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Recycling of Solid Waste and the '`*Yan Bola*' Underground Economy: A Survey of Environmental Entrepreneurs in Central Nigeria

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ABSTRACT In a society where environmental concerns over inadequate disposal of hazardous liquid and solid wastes and recycling are officially treated with somewhat nonchalance, the activities of human scavengers of metal, rubber, paper/paperboard yard and wood waste products, variously referred to in one of Nigeria's major local languages ("Hausa") as 'Yan Bola' or 'Yan Gwangwani' or 'Yan Tinka' squarely fit into the definition of 'environmental entrepreneurs' in Nigeria. Though their existence and activities are largely ignored by national statistics and indeed past policy interventions, the contribution to income generation, employment, tax revenue, skill/technology transfer and value added of this rather underground economy seems overwhelming. With cross-sectional data from four States in Central Nigeria, this study uses quantitative method to examine the contribution of the underground economy to income generation, employment and value added. The findings of the study merely go to confirm the increasingly important role the '`Yan Bola' business is playing in the local economy of the area.

1. INTRODUCTION

Like my co-workers and me, millions of people do believe in recycling, and act on that belief on a regular basis. "In this first week in November 1992, more adults took part in recycling that voted", says Jerry Powell, editor of 'Resource Recycling' Magazine. Recycling, according to Powell, is "more popular than democracy."

[Franke, Hindle and White (2001:8)]

The Twentieth Century will perhaps go down as the millennium which witnessed an unprecedented surge in environmental consciousness, particularly as recycling took place on an increasing scale and in almost every society. It has been observed that recycling has traditionally occurred because it has been economical (Berglund 2003). Since the early nineteen-seventies, the perception particularly in advanced countries has been that, society should not only minimize the depletion of already fast vanishing non-renewable resources, but recycle waste materials even more. This is often expressed in their legislations. In fact, environmental legislations in most European countries require that a large part of solid wastes should be recycled rather than burned or deposited in a landfill. This consciousness has even led to the emergence of the so-called 'waste hierarchy' which highlights waste management options as reduce, reuse, recycle, incinerate and landfill, leading to the first three to be preferred by most legislators. This hierarchy was initially made popular by environmental movements, *Friends of the Earth* and *Green Peace*, later adopted by the European Union as the order of preference in its directives in packaging of waste (Ackerman 1997). With the composition of solid wastes as outlined in table 1, similar far-reaching measures have been taken in the United States to promote recycling of municipal waste.

In Nigeria however, though there is emerging awareness of the need to recycle wastes, individual initiatives driven largely by entrepreneurial motives seem to be light-years ahead of government responsibilities in that regard.

An interesting question to ask is: why is recycling of waste so important an environmental concern? Historically, health and safety have been the major concerns in waste management. These are still relevant today; wastes must be managed in a way that minimizes risk to human health. Interestingly, today's society wants more to be done. Aside from being safe, waste management also needs not only look at its wider effects on the environment, but how economically value can be created from waste. Environmental concerns about the management and disposal of

waste can be divided into three major areas: conservation of resources; pollution of the environment; and creation of value or wealth from waste (Franke, Handle and White 2001). The relationship between waste and value is illustrated in Figure1.

Integrated waste management, being an essential component of environmentally sustainable development, is founded on the concept of 'more with less'. The Brundtland Report on Sustainable Development introduced the concept, and emphasized the need to produce more value from goods and services with fewer raw materials, energy consumption and less waste emission (Brundtland 1988). Sustainable waste management simply adopts this concept to emphasize calls for 'more with less', that is, more valuable products recovered from the waste with less energy and space consumption and less emission, as depicted in Figure 2.

On the whole, a well-planned and integrated recycling system has several advantages to the society. It reduces the overall environmental damage to amenities, crops, materials and ecosystems; curbs global warming; and protects human health. It also leads to increase in scales of production, sustains lower prices of recycled products and tempers price fluctuations (van Beukering 2001). Also, apart from improving the availability of products and services from the same materials, it extends the life-time of such products/ services (Nigel et al. 2001). Perhaps more importantly, especially for developing countries, it creates jobs, generates household income and tax revenue as well as prevents the 'crowding out' of local waste recovery (Gandy 1994).

Traditionally, recycling of solid waste in Nigeria revolves around the activities of human scavengers. In local parlance (particularly in northern and central Nigeria), they are referred to as 'Yan Bola' (*Hausa, plural*: guardians of the garbage), 'Yan Panteka' (*Hausa, plural*: motor scrap cannibals), 'Yan Gwangwani' '(*Hausa, plural*: metal scrap collectors), 'Yan Makera' (*Hausa, plural*: metal fabricators/smiths) or '´Yan Tinka' (*Hausa, plural*: tin boys). In the past, they collect scraps (metal, rubber, paper and paperboard, glass, leather, textiles and wood) from the garbage bins and government dump sites, construction sites, mechanics garages, markets and factories to recycle them into household and industrial products. Recently, with increasing demand for scrap materials from local iron and steel companies, plastics manufacturers, and importers from Asia and Latin America, the tempo, scope and frontiers of the recycling business in Nigeria have been extended in the last two decades. As a matter of fact, the business has now become a well-organized chain, stretching from the activities of scrap collectors to those of an indigenous emerging class of entrepreneurs acting as middlemen, as well as end users (scrap product retailers, metal smiths, local and foreign fabricators and manufacturers, and so on). Figure 3 shows a depiction of the web of recycling business in Nigeria, indicating sources, composition, uses and destination of recycled solid waste.

It would appear that the 'culture' and enterprise of recycling have not only come to stay but is poised to make appreciable contribution to the Nigerian economy in terms of job creation, income and tax revenue generation, value added and skill/ technology acquisition in. Ironically, inspite of its contribution and emerging importance, this economic activity is yet to be an integral part of the mainstream economic activity; it is often rather treated as part of the informal sector. Neither is its contribution within the computation purview of national domestic product (GDP).

Perhaps what is most amazing is the fact that, inspite of lack of institutional and infrastructural support, this 'underground economy' contributes in no small measures to entrepreneurial development in Nigeria. But another question is, who is an entrepreneur and are *´Yan Bola* truly entrepreneurs? An entrepreneur has been defined as an individual who has the zeal and ability to find and evaluate opportunities, assembly requisite resources, take sequential and systematic steps toward taking advantage of such opportunities (Ejere and Tende 2006). But an entrepreneur is also sometimes defined as an individual who starts his own new and small business. It should however be noted that an individual might not be an inventor, but so long as he is able to apply management concepts and techniques to understand what constitutes value to the consumer, standardizes his product, designs process and tools, analyzes work to be done and takes the risk to undertake the enterprise, he is an entrepreneur (Okpara 2000:3-4). Going by these definitions, the '*Yan Bola* in Nigeria can easily pass as environmental entrepreneurs.

Using a case of selected townships in four States of Central Nigeria, this study highlights

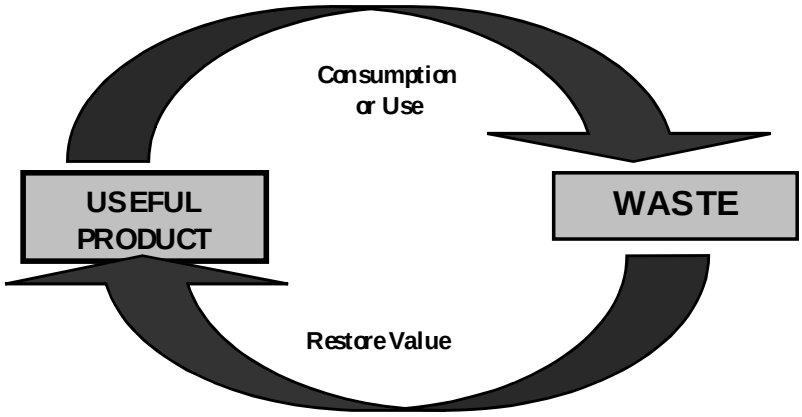

Fig. 1. Relationship between waste and value
Source: Franke, Hindle and White (2001).

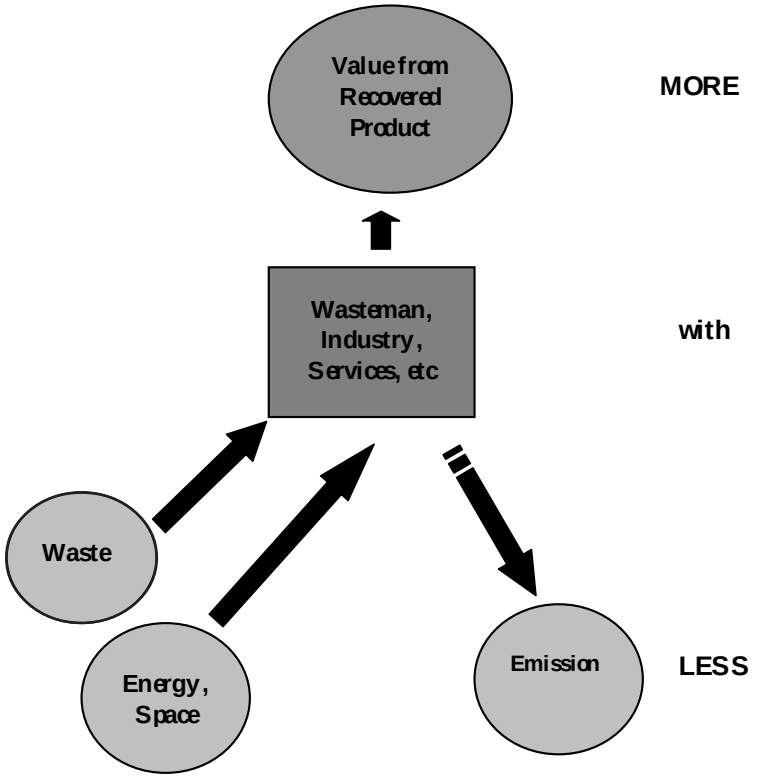

Fig. 2. Sustainable waste management showing the link between waste and value
Source: Franke, Hindle and White (2001).

their contribution. The study uses a quantitative method to assess their contribution to income and employment generation, tax revenue, skill/technology transfer and value added and their relative significance in determining entrepreneurial development in the study area.

The remainder of this paper is divided into three sections. The next section outlines the methodology of the study; analysis of the empirical results is the focus of third section; the last part forms the conclusion and recommendations segment of the paper.

2. METHODOLOGY

2.1. Study Area: The study covers four urban settlements in central Nigeria namely Jos, Keffi, Abuja and Kaduna as shown in Figure 4. In all, eighteen (18) locations/sites/dumps/markets were identified and covered (Table 2).

2.2. Method: An integrated research approach using a multiple-stage procedure was employed for this study. Under Stage I, field survey method was used to collect primary data on the '*Yan Bola* business for sorting, classification and aggregation. Stage II involved the construction of appropriate model for use in interpreting the data and determining relationships between variables. Under Stage III, the data were fitted to the regression and results therefrom analyzed.

Questionnaire and interview were the instruments used to collect data under Stage I. As a matter of fact, the first was employed as the main instrument, while the latter served as complimentary tool sparingly used to fill up gaps in the not-properly-completed returned copies of the questionnaire (where necessary).

Forty (20 each) per cent of the total copies of the questionnaire were distributed to Metal and Wood categories of the operators; fifteen (15) per cent each went to Rubber and Paper/paperboards categories; and the remainder was distributed evenly among Leather, Glass and Yard categories. On the whole, out of a total of five hundred (500) copies of the questionnaire sent out, three hundred and eighty one (381) were returned, representing about seventy-six (76) per cent response rate (Table 2).

2.3. Model Specification: Theory and empirical studies have shown that there is a strong positive relationship between entrepreneurial development (*ED*) and economic growth/development (Onuoha 1995; Kwanashie 1999). Though this relationship is direct, entrepreneurial development however translates into both tangible and invisible benefits to the economy via well-defined media, namely income generation (*IN*), employment or job creation (*EM*), tax revenue (*TR*) generation, creation of value added (*VA*), and local acquisition or transfer of skill/technology (*ST*). A positive relationship is often postulated for entrepreneurial development and these variables. In other words, a functional relationship can be said to exist between entrepreneurial development (*ED*) and income generation (*IN*), employment or job creation (*EM*), tax revenue (*TR*), value added (*VA*) and local acquisition or transfer of skill/technology (*ST*), in which there is a high propensity or probability that an improvement in any of the latter variables would positively influence entrepreneurial development. Mathematically we can represent this relationship as follows:

$$ED = p\ [IN, EM, TR, VA, and\ ST] \quad \ldots \quad (1)$$

Where

p = functional relationship between entrepreneurial development and other factors;

= enhancement in entrepreneurial development brought about by improvement in income generation is positive;

$\frac{\partial ED}{\partial EM} > 0$ = enhancement in entrepreneurial development brought about by improvement in employment or job creation is positive;

$\frac{\partial ED}{\partial TR} > 0$ = enhancement in entrepreneurial development brought about by improvement in tax revenue is positive;

$\frac{\partial ED}{\partial VA} > 0$ = enhancement in entrepreneurial development brought about by improvement in value added is positive;

$\frac{\partial ED}{\partial ST} > 0$ = enhancement in entrepreneurial development brought about by improvement in skill/technology transfer is positive.

The fact that the response variable, entrepreneurial development (*ED*), can be considered

Table 1: Municipal solid waste composition by weight in the United States of America (2000)

Category	*Percentage of total waste*
Glass	5.5
Metals	7.8
Plastics	10.5
Food Wastes	10.9
Paper/Paperboard	38.1
Rubber, Textiles and Leather	6.6
Yard Wastes	12.1
Wood	5.3
Other	3.2

Source: EPA (2002).

as *dichotomous* - that is, having the quality of turning positive or negative as it responds to improvement in any of the activities represented by the explanatory variables in the model - equation (1) could be treated as an exercise in determining the probability of outcome-responses of entrepreneurial development in practice. The problem, however, remains: how do we estimate equation (1) in reality? There are four traditional approaches used in estimating such model namely, (1) the *linear probability* model (*LPM*); (2) the *logit* model; (3) the *probit* model; and (4) the *tobit* (censored regression) model.

Whereas the *linear probability* model expresses the dichotomous variable as a linear function of the explanatory variables, since the conditional expectation of dependent variable given that the explanatory variables occur can be interpreted to mean the *conditional probability* that entrepreneurial development (*ED*) is enhanced as the activities of the '*Yan Bola* would positively impact on employment or job creation (*EM*), tax revenue (*TR*), creation of value added (*VA*) and local acquisition or transfer of skill/ technology (*ST*), the other approaches utilize the properties of cumulative distribution function (*CDF*) to their advantage. Besides, the linear probability model is associated with several problems such as (1) non-normality of error term; (2) heteroscedasticity of error term; (3) possibility of dependent variable lying outside the 0-1 range; and (4) the generally lower R^2 values (Gujarati, 1995). These problems have led researchers to prefer alternative approaches to the *linear probability* model (Pindyck and Rubinfeld, 1991).

In reality, the precise functional form of equation (1) is often unknown and only determined empirically by data. We therefore isolated the following three specifications to estimate our model using cross-sectional data collected from the survey.

Table 3: Rule for converting data for variable ED

Response to questions choice/option	*Code*	*Data conversion probability value*	*Binary code*
Very significantly	VS	0.9	
Significantly	SG	0.75	1
Slightly	ST	0.5	
Negligibly	NG	0.25	
Very negligibly	VN	0.1	0

Table 2: Study area, location visited and questionnaire administered

Study area/Urban centre	*Location/Sites*	*Questionnaire administered*	
		Sent out	*Returned*
Plateau StateJos	Katako Market	25	22
	Dilimi St. Market	25	23
	Timber Shed, Constitution Road	25	24
Nasarawa StateKeffi	Keffi Garage	25	18
	Nasarawa-Road market	25	19
	Unguwan Makerai	25	20
Federal Capital TerritoryAbuja	Apo Autoparts Market	25	24
	Waste Depot, Kubwa	25	21
	Building Materials Market, Deidei	25	19
	Gwagwada Market	25	21
	Waste Dump, Mpape	25	24
	Waste Dump, Kubwa	25	18
Kaduna StateKaduna	Sabon Tasha Market	25	21
	Railway Station Market	25	19
	Old Panteka Market	25	24
	New Panteka Market, Byepass	25	21
	Oriyakpata Market	25	20
	Kakuri Market, Makera	25	
	Kurmin Mashi Mechanics Village	25	23
	Total	500	381

1. ***The Linear Probability Model*** **(LPM)**

… (2)

Where:

β = coefficient to be estimated

= probability that =1;

= probability that = 0

E = mathematical expectation

2. ***The Probit Model***

…(3)

Where

= the inverse of the normal CDF

$$P_i = Pr(ED_i = 1) = Pr(I_i^* \le I_i) = F(I_i) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{I_i} e^{-t^2/2} dt$$

$$= \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\beta_0+\beta_1 EM_i+\beta_2 TR_i+\beta_3 VA_i+\beta_4 ST_i} e^{-t^2/} dt$$

= critical threshold level which becomes observable given the assumption of normality

t = a standardized normal variable, that is, $\sim N(0, 1)$.

3. ***The Tobit Model***

$$\beta_0 + \beta_1 EM_{2i} + \beta_2 TR_{2i} + \beta_3 VA_{2i} + \beta_4 ST_{2i} + \mu_{2i}$$

if $RHS > 0$ ....(4)

= 0, otherwise.

Where

RHS = right-hand side.

2.4. Data and Estimation: To generate data for entrepreneurial development (*ED*), operators' answers to the question regarding their contribution to entrepreneurial development were converted to probability values, which were later converted to binary code of 1 and 0 (Table 3) to allow for the linear probability model estimation.

As for income generation (*IN*), data on quarterly return on investment were collected, and then multiplied by 4 to arrive at annual figures. The number of persons employed in the business chain by entrepreneurs as well as auxiliary staff associated with their operations was used as proxy for the variable, employment or job creation (*EM*). Tax revenue (*TR*) was calculated from monthly/annual payments/remittances made by operators to local government tax collectors, union dues and periodic payments made to relevant guilds for franchise or permit to operate within the ambit of the business chain. Creation of value added (*VA*) was computed as the difference between quarterly value of inputs and quarterly value of finished goods/services which was later multiplied by 4 to arrive at annual figures. An index measuring the number of times an entrepreneur is consulted by others and or the number of times he/she had to contract or sub-contract jobs to others with special skill was used as a proxy for the variable, local acquisition or transfer of skill/technology (*ST*).

The *E-Views* (Version 3.0) Statistical Package was used to estimate equations (2), (3) and (4) and therefrom to analyze the results. The relative goodness of fit, explanatory power of the estimated coefficients and other statistics of the various models were then compared. Causality tests were also conducted to further confirm the direction of causation.

3. RESULTS AND DISCUSSION

3.1. Regression Results: The estimation results of the three models are shown in table 4. The *linear probability* model has an *R*-squared value of 0.8623, meaning that the behaviour of entrepreneurial development is explained by the behaviour of predictor-variables in the model by eighty-six per cent. This is somewhat higher than the performance of either of the other two models. However as pointed earlier, this interpretation should be treated with caution as, conceptually speaking, the linear probability model has the disadvantage of overstating/understating the *R*-squared statistic when compared with competing models.

Nonetheless, in the *linear probability* model estimation, income generation (*IN*) appears to be most significant in explaining entrepreneurial development in the '*Yan Bola* business. This is followed by creation of value added (*VA*) and employment or job creation (*EM*) [in order of importance]. Tax revenue (*TR*) performed relatively poorer while creation of value added (*VA*) even carried the opposite (unexpected) sign. The *tobit* model performed dismally, generally speaking, as well. Only income generation (*IN*) turned out to be significant at 10 per cent level. The coefficients of all other variables exhibited

poor explanatory power and insignificance at even 10 per cent level. The *probit* model, however, seems to explain the data better than the other two. Except for local acquisition or transfer of skill/technology (*ST*), all the coefficients turned out to be significant at 5 per cent level.

On the whole, the *probit* model seems to have performed relatively better than either the *tobit* or the *linear probability* model in explaining the phenomenon and enhancement of entrepreneurial development as influenced by improvements in income, tax revenue and employment generation, as well as value added resulting from the recycling activities of '*Yan Bola* in the study area. This is also evident from the residual statistics [standard errors (S.E.), sum of squared residuals, log likelihood, Akaike and Schwarz information criteria, and *prob* (F-stat)] which show the *probit* model has almost the lowest values than the rest (Table 4).

3.2. Tests of Causality: The analysis of the results in the preceding section seems to show that entrepreneurial development (*ED*) correlates well with its predictors [income generation (*IN*), employment or job creation (*EM*), tax revenue (*TR*) and creation of value added (*VA*)] in the '*Yan Bola* model of solid waste recycling in the sampled urban settlements. In other words, the interpretation of cross-sectional data on the activities of environmental entrepreneurs in the local solid waste recycling business in the study area, in terms of income, tax revenue and job generation as well as creation of value added, tends to support the assertion that in no small measures their activities may be having significant impact on entrepreneurial development in Nigeria. However, the question is: "Does correlation mean causation?"

Table 4: Regression results

All estimates At 5 % significance level

Variable	*Lpm*	*Probit*	*Tobit*
Constant	**0.7235**	**0.6052**	**0.6337**
z-statistic	(14.5549)	(4.322)	(8.6319)
p-value	0	0	0
IN	**4.51**	**1.8209**	**5.7706**
z- statistic	(0.1201)	(0.1742)	(0.1072)
p-value	(0.0491)	(0.0362)	(0.0981)
EM	**0.5815**	**0.6513**	**0.0931**
z-statistic	(0.0104)	(1.1264)	(1.1649)
p-value	(0.027)	(0.0286)	(0.852)
TR	**0.0387**	**0.0965**	**0.0518**
z- statistic	(0.0018)	(0.1705)	(1.165)
p-value	(0.0855)	0.0486	(0.0244)
VA	**2.3901**	**7.2901**	**3.3035**
z- statistic	(0.7642)	0.8017	(0.731)
p-value	(0.0442)	0.0443	(0.4648)
ST	**-0.0564**	**-0.1696**	**-0.085**
z- statistic	(-1.6496)	(1-.2496)	(-1.2050)
p-value	0.2448	0.2144	(0.2282)
Other Statistics			
R-squared or *McFadden R-squared	0.8623	0.7525*	-0.106
S.E. of Regression	0.4679	0.4674	0.4708
Sum of squared residual	82.0943	81.7267	82.8961
Log likelihood	-248.2113	-235.9667	-382.9844
Mean dependent variance	0.6805	0.6815	0.682
S.D. of dependent variance	0.4668	0.4664	0.4668
Akaike infor. criterion	1.3344	1.2735	2.0465
Schwarz criterion	1.3965	1.3357	2.1189
F-statistic	0.6524	3.5784	-
Probability (F-statistic)	0.6599	0.0116	-

To help us answer this contentious question, we performed pair-wise Granger Causality tests. The results of the tests are summarized in table 5. Columns 4 and 5 show the calculated *F*-statistic

Table 5: Pairwise Granger causality test results

A. Causality Test Results For The Primary Functional Relationship

	Null Hypothesis	*Obs.*	*F-Statistic*	*p-value*	*Decision*
1	*IN* does not Granger Cause *ED*	380	1.61647	0.02044	Reject Null
	ED does not Granger Cause *IN*		1.37094	0.24239	Accept Null
2	*EM* does not Granger Cause *ED*	380	9.29476	0.00246	Reject Null
	ED does not Granger Cause *EM*		0.12843	0.72027	Accept Null
3	*TR* does not Granger Cause *ED*	380	5.73988	0.01707	Reject Null
	ED does not Granger Cause *TR*		0.00165	0.96762	Accept Null
4	*VA* does not Granger Cause *ED*	380	0.00205	0.96392	Accept Null
	ED does not Granger Cause *VA*		0.29815	0.47673	Accept Null
5	*ST* does not Granger Cause *ED*	380	0.00453	0.9464	Accept Null
	ED does not Granger Cause *ST*		0.50735	0.47673	Accept Null

Fig. 3. Nigeria: Source, use and destination of recycled solid wastes
Source: Author's Survey, 2007.

Fig. 4. Map of Nigeria showing study area

for each pair of variables and their respective probability values, while columns 2 and 6 indicate the null hypotheses tested and the resulting interpretation of the outcomes. The first part of table 5 outlines the tests on the causal link between the regressand and explanatory variables. The results show there are three uni-directional relationships [between employment or job creation (*EM*) and income generation (*IN*); between entrepreneurial development (*ED*) and employment or job creation (*EM*); and between entrepreneurial development and tax revenue (*TR*)] - implying that the regression results are not superfluous. This translates to saying there is evidence to suspect that income generation (I*N*), employment or job creation (*EM*) and tax revenue (*TR*) may be impacting on entrepreneurial development in Nigeria.

On the whole, the *linear probability model* can be said to have performed well in explaining the cross-sectional data on the activities of environmental entrepreneurs in local solid waste recycling business in the study area.

4. CONCLUSION

The fact that a vibrant recycling industry exists in Nigeria is no longer in doubt. In the past, this rather underground economy was regarded as an obscure economic activity and treated as such by officialdom to the extent that its contributions to the economy were ignored in the computation of national statistics. With increased tempo of industrial activity especially in the newly emerging economies brought about by increased global competition for vanishing sources of raw materials, rapid industrialization occasioned by globalization and environmental consciousness, the recycling business in Nigeria is becoming an international enterprise. What is even remarkable is the fact that '*Yan Bola* underground economy is creating a new class of entrepreneurs in the country's environment industry.

This study tries to draw the attention of authorities concerned to the growing importance and contributions of the '*Yan Bola* enterprise to job creation, tax revenue generation and entrepreneurial development in Nigeria, and the need to integrate it into the mainstream. Though limited in scope, it has not only demonstrated that a nation-wide survey of this business activity is possible but the 'sector' should be treated as part of the wider macroeconomic policy on industrialization and environmentally sustainable development in the country, as when promoted, it could make tremendous impact on income, employment and tax revenue generation as well as value added in an era of high level of unemployment, poverty, misery, want and general low business activity in the mono-cultural economy of Nigeria. The study also shows there is strong evidence to suspect that the 'Yan Bola business could subtly be at the vanguard of promoting entrepreneurial development in Nigeria.

5. RECOMMENDATIONS

To propel the 'industry' to do more, we therefore make the following recommendations:

1. Full integration of the '*Yan Bola* business into the mainstream through appropriate legislations and creation of enabling operational environment;
2. Targeting of the '*Yan Bola* business for further entrepreneurial development and capacity building by way of incorporating it into the Federal Government's entrepreneur development schemes, job creation and promotion of small and medium scale enterprises strategy such as the national directorate of employment (NDE) scheme, existing poverty alleviation programmes and the small and medium enterprises schemes (SMIES);
3. Facilitation of the acquisition of cheap and appropriate recycling technologies for the operators so as to promote economic efficiency, cost minimization, increased value and energy efficiency, and as an overall objective, the reduction of potential harm to the environment as a result of recycling of solid waste; and
4. Restructuring of the national statistical system to enable timely, accurate and reliable production of statistics (including 'green' statistics), critical to effective planning, monitoring and evaluation of environment-related activities and other policies.

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