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Student Age as an Impact Factor for Student Evaluations of Instruction

By Katja Specht & Wolfgang Gohout
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Abstract- Student Evaluations of Instruction (SEI) are an important issue in countries like the USA, where the evaluation results can impact professional promotion chances and salary of faculty. According to Seldin [11], the percentage of American colleges using SEI grew from 29% in 1973 to 68% in 1983 and to 86% in 1993. Consequently, the adequacy of SEI has been examined extensively, and many statistical studies have been published. Non-instructional factors, which cannot be influenced by instructors, may bias the evaluation rating and should be identified and eliminated for a fair comparison. But in many cases, a mere linear regression of SEI on such potential factors is not adequate.

Keywords: *evaluation, extrinsic impacts, generalized linear models, regression, student age.*

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Student Age as an Impact Factor for Student Evaluations of Instruction

Katja Specht [α] & Wolfgang Gohout [σ]

Abstract- Student Evaluations of Instruction (SEI) are an important issue in countries like the USA, where the evaluation results can impact professional promotion chances and salary of faculty. According to Seldin [11], the percentage of American colleges using SEI grew from 29% in 1973 to 68% in 1983 and to 86% in 1993. Consequently, the adequacy of SEI has been examined extensively, and many statistical studies have been published. Non-instructional factors, which cannot be influenced by instructors, may bias the evaluation rating and should be identified and eliminated for a fair comparison. But in many cases, a mere linear regression of SEI on such potential factors is not adequate. This paper proposes a proper approach to such situations, namely Generalized Linear Models (GLM). The estimation algorithm will be presented step-by-step so that it can be replicated with own data. Eventually, the estimated model will be used to eliminate the extrinsic impacts.

Keywords: evaluation, extrinsic impacts, generalized linear models, regression, student age.

I. Introduction

Student Evaluations of Instruction (SEI) are very widespread and common practice in countries, where the evaluation results are applied for professional promotion chances and salary of faculty. In countries like Germany, SEI are used as an instrument for the internal quality management and teaching improvement process. This instrument is also of growing interest in the accreditation process of study programs and universities.

The intrinsic impact factors of the evaluation ratings are the single items of the evaluation questionnaire, which are answered by the students. But many statistical investigations have shown that there are undesirable extrinsic factors, like class size or the quantitative exposition of the course, which are noninstructional by nature and, therefore, should be eliminated for a fair comparison of the evaluation ratings. Costin, Greenough and Menges [2] presented a review of empirical studies regarding student ratings. They concluded that SEI can provide reliable and valid information on the quality of courses and instruction but for further interpretation extrinsic factors should be taken into account. Already Heilman and Armentrout [6], Lovell and Haner [8], McDaniel and Feldhusen [9] and Hamilton [5] have shown that teachers of large classes may receive lower ratings. Hoefer, Yurkiewicz and Byrne [7] assessed significant differences between undergraduate and graduate SEI. For that matter, Brightman [1] states that it is unfair to compare a faculty member teaching a required core class with another faculty member teaching a senior–level elective course. Peterson, Berenson, Misa and Radosevich [10] have recommended to establish appropriate sets of norming reports in which possible semester factor effects are considered.

It is tempting to perform a linear regression of the evaluation ratings on the non–instructional factors by the least–squares principle and to use the estimated model for the compensation procedure. But, this will only be admissible, if the latent variable is normally distributed. This can be tested by using the residuals from the regression as a proxy for the latent variable. Frequently, a dependent variable, like evaluation ratings, is skewed to the right. This, in turn, usually prevents the residuals from being normal. At least, this occurs with our data.

Therefore, our investigation focuses on a proper methodical approach of estimating a non–linear model. After a description of the data we shall present the Maximum–Likelihood (ML) estimation of a so–called Generalized Linear Model (GLM) step–by–step. The presentation is sufficiently detailed, so that the reader can, for instance, apply the procedure to own data with a matrix-based programming software like MATHLAB or GAUSS. We restrict our presentation to one non-instructional factor, namely 'student age' or, more precisely, the semester counter of the evaluated course. The proposed procedure can easily and obviously be extended to more non-instructive factors. Eventually, we shall show how to use the estimated model to correct actual and future evaluation ratings properly.

II. Data

We have collected $n = 140$ evaluation ratings z_i from seven-semester Bachelor programs from the Business Unit of a German University of Applied Sciences together with the semester counter (one to seven), to which the evaluated course regularly belongs. The evaluation ratings are means from a five–point Likert

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scale, where the choice 'one' is best and 'five' is worst. Unfortunately, the evaluation ratings are not normally distributed. More precisely, the standardized measure of skewness is 1.05 and the standardized measure of kurtosis is 4.51, indicating that the dependent variable is skewed to the right with a kurtosis much larger than that of the normal distribution. This results in non–normal residuals from a linear least-squares regression. And this prevents inferential conclusions of such a regression, like *t*–values and *p*–values. The usual methodology is no longer valid in this case.

Luckily, a Box Cox transformation of the evaluation ratings z_i can convert the ratings in (approximately) normally distributed values y_i:

$$y_i := g(z_i) := \frac{z_i^{\lambda} - 1}{\lambda} \sim N(\mu, \sigma^2).$$

The value of λ, which minimizes the absolute skewness of the transformed variables can be calculated numerically and is about 0.45 for our data. If we apply the rounded value 0.5, then we receive a standardized measure of skew-ness of about 0.03 and a standardized measure of kurtosis of about 2.85. The hypothesis of normality for the transformed variables y_i cannot be rejected by any test. The skew-ness–kurtosis test of D'Agostino, Belanger, and D'Agostino Jr. [3] yields a *p*–value above 90%. The transforming function g is called 'link function'.

$$y_i = E(y_i|X) + \varepsilon_i, \quad \varepsilon_i \sim N(0, \sigma^2)$$

X denotes the design matrix. In our example, it consists of a first column of ones, representing the constant, and a second column with the semester counts. Further columns may be appended for additional non–instructional factors. The latent variables ε_i are independent and identically (iid) distributed, representing the noise.

In a GLM, the dependent variable must belong to the exponential family and its expected value, given the design matrix X, may be a non–linear function h of the linear predictor $X\beta$:

$$\mu = E(y_i|X) = h(X\beta)$$

In our example, the column vector β consists of two unknown parameters, β_0 and β_1, and h is the inverse of the link function g and is called 'response function'.

The following ML estimation procedure is explained in more detail in Fahrmeir, Kneib, and Lang [4]. Let x_i be the i-th row of the design matrix X. Then we need the following symbols:

$$\eta_i := x_i'\beta, \quad \mu_i := h(\eta_i), \quad d_i := \frac{dh(\eta_i)}{d\eta_i}, \quad w_i := \frac{d_i^2}{\sigma^2}$$

$$y := (y_1, \dots, y_n)', \qquad \mu := (\mu_1, \dots, \mu_n)'$$

Consequently, the following diagonal matrices depend on β:

$$D := \mathrm{diag}(d_1, \dots, d_n), \qquad W := \mathrm{diag}(w_1, \dots, w_n)$$

The goal is to receive a solution of the non–linear equation system $s(\beta) = 0$, where $s(\beta)$ is the functional vector of partial derivatives of the log–likelihood function:

$$s(\beta) = \frac{\partial l(\beta|y, X)}{\partial \beta} = X'D(y - \mu)/\sigma^2$$

Now, the ML estimator may be iteratively approximated by the following equations:

$$\hat{\beta}^{(k+1)} = (X'W^{(k)}X)^{-1}X'W^{(k)}\tilde{y}^{(k)}$$

$$\text{with} \qquad \tilde{y}^{(k)} := X\hat{\beta}^{(k)} + D^{-1} \cdot (y - h(X\hat{\beta}^{(k)}))$$

III. Methodology and Exemplary Results

a) GLM estimation

The most general form of a regression model explains a variable by the sum of its (conditional) expected value and of some noise:

The normal distribution belongs to the so–called 'exponential family'. This admits the estimation of a GLM, which will be specified in the next section.

We have started the iterations with the least–squares estimator $\hat{\beta}^{(0)} = (X'X)^{-1}X'y$.

In order to estimate σ^2, which depends on β, we first have to eliminate duplicate rows in X. We denote the reduced design matrix by $\widetilde{X}$. Note, that in our example it has just seven rows due to the seven semester counts. The y_i have to be averaged to $\bar{y}_j$, $j = 1, \ldots 7$, within the seven groups of identical rows of X. Let n_j denote the number of observations in group j. Then, the variance can be estimated in each step of the iteration:

$$\hat{\sigma}^2(\hat{\beta}^{(k+1)}) = \frac{1}{7-p} \cdot \sum_{j=1}^{7} n_j \cdot \left(\bar{y}_j - h\left(\tilde{x}_j'\hat{\beta}^{(k+1)}\right)\right)^2$$

Here, p is the number of columns of X, in our example: $p = 2$.

Table 1 shows the five iterations, which are needed for convergence in our example.

Table 1 : Iterations of the Fisher–Scoring algorithm

k	$\hat{\beta}_0^{(k)}$	$\hat{\beta}_1^{(k)}$	$s(\hat{\beta}_0^{(k)})$	$s(\hat{\beta}_1^{(k)})$
1	0.1519	−0.0307	−0.1772	−0.6619
2	−0.2679	−0.0419	−0.1482	−0.5554
3	−0.4696	−0.0502	−0.1323	−0.5017
4	−0.5006	−0.0523	−0.0166	−0.0651
5	−0.5012	−0.0524	0.0000	0.0000

Therefore, we receive the following estimated model:

$$\hat{y} = h(X\hat{\beta}) \qquad \text{with} \quad \hat{\beta} = (-0.5012,\ -0.0524)'$$

The residuals from this model are clearly normal. Thus, they can be 'studentized' in order to eliminate outliers. In a first step, the residuals $\hat{\boldsymbol{\varepsilon}}_i$ have to be 'standardized':

$$r_i := \frac{\hat{\varepsilon}_i}{\hat{\sigma} \cdot \sqrt{1 - h_{ii}}} \qquad \text{with} \quad h_{ii} = x_i'(X'X)^{-1}x_i$$

In a second step, the standardized residuals will be transformed into a Student distribution:

$$r_i^* := r_i \cdot \sqrt{\frac{n-p-1}{n-p-r_i^2}} \ \sim \ t_{n-p-1}$$

We choose to define an outlier as an observation with an absolute studentized residual above the percentage point of order 0.975. This yields a 5% probability of an error of first kind. In our example we have excluded ten observations leading to $n = 130$ observations, to which the whole procedure is applied again. This final estimation yields:

$$\hat{y} = h(X\hat{\beta}) \qquad \text{with} \quad \hat{\beta} = (-0.5078,\ -0.0555)'$$

b) Model diagnostics

For model diagnostics, we can test the hypothesis $H_0 : C\beta = c$ by the asymptotically χ_r^2–distributed Wald statistic:

$$w = (C\hat{\beta} - c)'(CF(\hat{\beta})^{-1}C')^{-1}(C\hat{\beta} - c) \ \sim \ \chi_r^2$$

where r is the rank of C and $F(\hat{\beta}) = X'WX$ is the Fisher information matrix. In our example, the Wald statistic for $H_0 : \beta_0 = 0$ amounts to 34.32 with a p-value of almost zero. And the Wald statistic for $H_0 : \beta_1 = 0$ amounts to 6.79 with a p-value of 0.0091. Thus, both coefficients are highly significant.

The ML estimator $\hat{\beta}$ is (approximately) normally distibuted with covariance matrix $F(\hat{\beta})^{-1}$. Then, the transformed variable y may be estimated or predicted like this:

$$\hat{y} = E(y|X) = h(X\hat{\beta})$$

c) Back transformation

Eventually, we have to come back to the original evaluation ratings z_i. To this end, we apply a Taylor series approximation of the response function h, centered at $\mu = h(X\hat{\beta})$:

$$h(y) = (1 - y/2)^{-2}$$
$$\approx \tilde{h}(y) := (1 - \mu/2)^{-2} + (1 - \mu/2)^{-3}(y - \mu) +$$
$$\frac{3}{4} \cdot (1 - \mu/2)^{-4}(y - \mu)^2$$

The Taylor series approximation of the response function enables the conclusion for the evaluation ratings:

$$\hat{z} = E(z|X) = E(h(y)|X) \approx E(\tilde{h}(y)|X)$$
$$= (1 - \mu/2)^{-2} + \frac{3}{4} \cdot (1 - \mu/2)^{-4} \cdot V(y|X)$$
$$= (1 - h(X\hat{\beta})/2)^{-2} + \frac{3}{4} \cdot (1 - h(X\hat{\beta})/2)^{-4} \cdot \hat{\sigma}^2(\hat{\beta})$$

Because the expectation values of odd powers in the Taylor series are zero, the approximation error (with some $\vartheta \in [0, 1]$) is limited to:

$$\left| \frac{h''''(\vartheta y + (1 - \vartheta)\mu)}{4!} \cdot (y - \mu)^4 \right| < 0.0004$$

This may be imagined to be negligible.

Table 2 shows the estimated evaluation ratings in the last column for each group of identical co–variables:

Table 2 : GLM–estimated evaluation ratings

i	$\widetilde{X}_{i,1}$	$\widetilde{X}_{i,2}$	$\hat{y}_i$	$E(z_i\|X)$
1	1	1	0.6134	2.1661
2	1	2	0.5890	2.0853
3	1	3	0.5660	2.0136
4	1	4	0.5443	1.9495
5	1	5	0.5239	1.8921
6	1	6	0.5046	1.8402
7	1	7	0.4863	1.7933

It is clearly seen that the expected ratings in the last column are falling, and therefore getting better, with raising semester count in the third column. Thus, advanced students tend to be more patient with instructors.

d) Compensation

In the simple linear model $y = X\beta + \varepsilon$, the elimination of the impact of the 'extrinsic' factors in X is realized by the correction of the mean value of the dependent variable by the individual residual $\varepsilon_\bullet$ of an actual or future observation $(y_\bullet, x'_\bullet)$:

$$y_\bullet = x'_\bullet\hat{\beta} + \hat{\varepsilon}_\bullet \quad \Rightarrow \quad y^*_\bullet = \bar{y} + \hat{\varepsilon}_\bullet = \bar{y} + y_\bullet - x'_\bullet\hat{\beta}$$

The analogous procedure in a GLM yields:

$$y_\bullet = h(x_\bullet'\hat{\beta}) + \hat{\varepsilon}_\bullet \;\Rightarrow\; y_\bullet^* = \bar{y} + y_\bullet - h(x_\bullet'\hat{\beta})$$

$$\Rightarrow\; z_\bullet^* = h(y_\bullet^*) = h(\bar{y} + g(z_\bullet) - h(x_\bullet'\hat{\beta}))$$

$$\text{with} \quad \bar{y} = \frac{1}{n} \cdot \sum_{i=1}^{n} g(z_i)$$

Table 3 illustrates the consequences of these compensations for some randomly chosen ratings.

Table 3 : Some examples of proper corrections of evaluation ratings.

$z_\bullet$	$g(z_\bullet)$	$x_\bullet[2]$	$h(x_\bullet'\hat{\beta})$	$\bar{y}$	$y_\bullet^*$	$z_\bullet^*$
3.7	0.9602	1	0.6088	0.5395	0.8910	3.2521
1.5	0.3670	1	0.6088	0.5395	0.2977	1.3804
2.4	0.7090	2	0.5833	0.5395	0.6652	2.2452
1.4	0.3097	7	0.4768	0.5395	0.3724	1.5099

The arbitrary ratings $z_\bullet$ are corrected into the expected direction and yield the values in the last column. The ratings of early semesters are lowered, thus improved, and ratings of late semesters are raised, thus penalized.

e) Semester dummies

Now, we are going to model the impact of the categorical variable 'semester count' by semester dummies. This will drop the assumption of a monotonous influence in favour of more flexibility. We choose the first semester as the reference category. The dummy variables S_i, $i = 2, \ldots, 7$, are defined to be 'one', if the course is affiliated to semester i, and 'zero' otherwise. The related GLM reads:

$$y = h(X\beta) + \varepsilon = h(\beta_0 + \beta_1 \cdot S_2 + \cdots + \beta_6 \cdot S_7) + \varepsilon$$

with the $(n \times 7)$–dimensional design matrix

$$X = (1, S_2, \ldots, S_7)$$

The estimation procedure is the same as before. Six outliers can be identified in this model, leaving behind a sample number of $n = 134$ and the following vector of estimated coefficients:

$$\hat{\beta} = (-0.6484,\ 0.1065,\ 0.0545,\ -0.0216,$$
$$-0.3271,\ -0.3130,\ -0.1657)'$$

Again, the conclusion for the original ratings is performed by a Taylor series approximation of the response function. This yields the following expected evaluation rating values, dependent on the semester count:

Semester	1	2	3	4	5	6	7
$E(z_i\|X)$	2.0171	2.1669	2.0894	1.9907	1.7126	1.7224	1.8403

Evidently, with our data the evaluation ratings are 'raising' in the beginning and in the last three semesters. And they are 'falling back' in the middle part of the study program. But, remember that evaluation ratings are like 'grades' in our example, meaning that a 'high rating' is equivalent to a 'low grade'.

The residuals of this regression are clearly normal. The p–value of the skewness–kurtosis test is about 45%. The simultaneous significance of the dummy variables may be tested by the hypothesis $H_0 : C\beta = c$ with:

$$C = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \quad c = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

The asymptotically χ^2_6–distributed Wald statistic has a p–value less than 0.00001. Therefore, the simultaneous impact of the dummy variables is clearly significant.

Table 4 demonstrates the way of compensation for the non-instructional factor 'semester count' for seven exemplary evaluation ratings. Observed ratings $z_\bullet$ have to be reduced (i.e. improved) in the first four semesters and else raised (i.e. deteriorated). The corrected rates are listed in the last column.

Table 4 : Some examples of proper corrections of evaluation ratings with semester dummies.

$z_\bullet$	$g(z_\bullet)$	$x_\bullet[2]$	$h(x'_\bullet\hat{\beta})$	$\bar{y}$	$y^*_\bullet$	$z^*_\bullet$
2.7	0.7828	1	0.5703	0.5389	0.7514	2.5659
2.5	0.7351	2	0.6191	0.5389	0.6549	2.2107
2.2	0.6516	3	0.5945	0.5389	0.5960	2.0291
2.1	0.6199	4	0.5611	0.5389	0.5976	2.0339
2.0	0.5858	5	0.4518	0.5389	0.6729	2.2711
1.8	0.5093	6	0.4561	0.5389	0.5921	2.0179
1.5	0.3097	7	0.5051	0.5389	0.4008	1.5640

IV. Conclusions

Evaluation ratings are an important instrument in quality management of teaching. Several non–instructional factors may bias the intended evaluation of the instructor. It is essential to assess the quantitative influence of those non–instructional factors in order to compensate the evaluation ratings for these extrinsic factors and achieve a fair comparison.

It is tempting to perform a linear least–squares regression of the evaluation ratings on the non-instructive factors. The estimated model could easily be used to eliminate the extrinsic impact. But, if the residuals from this regression are not normally distributed, the results will not be reliable. Another method of estimation has to be applied.

At least with our SEI data, the residuals from a linear least–squares regression on student's age are skewed and far from beeing normal. But a proper Box–Cox transformation of the evaluation ratings yields a normally distributed dependent variable. This, in turn, enables the maximum likelihood estimation of a GLM. This procedure is not quite common. Therefore, it is explained in detail in this paper.

Once we have estimated a valid model, we can use it to eliminate the impact of the considered co–variable. Due to the non–linear GLM approach, this task requires a Taylor series approximation of the response function, which can be fairly easily performed. In our example, the expected evaluation ratings are getting better with rising semester count. Students seem to get more indulgent with growing age.

Finally, we have conducted the GLM regression of the transformed evaluation ratings on semester dummy variables. Now we receive more flexible, non–monotonic impacts of the semester count on evaluation ratings. Especially with small data sets, this might be the better approach.

An important message of this paper should be to carefully inspect the assumptions of an applied method. In many cases, these assumptions may not be met by the data. In these cases a less familiar procedure may serve as an alternative.

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Reliability Assessment of Offshore Floating Renewable Structures by AHP Methodology

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Abstract- The aims in selection the power generation system at offshore renewable energy production structures are the sustainability and the reduction of risk in order to achieve efficient operation, to enhance environmental friendly behaviors, to increase the safety and positively contribute to the overall operability management of the systems. In this article the use of multi criteria decision method on offshore energy structures is presented in order to provide, through the application of analytic hierarchy process (AHP) method, a model for assessing reliability based on qualitative (historical data) and quantitative (experts opinion) characteristics. According to the above method, data are evaluated and compared in pairs and the results may provide information on the improvements that will be included in the development of offshore structures in order to increase the probability of success, the structure reliability in energy production and its sustainability, depending on the choice of technology which will be installed.

Keywords: *renewable energy assessment; AHP; multi-criteria decision making.*

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Reliability Assessment of Offshore Floating Renewable Structures by AHP Methodology

Ioannis Dagkinis [α] & Nikitas Nikitakos [σ]

Abstract- The aims in selection the power generation system at offshore renewable energy production structures are the sustainability and the reduction of risk in order to achieve efficient operation, to enhance environmental friendly behaviors, to increase the safety and positively contribute to the overall operability management of the systems. In this article the use of multi criteria decision method on offshore energy structures is presented in order to provide, through the application of analytic hierarchy process (AHP) method, a model for assessing reliability based on qualitative (historical data) and quantitative (experts opinion) characteristics. According to the above method, data are evaluated and compared in pairs and the results may provide information on the improvements that will be included in the development of offshore structures in order to increase the probability of success, the structure reliability in energy production and its sustainability, depending on the choice of technology which will be installed. A field study for a floating desalination unit working with wind and waves installed in an isolated Greek island is presented to verify the proposed methodology. The results will assist the development of similar designs of large scale floating offshore installations which are essential in fighting water scarcity and electrification of isolated insular areas.

Keywords: renewable energy assessment; AHP; multi-criteria decision making.

I. Introduction

The challenge to found clean, sustainable alternatives to fossil fuels has increased rapidly in recent decades. Furthermore energy efficiency is among the main factors for ensuring sustainable development and the entire energy generation industry must change from fossil fuels to renewable energy sources – the sun, wind, waves and tides. Hence, the vast energy reserves of renewable energy sources can help to ensure that future adequacy with low cost and to provide independence from fossil energy sources. Immense challenges and opportunities lies ahead as the global energy industry makes this change to the inbred energy production.

The construction of offshore wind farms has been extended in many European countries, but off-shore wind energy will soon need to address areas beyond the shallow, congested southern North Sea if the goals set by policy makers and industry are to be reached. Most other seas with good wind are much deeper, making fixed foundations uneconomic.

This sector is quite underdeveloped in Greece. Up until now, there isn't any offshore wind farm under operation, while 37 studies are waiting for approval, three are in the stage of early planning and five have already been rejected [1]. On these sectors should be added the offshore desalination unit that works autonomous in pilot operation at Aegean Sea with power from a wind turbine [2].

The offshore systems are very large and complex and they include technical, economical, environmental and social components [3]. So the key factors that should be taken into account for the viability of renewable energy power systems are environment adaptation technology advances, economic feasibility and social acceptance. Nowdays offshore renewable energies installations show a great potential for further exploitations in this framework [4]. Thus exploitation aim of the abundant energy resources, either from the wind or from sea waves should be investigated and ensure that in the long term, the supply of energy will come from reliable, safe, efficient and economical accessible natural sources.

The aim of this article is to provide through an integrated implementation of analytic hierarchy process (AHP) multicriteria analysis a tool in order to select the most appropriate power generation installation in offshore structure. This method can be used for evaluation of an offshore system either for the provision of electricity to the mainland or for the consumption expected in an integrated production system for drinking water as this research. Accordingly, the first part introduces the aspects related the power production from wind, wave and the combination of wind-wave technologies, and an introduction of AHP method, while the second illustrates the application of the method for evaluate each technology, followed by a discussion of the results obtained from this analysis.

II. Renewable Power Production Technologies

The main factors that affect the selection of a technology for offshore structures have to satisfy the friendly to the environment and the autonomous operation. Environment friendly means that it does not have any side effects and autonomous means that the

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floating structure operates unmanned and that energy became from renewable source. The selected evaluation systems are the following:

a) Wind turbine system

The main application of offshore wind turbines is the production of electricity and its channeling into the mainland electrical grid or into a local grid. The coupling of wind turbines with desalination systems now is technically feasible, and the desalination systems driven by wind power could be a common renewable energy desalination plant.

The investigated pilot wind turbine model has the following features: (a) It has 30 kW in power, (b) Variable pitch of blades and (c) Variable speed. The role of the wind turbine is to provide energy for the desalination of sea water. During the system operation resulting that when the wind speed is high increased the available energy and the system produces more water. When the wind speed is low, energy production decreases and resulting less water production with a lower operational limit the 5KW. The mean water production in this case to the system installation area was 2,49 m^3/h. This is the result based on the recorded data of the pilot system.

b) Wave exploitation system

The other under consideration system of energy production is an exploitation system of wave energy. The global distribution of wave power resource is expressed in the Figure 1.In this figure the wide range of wave energy statistics for the offshore data points distributed along the Atlantic and Mediterranean European coasts is illustrated and the largest potential are in east Mediterranean Sea. On the other hand a large number of concepts (over 1000 techniques) are available for wave energy conversion (WEC) [5], which have been patented in Japan, North America, and Europe. Despite this large variation in design, WEC generally can be classified by their positions (on-shore, near-shore or offshore), by their size (point absorbers, versus large absorbers) or by their operating principle.

Figure 1 : The numbers on the map express the wave energy potential at the specific site – the higher the number, the greater the potential (kW/m) source: www.ecowavepower.com T.W. Thorpe.

Shoreline systems have advantages like their position which being close to the utility network, can easy overhauled, and as waves reach the coast attenuated as they travel through shallow water they have a reduced likelihood to be exposed in extreme weather conditions [6]. But this is one of the disadvantages because the waves due to the shallow waters loose some of their energy. The devices are installed in relatively shallow waters and attached to the seabed, which provides an appropriate stable base on which the oscillating body can operate, but like the shoreline devices drawback as shallow water causes a decrease in potential energy of the wave. Finally offshore devices are generally installed in deep waters. The advantage of installation a WEC in deep water is that it can obtain the exploitation of greater amounts of energy because of the higher energy content in deep water waves. In this paper regarding the needs of the under consideration desalination system the model studied was designed and constructed for the exploitation of wave energy. The data used in this article was exported of the research and implementation of this wave energy system which was put into autonomous operation as a trial. The specific wave devise has the following characteristics a) Wave front of 8 meters, b) Hydraulic power 25 kW, even if the waves have more power and c) It utilizes 11% of the available wave energy. Also, it is worth mentioning that while wind varies significantly even at five minutes intervals, waves remain stable enough for long periods [7]. The results obtained from the trial operation of this system on producing water from desalination system in the investigated period of five years in weather conditions of the area that was installed was 2,14 m^3/h.

c) Wind and wave combination system

The combination of a wind turbine in a platform with a wave exploitation device becomes an important contributor to energy production as in this case of desalination system. The advantages of combining offshore wind and wave energy into a single power production system include reduced hours of zero power output and reduced interhour variability. Both advantages facilitate the integration of variable renewable energy production to power grid [8]. The different power output profile of combined systems allows for a reduction in the required capacity of an offshore batteries storage system which allows the safe system operation. The design of a system which could anchor in deep water in areas where wave and wind conditions are ideal ensures a high level of predictable and almost constant energy production.

With regard to the water production, the combination of wind and wave device [9] can give greater water production, as we can observe from the following Figure 2. As it becomes easily understandable in the case in which only the wind turbine operates,

much less water is produced compared with the case in which both wind turbine and wave device operate together. The reason is that waves remain stable enough for long periods compared with the wind, which can vary significantly [10].

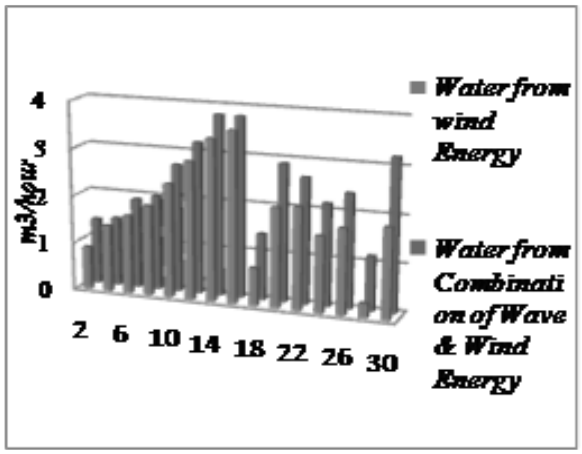

Figure 2 : Every 3 hours mean water production in a month

The most indicative finding of the combined power output is the smoother operation which provides higher availability than the individual productions systems. Both the peaks and the fast changes found in the individual productions are reduced when these are combined, and the percentage of time with null production reduces to a minimum. Variability reduces up to 31% and the percentage of time with zero production decreases to 6% [11]. The quantity of the produced water when a combination of wave and wind energy system that powering the desalination system is used, is increased compared to the previous systems, and can give a mean water production of 3,26 m^3/h.

III. AHP Methodology

The AHP is a methodology consisting of structuring, measurement and synthesis, contributing to help decision makers to cope with complex situations proposed by Saaty in 1980 [12][13]. Use of pairwise comparisons has inspired the creation of many other decision-making methods. Besides its wide acceptance, it also created some considerable criticism; both for theoretical and for practical reasons [14].

Step-by-step procedure in using AHP is the following: First define decision criteria in the form of a hierarchy of objectives. The hierarchy is structured on different levels from the top (the goal) through intermediate levels (criteria and sub-criteria on which subsequent levels depend) to the lowest level (the alternatives).

Then the criteria, sub-criteria and alternatives are evaluated according to their influence and their importance for the corresponding element of the higher level. For this purpose, AHP uses simple pairwise comparisons to determine weights and ratings so that the analyst can concentrate on just two factors at one time. One of the questions which might arise when using a pairwise comparison is: how important is the "economic feasibility" factor with respect to the "Social acceptance" attribute, in terms of the "Reliability of offshore floating" (i.e. the problem or goal)? The answer may be "equally important", "weakly more important", etc. The verbal responses are then quantified and translated into a score via the use of discrete 9-point scales Table I.

Table 1 : Scale used for pairwise comparisons

Intensity of importance	Value description	Explanation
1	Equal importance.	i and j are equally important
3	Weak importance	i is slightly more important than j
5	Strong importance	i is strongly more important than j
7	Very strong importance.	i is very strongly more important than j
9	Extreme importance	i is absolutely more important than j
2,4,6,8	Intermediate values	When a compromise in judgment is needed.

After a judgment matrix has been developed, a priority vector to weigh the elements of the matrix is calculated. Then Consistency Index *(CI)* and consistency ratio *(CR)* calculated to ensure the consistency of Criteria and Alternatives with respect to the Goal and finally the final priorities are calculated. If the matrix is inconsistent, evaluating must be made until a consistency is achieved. The calculation of inconsistency index as a ratio of the decision maker's inconsistency and randomly generated index is one of AHP major advantages. Because through this index the decision maker assures him that his judgments were consistent and that the final decision is made well. The inconsistency index should be lower than 0.10.

Otherwise, a higher value of the inconsistency index requires reassessment of pairwise comparisons, decisions obtained in certain cases could also be taken as the best alternative [15]. This matter of multiplying and adding carried out over the whole of the hierarchy and the results give to us the overall priorities and the solution for making the decisions.

IV. Evaluation Model and Results

Offshore renewable and efficient energy systems are preferred because they produce clean energy, but unfortunately none of the alternative systems can meet all the requirements solely. As pointed the three alternatives are the wind turbine system, the wave system and the combination of wind and wave system. In order to assess the reliability of the different renewable energy production systems are used and each technology is compared with the others. The criteria that are considered to assess the reliability and adequacy of selected systems in this study are:

- The adaptation flexibility in technology advances, which include the reliability of the system as result of technological maturity and the adaptation ability of each system to the technology improvements.
- Environmental impact of its installation to the surrounding ecosystems and conformability on new environmental demands are done without very costly modifications.
- The Economic Feasibility which includes the investment cost in comparison to service life, the operational and the maintenance cost and its trends on the chances for economical development to have sustainability.
- The Social Acceptance as a part of renewable energy technology implementation which can vary because renewable energy structures affect the residents' visual disturbance and the safety when they disturb the ship routes.

In the proposed model, a typical AHP hierarchy developed in order to assessing the offshore renewable technologies for reliable operation and through their pairwise comparison to propose the best one in respect of expert's judgments as it's shown in Figure 3.

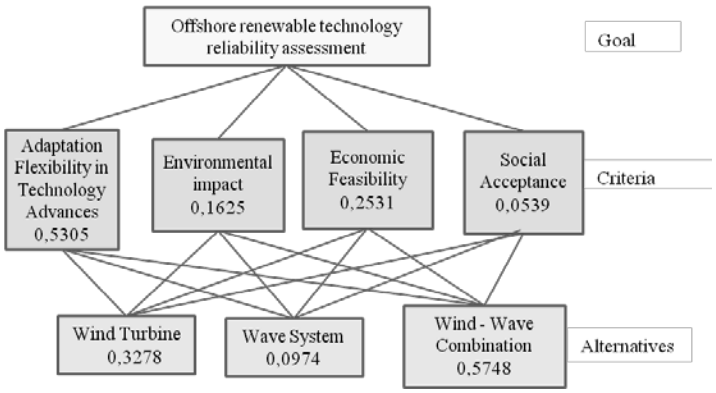

Figure 3 : Hierarchical structure and weights in Reliability assessment for offshore structures

The criteria are evaluated by five experts in areas of research and development for offshore structures, and technical departments. Also they taking into account the recorded data, compare the criteria one-to-one using the scale of Table I. With respect to weights resulting in Figure 3, adaptation flexibility in technology advances seems to be the most important criterion in determination of alternatives. The importance values are shown in figure 1 and the ranks for the alternatives dealt within the study presented in Table II where shown that from the three technology alternatives the wind and wave combination seems to be the best for sustainable and reliable choice according AHP methodology.

Table 2 : Ranks for the alternatives.

Power system	Rank
Wind Turbine	2
Wave System	3
Wind - Wave Combination	1

V. Discussion

Due to the high potential of renewable energy sources availability in various regions and the abundance of available technology the investigation that could lead to the selection of technology or the combination of technologies that will be used for harnessing this energy is essential. Also the production of energy from renewable sources would enhance the effort towards sustainable development. But the sustainability of structures using these technologies should be ensured as far as possible through research

and development in order to overcome the technological and economic implications which still exist.

Especially for countries with abundant renewable energy potential the exploitation could play crucial role in enhancing their energy security and reduce their dependences from fossil fuels. Furthermore it could improve their environmental footprint by reducing greenhouse gas emissions. Also the adoption of renewable systems development will reduce the initial investment costs through economies of scale. Therefore the investigation by using multicriteria methodologies (MCDM) will encourage the development; will propose solutions to problems that may arise and will improve the efforts in setting realistic goals.

VI. Conclusion

This paper presents a multi-criteria decision making method for assessing different technologies and determine the best alternative of renewable energy production system in offshore structure. The AHP approach is proposed as an efficient and effective methodology to be used by decision makers. The results of the decision analyses suggest that the wind and wave combination is the best renewable energy alternative in order to operates an autonomous desalination system.

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Strengthening Libor & Rate-Setting Processes: Recommendations for Policymakers

By Dr. Kosrow Dehnad & Darius K. Dehnad

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Introduction- The authors present two different models to better understand and analyze the recent Libor scandal. These models can be applied generally to other rate-setting processes and can be used by policymakers and regulators to effectively monitor benchmarks for manipulation.

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Strengthening Libor & Rate-Setting Processes: Recommendations for Policymakers

Dr. Kosrow Dehnad [α] & Darius K. Dehnad [σ]

I. Introduction

The authors present two different models to better understand and analyze the recent Libor scandal. These models can be applied generally to other rate-setting processes and can be used by policymakers and regulators to effectively monitor benchmarks for manipulation.

a) Basics of Libor

Libor was administered by the British Bankers Association (BBA) with Thomson Reuters as the calculation agent. For ten different currencies with 15 maturities each – a total of 150 rates every business day – contributor banks would submit rates giving an indication of the average rate at which they can obtain unsecured funding in the London interbank market for a given period, in a given currency. Every contributor bank is asked to base their Libor submissions on the following question: "At what rate could you borrow funds, were you to do so by asking for and then accepting inter-bank offers in a reasonable market size just prior to 11 am?"

b) Manipulation of Libor

It should be noted that the submissions of banking institutions are not necessarily based on actual transactions. In fact, a bank is not legally required to lend to other banks at the rate of its submission. So while banks were not supposed to have a vested interest in their reported rate, manipulation was inevitable.

There are two general categories of Libor manipulation – perception and trading. Perception-based manipulation is an intentional under-reporting of Libor to project an image of stability and health. Trading-based manipulation is the intentional under-reporting, over-reporting or holding constant of Libor to benefit trading positions or trader compensation. Internal emails uncovered from a Barclays trader revealed that even a basis point (.01%) drop in the Libor rate could create a few million dollars in gains for his positions.

A basic understanding of Libor is enough for the purpose of this paper, but a more in-depth understanding of Libor and the Libor fixing scandal can be found in the Statement of Facts that was part of the non-prosecution agreement between the United States Department of Justice and Barclays.*

II. Game Theory Approach

A bank estimates today's (unbiased) Libor submission rate to be 1%. The bank wants today's Libor to be set lower than 1%. What rate should they submit to increase the likelihood that Libor will be set in its favor?

The bank already knows the following setup of the game:

- Out of a total of 18 submitted rates, the highest four and lowest four submissions are excluded from the average.
- Significant deviations from the trimmed average will attract the unwanted attention of regulators.
- The estimated standard deviation of the reported rates from other agents will equal 1/10 = 10 bps, i.e. the typical bid/offer (Libid/Libor) spread for borrowing and lending between banks.
- Assuming the bank's rate falls within the 10 averaged rates, the maximum contribution of the submitted rate x would be (1% – x) / 10.

Under these conditions, a bank could adjust its submission within a reasonable range of 12.5bps, give or take a few basis points.

a) Formulation of Unbiased Conditions

We can mathematically represent the Libor process as follows:

$$L = \left(\sum_{i=k+1}^{n-h} S_i \right) / (n - k - h)$$

Where

L: fair (unbiased) Libor rate

S_i: rate submission of participant i

n: total number of participants surveyed

k: number of lowest submissions discarded

h: number of highest submissions discarded

We assume there is no collusion among participants and every submission is independent. All

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* http://www.justice.gov/iso/opa/resources/931201271017342636594 1.pdf

submissions are samples from the same distribution with density function *f(x)* and cumulative distribution function *F(x)*.

If a fair estimate of Libor is 1%, the distribution can be uniform [0.9%, 1.1%] with a mean of 1% and standard deviation of 12.9bps.

i. *Example*

Assume the 18 participants of the Libor process provide the following submissions ordered lowest to highest:

Participant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Submission	0.90	0.93	0.94	0.94	0.95	0.96	0.98	0.99	1.00	1.00	1.02	1.03	1.03	1.04	1.05	1.08	1.08	1.10

If k = 4 and h = 4, then:

$$L = \left(\sum_{i=4+1}^{18-4} S_i\right)/(18-4-4) = \left(\sum_{i=5}^{14} S_i\right)/10 = 1$$

b) Introduction of Manipulation

Now assume a participant has an interest in Libor set under the fair rate, L. This participant passes artificially depressed submission *X*, such that $X_i < S_i$. Keep in mind that an S_i that is too low would have no impact on *L*.

Our objective would be for *X* to be the $(k + 1)$ lowest number, the lowest number that would be included in (not discarded from) the average calculation. Our contribution to the calculation of the rate in that case would be $(L - x) / (n - k - h)$.

To derive our expected benefit, we start by noting that of the $(n - 1)$ remaining participants there are ${}_{(n-1)}C_k = (n - 1)! / (k! * (n - k - 1))!$ ways of choosing the lowest *k* estimates. The probability that all of these estimates will give an estimate less than *x* is $F(x)^k$. Of the $(n - k - 1)$ participants, the probability of submitting an estimate higher than *x* is $[1 - F(x)]^{(n-k-1)}$. Our expected benefit from submitting rate *x* in place of our original estimate L is $x * \{(n-1)! / (k! * (n-k-1)!\} * \{F(x)^k * [1 - F(x)]^{(n-k-1)}\}$. Our underlying goal would be to maximize the result of this equation. This maximization can be carried out either numerically, or by taking the logarithm of the above expression and putting its derivative equal to zero.

To derive the zero of the equation we maximize the logarithm of the equation $\ln(x) + k * \ln(F(x)) + (n - k - 1) * \ln(1 - F(x))$. To solve, we take the derivative of this new equation and set it equal to zero: $(1 / x) + [k * f(x) / F(x)] - [(n - k - 1) * f(x) / (1 - F(x))] = 0$. Alternatively, we can formulate the equation as: $[F(x) * (1 - F(x))] + [k * x * f(x) * (1 - F(x))] - [(n - k - 1) * x * f(x) * F(x)] = 0$.

i. *Example*

For an intuitive understanding of this model for manipulation let us apply it to Libor setting process. The Libor process is comprised of 18 participant financial institutions. The 4 lowest and 4 highest submissions are discarded. So, $n = 18$; $k = 4$; $h = 4$; $(n - k - h) = 10$. We assume that the "fair and unbiased" estimate of Libor to be 0.5% and the participants provide independent estimates from the uniform [0,1] distribution.

Based on this setup, an institution with an interest in a lower setting of Libor would want to provide the 5th lowest estimate $(k + 1 = 4 + 1 = 5)$. To optimize their benefit this institution would need to submit an estimate *x* such that the equation $\ln(x) + 4 * \ln(x) + 13 * \ln(1 - x) = 5 * \ln(x) + 13 * \ln(1 - x)$ is maximized. The derivative of this equation results in: $(5 / x) - [13 / (1 - x)] = 0$. Solving for *x*, we arrive at $x = 5 / 18 = 0.278\%$. This institution should submit an estimate of 0.278% to optimize its benefit. In other words, this value balances the risk of being discarded as a low bid and excluded from the averaging process and the chance of being included in the averaging process and pulling the average down in the banks favor i.e. maximizing our expected contribution to a lower setting of Libor.

c) Implication For Policymakers

Now we introduce uncertainty into our formulation. Suppose that of the 16 participant rate submissions the *k* lowest and $(8 - k)$ highest are discarded. Furthermore, *k* is unknown to the participants beforehand. An institution with an interest in a lower setting of Libor would want to provide the $(k + 1)^{th}$ lowest estimate. Assuming the same uniform distribution for submissions the optimal estimate would minimize $\ln(x) + k * \ln(x) + (16 - k - 1) * \ln(1 - x) = (k + 1) * \ln(x) + (16 - k - 1) * \ln(1 - x)$. The derivative would equal $[(k + 1) / x] - [(16 - k - 1) / (1 - x)] = 0$. Solving for x we arrive at $x = (k + 1) / 16$.

With this equation $x = (k + 1) / 16$ we arrive at significant policy implication for reducing Libor-setting (or any similar benchmark-setting) manipulation: a rate-setting body should both randomize and withhold the number of top and bottom submissions to be discarded. In the context of Libor for example, the BBA should have discarded the top 4 and bottom 4 one day, the top 2 and bottom 6 the next day, top 5 and bottom 2 the next day and so on all while not disclosing these values until *ex post facto*.

In hindsight an unknown *k* should be intuitive – the more unknowns added to an equation the more difficult it becomes to solve. The increased uncertainty increases the potential risk of drawing unwanted attention to a submission (assuming regulators are paying attention).

III. Empirical Bayesian Approach

In our game theory approach it was assumed that there was no cooperation or collusion among participants. But what if this is not the case? How could collusion be detected?

An empirical Bayes model can provide a framework to answer this question. Libor submissions are seen as a repeated game. A trader, or policymaker, will begin with the belief in the integrity of the market, i.e. Libor submission process. As the trader observes repeated Libor submissions and identifies potential bias, he will adjust this prior belief in the integrity of the market. His subsequent posterior beliefs continue to erode his belief in the integrity of the market.

For example, suppose a junior trader faces pressure from her managers to submit Libor estimates that benefit their firm. Her managers rationalize and justify their request by claiming that all participating institutions manipulate their submissions and that "if you can't beat 'em, join 'em". Nonetheless, the trader is uneasy with her managers' request.

Assume the trader's hypothesis H_m is that the Libor rate is not manipulated, and is fair and the process is policed by regulators to ensure an unbiased estimate of LIBOR. Her confidence in the integrity of the market can be represented as the subjective probability of the truthfulness of her hypothesis of market integrity as $p(H_n) = 99.99\%$. Let's call this the Prior.

Her idealism starts to fade as she observes evidence E of biased Libor submissions from other institutions. Her growing suspicion can be represented as the posterior probability of her faith in the market updated in light of new evidence, or $p(H_n|E)$. Let's call this the Posterior probability. What is the probability of her belief in the integrity of the market given E?

According to the Bayes rule this is $p(H_n|E) = [p(E|H_n) * p(H_n)] / p(E)$

The Posterior probability equals the $p(E|H_n)$ – chance of observing biased submissions if the market is unbiased and the biased is purely due to chance – multiplied by $p(H_n)$ – the Prior probability – divided by the market's bias or unbias. Note that P(E) = P(observation of biased submissions) = P(observation of biased submissions | market is biased) * P(market is biased) + P(observation of biased submissions | market is unbiased) * P(market is unbiased).

According to the above formula if $[p(E|H_n) / p(E)] < 1$ then $p(H_n|E) < p(H_n)]$. In other words, each biased Libor submission weakens the trader's belief in a market with integrity, $p(H_n)$ before observing the biased submission.

It's worth repeating our conclusion: $p(E) > p(E|H_n)$ or $[p(E|H_n) / p(E)] < 1$. This implies $p(H_n|E) < p(H_n)$.

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Simulation-Based Evaluation of Two-Sample Data in Presence of Less-Than-Detectable(LTD) Data in the Classical Domain

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GJMBR - G Classification : *JEL Code : C24, C81*

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I. Introduction

Limited dependent variable modeled are designed to handle samples that have been censored in some way.[1] It is common in environmental data analysis to deal with censored data. Censored data most commonly arise in these situations through laboratory analysis of samples with contaminant concentrations that are less than what the analytical method is able to detect reliably. Or suppose a study is conducted to measure the impact of a drug on mortality rate. In such a study, it may be known that an individual's age at death is *at least* 75 years. Such a situation could occur if the individual withdrew from the study at age 75, Censoring is a condition in which the value of a measurement or observation is not fully observed, although one can fit linear regression model or apply normal distribution to data with censored values.[2,3]

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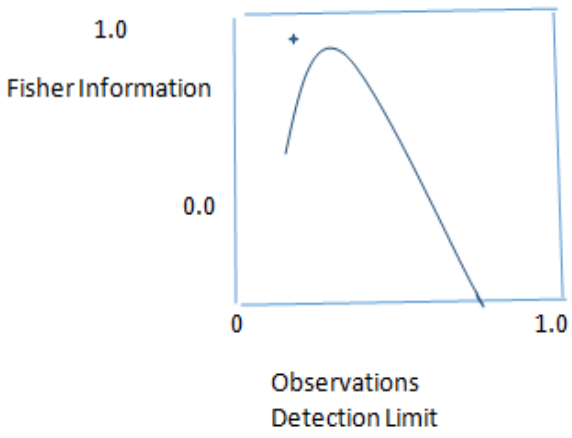
A sample is singly censored (e.g., singly left censored) if there is only one censoring level *t*. (Technically, left censored data are singly left censored only if all *n* uncensored observations are greater than or equal to *t*, and right-censored data are singly right censored only if all *n* uncensored observations are less than or equal to *t*. Otherwise, the data are considered to be multiply censored.)



Note Information contributed by a single observed value or a single value censored at a detection limit ranging from 0 to10. The population is assumed to be normal with mean 5 and variance 1.The standard error could have been calculated from the negative inverse of the Fisher information matrix given in Peng (2010).

Multiple censoring commonly occurs with environmental data because detection limits can change over time (e.g., because of analytical improvements), or detection limits can depend on the type of sample or the

[1]These two terms, truncated and censored are easily confused. A sample has been truncated if some observations that should have been there have been systematically excluded from the sample. For example, a sample of households with income under $1000.000 necessarily excludes all households with incomes over that level. It is not a random sample of all households. If the dependent variable is income, or something correlated with income, results using the truncated sample could potentially be misleading. On the other hand, a sample has been censored if no observations have been systematically excluded, but some of the information contained in them has been suppressed. Think of a 'censor' who made people's mail and blacks out certain parts of it. The recipients still get their mail but parts of it are unreadable.

[2] A sample is 'randomly' censored when both the number of censored observations and the censoring levels are random outcomes. This type of censoring commonly arises in medical time-to-event studies. A subject who moves away from the study area before the event of interest occurs has a randomly censored value. The outcome for a subject can be modeled as a pair of random variables, (x – c), where x is the random time to the event and C is the random time until the subject moves away. x is an observed value if x<c and right censored at c if x>c.

[3] It is also tempting to use a *t*- distribution instead of a normal distribution. This is not supported by statistical theory. The derivation of the t distribution is based on independent estimates of the mean and variance. When some observations are censored, the estimated mean and estimated variance are correlated. The magnitude of the correlation depends on the method used to estimate the parameters, the sample size and the number of censored observations. At best, using a t-distribution to calculate a confidence intervalis an ad-hoc method.

background matrix. The distinction between single and multiple censoring is mostly of historical interest. Some older statistical methods are specifically for singly censored samples. Most currently recommended methods can be used with either singly or multiply censored samples, but the implementation is often easier with one censoring level.

There has been a great deal of literature on the subject of estimating population parameters in the presence of censored data. See, for example, Statistical methods for dealing with censored data have a long history in the field of survival analysis and life testing ((Miller, (1981); EPA (2005). However a common simulation that has not been addressed adequately in the literature is when two samples are compared for equality of centrality. Two sample comparisons are frequently made in environmental studies. For example, it is common in all studies to compare site metal concentration to background concentration. In groundwater sampling or air monitoring, samples upstream of a suspected source are compared with sample downstream.

The purpose of the paper is to compare a number of techniques used in two sample hypothesis testing. The techniques considered are the Mann/-Whitney/ Wilcox on rank sum test, the Prentice test, the two-sample t-test using simple replacement of less – than- detectable data by one-half the detection limit and the ML test of a linear model. The methods are compared through simulations However, we begin with a brief review of methods for two sample comparisons in the presence of censored data.

II. Two- Sample Comparison

There are a number of techniques available for comparing two samples. They can be broken down into two categories: nonparametric and parametric methods. The nonparametric methods include linear rank statistics, quantile tests, survival analysis techniques and EM algorithm analogues[4] The parametric methods include t- test, survival analysis techniques discussed by Richards (2012), Singh and Mukhopadhyay(2011), Collet (2003). Rausand (2004) proposed a combination of ROS and likelihood ideas that they called \robust MLE" for log normal data. That is to use maximum likelihood to estimate the mean and standard deviation from log transformed values, impute log-scale values for each censored observation using the MLE's of the mean and standard deviation and exponentiate those imputed values to get imputations on the data scale. Finally, calculate standard deviation using the observed and ted values.ques and maximum likelihood methods.[5],[6]

Linear rank statistics from a general class of methods that involve tests based on linear combinations of the ranks of the two samples. The Mann-Whitney/ Wilcoxon rank sum is an example of a linear rank test statistic. The application of these in the presence of censored data is discussed in Peng (2010).

Quantiles tests involve specific applications of contingency table analysis. The median test is an example of a quantile test. They can be used to test for bimodality in concentration distribution than may correspond to site contamination. The tests are generally not affected by the presence of censored data. There are methods for estimating and constructing confidence intervals for population quantiles or percentiles. The general equation for a 100 (1 - α) confidence interval for a parameter $\hat{\mu}$ using a normal approximation $\hat{\mu}\, z_{i-\alpha}\, \hat{\sigma} < \hat{\mu} - + z_{i-\alpha}\, \hat{\sigma}$ and plugging in the estimated mean and standard error of the mean.

For a normal distribution, the estimated quantiles are functions of the estimated mean and standard deviation. For a lognormal distribution, they are functions of the estimated mean and standard deviation based on the log-transformed observations In the presence of censored observations, population percentiles are estimated using the same formulae used for uncensored data, but the mean and standard error are estimated using censored data formulae. For example, the maximum likelihood estimate of the *p*'th percentile of a log-normal distribution is where $\hat{\mu}$ and $\hat{\sigma}$ are the ML estimates of μ and σ on the log scale, and $z_p\, \hat{\sigma}$ is the *p*'th percentile of a standard normal distribution. The same plug-in approach could be used

[4] It was found that for data sets with less than 70% censored data, the best technique overall for determination of summary statistics was the nonparametric Kaplan–Meier technique, .ROS (robust Order Statistics) and the two substitution methods of assigning one half the detection limit value to censored data or assigning a random number between zero and the detection limit to censored data were adequate alternatives.. The technique of employing all instrument-generated data including numbers below the detection limits was found to be less adequate than the above techniques. At high degrees of censoring (greater than 70% censored data), no technique provided good estimates of summary statistics. Maximum likelihood techniques were found to be far inferior to all other treatments except substituting zero or the detection limit value to censored data.

[5] The mean, μ , ψ coefficient of variation, , and standard deviation σ_x μ of a lognormal distribution are functions of μ and σ ., By the invariance property of MLE's, the MLE's of μ , ψ , and σ are those functions of the MLE's of μ and σ . If some observations are censored, the MLE's of μ and σ are calculated by maximizing the log-likelihood function for censored data,

[6] Richards (2012) proposed a combination of ROS and likelihood ideas that they called \robust MLE" for log normal data. That is to use maximum likelihood to estimate the mean and standard deviation from log transformed values. Impute log-scale values for each censored observation using the MLE's of the mean and standard deviation and exponentiate those imputed values to get imputations on the data scale. Finally, calculate the mean and standard deviation using the observed and the imputed values.

with Kaplan-Meier (KM) or regression on order statistics (ROS) estimates of μ and σ but the estimated percentiles are no longer ML estimates. Very little statistical research has been done on constructing confidence bounds for percentiles when some observations are censored (Helsel (2005))...

Survival analysis method are characteristically devoted to handle censored data. However, in survival analysis, the data are typically censored on the right, whereas in environmental research, the data are usually censored on the left. Many of the survival analysis methods can be modified to handle left-censored data. Miller(!981) discusses the application of survival analysis methods to two-sample data.

The two sample situation can be modified by a one way design model in a regression setting. The test for differences between groups can either be implemented as a t- test of the appropriate model coefficient or as an F test of the mean square. In the presence of censored data, maximum likelihood techniques can be used to estimate model parameters. The EM algorithm provides an iteration solution to the maximum problem.[7] The EM algorithm is discussed and its application to linear models is considered by Aitken (1981) and Wolynetz (1979). The method is not truly the EM algorithm, nor does it provide a maximum likelihhod estimate. Non parametric analogues of the EM algorithm are discussed in Schneider and Weissfeld (1986). Tthere have been many studies of the performance of various estimators of the mean and standard deviation of data with below-detection limit observations. Helsel (2012,) summarizes 15 studies and mentions four more. Our interpretation of those studies leads to recommendations similar to Helsel's (2005):

- Do not use Kaplan-Meier for data with a single detection limit smaller than the smallest observed value. In this situation, Kaplan-Meier is substitution in disguise.
- For small-moderate amounts of censoring (e.g. < 50%), use Robust Order Statistics or Kaplan-Meier, if multiple censoring limits.
- For moderate-large amounts of censoring (e.g. 50% - 80%) and small sample sizes (e.g. < 50), use robust ML.
- For very large amounts of censoring (e.g. > 80%), don't try to estimate mean or standard deviation unless you are extremely sure of the appropriate distribution. Then use ML.

III. Tests Considered

Four methods are used in simulations to assess their ability to test two sample hypotheses in the presence of censored data. Two of test methods are nonparametric, the MWW and the Prentice test. The parametric methods considered are the two sample *t* test with simple replacement of LTD values by one half the detection limit and the Wolynetz interpretation of the BM algorithm for linear models.

Mann-Whitney Wilcoxon Test : The Mann-Whitney rank sum test also called Wilcoxon test, ranks all the data in both samples and then sums the ranks within each sample. The greater the difference between sums of the ranks, the more likely the two samples have different medians. This test will be denoted by MWW test for the remainder of our paper. The censored values are considered ties and assigned the average rank. MWW tests for equality of the medians between two groups. It assumes that the dispersion is the same in the two groups.

Prentice Test : We have the name Prentice Test to denote the linear rank test in which the ranks are transformed in normal scores. Under the null hypothesis of equal medians, this test does not depend upon the assumed distribution. However, when the null hypothesis is false and there is no censoring, this test is more powerful than the MWW when the two distributions are normal. As with the MWW test, the censored values are considered ties and assigned the average rank. The Prentice test also assumes homogeneous variance.

Two-Sample t test : The two-sample *t*- test is one of the most commonly used methods for testing the equality of means between two groups when there variances are equal.. In the presence of less-than-detectable data, the censored values are typically replaced with a value between 0 and the detection limit; commonly the replacement value is one-half the detection limit. This test will be denoted by DL/2.

Wolynetz's EM algorithm : The EM algorithm is an iterative method for finding a maximum likelihood estimate. Wolynetz (1979) develops the algorithm for the linear model. However the implementation is not truly the EM algorithm as it replaces individual censored values rather than sufficient statistics as is done in the EM algorithm Thus, it is not clear whether the method results in an MLE. The method involves first replacing the censored values with, say, the detection limit. Then the model parameters are estimated. With these estimates, replacement values for the censored data are recomputed using a maximum likelihood procedure. The

[7]Finding a maximum likelihood solution typically requires taking the derivatives of the likelihood function with respect to all the unknown values viz. the parameters and the latent variables — and simultaneously solving the resulting equations. In statistical models with latent variables, this usually is not possible. Instead, the result is typically a set of interlocking equations in which the solution to the parameters requires the values of the latent variables and vice versa, but substituting one set of equations into the other produces an unsolvable equation.

procedure iterates between the two steps to convergence.
The linear model used is

$$y_{ij} = \beta_0 + \beta_1 x_i + \theta_{ij}$$

where $i = 0, 1$, $j = 1 \ldots n$ $x_i = n$ and n_i is the number of observations in group i. The θ_{ij} are assumed to be independently and identically normally distributed with mean 0 and variance σ^2 To test the equality of group means the treatment effect parameter, β_i is tested to see if it is significantly different from zero. This test will be denoted by WEM.

IV. Simulation Methodology

The simulation used here was first used by Geweke (1989)and later used by Hajivassilion *et al* (1996) and Keaane (1993). It is sometimes called GHK simulator. The idea is to directly approximate the probability of a rectangle.. To simplify the presentation, we first consider the bi dimensional case. We have to estimate the probability of a rectangular domain

$p\ [\ v \in D\ ] = p\ (v \in\ [\ 1a_1, b_1\ ]\ x\ [\ a_2, b_2\ ]$ where $v \rightarrow N\ (0, \sum\ )$

We first transform the random term v to get a random vector with a standard normal distribution. The transformation may be chosen as a lower triangular matrix.

$v = A\mu$ where $A = \begin{bmatrix} a_{11} & 0 \\ a_{21} & a_{22} \end{bmatrix}$ where $\mu \rightarrow N(0, Id_2)$, $a_{11} > 0.\ a_{22} > 0$,

In terms of μ_1 , μ_2 the selection probability is

$P[v \in D] = p[a_1 < v_1 < b_1,\ a_1 < v_2 < b_2]$

$p[a_1 < a_{11}\ \mu_1 < b_1, a_2 <$

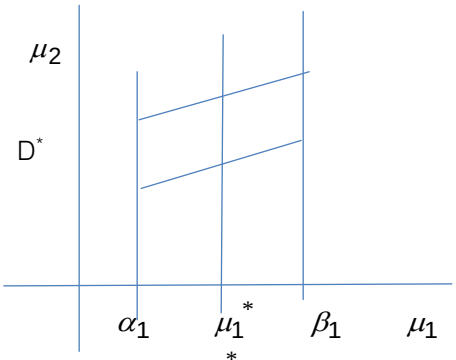
$a_2 \mu_1 + a_{22}\ \mu_2 < b_2)] =$

$$p\left[\frac{a_1}{a_{11}} < \mu_1 < \frac{b_1}{a_{11}}, \frac{a_2}{a_{22}} < \frac{a_{21}}{a_{22}}\ \mu_1 + \mu_2 < \frac{b_2}{a_{22}}\right],$$

$$= P[a_1 < \mu_1 < \beta_1, a_2 < \mu_2 + \gamma\ \mu_1 < \beta_2, \text{ say}$$

$$= p\ [\mu \in D^*]$$

In the μ space the domain D^* has the form shown in the following figure.



Domain D^*

Let us consider a drawing μ_1^* in the standard normal distribution restricted (or conditional) to $\alpha_1, \beta_1]$ and a drawing μ_2^* in the standard normal restricted to [$[\alpha_2\ \gamma\mu_1^*, \beta_2 - \gamma\mu^*_1\ ]$ it is easily seen that the distribution of (μ_1^*, μ_2^*) is not the bivariate standard normal distribution restricted to D^* . However an unbiased simulator of $p\ [v \in D]$ is

$$\hat{p}\ (\mu_1^*) = [\ \Psi\ (\beta_1) - \Psi\ (\alpha_1)][\Psi\ (\beta_2\ \gamma\ \mu_1^*) - \Psi\ (\alpha_2 - \gamma\ \mu_1^*)]$$

Indeed we have

$$E\ \hat{p}\ (\mu_1^*) = \int_{[\alpha_1\ \beta_1]} \hat{p}\ (\mu_1^*)\ \frac{\Psi\ (\mu_1^*)}{\psi\ (\beta_1) - \Psi(\alpha_1)}\ d\mu_1^*$$

$$= \int_{[\alpha_1, \beta_1]}, [\Psi(\beta_2\ \gamma\ \mu^*) - \Psi\ (\alpha_2 - \gamma\ \mu_1^*)]\Psi(\mu_1^*)\ d$$

$$\mu_1^*$$

$$= p\ [(\mu_1, \mu_2) \in D*$$

Note that μ_2^* has not been used but it has been introduced in order to prepare the general case.

A random sample of size 20 is selected from a standard normal distribution with $\mu = 0, \sigma = 1 = 0$ .The first ten pseudo numbers are assigned to the first group. The second ten their values shifted by addition of the mean of the second group, which took values 0, 0.05 and 1.0; these ten numbers are assigned to the second group. Hence the mean of the first group, μ_0 is always zero and the mean of the second group μ_1, could take the values 0, 0.5 or 1.0. The variance is constant within groups to meet the assumptions of the tests A set of simulations for each pair of means is created and analyzed at 20% censoring, with another set is simultaneously analyzed at 60 % censoring. The censoring points were determined from the joint density function of the two groups. For each censoring level, a single censoring point is calculated. Any observation falling below that point was censored. If the censoring resulted in either zero or one uncensored value in the entire data set, the sample is not analyzed. The samples were assumed to be from a log-normal distribution, with the values log-transformed to the normal distribution. This assumption has two purposes: First, it allows us to compute one-half the detection limit as DL – log 2, where DL is the detection limit on the normal scale. Second, for the parametric methods, which are testing means on the normal scale, the analogy is to testing medians on the log-normal scale, as the nonparametric methods would do.

The null hypothesis is that of equal medians, the alternative hypothesis is that the second group median is larger than the first. Hence, all tests are against a one-sided alternative. All tests are made with $\alpha = 0.05$. This one-sided alternative is used to mimic the common practice GHK in monitoring of comparing contaminated areas to background. In these circumstances, it is generally, not of interest to test if the concentration in contaminated areas is less than background.

V. Results & Renarks

Table 1 summarizes the results of the simulation. When $\mu_1 = 0$, the null hypothesis is true and the power is Type 1 error. As can be seen from the Table, only the MWW test maintain the α level at 0.05 for both censoring levels. The DL/2 test nearly maintains the α level for both censoring levels. The WEM test does not maintain the α level at 20 % censoring, the Prentice test is too small at both censoring levels. When μ_1 is greater than zero, the tests with highest power typically are the tests with inflated Type 1 errorrates. The power of the MWW tests is nearly as high as the most powerful tests under most situations. The DL/2method overall does have higher power than the MWW test, yet this power is partially gained by sacrificing the Type 1 error rate at 60 % censoring.

Table 1 shows the bias and the mean squared error (MSE) of the estimates of the model) parameters using the DL/2 and WEM methods. In general, the WEM method has less biased estimates of the parameters, but larger MSE than the DL/2 method. All the methods discussed here .can handle the case when there are multiple detection .For those who prefer confidence intervals to hypothesis testing, the DL/2 and WEM methods can be used, with coverage results that are expected to be comparable to the power results presented here.

If the sample size is sufficiently large for the sampling distribution of the estimated mean to be close to a normal distribution, one can construct an appropriate confidence interval. Peng (2010) proposed using the bootstrap sampling distribution to assess whether the sample size is sufficiently large.

If the likelihood function is parameterized in terms of the arithmetic mean, the standard error of the estimated mean can be obtained from the negative inverse of the Hessian matrix. However, to obtain an appropriate confidence interval, the sample size needs to be sufficiently large that the distribution of the estimated arithmetic mean is sufficiently close to a normal distribution. If the sample size is large, the difference between quantiles of the normal distribution and quantiles of t distributions is small, so the choice of degrees of freedom is less important. This normal approximation is not recommended when the sample size is small, e.g. n =10 or 20, because the empirical coverage of confidence intervals constructed using will be much smaller than nominal Peng (2010) developed a delta-method approximation to the variance of the arithmetic mean, which can be combined with constructing a confidence interval.

Again, when the sample size is small, e.g. n =10 or 20, the empirical coverage of delta-method confidence Interval is much smaller than nominal (Singh *et al*(2002) and then this method is not recommended.

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Table 1 : Summary of the Two - sample Comparison Results

The true mean of the first group μ_0 is zero, the true mean of the second group, μ_1 is shown in the left- most column

					$\beta_0 (= \mu_0)$			$\beta_1 (= \mu_1 - \mu_0)$		
μ_1	LTD	Method	N	POWER (SE)	Bias	SE	MSE	Bias	SE	MSE
0.0	20	DL/2	4000	0.0467 (0.0020)	-0.011	.0001	.0102	-0051	.0031	.2033
		WEM	4000	0.0713((0.0044)	.0041	.0002	.0102	0031	.0034	.0100.
		MWW	3800	0.0601 (0.0020)						
		Prentice	3800	0.0503 (0 .0101)						
0.0	50	DL/2	3980	0.0500 (0.0000)	0812	.0024	.0831	.0041	.0022	.1988
		WEM	3981	0.2500 (0.0011)	-0231	.0084	.2351	-0062	.0074	.3233
		MWW	3800	0.0601 (0.0001)						
		Prentice	3800	0.0402 (0.0101)						
		-								
0.5	20	DL/2	4000	0.2441(0.0031)	-0731	.0003	.1003	-0044	.0056	.3144
		WEM	4000	0.3144(0.0051)	-0313	.0013	.0001	0031	.0061	.4227
		MWW	1000	0.4311(0.0231)						
		Prentice	2000	0.4420 (0.0211)						
0.5	50	DL/2	3888	0.2531(0.3023)	.2141	.0001	.0820	-1320	.0040	.2891.
		WEM	3780	0.2140(0.3421)	.0361	.0062	.2873	.0454	.0071	.4360
		MWW	1000	0.3400(0.2300)						
		Prentice	1000	0.1800(0.2300)						

1.0	20	DL/2	3900	0.6421 (0.0071)	-.0031	.0052	.2011	.0099	.0044	.2053
		WEM	3820	0.72330(0.0031).	.0043	.0051	.2345	.0123	.0051	.2100
		MWW	1000	0.66332(0.0070)						
		Prentice	1000	0.29451(0.0231)						
0.5	50	DL/2	3888	0.2531(0.3023)	.2141	.0001	.0820	-1320	.0040	.2891.
		WEM	3780	0.2140(0.3421)	.0361	.0062	.2873	.0454	.0071	.4360
		MWW	1000	0.3400(0.2300)						
		Prentice	1000	0.1800(0.2300)						
1.0	20	DL/2	3900	0.6421 (0.0071)	-.0031	.0052	.2011	.0099	.0044	.2053
		WEM	3820	0.72330(0.0031).	.0043	.0051	.2345	.0123	.0051	.2100
		MWW	1000	0.66332(0.0070)						
		Prentice	1000	0.29451(0.0231)						

Table 1 continued . . .

					σ^2		
μ_1	LTD	Method	N	POWER (SE)	Bias	SE	MSE
0.0	20	DL/2	4000	0.0467 (0.0020)	.0421	.0032	.0871
		WEM	4000	0.0713((0.0044) .	-.0791	.0062	.1345
		MWW	3800	0.0601 (0.0020)			
		Prentice	3800	0.0503 (0.0101)			
0.0	50	DL/2	3980	0.0500 (0.0000)	-.4312	.0098	.1020
		WEM	3981	0.2500 (0.0011)	-.0871	.0098	.4131
		MWW	3800	0.0601 (0.0001)			
		Prentice	3800	0.0402 (0.0101)			
0.5	20	DL/2	4000	0.2441(0.0031)	.1132	.0053	.0921
		WEM	4000	0.3144(0.0051)	-0971	.0098	.3414
		MWW	1000	0.4311(0.0231)			
		Prentice	2000	0.4420(0.0211)			
0.5	50	DL/2	3888	0.2531(0.3023)	-.4811	.0082	.3213
		WEM	3780	0.2140(0.3421)	-0821	.0076	.4312
		MWW	1000	0.3400(0.2300)			
		Prentice	1000	0.1800(0.2300)			
1.0	20	DL? 2	3888	0.7134(0.0073)	-.0091	.0034	.0782
		WEM	4000	0.7532(0.0051)	-0934	.0061	.1456
		MWW	1000	0.7612(0.0312)			
		Prentice	2000	0.56810(.0250)			
1.0	50	DL/2	3890	0.6543(0.0081)	-.4617	.0060	.7131
		WEM	4000	0.6514(0.0077)	-.6878	.0034	...8123
		MWW	1000	0.7413(0.0054)			
		Prentice	1000	0.5137(0.0134)			

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Caracterizando a un Grupo De Empresas Paraguayas a Través De Sus Proyectos De Innovación

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Abstract- El objetivo del presente trabajo fue el de "caracterizan a un grupo de empresas paraguayas en el ámbito del Centro de Gestión Tecnológica e Innovación (CEGETEI) y el CEDIAL respecto a la demanda de proyectos de innovación".

Para ello se realizaron encuestas a una muestra intencionada de 70 empresas, seleccionadas con en base al criterio de participación en ferias internacionales, cuya participación fue fomentada a través del financiamiento del programa AL INVEST (*América Latina Investment*), con financiamiento de la Unión Europea.

Keywords: innovación; proyectos de innovación; pequeñas y medianas empresas.

GJMBR - G Classification : JEL Code : O31

Caracterizando a un Grupo De Empresas Paraguayas a Través De Sus Proyectos De Innovación

Dr. Sergio Duarte Masi[1]

Resumen- El objetivo del presente trabajo fue el de "caracterizan a un grupo de empresas paraguayas en el ámbito del Centro de Gestión Tecnológica e Innovación (CEGETEI) y el CEDIAL respecto a la demanda de proyectos de innovación".

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El resultado encontrado revela un número significativo de proyectos e ideas de innovación, más volcadas hacia el sector de los agronegocios, con un mérito innovador mayormente de nivel medio, y centrados en el desarrollo de diseño e investigación y desarrollo, y que posteriormente nutren de información para el diseño de las herramientas que impulsan la innovación en el ámbito del Consejo Nacional de Ciencia y Tecnología.

Palabras claves: innovación; proyectos de innovación; pequeñas y medianas empresas.

I. Antecedentes

La innovación, en OCDE (1997) se entiende como "la introducción de una novedad dentro del proceso productivo, cualquiera sea su magnitud y origen, para la consecución más eficiente de objetivos económicos." Otros autores la definen como "un proceso que consiste en conjugar oportunidades técnicas con necesidades, integrando un paquete tecnológico que tiene por objetivo introducir o modificar productos o procesos en el sector productivo, con su consecuente comercialización".

Si se tiene como objetivo desarrollar y hacer crecer un negocio existente o nuevo, la innovación por sí sola no basta, si no se crean las condiciones de entorno adecuadas, tales como recursos financieros suficientes y una relación estrecha entre ciencia y tecnología dirigida a la introducción de nuevos productos o servicios en el mercado; por lo tanto, el cuerpo de conocimiento, se estará formando con una serie de modelos que cubren las partes fundamentales de la generación y crecimiento de negocios. Por eso en este trabajo, se aborda la redefinición y expansión de los modelos existentes.

En la actualidad, una adecuada gestión de la tecnología constituye una de las claves del éxito de las empresas, según Battini (1994). La tecnología que utiliza una empresa puede ser generada internamente, mediante la actividad investigadora, o bien se adquiere en el exterior. En cualquier caso, si la empresa quiere conseguir y mantener una ventaja de carácter tecnológico que sustente su competitividad y su posición de dominio en el mercado, debe favorecer la investigación y el desarrollo propio; pues, la adquisición de tecnología ofertada en el mercado se encuentra al alcance de cualquier empresa competidora, y por tanto, no suele proporcionar a la empresa ventajas adicionales.

La complejidad y la rapidez de los cambios tecnológicos hacen que sea materialmente imposible que una empresa pueda generar por si misma todas las tecnologías que necesita, y a la vez resulta extremadamente difícil la asimilación de tecnologías genéricas sin una capacidad de investigación y desarrollo propios, en Freeman (1982).

La capacidad de desarrollo de una empresa depende de su adaptación con rapidez a los cambios del entorno, en especial del entorno tecnológico, e incluso para provocar modificaciones que le favorezcan. La innovación tecnológica puede ser de producto o de proceso. La de producto puede considerarse como la capacidad de mejora del propio producto o el desarrollo de nuevos productos mediante la incorporación de los nuevos desarrollos tecnológicos que le sean de aplicación o la adaptación tecnológica de los procesos existentes.

Esta mejora del producto puede ser directa o indirecta:

- Directa, si añade nuevas cualidades funcionales al producto para hacerlo más útil.
- Indirecta, si está relacionada con la reducción del costo del producto a través de mejoras en los procesos u otras actividades empresariales con el fin de hacerlos más eficientes.

La innovación tecnológica de proceso consiste en la introducción de nuevos procesos de producción o la modificación de los existentes mediante la incorporación de nuevas tecnologías. Su objetivo

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fundamental es la reducción de costos, pues, además de tener una repercusión específica en las características de los productos, constituye una respuesta de la empresa a la creciente presión competitiva de los mercados.

El proceso de innovación tecnológica se define como un conjunto de etapas que conducen al lanzamiento con éxito en el mercado de nuevos productos manufacturados, o a la utilización comercial de nuevos procesos técnicos. De acuerdo con esta definición, el proceso de innovación constituye la fuerza motriz que impulsa a las empresas hacia objetivos a largo plazo, conduciendo a nivel macroeconómico a la aparición de nuevos sectores de actividad económica. De una forma esquemática la innovación se traduce en los siguientes hechos:

a) Renovación y ampliación de la gama de productos y servicios.
b) Renovación y ampliación de los procesos productivos.
c) Cambios en la organización y en la gestión.

El proceso implica la transformación de ideas en productos o procesos técnicos nuevos o mejorados en acciones de desarrollo, fabricación y comercialización, lo que incluye la orientación de las innovaciones hacia objetivos específicos.

La innovación tecnológica es, por tanto, un proceso que abarca diversas fases orientadas a introducir en el mercado los resultados de la investigación. Cada fase tiene una duración temporal y un consumo de recursos propios, no siendo necesario su desarrollo secuencial. Pues, deben existir realimentaciones desde las fases posteriores hacia las fases anteriores, originando flujos de información a lo largo del tiempo entre las diferentes actividades.

II. Metodología

En la construcción de las herramientas de fomento para la gestión de la innovación en Pymes en Paraguay – que hasta la actualidad de utilizan-, se consideró como uno de los insumos básicos, el análisis exploratorio de la demanda de proyectos de innovación en una serie de empresas reales, utilizando entrevistas y guías de proyectos aportadas por el Consejo Nacional de Ciencia y Tecnología, realizada entre 2006 y 2008.

Para la selección de la muestra exploratoria de 70 empresas, se han considerado las PYMES exportadoras, o que participan de ferias internacionales, entre otros puntos, pues podrían ser aquellas que tengan alguna preocupación con la innovación o que mismo, tengan proyectos de innovación.

La institución CEDIAL – Centro de Cooperación Empresarial y Desarrollo Industrial, quien ha mas de 15 años viene asesorando las empresas paraguayas en el proceso de internacionalización, es la que ha proveído de dicho directorio de empresas exportadoras. Para esta actividad se recurrió a una consultora proveída por el Banco Interamericano de Desarrollo (BID), en el seno del montaje de una operación para financiar la innovación en el Paraguay, la cual arrancaba entre 2007 y 2008 y que estaría a cargo del Consejo Nacional de Ciencia y Tecnología..

Para inducir a las empresas a trabajar en la preparación de perfiles, fue necesario explicarles los alcances del relevamiento y en especial la elaboración de una futura línea de apoyo a proyectos de innovación a partir de los hallazgos. Se destaca el espíritu de colaboración muy positivo por parte de dichas empresas.

Todos los datos conseguidos con las empresas se volcaron en tablas para facilidad de presentación y lectura y para análisis de ciertos agregados.

a) Trabajo de campo

Se llevaron a cabo entrevistas a ejecutivos de PYMES Exportadoras paraguayas durante 2006 y 2008. Un total de 38 perfiles de proyectos fueron logrados, de un total de 71 empresas encuestadas. Muchas de ellas no lograron presentar proyectos, por la ausencia de capacidad en la elaboración del mismo y la carencia de gestores tecnológicos.

Análisis y evaluación de los perfiles de proyectos. La lectura inicial de todos los perfiles recolectados y su análisis y discusión de conjunto, permitieron diseñar formatos apropiados para llevar a cabo la tarea del "equipo de evaluación".

Análisis de resultados basado en características de la demanda. El "equipo evaluador" desagregó la información disponible en la siguiente información presentada en tablas:

Perfiles de proyectos de innovación en empresas paraguayas:

Tipos de datos	Características
Sobre matriz de proyectos:	Sector, tipo de innovación, actividad innovadora, Grupo ejecutor, meses de duración del proyecto, Monto solicitado, Impactos, Comentarios para formulación del proyecto.
Sobre empresas	Empresa, sector, gerente, dirección, teléfonos, direcciones electrónicas y sitios web, número de empleados, tamaño, productos, ventas, aspectos gerenciales.
Sobre proyectos	Empresa, nombre del proyecto, objetivo, tipo de innovación, actividad innovadora, articulación con el Sistema Nacional de Innovación, metas de mercado, indicadores de resultados, impactos.
Sobre Ejecutor	Grupo ejecutor, personal contratado por la empresa (Phd, Ms, profesional, técnico, asesores externos nacionales, internacionales)

Sobre Financiamiento	Empresa, proyecto, modalidad de financiamiento, monto solicitado, monto contrapartida, otras fuentes, monto total. Rubros: personal, laboratorio y calidad, equipo – planta piloto, viajes, insumos, asistencia técnica, propiedad intelectual, capacitación, otros.

III. Resultados

a) La demanda por sectores de los proyectos

Al realizar un análisis de la demanda tecnológica, según el monto y número de proyectos identificados, se observan los siguientes aspectos (Ver gráfica Nº 1 y Nº 2): La cadena agroindustrial y de alimentos presenta el mayor número de proyectos (21/36) y el monto más alto solicitado (USD 1,340.000), correspondiente al 64% del monto total solicitado para los proyectos. En segundo lugar el sector de desarrollo de software (9 proyectos) por un valor de (USD 385.000).

Gráfico Nº 1 – Montos aproximados de proyectos de innovación por sectores

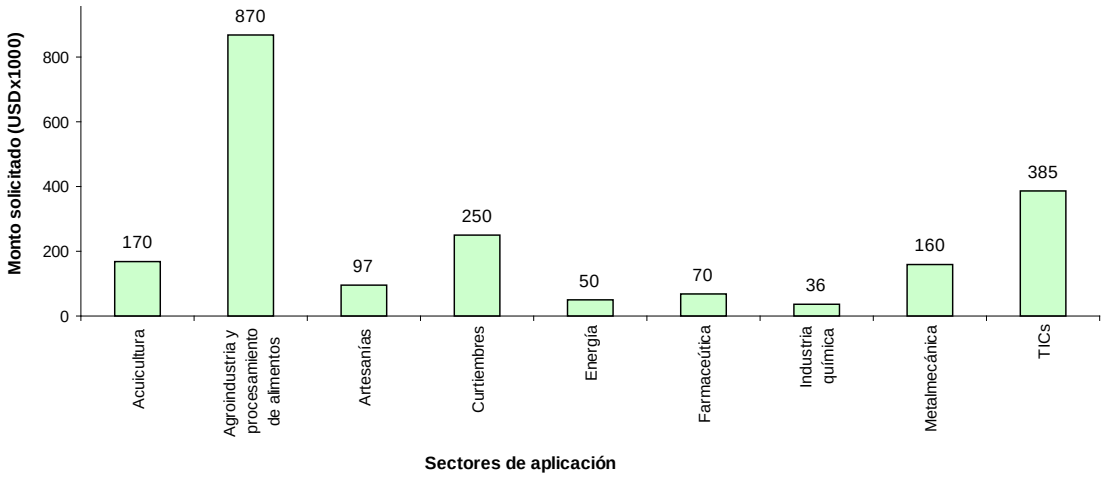
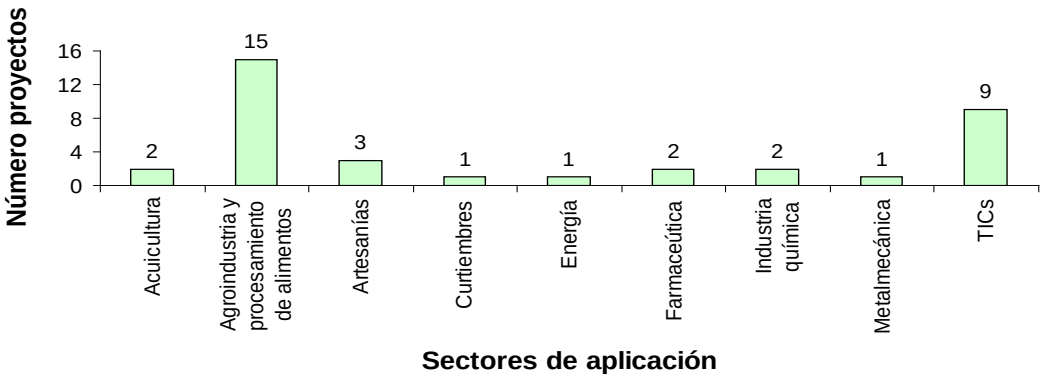


Gráfico Nº 2 – Cantidad de proyectos de innovación por sectores

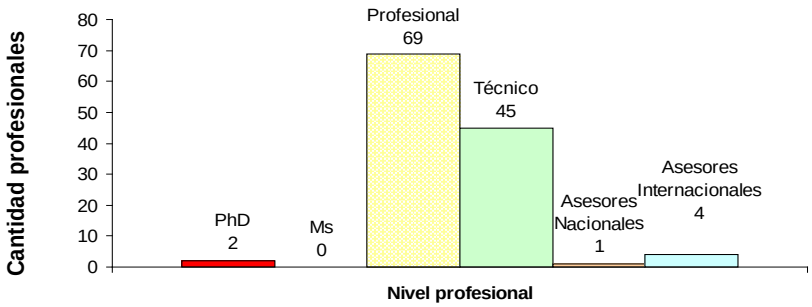


b) La demanda de personal profesional y técnico en los proyectos

Los 36 proyectos identificados vincularán 116 personas formadas en los siguientes niveles: 2 PhD; 69 Profesionales y 45 Técnicos.

Adicionalmente, se contempla la subcontratación de proyectos con empresas y entidades especializadas del orden nacional e internacional. Este trabajo demandará consultores y asesores especializados. Cabe observar la alta participación de técnicos y tecnólogos para el desarrollo de los proyectos y de operarios para ejecución de tareas de operación y mantenimiento. Sería lógico esperar que las empresas pudieran reforzar sus capacidades científicas, pues presentan muy poco personal con postgrado, mediante la vinculación con grupos de investigación de las universidades y otras instituciones de investigación.

Gráfico Nº 3 – Cantidad de profesionales según el nivel académicos en las empresas encuestadas

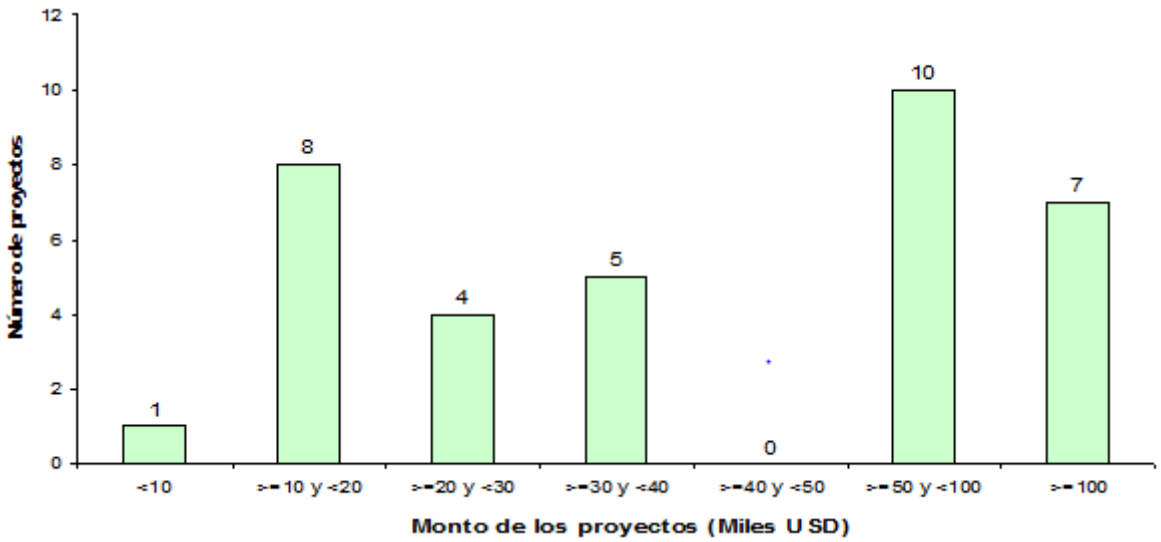


c) La demanda de recursos financieros según los montos de los proyectos

El mayor número de proyectos a realizar está en el rango de montos entre 50.000 a 100000 USD, correspondiente a 10 proyectos. En segundo lugar está el rango de montos entre 10.000 y 20.000 mil USD correspondiente a 8 proyectos. En proyectos que sobrepasan los 100,000 USD se identifican 7 (ver Gráfico Nº 4).

Una apreciación general en cuanto al monto y la duración de los proyectos es la necesidad de un mejor dimensionamiento de los mismos, en la fase de formulación de las propuestas. En algunos casos los recursos previstos son relativamente pequeños y los plazos muy cortos. El 36% de los proyectos tiene un plazo de ejecución por debajo de 6 meses, el 36% de los proyectos entre 6 y 12 meses y el 28% mayor a un año. En opinión del "equipo de evaluación", el monto de la demanda para los proyectos de innovación, podría casi duplicarse, al rediseñar los presupuestos de acuerdo con el alcance y plazo de los proyectos. En una formulación futura de los proyectos, deberían revisarse especialmente los proyectos con menos de seis meses de duración, pues podría tratarse del montaje de equipos y plantas piloto sin los correspondientes procesos de experimentación, transferencia de tecnología y capacitación de la gente.

Gráfico Nº 4 – Cantidad de proyectos por rango de montos solicitados



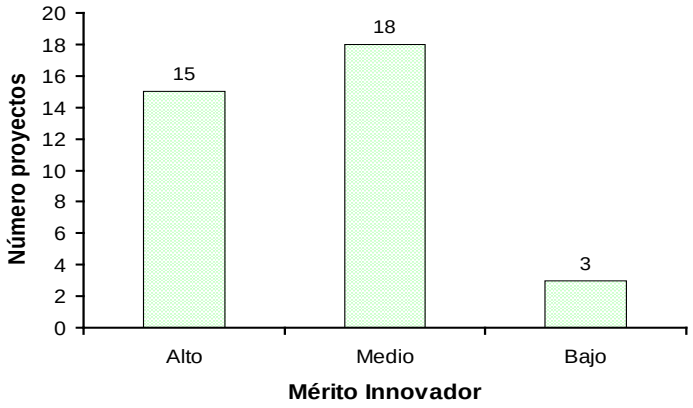
d) La demanda de los proyectos según el mérito innovador

La calificación del mérito innovador de los proyectos se considera fundamental para establecer categorías de incentivos y ordenar los proyectos de acuerdo con las prioridades para asignación de los recursos. Un sistema sencillo para calificar el mérito innovador de los proyectos se basa en la determinación de factores asociados a la estrategia y esfuerzo empresarial para desarrollar tecnología y en el impacto económico y social del proyecto. Además se califica el aporte del proyecto al estado del arte de la tecnología, con el concurso de una red de evaluadores del sistema nacional de innovación.

En principio se adoptaron los siguientes criterios para clasificar el mérito innovador de los proyectos:

* *Alto mérito innovador:* Proyectos de I&D, realizados dentro de una estrategia explicita de innovación y que contribuyen a las exportaciones.
* *Mérito medio:* Proyectos de gestión de calidad y de automatización industrial, realizados con base en tecnologías disponibles y conocidas.
* *Bajo mérito de innovación:* Proyectos de inversión y operación de maquinaria o de instalaciones industriales sin contemplar actividades de nuevos productos o procesos. También se clasifican en esta categoría proyectos que no tienen un aporte definido a la innovación tecnológica.

Gráfico Nº 5 – Cantidad de proyectos por mérito innovador



e) La demanda de ciertos rubros en los proyectos

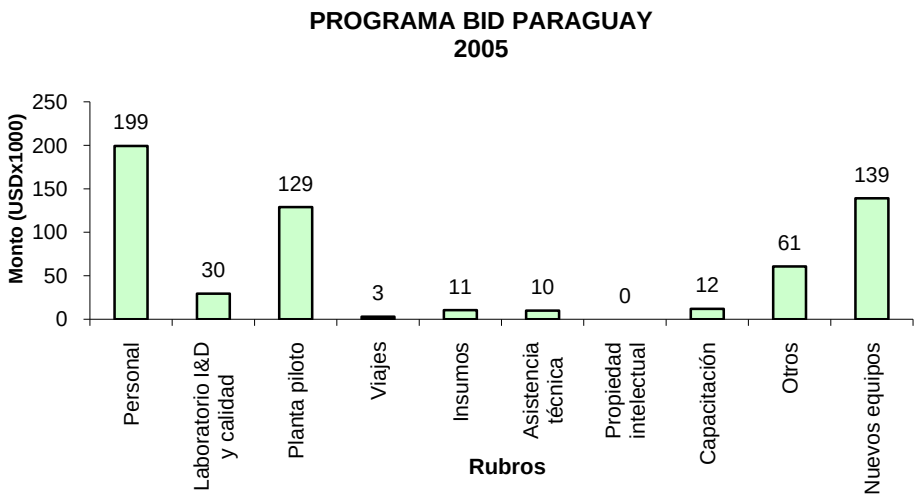
El rubro predominante es el de personal, seguido por el de plantas piloto para el desarrollo de nuevos productos. Es bastante normal que los mayores gastos se hagan en personal en este tipo de proyectos. Es muy baja la inversión en el rubro de capacitación, actividad que es esencial para la formación del grupo de investigación y la ejecución exitosa de los proyectos. La inversión en el rubro de propiedad intelectual es prácticamente inexistente, pese a la importancia de proteger los desarrollos tecnológicos (Ver Gráfico Nº 6).

El rubro de "nuevos equipos" se refiere a la compra de equipamiento para producción en serie o maquinaria. Como estos costos son elevados, unas pocas empresas elevan de modo considerable el rubro. En realidad, acá no se trata de compra rutinaria de máquinas sino de poner a operar equipos en el marco de un proceso de cambio técnico de la empresa.

Pese a la tendencia observada en las empresas entrevistadas – aún de aquellas que no presentaron perfiles – a adquirir tecnología mediante viajes al exterior, es paradójica también la poca demanda por este rubro en esta muestra. Este tipo de situaciones se podrá esclarecer con las empresas interesadas en un proceso de formulación de proyectos más detenido y cuidadoso.

En la fase de formulación de las propuestas se requiere desagregar los presupuestos por rubros, pues un buen número de empresas no los especificó. Los datos actuales, por consiguiente, deben manejarse acá con cierta prudencia, pues se refieren a las empresas que detallaron los rubros.

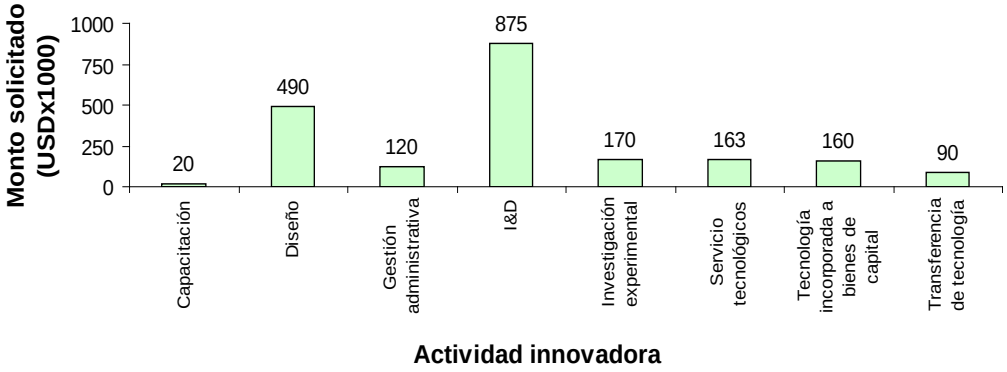
Gráfico Nº 6 – Desagregación por rubros solicitados en los proyectos de innovación



f) La demanda de actividades innovadoras

En la muestra existe un número razonable de proyectos de innovación basados en I&D (28%), los cuales representan el mayor monto de inversión en el total de los recursos asignados (USD 875,000 que representan el 42%). Este es un punto a favor de la muestra, pues son los proyectos más exigentes y posiblemente los que contribuyan a crear capacidades internas más perdurables de I&D en las empresas. Ciertos estudiosos del tema, desde la perspectiva evolutiva y del aprendizaje, como Morris Teubal, no vacilan en señalar que uno de los objetivos de la política de innovación en sus fases iniciales es apoyar el desarrollo de "actividades tecnológicas socialmente deseables", una de ellas y quizás la más importante, la creación de capacidades de I&D en las empresas nacionales (ver Gráfico Nº 7).

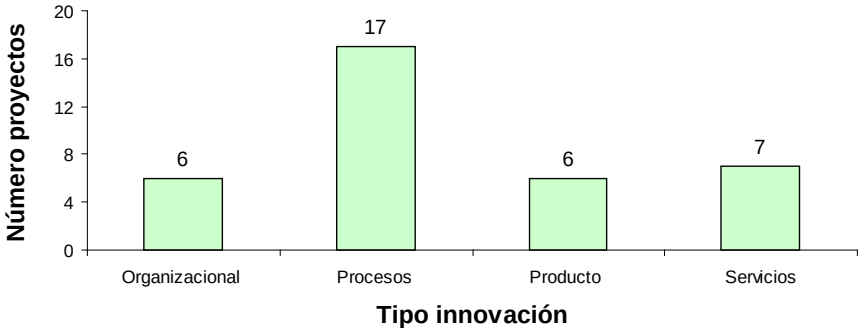
Gráfico Nº 7 – Demanda de actividades innovadoras y por montos solicitados



g) La demanda por tipos de innovación

El tipo de innovación en la mayoría de los perfiles de proyectos corresponde innovación de procesos (47%), lo cual es peculiar en las primeras fases del desarrollo de proyectos de innovación. Está de acuerdo con los patrones observados en Latinoamérica. Hay un grupo significativo de proyectos en servicios, especialmente en el área de TIC's, los cuales son importantes para crear ventajas competitivas, basadas en tecnologías disponibles. En innovaciones de producto se tiene un menor número de proyectos. Posiblemente estos proyectos exijan más esfuerzos en su concepción y formulación porque son de más riesgo. Se identificaron también innovaciones organizacionales, correspondientes a los programas de gestión de calidad HACCP e ISO 9000 y la creación de nuevos centros de diseño, certificación y servicios tecnológicos (Ver Gráfico Nº 7).

Gráfico Nº 8 – Cantidad de proyectos por tipos de innovación



IV. Conclusiones

Buena parte de las empresas respondieron con especial interés a la invitación hecha por CONACYT a presentar sus iniciativas de innovación. La demanda de recursos financieros pasa de los US$ 2 millones y con base en estimativos relativamente tímidos de las propias empresas, los cuales, de ser reformulados con más detalle, podrían aumentar la cifra..

Las empresas consultadas estarían dispuestas en aportar contrapartidas en el marco de la co–financiación, por tanto existen potenciales Pymes que podrían ser *quick winners* y que podrían ir produciendo efectos demostrativos en el entorno empresarial paraguayo.

a) *Implicaciones de las demandas específicas identificadas en los perfiles de proyectos.*

- Los proyectos demandarán diversos grados de mérito innovador. Podría penarse en un estímulo diferencial a proyectos más innovadores y aquellos que cooperen con otras entidades del sistema. Al menos 15 proyectos poseen mérito innovador mayor y podrían ser reconocidos mediante un incentivo mayor.
- El sector agroindustrial y el de software son los de mayor demanda y esto hay que tenerlo en cuenta. Además, hay varios proyectos de software que se cruzan con los de agroindustria.
- La demanda de recursos humanos estriba mucho más en el nivel profesional que en los de postgrados. Llama la atención la demanda de Técnicos que esperan involucrar en los desarrollos innovadores. Conviene pensar en el apoyo de Grupos de Investigación de las universidades en ciertos campos, pues el nivel científico podrá aumentar la capacidad de absorción de nuevo y más avanzado conocimiento.
- Debe anotarse que una formulación más cuidadosa haría elevar los presupuestos de proyectos, en especial de los más reducidos, pues parecen haberse subestimado el tiempo y ciertos rubros. O sea, es prioritario dimensionar mejor estos aspectos en una futura fase de formulación propiamente dicha.
- El rubro de personal es el más elevado, cosa que es natural en es este tipo de proyectos. Pero notamos que hay rubros bastante bajos como capacitación que convendrá tener en cuenta posteriormente en las fases de formulación de los proyectos, pues podrían hacerlos vulnerables. Asimismo, el uso de rubros como el de propiedad intelectual parecen no estar en el horizonte de las empresas consultadas.
- Aunque es natural la demanda de un volumen relativo mayor de proyectos de desarrollo de procesos, conviene no obstante en las fases de capacitación en gestión tecnológica hacer una buena pedagogía sobre los varios tipos de innovación, considerando de modo especial la innovación de productos.

b) *Implicaciones para la futura formulación y capacitación en gestión de proyectos de innovación*

- Deben tenerse en cuenta varios comentarios que se hicieron a los perfiles para mejorar su formulación y sobre todo la capacitación de Oficiales de Proyectos y de ejecutivos de empresas.
- La formulación de proyectos y en entrenamiento en gestión tecnológica deben ir de la mano. La capacitación de los oficiales de proyecto y de las empresas es necesaria.
- La capacitación debe incluir "entrenamiento en el trabajo", ejercicios reales con empresas. El hecho de conseguir información adicional de la empresa será parte de un ejercicio útil.
- La sensibilización a las empresas sobre cual es la naturaleza de la innovación, la filosofía de la línea financiera y como opera en cosas más precisas como el manejo de rubros, los tiempos de los proyectos, la búsqueda de información, son temas prioritarios. Un punto de partida en este proceso de formación es la elaboración de perfiles en las empresas mismas.
- Es conveniente considerar el entrenamiento en propiedad intelectual. Aunque se trata de pocos casos, es necesario explicar como se protege el conocimiento y como es el manejo de este rubro en los proyectos.

Para finalizar

1. Las empresas privadas contactadas están dispuestas a emprender procesos de innovación tecnológica y a llevar a cabo proyectos de innovación o mejoramiento de productos y procesos, incluyendo la adopción de tecnologías limpias. Son conscientes de los posibles impactos que pueden lograr. .
2. Las empresas aceptarían de buen grado la financiación de proyectos de innovación para mejorar la competitividad, productividad y rentabilidad y ven con buenos ojos la noción del cofinanciación. Los estímulos pueden mover a las empresas hacia los proyectos, como el financiamiento no reembolsable hasta por 65% del monto del proyecto, y estarían dispuestas a aportar su parte.
3. Sin embargo, para motivar la realización de proyectos y, más aún, la asociación con otras entidades, no bastan los estímulos económicos, pues se requiere inducir motivación y apoyo técnico durante la etapa de formulación de los
4. Es bastante factible que las empresas lleven a cabo Investigación y Desarrollo de nuevos productos y/o procesos, o su mejoramiento con respecto a lo que tienen en la actualidad, para satisfacer necesidades y oportunidades del Mercado.
5. Con su propio personal pueden realizar sus proyectos, pero ven posible la asociación con instituciones de investigaciones de dentro y de fuera del país, subcontratando servicios con empresas o consultores especializados. Esto hay que reforzarlo durante la capacitación en gestión tecnológica y a la hora de iniciar procesos de formulación de perfiles y de proyectos.

6. La formación y atracción de recursos humanos dedicados a la generación de nuevos conocimientos, el desarrollo tecnológico y la innovación. Hoy por hoy muy pocos postgraduados en proyectos de empresas.
7. Es factible tratar de fortalecer el Sistema Nacional de Innovación Paraguayo (SNIP) por medio de la realización de proyectos de innovación que creen nexos y cooperación entre los varios actores del sistema, y de modo especial entre empresas y universidades. De nuevo, la asistencia en la formulación de las propuestas se convierte en un factor crítico y los incentivos a la asociación, sin duda, pueden ser una de las claves que el CONACYT deberá ofrecer.

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Nigerian Agricultural Cooperatives and Rural Development in Ivo L.G .A., Ebonyi State, Nigeria

By Nnadozie, A.K.O, Oyediran, A.G, Njouku I.A & Okoli K.C

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Abstract- The study showed that multipurpose, production, marketing, thrift and savings agricultural cooperatives societies exist in Ivo Local Government, Ebonyi State, Nigeria. These cooperative source their finance from monthly dues, levies and fines and others. The cooperatives have greatly contributed to agricultural development in Ivo Local Government Area by provision of cash to small-holder farmers, processing, marketing and group management. However, there exist certain problems confronting the agricultural cooperatives from their expected roles and they include inadequate staff or personnel, low income and poor government interventions. Based on the findings, the researchers concluded that the agricultural cooperative societies in Ivo Local Government Area, Ebonyi State, Nigeria have contributed to rural and agricultural development despite the identified constraints.

Keywords: agricultural cooperatives, farm financing, group dynamics, rural development and wealth creation.

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Abstract- The study showed that multipurpose, production, marketing, thrift and savings agricultural cooperatives societies exist in Ivo Local Government, Ebonyi State, Nigeria. These cooperative source their finance from monthly dues, levies and fines and others. The cooperatives have greatly contributed to agricultural development in Ivo Local Government Area by provision of cash to small-holder farmers, processing, marketing and group management. However, there exist certain problems confronting the agricultural cooperatives from their expected roles and they include inadequate staff or personnel, low income and poor government interventions. Based on the findings, the researchers concluded that the agricultural cooperative societies in Ivo Local Government Area, Ebonyi State, Nigeria have contributed to rural and agricultural development despite the identified constraints.

The researchers recommended that both the three tiers of governments and non- governmental organizations should assist the cooperative societies to get funds and training of personnel to manage their cooperatives and contribute to rural and agricultural development in Ivo LGA specifically and Nigeria in general.

Keywords: agricultural cooperatives, farm financing, group dynamics, rural development and wealth creation.

I. Introduction

Agricultural cooperative in the view of Ijere (1998) can be seen as cooperative whose members are agricultural producers or are involved in related activities. They can be single or multiple purpose cooperatives, agricultural input supply cooperatives, marketing cooperatives, agricultural credit cooperatives, machinery cooperatives, land acquisition cooperatives, livestock producers cooperatives, fishermen cooperative society, oil mill cooperatives, rice mill cooperatives, etc. Berko (2001) stated that these cooperatives take various organizational forms as cooperative business enterprises, producers cooperatives, auxiliary or service cooperatives.

Empirical evidence has shown that informal cooperatives date back to the origin of man himself. Okeke (2011) agreed that modern cooperatives first found a home in Britain, though the movement was occurring almost simultaneously in various European countries. Kohls and Downey (2002) observed that workers in Britain cried out to Government to redress their sufferings and got no help, they turned to humanitarians and social reformers. Robert Owen and Dr. Williams King of the Briton cooperative Movement, were pioneer leaders of cooperatives. In France, the same suffering workers as a result of the evil of the industrial revolution led to the formulation of socialist societies. Charles Fourier, Philips Buzuchez and Louis Blanc, were the pioneer cooperatives trained in France.

In Germany, it was the substance of the peasant farmers, bitterness and thriftiness of the tradesmen and workers that led to the formation of cooperative societies. In 1850, Fredrick Wihelm Rainffesim recognized that what was badly needed at that time for the expansion of German agriculture was the infusion of credit through credit societies. He therefore, organized village and loan societies which developed into district and regional banks. At the same time, Shutz Delisch, the originator of urban credit system observed that tradesmen and workers experienced hardship in obtaining finance for their trade. Shutz therefore, decided to help them by setting up people's bank (Okeke, 2001).

In USA, there also emerged different cooperatives in livestock processing, fruits and vegetables, input supplies and manufacturing, credits, rural electrification, medical and health, insurance and irrigation cooperatives (Chukwu, 1990).In fact, Berko (2001) reported that cooperatives came in the form of farm settlements which did not only help them to increase food production but also to resist attacks from their aggressors. Two types of cooperatives set up in Isreali Moshay and Kibbuzz made outstanding success particularly in agriculture and the social life of the people who were before relegated to the background. The movements typified the axiom that necessity is the mother of invention! The cooperators inculcated in their membership: qualities of realities of readiness for sacrifices, perseverance, industry and entrepreneurship initiatives and creativeness. They were able to stand on faith and unity of purpose to turn the desert land to a flourishing one with milk and honey, eggs and meat, wheat, oats and barley. What more, irrigation principles

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and practices turned the erstwhile desert land into an ever green agricultural land for all season production.

In Nigeria, okeke (2001) observed that the modern cooperatives as known today started in 1935 when the enactment of the Nigerian ordinance of cooperative societies came into operation with the appointment of major Haig F.E.C as the registrar of cooperative societies. Nigerian membership of cooperatives has increased and expanded across the states and local governments of the federation with a high built up capital. Many cooperatives are in operation with involvements in different facets of the national economy.

II. Problem Statement

Development is one of the main goals that all farming communities try to achieve in order to improve their living standards (Mohammed 2004). Agricultural cooperative have played an important role in rural development through development of agriculture. Agricultural cooperatives are considered to be the most important organization that pay attention and try to support rural development in general and agricultural development especially through the activities and services achieved for the sake of farmers (Agbo, 2010)

Agricultural cooperatives are considered as one of the important economic and social organization in rural communities. They play very important roles in agricultural development by providing the farmers with production input, such as fertilizers, seeds, other chemical substances, etc. They also provide farmers with the necessary knowledge and skills. These are about the agricultural new methods that aim at increasing the agricultural production, and therefore, promoting the rural societies. Cooperatives globally, play major role in the rural society. They play major role in the agricultural food industries in various sectors and local setting of Nigerian rural Communities.

Despite these advantages, the problem identified is that contributions of Agricultural cooperative Societies in Ivo local Government Area of Ebonyi State, Nigeria have not been document and hence this study.

III. Purpose of the Study

The aim of the study is to find out the contributions of Agricultural Cooperatives to rural development in Ivo Local Government Area of Ebonyi State, Nigeria .

a) Objectives of the Studies

The broad objective of the study is to evaluate the contribution of agricultural cooperative societies to rural development in Ivo Local Government Area of Ebonyi State, Nigeria while the specific objectives are to:

1. determine the social economic characteristics of agricultural cooperatives members.
2. examine the various types of existing cooperative societies in the study area.
3. find out their sources of fund and input used in agriculture.
4. determine their contributions to agric development in Ivo LGA , Ebonyi State.
5. examine their problems relating to improvement of agriculture in the study area.

b) Justification of the Study

The extension strategy which is farmer centered is capable of developing agriculture by farmers themselves with their own resources and assistance of other stakeholders (Adeoyin, 2002). Community based organization are the cooperative societies whose members are the target beneficiaries in the communities have significant roles to play in rural and agricultural development . They participate in decision making process, identification of farmers needs, input service delivery, farmers education, financing, contracting, warehousing, processing, packaging and advertising of farm products among others.

Farinde, Akinloye, Banji and Achisa (2005) stated that farmers' cooperative societies such as credit, thrift and consumer cooperative , group farm cooperative, produce, buyer and marketing associations have written bye- laws that regulate their activities as unions. Its main focus is the socio-economic and political development of the town.

These community based associations according to Ekong (2003/ rely on cooperation from members and donations from well wishers to execute their rural development programmes. In terms of functions, voluntary organizations in a community are expected to contribute their own quota, be it moral, financial, physical, to the social, progress and economic advancement of the community in particular and state in general.

This is based on the belief that there is no government however benevolent, paternalistic or well meaning which can boast of the capacity to provide all the multifarious needs of all its citizens. This premise applied to both developed and less developed countries of the world. This may be due to their peculiar shortage of almost everything one can think of, financial resources, capital, skilled manpower, technical known how, to me ntion a few. It is therefore, obvious that one of the surest and quickest ways to enhance sustainable agricultural and rural development lies in the active participation and commitment of cooperative societies members .

IV. Research Questions

To guide the researchers, the following research questions were formulated:

1. What are the socio-economic characteristics of agricultural cooperative members?
2. What are the various types of cooperative societies existing in the study area?
3. What are the sources of fund and farm inputs?
4. Are the cooperatives contributing to agricultural development in Ivo Local Government Area?
5. Are there problems constraining the agricultural cooperatives in rural development in Ivo Local Government Area?

V. Research Methodology

Descriptive research Design was adopted by the researchers because it is cost effective and less time consuming. A small sample size is used to extrapolate for a larger population. The result obtained is acceptabl (Osuala,2007). Ivo Local Government Area of Ebonyi State is the study area. It has a population of 129,068 people based on the 2006 census (NPC.2006). The local government Area is composed of the following communities: Ishiagu, Isiaka, Ndiokoro ukwu, Nzerern and Obinagu. The people are mostly farmers and some few engage in stone crushing to supplement their farm income. Ivo is known for its inhabitants engage in various farmers 'groups and associations. Agriculturally, Ivo Local Government Area is known beyond Ebonyi State frontiers.

The study population comprised of the 80 registered agricultural cooperative societies at the local Government trade and commerce office and the Ebonyi State Agriculture Development programme office at Ivo Local Government Area. Structured questionnaire was used to collect primary data from the agricultural cooperative respondents to justify the objective and research questions. The questionnaire items were taken to two expert in test validation/ evaluation of the Computer science/statistics department, federal college of Agriculture, Ishiagu, for validation. They made corrections and suggestions which were effected before the researchers used the questionnaire items . The test re-test method was used where 2 cooperatives at Isiaka were randomly given the test instrument at 2 week interval and the mean of the test score was obtained to serve as a standard score. The mean of 0.6 which is 60% was high and therefore used. Descriptive statistics was used to present and analyze the data viz tables and percentages .

VI. Results and Discussion

Research questions one was: What are the agricultural cooperative members socio-economic characteristics ?

Table 1 : Socio-economic characteristics of agric. cooperative members

S/No	Characteristics	Frequency	Percentage
1	Age 18-25yrs	20	20
2	26-35	25	25
3	36-45	25	25
4	46-55	30	30
5.Education	0-2 yrs	30	30
6	3-6yrs	40	40
7	7-10yrs	25	25
8	10-15yrs	05	05
.Marital Status			
9.	Married	65	65
10	Not married	35	35
11	widow	10	10
12	widower	05	05
Annual Income	N less:10,000	13	13
14	11,000-30000	30	30
15	31,000-50,000	28	28
16	51,000-70,000	16	16
17	71,000-100,000	13	13
18 Farm size	01-2ha	25	25
19	2.5-4ha	30	30
20	4.5-6ha	20	20
21	6.5-8ha	10	10
22	8.5-10ha	11	11
23	10.5-above	04	04

Source: field data (2015)

Results on the socio–economic characteristics of the cooperative farmers showed that 20 percent of them are within the age range of 18-25 years, 25 percent each are within the age range of 26-35 years and 36-45years respectively . However, 30 percent of the respondents are within age range of 46-55years .This implies that about 70 percent of the cooperative members are youthful and 30 percent are above 46-55 years. The youths are greatly involved in cooperatives and they are contributing greatly to the agricultural and rural development in Ivo Local Government Area of Ebonyi State Nigeria .

Educational status as in table 1 shows that 95 percent of the respondents spent 10 years and below in schooling which implies that they obtained JS3 Certificate or junior WAEC while only five percent had above 10 years schooling. The implication is that cooperatives members are low in literacy level and this have serious implications for adoption level of agricultural innovations and thus have serious policy implications for increased agricultural extension education and farmers education which need to be highly intensified .

The marital status showed that 65 percent of the cooperative members are married and only 35 percent single. The implication is that marriage is an Institution that have increased the responsibilities of those who are involved . Thus , with their low literacy level and high marriage rate, the members are highly responsible and contribute to the social, rural and agricultural development in Ivo Local Government Area of Ebonyi State , Nigeria , The group dynamics and synergy help them in articulation and pioneering farmers group meetings and taking good decisions to assist them in the various farm operations. These resulted into high production and group members' income.

Annual income levels are also shown with 30 percent of them obtaining a mean income of N15,500.00 annually; 28 percent others have a mean annual income of N40,500.00 and 16 percent have a mean annual income of N60,500.00 while 13 percent of them have above N80,500.00 annually. This implies that greater percentage (28%) of annual income of N40,500.00 were earned by the respondents and about 29 percent of the agricultural cooperators have annual income of above N60,500.00 and 13 percent obtained below N10,000.00 annually. However, the income generated by the cooperatives members have played vital role in rural and agricultural development since all the cooperatives societies are fully engaged in agricultural activities.

The farm size holding was also analyzed and the results showed that 25% of the cooperative members had farm size of 1-2 hectares and 30 percent of them own 2.5-4 hectares. Another 20 percent own 4.5- 6 hectares and 10 percent posses 6.5-8 hectares of farms. About 11 percent own more than 8.5 hectares and 4 percent own above 10.5 hectares. The holdings are encouraging showing that of the 50 percent membership that engage in production activities, have a very high involvement in agricultural production that results in increased food production and income to farmers' cooperative members and to the Ivo Local Government Area in Ebony State. Empirical evidence has shown that farm size is negatively related to farm output which implies that the size of farm holdings influence output. That is the smaller the size of farm, the smaller the output and invariably the farm income . The mean farm size of members engaged in production was 5.525 hectares. This by no means is not small and therefore, encourage rural and agricultural development in Ivo local Government Area of Ebonyi State Nigeria. The above results on socio-economic characteristics have justified research question one of this study on socio-economic variables of agricultural cooperative members in the study area.

Research question two results were presented in table 2. Data result showed that there exist Agricultural Cooperatives which include multipurpose cooperatives with 30%. Production cooperatives was 20 percent and thrift –savings cooperatives accounted for about 40 percent while 10 percent of them are involved in marketing.

The result showed that more of the agricultural cooperatives engaged in savings and thrifts which help in harnessing fund and making it available or as loans to farmers. Thus increasing farm production, farmers' income and their standards of living. These savings and thrift cooperatives could also be said to have contributed to about 40 percent of the development in rural and agricultural sector of the study area. The multipurpose cooperative also accounted for growth and development of agricultural sector with about 30 percent positive contribution. This type of agricultural cooperative serve all the sectors-namely: financing storage, processing, production, marketing, thrift and savings with overall education of cooperative farmers. Cooperatives as multipurpose is sometimes serving as engine of growth following its numerous contributions to growth and development of the rural communities because individual resources are pulled together and therefore making a huge sum of fund that can used and or invested. The findings agreed with Farinde, Akinloye, Banji and Achisa (2005) and Agbo (2010) that agricultural cooperatives are considered to be the most important organizations that pay attention and try to support rural development in general and agricultural development especially through the activities and services achieved for the sake of farmers.

This implies that cooperatives act like government agents for rural development. About 20 percent of them are: pure production or primary production. The production activities are into crops,

livestock, processing, mining and quarrying enterprises in the study area are generating streams of incomes, employment while reducing poverty.

Research Question Two: What are the existing types of Agric Cooperatives in Ivo.

Table 2 : Types of Agric cooperatives in Local Government Area

S/NO	TYPES	FREQUENCY	PERCENTAGE
1	Multi purpose	30	30
2	Production	20	20
3	Thrift and Saving	40	40
4	Marketing	10	10
Total.		100	100

Source : field data (2015)

The third research question was on the sources of funds for the agricultural cooperatives. The sources are presented in table three with the highest coming from monthly dues (38 %), followed by levies (23%), sales (20%) and fines (20%) respectively. Other sources of fund include Registration (10%), service charge (10%), Rentals (5%) and capital invested (share stock, 2%).

The various kinds of agricultural cooperatives put their members into a formidable groups that are eager to grow by participating regularly in meetings and paying their dues and levies as when appropriate without any hitch. This shows effective mobilization of individual funds that are harnessed together for group usage and advantages. The harnessed funds or resources would have otherwise been left wasting and unutilized.

This also applies to leadership development principles for members especially youths who follow the democratic process of doing things. They also imbibe the spirit of group and team work which help reduce the chuvenistic individualism that stunts growth and development. The group dynamics and synergy involved in agricultural cooperatives also engender group collateral in seeking and obtaining financial helps from micro-finance Institutions eg: Ishiagu Community Micro-finance bank. This breaks the vicious cycle of poverty and injects new flow of cash into farm enterprises with this new status of agricultural cooperatives, they break the impending obstacles of access to farm financing. For instance, Onogwu and Arene (2007) observed that low level of income and savings among small–holder farmers in Nigeria, impose limitations on the availability of adequate equity capital for financing small holder agriculture. They further argued that the remoteness of microfinance institutes to small–holder farmers in critical need of credit and the cumbersome lending procedures further affects their accessibility to credit.

Research question three: What are the sources of fund to agricultural cooperative in Ivo LGA, Ebonyi State?

Table 3 : Sources of fund to Agric Cooperatives in Ivo Local Government Area

S/NO	SOURCES	FREQUENCY	PERCENTAGE
1	Monthly dues	38	38
2	Registration.	10	10
3	Sales.	20	20
4	Service charge	10	10
5	Rent charges	05	05
6	Fines	20	20
7	Levies	23	23
8	Capital Shares	20	20

*Source : field Data (2015).Multiple responses**

For Okoye and Arene (2005), this hits small holder farmers most as they are being discriminated against by the financial system on the grounds that they are generally risky and unviable, and that transaction costs for smaller holder loans are higher than those for large loans. This approach of group or team spirit inculcates the good habits of book-keeping or accounting records which strengthens farm records that individuals do not normally keep. The good habit of record keeping goes a long way in addressing the short falls associated with farmers' illiteracy and lack of ability to record farms operations vis–a-vis income flows and expansion. This allow for better analysis of profit and loss accounts of each agricultural cooperatives at the end of each farming season and or end of the year .

The application of the cooperative acts ie code of conducts also instill obedience to rules and regulations as lateness to cooperative functions attracts a fine. This served as 20 percent of income to the cooperatives. It implies that laxity on the part of members are rather turned into income generation

and general levies with 23 percent respectively. The results agreed with the opinion of Agbo (2010).

Research question four sought to find out the contributions of cooperative societies in rural and agricultural development in the Study area. Data results in table 4 showed various contributions of the various agricultural cooperatives societies in Ivo Local Government Area to rural and agricultural development.

One of the major contributions is the mobilization of cooperative members for agricultural Development. The result shows that the highest percentage of 20 percent was on agriculture development especially in primary food production, marketing, processing, storage, thrift and saving which help farmers who are the majority of the people living in Ivo Local Government Area of Ebonyi State. The second most important contribution is the provision of cheap farm credit or loan with 18 percent of cheap farm credits or loan with 18 percent. It means that the funds pulled together are available for those who are in need of cash. The case are given to these members without any form of interest and the mode of processing the farm credit is very easy and straight forward as the repayment is done during and after the harvest of crops, livestock and sales with ease and without any collaterals.

The injection of cash into financing small holders farm operations is an area critical to agricultural development that the cooperatives have been very active, otherwise the sourcing of farm credits from formal financial Institutions are hectic and time consuming. At times too complex for the understanding of the illiterate small holder farmers. Group processing of farm products ranked third in the contributions of agricultural cooperatives in the study area to rural and agricultural development with 16 percent. This activities reduce the level of spoilage of farm produce and also increase their products, enhance the shelf lines of products and make it easier to handle by packaging and marketing networking in easier and achievable manners. This is based on group synergy and dynamics because advertising cost is reduced as market will exist for products at point of processing that encourage larger volumes of processing agricultural products because existing markets and demands so created act as motivation to agro-industrial enterprises. It has a multiplier effect in the study area because of other associated jobs creation opportunities to the youths in the study area.

The 4th is low cost of agrochemicals provided by the cooperative societies to farmers with 15% and followed by access to innovation with 14%. This showed that 15% of the agrochemicals used were provided by the cooperatives just as innovation to agriculture technology was another important contribution to agricultural development by cooperative societies in Ivo Local Government Area. The agricultural cooperatives Societies also contributed to savings with 13 percent response and provision of input of seeds and seedlings was 12 percent. This was also the position of training and retraining of farmers. Assisting farmers to obtain fertilizer and farmers' production obtained 10 percent each. The cooperatives dividends had 9% of their contributions to rural and agricultural development in Ivo Local Government Area, Ebonyi State. Storage and linkage of cooperative farmers to micro-financial Institutions forms another vital intervention of the co-operatives societies in Rural and Agricultural development in Ivo Local Government Area , Ebony State , Nigeria .

In general terms the agricultural cooperative societies have contributed to rural and agricultural development in Ivo Local Government Area in the following: Easy access to government agencies for assistance, Hire and purchase of machines, management of fish ponds, marketing outlets, had acquisition and networking of financing and marketing which have increased members financial strengthen out .The various cooperative societies studied in Ivo Local Government Area have immensely contributed to the socio-economic and agricultural development. This arose from the fact that majority of the Ivo Local Government Area inhabitants are practicing farmers. The group formation have also engineered farmers to utilizes idle funds by borrowing at low interest or no interest rate. This make cash available to the members and which they repay at the end of farming season or at harvest and sales with ease.

Research Question 4: Are there contributions of agricultural cooperative societies to rural and agricultural development in Ivo Local Government Area of Ebonyi State?

Table 4 : The contributions of agricultural Cooperative societies to rural and Agricultural Development in Ivo, Local Government Area

S/NO	CONTRIBUTION	FREQ	PERCENTAGE
1	Educating farmers	10	10
2	Provision cheap farm credits / loan	18	18
3	Assisting farmer members to get fertilizes	10	10
4	Group processing	16	16
5	Sourcing of market	05	05
6	Storage and packaging	08	08
7	Hire and purchase of machine	07	07
8	Linking members to micro finance	06	06
9	Cooperative easily have access to govt	05	05
10	Training and retaining of farmers	12	12
11	Provide at low rate agro-chemical	15	15
12	Easily accessible to obtain innovation	14	14
13	Land acquisition for use by members	03	03
14	Networking to increase profit by sales	02	02
15	Dividends share increase income	09	09
16	Provision of seeds/ seedlings to farmers	12	12
17	Management of fish ponds	04	04
18	Provision of mini-slaughter house	05	05
19	Mobilization of cooperative members for agric development	20	20
20	Encouraging savings for members	13	13

*Source : Field Data (2015). Multiple Response**

Research question 5 : what are existing problems relating to cooperatives in Agricultural development in Ivo Local Government Area, Ebonyi State.

Table 5 : The existing problems relating to cooperatives in Agricultural development in Ivo Local Government Area, Ebonyi State

S/NO	PROBLEMS	FREQUENCY	PERCENTAGE
1	Poor quality Harvest	15	15
2	Lack of qualified Personnel	20	20
3	Low income earning of farmers	22	22
4	Stalls and stores inadequacy	10	10
5	low government intervention subsidy	12	12
6		11	11
7	Pest and disease control	10	10
8	Total	100	100

Source: field Data (2015)

The fifth research question sought to find out the problems current hindering the contributions of the cooperatives to the contributions of the cooperatives to the growth and development of agriculture in the study area. About seven major problems were identified and presented in table 5.

Results showed that one critical problem facing the cooperative societies in Ivo are troubled by the low income of her members which was stored 22 percent to rank first, followed by lack of qualified personnel with 20percent to rank second. The third in ranking was poor quality of harvest which had 15 percent to rank second. The third in ranking was poor quality of harvest which had 15 percent.

Others were low government intervention with funding with 12 percent to rank fourth and followed seasonal price variations with 11 percent. Finally two problems tangled at 10 percent each and include pests and disease control, and inadequate stall/stores.

These problems are not uncommon but the way forward is by providing solution to the shooting problems. The intervention of non-governmental Organizations and the and the three tiers of government in providing financial assistance to the existing cooperatives. Assistance should also come in from kinds on training and re-training of their personnel to ensure to ensure effective cooperative management support also come in form of provision of low cost housing and stalls to assist the agricultural cooperatives societies.

It implies that with added support and assistance to above mentioned problems would be suppressed by the cooperative societies in Ivo Local Government Area of Ebonyi State, Nigeria. This is

because these cooperatives have grea potentials that need to be harnessed by all and sundry. The various contributions of the cooperative societies in the Study area (Ivo-Local Government Area) showed that the organization is veritable instrument for agricultural development in Ivo Local Government Area of Ebonyi State, Nigeria and the world over .

VII. Implication of the Findings

The data results showed that various types of cooperatives exit in Ivo Local Government of Ebonyi State. The cooperatives despite some financial and personnel shortage have contributed greatly to agricultural development in Ivo Local Government Area, Ebony State, Nigeria. Access to farm inputs, credit and processing machines and group management of assets help in the agricultural development because majority of Ivo populace are rural farmers.

The findings implicated poor government intervention in financing co-operatives in the study area.

VIII. Conclusion

The authors concluded that agricultural cooperatives were efficacious in agricultural and rural development in the study area and recommended that government at the three levels and all stake holders should endeavour to assist cooperatives because of their multiplier effects on poverty reduction, food security, job and wealth creation.

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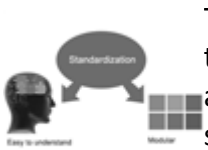

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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

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29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

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- Reason of the study - theory, overall issue, purpose
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- Significant conclusions or questions that track from the research(es)

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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