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Impact of animal health programmes on poverty reduction and sustainable livestock development

J.-P. Pradère

Port Hallan, 56360 Le Palais, France
E-mail: pradere99@orange.fr; j-p.pradere@oie.int

Summary
Based on data from publications and field observations, this study analyses the interactions between animal health, rural poverty and the performance and environmental impact of livestock farming in low-income countries and middle-income countries.
There are strong statistical correlations between the quality of Veterinary Services, livestock productivity and poverty rates. In countries with effective Veterinary Services, livestock growth stems mainly from productivity gains and poverty rates are the lowest. Conversely, these analyses identify no statistical link between the quality of Veterinary Services and increased livestock production volumes. However, where animal diseases are poorly controlled, productivity is low and livestock growth is extensive, based mainly on a steady increase in animal numbers. Extensive growth is less effective than intensive growth in reducing poverty and aggravates the pressure of livestock production on natural resources and the climate.

Keywords
Animal diseases – Animal health – Climate – Growth – Livestock production – Poverty – Productivity – Sustainable development.

Introduction

Livestock production has been the big loser as poverty reduction and development policies have evolved. In 2006, following a long period of decline, the share of official development assistance (ODA) allocated to agriculture started to rise. However, this rise benefited mainly crop production. The proportion of agriculture funding allocated directly to livestock production is still astonishingly low. In 2013, the agricultural sector (excluding forestry and fisheries) received 9.2 billion US dollars (USD) of ODA. Of this amount, despite its importance for the economy and the food security of poor rural households, livestock farming (animal production and health) received only USD 180 million directly, which represents less than 2% of the ODA funding allocated to agriculture (1).

In this unfavourable context, the aim of the study is to assess the value of boosting support to improve livestock performance, combat rural poverty and safeguard the planet. It sets out to analyse the links between the level of animal health protection, livestock productivity, rural poverty and the climate impact of livestock production in countries where poor farmers represent a large proportion of the population, as well as in a few middle-income countries (see below).

Advantages of livestock for poor farmers

The majority of poor rural households (80–90%) keep animals (2). For these households, livestock production is particularly attractive where animals can graze freely on common land or fallow land and where they have access to agricultural by-products of no commercial value.

For poor farmers, livestock farming performs a range of functions. Animals not only provide income and food, but also transport for people and agricultural products. They help to fertilise the soil and provide labour for agricultural tasks. They also have important social functions. In pastoral societies, communal herd management serves as a bond for

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social cohesion, and in many regions, the consumption and gifting of animal-based products are a vital part of festive and religious events. The animals themselves have a capital value and the growth and reproduction of the animals ensures a return on this capital.

For poor farmers with no access to the banking system, animals are the main means of preserving the resources needed to manage agricultural crises and to help them escape poverty. As the risks weighing on crop production and animal production differ, farmers can overcome a crisis in one of these activities by using the income or products from the other (3).

The contribution of livestock to incomes is proportionally greater for very poor farmers than for those who are more affluent. For example, in Kenya, livestock production provides 60% of the income of very poor households and 38% of the income of more affluent households. In Egypt, livestock production provides 63% of the income of very poor households and 14% of the income of more affluent households (4).

Animal diseases are the scourge of poor farmers

In poor countries, animal diseases kill many animals and reduce livestock productivity (Table I). In the least-developed countries (LDCs – 48 countries with gross domestic product [GDP] per capita of less than USD 1,242 under the United Nations [UN] classification) the average numeric offtake rates of livestock are low, in the order of 10.5% for cattle, 36% for sheep and goats and 112% for pigs (5). (The numeric offtake rate is the ratio between the number of animals sold or consumed during one year and the average number of animals of the same species during the year. For species that reproduce rapidly, such as poultry and pigs, this rate is normally greater than 100%). A comparison with mortality rates shows that cattle farmers lose almost as many animals as they sell. The situation is slightly less unfavourable for small ruminant breeders (one animal lost for every two sold) and for pig farmers (around one animal lost for every two or three sold).

Table I

Average mortality rate for certain animal categories in different livestock systems, in least-developed countries, and poor regions

Afghanistan has been included as an example of how a programme of veterinary care can substantially reduce mortality rates in least-developed countries. Vietnam has been included as it enables a comparison of mortality rates in traditional and semi-intensive systems in one country over a single period (very few countries have sufficient data available to make this comparison)

Country or region [b]	Livestock production system	Mortality rate [a]						Ref.
		Calves	Adult cattle	Lambs and kids	Sheep and goats	Poultry	Pigs	
LDCs	Traditional village farms	20%	7%	2 %	15%	50% [c]	40-50% [e]	(6)
West Africa	Traditional village farms	20–23%	4–8%	–	–	–	–	(7)
Sub-Saharan Africa	Traditional village farms	20–23%	4–9%	19–33%	10–17%	46% [d]	–	(8, 9)
	Semi-intensive	12%	5–9%	–	–	24% [d]	–	
	Intensive	8%	4%	–	–	–	–	
South and South-East Asia	Traditional village farms	15–25%	–	–	–	–	–	(10)
Vietnam [f]	Traditional village farms	–	–	–	40%	–	–	(12)
	Semi-intensive	–	–	–	17%	–	–	
Afghanistan	Traditional: With no veterinary programme	21%	6%	23%	16%	–	–	(13)
	Traditional: With veterinary programme	16%	4%	18%	7%	–	–	

LDCs: least-developed countries (48 countries)

a) The mortality rate is the ratio between the number of animals that died during one year and the average number of animals of the same species during the same year

b) All countries within poor regions are low-income countries, but not all are categorised as least-developed countries

c) Between 0 and 6 months

d) Pre-weaning

e) Between 0 and 3 months

f) Middle-income country (with per capita GDP between USD 1,026 and USD 12,476; World Bank ckassification)

In addition to their dramatic impact on poor farmers, animal losses have serious consequences for national economies. According to Kaboret (14), in 2009, a total of 2.1 million cattle and 13.1 million small ruminants died of disease in three countries: Burkina Faso, Mali and Niger. The value of these losses was around EUR 322 million for cattle and EUR 599 million for small ruminants, totalling EUR 921 million. For comparison, these losses represented around 34% of livestock GDP, 14.3% of agricultural GDP and 5.5% of total GDP for these three countries. Kaboret's estimates concerned only ruminants. Taking all animal species and other direct and indirect losses into account would have resulted in much higher estimates.

Indirect losses, which include additional costs incurred due to animal diseases and their effects on all economies, are generally higher than direct losses (15). The fact is that there is little data available in poor countries on the scale of the problem. The few estimates available concern major transmissible diseases. For example, in tsetse-fly zones, which extend over 10 million km² of cultivable land, trypanosomiases reduce cattle production by 50% (16) by killing animals and decreasing their production and their capacity for work.

In addition to their effects on animals, zoonoses, whose agents are transmitted naturally from animals to humans, have a dramatic impact on poor populations living in contact with animals farmed under poor husbandry and hygiene conditions. According to World Health Organization (WHO) estimates, zoonoses kill thousands of people every year, e.g. trypanosomiasis kills 75,000, rabies kills 55,000, cysticercosis 50,000 and trematodosis 10,000. Each year, 2.2 million people, mainly young children, die of diarrhoeal diseases, largely of zoonotic origin, caused by *Campylobacter* or *Salmonella*. In LDCs, endemic zoonoses taken as a whole kill as many people as malaria (17).

Better animal disease control improves livestock performance

Common sense tells us that good veterinary programmes have the ability to reduce losses and secure the investment required to underpin technological innovations in the livestock sector; however, data to demonstrate this relationship are difficult to obtain because animal health improvements are generally implemented in parallel with other livestock farming improvement measures, such as better housing, better animal nutrition and genetic improvements. This makes the effects of improved animal health on productivity difficult to distinguish from the effects of other improvements. Nevertheless, researchers have succeeded in identifying the specific benefits of veterinary programmes and have clearly shown that, in both poor and developed countries, better control of animal diseases, with no change in other livestock farming conditions, can improve output and, in some cases, reduce the environmental impact of livestock production.

For example, Ayssiwede *et al.* (9) showed that, in sub-Saharan Africa, village vaccination programmes have halved the mortality rate of chickens and increased the number of birds sold. Schreuder *et al.* (13) showed that in Afghanistan, enhanced veterinary care, with no other change in farming practices, has reduced animal losses and improved livestock performance (Table I). Among many other examples, the research of Elliott *et al.* (18) and Kenyon *et al.* (19) in the United Kingdom confirms the benefits of veterinary programmes in terms of higher productivity and better environmental protection (see below).

Strong statistical links between the effectiveness of Veterinary Services and poverty

The activities of national (or public) Veterinary Services and private veterinarians are complementary and, within the same country, there are strong links between their respective capacities. Countries with the best organised national Veterinary Services are also those where private veterinarians are the most effective (20).

There are very few data available to compare the quality of private veterinarians in different countries; however, comparisons of national Veterinary Services are possible, thanks to assessments carried out using the 'Tool for the Evaluation of the Performance of Veterinary Services' (PVS). The PVS Tool, which was developed by the World Organisation for Animal Health (OIE), is used to assess the extent to which Veterinary Services in different countries comply with OIE standards (Box 1).

A statistical analysis of the data in Table II shows a strong statistical link (correlation coefficient –0.7) between the poverty rate and the average scores obtained in PVS evaluations. In other words, in countries with more effective Veterinary Services, the poverty rate is lower. Moreover, there is a very strong link (correlation coefficient 0.83) between the quality of Veterinary Services and the per capita GDP of the countries studied. This observation can be compared with the conclusions of a study by Alleweldt *et al.* (20), which identified a very strong correlation between the budgets of Veterinary Services and per capita GDP. According to these authors, the funding of Veterinary Services depends mainly on a country's ability to pay and

Box 1
OIE Tool for the Evaluation of the Performance of Veterinary Services

The OIE has created a tool for the evaluation of the Performance of Veterinary Services, known as the 'PVS Tool', to help the Veterinary Services of its members to identify their shortcomings and their ability to comply with international standards. This tool is used, at the request of the countries concerned, by teams of specially trained experts approved by the OIE.

The PVS evaluation covers the four fundamental components of Veterinary Services: the availability of human, physical and financial resources; the ability to deal with existing or new problems; interaction with the various categories of livestock production stakeholders; and the ability to provide market access for animal products. A set of 46 'critical competencies' is used to evaluate the compliance of the four fundamental components with established OIE standards and to report on the effectiveness of Veterinary Services. For each critical competency, there are five stages of progress, ranging from stage 1 (no compliance) to stage 5 (compliance with OIE standards).

The conclusions of PVS evaluations are confidential. A few countries have, nevertheless, agreed to waive the confidentiality of evaluation reports, which allows them to be published on the OIE web site.

Source: World Organisation for Animal Health (21)

not on the need to reinforce these Services. The direction of the relationship between the wealth of a country and the quality of its Veterinary Services is therefore not clear and it would require longitudinal datasets to establish lag periods and causality.

Animal health is a key factor in livestock productivity

The data in Table II show no statistical link between increased beef production and the PVS scores obtained by the Veterinary Services (correlation coefficient –0.02). However, there is a strong correlation between the beef offtake rate and the PVS score (0.6). In the case of the beef production in this study, there may therefore be strong growth in output despite poor control of animal diseases. However, where animal diseases are poorly controlled, productivity is low and livestock growth is largely extensive, with a steady increase in animal numbers, while in situations where diseases are well controlled, increases in livestock production are based on productivity gains and can therefore be achieved without increasing the number of animals.

A comparison of livestock performance in LDCs (where the Veterinary Services lack capacities) and in emerging countries (where the Veterinary Services are increasingly effective) confirms this finding. In LDCs, output per animal rises very little. As a result, to meet strong demand, farmers use ever-larger numbers of animals and more land surface, giving priority to extensive growth (Box 2). In 2013, the 48 LDCs, which together possess 19% of the world cattle population and 23% of the world's sheep and goats, produced only 5.5% of the world's beef, 14% of its sheep and goat meat and 2.6% of its milk.

In the same year, the performance gaps between poor countries, emerging countries and developed countries were huge. For beef, for example, the offtake rate was around 18 kg per head per year in sub-Saharan Africa, 74 kg in China and 95 kg in developed countries. For pork, the offtake rate was around 36 kg in sub-Saharan Africa, 109 kg in China and 145 kg in developed countries (FAOSTAT [5]).

Improved animal health offers direct benefits to farmers, notably because it reduces losses of animals, it preserves the farmer's capital and because healthy animals make better use of the feed they are given. It also makes it possible to secure the investment needed to improve farming conditions, develop technological innovations and maintain animals with high genetic potential.

For poor farmers, securing production and safeguarding animals are key factors. Poor farmers are highly risk-averse because the loss of a portion of their assets can jeopardise their chances of escaping poverty and in some cases it may threaten their very survival (27). When poor farmers deem the risk to be too great, they choose options that offer less profit but carry a lower risk, rather than options that could generate more profit but carry a higher risk. In practice, instead of choosing more efficient but higher-risk production systems, they prefer extensive and diversified farming systems, using less productive indigenous breeds that are well adapted to the environment and relatively resistant to local endemic diseases.

However, the attitude of poor farmers is not set in stone. When the risk of disease decreases to a level they deem acceptable in relation to the expected gains, they will invest to improve their production techniques. For example, in Kenya and Uganda, in regions where altitude reduces the risk of disease and where there is veterinary support, small farmers buy dairy cows, which can sometimes cost several years of their monetary income, but from which they expect to make good profits (28). Similarly, near large towns in poor countries, where better veterinary services reduce the risk of disease and high prices for animal products make investment more attractive, small farmers set up semi-intensive farms for poultry, pigs or dairy cows.

Table II
Data on the quality of national Veterinary Services, on poverty and on beef cattle production parameters in least-developed countries and in middle-income countries

Country	Average PVS scores [a]	Poverty rate [b]	Per capita GDP [c] (2015)	Growth in beef production from 2005 to 2013 [d]	Offtake rate [e] (kg/animal/year)
Least-developed countries					
Benin	1.64	53%	779	39%	13
Chad	2.11	35%	775	20%	13
Ghana	2.30	25%	1,381	– 4%	18
Guinea	2.64	35%	531	33%	14
Guinea Bissau	1.68	67%	573	29%	10
Haiti	1.65	53%	828	6%	28
Laos	1.61	18%	1,812	17%	27
Niger	1.74	46%	359	–7%	15
Togo	1.98	54%	548	20%	23
Middle-income countries [f]					
Bolivia	3.09	7%	3,095	26%	30
Botswana	3.37	18%	6,360	34%	26
Colombia	4.15	6%	6,056	8%	37
Costa Rica	3.54	2%	10,629	9%	67
South Africa	3.45	16%	5,695	21%	69
Swaziland	2.89	42%	3,154	21%	27
Vietnam	2.27	3%	2,111	52%	51

a) PVS: Evaluation of the Performance of Veterinary Services. The average PVS scores were obtained from the PVS evaluation reports published between 2011 and 2015, taking the average of the scores awarded for each of the 46 critical competencies
b) Ratio of the population with less than USD 1.9 per day (as a percentage of the total population). Estimates published between 2011 and 2014, depending on the country. *Source*: World Bank (22)
c) Gross domestic product (GDP) per capita in 2015, current US dollars. *Source*: World Bank (23)
d) According to FAOSTAT data (5)
e) The offtake rate is a partial index of productivity. It represents the ratio between the quantity of meat produced, in kilograms of carcass weight, in one year and the average livestock number of the species during the year
f) Middle-income country (with per capita GDP between USD 1,026 and USD 12,475; World Bank classification)

Box 2
Livestock productivity and offtake

In common usage, the term 'productivity' has various meanings when applied to livestock. It is sometimes used to refer to the level of production and sometimes the efficiency of production. In addition, it is commonly used in two different senses: economic (emphasises the economic efficiency of a production system) and physical (production volumes and technical performance). In all cases, productivity expresses a relationship between the outputs (all of the goods and services produced by livestock) and the inputs, used to generate those outputs (farmers' labour, livestock, land, fodder, veterinary costs, etc.). In practice, this total factor productivity is rarely used for agricultural systems, because of the difficulty of finding common index numbers for all of the inputs and outputs (24).

For the purposes of this paper, productivity is defined as the efficiency of a production system, and the offtake rate (Table II) is used as a partial index of productivity. Although milk, draught power, manure, capital value, etc., may be important outputs, offtake of animals is invariably a major form of output (25).

The Organisation for Economic Co-operation and Development (OECD) (26) has shown that the most powerful determinants of agricultural productivity are the quality of public interventions – sector policies (including animal health policies), research and development, infrastructure – and various factors associated with the quality of the natural environment. Demand is another determinant of productivity. However, without public interventions, demand alone would not suffice to improve productivity.

In poor countries, better agricultural productivity (including livestock production) is the main driver of poverty reduction

No large country has succeeded in reducing rural poverty without increasing agricultural productivity. In countries where the primary sector accounts for a large share of the economy, improved agricultural productivity clearly contributes more to poverty reduction than growth in non-agricultural sectors (29). (Christiaensen *et al.* [30] confirm this finding and explain that it is difficult to transfer income generated in one economic sector to another sector. As a result, the poor derive more benefit from growth if it occurs in their own sector.) In addition, agriculture is highly labour-intensive, so growth in this sector provides jobs for low-skilled workers, creating wealth and providing basic products that foster growth in local manufacturing and the development of non-agricultural jobs.

These observations are confirmed by the lessons drawn from the fight against poverty: without an improvement in agricultural productivity, economic growth in itself is not enough to reduce poverty. For example, for several years, sub-Saharan Africa has recorded solid economic growth of around 5% a year, but this growth is based on the exploitation of raw materials, infrastructure investment and rising agricultural production, not an increase in productivity (31). Livestock production volumes in Africa are estimated to be rising at rates that are just as high (meat) or even higher (milk) than growth rates in the rest of the world; however, unlike growth in agriculture in major economies in the 19th Century and in large Asian countries at the end of the 20th Century, agricultural growth (including livestock) in Africa is mainly extensive and productivity gains are scant. As a result, although agriculture employs more people (at the moment two-thirds of workers), output per worker remains fairly stable and payment for labour has not changed. In countries where agriculture plays a key role in the economy, extensive agricultural growth helps create jobs but does not achieve a significant reduction in poverty.

Conversely, China has succeeded in increasing productivity and reducing poverty in recent years thanks to major sectoral reforms and large-scale support programmes to fund agriculture (which in 2010 represented 17% of the value of agricultural output). These funds were used to boost research and to develop agricultural training and infrastructure (including in the veterinary field). Agricultural productivity (including livestock production) has made remarkable progress. Livestock production has helped to boost and diversify the incomes of peasant farmers and between 1981 and 2014 the poverty rate plummeted from 77% of the total population to just 7% (32, 33).

Livestock production is a major branch of agriculture. It accounts for an average of 35% of agricultural GDP in the LDCs and almost 50% in developed countries, because the consumption of animal products increases as incomes rise. Pica *et al.* (34) showed that livestock farming is particularly effective at reducing poverty and contributing to economic growth. Based on data from 66 countries, these authors found a statistically significant link between livestock sector development and economic growth. They found a statistically significant causal relationship between livestock sector development and economic growth in 36 of the 66 countries analysed, and in 33 of these 36 countries livestock sector development appears to have been a driver of per capita GDP growth. Only in three countries did increases in livestock sector productivity appear to have been driven by per capita GDP growth. But causality on all cases is not clear.

The particular ability of livestock farming to reduce poverty stems from its indirect benefits for agricultural productivity (by providing work and organic fertiliser), for marketing produce (by providing transport) and for human health (by reducing zoonoses and improving nutrition), as well as enabling animals to be used as savings or as a means of capital accumulation.

Better productivity can reduce the impact of livestock on natural resources and the climate

In developed countries and a growing number of developing countries, thanks to the effective control of animal diseases, technological progress and productivity gains, livestock farming has proven its ability to provide strong, sustainable growth while reducing its impact on the environment.

A number of publications confirm this observation. Havlík *et al.* (35) showed that, over the past 50 years, livestock productivity gains have prevented the emission of 590 gigatonnes (Gt) of CO_2 equivalent. They also estimated that, thanks to improved productivity, between now and 2030, greenhouse gas emissions from livestock farms will decrease by 0.73 Gt of CO_2 equivalent a year. These authors believe that the intensification of production systems and more animal health interventions should become key technologies in combating global warming.

In the United Kingdom, Elliott *et al.* (18) demonstrated that a veterinary programme capable of halving the impact of ten dairy cattle diseases and physiological disorders (mastitis, lameness, infertility, etc.) could improve the productivity and competitiveness of dairy farming and reduce its carbon footprint by between 7% and 13%. In Scotland, Kenyon *et al.* (19) showed that treatments against gastro-intestinal parasites in lambs would allow lambs to be marketed at a younger age, thereby improving the profitability of farming and reducing their carbon footprint by around 10%.

In poor countries, animal diseases cause enormous wastage of food and environmental resources because when animals die of disease their meat cannot be consumed as food, even though they have used natural resources as feed and contributed to the carbon footprint of livestock production. In these countries, starting from a very low level, improved animal health results in significant environmental benefits. A simulation based on animal husbandry data for cattle herds in the Sahelian countries showed that a modest improvement in animal health could reduce the annual average mortality rate of calves to 15% (rather than 20%) and the annual average mortality rate of adult cattle to 5% (instead of 7%), resulting in a 23% increase in the number of animals exploited. For the same volume of meat produced, this reduction in the mortality risk would also result in a decrease of 17% in methane gas emissions in the herds studied (36).

Demographic growth and greater household purchasing power is boosting demand for animal products and strong growth in worldwide animal production is set to continue. However, a rise in the environmental impact of livestock production is not inevitable. Lessons learned from the trend in livestock farming practices in developed and emerging countries indicate that productivity gains, more rational farming methods and the gradual replacement of ruminant meat with poultry and pig meat can ensure that increased animal production is compatible with reduced pressure from livestock farming on natural resources and the climate (36). In 2013, thanks to much higher productivity, and despite a substantially lower number of cattle, Europe produced ten times more cow's milk and four times more beef, but 36% less enteric methane (CH_4 – 0.2 Gt), than the LDCs [FAOSTAT (5)].

Conclusion

The international community has set a target of ending poverty by 2030. In a world where poor farmers, who form the hard core of poverty, rely largely on livestock farming to increase their income and assets, achieving this ambitious objective calls for improving rural policies and boosting public support to secure and enhance livestock performance.

All economic sectors are interdependent. Clearly it would be too restrictive to confine poverty reduction efforts to support for improving agricultural output and, by extension, improving livestock farming productivity. Nevertheless, for disadvantaged farmers with income on which they can barely survive, boosting such support would appear to be vital to increasing their incomes and well-being (Box 2).

The above-mentioned analyses indicate links between animal health, poverty rates and the scale of livestock impacts on natural resources and the climate. The nature of these relationships needs to be better understood, with particular emphasis on better knowledge of the sequence of events (does improving animal health and productivity lead to poverty reduction, or is it the reverse?).

For such studies there needs to be the development of an assessment framework and data collection, capture and analysis protocols that link social and economic change with animal health and livestock productivity. Such work needs longitudinal datasets in order to examine causality. They merit being conducted by multi-disciplinary teams, objectively and without the preconceived ideas that led to livestock production being marginalised in development policies, because animals were being blamed for global warming, deforestation and the destruction of biodiversity.

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