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by

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ABSTRACT

Poverty in the country remains a challenge for many Filipinos. The growing prevalence of poverty needs efficient solutions and this can be done by managing the local cities and municipalities to easily identify the factors that affect poverty. Despite the many efforts of the government and even by some of the non-government organizations in their poverty alleviation programs, the poverty incidences at the city and municipal level in the Autonomous Region in Muslim Mindanao (ARMM) remains alarming. Thus, this paper aims to present the results of a study that generates the city and municipal level poverty statistics of the Philippines and use the statistics to assess the poverty conditions in the region for year 2012. In generating the city and municipal level statistics, an indirect small area estimation (SAE) technique was employed which follows a model-based approach. The city and municipal level estimates of ARMM were generated using the Poisson regression modeling approach based on the income collected through the Family Income and Expenditure Survey, Labor Force Survey (LFS), Census of Population and Housing (CPH), Barangay Listing (BL) and administrative data sets of the region. Through SAE, poor areas are immediately identified wherein programs can be implemented to help them.

Keywords: poverty statistics, small area estimation, survey and census data, time invariance

1. Introduction

The Philippines is one of the developing countries in Asia. Based on its 2014 economic performance, it has been the second fastest growing economy in Asia following China. However, amidst the positive tract of the economy, poverty in the country remains to be one of biggest challenges that the Philippine Government is facing. Based on the 2012 official poverty statistics generated by the Philippine Statistics Authority, one out of every four Filipino is poor. According to a report on poverty in the Philippines by Aldaba [1], the decline of the proportion of households living below the poverty line for the past decades is slower compared to neighboring countries like China, Indonesia, Thailand, and Vietnam. Weak employment generation, huge inequalities among income levels, regions and sectors, as well as unmanaged population growth, are considered as the main constraints of efficient poverty reduction effort. The usual typhoon-trail areas in Visayas and the island of Mindanao are the large contributors on the poor population of the country. This exemplifies that the country has its poverty as a rural phenomenon. Most provinces in Visayas and Mindanao have evident cases of high poverty incidences considering that these islands have rich natural resources which could be a source of income-generating opportunities.

In year 2008, the prevalence of poverty in the country was responded by the Conditional Cash Transfer (CCT) program of the Pantawid Pamilya Pilipino Program (4Ps) which was spearheaded by the Philippine Department of Social and Development Welfare. The project aims to tail off poverty by providing monthly cash allowance to eligible families in target areas that are deemed to be under the poverty line. Impact assessment was conducted to determine the feasibility of the objective of the program. To further monitor the development of poverty in the country, Philippine Statistics Authority (PSA) has been conducting a project on poverty estimation at lower level disaggregates using small area estimation. Since the official poverty

statistics that are released by PSA are at the national, regional and provincial level only, there have been demands to produce poverty estimates at municipal and city levels.

This paper aims to present results of one of the PSA's initiatives to be responsive to the needs of the Philippine Statistical System as the Philippine Statistical Development Program (PSDP) 2011-2017 reflected statistical programs and activities related to SAE of poverty, i.e., regular generation of poverty statistics at the municipal and city levels and improvement of the estimation methodology on city and municipal level poverty statistics towards the adoption of an official methodology. Specifically, the paper will present the results of city and municipal poverty statistics generated through SAE technique using Poisson modeling approach and evaluate the result of the poverty estimates of the cities and municipalities of the ARMM, Philippines.

2. Research Methodology

2.1 Data Sources

This study utilized the survey data sets that came from the FIES, LFS, BL, CPH and Census of Population (CP) which were all conducted by the Philippines Statistics Authority (PSA). Specifically, the 2012 FIES and LFS survey data sets, 2010 CPH, and 2010 BL for ARMM were used. Some administrative data sets were also utilized in the study.

The LFS is a nationwide survey conducted every quarter of the year, which is the major source of official employment data of the country. It also collects data on the demographic and socio-economic characteristics of population [2]. On the other hand, FIES, a rider to the LFS, is conducted every three years. Aside from family income and expenditure, FIES also included the levels of consumption of items which led to the identification of spending pattern and standard of living of Filipino families [3]. Since the FIES data set is only available every three years and considered as main source of poverty statistics, the poverty statistics presented in this paper are also in three-year interval.

The CPH is a complete enumeration of the population in the country and conducted every ten years. It gives information on the distribution of population and its characteristics of their housing units.

The Barangay Listing in 2010 includes some characteristics for all the barangays in the country and data from this source were also used in the estimation.

2.2 Data Analysis

There are numerous SAE techniques that can actually be used to generate statistics at the local area. One of these techniques is the Poisson modeling approach, wherein it is used for modeling count data which was employed to determine the total number of poor population in municipal and city level for ARMM.

First, the auxiliary variables from the POPCEN and barangay listing were correlated to the obtained direct estimates to determine the variables that are significantly correlated with poverty counts. The identified auxiliary variables were utilized in developing the Poisson regression model. The maximum likelihood estimators of the regression coefficients were obtained by regressing the log of the expected weighted counts of poor households on the auxiliary variables. The exponentiated predicted values served as the model-based estimates. Estimates of standard error and coefficient of variation were computed to evaluate the predicted values.

Also, the model was assessed through its obtained pseudo R-square, which is a good criterion for prediction purposes, wherein pseudo R-square values that around or greater than 0.5 are considered to be ideal. Additionally, the parsimony, significance of the predictors and model, and the underlying economic theory of the predictors chosen where also considered. The fit of the model was assessed using the Pearson chi-square goodness-of-fit test. The procedure tested the hypothesis that the total number of poor individuals follows the Poisson distribution. Rejection of the null hypothesis would mean that the data is not Poisson distributed; hence, the model does not fit well to the given data set.

The assessment of candidate models for a region involved comparison of the similarity (a subset of) parameter estimates and similarity of small area estimates, in addition to basic statistical criteria such as adjusted R squares, among others. The model should also be simple and possess parameter estimates that are logical.

3. Research Results and Discussion

ARMM is located at the southernmost part of the Philippines and is composed of five provinces, namely; Basilan, Lanao del Sur, Maguindanao, Sulu, and Tawi-tawi. It has 116 municipalities and 2 cities, namely; City of Lamitan, Basilan and Marawi City, Lanao del Sur. Based on the 2010 Census of Population and Housing (CPH), the Region has a total population of 3,248,787 with 538,981 households. From these households, a sample of 1,864 households was used in the 2012 household surveys like the Family Income and Expenditure Survey (FIES) and Labour Force Survey (LFS). Marawi City, the capital of Lanao del Sur, is the most populated municipality/city in the Region with a population of 183,202, while the Municipality of Turtle Islands in Tawi-tawi is the least populated having only a population of 3,772.

The characteristics of the residents of ARMM as well as the variables pertaining to the economic condition of the region were used to estimate the poverty incidences of the 118 municipalities and cities of ARMM in year 2012. The Poisson modeling approach was specifically utilized to obtain model-based estimates of the number of poor households in ARMM.

The Poisson modeling approach was specifically utilized to obtain model-based estimates of the number of poor households in ARMM. Considering the assumptions of the estimation technique, there were five predictors that entered the Poisson regression model which can be observed in Table 1. One predictor referred to the proportion of financial establishments in the municipality with at least 100 employees. The other four predictors deal with count of manufacturing establishment(s) outside the barangay but within 2 kms with at least 10 but less than 100 employees, household(s) that has at least 1 member who is an overseas Filipino worker (OFW) in the municipality/city, household(s) that has a household head with at least college education in the municipality/city, and barangay(s) that is a part of a town/city proper of the municipality/city. It can also be observed that all predictors are significant at 5% level and even the model as a whole was noted to be significant. The model had a Psuedo-R2 of 74.3%. Pearson chi-square goodness-of-fit test indicated that the model is not fitted to the data set and hence must be used with caution. With less than 0.0001 probability value, the predicting model was used to estimate the total number of poor for each city/municipality.

Correlating the direct estimates with the auxiliary variables obtained from the census data source, the number of manufacturing establishment(s) outside the barangay but within 2 kms with at least 10 but less than 100 employees obtained the highest correlate with a strong (0.6313) positive relationship to the direct estimates. The effect of their coefficients on the counts of the poor were also shown in the table. It can be noted that the proportion of financial establishments in the municipality with at least 100 employees and number of household(s) that has a household head with at least college education in the municipality/city showed a negative effect, implying

that these predictors drive down the number of poor in municipality or city. On the other hand, the following predictors that contributed a positive effect on the total count of poor were number of manufacturing establishment(s) outside the barangay but within 2 kms with at least 10 but less than 100 employees, number of household(s) that has at least 1 member who is an overseas Filipino worker (OFW) in the municipality/city, and number of barangay(s) that is a part of a town/city proper of the municipality/city.

Table 1. Predictors of the Poisson model with their corresponding effect on the dependent variable and computed p-value.

Predictor	Effect	p-value
Proportion of financial establishments in the municipality with at least 100 employees	-	0.00*
Number of manufacturing establishment(s) outside the barangay but within 2 kms with at least 10 but less than 100 employees	+	0.00*
Number of household(s) that has at least 1 member who is an overseas Filipino worker (OFW) in the municipality/city	+	0.00*
Number of household(s) that has a household head with at least college education in the municipality/city	-	0.00*
Number of barangay(s) that is a part of a town/city proper of the municipality/city	+	0.02*
Constant		0.00*

*Significant at α = 0.05

The distribution of the municipalities based on their obtained estimates from the Poisson modeling approach are shown in Table 2. This shows that 58% of the municipalities have poverty counts between 15,001 to 20,000. Followed by 30% between 20,000-25,000. This shows that most of the municipalities had poverty counts between 15,000 and 25,000. There are only a few cities and municipalities falling on the extreme values of estimates especially on the high values. The 118 direct estimates obtained are found in Appendix Table 1.

Table 2. Distribution of estimates of the number of poor at the city and municipal level

Estimates	Frequency	Percent
<15,000	2	1.96
15,001-20,000	59	57.84
20,001-25,000	30	29.41
25,001-30,000	8	7.84
>30,000	2	2.94
Total	102+	100.00

+Estimates with unreliable CV are excluded.

By obtaining the coefficients of variation for each of the estimated poverty incidence, the reliability of the estimate is determined. Table 1 shows the percentage distribution of the coefficients of variation of the poverty counts obtained. There were 33 municipalities that had a coefficient of variation at most 10. While there were 69 municipalities with coefficient of variation between 10.1 and 20. And only 16 out of the 118 municipalities had coefficient of variation greater than 20. Almost 87% of the resulting estimates are with acceptable measures of reliability. The rest are unreliable and should be used with much caution.

Table 3. Distribution of municipalities and cities based on Coefficient of Variation

Coefficient of Variation	Frequency	Percent
At most 10.0	33	1.96
10.1 – 20.0	69	57.84
Greater than 20.0	16	29.41
Total	118	100.00

4. Conclusion

For estimating the poverty counts in ARMM, the 2012 FIES and 2010 CPH were used to generate estimates on the poor population at the city and municipal levels of the region. One hundred eighteen estimates were obtained. Almost 87%, which was 102 out of 118, of the generated municipal and city level estimates have acceptable measures of reliability. It was also observed that most of the cities and municipalities that obtained high counts of poor households are also among those that have high actual household counts, indicating that, understandably, there are higher counts of poor on populated areas.

In conclusion, small area estimation, using the Poisson modeling approach, can be used successfully to produce poverty counts at the municipal and city levels. The generation of poverty counts is advantageous for policy makers since identification of areas that have high magnitude of poor population aids the government to establish programs for the right beneficiaries. Since the technique generates poverty counts, this approach could be explored to produce poverty incidences to be compared with municipal and city level estimates generated from the SAE of Poverty Project of PSA.

Furthermore, the technique could be further explored so that it could be used for other relevant indicators like employment, infant and maternal health, and nutrition statistics.

Acknowledgement

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Appendix 1. Model-based estimates for the total number of poor in ARMM.

Province	City / Municipality	Indirect Estimates	SE	CV (%)
BASILAN	CITY OF LAMITAN	39,396	11,431	29.02
	LANTAWAN	19,832	2,124	10.71
	MALUSO	22,000	2,974	13.52
	SUMISIP	30,113	4,749	15.77
	TIPO-TIPO	22,545	2,444	10.84
	TUBURAN	24,589	3,149	12.80
	AKBAR	24,126	2,917	12.09
	AL-BARKA	25,747	3,047	11.84
	HADJI MOHAMMAD AJUL	24,332	2,729	11.21
	UNGKAYA PUKAN	21,748	2,482	11.41
	HADJI MUHTAMAD	18,887	1,292	6.84
	TABUAN-LASA	27,129	3,175	11.70
LANAO DEL SUR	BACOLOD-KALAWI (BACOLOD GRANDE)	16,600	1,823	10.98
	BALABAGAN	21,773	3,763	17.28
	BALINDONG (WATU)	25,838	4,385	16.97
	BAYANG	36,177	9,369	25.90
	BINIDAYAN	20,827	3,254	15.63
	BUBONG	23,887	4,458	18.66
	BUTIG	18,761	2,410	12.85
	GANASSI	21,056	3,429	16.28
	KAPAI	16,600	1,871	11.27
	LUMBA-BAYABAO (MAGUING)	18,179	2,940	16.17
	LUMBATAN	17,561	1,840	10.48
	MADALUM	27,899	6,256	22.42
	MADAMBA	16,912	1,520	8.99
	MALABANG	20,252	3,312	16.35
	MARANTAO	16,087	1,920	11.93
	MARAWI CITY (Capital)	79,782	20,982	26.30
	MASIU	19,360	3,517	18.17
	MULONDO	19,023	1,679	8.83
	PAGAYAWAN (TATARIKAN)	17,315	1,030	5.95
	PIAGAPO	20,840	3,117	14.96
	POONA BAYABAO (GATA)	16,885	1,943	11.51
	PUALAS	16,468	1,183	7.18
	DITSAAN-RAMAIN	16,836	1,938	11.51

Province	City / Municipality	Indirect Estimates	SE	CV (%)
	SAGUIARAN	16,175	1,517	9.38
	TAMPARAN	26,414	5,974	22.61
	TARAKA	16,185	1,544	9.54
	TUBARAN	19,738	2,452	12.42
	TUGAYA	17,595	2,124	12.07
	WAO	50,918	13,401	26.32
	MAROGONG	18,451	1,659	8.99
LANAO DEL SUR	CALANOGAS	18,891	1,509	7.99
	BUADIPOSO-BUNTONG	17,403	1,708	9.82
	MAGUING	18,519	2,212	11.94
	SULTAN GUMANDER	19,262	2,120	11.01
	LUMBAYANAGUE	15,761	1,626	10.32
	BUMBARAN	20,416	2,893	14.17
	TAGOLOAN II	22,253	3,293	14.80
	KAPATAGAN	4,861,784	2,078,524	42.75
	SULTAN DUMALONDONG	16,862	1,321	7.83
	LUMBACA UNAYAN	17,515	1,001	5.71
MAGUINDANAO	AMPATUAN	18,509	1,845	9.97
	BULDON	18,163	2,217	12.21
	BULUAN	20,222	3,027	14.97
	DATU PAGLAS	18,012	1,992	11.06
	DATU PIANG	17,434	2,320	13.31
	DATU ODIN SINSUAT (DINAIG)	55,679	14,670	26.35
	SHARIFF AGUAK (MAGANOY) (Capital)	24,165	4,007	16.58
	MATANOG	17,806	1,588	8.92
	PAGALUNGAN	18,706	2,678	14.32
	PARANG	21,328	4,854	22.76
	SULTANKUDARAT(NULING)	134,863	42,273	31.35
	SULTAN SA BARONGIS (LAMBAYONG)	18,918	1,739	9.19
	KABUNTALAN (TUMBAO)	26,012	4,023	15.47
	UPI	13,111	2,039	15.55
	TALAYAN	42,062	7,671	18.24
	SOUTH UPI	14,029	1,575	11.23
	BARIRA	17,570	1,535	8.74
	GEN. S. K. PENDATUN	26,451	3,860	14.59
	MAMASAPANO	19,423	1,902	9.79
	TALITAY	20,151	1,753	8.70
	PAGAGAWAN	19,972	2,649	13.26
	PAGLAT	17,442	1,098	6.29
	SULTAN MASTURA	27,950	4,272	15.28
	GUINDULUNGAN	19,929	1,869	9.38
	DATU SAUDI-AMPATUAN	21,563	2,320	10.76

Province	City / Municipality	Indirect Estimates	SE	CV (%)
	DATU UNSAY	18,134	1,287	7.10
	DATU ABDULLAH SANKI	22,319	2,649	11.87
	RAJAH BUAYAN	22,344	2,919	13.06
	DATU BLAH T. SINSUAT	16,368	1,052	6.42
	DATU ANGGAL MIDTIMBANG	21,384	2,028	9.48
	MANGUDADATU	20,068	2,087	10.40
	PANDAG	17,642	1,633	9.26
MAGUINDANAO	NORTHERN KABUNTULAN	18,133	1,776	9.79
	DATU HOFFER AMPATUAN	19,897	1,914	9.62
	DATU SALIBO	40,878	7,324	17.92
	SHARIFF SAYDONA MUSTAPHA	19,593	2,117	10.81
SULU	INDANAN	23,703	4,515	19.05
	JOLO(Capital)	35,412	10,982	31.01
	KALINGALAN CALUANG	19,816	1,834	9.26
	LUUK	20,899	2,247	10.75
	MAIMBUNG	28,188	5,613	19.91
	HADJI PANGLIMA TAHIL (MARUNGGAS)	18,438	1,521	8.25
	OLD PANAMAO	20,242	2,318	11.45
	PANGUTARAN	19,671	2,047	10.40
	PARANG	26,096	5,482	21.01
	PATA	17,750	1,144	6.45
	PATIKUL	21,419	3,663	17.10
	SIASI	46,396	13,067	28.16
	TALIPAO	20,561	3,260	15.86
	TAPUL	16,576	1,410	8.50
	TONGKIL	16,611	1,133	6.82
	PANGLIMA ESTINO (NEW PANAMAO)	20,636	2,689	13.03
	LUGUS	20,043	2,279	11.37
	PANDAMI	17,395	1,658	9.53
	OMAR	23,653	2,536	10.72
TAWI-TAWI	PANGLIMA SUGALA (BALIMBING)	17,669	2,007	11.36
	BONGAO (Capital)	40,517	11,217	27.68
	MAPUN (CAGAYAN DE TAWI-TAWI)	15,433	1,598	10.36
	SIMUNUL	38,979	8,258	21.19
	SITANGKAI	40,585	8,138	20.05
	SOUTH UBIAN	25,765	4,283	16.62
	TANDUBAS	17,578	2,407	13.69
	TURTLE ISLANDS	17,827	1,047	5.88
	LANGUYAN	19,181	2,839	14.80
	SAPA-SAPA	15,520	1,774	11.43
	SIBUTU	15,570	2,217	14.24