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Full Length Research Paper

Spatial distribution of the European union-assisted water supply and sanitation projects in Imo state, Nigeria

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This study analyses the spatial distribution of EU-MPP6 water supply and sanitation projects in Imo state, Nigeria and ascertains whether the projects are a function of the expectations of the benefitting communities as well as those of the organizers. Primary data were collected with the aid of two sets of questionnaires from households in the study communities and key staff of the European Union Micro Projects Program. The study employed Chi-square, the Gini-coefficient model and student 't' test analytical technique. The analysis revealed an even spatial pattern of water and sanitation projects. This was confirmed by Gini indices of 0.408 and 0.303. It also revealed that the EU-MPP6 water supply and sanitation projects are a function of the expectations the benefitting communities in Imo State as well as that of the organizers, because statistics showed the Chi-square values to be significant. The study concludes that in terms of spread and access, the project goal of improved socio-economic well-being of the benefitting communities is attained. Furthermore, the objectives of the EU-MPP6 water supply and sanitation projects are achieved; which indicates that the whole planning and execution exercise of the EU-MPP6 water supply and sanitation projects in Imo State has been very successful.

Keywords: Communities; European Union; Expectations; Nigeria; Projects; Spatial

INTRODUCTION

European-Union-assisted water supply and sanitation projects (EU-MPP6) were executed in six states namely; Abia, Akwa-Ibom, Cross River, Edo, Imo and Ondo, under the auspices of European-Union Micro-Projects Programme. The goal of the projects is the development of the social and economic well-being of benefitting communities in response to their needs through a participatory approach, while the specific objectives of the

project are: to improve communities' access to water supply and sanitation facilities and services; to cultivate the spirit of community ownership of the water supply and sanitation projects through the involvement of the communities in their planning and execution; to build the capacities of the communities to enable them continue local actions stimulated by the water supply and sanitation projects; and to promote the ability of the communities to initiate new projects as a result of the built-up capacity of the benefitting communities (FGN-EU 2006). The assumption is that local communities have the capacity to plan, execute and manage their facilities on sustainable

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basis if adequately empowered. The basic tenet is that local control of projects, as opposed to centralized control, will result in more accountable service provision and better services (FGN-EU 2006).

Viewed from project perspective, project sustainability is the percentage of project initiated goods and services that is still delivered and maintained five years past the termination of donor resources, the continuation of local action stimulated by the project, and the generation of initiatives as a result built local capacity by the project (Honadle and Vansant 2008). But, in spite of all the efforts in the water supply and sanitation sector by Nigerian government and the International Community, there still exists a wide gap in spatial coverage of projects among communities in Nigeria. According to Federal Ministry of Water Resources FMWR (2000), water supply project coverage in urban areas of Nigeria is 50 per cent, in small towns 20 per cent and in the rural areas 10 per cent. Edet and Okereke (2001), have reported that the available water supply sources do not follow a pattern of even distribution. As corroborated by Akinyele (2004), the distributions of services have been inequitable.

Fox (2006), opines that the construction of water supply and sanitation facilities is just a phase in the process of service provision. Where the construction which is the element enjoys more attention than the provision of a service, then it is likely that projects will be unsustainable. With respect to service provision, the location and distribution of projects are key issues in contemporary development; they originated from the central place model put forward by Christaller (1933). The major tenet of the model is that the fundamental order of things is the centralization of its mass about a nucleus. Its concern for the planning and provision of accessible facilities and services to communities and individuals in the society cannot be overemphasized. Thus, the choice of facilities and services any group of individuals are prepared to make, depends on the real price they have to pay which is made up two distinct elements: the market price, which is the price at the point of sale; and the cost of traveling to and from that point. The market range of a service activity, on the other hand, is the maximum distance which people are willing to travel to reach a service. Distance is the economic distance or physical distance converted into such units as cost of overcoming the friction of space or cost of travel; time wasted; discomfort encountered; among others. If the distance is too great, the service will not be consumed because it will be too expensive (Handy and Niemeier 2007).

Again, there are aspersions cast by some scholars that most water supply and sanitation projects have been initiated and implemented with little or no impact on benefiting communities. Chima 1989; Momohjimoh 1998; Nkwocha and Egejuru (2010), assert that the features of most water supply and sanitation schemes are mainly

boreholes with installed hand pumps too complex and beyond the technological know-how of communities using such appliances. Fox (2006) reported that completed water supply and sanitation projects easily become inoperative a few years after they have been commissioned. In effect, the expected water supply and sanitation project outcomes have been very low and unsustainable.

Thus, this study seeks:

- i. to analyze the spatial variation in the distribution of the EU-MPP6 water supply and sanitation projects initiated and completed in Imo State.
- ii. to determine whether the planned and executed EU-MPP6 projects in Imo State are a function of the expectations of the benefitting communities in Imo State as well as those of the organizers.

MATERIALS AND METHODOLOGY

The survey method was employed in this study to select the target population and to get the desired responses on the EU-MPP6 water supply and sanitation projects. The research population included households where the EU-MPP6 water supply and sanitation projects were initiated and completed, members of staff of the EU-MPP6 water supply and sanitation projects; and the EU-MPP6 project managers. Data for the study were collected from both primary and secondary sources.

There are 301 communities in 27 Local Government Areas of Imo State. The study adopted a multi-stage stratified random sampling approach in selecting subjects for the study. The 27 Local Government Areas are taken as clusters. The 27 Local Government Areas form the first sample frame from which 44 percent of the Local Government Areas, representing 12 Local Government Areas of Imo State were randomly selected. In each of the randomly selected 12 Local Government Areas, communities where the EU-MPP6 water supply and sanitation projects were initiated and completed were identified. The list of these communities formed the second sample frame from which 50 percent of the communities, representing 29 communities were randomly selected. The same procedure was employed in selecting the 50 percent of the communities. In terms of the selection of the respondents, the randomly selected 29 communities served as the third sampling frame from which stratified sampling method was employed to draw out 20 households from each of the communities. Stratified sampling method was adopted to take care of the heterogeneous and the amorphous nature of the population of study. In terms of geographical spread, the study covered randomly selected 580 households from randomly selected 29 communities which benefited from the EU-MPP6 water supply and sanitation intervention in of Imo State.

Table 1. Distribution of initiated, completed and functional EU-MPP6 water supply and sanitation projects in communities in the local government areas.

LOCAL GOVERNMENT AREA	NUMBER OF INITIATED, COMPLETED AND FUNCTIONAL PROJECTS						
	INITIATED		COMPLETED		FUNCTIONAL PROJECTS		% OF FUNCTIONAL PROJECTS OVER COMPLETED PROJECTS
	NUMBER	% DISTRIBUTION	NUMBER	% DISTRIBUTION	NUMBER	% DISTRIBUTION	
Aboh Mbaise	4	8	4	8	2	7	50
Ahiazu Mbaise	5	10	5	10	3	10	40
Ezinihite Mbaise	6	12	6	12	3	10	50
Ideato South	1	2	1	2	1	3	0
Isiala Mbano	7	14	7	14	4	14	43
Ikeduru	12	24	12	24	6	21	50
Isu	1	2	1	2	1	3	0
Mbaitoli	6	12	6	12	3	10	50
Ngor Okpala	1	2	1	2	1	3	0
Nkwerre	3	6	3	6	2	7	33
Obowo	1	2	1	2	1	3	0
Owerri North	3	6	3	6	2	7	33
Total	50	100	50	100	29	100	42

Number of Sampled Local Government Areas =12
 Source of Data: Author's Field Work (July-September 2011)

Two sets of questionnaire were designed and utilized. The first set of questionnaire was designed for households in the study communities. The second set was designed for key staff of the European Union Micro Projects Program. Descriptive statistics such as frequency distribution and percentages were used to present the data from the field survey. Inferential statistics such as Chi-square, the Gini-coefficient model and student't' test were applied to analyze the data. The Gini-coefficient Model was used to measure the degree of equality or inequality in the water supply and sanitation facility and service distribution among the communities.

RESULTS AND DISCUSSION

Distribution of the EU-MPP6 water supply and sanitation projects initiated, completed and functional in Imo State

A field survey of the EU-MPP6 water supply and sanitation projects initiated, completed and functional in the communities of the sampled 12 Local Government Areas is carried out. The survey revealed the number and the distribution of the projects initiated, completed and

functional in the Local Government Areas as are shown in Table 1. From the Table, the number of EU-MPP6 water supply and sanitation projects initiated in each of the Local Government Areas were the ones completed while the distribution, with respect to the total executed projects, varies from 2 percent in Ideato South, Isu and Obowo to 14 percent and 24 percent in Isiala Mbano and Ikeduru respectively. In addition, the number and the distribution of the projects executed that are functional in the Local Government Areas varies from 0 percent in Ideato South, Isu and Obowo to 50 percent in Aboh Mbaise, Ezinihite Mbaise, Ikeduru and Mbaitoli.

To ascertain if meaningful changes have occurred in the socio-economic well-being of the benefiting communities as a result of the spread of the functional projects, the null hypothesis that states that there is no significant variation in the distribution of the EU-MPP6 water supply and sanitation in Imo State is set up. To ascertain the degree of even distribution in spatial analysis, the statistical technique that readily calls to mind is the Gini coefficient also known as the Gini index (Wessa, 2012).

Mathematically, the Gini-Coefficient can be calculated as:

$$G = 1 - \sum_{i=0}^N (\sigma Y_{i-1} + \sigma Y_i)(\sigma X_{i-1} - \sigma X_i) \dots \dots \dots (1)$$

Table 2. Spread of the EU-MPP6 water supply and sanitation projects in the local government areas

Concentration - Ungrouped Data	
Entropy	2.209515
Maximum Entropy	2.484907
Normalized Entropy	0.889174
Exponential Index	0.109754
Herfindahl	0.131200
Normalized Herfindahl	0.052218
Gini Coefficient	0.403333
Concentration Coefficient	0.440000
Categories	12

Table 3. Spread of functional EU-MPP6 water supply and sanitation projects in the local government areas

Concentration - Ungrouped Data	
Entropy	2.321016
Maximum Entropy	2.484907
Normalized Entropy	0.934045
Exponential Index	0.098174
Herfindahl	0.112961
Normalized Herfindahl	0.032321
Gini Coefficient	0.313218
Concentration Coefficient	0.341693
Categories	12

Where;

σX and σY is the cumulative percentages of Xs and Ys variables (in fractions)

N is the number of elements (observations).

\sum is the sum of.

By subjecting the data in Table 1 to Wessa (2012) model, it is found that the Gini index within the sampled 12 local government area is 0.403 with a concentration coefficient of 0.44 as shown in Table 2.

However, good spread is one thing while accessibility is another. In order to assess the effectiveness of the spread of the projects using functionality of the EU-MPP6 water supply and sanitation as a surrogate, the Wessa (2012) coefficient model is also used. It is found that in the case of spatial variation in the functional EU-MPP6 water supply and sanitation projects in the Local Government Areas, a Gini index of 0.31 with a concentration coefficient of 0.34 as shown in Table 3 is the result.

Smith (2004) and Lui (2007) agree that a low Gini index indicates a more even distribution while a high index is

indicative of more unequal distribution. From the foregoing, it is very clear that the EU-MPP6 projects in Imo State exhibit a good spatial distribution of the functional projects. To push the analysis further, the students t-test model given by the formula:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \text{ ----- (2)}$$

where; r is the correlation coefficient, n is the number of subjects in the sample, is used to test the hypothesis that there is no spatial variation in the distribution of the EU-MPP6 project in Imo State. It is also found the t-statistic is 1.380. Testing at 95 percent significance level at 10 degrees of freedom, the critical value is 1.812. Since the t-statistic is less than the critical value, the null hypothesis is accepted.

Furthermore, plotting the cumulative percentages of the populations against the cumulative percentages of observed variables in Tables 4 and 5, derived from Table 1, the respective Lorenz Curves in Figures 1 and 2 are

Table 4. Spread of the EU-MPP6 water supply and sanitation projects in the local government areas in Imo state for lorenz curve

Cumulative% of population	Cumulative % of variable Observed
0	0
8	2
17	4
25	6
33	8
42	14
50	20
58	28
67	38
75	50
83	62
92	76
100	100

Table 5. Functional EU-MPP6 water supply and sanitation projects by the communities in the local government areas of Imo state for lorenz curve

Cumulative% of population	Cumulative % of variable Observed
0	0
8	4
17	7
25	10
33	13
42	20
50	28
58	34
67	45
75	55
83	66
92	79
100	100

produced by denoting the Gini coefficient by G, and using the formular;

$$G = \frac{A}{A+B} \quad (3)$$

The result from Figure 1 is 0.408 and that from Figure 2 is 0.303 and yet these results do not differ significantly from the earlier conclusions reached.

The inference is that there is no significant spatial variation in the distribution of the EU-MPP6 water supply and sanitation projects in Imo State. This means that the projects are evenly distributed and the benefiting

communities have access to functional MPP6 water supply and sanitation facilities for the improvement of their socio-economic well-being. Therefore, in terms of distribution of functional projects, the EU-MPP6 water supply and sanitation projects in Imo State have been effective.

Expectations from EU-MPP6 water supply and sanitation projects by the benefiting communities

The respondents were asked to rate the achievement of their expectations from the EU-MPP6 water supply and sanitation projects. The expectations by the respondents

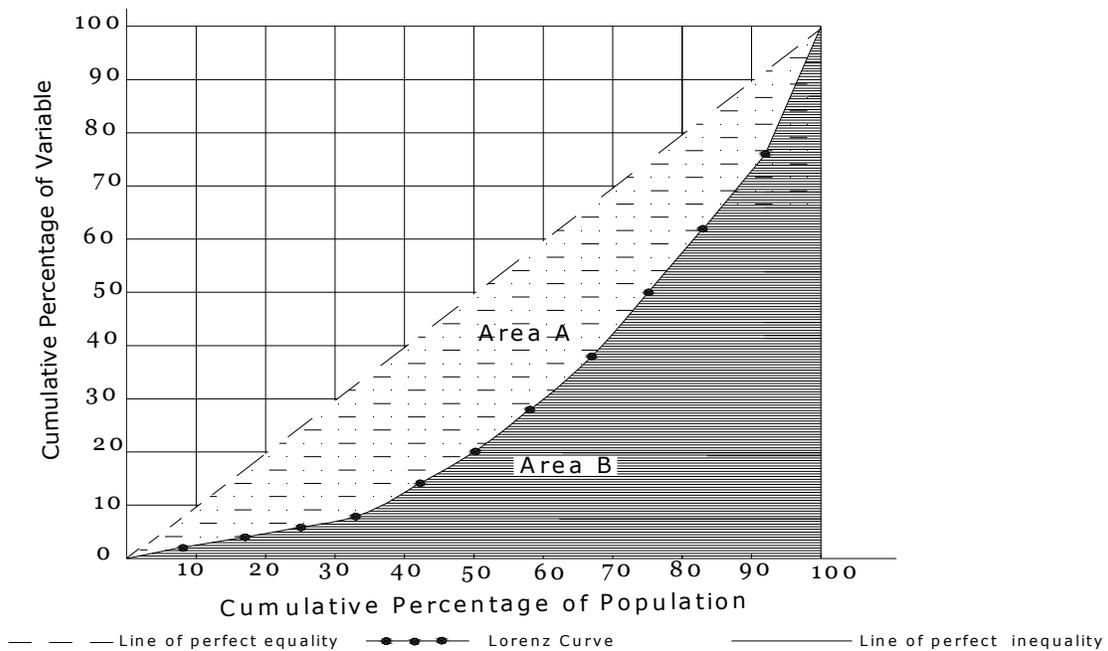


Figure 1. Lorenz curve based on spread of the EU-MPP6 water supply and sanitation projects in the local government areas in Imo state

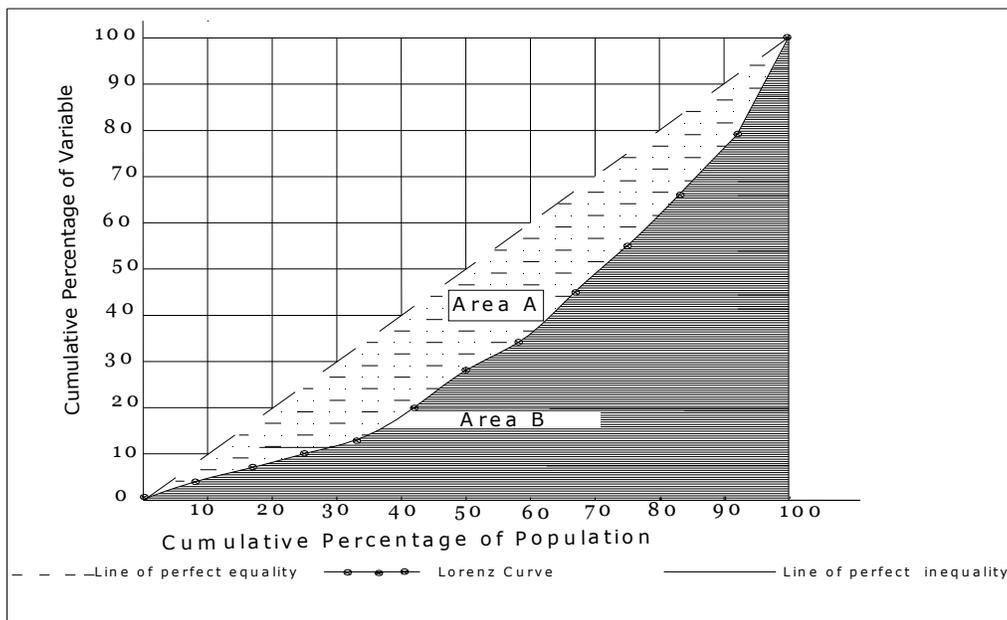


Figure 2. Lorenz curve based on functional EU-MPP6 water supply and sanitation projects in the communities in the local government areas of Imo state

as shown in Table 6 are; community involvement, capacity building, sense of community ownership of the project, activities of the water and sanitation committee, operation

and maintenance of facility, functioning of facility, sanitation inputs, and achievement of improved socio-economic well-being in the community. From the Table, high achievement

Table 6. Achieved Expectations from EU-MPP6 water supply and sanitation projects by the benefiting communities.

ACHIEVED EXPECTATIONS	PERCENTAGE RESPONSE		
	HIGH	AVERAGE	LOW
Community Involvement	12.9	53.7	33.4
Capacity Building	19.7	16.7	63.6
Sense of Community Ownership of Projects	14.1	18.8	67.1
Activities Of Water And Sanitation Committee	19.8	17.1	63.1
Operation And Maintenance of Facility	25	18.6	56.4
Functioning of Facility	10.7	67.9	21.4
Sanitation Input	3.1	18.3	78.6
Improved Socioeconomic Wellbeing	29.2	55.3	15.5
Average Percentage Response	17	33	50

Number of Sampled Households=580

Source: Field Survey, July-September, 2011

of community involvement is indicated by 12.9 percent of the respondents, 53.7 percent of the respondents rate the achievement average, while 33.4 percent of the respondents rate the achievement low. On capacity building, 19.7 percent of the respondents indicates high rating, 16.7 percent indicates average rating, while 63.6 percent of the respondents indicates low rating. Responses of respondents on high rating with respect to achievement of sense of community ownership of the project account for 14.1 percent, responses of respondents on average rating account for 18.8 percent, while 67.1 percent of the respondent indicates low rating for the achievement of the aspect. On the activities of the water and sanitation committee, 19.8 percent of the respondents indicates high rating on the achievement, 17.1 percent indicates average rating, while 63.1 percent of the respondents indicates low rating. Responses of respondents on high rating with respect to achievement of operation and maintenance of facility account for 25 percent, responses of respondents on average rating of the achievement account for 18.6 percent, while 56.4 percent of the respondent indicates low

rating. On the functioning of facilities, 10.7 percent of the respondents indicates high rating on its achievement, 67.9 percent indicates average rating, while 21.4 percent of the respondents indicates low rating on the achievement of the functioning of the facility. Responses of respondents on high rating with respect to sanitation inputs account for 3.1 percent, responses of respondents on average rating account for 18.3 percent, while 78.6 percent of the respondent indicates low rating on the achievement of sanitation inputs. On the achievement of improved socio-economic well-being in the community, 29.2 percent of the respondents indicates high rating, 55.3 percent indicates average rating, while 15.5 percent of the respondents indicates low rating on the achievement. Observably, the responses of respondents on high rating with respect to all the variables of level of achievement of the expectations of the benefiting communities account for 50.1 percent while responses of respondents on low rating of all the variables of level of achievement of expectations accounted for 49.9 percent of the respondents. Overall, the level of achievement of the benefiting communities' expectations

Table 7. Achieved Expectations from the EU-MPP6 water supply and sanitation projects by the organizers.

ACHIEVED EXPECTATIONS	PERCENTAGE RESPONSE		
	HIGH	AVERAGE	LOW
Community Involvement	32	68	0
Capacity Building	48	52	0
Sense of Community Ownership Of Projects	53	47	0
Activities of Water And Sanitation Committee	0	52	48
Operation And Maintenance of Facility	0	42	58
Functioning of Facility	53	47	0
Sanitation Input	47	53	0
Improved Socioeconomic Wellbeing	71	29	0
Average Percentage Response	38	49	13

Number of Sampled Households=580

Source: Field Survey, July-September, 2011

from the EU-MPP6 water supply and sanitation projects is highly above average as indicated by 84.4 percent of the respondents.

Expectations from EU-MPP6 water supply and sanitation projects by the organizers of the projects

Similarly, sampled 8 members of the organizers of the EU-MPP6 water supply and sanitation project were asked to rate the achievement of the organizers' expectations from the EU-MPP6 water supply and sanitation projects. The indicated expectations by the respondents as shown in Table 7 are; community involvement, capacity building, sense of community ownership of the project, activities of the water and sanitation committee, operation and maintenance of facility, functioning of facility, sanitation inputs, and achievement of improved socio-economic well-being in the community. From the Table, 32 percent of the respondents rates community involvement high while 68 percent of the respondents indicates average rating for the

achievement of the aspect. On capacity building, 48 percent of the respondents indicate high rating while 52 percent indicates average rating on the achievement. Responses of respondents on high rating with respect to achievement of sense of community ownership of the project account for 53 percent while responses of respondents on average rating account for 47 percent. On the activities of the water and sanitation committee, 42 percent of the respondents indicate average rating on the achievement while 58 percent of the respondents indicate low rating on the achievement of the activities of the water and sanitation committee. Responses of respondents on average rating with respect to operation and maintenance of facility account for 42 percent while responses of respondents on low rating of its achievement account for 58 percent. On the functioning of facilities, 53 percent of the respondents indicate high rating on its achievement while 47 percent indicates average rating on the achievement of the functioning of the facility. Responses of respondents on high rating with respect to sanitation inputs account for 47 percent while responses of respondents on

Table 8. Chi-square statistics based on expectations from the EU-MPP6 water supply and sanitation projects by the benefiting communities.

O_{ij}	e_{ij}	$O_{ij} - e_{ij}$	$\frac{(O_{ij} - e_{ij})^2}{e_{ij}}$
12178	12177.99		4504.094

Table 9. Chi-square statistics based on expectations from the EU-MPP6 water supply and sanitation projects by the organizers.

O_{ij}	e_{ij}	$O_{ij} - e_{ij}$	$\frac{(O_{ij} - e_{ij})^2}{e_{ij}}$
6093	3433.25		11089.580

average rating of its achievement account for 53 percent. On the achievement of improved socio-economic well-being in the community, 71 percent of the respondents indicate high rating on its achievement while 29 percent indicated average rating. Generally, 48 percent of the respondents indicate high rating with respect to the level of achievement of all the organizers' expectations from the EU-MPP6 projects while 51.5 percent of responses of respondents accounts for average rating of level of achievement of the expectations. Overall, the expectations of the organizers of the EU-MPP6 projects are highly achieved as indicated by 99.5 percent of the respondents. When this result is matched against that of the expectations of the communities, it indicates that the objectives of the EU-MPP6 water supply and sanitation projects in the communities have been achieved.

To ascertain if the projects are the expectations of the benefiting communities in Imo State, the second null hypothesis that state that the EU-MPP6 water supply and sanitation projects are not a function of the expectations of the benefiting communities in Imo State as well as those of the organizers is formulated and subjected to the Chi-square model. The Chi-square random variable (X^2) employed is defined by the following equation.

$$X^2 = \sum [(O_i - E_i)^2 / E_i] \dots\dots\dots(4)$$

Where;

O_i is the observed frequency count for the i th level of the categorical variable, and E_i is the expected frequency count for the i th level of the categorical variable.

The data extracted from the Table 2 on the achieved expectations from the EU-MPP6 Water Supply and Sanitation Projects by the benefiting communities and Table 3 on the achieved expectations from the EU-MPP6

Water Supply and Sanitation Projects by the organizers are respectively subjected to Chi-square random variable. It is found, in the case of the expectations of the benefiting communities, that the Chi-square statistic is 4504.094 as shown in Table 8. Testing at 95 percent significance level at of 28 degrees of freedom it is found that the critical value is 41.337. Since the Chi-square statistic is greater than the critical value, the null hypothesis is rejected.

In the case of the expectations of the organizers, the Chi-square statistics derived is 11089.580 as shown in Table 9. The critical value at 28 degrees of freedom for 95 percent confidence limit is 41.337. Since the Chi-square statistic is greater than the critical value, the null hypothesis is rejected.

It is also interesting to observe that at 99.9 percent (56.893) significance level the null hypotheses are also rejected. It is therefore, affirmed that the EU-MPP6 water supply and sanitation projects is a function of the expectations the benefiting communities in Imo State as well as that of the organizers. What this means is that the expectations of the organizers and benefiting communities are very highly achieved. One can comfortably conclude that the objectives of the EU-MPP6 projects are highly achieved; the whole exercise in Imo State has been very successful and ultimately effective.

CONCLUSION

This study has demonstrated that with the presence of the EU-MPP6 projects, there is a good spatial spread of water supply and sanitation projects in the benefiting communities. The spatial spread of the projects is in accord with the ordering principles of threshold population

and market range (Christaller 1933). The spread of the projects is accompanied by good community access. Therefore, in terms of spread and access, the project goal of improved socio-economic well-being of the benefitting communities is attained.

It is pertinent that in assessing a project, emphasis should be placed on the objectives of the project with a view to ascertaining whether outcome meets intended objectives. The study revealed that community involvement, capacity building, sense of community ownership, integration of community-based organization in project development, access to functional facilities, operation and maintenance of facilities, and adequate sanitation inputs are the established objectives of the projects as well as the expectations of both the benefitting communities and those of the organizers; and all of these are met by the projects.

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