent probability of error (T-value > 1.96). Whilst others like IATRM2 and PM3 were both significant at 10 percent level of significance (T-value > 1.65). Whereas for PIC2 and AC2, there were no sufficient evidence to establish that the indicators significantly contributed to the formation of their respective latent constructs.

Loadings significance (T-values)

Since the observed variables, PIC2 and AC2 were not significant, further assessment of the observed indicators for their absolute importance relative to the construct they formed was carried out through the estimation of the results obtained from the loadings output. The result obtained from the output of the ordinary PLS-SEM algorithm, and a bootstrapping of 746 samples and 5000 subsamples respectively revealed that the previous two indicators that was under scrutiny of their prospect of being a contributor to its respective latent constructs had loadings of 0.4589 and 0.7596 for PIC2 and AC2 indicators respectively and were significant at 1 percent level of significance from the bootstrapping carried out.

Structural model assessment of the sustainable palm fruit value chain model

The investigation of the structural model was done at the second stage of the two-stage approach. The analysis during the second-stage approach of the PLS-SEM converged at a stop criterion of 2 iterations. Further assessment for the structural model is shown below:

Diagnosis of multicollinearity among constructs

The assessment for the presence of multicollinearity among the derived latent constructs was also carried out. The model is a higher-ordered model; thus, the investigation was based on the order of the constructs. It was observed that within the secondary inner model (made up of the link between the first-order latent constructs and their corresponding value addition stages which is the second-order latent constructs) of the suggested value chain model, the regressed output between the linked latent constructs within the model had multicollinearity estimates range of 0.54 to 0.876 for its tolerance value. While for the corresponding variance inflated factor values, the range was within 1.142 to 1.851. A further investigation was also carried out for the primary inner model (which is a link between the main third-order construct and the second-order construct) result obtained also showed that the second-order latent constructs values of tolerance and VIF were between 0.278 to 0.554, and 1.806 to 3.603 respectively.

Assessment of the structural path coefficients

The path coefficients estimate as well as the T-values from the test of hypotheses proposed for the study were also investigated. Bootstrapping the model using 5000 samples was used to carry out this test for the second stage of the two-stage technique. Since the inner model was made up of the secondary and primary inner models, results from the secondary inner model were discussed first before that of the primary inner model.

In this subsection of the manuscript, the use of the secondary inner model was used to explain the relationship between the exogenous variables of the first-order construct and the lower endogenous variable for second-order construct. The secondary inner model for this study is simply the link between the masked factors causing value with each corresponding value addition stages. The links between this latent variable are represented using path coefficients as shown in Table 1.

a. *Secondary inner model:* The endogenous variable for the model are CBI, UUP, DP, and PPA.

i. *Consumer base identification stage (CBI):* For the first stage of the value chain, it was observed that the exogenous variable which were: seeking information about the product market (IATPM) (0.6433) followed by the seeking information about the raw material (IATRM) (0.5707) had a moderate uphill relationship with the second-order latent construct called the consumer base identification stage (CBI). The association with this latent construct was positive and they were both statistically significant at a critical p-value of 0.01 (T-valve > 2.57) (see Table 1).

ii. *Upstream processing stage*: The next section of the secondary structural model that was assessed was the link between the upstream processing stage (UPP) and its proposed association with other latent factors. The investigation of the pathway reveals the path coefficients of the exogenous variables linking this lower endogenous construct (see Table 1). The first-order constructs which were linking this endogenous construct were: purity maintenance in palm oil (PM) (0.2935); digestion of palm fruit (DIG) (0.2751); redness promotion of the palm oil (BP) (0.2712); free fatty acid control in palm oil (FFACDP) (0.2697); and poison prevention of palm oil (PPP) (0.2324). The bootstrapping of these exogenous constructs as shown in Table 1 also displayed that the exogenous variables were all significant factors forming the upstream processing stage.

iii. *Downstream processing:* Table is the downstream processing stage (DP). It is a lower endogenous construct which is the third value addition stage for this article. The factors that form these constructs are activities that involve the production of by-products from palm oil (BPFPO) (0.4793); by-products from Palm Kernel (BPFPK) (0.4221); and by-products from biomass (BPOB) (0.4011). By carrying out bootstrapping, the result revealed that these exogenous variables were also all significant factors that form the downstream processing stage. The factors level significances were at 0.01 probability of error (T-values > 2.57).

iv. Post-processing activities: Finally, for the remaining lower endogenous variable, which are the post-processing activities stages (PPA), it was observed that the factors which determine the construct include: product identity creation (PIC) (0.2898); awareness creation (AC) (0.2866); free fatty acid post-processing handling (FFAPPH) (0.2753); selling of by-products (SOB) (0.2623); and trust building (TB) (0.2387). The significance of these factors in forming the construct PPA were statistically significant at T-values greater than 2.567 ($\alpha < 0.01$) (see Table 1).

b. *Primary inner model:* The target endogenous variable in this model is value addition in the palm fruit value chain. Subsequently, after the secondary structural model for the value chain theory have been assessed of its relevance, the main structural model was examined. Table 1 below also shows the results for the hypothesis that the various value addition stages are factors contributing to value addition in the palm fruit value chain. Findings (from Table 1) show that the latent constructs which are: the post-processing activities stage (PPA) (0.312); upstream processing stage (UPP) (0.305); downstream processing stage (DP) (0.275); and designing and planning stage (DNP) (0.2722) were all stages in the palm fruit value chain that are assumed to statistically cause value addition. The importance of them being a major cause of value addition in the value chain was consequential at 1 percent critical significant level of error probability (α <0.01). Thus, this agrees with the prior expectation that the value addition stages are factors explaining value addition in a value chain map.

Table 1: Structural model assessment with the test of hypotheses

r model	nt constructs ionship	othesis No	ri Expectation	coefficients	dard Error	atistics / (P- e)
ndary	PM -> CBI			3	3	23***
	RM -> CBI			7	1	72***
	> UPP			2	5	09***
	-> UPP			1	2	16***
	CDP -> UPP			7	4	06***
	> UPP			5	8	58***
	-> UPP			4	9	92***
	PK -> DP			1	9	79***
	PO -> DP			3	8	46***
	B -> DP			1	9	2***
	> PPA			6	9	61***
	PPH -> PPA			3	5	16***
	> PPA			8	6	35***
	-> PPA			3	6	43***
	> PPA			7	4	97***
ary	> VA			2	9	42***
	-> VA				9	92***
	> VA				8	48***
	-> VA				8	41***

*** α=0.01; T-statistics >2.57

Assessment of the model predictive power

Finally, the model predictive power was investigated. To assess the predictive power of a model, the practice of reviewing the R^2 called the coefficients of determination have being the general rule. The coefficients of determination are used to investigate the amount of variance in a specific endogenous variable that is caused by its corresponding exogenous variables. The inquiry carried out revealed that maximum variance was explained for all the endogenous variables because the coefficients of determination for all the endogenous constructs under investigation were about 100 percent.

DISCUSSION OF THE FINDINGS

This section of this manuscript attempts to hash out every result from the investigation. Assessment of the investigation began with an appraisal called redundant analysis. Redundant analysis is used for evaluating formative measurement models (Hair et al., 2017). In which it is used to assess if a formative index is highly associated with a corresponding reflective measure of the same construct. Carrying out redundant analysis leads to the establishment of convergent validity for the constructs (Diamantopoulos,

et al., 2008; Hair et al., 2017). With the findings from the results, it was revealed that convergent validity was fully established for all the suggested constructs needed for the investigation. This discovery was in line with Hair et al., (2017) criteria for when formative constructs establish convergent validity. Thus, it can be inferred that the formative indicators linking specific a construct determined the variance of the construct it was purported to measure.

Next, the inspection of all the observed items used to build the latent constructs for the model were evaluated for the issues of multicollinearity. It is noteworthy that Hair et al., (2017) have mentioned that if an indicator exhibit collinearity issue in a model, it does not only reduce the capacity of a model to show the indicators that are important factors, it also lead to the origination of wrong indications by reversing their signs. Where Garson (2016) have also revealed that indicators of a formative factor inflates standard errors and makes investigation of the relative significance of the independent variables unreliable. Thus because of this, literatures have recommended accepted critical values for this estimate. In 2014, Gakin and Lowry proposed an acceptable range of less than 3.3 for the variance inflated factor (VIF) values with the corresponding tolerance values of the indicators. Garson (2016) pegged the VIF of equal to or less than 4 as the cutoff point. Hair et al., in 2017 suggested that if the VIF is more than 5 and the corresponding tolerance value is less than 0.2, the researcher should be aware of collinearity threat. But in this study, the estimates derived were within the range of 0.634 to 0.98 for the tolerance values and 1.02 to 1.578 for the VIF values, it can be deduced that the indicators used to develop the model had no issues of collinearity. In other words, it can be rigorously put that that the indicators used for this assessment contribute a high proportion (63.4 percent to 98.0 percent) towards the variance of the constructs they measure (Hair et al., 2017). Thus, leading to the development of a formative validity (Gakin and Lowry).

Following the establishments of formative validity among the observed indicators and the corresponding constructs the form, supplementary appraisals were also carried out to confirm more about the quality of the measurement model. It would be recalled that a two-stage modelling approach was adopted for this inquiry. First to produce reliable estimates needed for the second stage modelling, inspection of the stop criterion revealed that the iterations reached before the simulation converged at the first stage modelling was 79 iterations. In 2013, Wong revealed that whenever a model converged before reaching the maximum number of iterations required (i.e. 300 iterations), it is assumed that the model is not only an ideal one but that stable estimations were obtained for the model investigated. Nevertheless, Hair et. al., in 2017 have highlighted that the though cases of the algorithm not converging have been recorded, the rate are however occasional and still do not reasonably have an effect on the final results.

Later investigation of the weight output from the first stage modelling was carried out. The result obtained showed that most of the measured indicators linking the corresponding unobserved exogenous constructs which they form, had somewhat equal weights which reconfirms the evidence of presence of convergent validity among the indicators-construct linkage (Gakin and Lowry, 2014). This was confirmed with the bootstrapping carried out were it denotes that there was significant evidence that most of the observed indicators were significant constitutes of their respective latent constructs under investigation with the exception of variable PIC2 and AC2. Though it was observed that PIC2 and AC2 were not significant contributors to their latent constructs, Hair et al., (2017) further pointed out that such indicators should be further assessed of their absolute contribution to the construct and this measure can be done through the assessment of the indicator loading output.

In the pursuit of promoting high quality measurement model in order to empirically evaluate the formatively latent constructs, the indicator output loadings and that of bootstrapping the indicators for PIC2 and AC2 were specifically examined. The implication of this finding was that both indicators were able to demonstrate that though they were totally significant indicators of their construct, their relevance toward the construct was somewhat significant. This assessment was in accordance with Hair et al, (2017) caution given during evaluation of formative indicators, in order to avoid deletion of indicators. It is noteworthy that the elimination of formative indicators base on the statistical ground was not a

conventional practice. Doing it tends to alter the meaning of a formative latent construct (Diamantopoulos et al., 2008; Gakin and Lowry, 2014; Hair et al., 2017). Hence Diamantopoulos et al., (2008) advised against the removal of insignificant indicators. However, in order to uphold the principle of not deleting these formative indicators, Wong (2013) further recommend that if a formative indicator weight was not significant after bootstrapping was carried out, assessment of their corresponding loadings should immediately be done. Then if in spite of reviewing the indicator loadings and it still shows it is insignificant, then such an indicator can then be justified to be removed for the model (Hair et al, 2017).

Subsequently after the evaluating the measurement model, the structural model was reviewed. Primarily, the output of the stop criterion was investigated. The output revealed that the convergence of the model was below 300 iterations indicating the attainment of a stable model. Afterward, examination of the structural model for collinearity issue was also carried out. Checking for the presence of multicollinearity issue was important because assessment of the path coefficients in the structural models is established on Ordinary Least Square (OLS) regressions of each endogenous latent variable on its corresponding predecessor constructs (Hair et al, 2017). To assess for the presence of collinearity issue, the tolerance and variance inflation factors estimates were used. The finding from this study is in harmony with the standard criteria for assessing multicollinearity (Hair et al., 2011; Hair et al., 2017; Wong, 2013). Whereby multicollinearity parameter estimates of about 5 for the VIF and 0.2 for its corresponding tolerance index. However, the implication of the finding was that the developed constructs for this assessment were empirically reliable and free from errors because there was no threat of multicollinearity.

After the assessment of multicollinearity issue was done, the investigation of the structural model was further assessed of how the latent variables relates with each other (see Table 1). First, the secondary structural model which shows the links between the first-order latent constructs and the corresponding value addition stages they linked was examined before that of the primary structural model which is a relationship between the various value addition stage and the endogenous construct value addition.

For the first stage, it was revealed that seeking information about the product market, as well as for the raw material to be used have a relationship with the consumer-based identification stage suggested for the suggested value chain model. The finding empirically provides evidence that identifying the target market before embarking on palm fruit processing was a way of knowing what the market need (PIND, 2011) which commonly is expected to increases actors' profits. Looking at the next stage, which is the upstream processing stage. Results from the analysis provides empirical shreds of evidence to the hypotheses proposed that Purity maintenance in palm oil (PM); Digestion of palm fruit (DIG); Redness promotion of the palm oil (BP); Free fatty acid control in palm oil (FFACDP); and Poison prevention of palm oil (PPP) were factors influencing the upstream processing stage of palm fruits. The results from the investigation further revealed that the aspects were significant dimensions in the upstream processing stage of palm fruit and the factors had a weak positive relationship with the upstream processing stage. Furthermore, the finding has a significant important because, apart from the normal product differentiation of palm fruit into palm oil through digestion, other emerging ways that value can be added to palm fruits during the processing stage was for actors to demonstrate that their palm oil is within tolerable FFA content; and being free from harmful compounds. It will also be highlighted that these two criteria have been the major factors used as measurable standards in the international market where palm oil prices are highly competitive.

One more value addition stage assessed for this investigation was the downstream processing stage. The result from the investigation was able to validate that being involved in the further processing of feedstocks from the upstream processing stage were other aspects to be considered to add value to palm fruits through the downstream processing stage. These findings agree with derivatives identified by Arifin (2009); Carrere (2010); Mishra (2013); PIND (2011); Poku (2002); Tambichik (2018); Zigah (2014). This is because the products are value-added products inherent in the downstream processing stage.

Lastly, among the suggested value addition stages the post-processing activities stage was investigated. Finding from this stage is an important one because it was able to illuminate other important dimensions that could be used to capture more value for palm fruits beyond production and processing stages of the palm fruits.

After the examination of the significance of the constructs in the secondary inner model, assessment of the primary model was done in which the prior expectation was upheld. This thus finally led to the examination of the predictive power of the model. Though the finding was not unexpected, Hair et al., (2017) have indicated that whenever the coefficients of determination (R2 values) is 1, then such endogenous variables are to be referred to as composite variable. Henseler (2017) was also able to elucidate more information about composites models. It was indicated that with composites models, researchers have the ability to share information on what ought to be. Thus, it can be concluded from this finding, that the proposed model could be a pathway to the growth in the small-scale palm fruit value chain.

The implication of the model for sustainability of the smallholder palm fruit's value chain

The investigation carried out was to empirically provide pieces of evidence towards a new path for promoting an SSPFVC in Nigeria. The nineteen hypotheses put forward provided tentative suggestions which, if properly utilized, could lead to the green nation through the sector. The proposed value chain model met the ethics of how a sustainable value chain should be as proposed by the FAO (2014; 22-56). The new proposed measurement model is robust. This is because it can be used for measuring the performance of actors within the value chain; understanding their performance within various stages of value addition, and providing the solution to improve on their performance. With this measurement model, issues like competency build up, food safety issues, and more income generation will be effectively addressed.

CONCLUSION

With the derived shreds of evidence, there is every proof for the Nigerian small-scale value chain actors to share the consumers' expenditures with their large-scale counterparts. To further confirm the fit of such a theory, the author further proposes a confirmatory test as well as the identification of other significant features in the suggested model.

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