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Citation: Ergano, K., Duncan, A.J. and Oosting, S.J. Unlocking the potential of livestock technologies in Ethiopia: Shifting from individual pieces to optimizing the sum of the parts. 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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Unlocking the potential of livestock technologies in Ethiopia: Shifting from individual pieces to optimizing the sum of the parts

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Abstract: The reasons why farmers are unable to harness the benefits embedded in technologies and take advantage of business opportunities in livestock sector in developing countries remain unresolved. Drawing on insights from innovation systems approaches, this paper assesses innovation constraints, identifies the bottlenecks and missing links in dairy sector and suggests some instruments needed to address the constraints. We find that missing actors, limited capacity of existing actors, inadequate interactions between actors and poor coordination of activities along dairy value chain have been the major reasons for low technology adoption and underdevelopment of dairy subsector in developing countries. Future research should pay attention to designing, prototyping and experimenting with alternative institutional arrangements that can effectively coordinate inputs, services, processes and outputs in livestock value chains.

Media grab: There is increasing demand for milk and milk products in Ethiopia due to increasing urbanization and rising income. However, milk production in the country has not been able to keep pace with growing demand. Although there is sufficient *scientific* knowledge about the dairy production technologies in Ethiopia, the number of smallholder farmers using these technologies is very low. New organizational arrangements that coordinate activities along the dairy value chain are needed in order to reap the benefits from technologies.

Introduction

The demand for dairy products is growing rapidly in Ethiopia. For example, the demand for milk and milk products in Ethiopia is projected to increase from 19 kg per capita in 2008 to approximately 27 kg per capita in 2020 (Francesconi et al. 2010; Duguma et al. 2011). However, milk production in the country has not kept pace with growing demand. Per capita milk production in Ethiopia is estimated at 20.83 kg in 2009 (Tefera et al. 2010). Livestock sector in Ethiopia has not been able to meet the growing demand for animal source foods mainly due to failures to take advantage of potential benefits improvements to technical aspects of dairy production. The increasing demand for milk and milk products needs to be met within the limited land and water resources. The challenge is to provide for the needs of a growing human population and at the same time sustain scarce land and water resources. Successful approaches are likely to bring together positive aspects of sustainable intensification and resource conservation. Increasing demand for milk and milk products and increasing competition for land and water resources, therefore, imply that

livestock production systems in Ethiopia will have to intensify to ensure acceptable livelihoods for its producers (Descheemaeker et al. 2009). Past experience and research findings have shown that agricultural productivity gains are strongly associated with adoption of improved agricultural production technologies (Shaw 1987; Minten and Barrett 2008). Development and effective utilization of new agricultural technologies and practices can shape the extent to which farmers take up business opportunities in the dairy subsector. Several technologies and interventions have been promoted in Ethiopia to enhance the productivity of dairy cattle (Staal 1995; Ahmed et al. 2004). In spite of the higher productivity gains resulting from use of livestock technologies, adoption of the technologies at smallholder farmers' level has been very low. The productivity levels achieved on research stations and a few commercial dairy farms are seldom achieved at smallholder farmers' level. The reasons that farmers are not reaping the benefits of improved technical practices and not taking advantage of business opportunities in the livestock sector in the country remain unresolved. The persistent resistance of subsistence farmers to adopt improved production technologies can sometimes be hidden in higher-order coordination issues. In this paper, we assess innovation constraints, identify the bottlenecks and missing links in dairy subsector development using a systemic innovation policy framework (Wieczorek and Hekkert 2012) and suggest some policy instruments needed to address system weaknesses.

Methods

We use event history analysis to assess the fulfilment of the seven innovation functions needed to build market oriented dairy. The historical event analysis method is a longitudinal research method that is based on the construction of an event sequence and has proven to be powerful in creating insights into the dynamics of innovation (van de Ven 1990; van de Ven et al. 1999). In total, 39 program and policy documents covering 1950's to 2013 were reviewed. The information was obtained particularly from government policy documents, program outcome reports, project and program evaluation reports, peer reviewed journal articles and information from websites of relevant organizations. The occurrence of the events was cross-referenced using published materials wherever possible.

Results and discussion

We find evidence that the major thrust of livestock development in the country over the past five decades has been placed on the technical solutions to breeding, feeding and health constraints. Organizational and marketing issues were treated lightly or totally neglected by most projects and programs implemented in the country (Table 1).

Table 1. Summary of major events that shaped innovation system functions in livestock sector in Ethiopia

Time line	Policies, programs and projects	Focus areas
1950s	Exotic dairy cattle introduced to Ethiopia and Shola milk processing plant	Introduced the first batch of dairy cattle to Ethiopia
1960	Dairy Development Enterprise (DDE)	Set up for collection, processing and distribution of milk for the Addis Ababa market
1958–63	1st Livestock Development Project	Supporting commercial dairy development enterprise around the capital city, Addis Ababa
1964	National Veterinary Institute (NVI)	A primary task of producing vaccines
1967	National Artificial Insemination Service (SNAIS)	AI service
1970–1980	CADU/ARDU	Focus on Production and distribution of cross breed heifers ,AI service, animal health, forage production and marketing
1971	Addis Ababa Dairy Development Project (AADDP)	Launched with the objective of developing commercial dairy production and providing support for smallholder producers in the form of credit, imported cattle and technical services
1971–1975	Wolayta Agricultural Development Unit (WADU)	Focus on bull station and AI services
1973–81	2nd Livestock Development Project	Establishing slaughter facilities for provincial towns and cities
1974–1991	Intensive dairy development effort through producers' cooperatives	Distribution of crossbred dairy cows, AI and milk marketing

Time line	Policies, programs and projects	Focus areas
1972–1981	Addis Ababa Dairy Development Project (AADDP)	Developing commercial dairy production and providing support for smallholder producers in the form of credit, imported cattle and technical services
1972–1985	1st and 2nd Agricultural Minimum Package Projects	Major components include distribution of crossbred in-calf heifers, bull service and AI services and veterinary service
1986–1992	Dairy Rehabilitation and Development Project (DRDP)	Focus on cooperative dairy farm, development through introduction of crossbreds, state farm development and health services
1987–1991	Selale Peasant Dairy Development Pilot Project (SPDDP)	Focus was on dairy stock distribution and cooperative development
1988–1994	Fourth Livestock Development Project (FLDP)	Focus of the project was on feed and forage improvement as well as increased coverage of veterinary services in the highlands of Shoa and Gojam
1991–1994	Smallholder Dairy Development Pilot Project (SDDPP)	Focus on milk processing and marketing
1999–2002	National livestock development project (NLDP)	Aim of livestock health and breed improvement. Focused on establishment of seven regional AI sub centres, establishment of a bull dam farm and training of artificial insemination professionals and forage development throughout the country
2005–2011	SNV Ethiopia's Value Chain Development Program	Aimed to enable small farmers in Ethiopia to adapt their production and arrange for more profitable market outlets for their produce through improving business to business relations based on vertical linkages in value chains
2005–2011	Improving Productivity and Market Success (IPMS) of Ethiopian Farmers (IPMS) project	Aimed at developing a more efficient system for market-oriented agricultural development
2010/11–2014/15	Growth and Transformation Plan	Seeks to bring about an improvement in the livestock sector by enhancing the quality and quantity of feed, providing improved extension services, increasing livestock health services and improving productivity of local cows by artificial insemination while preserving the indigenous breeds
2012–2015	AGP–Livestock Market Development Project	Aims to improve smallholder farmer incomes and nutritional status through investments in livestock value chains including beef, dairy and hides
2012–2016	Market-linked Innovation for Dairy Development (MIDD) program	Aims at dairy value chain development in Ethiopian regions
2013–2018	Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES) Project	Aims to contribute to enhanced income of smallholders and other value chain actors through increased and sustained market off-take of high value livestock and irrigated crop commodities.

Most projects have targeted limited technical problems at one or two steps in the value chain. We find that shortage of scientific and technological knowledge is not a big constraint. There are articulate actors who can explain science to a scientist but cannot show proof of concept in farmers' fields. The main reasons for low adoption of dairy technologies and slow response to the growing demand for livestock products can be attributed to the underappreciated problem of coordination failures in dairy value chains. So far, public research and extension systems have not been able to provide the institutional set up to coordinate complementary sources of knowledge and resources along livestock value chains. Little attention has been given to research which looks at the organizational requirements of the innovation process in the livestock sector.

Experience and research findings show that business success is not solely a function of good technologies; it is also about the capability to apply and maintain them in sustainable actions (Gopalakrishnan et al. 2010). Thinking through all activities along the value chain and dealing with all the challenges that will inevitably come at every step of the value chain require organizational innovation. Invention and implementation of organizational models are as important as development of the physical technologies themselves. The lessons from a highly acclaimed Operation Flood India suggest that organizational strategy that is functionally and spatially integrated, that seeks to exploit technological and scale advantages, that aims at a near-saturation coverage of an area and that builds upon a synergy among various activities was perhaps the single most critical factor which influenced its performance (Sambrani 1982; Bellur et al. 1990). This suggests that innovation in institutional arrangements is key to translate technological inputs and services into farmers' practices and to induce innovation in livestock sector.

Conclusions and recommendations

Our findings suggest that the components of most of the projects and programs implemented in the country over the past five decades have been focused on the technical solutions to breeding, feeding and health constraints. Organizational and marketing issues were treated lightly or totally neglected. A suitable combination of technologies, skills and behaviour, processes and organizations are needed to unlock the full potential of dairy technologies. Exploring alternative institutional arrangements for organizing knowledge, skills, services, inputs and outputs in livestock sector should be one of the research priorities. Designing, prototyping and experimenting with alternative institutional arrangements that can effectively coordinate inputs (e.g. existing and new technologies), services, processes and outputs in livestock value chains should be taken as a serious research undertaking. There are promising results emerging from piloting innovation platforms, milk shed hubs, community based breeding schemes and vertically integrated dairy cooperative models. These efforts require proper recognition, resources and rewards. Governments and donors need to encourage the search for new models of institutional arrangements and allocate necessary resources. Monitoring the efficacy of different models of institutional arrangements should also be taken as serious research agenda.

Acknowledgements

Financial support for this field research was obtained from CGIAR Challenge Program on Water and Food (CPWF) through International Livestock Research Institute (ILRI) and Dutch Ministry of Economic Affairs.

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