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Citation: Eba, B., Hialeslassie, A., Animut, G., Duncan, A. and Peden, D. Effects of livestock feed sourcing and feeding strategies on livestock water productivity in mixed crop–livestock systems of the Blue Nile basin highlands of Ethiopia. In: Wolde Mekuria. (ed). 2013. *Rainwater management for resilient livelihoods in Ethiopia: Proceedings of the Nile Basin Development Challenge science meeting, Addis Ababa, 9–10 July 2013*. NBDC Technical Report 5. Nairobi, Kenya: International Livestock Research Institute.

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Effects of livestock feed sourcing and feeding strategies on livestock water productivity in mixed crop–livestock systems of the Blue Nile basin highlands of Ethiopia

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Abstract: Inefficient management and use of water is unanimously the most single constraint of agricultural production of Ethiopia. The study was conducted to assess the effect of livestock feed sourcing and feeding strategies on livestock water productivity (LWP) in mixed crop–livestock production systems of the Blue Nile Basin in Ethiopian Highlands. Three districts representing diverse agricultural farming systems were considered. Each district further stratified to different farming systems. Multi-stage stratified random sampling technique was employed to select farm households. Household survey, group discussions and plant biomass sampling were done to generate data on beneficial outputs, water depleted and feed sourcing and feeding strategies. LWP was estimated as a ratio of livestock's beneficial outputs and services to depleted water. The results indicated that the major feed sources were mainly from crop residues (58.5 to 78.2%), natural pasture (10.9 to 33.4%) and aftermath grazing (9.9 to 24.3%) in study farming systems. The feed source from energy dense (improved forages) was low. The feeding strategies were relatively similar among the study farming systems. No apparent difference ($P>0.05$) was observed in LWP within all districts among the farming systems and the value falls between USD 0.15–0.19 m⁻³. However, LWP difference was observed within clustered wealth status within all farming systems and lower value of LWP general observed for the poor farm households. Such differences of LWP values can be accounted for by the strategies farm households are following in feed sourcing and how water productive those feed sources are. Hence, in the context of this work, options to improve LWP mainly involve sourcing water productive and higher quality feed.

Media grab: Improving feed sources, feed quality and feeding system increases water productivity and hence LWP

Introduction

Water competition among different uses and users can hinder meeting increasing food–feed demands (Benin et al. 2006). For decades, long irrational communal exploitation of land, has led to competition over land and water and thus caused water scarcity in Blue Nile Basin (WFP 2007). The Nile basin in Ethiopia contains about 27.6 Tropical Livestock Unit (TLU) per km² (Breugel et al. 2007) but livestock's requirements for and impact on agricultural water uses have been largely ignored (Peden et al. 2007; Peden et al. 2008). Globally, current animal production depletes more than 1×10^{12} m³ of water per year only for feed and this is about one seventh of the global water depletion for agriculture (Peden et al. 2007). However, by 2020, livestock will likely produce more than half of the total global agricultural output in monetary value. This will place a significant extra demand on agricultural water resources; especially for livestock feed production. Hence, emerging understanding suggests that better integration of livestock and water development can help improve agricultural water productivity in the Blue Nile basin (Peden et al. 2007). A livestock water productivity framework enables a better understanding of livestock–water interactions. However, little is known about water depleted to produce feed, the efficiency with which feed is converted into animal products and services and the impact animals have on water resources in different landscape of crop–livestock system. Hence, the aim of this study was to assess the effect of current feeding strategies and feed sourcing on livestock water productivity in different farming systems and landscapes of the mixed crop–livestock systems of Blue Nile Basin of Ethiopia.

Materials and methods

Study sites

This research was undertaken in Diga, Jeldu and Fogera Districts, as part of the Nile Basin Development Challenge (NBDC) project. Three study watersheds one from each district were selected. The watersheds identified were; Dapo from Diga, Meja from Jeldu and Mizewa watershed from Fogera.

Stratification, household survey and estimation of LWP

A multi stage stratified random sampling technique was employed to select farm households. Household survey, group discussions, feed resources assessment using harvest index and plant biomass sampling were done to generate data on beneficial outputs, water depleted and feed sourcing and feeding strategies. LWP was estimated as a ratio of livestock's beneficial outputs and services to depleted water.

Results and discussion

Feed sources

Sufficient and quality feed resources availability are some of the major determinants of livestock productivity. In all study systems, majority of sample farmers responded that crop residues, green grass from natural pasture and aftermath grazing are major feed resources. The contribution of each of these feed ingredients to the diet of livestock varies across study systems. Generally, for all farming systems, the crop residues contribution to feed on a dry matter basis ranged from 58.5 to 78.2%. But the point is as to whether these major feed sources; crop residues, influence the livestock water productivity in mixed crop livestock systems of Ethiopia. The grazing land and aftermath grazing contribution on dry matters basis ranged from 10 to 33 and 9 to 24% in study systems, respectively. Decline of areas and dwindling of biomass productivity of grazing lands in the study areas are some of the major concerns. What is encouraging in terms of future improvement of dry matter productivity and associated LWP is the huge yield gaps between these traditional practices and research managed intervention. For example, in Fogera as much as 10.8 t dry matter yield per hectare was reported (Ashagre 2008) from improved natural pasture. By closing yield gaps as high as 100%, improvement in LWP is reported for mixed crop livestock systems of India (Haileslassie et al. 2011). Moreover, the results of this study demonstrated that improved forages production and feed supplementation (e.g. bran, oil cake)

were rarely practised in all study sites. This indicates that to date adoptions of technologies are generally limited to peri-urban and urban areas. The relevant question here is probably as to why policy measures that enhance improved forage production could not be implemented and as to whether policy recommendations, if they exist, are system specific or generalized.

Feeding systems

In teff–millet system of Diga, about 34.3% of respondents practice tethering of livestock on grazing land. However, in Jeldu and Fogera, most of the private grazing lands were grazed by herding and some of it used for hay making. About 95.6 and 96.7%, of respondents practice giving small amount of crop residues to livestock near homestead in farming systems of Jeldu and Fogera, respectively. About 76.1 to 96.8% of respondents did not practice any treatments or improvements made during feeding to increase the quality of straws in all study systems.

Livestock water productivity

Although the magnitude of LWP varies across systems and study sites, differences were not statistically significant. LWP is derived from number of data sets and assumptions. Therefore the reason for similarity or divergence of LWP values among systems can trace back to those data sets. A simple example is the livestock beneficial outputs and the water depleted for feed production in the study system. The beneficial output on TLU basis, for example, does not show many discrepancies among system. This implies that the farming practices from which the beneficial outputs mainly derived is very similar. Probably difference emerges when considered at farmers' wealth category level where difference in land holding is important and thus beneficial outputs from livestock services differed between farm households. One major trend worth mentioning here is that in areas of higher beneficial outputs (e.g. Fogera rice system) as the results of livestock density, the water depletion for feed was very high and this offset the LWP value. Generally, LWP values for the study farming systems falls between USD 0.15 m⁻³ to USD 0.19 m⁻³. The LWP estimates of this study, for rice system, was comparable with the study of Hailelassie et al. (2009) (USD 0.15 m⁻³) of Gumera watershed. Cook et al. (2008) also suggests those kinds of variability to the temporal and spatial scales at which livestock production systems are analysed and strong fluctuations in water availability related fluctuations in livestock productivity. Descheemaeker et al. (2010) also suggested that the amount of water used by different feed types and the influence of management practices and agro-ecological conditions lead to variation of LWP value.

The value of LWP (USD 0.25 m⁻³ to USD 0.39 m⁻³) from a controlled experiment reported by the Geberselassie et al. (2009) shows greater values than this study. This may be due to the difference of feed composition, animal age and weight under considerations. This indicates that there are options to increase LWP by improving feed quality in the study areas. To understand more if there are any LWP differences related to household access to resources, LWP estimates in the study were disaggregated into household clusters. The livestock water productivity, for example, among wealth group within each farming system varies. Generally, the livestock water productivity of poor smallholder is lower than other wealth clusters. The average value of LWP among wealth status in this study lies between USD 0.08 m⁻³ to USD 0.23 m⁻³ per household for all farming systems. The fact that the range among wealth categories is wider than the system scale suggests also higher opportunities to improve LWP by targeting farmer's livelihoods. Such big differences of LWP values among farm households can be accounted for by the strategies farm households are following in feed sourcing and how water productive those feed sources are.

Conclusion

- Currently, in all of the study farming systems, crop residues constitute the major ingredient of livestock diet. Supplementary feeding with high value feed is not commonly practised. Hence, strategic way of feed source diversification (forage production), improvement of quality and improved feeding strategies are important entry for feed productivity improvement and hence LWP values.

- System scale LWP did not show apparent divergences between farming systems as the farm scale did. The farm scale showed a very wide range between the resources of poor and better off farmers. Such big gap of LWP for farm households operating in the same farming system suggests a potential for improvements. Hence, to exploit this potential, policy measures that build farmers' capacity to access key livelihood assets (e.g. land and livestock) is important.

Acknowledgements

This paper is part of a thesis work for MSc degree at Haramaya University by the first author under the supervision of the co-authors. We would like to acknowledge the International Livestock Research Institute (ILRI) for financial support for this research. Besides, the first author is grateful to International Livestock Research Institute/International Water Management Institute (IWMI) for offering the graduate fellowship during the study period. We are also grateful to smallholder farmers who liberally shared their accumulated knowledge.

References

- Ashagre Abate. 2008. Effect of nitrogen fertilizer and harvesting stage on yield and quality of natural pasture in Fogera woreda, North Western Ethiopia. MSc thesis. Haramaya University.
- Benin, S., Ehui, S. and Pender, J. 2006. Policies for livestock development in the Ethiopian highlands. *In*: Pender, J., Place, F. and Ehui, S. (eds), *Strategies for sustainable land management in the East African highlands*. Washington, DC: IFPRI. pp. 141–164.
- Breugel, P.V., Herrero, M. and Peden, D. 2007. Livestock and water in the Blue Nile basin. Nairobi, Kenya: International Livestock Research Institute.
- Descheemaeker, K., Tilahun Amede and Amare Hailelassie. 2010. Improving water productivity in mixed crop–livestock farming systems of sub-Saharan Africa. *Agricultural Water Management* 97:579–586.
- Geberselassie, S., Peden, D., Hailelassie, A. and Mpairwe, D. 2009. Factors affecting livestock water productivity: Animal scale analysis using previous cattle feeding trials in Ethiopia. *The Rangeland Journal* 31:251–258.
- Hailelassie, A., Peden, D. and Solomon Geberselassie, Tilahun Amede and Descheemaeker, D. 2009. Livestock water productivity in mixed crop–livestock farming systems of the Blue Nile Basin: Assessing variability and prospects for improvement. *Agricultural System* 102(1–3):33–40.
- Hailelassie, A., Blummel, B., Clement, F., Descheemaeker, K., Tilahun Amede, Samireddypalle, A., Acharya, S., Radha, V., Ihaq, S., Samad, M., Murty, M.V.R. and Khan, M.A. 2011. Assessment of the livestock-feed and water nexus across a mixed crop livestock systems intensification gradient: An example from the Indo-Ganga basin. *Experimental Agriculture* 47:113–132.
- Peden, D., Girma Tadesse and Misra, A.K. 2007. Water and livestock for human development. *In*: Molden, D. (ed), *Water for food, water for life: A comprehensive assessment of water management in agriculture*. Colombo, Sri Lanka: International Water Management Institute.
- Peden, D., Alemayehu, M., Amede, T., Faki, H., Hailelassie, A., Herero, M., Mpairwe, D., Tadesse, G. and van Breugel, P. 2008. Options for increasing livestock water productivity in the Nile Basin. Proceedings of Nile basin development forum, 16–19 November, Sudan Khartoum.
- WFP. 2007. Sudan: Comprehensive Food Security and Vulnerability Analysis (CFSVA).