

Panzootics and the poor: devising a global livestock disease prioritisation framework for poverty alleviation

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Summary

Panzootics such as highly pathogenic avian influenza and Rift Valley fever have originated from the South, largely among poor communities. On a global level, approximately two-thirds of those individuals living on less than US\$2 per day keep livestock. Consequently, there is a need to better target animal health interventions for poverty reduction using an evidence-based approach. Therefore, the paper offers a three-step prioritisation framework using calculations derived from standard poverty measures: the poverty gap and the head count ratio. Data from 265 poor livestock-keeping households in Kenya informed the study. The results demonstrate that, across a spectrum of producers, the dependence upon particular species varies. Furthermore, the same livestock disease has differing impacts on the depth and severity of poverty. Consequently, animal health interventions need to account for variability in income effects at the species and disease levels.

Keywords

Eradication – Global – Global animal health – Livestock disease – Livestock keeper – Poor – Poverty – Prioritisation.

Introduction

A number of zoonotic and panzootic diseases such as severe acute respiratory syndrome, Rift Valley fever and highly pathogenic avian influenza have emerged from communities in the South, largely among the poor. And it is unlikely that this trend will reverse. Conservative estimates place the worldwide population of smallholder farmers between 1.5 and 1.9 billion (1, 44). This figure, however, ignores the landless and urban poor, who in many developing countries also keep livestock (29, 40). Thus, the global community of poor livestock keepers is vast and growing (1, 6, 22, 44).

The sustainability of livestock-based livelihoods of the poor is greatly impacted by livestock disease (19, 20, 31, 32). Lack of access to services and appropriate knowledge regarding disease prevention and treatment are critical barriers (19, 20, 25). It is increasingly recognised that, for

the development community to address these needs, efforts must be better focused (37). In recent years there has been an interest in rationalising resources within the health sector (21), by combining human and animal health services/interventions (often referred to as the 'one medicine' paradigm) (45, 46). Any such attempt at combining resources in the South will be greatly aided by an evidence-based prioritisation process for animal health.

While the concepts of Disability Adjusted Life Years and Quality Adjusted Life Years have informed resource allocation in the human health sector (28, 30, 39), no such calculation exists for animal health. While such approaches in human health management are not without criticism (30), any ethical arguments against the rationalisation of resources on the animal health side are clearly less relevant.

Within the livestock sector, prioritisation exercises have largely been undertaken at the institutional level (33).

There are notable exceptions: Perry *et al.* (32) performed a wide-ranging study to discern the livestock disease priorities of the poor to better target animal health interventions. However, the data inputs were limited to focus groups of experts. Other attempts to base disease priorities simply on those ranked or rated by the poor themselves (2, 3, 4) suffer similar problems, with practitioner and community-level bias (23, 26). Thus, the application of priority-setting methods does not guarantee impartiality and fairness (33, 34), as such exercises are often heavily influenced by the demands of stakeholders (25). As Perry *et al.* noted (34):

‘...[at] the national and international levels...[livestock disease] priorities become much more difficult to distinguish both in terms of the magnitude of the problems they cause, as well as who stands to gain from efforts to relieve those constraints.’

Therefore, new tools and methods are required for the livestock sector which, similar to those utilised in human medicine, adopt an evidence-based approach. To discern the poverty impacts of a livestock disease, tools which directly measure the impact of a particular disease on poverty are required. Perceptions of impacts derived from stakeholders, while informative, are unlikely to be sufficiently robust to support policy formulation.

Another issue relates to the starting point of the prioritisation framework itself. Most efforts at animal health prioritisation begin at the level of the disease and subsequently assess or rank disease-related impacts. And the values obtained for each disease are then weighted by priority species. However, by starting with the disease, rather than the species, any early errors will be magnified across the system.

Rather, when determining the priority animal health constraints of the poor, there are three critical issues that first must be considered. The poverty impacts of livestock diseases will be directly related to the relative importance of different species to the household/production system involved. Furthermore, some species are more likely to be kept by the poorest livestock keepers than those who are better off (20). And therefore, the proportion of total household income derived from any given species is likely to vary across a spectrum of livestock keepers (19). Finally, for the poor, the reliance upon a species will also change with the economic standing of the individual or household involved. For example, while a group of livestock keepers may obtain only 1% of their income from poultry, clearly this 1% will be far more important to the poorest, than the wealthiest. Consequently, the priority species is related to the ownership patterns, the income derived and the relative importance of this income to the household involved. Therefore, the prioritisation framework offered

in this paper begins by determining the importance of a particular species to household poverty and then examines the impact of particular diseases on species-derived income.

Three calculations for livestock disease prioritisation are described. First, a weighted measure to assess the poverty impacts of particular species or the ‘species gap’ is offered. Second, a ranking calculation is detailed which mediates the ‘wealth effects’ of different species. Finally, a calculation for the ‘disease gap’, or changes in the poverty status of a household due to the impact or influence of a livestock disease, is detailed. Combined with the disease-specific morbidity and mortality rates reported by farmers, this calculation can be utilised to create a ranking of those livestock diseases with the greatest poverty impacts.

As will be further described below, to ensure a reproducible set of calculations, the above equations are based upon accepted measures of poverty, namely, the poverty gap and the head count ratio. The national poverty line figure of 1,239 Kenya Shillings per person per month was utilised to inform the framework. A standard production system classification was also required. Therefore, the framework uses Seré and Steinfeld’s typology (36). In the following analysis, participants are disaggregated into livestock only, rangeland-based, arid/semi-arid systems (pastoralists) and mixed, rain-fed, arid/semi-arid systems (subsistence farmers). Data from 265 livestock-keeping households in Kenya, comprising 2,453 individuals informed the study.

Within the framework, livestock are treated as an economic asset. This is not to dispute the social and other roles of livestock in the livelihoods of the poor (18, 19, 20, 40). Rather, the focus is limited to livestock as a core asset of the poor and the impact of animal health constraints on this asset.

Materials and methods

The prioritisation framework

As Figure 1 illustrates, each step of the framework comprises a series of calculations, which correspond to the issues raised above. Further, the calculations are performed at the individual level. In general, most poverty statistics are offered at the individual level in order to account for variations in household size (5, 41). While it may be argued that livestock herds are household-level assets, the study presumes that all individual household members have at least some access to herd resources. The calculations are further described below.

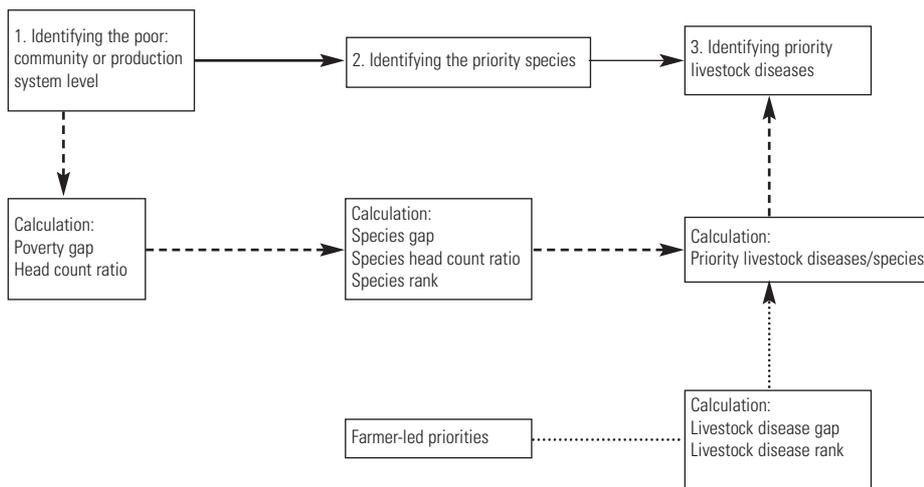


Fig. 1
Livestock disease prioritisation framework

Step 1 – Identifying the poor: the head count ratio and the poverty gap

As stated above, to define the poverty levels among individual livestock keepers, two standard measures were utilised: the head count ratio and the poverty gap. The head count ratio is simply the proportion of individuals living below the poverty line (35) and is calculated as follows:

$$\text{Head count ratio} = \frac{\text{[Total population under study]}}{\text{[Number of individuals living below the poverty line]}}$$

The poverty gap (also referred to as the P1 measure) portrays the mean aggregate income or consumption shortfall relative to the poverty line for this population. In this manner, the poverty gap (PG) is a calculation used to measure the ‘depth’ of poverty (i.e. the average gap between income levels and the poverty line) and the ‘severity’ of poverty (i.e. the differences in poverty levels among the poor) of those individuals living below the line (41), and is represented as follows:

$$PG = \frac{1}{n} \sum_{i=1}^q \left[\frac{z - y_i}{z} \right]$$

Within the equation, z is the poverty line income and y_i is the per caput income of a person i residing below the line, while n is the number of individuals in the population in question and q the number of poor people. Conventionally, the unit of measurement is in income per person and month. The non-poor are generally considered to have a poverty gap of 0.

Step 2 – Identifying the priority species: the species head count, gap and rank

The species head count represents the proportion of individuals keeping a particular species out of the total population of livestock keepers:

$$\text{Species head count} = \frac{\text{[Number of individuals keeping species x]}}{\text{[Total population under study]}}$$

Conversely, the species gap calculation measures changes to the depth and severity of poverty in the absence of income from a particular species, while the species rank accounts for differences between species with regard to the proportional income derived.

In this manner, the three calculations respond to the core prioritisation issues detailed above: identifying the livestock ownership patterns of the poor, estimating the income derived from specific species and evaluating the importance of this income to the individual or household involved.

The species gap (SG) is calculated as follows:

$$SG = \frac{i}{n} \sum_{i=1}^q \left[\frac{z - (y_i - w)}{z} \right]$$

Within the equation, i is the number of individuals keeping a particular species and n is the total number of individuals in the group in question (with q the number of poor people). While z is the poverty line income, y_i is the per caput income of an individual living below the line and w is the species-related income per individual. In this

manner, the unit of measurement, similar to the poverty gap above, is income per person per month. However, in order to evaluate the importance of particular species for the better off, the species gap for those residing above the poverty line is negative.

The difference between the poverty gap and the species gap increases with the severity or depth of poverty. The species gap relates the impact of the loss of species-related income to an individual's position on the poverty line. For example, if both a poor and a better-off livestock keeper earn the same income from a particular species, both individuals will move the same distance down the line. Obviously, the poorer a person is, the harder it is to obtain the cash transfers required to reach the poverty line income.

To account for the greater dependency of the poor on livestock-derived income than those who are better off, the species gap scores were then multiplied by the proportional income obtained from each species across income classes. In this manner, the species rank adjusts for the differing importance of species-related income to the individuals involved. The calculation is as follows:

Species rank = [Species gap] * [Proportional income derived from species]

The rank scores were then normalised, with a score of one given to the species most important to the poor.

Step 3 – Identifying the priority livestock diseases

Within the framework, disease priorities are derived from two calculations: the disease gap and the disease rank. The disease gap is the change to the depth and severity of poverty due to the loss of income in the presence of a particular livestock disease, while the disease rank accounts for the proportional importance of a species to the individual or group involved. However, as will be further detailed below, within the ranking, two further factors must be accounted for. First, the poor and the better off are likely to spend different amounts on treatment and prevention, even for the same disease. Second, studies have shown that the poor, when faced with high mortality, will often sell off sick animals (19).

The disease gap calculation explores the sum of changes to the poverty status of individuals in the presence of a livestock disease. Combined with the mortality rates reported by farmers, this calculation can be utilised to create a ranking of those livestock diseases with the greatest poverty impacts. The formula for the livestock disease gap (DG) is as follows:

$$DG = \frac{i}{n} \sum_{i=1}^q \left[\frac{z - (y_i - d)}{z} \right]$$

Within the equation, i is the number of individuals keeping a species and n represents the number in the group, with q the population of the poor. The poverty line income is z , with y the per caput income of an individual residing below the line with d the estimated loss of income per person per month due to disease treatment and prevention costs. Losses due to mortalities are also reflected in the calculation:

$$d = [(p + t)/\text{per person per month} + (\text{crude death rate} \times \text{average cost of adult animal})/\text{person per month}]$$

In the calculation, p and t reflect the average monthly expenditure on prevention and treatment per person per month. The cost of livestock mortality is calculated by the average cost of an adult animal multiplied by the crude death rate. Again, the figure is offered per person per month.

The disease gap relates direct expenditure and losses (as opposed to total costs) of a livestock disease to a household's position on the poverty line. Thus, the disease gap can also illustrate the 'affordability' of treatment options for the poor and the likelihood of the uptake of specific interventions.

The disease rank calculation is as follows:

$$\text{Disease rank} = \text{Species head count} [\text{Disease gap} \times \text{Proportional income losses due to disease}]$$

The ranking scores were normalised, with a rank of one given to the disease with the highest score.

Data collection activities

Sample frame and data collection activities

In Kenya, the selection of districts was undertaken utilising national, state and district poverty development plan data (7, 8, 9, 10, 11, 12, 13, 14, 15, 16). Criteria for district selection included overall poverty levels and/or the presence of vulnerable livestock-keeping populations. Data were collected in five districts: Samburu, Kajiado, Baringo, Machakos and Garissa.

Within each district, the study used 'chain interviewing' to identify key informants (38, 43). Therefore, within each district/state, a range of actors from the government, academic institutions and non-governmental organisations (NGOs) was consulted in order to identify the production systems and communities with most poor livestock

keepers. Meetings were generally held with district government veterinary officers first to identify the geographic location and spheres of activities of donors, parastatal organisations and local, national and international NGOs. Interviews with local government and NGO representatives were then undertaken and a recommended list of poor livestock-keeping communities compiled. At the community level, non-probabilistic, purposive sampling was utilised with multi-stage sample selection to target a range of livestock keepers.

Purposive sampling was used for two reasons. First, the aim of the study was to explicate the income effects of a particular species and to assess exposure to livestock disease among a sample of poor livestock keepers. Therefore, a range of livestock keepers living above and below the poverty line was required. Second, random sampling would be likely to generate data from households who were not livestock keepers and/or were commercial producers.

During the first stage of sample selection, community-level focus groups were assembled in which mapping exercises were performed to identify the geographic locality of livestock-keeping households and compounds (from which commercial producers were excluded). Meetings with key informants were then held to verify the maps, and interviews were undertaken with the identified livestock keepers. Community mobilisers were utilised to inform those individuals who were not present at the initial community-level meeting of the aims and purpose of the study. Mobilisers then set a date and time for the interview. Such a strategy accorded high levels of cooperation across the study site.

The interview

At the individual level, semi-structured interviews were performed. All interviews took place within the respondent's home to aid privacy. Questions were open-ended with a focus on household livelihoods, demographics and herd structures. While the study interviewed individuals, participants were asked detailed information regarding the households in which they lived. Thus, within the forthcoming calculations all household members were included. Study participants, however, were generally limited to the primary household head or spouse. No attempt was made to further target participants by age, gender or other demographic factors for two reasons: first, the impact of livestock disease on economic well-being was unlikely to be influenced by these factors and second, data were being collected on all household members.

In the interview participatory tools such as compound maps, disease timelines and ranking exercises were used to corroborate household demographics, livelihood strategies

and livestock herds (24). The compound mapping exercises in particular were utilised to detail information about the wider household, livelihood activities, and access to and ownership of livestock resources. In this manner, all quantitative information was corroborated in up to three sections of the interview.

With regard to livestock disease, study participants were asked to report on the incidence of disease over the past 12 months. For each species, participants were asked to list the symptoms, treatment protocols and the outcome of those diseases impacting household herds. Livestock disease and mortality were also detailed in a livestock timeline. To aid the accuracy of recall, the question was framed within the start and end period of a specific yearly event, e.g. at the beginning of the long rains.

The analysis utilised disease reporting, rather than ranking, in order to avoid potential biases relating to farmers' notions of the importance ascribed to any given disease (23). While it was recognised that farmers often under-report or misdiagnose livestock diseases, overall these factors were likely to be more consistent influences and therefore, less problematic in terms of bias.

Livelihood and income data were explored in compound resource maps and in a specific livelihood section of the interview. The livelihood activities of all household members were detailed. It is recognised that income data can often be difficult to collect, as individuals may be reluctant to divulge such personal information. To aid in data accuracy, community-level focus groups at the start of data collection activities in each community were utilised to detail the average income obtained across a list of local livelihood activities. Utilising the figures, within the interview, participants were then asked to discuss any discrepancies and/or differences in the income derived by individual family members, in comparison to the community norm.

Questionnaire development and outcome

As interpreters were required for the non-local language speakers, the questionnaire was pre-tested among an initial sample group to identify any linguistic differences in the wording and/or meaning of specific phrases. Therefore, the questionnaire was pre-tested among the different ethnic groups involved. For example, in Baringo district the study interviewed both pastoralists and settled agriculturalists. Pre-testing was performed among a select group of participants (generally four to five individuals) in these different communities prior to wider data collection activities.

The team linguist was responsible for ensuring that the wording of questionnaires was accurate and phrasing appropriate to the local language. Changes were also made

to the ordering of questions when required. For example, among many pastoralist communities information regarding herd sizes is often sensitive (17, 19). Therefore, in these communities, questions regarding livestock disease were asked prior to those regarding herd structures. In this manner, interviewers could use the animal health section as a further means of corroborating information regarding the herd (e.g. six calves with East Coast fever must later be accounted for in the herd section). Interviews were also taped to enable researchers to study particular responses as required. Completing the questions on household demographics, livelihoods and animal health took approximately 25 to 30 minutes.

Training of enumerators

In qualitative research, issues of bias are addressed on the researcher and informant level, rather than in regards to the study protocol (27). Therefore, within the context of the study, to lower intra- and inter-observation bias, prior to fieldwork, local enumerators underwent a five-day training course in qualitative data collection techniques with core project staff. All team members were provided with training in key areas of a quality interview: accuracy, richness of responses and internal consistency (24). Further issues addressed included the difference between probing and prompting responses and effective triangulation. Enumerators were also trained to recognise and probe any inconsistencies in the figures offered by participants in the core sections of the interview, i.e. income, herd sizes and disease expenditure. During the fieldwork, interviews were assessed on a daily basis by a single researcher for quality, descriptive detail, and internal coherence. Any issues were then brought to the attention of the individual enumerator involved. Finally, prior to analysis, data cleansing was undertaken by a single researcher to remove responses which were unrelated to the question asked or where the information or figures offered were inconsistent across the interview.

Results

Step 1 – Calculating the income gap, poverty gap and head count ratio

Overall, 75% of the study group lived below the poverty line, with transfers of nearly 50% of total income required to bring households up to this level of income (Box 1).

Step 2 – Calculating the species gap and rank

The results for the species gap and rank calculations are shown in Table I. For the poorest pastoralists, sheep and goats had the largest influence on a household's change in status with respect to the poverty line. Cattle had the

Box 1 Income gap, poverty gap and head count ratio in 265 livestock-keeping households in Kenya

Poverty line	<1,234 Kenya Shillings per person per month
Average income per person per month	425.30 Kenya Shillings
Head count ratio	0.75
Income gap ratio	0.65
Poverty gap	0.49

highest proportional contribution to income, thereby explaining the ranking. Among the subsistence farmers, the income derived from cattle was the most critical to household well-being across all groups.

Step 3 – Calculating the livestock disease gap and rank

The disease gap and rank for households are detailed in Table II. From the calculation, East Coast fever in both production systems (pastoralists/subsistence farmers) had the greatest impact on the depth and severity of poverty. Nevertheless, when disease reporting was accounted for, the poorest households had a lower ranking in the mixed, rain-fed (subsistence farmers) production system. Foot and mouth disease was more problematic for the better-off pastoralists in the livestock-only system. Thus, the calculation illustrates the differential importance of the same disease within a particular production system for the poor versus the better off.

Discussion

The prioritisation framework detailed above is based upon income data. And the collection of accurate income data among the poor throws up a variety of challenges, which must be recognised and addressed from the outset. First and foremost, all income data must be verified and triangulated across an interview. Second, while a range of income is likely across the same activity, among communities in the South, this range is often very narrow. Therefore, in the application of any such framework, income must also be verified on a collective level.

The results demonstrated the variability in income streams derived from the same species across wealth groups. For example, poor subsistence farmers earned 50% less from their cattle than those residing above the poverty line, even when herd sizes were similar. Thus, as households became wealthier, not surprisingly, the productivity of their animals appeared to increase. Clearly management and husbandry conditions play a role in this. However, with

Table I
Species gap, species rank and scores indicating the priority species for 265 poor livestock-keeping households in Kenya

A score of one indicates the species that were considered most important

Production system	Species	Income class					
		SG	SR	Score	SG	SR	Score
Livestock only, arid/semi-arid	Camels	0.10	0.01	3	-0.23	0.00	3
	Cattle	0.35	0.06	1	-1.68	-0.10	1
	Goats and sheep	0.66	-0.05	2	-2.15	-0.06	2
	Poultry	0.09	0.00	4	-0.75	0.00	4
Mixed, rain-fed arid	Cattle	0.58	0.11	1	-0.72	-0.05	1
	Goats and sheep	0.60	0.05	2	-0.76	-0.01	2
	Poultry	0.59	0.01	3	-0.97	0.00	3

SG: species gap

SR: species rank

Table II
Livestock disease calculations for 265 livestock-keeping households in Kenya living above and below the poverty line

Production system and disease	Species	Disease gap		% Change in poverty gap		Disease reporting*		Disease rank	
		Below line	Above line	Below line	Above line	Below line	Above line	Below line	Above line
Livestock only, arid/semi-arid									
Diarrhoea/helminthosis	Sheep/goats	0.67	-2.27	1.18	2.40	155	111	3	3
East Coast fever	Cattle	0.78	-2.17	5.89	9.84	61	53	1	2
Foot and mouth disease	Cattle	0.72	-2.21	2.21	12.82	47	82	2	1
Respiratory disease	Sheep/goats	0.68	-2.27	1.94	1.00	22	15	4	4
Mixed, rain-fed arid/semi-arid									
Diarrhoea/helminthosis	Sheep/goats	0.64	-0.98	0.57	1.61	71	8	1	2
East Coast fever	Cattle	0.69	-0.92	5.62	3.21	8	13	2	1
Respiratory disease	Sheep/goats	0.66	-0.98	0.77	1.00	15	0	3	-

* Average number of disease cases reported per year

regard to prioritisation, it is important to recognise that this variability in income will ultimately influence disease impacts.

The study also illustrates the reliance of the poorest households on the livestock in their care. Poor households often derived a proportionally higher income from milk and livestock sales than their better-off counterparts. While this is not surprising (and indeed has been well explicated by previous authors [17, 19, 42]), there are obvious implications for disease prioritisation. It is likely that subsistence farming households in the lowest income group will be the most impacted by production diseases. The poorest pastoralists are likely to be more affected by diseases of small ruminants, which impact price and/or mortality rates.

While greater numbers of poor pastoralists were dependent upon small ruminants, cattle provided a much

higher percentage of gross income. Therefore, interventions aimed at poor cattle owners could significantly impact their well-being. Thus, when devising livestock development projects and programmes for pro-poor impacts, the proportional income derived from a species must be balanced against the livestock ownership patterns of the group in question.

The disease gap calculation further identified differences between the poor and the better off. The study found large variations in the impact of the same disease, across the wealth groups, within the same production system: among pastoralists foot and mouth disease had a proportionally greater impact on the well off than on the poor. For diseases with a high morbidity but comparatively low mortality, poor households spent much less on treatment and prevention than the better off. Similarly, tick-borne diseases, which required a higher cash outlay for treatment and prevention, tended to be more devastating for those

living below the poverty line. The finding is contrary to recent arguments that East Coast fever is not particularly important to the poor (34).

Thus, the study demonstrated that disease prioritisation must take account of the temporal and temporary nature of both livestock disease and poverty itself. To create an accurate and reflective disease-management priority framework, the reality faced by the poor (as opposed to perceptions) must be factored in. Portrayals of such reality should not be open to charges of bias at the community, institutional or individual-actor levels. Therefore, the species and disease gap measures were devised to create measures, which are based on primary data and not on the

perceptions regarding the importance of different livestock diseases of either experts or the poor. The framework thus supports an evidence-based approach to the design and implementation of animal health interventions for the poor.

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Panzooties et pauvreté : établir les priorités de la lutte contre les maladies du bétail en vue de réduire la pauvreté

C. Heffernan

Résumé

Les panzooties telles que l'influenza aviaire hautement pathogène et la fièvre de la Vallée du Rift se sont propagées à partir de pays du Sud, généralement au sein des communautés les plus pauvres. À l'échelle planétaire, un tiers environ des personnes vivant avec moins de deux dollars par jour vit de l'élevage. En conséquence, il est impératif d'axer davantage les interventions de santé animale sur des objectifs de réduction de la pauvreté en faisant appel à des méthodes scientifiquement fondées. L'auteur propose un cadre en trois étapes pour établir les priorités en la matière, basé sur des calculs dérivés des méthodes standard de mesure de la pauvreté : l'intensité de la pauvreté (définie comme l'écart relatif entre le niveau de vie médian de la population pauvre et le seuil de pauvreté) et l'incidence de la pauvreté (définie comme le pourcentage de personnes pauvres dans la population totale). Cette étude est basée sur un échantillon de 265 foyers d'éleveurs pauvres du Kenya. Les résultats montrent que la dépendance à l'égard d'une espèce animale particulière varie d'un éleveur à l'autre. De plus, une même maladie animale peut avoir des conséquences diverses sur la profondeur et la sévérité de la pauvreté. Les interventions de santé animale doivent donc tenir compte des effets de cette variabilité, liée à l'espèce et à la maladie, sur les revenus des éleveurs.

Mots-clés

Éleveur – Éradication – Maladie du bétail – Mondial – Pauvre – Pauvreté – Priorité – Santé animale mondiale.



Las panzootias y los pobres: concepción de un marco mundial de jerarquización de enfermedades bovinas con fines de lucha contra la pobreza

C. Heffernan

Resumen

Enfermedades panzoóticas como la influenza aviar altamente patógena o la fiebre del Valle del Rift se han originado en el Sur, en gran medida en comunidades pobres. A escala planetaria, alrededor de dos tercios de las personas que viven con menos de 2 dólares al día se dedican a cuidar ganado. De ahí la necesidad de orientar con más precisión las intervenciones zoonosológicas encaminadas a reducir la pobreza atendiendo a criterios científicamente fundamentados. El autor, en este sentido, propone un sistema de jerarquización en tres etapas utilizando cálculos obtenidos a partir de dos indicadores clásicos para medir la pobreza, a saber: la "brecha de pobreza" [*poverty gap*] y el "índice de recuento" [*head count ratio*] de la pobreza. Los resultados del estudio, efectuado con datos procedentes de 265 hogares de ganaderos pobres de Kenya, demuestran que en todo un espectro de productores hay un grado variable de dependencia respecto a una especie en particular. Por otra parte, una misma enfermedad bovina ejerce una influencia variable en la amplitud y el grado de pobreza. Al aplicar intervenciones zoonosológicas, por consiguiente, debe tenerse en cuenta que para determinada especie y enfermedad se observan efectos heterogéneos en el nivel de ingresos.

Palabras clave

Cuidadores de ganado – Enfermedad bovina – Erradicación – Jerarquización – Mundial – Pobres – Pobreza – Sanidad animal mundial.



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