

Improving animal health and livestock productivity to reduce poverty

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Summary

The study is based on scientific publications, statistics and field observations. It shows the importance of livestock in the economy and in the risk management strategies implemented by poor farming households. A comparison of livestock performance trends with the evolution of rural poverty in developing countries indicates that growth in livestock production alone is not enough to reduce rural poverty. To help reduce poverty, sustainable production should be based on productivity gains. Prerequisites for improving productivity include better public policies, enhanced research, and the reduction of animal disease risk. The study draws attention to the economic, social and environmental consequences of inadequate support for animal health and production in the least developed countries, especially those of sub-Saharan Africa.

Keywords

Animal health – Least developed countries – Livestock production – Poverty reduction – Productivity.

Introduction

Growth in livestock production has been strong in all regions of the world. However, the impact of this growth on reducing the poverty of

households that derive income from livestock has varied widely from country to country and is not well described.

Between 1962 and 2012, global meat production (from all species) increased by an average of 2.9% per year, and egg production by 3.1% per year. Milk production grew more slowly until the 1990s, at around 1.5% per year, but subsequently the growth rate increased to around 2.1% per year, thanks to strong production growth in Asia (author's estimates based on FAOSTAT, 2014) (1) (Fig. 1).

Based on data from scientific publications, statistics and field observations, the study shows the importance of livestock in the economy and in the risk management strategies implemented by poor farming households. It compares the capacity of intensive growth and extensive growth in livestock production to reduce poverty, as well as the experiences of countries that have achieved differing results in fighting poverty. It concludes by examining the conditions needed for improving livestock productivity and the barriers that animal diseases pose to this improvement.

The evolution of poverty in developing countries

The World Bank and United Nations define poverty as a multidimensional phenomenon leading to 'pronounced deprivation of well-being'. While the monetary dimension is the most important one, poverty is usually associated with undernourishment, severely curtailed access to housing, education and health care, and discrimination, affecting either individuals or groups. Extreme poverty is considered to stem mainly from public policy shortcomings and to be exacerbated by a host of factors, including: climate-related crises, conflict, ill-defined or unfair land ownership in the case of rural poverty, and lack of education. Most social groups living in extreme poverty are at a severe economic disadvantage from the outset and are caught in a vicious circle where the causes of poverty are hard to distinguish from its effects.

The extreme poverty rate fell sharply in developing countries from 52% in 1981 to 20% in 2012. However, high population growth has

meant that the number of extremely poor people has fallen only slightly. In 2012, a total of 2.6 billion people in developing countries were still living on less than US\$2 a day. Of these, 1.2 billion – nearly one-fifth of the world's population – were living in extreme poverty (on less than US\$1.25 a day). Most poor people lived in rural areas (2). In addition, progress has been uneven across regions (Fig. 2). While the People's Republic of China and other East Asian countries have achieved spectacular results, the extreme poverty rate in sub-Saharan Africa has decreased very little.

Benefits of livestock to poor farmers

In virtually all countries, poverty is predominantly rural – and rural poverty feeds urban poverty. (The exception is South America, where poverty originates in urban areas.) Living conditions, defined in terms of household consumption and access to education, health care, safe drinking water, sanitation, housing, transport and communications, are much worse for the rural poor than for the urban poor (3).

Between 80% and 90% of very poor rural households, representing 800 to 900 million people, are engaged in some form of agriculture (4).

The list of low-income food-deficit countries compiled by the Food and Agriculture Organization of the United Nations (FAO) is based on three criteria: a country's per capita gross national income, its food trade position (gross food imports less gross exports) and a self-exclusion criterion (whereby countries that meet the previous two criteria specifically request to be excluded from the list). In 2013, there were 62 countries on the list, which included most of the least developed countries (LDCs), plus an additional six countries in Africa, two in the Americas and ten in Asia (5). In low-income countries, which have the highest proportion of poor people, poor farmers engage in pastoralism or a mix of crop and livestock farming, depending on agro-climatic conditions and their social background. Increasingly, the permanent settlement of livestock farmers and changing lifestyles are giving rise to intermediate livestock systems, where animals are transhumant for a few months and rely on crops the

rest of the time. In low-income countries, there are very few intensive livestock farms, and those that exist are owned by wealthy farmers or investors (see below).

Pastoralism is practised by often marginalised communities over vast swathes of dryland where the extreme climate prevents any sort of crop cultivation and only the extensive farming of ruminants is viable. There are roughly 120 million nomadic and transhumant pastoralists worldwide, including around 50 million in sub-Saharan Africa (6). Although some pastoralists own large herds, their living conditions are always harsh and pastoral communities are some of the poorest in the world. In developing countries, pastoralists farm around 50% of the land reserved for livestock production (7). Despite this, they produce only 25% of the ruminant meat because the areas they farm are fragile and the need to preserve pasture quality necessitates a low stocking rate (8).

The majority of poor farmers live in areas where livestock are farmed along with crops. To reduce agricultural risk, poor farmers diversify their production. They grow several crop species and, those who can, also maintain several animal species. Nearly all rural households have animals and those that do not would like to have some (9). As the risks posed to crop production differ from those for animal production, when a bad crisis affects one type of production, mixed farmers are able to cope by relying on the income or proceeds from the other (10). Animals provide not only income and food but also draught power for farm work and transport, as well as helping to maintain soil fertility. In many cases, the value of animals' manure and labour outstrips that of their milk, eggs and meat. A study in Bangladesh showed that manure accounted for 40% of direct income from cattle production and labour accounted for 23%, far exceeding income from milk (22%) and meat (15%) (11).

For poor households, animals also provide the best means of preserving the necessary resources to manage agricultural crises and to exit poverty (10, 12). Researchers have estimated financial services to be worth 23% of the total value of output from cattle farming in

upland areas of Indonesia and 11% of the value of goat farming output in eastern Ethiopia (13) (Table I).

Table I here

For poor farmers, the economic value of livestock is heightened by the low value of the inputs they use to feed their animals. In most cases, ruminants are able to graze freely on community or fallow land, or to eat agricultural by-products with no commercial value. Poultry are left free to roam and feed mainly on kitchen waste, wild seeds and insects.

Poor farmers make a major contribution to the economy and to livestock production in low-income countries

In low-income countries, especially the LDCs, agriculture is an important component of the economy and the main source of employment. In 2013, there were 49 LDCs: 34 in sub-Saharan Africa, 9 in Asia, 5 in the Pacific and 1 in the Antilles (15). Agriculture in LDCs accounted for an average 25% of gross domestic product (GDP) and employed 62% of the workforce. The share of livestock production in agricultural GDP was approximately 35% (12).

With the exception of pastoral communities whose diet consists largely of milk or meat, poor farmers sell most of their livestock production (16). In many low-income countries, except in Latin America, despite low production per farm, poor farmers provide the majority of the animal products marketed because they are so numerous (12). The contribution of livestock to income is proportionally greater for very poor farmers than for wealthier farmers. Fasina *et al.* (17) show that, in the villages of southern Nigeria, poor farming households that own poultry sell all their meagre production (eggs and chickens). These households consume a large proportion of their own crops and derive around 80% of their cash income from poultry farming.

Differing foundations for growth in livestock production

Although growth in livestock production has been very strong all over the world (Fig. 1), the foundations for growth differ from region to region. In developed countries and East Asian and Latin American emerging countries, advances in genetics and veterinary medicine, coupled with better animal nutrition and livestock production conditions, have resulted in remarkable productivity gains (see Box 1 for the definition of 'productivity' used in this article). Off-take ratios have improved (the off-take ratio is considered here as an indicator of partial productivity). The majority of the growth was intensive growth, i.e. it stemmed from productivity gains and production intensification (Table II).

Box 1

Definition of 'productivity'

'Productivity' is defined here as the relationship between the volume of goods and services produced by animals and the volume of resources used to obtain them (i.e. labour, animals, land, feed, veterinarians, etc.). In all cases, 'productivity' refers to the efficiency with which a given agricultural unit (farm, region, country) uses the resources to obtain the end product. Productivity gains enable the creation of a surplus which can be distributed to producers or consumers.

By contrast, in LDCs, sub-Saharan Africa and parts of South Asia, production growth was mainly extensive, which is to say that it stemmed from a sharp increase in animal numbers, with few productivity gains.

Between 1962 and 2012, total meat production in LDCs rose from 2.5 million tonnes (Mt) to 9.2 Mt, corresponding to an average annual growth rate of 2.9% – identical to growth in global meat production. Milk and egg production increased by an annual 2.5% and 3.6% respectively, faster than in the rest of the world (growth rates were calculated on the basis of FAOSTAT data for 2014) (1). However, off-take ratios for pork are nearly four times lower than in developed

countries and, for beef, around seven times lower (Table II). Despite the fact that Nigeria and Pakistan are large countries too densely populated to be ranked as LDCs, their off-take ratios are comparable to those of LDCs.

In 2012, the 49 LDCs, which together owned 225 million cattle (14% of the world's cattle population) and 380 million sheep and goats (19% of the world's sheep and goat population), produced a mere 4.9% of the world's beef, 11% of its sheep and goat meat and 3.4% of its milk (1).

The LDCs are lagging behind in terms of productivity and there is no indication that they are beginning to catch up. In these countries, extensive growth still accounts for the largest share. The share of intensive growth in broiler production in sub-Saharan Africa and in LDCs and in pork production in Asian LDCs is comparatively greater, owing largely to the recent establishment of factory farms close to large urban centres (see below).

Improving agricultural productivity and public policies as a prerequisite for poverty reduction and economic growth

As a result of Joseph Schumpeter's work in the early 20th century, innovation and improved productivity are now considered to be the basic components of economic growth.

Modern-day economists, including De Soto (18) and Barro and Sala-i-Martin (19), have confirmed the importance of technological progress (and hence of productivity gains) and shown the diversity of determinants of growth, the most important being the quality of policies and public institutions and the securing of investment. Land ownership (with transferable and tradable land rights) is seen as key to reducing rural poverty and improving productivity because it secures investment and promotes productive investment. Ill-defined or unfair land ownership is considered to be a major cause of extreme rural poverty. Furthermore, in many low-income countries, free and unregulated access to grazing land (or failure to comply with existing

regulations) is a constraint on intensification, a major cause of natural resource degradation and sometimes a source of conflict among pastoralists and between pastoralists and agro-pastoralists.

Improved agricultural productivity formed the basis for growth in the major economies in the 19th century (including the United States, Japan and Europe) and, more recently, in the major emerging countries: China, Brazil and India (20, 21). No country has yet managed to reduce rural poverty without increasing the productivity of its agriculture (22, 23).

In countries where the primary sector accounts for a large share of the economy, agricultural growth contributes significantly more to the reduction of poverty than growth in non-agricultural sectors (3, 10). Christiaensen *et al.* (24) confirm this fact and explain that it is difficult to transfer the income generated in one economic sector to another. As a result, poor people derive greater benefits from growth if it occurs in their own sector. Furthermore, Thirtle *et al.* (25) show a strong correlation between the rate of agricultural productivity growth and the pace of poverty reduction.

The unique ability of livestock production growth to reduce poverty

According to Pica *et al.* (26), livestock-sector development has a unique ability to reduce poverty and contribute to economic growth. Based on data from 66 low- and middle-income countries, these authors found a statistically significant causal relationship between livestock-sector development and economic growth in 36 of the 66 countries surveyed. In 33 countries, development in livestock production seems to be (or to have been) an engine of growth in per capita GDP. According to the authors, the unique ability of livestock production to reduce poverty stems from its indirect benefits to agricultural productivity (through organic manure), product marketing (through transport) and human health (by reducing zoonoses and improving nutrition) and from the use of animals for savings and capital accumulation, facilitating poverty exit.

Growth limited to extensive livestock production does not contribute to poverty reduction

Poverty has declined markedly in countries that have succeeded in improving livestock productivity. However, it has stagnated in countries where growth in livestock production has been mainly extensive. The reason lies in the characteristics of these two forms of growth. Improving productivity makes it possible to produce more by making better use of the factors of production and, in particular, by providing livestock producers with a better return on their work. However, to produce more, growth in extensive production requires greater use of the factors of production (more animals, using more pasture and demanding more work) but it fails to make better use of the factors of production and, in particular, fails to provide livestock producers with a better return on their work. As a result, farmers' income stagnates. In other words, extensive growth is able to create jobs if new farmers start up in the sector but it does not lead to a significant reduction in poverty.

Moreover, to improve livestock productivity it is necessary to improve animal health, the effect of which is to reduce livestock losses and so preserve the capital that enables poor farmers to cope with agricultural crises better and to exit poverty (see above).

Animal diseases are a barrier to improving livestock productivity and a burden on poor farmers

The animal health situation usually reflects a country's level of economic development. In developed and emerging countries, animal diseases are being controlled ever more effectively. By contrast, in low-income countries, where the death of a single animal can have dramatic consequences for a vulnerable family, the economic and social impact of animal diseases is particularly severe.

The dramatic impact of zoonoses on vulnerable populations

Alongside emerging zoonoses, which pose a pandemic risk for people around the world, established zoonoses are still endemic in 149 countries, where they affect the most vulnerable populations the hardest (27). In low-income countries, these zoonoses kill as many people as malaria (28, 29). According to estimates of the World Health Organization (27), trypanosomosis kills 75,000 people annually, rabies kills 55,000, cysticercosis 50,000 and trematodosis 10,000 (to name but a few of the zoonoses in existence). Every year, 2.2 million people in LDCs, most of them young children, die from diarrhoeal diseases, chiefly of zoonotic origin, caused by *Campylobacter* or *Salmonella*.

Animal diseases lead to significant losses and decrease productivity

A meta-analysis taking into account the results of more than 100 scientific papers shows that animal diseases kill around 18% of the livestock population in low-income countries (World Organisation for Animal Health [OIE], unpublished). In LDCs, mortality rates in traditional village livestock systems average 20% to 22% for calves, 7% for cattle aged over 12 months, 22% to 24% for lambs and kids, 15% for adult sheep and goats, 40% to 50% for piglets and 50% for chickens aged 0 to 6 months.

Cattle farmers lose as many animals as they sell. The situation is a little less unfavourable for small-ruminant farmers (one animal lost for every two sold) and pig farmers (one animal lost for every two to three sold). Depending on the species, average mortality rates in low-income countries are 3 to 10 times higher than in developed countries.

Not only do animal diseases cause deaths, they also lead to production losses and indirect losses, which are generally far greater. Very few studies provide information on total losses in low-income countries caused by animal diseases. However, the information available for transmissible diseases confirms that losses are heavy. For instance, an

epizootic of Rift Valley fever in Somalia in the early 2000s had little impact on the country's livestock but, when Saudi Arabia banned Somalian livestock imports to protect its human and animal population, it drove down livestock prices on local markets, causing Somalian livestock producers to lose US\$47 to US\$55 million (30). Further estimates relate to the impact of trypanosomosis in tsetse-infested areas, which span 37 countries and 10 million km² of farmland. In some countries, trypanosomosis is estimated to cause cattle production losses of 50%. Compounding these losses is the cost of treatment, estimated at US\$35 million per year (31).

Animal diseases are an investment constraint for poor farmers, preventing them from taking advantage of technological advances and exacerbating inequalities

Farmers take into account the risk of animal diseases and adapt their behaviour to their vulnerability and ability to reduce the impact of risk. The poorest farmers, whose income is barely enough to live on, are strongly risk-averse because the loss of part of their assets may jeopardise their chances of exiting poverty and can sometimes threaten their survival (32). To minimise this risk, they are forced to diversify their activities and to choose less profitable but lower-risk options at the expense of potentially more profitable options that pose a higher risk. They therefore refrain from making even the very modest investment required to improve their farming techniques or animals, preferring to continue extensive farming, using animals that are less productive but more resistant to local endemic diseases. As a result of their sub-optimal production and investment choices, the economic efficiency of poor farmers declines. Over time, they marginalise themselves and turn their backs on the most profitable economic channels (33).

Wealthier farmers are less risk-averse because, in the event of failure, they are unlikely to fall into extreme poverty. In addition, they have the ability to reduce disease risk by isolating their animals from the harsh external environment and by engaging the services of private veterinarians. They manage to maximise profits from risky activities

by introducing intensive farming (often poultry farms close to large cities). Thanks to strong demand, they are usually able to incorporate the costs of risk prevention and treatment into their production costs, passing them on to consumers. The proliferation of intensive farming by wealthy livestock producers explains the strong growth in poultry production in low-income countries. Poor farmers, who bear the brunt of animal diseases, have no share in this production growth. What is more, their products face competition in local markets from those of wealthier farmers.

In a context of poor animal health and inefficient Veterinary Services, the risk of animal diseases is not only a barrier to both investment and increased productivity, it is also a factor of social inequality and contributes to the marginalisation of the poorest farmers.

Justification for support to improve animal health and livestock productivity in low-income countries

Determinants of improved livestock productivity

In meta-analyses, Latruffe (34) and Shimura and Moreddu (35) show that the most powerful determinants of productivity are the quality of public interventions (sectoral policies [including animal health policy], research and development, and infrastructure), the quality of the natural environment (climate and soil fertility), market conditions (strength of demand), and the farms' level of commercialisation (commercial farming as opposed to subsistence farming).

According to these authors, livestock producers are not in a position to control the most powerful determinants of productivity, except for the level of commercialisation. This would explain, at least in part, the low productivity levels in countries where sectoral policies are weak and there is very little support for livestock production, and the high productivity levels in countries where agriculture receives strong government support. The lack of control of livestock producers over most of the determinants would also explain why farmers in the same area tend to have comparable productivity levels, irrespective of their personal expertise.

Livestock enjoys considerable support in developed countries

Total agricultural support is a composite indicator of: producer support; support for general services such as research, infrastructure, agricultural training and inspection; and consumer support.

Farmers in developed countries receive significant government support to promote higher productivity. This support is distributed equitably between crop and livestock production. Although the support provided by member countries of the Organisation for Economic Co-operation and Development (OECD) to their farmers has shrunk considerably in recent decades, it was still worth US\$258 billion in 2012, or 19% of the total value of farm products.

Improvement in agricultural productivity has been the key factor in reducing poverty in East Asia

The countries of East Asia, which have provided strong support to agriculture, are those that have achieved the best results in reducing poverty (Fig. 2). Along with sectoral policy reforms, China has gradually increased total agricultural support to a full 17% of the value of agricultural production in 2011. This exceptionally high level accounted for 3.7% of national GDP. In OECD countries, government support for agriculture in 2011 accounted for 0.9% of GDP (37). In China, animal health and livestock production, particularly milk production, have greatly benefited from this support. Remarkable productivity gains have been made in the livestock sector (Table II). Meanwhile, poverty has dropped sharply – from 77% of the population in 1981 to 12% in 2012. Poverty reduction has been compatible with maintaining a large rural population (50%) and a large number of farms. In 2012, there were 200 million farming households in China. The average farm size was 0.65 hectares.

Montalvo and Ravallion (38) showed that, in China, improved agricultural productivity has been the key factor in reducing poverty. They conclude that the idea that the secondary sector (manufacturing) and tertiary sector (services) have played a role in fighting poverty is

debatable, because there are very few data demonstrating the influence of these two sectors on growth.

Weak sectoral policies and inadequate government support for livestock production in low-income countries

Despite its economic and social importance, the livestock sector has been the biggest loser in the changing international aid strategies and economic policies of the poorest countries.

Until the 1980s, the governments of most LDCs provided significant support to livestock production. However, the implementation of structural adjustment policies in the 1980s and 1990s led to the rapid withdrawal of public Veterinary Services from the field, even though there were not enough private operators capable of taking over. This led to the sudden cessation of many services (mass vaccination, dip tanks, veterinary clinics, etc.), with serious consequences for livestock performance (39).

In 1999, the International Monetary Fund [IMF] and World Bank launched Poverty Reduction Strategy Papers (PRSPs). They did so against a backdrop of debt crisis and the failure of structural adjustment policies to reduce poverty. At the same time, there was a push to achieve the Millennium Development Goals established in 2000 following the Millennium Summit. These consisted of eight quantified goals to be achieved by 2015, covering issues such as the reduction of poverty, the improvement of maternal and child health, the improvement of education and the establishment of a global partnership for development. Efforts to achieve these goals, coupled with the introduction of PRSPs, resulted in significant increases in aid to the social sector (especially health and education) and to institutions, and a sharp reduction in government support and international aid for economic infrastructure and the productive sectors, including agriculture. Support for livestock production collapsed.

In 2012, development assistance (all donors) totalled US\$172 billion, of which agriculture as a whole received US\$11.5 billion. The share

of assistance allocated directly to the livestock sector was US\$173 million, including US\$114 million for livestock production and US\$59 million for animal health and support for achieving compliance with OIE quality standards for Veterinary Services (40). This means that, in 2012, direct assistance for livestock production was only 1.5% of total assistance for agriculture (41), which is tiny given the economic and social importance of livestock. This catastrophic situation is primarily the result of policy decisions.

In LDCs, where international aid represents a large share of national agricultural investment budgets (often in excess of 30%), this sharp reduction in aid financing has acted as a constraint on improved livestock productivity.

National strategies reflect PRSP guidelines because countries are required to have their PRSP approved before they are eligible for IMF and World Bank financial assistance or debt relief. A study of references to livestock production in the PRSPs of 49 countries reveals that no PRSP presented a coherent picture of the importance of livestock in the economy and in poverty reduction (42). The PRSPs of countries where most of the population depends mainly on livestock for their livelihoods (such as Niger or Tajikistan) gave only a brief overview of livestock production. The few recommendations concerning livestock production were general, failing to specify the activities to be performed or to quantify budgetary needs. According to the study's authors, this reflected a lack of willingness to develop livestock production.

Conclusions

In most low-income countries, poor farmers do not receive the support they need to improve the health and productivity of their animals. As a result, they bear the brunt of the effects of animal diseases, which reduce their income and kill or weaken their animals, destroying much of their food resources and assets. Furthermore, the risk posed by these diseases prevents poor farmers from making the modest investment required to take advantage of technological advances and

improve the productivity of their animals. It also discourages foreign investment in the sector.

So, in response to strong demand, instead of intensive growth that makes full use of the factors of production and conserves natural resources, livestock production development is often extensive, which does nothing to reduce poverty and uses more and more animals and natural resources.

The development history of the major economies, the findings of many studies and the experience of countries that have recently won their fight against rural poverty, confirm that improving the productivity of agriculture, especially livestock, requires external support based on the public good concept (Box 2) (43) and that a prerequisite to reducing rural poverty is raising agricultural productivity, in particular livestock productivity.

This evidence warrants a debate on the benefits of improving support for livestock health and production.

Box 2

Definition of a 'global public good'

According to Kaul *et al.*, (43) public goods are goods that include the concepts of:

- non-rivalry: if a group enjoys a 'global public good', it should not be to the detriment of other groups but to their benefit;
- non-exclusion: no-one should be excluded.

Public goods are therefore *de facto* global public goods if they can benefit all countries, population groups and generations.

In the case of controlling transmissible diseases, the benefits may extend to all countries and population groups and these benefits may be intergenerational. Countries are interdependent and an inadequate response in one country can affect all the others. The eradication of a globally important animal disease (such as a zoonosis or animal disease with a severe economic impact) can benefit all countries and none should be excluded from this benefit. The eradication of a disease therefore benefits not only the current generation but also future generations.

References

1. Statistics Division of the Food and Agriculture Organization of the United Nations (FAOSTAT) (2014). – FAO statistical databases. Available at: faostat.fao.org/DesktopDefault.aspx?PageID=569# (accessed on 9 September 2014).
2. World Bank (2014). – World development indicators. Available at: www.worldbank.org/en/topic/poverty (accessed on 9 September 2014).
3. Hasan Khan M. (2000). – Rural poverty in developing countries. *Fin. & Dev.*, 37 (4), 26–29.
4. International Fund for Agricultural Development (IFAD) (2011). – Rural poverty report 2011. Available at: <http://www.ifad.org/rpr2011/report/e/rpr2011.pdf> (accessed on 9 September 2014).
5. Food and Agriculture Organization of the United Nations (FAO) (2013). – Pays à faible revenu et à déficit vivrier. Available at: <http://www.fao.org/countryprofiles/lifdc/en/> (accessed on 9 September 2014).
6. Brussels Rural Development Briefings (2009). – The role of livestock for ACP countries: challenges and opportunities ahead. Briefing no. 12. Partnership between the African, Caribbean and Pacific Group of States (ACP) and the European Community (EU), Brussels.
7. World Bank (2009). – Minding the stock: bringing public policy to bear on livestock sector development. World Bank, Agriculture and Rural Development Department, Washington, DC.
8. Steinfeld H., Wassenaar T. & Jutzi S. (2006). – Livestock production systems in developing countries: status, drivers, trends. *In* Animal production food safety challenges in global markets (S.A. Slorach, ed.). *Rev. sci. tech. Off. int. Epiz.*, 25 (2), 505–516.

9. Pica-Ciamarra U., Tasciotti L., Otte J. & Zezza A. (2011). – Livestock assets, livestock income and rural households: cross-country evidence from household surveys. FAO Working Paper No. 11-17. Food and Agriculture Organization of the United Nations (FAO), Rome.

10. Alary V. (2003). – L'élevage dans la gestion des risques par les producteurs du Nord de l'Inde. In *Élevage et pauvreté : actes de l'atelier du Centre de coopération internationale en recherche agronomique pour le développement (CIRAD)*, Montpellier, France.

11. Food and Agriculture Organization of the United Nations (FAO) (1999). – Poverty alleviation and food security in Asia: role of livestock. FAO Regional Office for Asia and the Pacific, Bangkok.

12. Food and Agriculture Organization of the United Nations (FAO) (2012). – Livestock sector development for poverty reduction: an economic and policy perspective – livestock's many virtues (J. Otte, A. Costales, J. Dijkman, U. Pica-Ciamarra, T. Robinson, V. Ahuja, C. Ly & D. Roland-Holst, eds). FAO, Rome, 161 pp.

13. Food and Agriculture Organization of the United Nations (FAO) (2007). – The state of the world's animal genetic resources for food and agriculture (B. Rischkowsky & D. Pilling, eds). FAO, Rome.

14. Neumann C.G., Bwibo N.O., Murphy S.P., Sigman M., Whaley S., Allen L.H., Guthrie D., Weiss R.E. & Demment M.W. (2003). – Animal source foods improve dietary quality, micronutrient status, growth and cognitive function in Kenyan school children: background, study design and baseline findings. *J. Nutr.*, **133** (11), 3972S–3980S.

15. United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS) (2013). – About LDCs. Available at: unohrlls.org/about-ldcs/about-ldcs/ (accessed on 9 September 2014).

16. Mbyuzi A.O., Komba E.V.G. & Mulangila R.C.T. (2012). – Integrating interventions against village chicken diseases to reduce mortalities of chicks and growers in southern zone, Tanzania. *Livest. Res. rural Dev.*, **24**, Article # 23.

17. Fasina F.O., Wai M.D., Mohammed S.N. & Onyekonwu O.N. (2007). – Contribution of poultry production to household income: a case of Jos South Local Government in Nigeria. National Veterinary Research Institute Research Report No. 3. *Family Poult.* **17** (1&2), 30–34.

18. De Soto H. (2000). – The mystery of capital: why capitalism triumphs in the West and fails everywhere else. Basic Books, New York.

19. Barro R.J. & Sala-i-Martin X. (2004). – Economic growth, 2nd Ed. MIT Press, Cambridge, Massachusetts.

20. Adelman I. & Morris C. (1988). – Comparative patterns of economic development, 1850–1914. Johns Hopkins University Press, Baltimore.

21. Krueger A., Schiff M. & Valdés A. (1988). – Agricultural incentives in developing countries: measuring the effect of sectoral and economy-wide policies. *World Bank econ. Rev.*, **2** (3)? 255–272.

22. Gallup J., Radelet S. & Warner (1997). – Economic growth and the income of the poor. CAER Discussion Paper No. 36. Harvard Institute for International Development: Cambridge, Massachusetts.

23. Irz X., Lin L., Thirtle C. & Wiggins S. (2001). – Agricultural productivity growth and poverty alleviation. *Dev. Policy Rev.* **19** (4), 449–466.

24. Christiaensen L., Demery L. & Kuhl J. (2010). – The (evolving) role of agriculture in poverty reduction: an empirical perspective. WIDER Working Paper No. 36. United Nations University–World Institute for Development Economics Research, Helsinki.

25. Thirtle C., Lin L. & Piesse J. (2003). – The impact of research led agricultural productivity growth on poverty reduction in Africa, Asia and Latin America [conference paper]. 25th Conference of the International Association of Agricultural Economists: ‘Reshaping Agriculture’s Contributions to Society’, 16–22 August, Durban, South Africa.

26. Pica G., Pica-Ciamarra U. & Otte J. (2008). – The livestock sector in the World Development Report 2008: re-assessing the policy priorities. Pro-Poor Livestock Policy Initiative: a living from livestock. Research Report No. 08-07. Food and Agriculture Organization of the United Nations, Rome.

27. World Health Organization (WHO) (2010). – The control of neglected zoonotic diseases: community-based interventions for prevention and control. Report of the third conference, 23–24 November, Geneva. Organised with the European Union Framework 7 Project ‘Integrated Control of Neglected Zoonoses in Africa’, United Kingdom Department for International Development’s ‘Research into Use’ Programme, Bill & Melinda Gates Foundation, Research Directorate of the European Commission, Stamp Out Sleeping Sickness Project, UNDP/UNICEF/World Bank/WHO Special Programme for Research and Training in Tropical Diseases, and the Food and Agriculture Organization of the United Nations, with the participation of the International Livestock Research Institute and World Organisation for Animal Health (OIE).

28. Coleman P. (2002). – Zoonotic diseases and their impact on the poor. *In* Investing in animal health research to alleviate poverty (B.D. Perry, T.F. Randolph, J.J. McDermott, K.R. Sones & P.K. Thornton, eds). International Livestock Research Institute, Nairobi.

29. Torgerson P.R. & Macpherson C.N.L. (2011). – The socioeconomic burden of parasitic zoonoses: global trends. *Vet. Parasitol.*, **182**, 79–95.

30. Cagnolati V., Tempia S. & Abdi A. (2006). – Economic impact of Rift Valley fever on the Somali livestock industry and a novel surveillance approach in nomadic pastoral systems.

31. Food and Agriculture Organization of the United Nations (FAO) (2013). – Programme against African Trypanosomosis (PAAT). Available at: www.fao.org/ag/againfo/programmes/en/paat/home.html (accessed on 9 September 2014).

32. Hardaker B. (2000). – Some issues in dealing with risk in agriculture. Working Paper Series in Agricultural and Resource Economics. No. 2000-3, University of New England.

33. Antón J. & Thompson T. (2008). – Risk aversion and competitiveness. OECD Publishing, Paris.

34. Latruffe L. (2010). – Competitiveness, productivity and efficiency in the agricultural and agri-food sectors. OECD Publishing, Paris. Available at: www.oecd-ilibrary.org/agriculture-and-food/competitiveness-productivity-and-efficiency-in-the-agricultural-and-agri-food-sectors_5km91nkdt6d6-en (accessed on 9 September 2014).

35. Organisation for Economic Co-operation and Development (OECD) (2011). – Determinants of productivity growth and competitiveness. *In* Fostering productivity and competitiveness in agriculture. OECD Publishing, Paris.

36. Organisation for Economic Co-operation and Development (OECD) (2013). – Trends in the OECD area. *In* Agricultural policy monitoring and evaluation 2013: OECD countries and emerging economies. OECD Publishing, Paris. Available at: http://dx.doi.org/10.1787/agr_pol-2013-6-en

37. Organisation for Economic Co-operation and Development (OECD) (2011). – Agricultural policy monitoring and evaluation 2011: OECD countries and emerging economies. OECD Publishing, Paris. Available at: <http://www.oecd-ilibrary.org/agriculture-and->

food/agricultural-policy-monitoring-and-evaluation-2011_agr_pol-2011-en.

38. Montalvo J. & Ravallion M. (2009). – The pattern of growth and poverty reduction in China. *J. comp. Econ.*, **38** (2010), 2–16.

39. World Organisation for Animal Health (OIE) (2013). – The OIE PVS Pathway. Available at: <http://www.oie.int/en/support-to-oie-members/pvs-pathway/> (accessed on 9 September 2014).

40. Food and Agriculture Organization of the United Nations (FAO) (2013). – World livestock 2013: changing disease landscapes. FAO, Rome.

41. Organisation for Economic Co-operation and Development (OECD)/Development Assistance Committee (DAC) (2013). – Aid statistics. Available at: <http://www.oecd.org/dac/stats/> (accessed on 9 September 2014).

42. Blench R., Chapman R. & Slaymaker T. (2003). – A study of the role of livestock in Poverty Reduction Strategy Papers (PRSPs). PPLPI Working Paper No.1. Pro-Poor Livestock Policy Initiative (PPLPI). FAO, Rome.

43. United Nations Development Programme (UNDP) (1999). – Global public goods: international cooperation in the 21st Century (I. Kaul, I. Grunberg & M.A. Stern, eds). Oxford University Press, 585 pp.

Table I
Direct and indirect benefits of livestock ownership for poor rural households

Product or function	Direct benefits	Indirect benefits
Animal products for human consumption (milk, meat, eggs)	Home consumption Source of income	Contribution to food security Improved nutrition (better cognitive function and health)*
Transportation, agricultural labour force	Draught power – Income Transportation (goods and people)	Contribution to improving agricultural productivity Better market access
Manure	Organic fertilisation	Improved soil fertility and agricultural productivity
Source materials for traditional crafts	Work with leather, wool and bristles, manufacturing of clothing and carpets, etc.	Additional income and jobs, often for the most vulnerable people (women, the elderly)
Wealth function	Monetary reserve Capital accumulation factor	Means of saving. Can be mobilised in the case of agricultural risk or a life event
Social function	Compliance with social and cultural obligations	Enhances integration into a community

* According to Neumann C.G. *et al.* (2003) (14)

Table II
Off-take ratio and the contribution of intensive growth to overall growth in meat production from chickens, pigs and cattle, in major world regions and in the least developed countries, between 1981 and 2012

Region	Off-take ratio* (kilograms of meat per head)				Percentage of overall growth attributable to intensive growth**			
	Cattle	Pigs	Chickens	Sheep/goats	Cattle	Pigs	Chickens	Sheep/goats
Sub-Saharan Africa	18	36	2.7	4.4	17%	14%	39%	23%
Latin America and the Caribbean	44	86	8	3.8	53%	88%	66%	
East Asia and the Pacific	62	101	3.2	10	86%	80%	44%	83%
South Asia	5	89	2.3	4.3	60%	68%	23%	-7%
Middle East and North Africa	50		7.7	5	68%		55%	
Least developed countries	13	38	1.9	4.1	21%	34%	43%	16%
Developed countries	95	145	8.5	9.1	100%	100%	41%	100%

Off-take ratio and intensive growth rates calculated on the basis of data from the Statistics Division of the Food and Agriculture Organization of the United Nations (FAOSTAT) in 2014 (1)

* The off-take ratio is calculated by dividing the amount of meat obtained from a species in a year (usually expressed in kilograms) by the average number of animals of that species for the same year

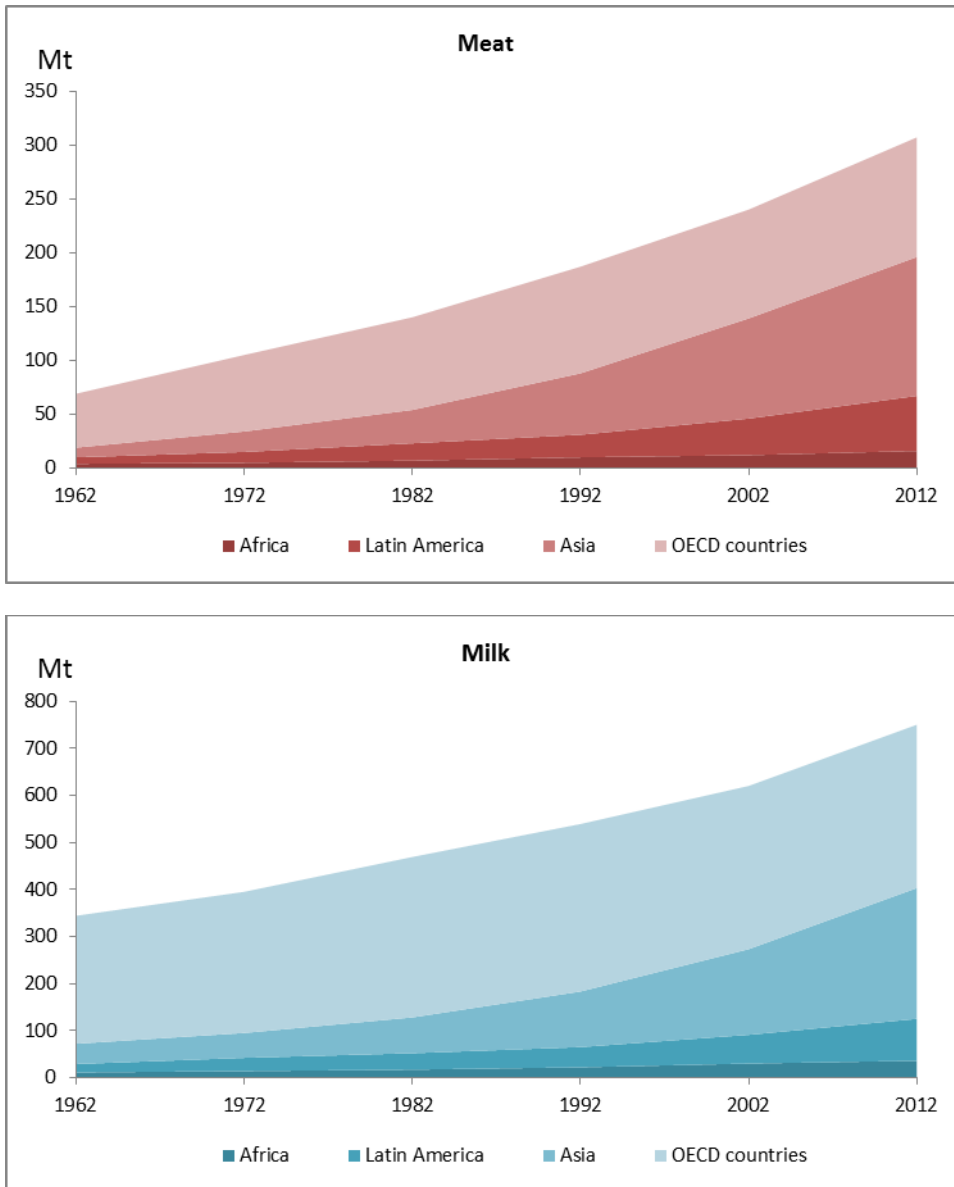
** The percentage of production gains due to intensive growth (with productivity gains) between year A (start of period) and year B (end of period) is determined by the formula:

$$\frac{\text{Production year B} - [(\text{production year A} \div \text{number of animals year A}) \times \text{number of animals year B}]}{\text{Production year B} - \text{production year A}}$$

Fig. 1

Trend in meat and milk production in major world regions from 1962 to 2012 (millions of tonnes)

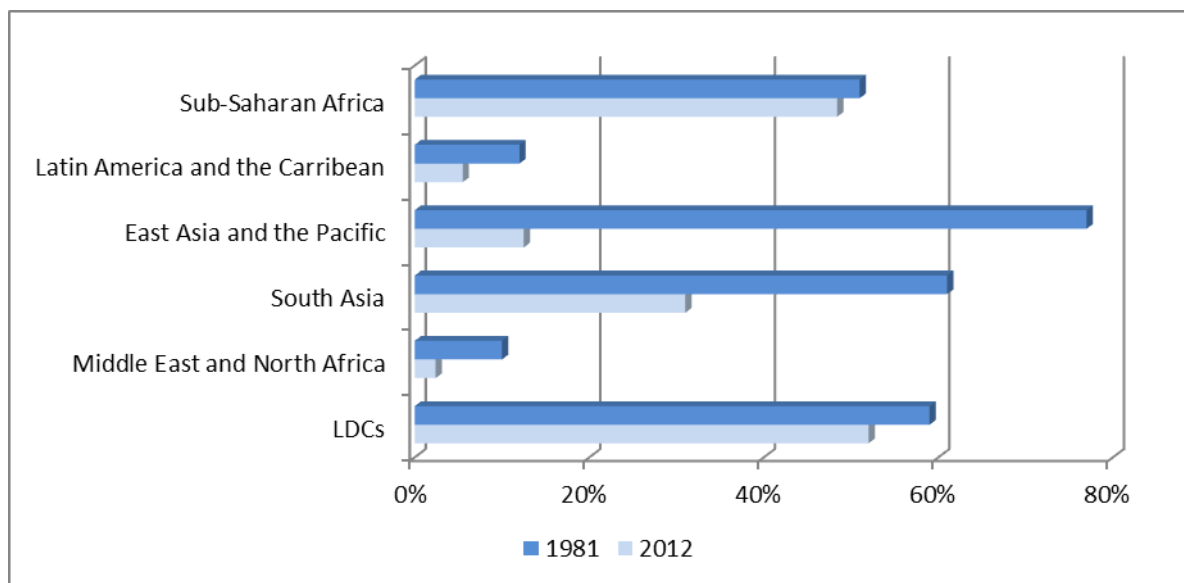
Source: Statistics Division of the Food and Agriculture Organization of the United Nations (FAOSTAT) (2014) (1)



MT: million tonnes

Fig. 2
Percentage of people living in extreme poverty in developing countries in major world regions and in the least developed countries, in 1981 and in 2012

Source: World Bank (2014) (2)



LDCs: least developed countries