ASSESSING VULNERABILITY TO POVERTY IN FISHING COMMUNITIES*

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ABSTRACT

In this paper we develop an index of economic vulnerability which we use conjointly with a more conventional measure of income poverty to explore the different dimensions of poverty (transient, chronic, vulnerability) that affect fishing communities in developing countries. We illustrate the potential uses of this method with cross-sectoral data of farming-fishing communities from a remote rural area in Democratic Republic of Congo. In line with recent works on poverty and vulnerability our analysis suggests that income poverty and economic vulnerability are only loosely correlated at the household level. In particular, the data show that households can remain highly vulnerable even when their incomes lie well above the average local income. The analysis also highlights the high vulnerability of full-time fisherfolks and identifies mobility as a key-factor increasing vulnerability. These different results are consistent with the conclusions usually proposed in the more specialized literature on small-scale fisheries in Africa.

Keywords: Vulnerability index; Income poverty; Small-scale fisheries; Methodology

INTRODUCTION

The last 15 years have seen rapid progress in our understanding of poverty. Moving away from the initial view of poverty as a static (low-income) condition, recent research has highlighted the importance of considering the dynamic nature of poverty. Baulch and Hoddinott [1] for instance, reviewing work in developing countries, conclude that the 'poverty problem' is often one involving a large turnover of vulnerable people rather than a large core group of chronically poor. Economists are thus increasingly stressing the importance of the distinction between transitory and chronic poverty [2,3,4] and how these relate to the concept of economic vulnerability [5,6,7].

Pioneering studies on vulnerability highlighted the greater exposure and lower resilience of the chronically poor to idiosyncratic or covariant livelihood shocks [8,9] and vulnerability is now recognized as a central element of poverty [8,10,11]. Recent work demonstrates, however, that while vulnerability and poverty are related, they are not systematically correlated [12]. These recent refinements in the conceptualization of poverty have important implications for the ways poverty in developing countries is conceptualized and addressed.

In fisheries, the conventional perception conveyed by the literature is that fisheries (especially small-scale fisheries in less-developed countries) and rural poverty are intimately correlated (see e.g. [13]) conveying the idea of a structural, chronic (or even persisting) poverty in fishing communities. Panayotou contends for instance that "the fundamental problem of small-scale fishermen around the developing world is their persisting absolute and relative poverty" [14, p.1 -–emphasis are ours].

This particular view has, however, been recently disputed by several authors (e.g. [15,16]). These authors argue that fisherfolks are not necessarily the poorest of the poor in monetary terms, but may, instead, be amongst the most vulnerable socio-economic groups, due to their particularly high exposure to certain natural, health-related or economics shocks and disasters [16].

The question of whether fishers are chronically poor because of the inherent low-productivity of the sector, or vulnerable to poverty due to their high exposure to risks and shocks, or possibly both, has immediate relevance for the design of cost-effective poverty reduction strategies. Unfortunately very little information exists that would allow scholars and policy-makers to acquire a better understanding of these issues. Fisherfolk, particularly inland fishing communities, are notoriously marginalized in national statistics, especially in developing countries. While a few rapid rural appraisals and qualitative poverty profilings have been conducted in fishing communities in West Africa during the early 2000s through the Sustainable Fisheries Livelihood Programme [17], no quantitative and longitudinal survey focusing specifically on this group exists in most sub-Sahara African or even Asian countries.

This data-poor environment represents a major limitation for fisheries economists, as the estimation of transient and chronic poverty and the measurement of vulnerability depend largely on the existence of reliable longitudinal data [18,19,20]. In the absence of those longitudinal data, it seems difficult to draw rigorous conclusions regarding the level and nature of poverty and vulnerability in fishing communities - unless some alternative metric is developed that can make use of the few cross-sectional surveys that are available at the present time. The objective of this paper is to propose such metric, and to illustrate its potentials with data collected amongst a group of farming households engaged in fishing activities in the Salonga area in the Congo Basin (Democratic Republic of Congo).

METHODOLOGY

Concept and measure of vulnerability

In its most widely accepted form, the concept of vulnerability has been defined as a composite factor having two dimensions –exposure to risk, and susceptibility [8,21,5,6]. Exposure usually refers to shocks or stresses that are generic to a given group (i.e. 'covariate' risks, such as drought, flood, or outbreak of crop-pest) and susceptibility is a measure of (lack of) ability to cope with, and recover from, risk factors that are specific to individuals or individual households ('idiosyncratic' risk such as illness, death, or lost of job). Measuring and quantifying such composites is not straightforward and economists have only recently attempted to develop quantitative measures of vulnerability, essentially focusing on welfare and in particular economic vulnerability -see [18,22,12,7].

All these approaches are based on the same underlying framework where vulnerability is quantified through the probability of attaining (or failing to attain) a certain welfare level (be it in terms of income, consumption, education or health), calculated on the basis of past information. Within this framework, a person is considered vulnerable if the probability of attaining this welfare level is lower than a given probabilistic threshold [18, p.2]. McCulloch and Calendrino [12] for instance propose to measure vulnerability to income-poverty as the probability of falling below the poverty line in any given year, that is:

$$V_i = \text{Prob}\left(y_{it} < \bar{z}\right) \qquad (1)$$

where V_i is the proposed vulnerability index, y_{it} is the total consumption expenditure of household i in year t, and $\bar{z}$ is the poverty line[a].

Technically these types of measure require longitudinal (panel) data recorded for the same groups of households over a certain period. Such a data requirement is a major challenge in Sub-Saharan Africa where household data are relatively scarce or fragmented. Small-scale fishers, and in particular inland small-scale fishing communities, are doubly affected by these issues, first because a large number of them are temporally or seasonally mobile, living part of the year in provisional or itinerant fishing camps located in areas which are often inaccessible for several months of the year, and secondly because they are usually not properly incorporated into a distinct professional category but instead included into the all-encompassing 'smallholder farmers' category in national statistic systems –making them virtually 'invisible' as fishers. As a result, quantifying the specific poverty and vulnerability levels affecting small-scale fishing communities may reveal particularly challenging.

A cross-sectional vulnerability index

In this section, we propose an alternative approach to estimate household economic vulnerability when no longitudinal data exists. For this, we develop a vulnerability index that can be estimated from cross-section data. To develop this vulnerability index, we first return to the original definition of vulnerability as being a combination of the two concepts of exposure and susceptibility. We then follow Devereux who proposes that, at the household level, a proxy for exposure could be the coefficient of variation of food production or earned income, while a proxy for susceptibility might be the proportion of food consumption or income derived from the household's primary economic activity [6, p.509]. Following this definition, a basic index of economic vulnerability would look like:

$$V_{ig} = CV_g \cdot Dep_{ia} \qquad (2)$$

where V_{ig} is the vulnerability index, CV_g is the coefficient of variation (CV) of households' incomes belonging to the same group g, and Dep_{ia} is the proportion of total cash-income (thereafter referred to as cash dependence) of the household i derived from its main activity a. Dep_{ia} is therefore a percentage that varies from 0 to 1. As it stands the index (2) indicates that the overall vulnerability of household i results from the combined effect of covariate shocks affecting the entire group g –captured through the exposure proxy CV_g - and the idiosyncratic susceptibility characterizing individual households -expressed through Dep_{ia} . In sectional data, however, one can only estimate the variability of expenditure or income across households, not over time. One has therefore to hypothesize that this variation across households somehow mirrors consumption or income changes over time. One would therefore have to modify Devereux' initial index and assume that the individual households' exposure to covariate risks over time is captured through the heterogeneity of the group's income and reflected in CV_g.

In this form, however, the index does not reflect the fact that households traditionally diversify their activity 'portfolio' by engaging in several subsistence or commercial activities in order to decrease the adverse impact of uncertain environment and market fluctuations [23,24,25]. To account for this important relation between vulnerability and diversification, we include a 'diversification' component in the index (2), as follows:

$$V_{ig} = CV_g \cdot Dep_{ia} \cdot \frac{1}{Div_i} \qquad (3)$$

where $Div_i = A_i \cdot (1 - Dep_{ia}) + \sqrt{Sub_i + 1}$ with A_i : the total number of activities in which the household *i* is engaged, and Sub_i : the number of subsistence activities amongst this total number. The first component $A_i \cdot (1 - Dep_{ia})$ accounts for the effect of economic diversification, but is weighted by the total relative importance of the complementary activities in which the household is engaged (aside its main income-generating activity *a*). The second component $\sqrt{Sub_i + 1}$ accounts for the diversification through subsistence-based activities. The square root is used as we assume a decreasing marginal positive effect of those subsistence activities on household vulnerability. A constant 1 is added in the square root to allow for the computation of Div_i in the case where $Dep_{ia} = 1$ and $Sub_i = 0$ [b].

Finally, while we acknowledge that income poverty and vulnerability are separate concepts, we also recognize that *ceteris paribus* a household who is far above the poverty line is less likely to be poverty-vulnerable[c] than a household who is just above the poverty line. We therefore include a poverty gap component in the index so that it finally becomes:

$$V_{ig} = CV_g \cdot Dep_{ia} \cdot \frac{1}{Div_i} \cdot Pov_i \qquad (4)$$

where $Pov_i = \sqrt{\bar{z}/z_i}$ with $\bar{z}$: the poverty line, and z_i : the daily cash-income of household *i*. Note that we use the square root of the poverty gap as we assume a decreasing marginal positive effect of this poverty gap on household vulnerability. See [26] for the details of the full methodological analysis.

THE DATA

The empirical relevance of the index is tested with data obtained from a survey implemented in 2006 along two of the main rivers of the Salonga area in Democratic Republic of Congo, the Luilaka River and the Salonga River [27]. Along the 519 km of river that were sampled, 104 fishing camps and landing sites were counted, of which 43 were surveyed randomly (41% of the total number).

For fish products, estimate of the total catch over the last fishing season (approximately 3 months) was made through individuals' interviews and extrapolated to the whole year after adjustment for catch yield seasonality. These seasonal adjustment coefficients were estimated during focal groups and triangulated during individual interviews. Estimates of the fish home-consumed and the cash-incomes derived from marketed crops were obtained through the same approach.

Additional information about the originating village of the households (size, proportion of households engaged in fishing activities, distance and time to travel from the fishing camp) were also recorded. Based on this last information, the households were divided into two groups. Households originating from villages from more than seven walking or paddling hours (i.e. one full-day of travel) were considered non-local and categorized as "comers" -in reference to the Congolese French name ("les venants") used by the local population to designate them-, while households originating from villages less than one-day travel were considered 'resident'. These two groups were farther divided according to the river they were operating on when interviewed (river Salonga versus river Luilaka). Based on this partitioning, four 'geo-economic' groups were identified:

- Resident fishers operating along the Salonga, noted [Res-Sal];
- Resident fishers along the Luilaka [Res-Lui];
- Comers operating along the Salonga [Com-Sal];
- Comers operating along the Luilaka [Com-Lui].

RESULTS

The level of economic vulnerability of the individual 74 households was computed using the index as defined in (4). Fig.1 represents the scatter plot of those vulnerability indexes (X-axis) and total cash income (Y-axis). No apparent pattern or trend seems to emerge from the scatter plot. A series of subsequent analyses were performed to verify this graphical observation.

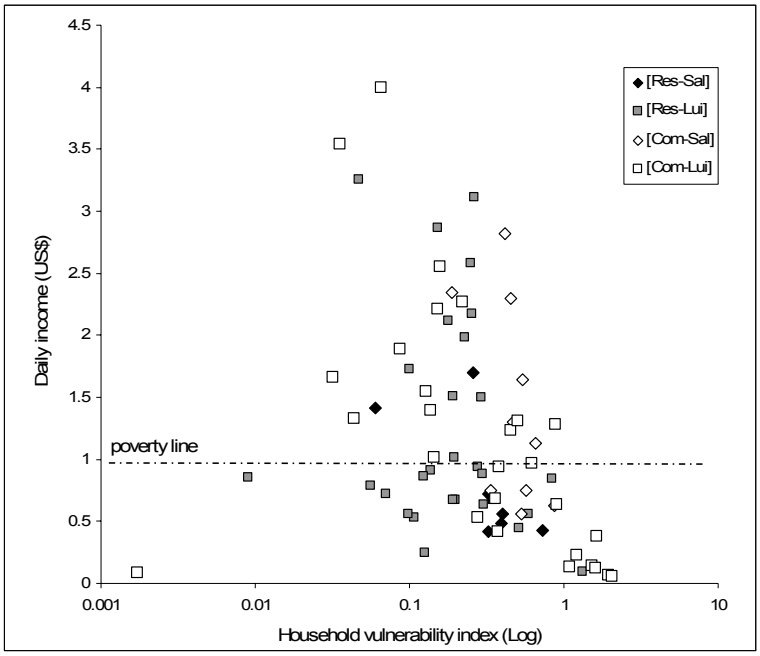

Fig.1. Scatter-plot of the 74 households' vulnerability index and total cash-income for the four groups [Res-Sal], [Res-Lui], [Com-Sal], and [Com-Lui] (the vulnerability index series has been log-transformed).

First, the vulnerability indexes of the households were compared between the four groups [Res-Sal], [Res-Lui], [Com-Sal], and [Com-Lui]. The objective was to determine whether differences in the level of economic vulnerability exist between these four groups and, if so, whether these differences can be linked to the status of the households (resident versus 'comers'), or to other external factors related to the location of their fishing grounds (Salonga River versus Luilaka River). The results are summarized in Table 1. The average vulnerability index of fishers operating along the Salonga River is similar to that of the fishers operating along the Luilaka River (0.441±0.09 and 0.436±0.02 respectively). In contrast, the level of vulnerability of the comers is almost twice as high as that of the residents (0.582±0.07 versus 0.284±0.05). A 2-way Anova indicates that the difference in vulnerability related to the latest result (resident versus comers) is significant ($F_{0.1(1,73)} = 2.77$; $F_{obs} = 3.92$ $P = 0.05$), with both groups of 'comers' displaying the two highest degrees of vulnerability (0.502 for [Com-Sal] and 0.611 for [Com-Lui]). Neither the location ($F_{obs} = 0.007$; $P = 0.93$), nor the interaction between the two factors ($F_{obs} = 0.62$; $P = 0.43$) are statistically significant. In summary: the comers have on average a higher level of economic vulnerability than the residents, irrespective of the location (river) from which they operate.

A parallel analysis was made on the daily income after adjustment for fish subsistence and barter. The analysis (Table 2) shows that the income of the comers is more than 25% higher than the income of the residents (US$ 1.29±0.32 vs. US$ 1.03±0.30). The difference however is not statistically significant

($F_{0.1(1,73)} = 2.77$; $F_{obs} = 1.102$; $P = 0.29$). Similarly, the average income of the Salonga River fishers is not significantly different from that of the Luilaka fishers (US$ 1.12±0.35 vs. US$ 1.20±0.22) ($F_{obs} = 0.096$; $P = 0.75$). Comparing these results with the vulnerability analysis suggests that groups of households which do not differ significantly from one another in terms of daily income can however be characterized by statistically different levels of economic vulnerability. This is the case in particular for the two groups of comers [Com-Sal] and [Com-Lui].

Table 1. Two-way analysis of variance testing the effect of fishers' status (resident vs comer) and location (Salonga River vs Luilaka River) on household vulnerability.

status (residents vs comers)				location (Salonga vs Luilaka)				interaction (status × River)	
Group	N	Mean	(95%CI)	Group	N	Mean	(95%CI)	Group	Mean
residents	36	0.284	(0.05)	Salonga	17	0.441	(0.09)	res. × Sal.	0.355
comers	38	0.582	(0.07)	Luilaka	57	0.436	(0.02)	res. × Luil.	0.268
								com. × Sal.	0.502
								com. × Luil.	0.611

Source of Variance	d.f.	SS	MS	*F*	*P*	
Status	1	0.766	0.766	3.92	0.05	*
Location	1	0.001	0.001	0.007	0.93	NS
status × river	1	0.122	0.122	0.62	0.43	NS
Residual	70	13.68	0.195			
Total	73	15.45	0.211			

*: significant ($\alpha = 10\%$); NS: non significant

Table 2. Two-way analysis of variance testing the effect of fishers' status (resident versus comer) and location (Salonga River versus Luilaka River) on household cash-income.

status (residents vs comers)				location (Salonga vs Luilaka)				interaction (status × River)	
Group	N	Mean	(95%CI)	Group	N	Mean	(95%CI)	Group	Mean
residents	36	1.03	(0.30)	Salonga	17	1.12	(0.35)	res. × Sal.	0.819
comers	38	1.29	(0.32)	Luilaka	57	1.2	(0.22)	res. × Luil.	1.233
								com. × Sal.	0.414
								com. × Luil.	0.388

Source of Variance	d.f.	SS	MS	*F*	*P*	
status	1	0.913	0.913	1.10	0.29	NS
location	1	0.079	0.079	0.09	0.75	NS
status × river	1	1.440	1.440	1.73	0.19	NS
Residual	70	57.993	0.828			
Total	73	59.566	0.816			

NS: non significant

In Fig.2, we combine the results of the last two analyses into a scatter plot showing the average vulnerability index (X-axis) vs. daily income (Y-axis) calculated for the four groups. The figure confirms the conclusions highlighted above. The two groups of comers [Com-Sal] and [Com-Lui] are located on the right side of the scatter plot, exhibiting relatively higher average vulnerability indexes than the two groups of residents [Res-Sal] and [Res-Lui]. On the Y-axis, the income levels of three out of the four groups fluctuate around US$ 1.2 per day, while the average income of the fourth group [Res-Lui] remains below the poverty line, around US$ 0.8 per day.

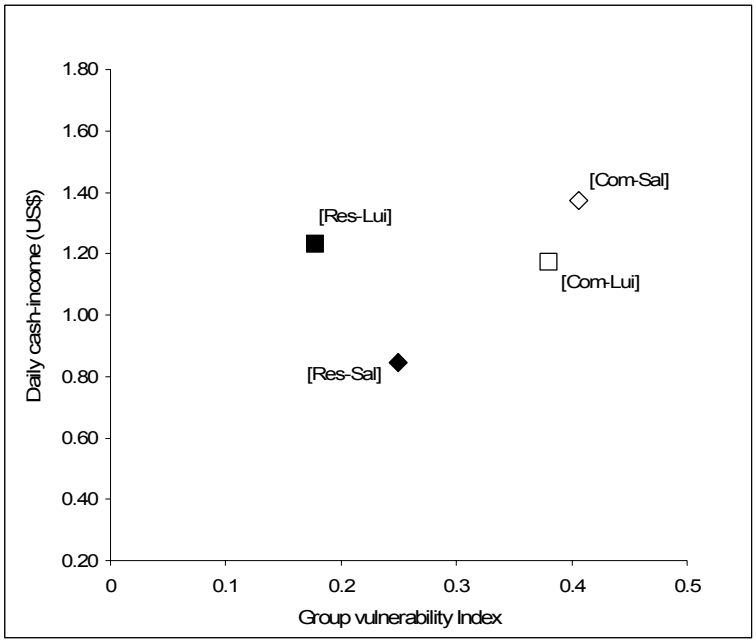

Fig.2. Scatter plot of the average vulnerability index and daily income of the four groups of fishers surveyed in the Salonga area.

DISCUSSION

We were interested in this article in exploring the potential link that exists between poverty and vulnerability in small-scale fishing communities. While a reasonable number of methods have been developed to quantify economic or more generally welfare vulnerability, most of these recent techniques rely on large samples of longitudinal data. These data sets, unfortunately, are rarely available for mobile and/or geographically isolated socio-economic groups such as fishing communities. To address this limitation we proposed in this paper a simple vulnerability index calculated on single-round cross-sectional data.

In fisheries, while fisherfolks have been commonly associated in the literature with chronic poverty, some recent works have questioned this assumption, emphasizing instead the potentially very high vulnerability that can affect the households engaged in this sector [16]. The question of whether fisherfolks are chronically poor or mainly vulnerable is therefore pertinent and responses to this question will have important implications for policy and poverty alleviation programs. Chronically poor fishing households can be defined as being unable to maintain a minimum living standard even with the resource at their disposal. In that case, poverty reduction policies should promote interventions that improve the capacity of the fishers to enhance the productivity of the sector through, e.g., improved marketisation, micro-credit or post-harvest losses management programs. On the other hand, vulnerable fishing households are those households that may initially be above the 'welfare threshold' (e.g. poverty line) but face risks or shocks that could drive them below that threshold almost instantaneously (e.g. loss of boat, fishing gear or even loss of life). In that case, vulnerability interventions should try to address the risks and uncertainty that affect the households through, e.g., provision of social safety nets, reduction of income dependence on fishing, diversification of livelihoods, or improved access to formal insurance schemes.

In the case of the Salonga area, the conceptual distinction between vulnerability and income poverty turned out to be relevant as it shows that some groups of households that are not income-poor, may

nonetheless be highly vulnerable. This was the case, in particular, of the comers who appear to be exposed to much higher levels of vulnerability than the residents and yet display equivalent or even higher daily-income levels.

These results present interesting similarities with some of the conclusions proposed in the literature on small-scale fisheries where a distinction is usually made between 'migrant fishermen' [28] -usually full-time fishers using specialized gears-, and 'multi-active sedentary fishermen or farmer fishermen' [29]- who engage generally in fishing as part of a more diversified livelihood strategy. Explicitly associated with this dichotomy is the assumption that full-time fishers are usually highly productive but at the costs of higher risks, whereas fishing farmers are more risk-averse but generally less efficient[d]. Morand and his co-authors concisely summarize this situation in the case of West African inland fishers.

> "These groups [of migrant fishers] appear to have been the first to include families whose livelihood strategies were entirely based on fishing, with all the constraints (mobility) equipment (large canoe) and know-how (navigation) that this implies. This singular way of life resulted in a particular mindset and this is why these groups continue to be thought as the 'real fishermen'. However the first model of livelihood strategy [the farmer fisherman] long remained the most widespread and common in West Africa probably because it is the safest: the farmer fisherman produces his own domestic needs in cereals and can thus feed his family without depending on the market. By contrast the migrant professional fisherman is exposed to a larger number of risks of all kinds. However he has the advantage, when everything is going well, of deriving substantial monetary income from the sale of fish, which enables him more easily to move within the now dominant market economy" [33, p.76].

The Salonga data are consistent with this typology. First, the analysis shows that the majority of households in the Salonga area have adopted a multi-activity livelihood strategy while only few are engaged in full-time fishing. Second, the data show that the group of 'migrant fishers' (i.e. the 'comers') is characterized by higher average household income than the group of resident fishers. This, again, is in line with the quote above where Morand and his co-authors describe the migrant fishers as those who derive "substantial monetary income from the sale of fish". Finally, and more importantly in relation to our discussion on vulnerability, both comers and full-time fishers were identified as the most vulnerable groups. In Morand's model, these migrant and full-time fishers are also the most vulnerable groups that are "exposed to a larger number of risks of all kinds".

CONCLUSION

This research was motivated by the urgent need to improve our understanding about the different dimensions of poverty (chronic poverty, vulnerability) that affect fishing communities in developing countries. For this, we developed an index of economic vulnerability that was then used in combination with a more conventional economic measure of poverty to explore the potential links between vulnerability and income-poverty.

One of the advantages of the vulnerability index as proposed in this article is that it can be computed for individual households originating from different groups (e.g. different villages characterized by dissimilar ecological / economic conditions, diverse livelihood strategies and different degrees of exposure to uncertainty), thus allowing comparative analysis of vulnerability amongst different socio-economic groups. Also importantly, our vulnerability index does not require long time series or longitudinal data. However, a series of important caveats are attached to this last point and are discussed in earlier parts of this article. In brief, the vulnerability index suffers from the same limitations than other approaches using cross-sectional data. In particular, the index strongly depends on the period at which the cross-sectional data are collected, requiring additional attention when interpreting the results. One the other hand, the

index can be used to estimate vulnerability from data collected through single surveys of few dozens of households, which is an important advantage, in particular in situations where data are scarce, as it is often the case in field research conducted in developing countries.

The index shows a strong consistency both with the recent econometric analyses on income poverty and vulnerability, and with the more descriptive work proposed in the literature on fishing livelihood strategies. These different evidences confirm that this new vulnerability index can provide a simple but meaningful methodology to analyse economic vulnerability.

In the specific case of the Salonga fisherfolk, while the analysis does not provide any definite answer on the real nature of 'poverty', it is the first attempt to include more formally the concept of economic vulnerability in the research on small-scale fisheries. It shows the need to go beyond the static vision of fishers as being the 'poorest of the poor' where poverty is considered as a chronic status reflecting essentially low endowments and low returns to these endowments, towards a more dynamic vision where 'poverty' is understood as a conjunction of these chronic factors combined with a particularly high vulnerability to shocks and external changes.

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ENDNOTES

[a] To compute this probability function (1) in any given year, McCulloch and Calendrino [12] assume the distribution of the inter-temporal consumption for each household to be normal and use the longitudinal component of the individual household data to estimate the mean and the variance of this distribution.

[b] In addition, note that because *Sub* is an integer, adding 1 in the square root ensures the linearity of the function $\sqrt{Sub_i + 1}$ on 1.

[c] In the sense defined by McCulloch and Calendrino [12] –see equation (1) above.

[d] This assumption is also consistent with the hypothesis generally accepted in agricultural economics about the existence of an inverse relationship between small-scale farmers' productivity and their degree of risk-aversion [30,31,32].