PUBLICATION

Fact Check 8: Livestock Yield Gaps


FACT CHECK

Livestock Yield Gaps

To what extent can livestock productivity be improved?

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Variation in productivity among farmers, both within and between defined production systems, suggests there is potential for productivity improvement, also known as closing the yield gap). Yield gaps define the difference between actual and potential yields (a maximum achievable production with best management practices); however, yield gap analyses can, and have been, applied to livestock systems[1-4].

In low and middle incomes countries (LMICs) access to resources is often limited, so it may be impossible to attain maximum technically achievable yields. More realistic expectations are set using relative yield gaps between actual and attainable yields, given locally available resources[2, 5]. Furthermore, variation between different production systems can be caused by differences in environment, technology, or management decisions and processes; to what extent each of these has an influence and how controllable they, are will influence the quantification of attainable yields[1, 6].

How can we quantify yield gaps?

To estimate the magnitude of livestock yield gaps within a location, a simple benchmarking method can be used. Using data usually gathered through surveys, the average farm performance is compared to the best performing farms (e.g. top 10% producers)[2,4]. This can inform what is feasible if average farms were to adopt the practices of their high performing neighbours[2]. Another approach is to construct production frontiers for the farm population. The frontier (or curve) represents the most efficient farms in the population, considering all inputs and outputs, thus describing the maximum level of output achievable by farms in a population. Given their existing inputs, each farm is given a technical efficiency score based on the gap between their current and attainable productivity. These can be averaged to give an illustration of the population yield gap[1, 4](Figure 1).

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To what extent livestock productivity can be improved?

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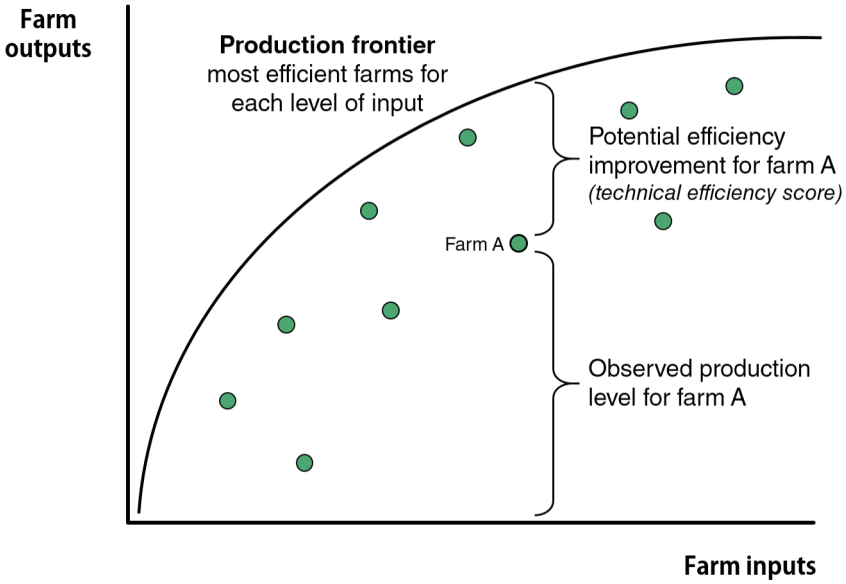

Figure 1. Simplified example production frontier with suggested potential for efficiency improvement for an individual farm.

The usefulness of system models

Livestock keepers in LMICs are unlikely to change their practices based on the promise of increased production alone; livestock are often multi-functional and can fulfil various objectives, including risk mitigation or displays of status[7]. System modelling, such as that carried out in the LiveGAPS project[8], is particularly useful in taking the production improvements suggested by yield gap analysis and demonstrating how these are likely to impact the broad household system. Notably, interventions that produce the greatest increase in production do not always lead to the greatest increase in household profit. For instance, market access was also identified as an important component to accompany increase in production[1,4,6,9].

The benefit of combined interventions

Modelling suggests that the greatest increases to livestock system productivity will occur when interventions (e.g. improved livestock nutrition and animal health, as well as the use of improved cross-breeds) are applied in combination[4, 9]. This is supported by examples of both past successful and failed efforts to improve livestock systems in LMICs. For instance, attempts at livestock genetic improvement which do not include accompanying management changes (improved feeding and health), were observed to have little success[10]. Whilst there is evidence of success, breed improvements that have also been

accompanied by appropriate support and access to resources, were more likely to realise production potentials[11-13].

Yield gaps for decision making

The limitations of modelling studies and the complexity of LMIC livestock systems must always be kept in mind. However, it is valuable to understand the factors limiting livestock productivity in order to define and prioritise appropriate investment of resources to reach maximum positive impact. Funders should recognise the value of combined interventions to effectively support livestock production improvements

References

1. *Henderson, Godde, C., Medina-llidalgo, D., van Wijk, M., Silvestri, S., Douxchamps, S., Stephenson, L., Power, B., Rigolot, C., Cacho, O. & Herrero, M. 2016. Closing system-wide yield gaps to increase food production and mitigate GHGs among mixed crop-livestock smallholders in Sub-Saharan Africa. Agricultural Systems, 143: 106-113.*
2. *Cortez-Arriola, J., Groot, J. C. J., Améndola Massiotti, R. D., Scholberg, J. M. S., Valentina Mariscal Aguayo, D., Tittonell, P. & Rossing, W. A. H. 2014. Resource use efficiency and farm productivity gaps of smallholder dairy farming in North-west Michoacén Mexico. Agricultural Systems, 126: 15-24.*
3. *van der Linden, A., Oosting, S. J., van de Ven, G. W. J., de Boer, I. J. M. & van Ittersum, M. K. 2015. A framework for quantitative analysis of livestock systems using theoretical concepts of production ecology. Agricultural Systems. 139: 100-109.*
4. *Mayberry, D., Ash, A., Prestwidge, D., Godde, C. M., Henderson, B., Duncan, A., Blummel, M., Ramana Reddy, Y. and Herrero, M. 2017. Yield gap analyses to estimate attainable bovine milk yields and evaluate options to increase production in Lthiopia and India. Agricultural Systems, 155: 43-51.*
5. *Tittonell, P. & Giller, K. E. 2013. When yield gaps are poverty traps: The paradigm of ecological intensification in African smallholder agriculture. Field Crops Research, 143: 76-90.*
6. *Herrero, M., Mayberry, D., Van de Steeg, J., Phelan, D., Ash, A., Diyezee, K., Robinson, T., Henderson, B., Gilbert, M., Van Wijk, M., Godde, C., Blummel, M., Prestwidge, D., Stephenson, E., Power, B. & Parsons, D. 2016. Understanding livestock yield gaps for poverty alleviation food security and the environment: The*

LiveGAPS Project. CSIRO, Brisbane, Australia.

7. *Salmon, G., Teufel, N., Baltenweck, I., van Wijk, M., Claessens, L. & Marshall, K. 2018. Trade-offs in livestock development at farm level: Different actors with different objectives. Global Food Security, 17: 103-112.*
8. *CSIRO. 2018. LiveGAPS. Online accessed 04/01/2018.*
9. *Mayberry, D., Ash, A., Prestwidge, D. & Herrero, M. 2018. Closing yield gaps in smallholder goat production systems in Ethiopia and India. Livestock Science, 214: 238-244.*
10. *Kosgey, I. S. & Okeyo, A. M. 2007. Genetic improvement of small ruminants in low-input, smallholder production systems: Technical and infrastructural issues. Small Ruminant Research, 70: 76-88.*
11. *Thorpe, W., Muriuki, H. G., Omore, Owango, M. O. & Staal, S. 2000. Dairy development in Kenya: the past, the present and the future. In Annual Symposium of the Animal Production Society of Kenya (KARI Headquarters, Nairobi.*
12. *Peacock, C., Ahuya, C. O., Ojango, J. M. K. & Okeyo, A. M. 2011. Practical crossbreeding for improved livelihoods in developing countries: The FARM Africa goat project. Livestock Science, 136: 38-44.*
13. *Rege, J. E. O., Marshall, K., Notenbaert, A., Ojango, J. M. K. & Okeyo, A. M. 2011. Pro-poor animal improvement and breeding — What can science do? Livestock Science, 136: 15-28.*

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