

# The future of pastoralism: an introduction

J. Zinsstag<sup>(1,2)\*</sup>, E. Schelling<sup>(1,2)</sup>, B. Bonfoh<sup>(3)</sup>, L. Crump<sup>(1,2)</sup> & S. Krätli<sup>(4)</sup>

(1) Swiss Tropical and Public Health Institute, Socinstrasse 57, PO Box, 4002 Basel, Switzerland

(2) University of Basel, PO Box, 4002 Basel, Switzerland

(3) Centre Suisse de Recherches Scientifiques en Côte d'Ivoire, 01 BP 1303 Abidjan 01, Côte d'Ivoire

(4) Editor of *Nomadic Peoples*, journal of the Commission on Nomadic Peoples of the International Union for Anthropological and Ethnological Sciences

\* Corresponding author: jakob.zinsstag@unibas.ch

## Summary

Two-thirds of the agricultural land on planet Earth is grassland on which no other crops can be grown, either because of limited rainfall, high altitude or mountainous conditions. Most of these semi-arid and high-altitude pastoral ecosystems are used by livestock husbandry systems with various forms of mobility and are not in competition with crop production for human nutrition. By devoting an issue of its *Scientific and Technical Review* to pastoralism, the World Organisation for Animal Health (OIE) is encouraging debate on this important topic and helping to shape the future of pastoralists and their livestock. Pastoralism is a complex system, driven by interacting ecological, social and economic factors that cannot be adequately addressed by one discipline or sector alone. For its future development, we must engage with local knowledge systems and with all stakeholders. This issue of the OIE *Review* endeavours to take a broad view and provide a synthetic vision for the sustainable use of pastoral ecosystems, with innovative ideas for livelihoods, economic development, sustained ecosystem services and social and institutional development as the context for animal and human health and wellbeing.

## Keywords

Animal health – Climate change – Climate variability – High-altitude pasture – Mobility – Mountain pasture livestock – One Health – Pastoralism – Semi-arid grassland – Transdisciplinary.

## Introduction

Two-thirds of the land used for agriculture on the planet is grassland. This corresponds to about 30 million square kilometres, or roughly the combined land area of China, the United States and Europe (1). In most of these grasslands, highly variable precipitation rates result in key resources becoming available in ephemeral, unpredictable concentrations (2). Extensive, and usually mobile, pastoral systems have co-evolved within these particular agricultural environments. With rare exceptions, these grasslands have no sustainable crop alternative due to climate, altitude or terrain, therefore livestock production in pastoral systems is not in competition with crop production for human nutrition. On the contrary, many pastoral systems worldwide have developed forms of integration with crop

farming (for example, using crop residues), often seasonally, over long distances (for instance, between highlands and lowlands, summer and winter pastures or between semi-arid and sub-humid areas), contributing to increased livelihood resilience in both contexts (3, 4). Despite the global deficit of statistical data on pastoral systems (5), information from case studies and systematic reviews consistently point at their substantial economic contribution and their irreplaceable role in the ecologically sustainable use of the grasslands for food production (6, 7, 8, 9, 10); therefore, any credible scenario for sustainable development must include pastoral systems.

The World Organisation for Animal Health (OIE) was created in 1924 with the primary objectives of ensuring transparent sharing of animal health information and developing standards for safe trade in animals and animal products,

to prevent the spread of transboundary animal, primarily livestock, diseases. Other objectives concern animal welfare and sustainable livestock production systems. As livestock (chiefly ruminants, camelids and equines) are an integral element of livelihoods in pastoral areas, the future of pastoralism is of great interest to the OIE. By publishing this review, the OIE is opening up the debate on this issue and helping to forge the future of pastoralists and their livestock worldwide.

Pastoral production systems are shaped and driven by correlated and interconnected ecological, social and economic processes, requiring genuine transdisciplinarity to transcend the traditional nature/culture divide. These complex relationships are often best understood in terms of non-linear relationships and feed-back loops or, alternatively, as social-ecological systems, which may go through periods of 'creative destruction' and renewal. The ability of these systems of social and ecological relationships to withstand stresses and survive under pressure is the focus of 'resilience thinking' (11, 12, 13). Classic disciplinary and interdisciplinary approaches often fail to capture and represent these relationships. Social and ecological processes in pastoral systems are discontinuous and dynamic and, as in all dynamic systems, static equilibria are the exception rather than the rule (14). For example, years with adequate rainfall may be followed by years with very little rainfall, and locust invasion and other disasters may occur.

Reflection on the future of pastoralism must consider the contribution of all key stakeholders, and especially pastoralists themselves, combining academic thinking with local knowledge systems in participatory processes (15, 16). Guidance for the future of pastoralism cannot be developed by asking simple questions which assume direct or linear causation. As in all complex systems, pastoral systems can be viewed from different, often conflicting, perspectives. These perspectives reflect different kinds of evidence selected according to the values of the observers. To frame the discussion, the authors offer dialectic questions illustrating opposite viewpoints:

- Is pastoralism a backward, hopelessly unproductive way of life *or* an adaptive, sophisticated, and resilient livelihood system, which is economically profitable and ecologically sustainable but currently challenged by unbalanced economic interests, both national and international, and the cumulative impact of historical misunderstanding and marginalisation?
- Are pastoral regions inherently ungovernable, prone to scarcity, separatism, and insecurity *or* historically neglected, starved of good governance and actually, with proper policies and investments, high-potential assets?

- Should basic social services, ranging broadly from education and public health to veterinary care and security, be adapted to effectively reach communities whose livelihoods require geographical dispersion and mobility *or* should pastoralists adapt to traditional service provision as conceived for sedentary communities?

- Have pastoralists resisted modernisation *or* have they been, to date, failed by government policies and development schemes constructed under the assumption that progress and pastoralism are mutually exclusive?

These questions are interwoven and must, therefore, be addressed together, providing a considerable challenge for all involved. Pastoral systems are inherently dynamic because of the high climatic, ecological and social variability and are rarely in a static equilibrium. But solutions that look beyond the legacy of equilibrium thinking are only beginning to take form. There is a need for sectoral approaches which engage with systemic processes and relational causation, based on understanding the context, including historical aspects.

The papers are organised into five sections:

- i) constraints to pastoralism – pastoral production systems are threatened by fragile ecosystems and ill served with social services for health, education and security
- ii) opportunities – pastoralists have centuries-old knowledge on land use and livelihoods in places where other people would be barely able to make a living
- iii) social and economic viability of pastoralism – pastoralism has great social and economic potential and can serve multiple functions beyond livestock rearing, provided pastoralists can benefit from improved and locally adapted social services
- iv) tools for pastoral development – innovative modes of education and the ongoing revolution of communication offer a wide perspective on a modernised pastoral way of life
- v) human and animal health services for pastoralists – there is untapped potential for closer cooperation between public and animal health services under a One Health paradigm.

## Constraints to pastoralism

Pastoral ecosystems are the subject of ongoing controversy, especially with regard to their main use by livestock. There are alarming reports of degradation and contribution to climate change. Conversely, the arguments that pastoralist ecosystems are doomed to failure are also challenged. Evidence for the

claims on desertification is inconclusive, contradictory, and often exaggerated, with flawed theoretical bases. Scholars that dispute these claims point out that pastoral systems support more livelihoods than any other sustainable alternative in the grasslands and, at the same time, absorb carbon and yield livestock and animal products for the wider economy. However, the efficient use of pastoral ecosystems requires a great deal of flexibility to manage high environmental variability, including periodic extreme events such as droughts, locust invasions or long-lasting frozen pastures. Whilst struggling to access formal education, pastoralists nonetheless have both explicit and tacit knowledge of their environment and livestock management and should, therefore, be actively involved in the relevant planning processes. In the first section of this issue, Yazid Ben Hounet *et al.* address the importance of cultural heritages of pastoralism in Central Africa (17), Maryam Niamir-Fuller looks at pastoralism from the wider perspective of the livestock sector, considering both intensive and extensive systems which contribute to sustainable livelihoods (18), Andrew Catley *et al.* summarise the socio-economic impacts of pastoralism (19), Tobias Haller and Han van Dijk discuss the relationships of conflict, security and marginalisation (20), and Mario Herrero *et al.* complete this section with insights on climate change and its impact on pastoralism (21).

## Opportunities

Pastoralism has a long cultural heritage, beginning with the domestication of livestock over 10,000 years ago. It can be argued that urban development would not have been possible without domestication of livestock to provide a reliable source of food (22). Pastoralism is at the foundation of both Judeo-Christian and Islamic (Abrahamitic) cultures. Today, rather than being a remnant of a backward attitude, pastoralism remains a way of life because of climatic and geographic conditions, offering a pathway to modernity. Clearly, pastoralism is not an outdated stage in the progress to civilisation but a way of life highly adapted to local and regional conditions in modern society. It has deep cultural and social traditions harbouring key concepts and institutions for governance and social organisation, knowledge management, and transformation. The environmental benefits of pastoralism are highlighted as Seid Mohammed Ali shows the contribution pastoralism makes to environmental services (23), Brigitte Kaufmann *et al.* describe pastoral livestock genetic resources and biodiversity (24), Bilal Butt addresses the issues of rangeland dynamics and management (25), and Felix Lankester and Alicia Davis discuss pastoral land use and wildlife (26).

## Improving the economic viability and social aspects of pastoralism

Understanding of the economics of pastoralism spans a range of perspectives. Some argue that pastoralism is dying, either because pastoralist practices are inherently unsustainable or because pastoralists are being excluded from key resources or because demographic growth is suffocating. Others purport that the role of pastoralists is multifunctional and that they play a part in activities as diverse as tourism, the food industry, natural resource management and the maintenance of ecological diversity, as well as contributing to carbon sequestration and even 'state' services (e.g. occupying remote border areas which are otherwise impossible to patrol, as argued in the 2013 N'Djamena Declaration [27]). It is argued, therefore, that pastoralists should be rewarded with direct payments by the state as, for example, in Europe. Yet another viewpoint maintains that pastoral production systems contribute significantly to gross domestic product, e.g. in African countries. Saverio Krätli introduces this section with an overview of the 'barriers' in the methodological legacy of pastoral development and the pressing need to update it (28). Bassirou Bonfoh *et al.* consider the economic, institutional and policy aspects of pastoralism (29), and other authors provide case studies on institutional development in various parts of the world: Ulan Kasymov *et al.* discuss Central Asia (30), Lu Yu and Katharine Farrell describe the situation in China (31), Gilbert Fokou and Bassirou Bonfoh provide examples from West Africa, (32), Eduardo Grünwaldt *et al.* outline arrangements in Latin America (33), and Karina Liechti and Jean-Pierre Biber discuss Europe (34). Henri Rueff and Inam Rahim (35) describe how the economic viability of pastoralism can be enhanced through markets, Sarah Janzen *et al.* (36) show that viability is similarly enhanced by livestock insurance schemes, and Christoph Jans *et al.* (37) and Ilse Köhler-Rollefson (38) show that innovations in food conservation and livelihood pathways, respectively, can also improve the economic prospects of pastoralism.

## Tools for pastoral development

To complement the institutional and economic aspects of pastoral development, Razingrim Ouedraogo and Johnathan Davies summarise programmes, studies and projects which promote pastoralism (39), Caroline Dyer describes the importance of locally adapted mobile-education approaches for pastoralists (40), while Seid Mohammed Ali *et al.* (41) and Mirjam de Bruijn *et al.* (42) show how modern communication influences the pastoral way of life.

## Human and animal health

Improved social services such as human and animal health services, combined with participatory social processes identifying priorities for locally adapted governance and integrated adaptive management, are keys to the future forms of economically rewarding and ecologically sustainable pastoral systems. Cross-border animal disease control in pastoral areas also contributes to conflict transformation. Good quality human and animal health surveys are feasible among pastoralists but are still not commonly done, as shown by Esther Schelling *et al.* (43). Jakob Zinsstag *et al.* (44) argue that cost-effective control strategies are needed to improve animal health, and Fayiz Abakar *et al.* (45) outline the potential for collaborative provision of veterinary and public health services for pastoralists.

## Conclusions

The previously proposed dialectic questions regarding the future of pastoralism must be addressed together. This volume presents a spectrum of expertise on specific issues of pastoralism but still does not represent a wholly comprehensive systemic analysis of pastoralism. Jakob Zinsstag *et al.* use the Sustainable Development Goals of the 2030 Agenda for Sustainable Development (46) as a guiding principle to develop a synthetic conclusion and vision at the end of this issue (47). This statement on a vision for the future of pastoralism, along with the continued engagement of the OIE, should stimulate critical examination and progress in the development of integrated research on pastoralism and inform contextual adaptations of pastoral policies for provincial and national governments and international organisations.

## References

- Asner G.P., Elmore A.J., Olander L.P., Martin R.E. & Harris A.T. (2004). – Grazing systems, ecosystem responses, and global change. *Ann. Rev. Environ. Resour.*, **29** (1), 261–299. doi:10.1146/annurev.energy.29.062403.102142.
- Behnke R., Fernandez-Gimenez M.E., Turner M. & Stammler F. (2011). – Pastoral migration: mobile systems of livestock husbandry. In *Animal migration: a synthesis* (E.J. Milner-Gulland, J. Fryxell & A.R.E. Sinclair, eds). Oxford University Press, Oxford, 144–171. doi:10.1093/acprof:oso/9780199568994.003.0010.
- Scoones I. & Wolmer W. (2002). – Pathways of change: crop-livestock integration in Africa. In *Pathways of change in Africa: crops, livestock and livelihoods in Mali, Ethiopia and Zimbabwe* (I. Scoones & W. Wolmer, eds). James Currey, London, 236 pp.
- Schiere H., Baumhardt R.L., Van Keulen H., Whitbread H.M., Bruinsma A.S., Goodchild T., Gregorini P., Slingerland M. & Wiedemann-Hartwell B. (2006). – Mixed crop-livestock systems in semi-arid regions. In *Dryland agriculture* (G.A. Petersen, ed.). American Society of Agronomy Inc., Crop Science Society of America, Inc., Soil Science Society of America, Inc., Madison, Wisconsin.
- Pica-Ciamarra U., Baker D., Morgan N., Zezza A., Azzarri C., Ly C., Nsiima L., Nouala S., Okello P. & Sserugga J. (2014). – Investing in the livestock sector. Why good numbers matter. A sourcebook for decision makers on how to improve livestock data. World Bank, Washington, DC, & Food and Agriculture Organization of the United Nations, Rome.
- Hatfield R. & Davies J. (2006). – Global review of the economics of pastoralism. Prepared for the World Initiative for Sustainable Pastoralism. International Union for Conservation of Nature, Nairobi, 44 pp.
- Anon. (2011). – Economic spaces of pastoral production and commodity systems. Ashgate Publishing, Farnham, UK.
- Krätli S. (2014). – If not counted does not count? A programmatic reflection on methodology options and gaps in Total Economic Valuation studies of pastoral systems. International Institute for Environment and Development, London.
- International Union for Conservation of Nature (IUCN) (2012). – Supporting sustainable pastoral livelihoods: a global perspective on minimum standards and good practice. International Union for Conservation of Nature Regional Office for Eastern & Southern Africa, Nairobi.
- Davies J. & Hatfield R. (2007). – The economics of mobile pastoralism: a global summary. *Nomad. Peoples*, **11** (1), 91–116.
- Poser H. (2012). – Wissenschaftstheorie: eine philosophische Einführung. Reclam, Stuttgart.
- Ostrom E. (2007). – A diagnostic approach going beyond panaceas. *Proc. Natl Acad. Sci. USA*, **104** (39), 15181–15187. doi:10.1073/pnas.0702288104.

13. Berkes F & Folke C. (1998). – Social and ecological systems: management practices and social mechanisms for building resilience. Cambridge University Press, Cambridge.
14. Krätli S. (2015). – Valuing variability. New perspectives on climate resilient drylands development. International Institute for Environment and Development, London.
15. Hirsch Hadorn G., Hoffmann-Reim H., Biber-klemm S., Grossenbacher W., Joye D., Pohl C., Wiesmann U. & Zemp E. (2008). – Handbook of transdisciplinary Research. Springer, Heidelberg.
16. Schelling E., Wyss K., Diguimbaye C., Béchir M., Taleb M.O., Bonfoh B., Tanner M. & Zinnstag J. (2008). – Towards integrated and adapted health services for nomadic pastoralists and their animals: a North–South partnership. In Handbook of transdisciplinary research (G. Hirsch Hadorn, H. Hoffmann-Reim, S. Biber-klemm, W. Grossenbacher, D. Joye, C. Pohl, U. Wiesmann & E. Zemp, eds). Springer, Heidelberg, 277–291.
17. Ben Hounet Y., Brisebarre A.-M. & Guinand S. (2016). – The cultural heritage of pastoralism – local knowledge, state identity and the global perspective: the example of local breeds in Morocco. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 365–370. doi:10.20506/rst.35.2.2523.
18. Niamir-Fuller M. (2016). – Towards sustainability in the extensive and intensive livestock sectors. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 371–387. doi:10.20506/rst.35.2.2531.
19. Catley A., Lind J. & Scoones I. (2016). – The futures of pastoralism in the Horn of Africa: pathways of growth and change. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 389–403. doi:10.20506/rst.35.2.2524.
20. Haller T., van Dijk H., Bollig M., Greiner C., Sherika N. & Gabbert C. (2016). – Conflicts, security and marginalisation: institutional change of the pastoral commons in a 'glocal' world. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 405–416. doi:10.20506/rst.35.2.2532.
21. Herrero M., Addison J., Bedelian C., Carabine E., Havlik P., Henderson B., van de Steeg J. & Thornton P.K. (2016). – Climate change and pastoralism: impacts, consequences and adaptation. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 417–433. doi:10.20506/rst.35.2.2533.
22. Sherman D.M. (2002). – Tending animals in the global village: a guide to international veterinary medicine. Lippincott Williams & Wilkins, Philadelphia, 495 pp. doi:10.1002/9780470292136.
23. Seid M.A. (2016). – The role of pastoralism in the regulation of ecosystem services. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 435–444. doi:10.20506/rst.35.2.2534.
24. Kaufmann B.A., Lelea M.A. & Hülsebusch C.G. (2016). – Diversity in livestock resources in pastoral systems in Africa. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 445–459. doi:10.20506/rst.35.2.2535.
25. Butt B. (2016). – Ecology, mobility and labour: dynamic pastoral herd management in an uncertain world. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 461–472. doi:10.20506/rst.35.2.2530.
26. Lankester F & Davis A. (2016). – Pastoralism and wildlife: historical and current perspectives in the East African rangelands of Kenya and Tanzania. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 473–484. doi:10.20506/rst.35.2.2536.
27. Anon. (2013). – Déclaration de N'Djamena sur la République centrafricaine. Available at: [www.journaldutchad.com/files/communiqués/178.pdf](http://www.journaldutchad.com/files/communiqués/178.pdf) (accessed on 6 June 2016).
28. Krätli S. (2016). – Discontinuity in pastoral development: time to update the method. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 485–497. doi:10.20506/rst.35.2.2528.
29. Bonfoh B., Fokou G., Crump L., Zinsstag J. & Schelling E. (2016). – Institutional development and policy frameworks for pastoralism: from local to regional perspectives. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 499–509. doi:10.20506/rst.35.2.2537.
30. Kasymov U., Undeland A., Dörre A. & MacKinnon A. (2016). – Kyrgyzstan and the learning experience in the design of pastoral institutions. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 511–521. doi:10.20506/rst.35.2.2538.
31. Yu L. & Farrell K.N. (2016). – The Chinese perspective on pastoral resource economics: a vision of the future in a context of socio-ecological vulnerability. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 523–531. doi:10.20506/rst.35.2.2539.
32. Fokou G. & Bonfoh B. (2016). – Institutional development: from legal pluralism to institutional bricolage in West African pastoralism. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 533–541. doi:10.20506/rst.35.2.2540.
33. Grünwaldt J.M., Castellaro G., Flores E.R., Morales-Nieto C.R., Valdez-Cepeda R.D., Guevara J.C. & Grünwaldt E.G. (2016). – Pastoralism in the drylands of Latin America: Argentina, Chile, Mexico and Peru. In The future of pastoralism (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 553–560. doi:10.20506/rst.35.2.2526.

34. Liechti K. & Biber J.-P. (2016). – Pastoralism in Europe: characteristics and challenges of highland–lowland transhumance. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 561–575. doi:10.20506/rst.35.2.2541.
35. Rueff H. & Rahim I.U. (2016). – Enhancing the economic viability of pastoralism: the need to balance interventions. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 577–586. doi:10.20506/rst.35.2.2542.
36. Janzen S.A., Jensen N.D. & Mude A.G. (2016). – Targeted social protection in a pastoralist economy: case study from Kenya. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 587–596. doi:10.20506/rst.35.2.2543.
37. Jans C., Mulwa Kaindi D.W. & Meile L. (2016). – Innovations in food preservation in pastoral zones. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 597–610. doi:10.20506/rst.35.2.2527.
38. Köhler-Rollefson I. (2016). – Innovations and diverse livelihood pathways: alternative livelihoods, livelihood diversification and societal transformation. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 611–618. doi:10.20506/rst.35.2.2529.
39. Ouedraogo R. & Davies J. (2016). – Enabling sustainable pastoralism: policies and investments that optimise livestock production and rangeland stewardship. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 619–630. doi:10.20506/rst.35.2.2544.
40. Dyer C. (2016). – Approaches to education provision for mobile pastoralists. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 631–638. doi:10.20506/rst.35.2.2525.
41. Seid M.A., Yoseph L.W., Befekadu U.W., Muhammed A. & Fikre Z. (2016). – Communication for the development of pastoralism. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 639–648. doi:10.20506/rst.35.2.2545.
42. De Bruijn M., Dokkala E.L., Sangaré B. & Amadou A. (2016). – Mobile pastoralists in Central and West Africa: between conflict, mobile telephony and (im)mobility. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 649–657. doi:10.20506/rst.35.2.2546.
43. Schelling E., Greter H., Kessely H., Abakar M.F., Ngandolo B.N., Crump L., Bold B., Kasymbekov J., Baljinnyam Z., Fokou G., Zinsstag J., Bonfoh B., Hattendorf J. & Béchir M. (2016). – Human and animal health surveys among pastoralists. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 659–671. doi:10.20506/rst.35.2.2547.
44. Zinsstag J., Abakar M.F., Ibrahim M., Tschopp R., Crump L., Bonfoh B. & Schelling E. (2016). – Cost-effective control strategies for animal and zoonotic diseases in pastoralist populations. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 673–681. doi:10.20506/rst.35.2.2548.
45. Abakar M.F., Schelling E., Béchir M., Ngandolo B.N., Pfister K., Alfaroukh I.O., Hassane M.H. & Zinsstag J. (2016). – Trends in health surveillance and joint service delivery for pastoralists in West and Central Africa. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 683–691. doi:10.20506/rst.35.2.2549.
46. United Nations (UN) (2015). – Transforming our world: the 2030 agenda for sustainable development. Resolution adopted by the General Assembly on 25 September 2015. A/RES/70/1. UN, New York, 35 pp. Available at [www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/70/1&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E) (accessed on 6 June 2016).
47. Zinsstag J., Bonfoh B., Zinsstag G., Crump L., Alfaroukh I.O., Abakar M.F., Kasymbekov J., Baljinnyam Z., Liechti K., Seid M.A. & Schelling E. (2016). – A vision for the future of pastoralism. *In The future of pastoralism* (J. Zinsstag, E. Schelling & B. Bonfoh, eds). *Rev. Sci. Tech. Off. Int. Epiz.*, **35** (2), 693–699. doi:10.20506/rst.35.2.2550.