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ABSTRACT

For poverty reduction strategies to be effective, they must be closely linked with the objectives of the poverty alleviation program. In the Philippines, official poverty statistics released at the provincial level by the National Statistical Coordination Board (NSCB) are focused on the poverty incidence, the income gap, the poverty gap and the Foster-Greer-Thorbecke measure of the severity of poverty. However, identifying the characteristics of vulnerable families and the vulnerable provinces is important towards understanding the causes of their vulnerability and in formulating programs on poverty reduction.

Thus, if the main objective of the poverty alleviation program of government is, in support of the Millennium Development Goal to halve poverty between 1990 and 2015, to reduce poverty incidence in the medium term, poverty reduction strategies must be so designed that focus is given to include families with income close to but not necessarily below the poverty threshold.

This paper proposes a framework and a methodology for identifying the provinces where these families are located to guide program implementors in the allocation of resources. It also monitors the progress of such provinces from 1997 to 2000, using data from the Family Income and Expenditures Surveys (FIES) of the National Statistics Office (NSO).

Keywords: poverty, poverty incidence, poverty threshold, vulnerability, panel data, poor, nonpoor, logistic regression, cluster analysis

I. Introduction

The identification of the poorest 44 provinces that would benefit from the KALAHI-CIDSS² program of the government was based on the official poverty incidence [4] released by the National Statistical Coordination Board (NSCB). But the official poverty incidence [6] is based on a headcount ratio that does not capture the risk that the poverty situation in a province will worsen. Thus, the official poverty statistics do not provide a glimpse into the chronic or transient nature of poverty, particularly the vulnerability of a province to poverty in the future.

Vulnerability to poverty is an important dimension of poverty analysis. A number of papers have been written on this subject, [1], [2], [3] and [5] that

¹ Secretary General, Statistical Coordination Officer VI, Statistical Coordination Officer III and Statistical Coordination Officer II, respectively, of the National Statistical Coordination Board. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the NSCB. The authors acknowledge the assistance of the following members of the NSCB Poverty Team in the preparation of this paper: Redencion M. Ignacio, Jessamyn O. Encarnacion, Glenita V. Amoranto, Melissa C. Pascua, Bernadette B. Balamban and Amando G. Patio Jr.

² Kapit-Bisig Laban sa Kahirapan – Comprehensive and Integrated Delivery of Social Services.

define vulnerability in various ways. Vulnerability has been referred to as ex-ante poverty, to reflect the fact that it refers to a reckoning time prior to the onset of actual poverty. Thus, while measurable, vulnerability defined in this manner is not observable the way ex-post poverty captured thru a headcount index is. It has also been measured to include [2] the probability not only of the nonpoor becoming poor, for whom poverty could be transient, but also the poor continuing to be poor, for whom poverty could be chronic.

Regardless of how vulnerability is defined, like poverty, it is multidimensional in nature. It is associated with risks as well as opportunities that bear on well-being. These risks relate to events occurring both within and beyond the control of individuals, families and households. Opportunities, on the other hand, refer to the various options available to individuals for them to achieve well-being. Vulnerability can thus be considered as the susceptibility to deterioration in well-being as a result of risks including external shocks and seasonal fluctuations, as well as of opportunities offered by resources owned or transfers received thru various means. In this context, vulnerability is more difficult to measure than poverty.

Thus, while available official poverty statistics can be used for direct poverty alleviation programs, measures of vulnerability can be useful in the formulation of preventive interventions. Since poverty reduction strategies that focus on prevention rather than on alleviation maybe a more effective approach, the relevance of vulnerability measures cannot be overemphasized.

Understanding the causes and determinants of poverty at the household/family level and the identification of vulnerable groups would be an important step in developing programs and projects that will reduce the social risks to Filipino households. Likewise, a profile of the sources of vulnerability for different segments of the population would be useful in determining the types of poverty prevention programs that are necessary to cushion the impacts of external and internal shocks to the different vulnerable groups within the population.

In the Philippines, external shocks such as trade liberalization, the Gulf War, 1997 Asian financial crisis, oil price hikes and internal shocks such as episodes of the El Niño and La Nina, peace and order concerns and political uncertainties have contributed in varying degrees to the vulnerability of the population. The poverty alleviation program of the government has thus given greater emphasis to the need to address not only the poor but also the vulnerable groups.

This paper proposes to add a measure of vulnerability to the official statistics on poverty generated by the NSCB. Section 1 starts with an introduction to the concept of vulnerability and the rationale for its measurement. Section 2 presents the proposed framework while Section 3 discusses the methodology for identifying the vulnerable families and for measuring the vulnerability incidence. Section 4 shows the results; Section 5 deals with the limitations and Section 6, the recommendations.

The original plan of the paper was to use panel data from the Family Income and Expenditures Survey (FIES) of the National Statistics Office (NSO) and to identify the vulnerability of the provinces in 1997 and 2000 and validate the results using the 2000 and 2003 FIES. However, the FIES design does not provide for panel data that can be used in the validation.

II. Framework for Measuring Vulnerability

In this paper, vulnerability is defined as the probability that a family that is nonpoor at time t will become poor at time $t+1$. Operationally, the time horizon will refer to the years when the NSO conducts the FIES³. The paper does not argue that this is the best, the most conceptually correct or the most appropriate way to define vulnerability. The main interest of this paper is to come up with a holistic tool that can be used consistently with official poverty statistics to enrich the available indicators needed in the formulation of more effective poverty reduction strategies.

The diagram in **Figure 1** presents an overall framework for analyzing vulnerability to poverty. It focuses on the family/household as the unit of analysis and attempts to identify variables that can be used to estimate/quantify vulnerability as defined in the paper.

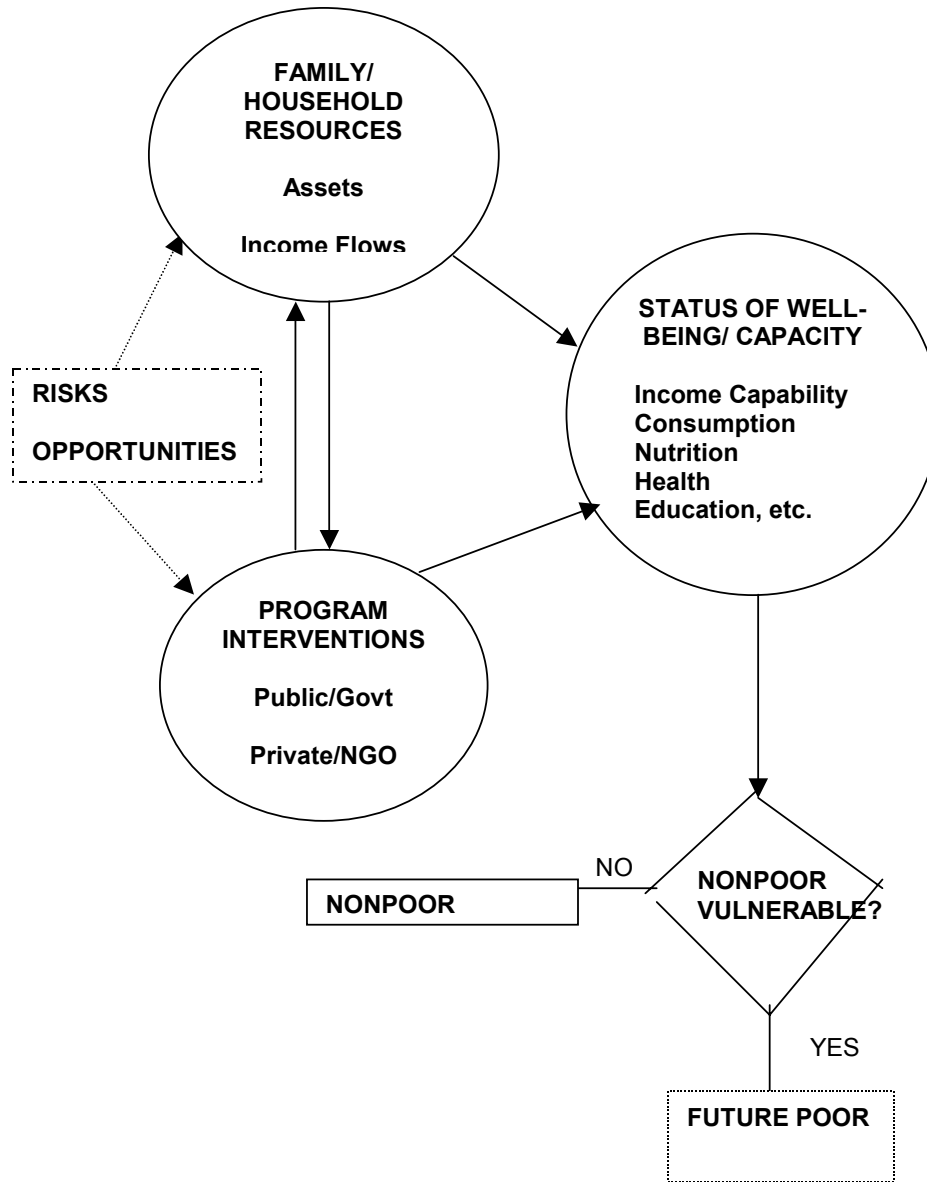
In the diagram, families/households have certain resources in the form of assets and income flows including transfers which can be utilized towards their well-being. The state of well-being can be described thru their capability to purchase goods and services, their actual consumption of goods and services, their nutritional status, health education, etc. In addition, interventions from both the private and public sectors can also influence and be influenced by the resources available to the families/households and likewise contribute to their well-being. As the World Development Report [7] stresses, building the assets of poor people requires increasing the focus of public spending on poor people, ensuring good quality service delivery through good governance and the use of market and multiple agents and ensuring the participation of poor communities and households in choosing and implementing services and monitoring them to keep the providers accountable. All these, however are subject to different forms of risks, including opportunities. Depending on the state of well-being at fixed points in time, the vulnerability of the families/households can thus be measured by assessing the status/performance of the family or household with respect to certain indicators of well-being.

Based on the overall conceptual framework, a statistical framework on vulnerability indicators can be developed as shown in **Figure 2**.

As previously mentioned, in this paper, vulnerability refers to the probability that a nonpoor family will become poor. The indicators used to assess vulnerability will therefore focus on aspects that bear on this event. This implies that the indicators should be able to capture the distance between being poor and being nonpoor.

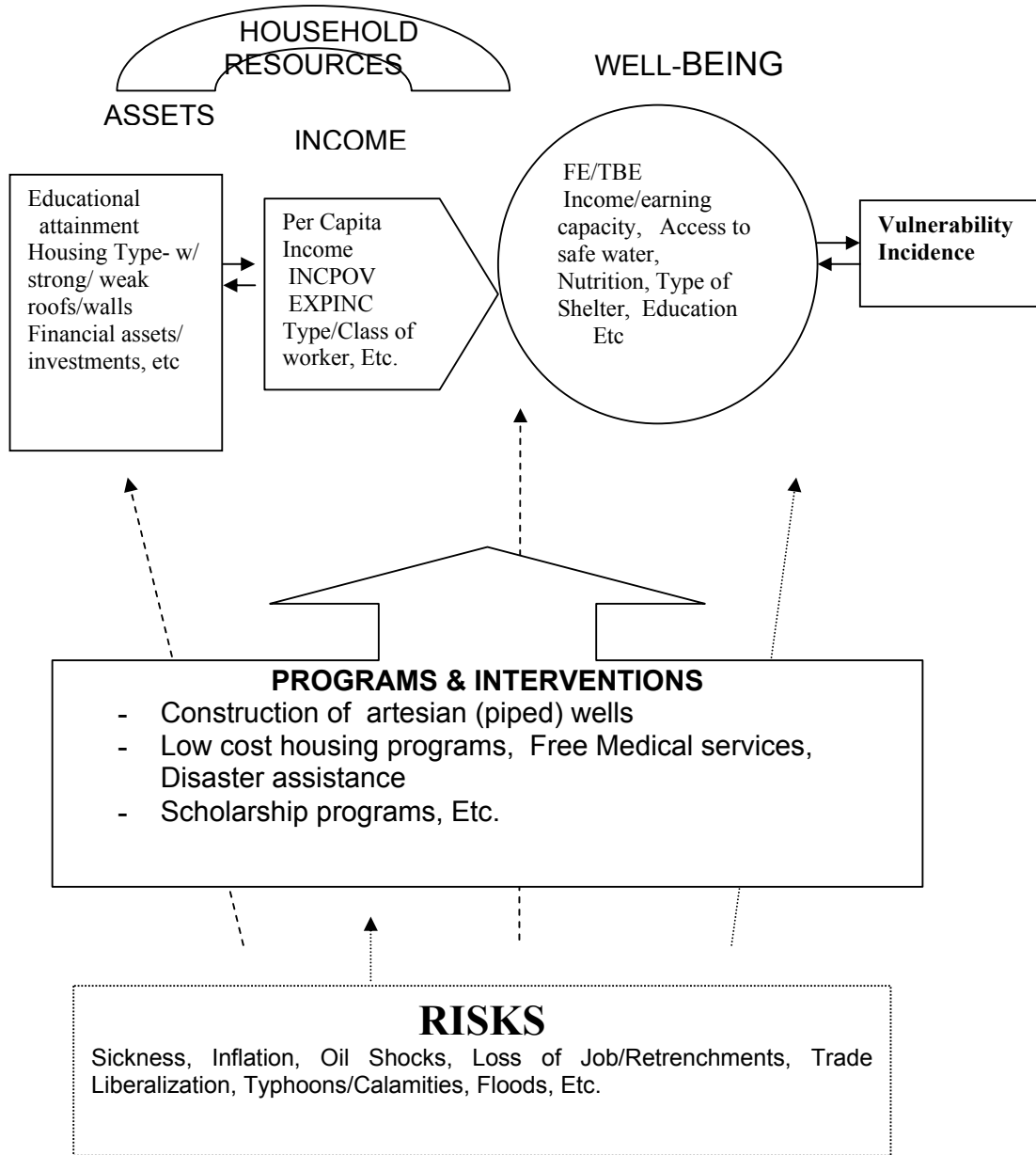
³ Currently, the NSO conducts the FIES every three years, the last one being in 2003.

FIGURE 1. FRAMEWORK FOR ANALYZING VULNERABILITY TO POVERTY



In principle, the vulnerable families are those whose incomes lie above the poverty line but below a certain level, i.e, not invulnerable or ultra-rich, and with characteristics that reflect the susceptibility of their income falling below the poverty line in the next reckoning period. **Figure 3** below shows this relationship in diagrammatic form.

Figure 2. Proposed Statistical Framework on Poverty and Vulnerability Measurement



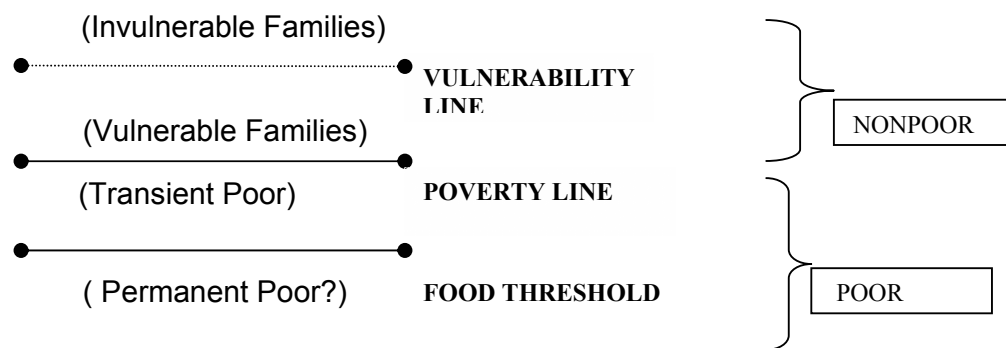
III. Methodology for Measuring Vulnerability

Logistic regression is used to identify the determinants of poverty. While the logistic function may already be used to measure vulnerability by specifying a cut-off point for the probability level, say 0.5 or higher, this approach treats vulnerability more like ex post poverty rather than ex ante poverty, i.e. the logit gives an indication whether a family is currently poor or nonpoor, based on the explanatory variables.

Thus, from the determinants identified thru the logistic regression, variables are chosen which will be used in the quantification of the vulnerability of a family as ex ante poverty, via a decision-tree approach. The cut-off points for the variables entering into the decision tree are determined using cluster analysis.

Other papers [1] use consumption as a basis for measuring vulnerability. In this paper, variables are chosen, involving both income and expenditure. The use of income-based indicators is based on the fact that since the official methodology for measuring poverty incidence is income-based, the comparison/validation of official poverty statistics and vulnerability statistics will be made more meaningful.

Figure 3. Poverty Line, Food Threshold and Vulnerability Line



IV. Methodology for Identifying Vulnerable Families and Measuring Vulnerability Incidence

A. Identifying Vulnerable Families

The logistic regression identified the following statistically significant indicators in the order of the magnitude of their coefficients:

1. Ratio of Income to Poverty Threshold - incpov
2. Ratio of Food Expenditure to Total Basic Expenditure - fetbe
3. Ratio of Expenditure to Income - expinc
4. Attainment of Secondary Education of Household Head – no_hsdeg
5. Quality of Roofing Materials – roof_weak
6. Access to safe water – water_unsafe
7. Class of worker - notwage
8. Tenure status of Housing – squatter

The last five variables were dichotomized and the first variable, of course, had perfect predictive power.

In coming up with the decision tree, a number of approaches were tried but only those that seemed to produce a reasonable measure of vulnerability incidence are presented.

First Approach:

1. In accordance with the definition of vulnerability in this paper, the poor families in the FIES sample were taken out, leaving only the nonpoor families, from whom the vulnerable families will be identified.
2. Cluster analysis is performed on the remaining sample families (the nonpoor families) using incpov, producing three clusters, one of which is identified as the most vulnerable to poverty. The median of incpov is computed for the most vulnerable cluster, and all families with income above this median are taken out from the sample.
3. For the sample left, the median of fetbe (the variable with the highest coefficient in the logistic regression) is computed and all families with fetbe below the median are taken out.
4. The median of expinc (the variable with the second highest coefficient) is computed and all families with expinc below the median are taken out.
5. Families that pass the following criteria (on the remaining variables) simultaneously are taken out:

roof_weak = 0, water_unsafe = 0, squatter = 0, not_wage=0,
no_hsdeg = 0

6. The remaining families are considered to be the vulnerable families.

Second Approach

1. Same as #1 of the First Approach.
2. Cluster analysis is performed on the remaining sample families (the nonpoor families) using incpov, producing three clusters, one of which is identified as the most vulnerable to poverty. The medians of incpov, fetbe and expinc are computed for the most vulnerable cluster. Families that pass the following criteria simultaneously are taken out :

incpov > med (incpov), fetbe < med (fetbe), expinc < med (expinc)

3. Same as # 5 of the First Approach
4. The remaining families are considered to be the vulnerable families.

Third Approach

1. Same as #1 of the First Approach.
2. For the remaining sample families (the nonpoor families), compute the medians of incpov, fetbe and expinc. Families that pass the following criteria simultaneously are taken out:

incpov > med (incpov), fetbe < med (fetbe), expinc < med (expinc)

3. Same as #5 of the First Approach.
4. The remaining families are considered to be the vulnerable families.

Fourth Approach

1. Same as #1 of the First Approach.
2. Cluster Analysis is performed on the remaining sample families using incpov, fetbe and expinc, producing three clusters. One of these clusters is a group of families that appears to be the most vulnerable group because, among the three clusters, it had the lowest median for incpov and the highest median for both fetbe and expinc. From this most vulnerable cluster, families that pass the following criteria simultaneously are taken out:

$$\text{incpov} > \text{med}(\text{incpov}), \text{fetbe} < \text{med}(\text{fetbe}), \text{expinc} < \text{med}(\text{expinc})$$

3. Same as #5 of the First Approach.
4. The remaining families are considered to be the vulnerable families

B. Measuring Vulnerability Incidence

In this paper, the vulnerability incidence V for a province is defined as the incidence of vulnerable families in the province, i.e.

$$\begin{aligned} V &= n_v / N \\ \text{where } n_v &= \text{number of vulnerable families in the province} \\ N &= \text{total number of families in the province} \end{aligned}$$

Using the FIES⁴ survey data, n_v and N are estimated as follows:

$$\begin{aligned} n_v &= \frac{\sum w_i I_i}{\sum w_i} \\ N &= \sum w_i / 10 \\ \text{where } w_i &= \text{FIES weight of family } i \\ I_i &= \begin{cases} 1, & \text{if family } i \text{ is vulnerable and} \\ 0, & \text{if family } i \text{ is not vulnerable.} \end{cases} \end{aligned}$$

The values of I_i are determined using anyone of the four approaches previously described.

Similarly, for a region or for the entire country, the vulnerability incidences are

$$\begin{aligned} V &= n / N \\ \text{where } n &= \text{number of vulnerable families in the region/country} \\ &= \text{sum of the numbers of vulnerable families in the provinces of the region/country} \\ N &= \text{total number of families in the region/country} \end{aligned}$$

⁴ The true FIES weights have been multiplied by 10.

V. Results

Logistic Regression

The logistic regression using the STATA software resulted in the variables that are statistically significant in identifying whether a family is poor or nonpoor (at the national level, using the 2000 FIES) as shown below.

Table 1. Results of Logistic Regression

Variable	Coefficient	Std. Error	t	Prob>t
roof_weak	1.260973	0.0413839	30.47	0.000
water_unsafe	0.7302809	0.0507253	14.4	0.000
squatter	0.2018856	0.1017905	1.98	0.047
fetbe	6.170946	0.4921358	12.54	0.000
notwage	0.2965064	0.0400517	7.4	0.000
no_hsdeg	1.927617	0.1319703	14.61	0.000
expinc	3.703553	0.1104741	33.52	0.000
cons	-11.20805	0.3519165	-31.85	0.000

Note: The variable incpov predicts data perfectly.

Table 2. Correlation Matrix

Variable	poor	Roof_w~ k	water_~e	squatter	fetbe	incpov	expinc	notwage	no_hsde g
Poor	1								
roof_weak	0.3292	1							
water_unsafe	0.2172	0.1869	1						
Squatter	0.0368	0.0616	0.036	1					
Fetbe	0.2154	0.2803	0.144	-0.0002	1				
Incpov	-0.3007	-0.2047	-0.1334	-0.0433	-0.1471	1			
Expinc	0.328	0.0962	0.0753	0.0185	0.0869	-0.2802	1		
Notwage	0.1664	0.1083	0.1567	-0.0096	0.2131	-0.1111	0.091	1	
no_hsdeg	0.1953	0.1631	0.0996	0.0351	0.1261	-0.3533	0.1191	0.1526	1

Some variables that were also considered but eventually dropped because of multicollinearity considerations. These were as follows:

Variable	roof_weak	incpov
wall weak	0.7295	
Pcfood		0.6815

The results of the cluster analysis in the Fourth Approach and the results of the four approaches for the Philippines, together with the estimates of the vulnerability incidence are presented in **Tables 3** and **4** below:

Table 3. Results of Cluster Analysis

	Cluster	Median		
		incpov	fetbe	expinc
Philippines	1	3.5562	0.6475	0.8130
	2	1.5594	0.6714	0.9091
	3	8.4355	0.6456	0.7129

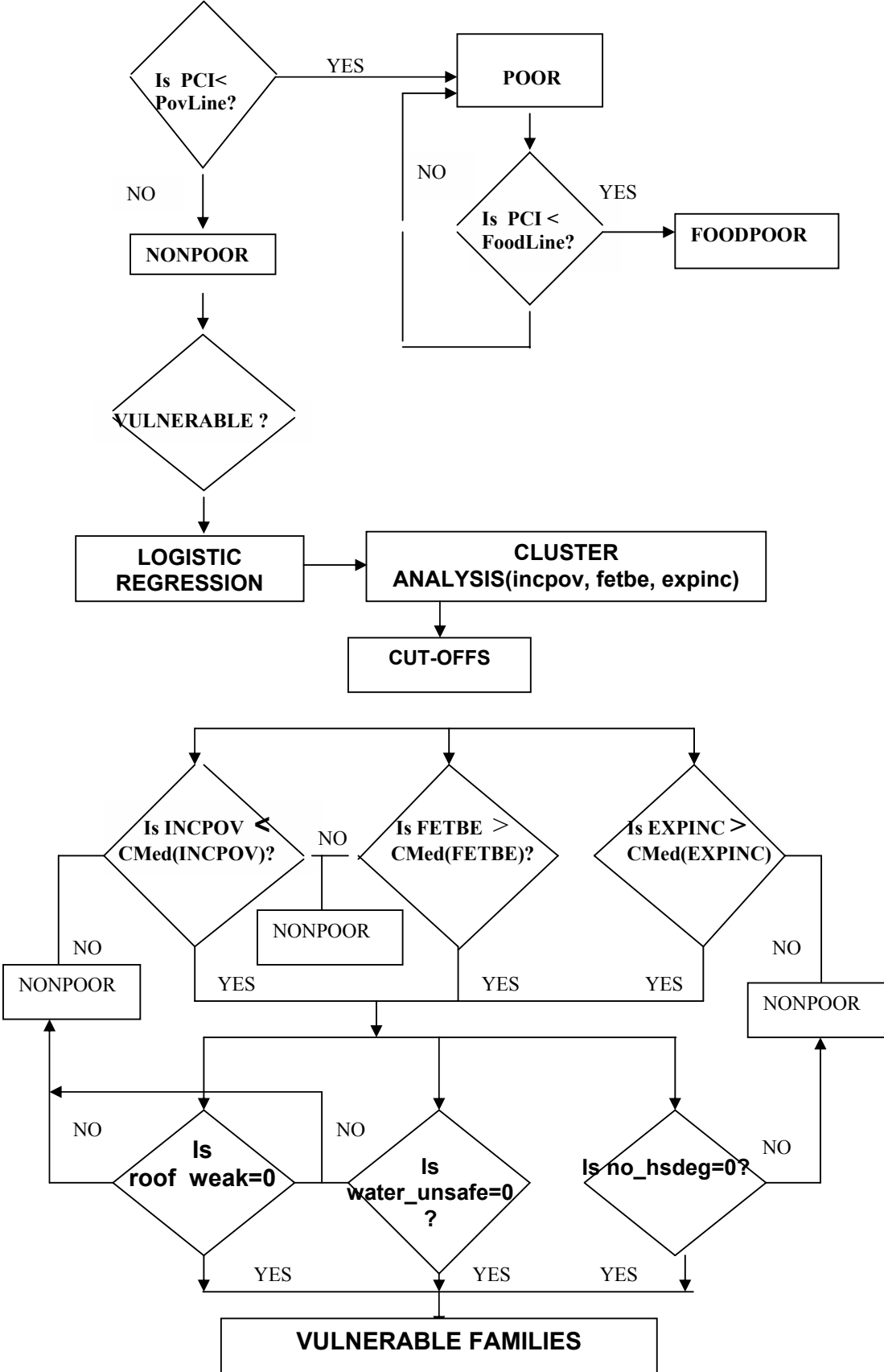
Table 4. Summary Results of the Four Approaches in Vulnerability Incidence

Approach	Incpov	Fetbe	Expinc	Vulnerability Incidence (%)
	<?	>?	>?	
First	1.5602	0.6791	0.9233	8.4
Second	1.5602	0.6714	0.9086	48.6
Third	2.1273	0.8666	0.6570	75.4
Fourth	1.5594	0.6714	0.9091	48.5

Based on the results of the four approaches, the fourth approach which performs the cluster analysis using the three variables incpov, fetbe and expinc, imposes simultaneously the median cut-offs of these three continuous variables and further subjecting the remaining families to simultaneous satisfaction of conditions on the four dichotomous variables appears to be the most appealing because it demonstrated the consistency of the criteria in identifying the vulnerable cluster. **Figure 4** shows the diagrammatic scheme for implementing the Fourth Approach. However, the second approach, which differs from the fourth only in terms of using only one clustering variable (incpov) is also worth considering, especially because these two approaches produced basically the same vulnerability incidence.

The fourth approach was also tested on the 1997 FIES data for three provinces. One province has the highest percentage point deterioration in poverty incidence [4] from 1997 to 2000 (Tawi-tawi), one province has the highest percentage point improvement in poverty incidence (Siquijor) and the third province has a poverty incidence that barely moved from 1997 to 2000 (Kalinga). The result for Siquijor was initially surprising because its poverty incidence declined significantly from 1997 to 2000 and yet it had a high vulnerability incidence in 1997. Thus, the exercise was tried for a second province, Davao Oriental, which had the second highest decline in poverty incidence from 1997 to 2000. The same “surprising” result was obtained. The poverty gap, income gap and FGT measure for the two provinces of Siquijor and Davao Oriental [4], however, also show improvements consistent with the decline in their poverty incidence. This leads to the realization that in looking at the vulnerability of a province, a more complete and accurate picture and more useful information will be generated if one looks not only at the nonpoor families becoming poor but also at the poor families becoming nonpoor, particularly those with income close to the poverty line. Of course, it is also possible that the program intervention and poverty alleviation efforts in these two provinces were quite successful. The results are shown in **Table 5** below:

Figure 4. Identification of Vulnerable Families (Fourth Approach)



It is worth mentioning that in the application of this methodology, the choice of the number of clusters also depends on the budget available to carry out the intervention programs designed for the vulnerable groups. Thus, the number of clusters and the resulting median cut-offs may be increased or decreased depending on the resources available for designing the poverty reduction programs for the vulnerable families and the vulnerable provinces.

Table 5. Vulnerability Incidence of Selected Provinces

Province	No. of Vulnerable Families	Total Non-Poor Families	Vulnerability Incidence	1997-2000 Increase/ Decrease in Poverty Incidence		FIES Sample Size
Kalinga	1,009.90	18,208.20	5.55	0.10	no change	181
Tawi-Tawi	12,680.30	34,501.30	36.75	21.50	increasing	240
Siquijor	5,118.10	10,895.50	46.97	(16.10)	decreasing	191
Davao Oriental	30,131.40	74,244.90	40.58	(12.30)	decreasing	678

VI. Limitations of the Study

As already mentioned, the original plan was to use panel data to be able to ascertain the validity of the methodology used. In the absence of panel data from the FIES, the validity of the methodology can be assessed by looking at the vulnerability incidence at time t and comparing this with the trend of poverty incidence from time t to time $t+1$. Provinces with high vulnerability incidences at time t are expected to have their poverty incidences to worsen or at least not improve from time t to time $t+1$. Conversely, provinces with low vulnerability incidences may have their poverty incidences improve from time t to time $t+1$.

Unfortunately, time constraint did not allow this to be evaluated in the paper. The same time constraint did not allow the paper to show the results for all the provinces. Thus, the methodology was applied to the whole country, i.e. to the entire FIES file instead of to each individual province to come up with the vulnerability incidence for the whole country.

As the purpose of the paper is to come up with a holistic approach to measuring vulnerability, the proposed methodology does not claim to be optimal by any means. Already, the computations for Siquijor and Davao Oriental indicate the need to re-define the concept of vulnerability to take into consideration the poor families with income close to the poverty line and have good chances of becoming nonpoor.

VII. Future Directions/Recommendations

One of the problems encountered in the preparation of this paper is the absence of panel data from the FIES. The proposed methodology also did not benefit from a thorough evaluation of its merits. In this light, the following recommendations are made:

1. The PSS, the NSO, in particular should consider incorporating a panel in the FIES to allow for richer analyses. This does not have to be done in one stroke and it is not necessary to have a panel for all the domains of the FIES.
2. The methodology proposed in this paper should be subjected to further refinements. More testing with the FIES data will enhance the evaluation of the approaches presented in the paper. And the inclusion in the analysis of the poor families with income close to the poverty line should be considered.
3. The Technical Committee on Poverty Statistics under the NSCB should evaluate the proposed methodology for possible inclusion in the poverty statistics generated by the NSCB.
4. Finally, political will should be demonstrated by all concerned in the allocation of resources to the generation of good quality official poverty statistics.

Acronyms

FIES	FAMILY INCOME & EXPENDITURES SURVEY
NSCB	NATIONAL STATISTICAL COORDINATION BOARD
NSO	NATIONAL STATISTICS OFFICE

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