

Moving Ethiopian smallholder dairy along a sustainable commercialization path: missing links in the innovation systems

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Abstract

Ethiopian needs to achieve accelerated agricultural development along a sustainable commercialization path to alleviate poverty and ensure overall national development. In this regard, sustainable commercial of smallholder dairying provides a viable and growing opportunity; with deliberate, appropriate and sustained policy support. A recent empirical analysis concludes however, that Ethiopian smallholder dairy sub-sector has not been able to take-off despite decades of development interventions. The current paper looks into this paradox of Ethiopian smallholder dairy development; identifies and discusses the implications of emerging opportunities and challenges for the sub-sector development; and explores strategic options for the sub-sector take-off. This paper argues that the impact of the decades of efforts for the sub-sector developments have been hampered, among others, by disconnects in the dairy innovation systems. There are missing/weak linkages between diverse knowledge sources, technological and non-technological innovations, development interventions and local context, production and market, R&D services and development challenges, public and private efforts, and between policymaking and development practice. Some strategic options are identified along with implementation modalities. The recommendations forwarded to get Ethiopian smallholder dairying moving along a sustainable commercialization path encompass: improving economic incentives to encourage innovation; organizing dairy producers and linking them with vertically coordinated value chain; pursuing holistic approach to achieving sustainable technological innovation to increase supply response; supporting private sector development and promoting public-private partnership, creatively using the expanding ICT infrastructure as a means for facilitating multi-stakeholder interaction and knowledge management; formulating appropriate and adaptive policy for the sub-sector development; along with complementary national strategy capable of providing clear roadmap; guiding spatially targeted investment and intervention decisions; and defining principles for pragmatic participation, inter-organizational interaction and coordination. Finally, strengthening commodity-based local - woreda/milkshed- innovation systems capacity with value chain perspective is underlined. The later provides a practical option to stimulating process-driven collective experiential learning for achievement of better impact through continuous incremental improvement/innovation, and facilitates scaling up and-out of successful experiences to achieve wider socio-economic impact and inform policymaking.

Key words: Ethiopia, smallholder, dairy, commercialization, innovation systems

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Introduction

Ethiopia has a huge potential for dairy production. The Ethiopian dairy sub-sector is predominantly smallholder and subsistent-oriented. Market-oriented development of smallholder dairying has a potential to spur economic growth and alleviate poverty (Bennett et al., 2006). Policy and development interventions over the past six decades in Ethiopia for the sub-sector development have, however, had limited impact on commercialization of the sub-sector. Conventionally, ‘supply-push’ through the transfer of technology and provision of inputs and services had been the focus of most of, mainly donor-financed, dairy development projects.

Overcoming the supply-side constraints related to feeding, breeding and animal health was, and still is, crucial to achieving productivity growth in the dairy sub-sector. Nonetheless, successful technological change should go hand in hand with institutional change (Pérez, 1989, cited in Altenburg et al., 2008; Leeuwis, 2004). Further, growth in demand for milk and milk products, spurred by rapid growth in population, urbanization and per capita income, has been the major driving force worldwide for the faster growth of the livestock sector in general (Delgado et al., 2002). Likewise, recent empirical evidence (Staal et al., 2008) shows that Ethiopian dairy sub-sector development has primarily been conditioned by the demand situation, more than the supply-side constraints. Moreover, experience of many developing countries has shown that demand-led structural transformation in the dairy sub-sector can/should be achieved through vertical integration, economies of scale, geographical concentration (Delgado, 1999), and through innovations (Hall, 2006), to address both technical and non-technical impediments to sustainable commercialization of smallholder dairying.

The paper presents ‘a work in progress’ and represents an attempt to reflect on a fundamental question which, in the authors’ view, is still inadequately answered. *How to get Ethiopian smallholder dairy sub-Sector moving along a sustainable commercialization path?* Specifically, what types of knowledge and innovations are required to seize opportunities and respond to emerging challenges? What are the improvements required in the policy environment and policymaking process? What are the options available to strengthen capacity in the dairy innovation systems? How to get there?

The analysis is informed by the Innovation Systems Perspective, complemented by the value chain approach. To make its case for change, the paper draws on: i) the results of rapid appraisal of dairy and fodder innovation systems carried out by IPMS project in its eight Pilot Learning Woradas (PLWs) in Amhara, Oromia, SNNP and Tigray Regions; ii) the available empirical evidence on the status of Ethiopian dairy sub-sector development, and relevant successful lessons from other developing countries; and iii) plausible theoretical arguments

The next section provides an overview of historical perspective on dairy development in the country, with a focus on development intervention- achievement gaps. Section three outlines key insights underpinning the innovation systems perspective and the value chain approach. Section four outlines some of the major challenges calling for innovations in the sub-sector. Finally, Section five draws conclusions and recommends strategic option for addressing the missing links in the Ethiopian dairy innovation systems.

Defining the problem: Ethiopian dairy development paradox

Ethiopia, with about 48 million (56% female) cattle (CSA, 2008) with conducive and diverse agro-ecologies, has a huge potential for dairy production (Ahmed et al., 2004; Pratt et al., 2008). There is also potentially large market for dairy products, which is expected to grow with growing population, urbanization and per capita income. The national rural development policy and strategy envisions achieving sustainable rural livelihood improvement through increasing productivity and market-orientation of the smallholder production systems in a sustainable manner. Market-oriented smallholder dairy development presents a promising option to boost rural incomes, improve food and nutrition security, and to achieve sustainable rural poverty alleviation with a positive gender impact on women and landless rural households and on-farm as well as off-farm employment that could be generated along the dairy value chain (Bennett et al., 2006). On the flipside, intensive dairying might raise public health and environmental concern in the absence of effective institutional and regulatory environment (Delgado, 1999).

Formal dairy development efforts in Ethiopia began in the late 1940s (Getachew, 2003); and has continued to the present, mainly through donor-financed development projects. An analysis of the focuses and strategies of these interventions shows that constraints to development was seen primarily as technical, and hence emphasized the transfer of technology and public provision services (Tesfaye and Ranjitha, 2007). The primary focus was on improvements of breeds, feed, health service and promotion of milk processing and marketing, infrastructure and technical capacity building. Recent empirical analysis (Staal et al., 2008) concludes that *“these development efforts had little impact on the growth of the sector as a whole, even in the areas where they were implemented.”* CSA (2008) has recently generated even more compelling yet worrisome empirical evidence on the performance of the sub-sector. The report shows that only 0.15% of livestock holders reported on-farm production of improved forages, 0.8% use industrial by-products, and improved dairy cows in rural areas account for less than 1% of the total dairy cattle population. More importantly, the total milk production from about 9.9 million milking cows is estimated at about 3.2 billion liters, which is translated into 1.54 liters per cow per day.

The performance of dairy sector is lagging behind that of neighboring countries (Figure 1). The available evidence (Ahmed, 2004; Azage et al., 2006; Staal et al., 2008; CSA, 2008) also indicates that the generic supply-side constraints to development of the sub-sector are still awaiting innovative and sustainable resolution; until recently improvement and promotion of indigenous breeds and fodder have received little attention; the coverage and quality of supportive service still needs significant improvement; and private provision of service is still underdeveloped, and service provision by multiple actors is in disarray due to lack of effective coordination.

Innovation systems perspective and milk value chain

The research has been informed by the innovation systems perspective, as it provides a holistic framework for understanding the system functioning, going beyond technologies and acknowledging the importance of institutions and policy. The value chain approach complements innovation systems approach to enhance a better understanding of the entire dynamics of dairy innovation systems. This section highlights the key issues and insights underpinning both approaches to inform the current analysis.

Northeast Africa

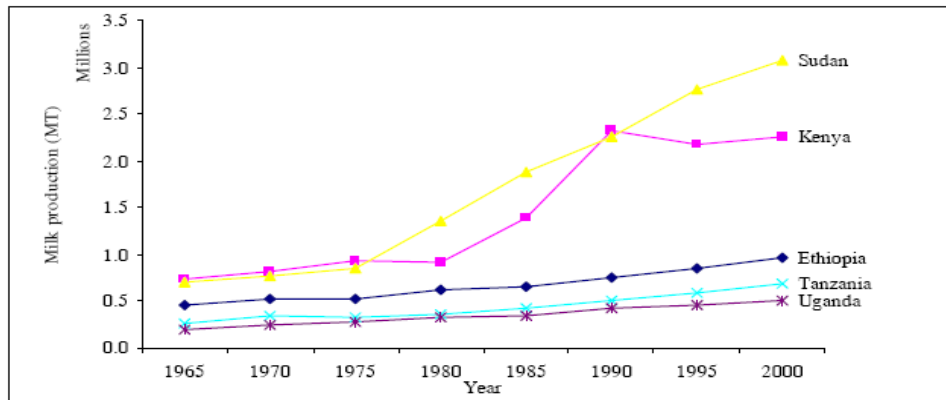


Figure 1: Milk production trends in Northeast Africa (source: Pratt et al., 2008)

Innovation Systems Perspective

Innovation is a social process of acquisition, exchange, adaptation, creation and productive use of knowledge. It results from successful use of *new knowledge, accumulated knowledge or creative use of existing knowledge* (World Bank, 2006) for solving practical economic, social and environmental problems. It would be possible to improve productivity and efficiency of smallholder livestock sector in developing countries by creatively using already existing low-cost technology, established tools, and through new way of thinking about problems and doing business (Hall, 2006).

There are different types of knowledge (Spielman, 2006), and the types of knowledge to be used to improving productivity and market success of milk producers could thus be technical or technological, organizational/managerial, institutional/policy or market-related or the combinations thereof. The sources of these knowledge types are multiple (Biggs, 1989); formal research, indigenous knowledge; entrepreneurs processors, and policymakers, etc. Each actor is thus a source as well as a seeker of knowledge. Also, there are multiple mechanisms for knowledge exchanges (Spielman, 2006); public extension is just one mechanism for knowledge sharing. Ability to communicate with various actors is necessary to access knowledge of different kinds from various sources.

Innovation process requires the integration of ideas, knowledge, experience and creativity from multiple actors through networking, linkage creation and partnerships (Leeuwis, 2004). Innovative capability depends on the quality and density of relationships among producers, between producers or producer groups and enterprise, and between producers, enterprises and supportive services – public and private organizations. The later include organizations which carry out research, train, advice, finance, coordinate and regulate (Altenburg et al., 2008).

Institutions are defined as formal and informal structures, routines, procedures and behaviors and, are not synonymous with organizations. The existence, intensity and quality of interactions between actors are conditioned by institutions (Hall, 2006). The prevailing institutional

arrangements such as performance appraisal and reward systems, organizational processes and accountability mechanism can encourage or discourage, interacting, knowledge sharing and innovation both within and between organizations (OECD, 2005).

Coordinating inputs (knowledge, finance, social and political capital) of various actors and their expectations in a way that enables, rather than impairs, innovation is critical. Achieving effective coordination is highly context specific. Also, innovation entails creating and managing linkages for alignment of actors and this might require brokering agents: a ‘lead operator’- who organizes and manages networks; and a ‘caretaker’- who maintains the integrity of the network.

Policies could promote creativity and innovation by providing incentives, resources and support structures, and have a profound influence on the process and nature of agricultural innovations (Hall et al., 2006). Four policy pillars for commercialization of smallholder dairying have been identified: removing market distortions; building participatory institutions of collective actions by small producers to facilitate their vertical integration; increasing investment to improve productivity; and promoting effective regulatory institutions to deal with public health and environmental concern of livestock intensification (Delgado et al., 1999). Ensuring effective coordination of policies, and context specific and adaptive process of policymaking, informed by impact and process monitoring, are equally important to optimize impacts (Hall et al., 2006). Engaging policymakers and administrators in debate, vision development and decision making as partners, along with other actors is important (Alsop and Farrington, 1998). Policy capacity for effective facilitation of participatory and adaptive policymaking also needs to be strengthened.

Innovation is regarded as a context specific social learning process. As such it cannot be understood independently of its local-specific institutional and cultural settings (Altenburg et al., 2008)). This context specificity implies that appropriate solutions to complex problems of getting smallholder dairying moving along a sustainable commercialization path need to be sought and *built up in situ* – in the field- taking advantage of indigenous knowledge and innovative abilities of milk producers (Douthwait et al., 2003). This process of experiential social learning, in turn, requires piloted joint innovation activities, participatory process and impact monitoring, documentation and learning. The new knowledge obtained through monitoring change as it occurs and filtering lessons should inform next or future actions (Alsop and Farrington, 1998). Systematic process learning therefore implies that strategy should be developed in such a way that the social and organizational process that has brought out desirable economic, social and environmental impacts would be replicated – scaled-out and-up. ‘Scaling out’ is the spread of innovations within the same stakeholders group, whereas ‘scaling-up’ is a vertical institutional expansion of innovations (Douthwait et al., 2003).

Sustainable Value Chain Development

The value chain approach, which emphasizes ‘trans-boundary’ linkages, complements the ‘territorial-bounded’ innovation systems approach (Altenburg et al., 2008). The value chain approach links local innovation systems with regional, national, and global forces. Together, the two approaches facilitate a comprehensive understanding of the entire dynamic of innovation systems. Vertical coordination and integration along the milk value chain is probably the best option available to achieve economies of scale through reduction of operation and transaction costs, to meeting consumers demand for quality, safety and reliability of supply, to facilitate

innovation partnership along the chain, and to improve response capability of producers (Delgado et al., 1999; 2002; Costales et al., 2006). There is however, a concern that smallholder producers may be excluded from the emerging value chain due to capacity limitations. Small producers lack the necessary technological, organizational and institutional capacity for successful participation in the value chain. They are less organized and distant from market, lack economies of scale, face higher transaction costs and lack institutions for risk management. Hence, they could be left out from the value chain due to inability to meet the required volume, quality and consistency of supply. Yet, these problems are not insurmountable with appropriate organizational and institutional innovations (Costales et al., 2006) such as contract farming and vertically integrated dairy cooperatives (Delgado et al., 1999).

Reflections on Ethiopian dairy development paradox: challenges calling for innovations

Market for dairy products

Demand and consumption patterns are critical for the success of market-led dairy development. Consumers express their demand through the price they are willing and able to pay; and market transmits the price signal to producers for them to respond accordingly. With respect to this, there are a number of restraining factors. Per capital consumptions of milk and milk products in Ethiopia is very low due to economic and cultural reasons. National per capita income is also very low and not significantly changing, limiting the purchasing power of consumers. Average expenditure on dairy products by households constitutes only 4% of the total household food budget (Staal et al., 2008). This shows that the habit of consuming dairy products is not well developed even among middle income households. The problem is compounded by the fact that Orthodox Christians refrain from consuming dairy products during their fasting period. This is further compounded by seasonality of supply of products. Processors and dairy cooperatives reduce the quantity of milk to be collected during fasting seasons and pay lower price for the limited amount they collect. But dairy producers indicated that selling raw milk was more profitable than processed products under the prevailing conditions (Tesfaye and Ranjitha, 2007).

About 63% of the annual total national milk production is produced by rural smallholders in mixed farming system of the highlands; with small urban/peri-urban producers contributing about 22% of the total national production. More than three-fourth of the milk produced by rural households is consumed at home (Staal et al., 2008). The small quantity of milk produced, high transportation cost and transaction costs are reinforcing the subsistence-orientation of the production systems. Higher transaction cost means lower price for producers and also higher product price for poor urban consumers, thus low effective demand. Hence, only surplus raw milk by producers nearby market centre and butter by those far away from the market are sold mainly through informal channel. About 20% of dairy products are sold through formal channel, and even in Addis Ababa informal market handles 70% of raw milk and butter sold to the consumers (Jabbar and Benin, 2005). Whilst the informal channel is useful and seems to work better for the poor producer and user of dairy products (Ouma et al., 2007), it also raises public health concern. Furthermore, there is neither functional quality and safety regulation mechanism exists for dairy products nor adequate incentive available for smallholders who are able to supply the market with safe milk (Tesfaye and Ranjitha, 2007). Yet, development interventions have focused entirely on improvement of the formal market only.

Supportive services

To promote sustainable commercialization of smallholder dairy production, the producers should have timely and cost-effective access to relevant knowledge, inputs, market, and support services. This is contingent upon coordinated and integrated contributions of multiple actors. The identified limitations (Tesfaye and Ranjitha, 2007) are outlined in the following paragraphs.

Availability, seasonal variation and poor quality of feed is the most limiting factor in dairy production. Land, water and feed resource-base are increasingly dwindling; and the competition for accessing whatever is available is fiercer today than every before. Some causes are location specific, while others are crosscutting; these include expansion of urban centers to rural-urban fringe, establishment of public facilities on traditional grazing land, invasive weeds, resettlement programs, redistribution and development of swampy areas for crop production, increasing water logging and soil compaction, and expansion of coffee, deforestation, drought, etc. The size and quality of communal grazing land have been substantially reduced over the past five years across the PLWs. The reported impacts of the deterioration in feed resource-base were high seasonal variability in milk production, biodiversity loss, declining cattle population, and expansion of fodder market with rising fodder prices. The fodder scarcity is however, stimulating a certain degree of on-farm fodder production and more efficient crop residue utilization.

Many development organizations are making efforts to promote on-farm production of improved forages. These efforts however are not based on a solid strategy, and are diffused and uncoordinated. There is neither formal strategy for forage development nor coordinated forage multiplication and distribution systems. Until recently, the country did not have a national system for evaluation and release of improved forage crops. According to the regional Bureaus, the Ethiopian Seed Enterprise and private sector actors alike are not willing to engage themselves in forage production and distribution business, due to the perception that the activities are financially unviable. The fact that some GOs and NGOs distribute forage for free or at highly subsidized price has, to some extent, discouraged the development of forage seed multiplication and distribution as a business.

Breeding services are primary provided publicly through AI and multiplication of improved heifer on public ranches and distribution through the extension systems. The availability and accessibility of AI service has substantially improved over the past five years due to the establishment of regional facilities for sourcing liquid nitrogen and semen, and also due to the training and deployment of increasing number of AI technicians. However, there is a concern with regard to the effectiveness and efficiency of AI, due to technical and logistical reasons. In fact, most of the dairy producers expressed preference for improved heifer to AI. According to some producers, AI requires physically fit and well-fed cattle and the success rate is low.

Animal health coverage is generally low in all Regions. Some improvements have been observed recently due to the training and deployment of many Animal Health Assistants, increased training and use of paravets and Community Animal Health Workers (CAHWs), and also as a result of the increasing role of private vet drug vendors in supplying drugs and limited animal health diagnostic and treatment service provision. The issue of quality assurance with respect to the service paravets and CAHWs provide, among others, by creating innovative way of linking them to professional service providers still remains; and illegal drug importation is another issue.

Credit and saving and micro-finance organizations such as Amhara Credit and Saving Institution, Dedebit Credit and Saving Institution in Tigray, Oromia Credit and Saving Share Company, Omo and Sidama Micro-finance in the SNNPR, and other NGO affiliated micro-finance institutions are providing financial services in most of the rural areas for investment in the livestock sector. Nonetheless, many of these financial institutions, probably except DCSI, extend short-term loan for a maximum of two years for livestock. Such a loan may not be suitable for investment in dairy production because of its relatively long gestation period. As a result, small ruminant production and fattening are receiving a lion's share of the credit.

Dairy research and extension

Knowledge generated by the national research system is often not communicated in a useful and accessible manner to livestock keepers (Azage et al., 2006). The traditional focus of public dairy research has been on the generation of technical knowledge/technology; with limited research activities on livestock policy, marketing and service delivery organization and financing (Tesfaye et al., 2008). As a result, dairy research has little to offer the public and non-public actors who often grapple with non-technical impediments such as actionable market-oriented livestock policy and strategy, facilitation of dairy value chain development, alternative institutional arrangement for organizing, financing and coordinating pluralistic livestock service delivery, etc. However, there is an encouraging tendency of moving away from the conventional disciplinary and supply-driven research and technology demonstration approach to commodity-based (ARARI and TARI), interdisciplinary project-based (SARI) and field-based Farmer Research Group (ORARI)[@] approaches.

The national strategy for agricultural extension has changed to Farmers Training Centers (FTCs) approach. The establishment of FTCs and the deployment of three ATVETs graduates as DAs per FTC are widely perceived as having a positive contribution to dairy development. One of the three development agents being assigned to an FTC has specialized in livestock production and s/he is supposed to focus on livestock and dairy extension. To our dismay, however, the recent Livestock Survey Report (CSA, 2008) shows that only 133,000 households (about 1% of the total livestock holders) reported that they had participated in livestock extension package; with about a quarter of them in dairy development package.

Public extension has a long tradition of working with subsistence dairy producers; and it has been aggressively promoting cereal-biased productivity-enhancing technology in a top-down fashion; with little attention to marketing (Berhanu et al., 2006), institutional and policy constraints. The existing public extension system has been criticized, among others, for neglecting the demand side of the commercialization of process, and failure to empower its rural client (World Bank, 2006) and to reconfigured itself in line with the policy shift, the emergence of new private sector actors and increasing needs for innovations of different nature, both by its conventional and new clients. The private actors also fail to be part of knowledge networks to be able to respond and succeed in the fast changing context (Tesfaye et al., 2008).

[@] ARARI, ORARI, SARI and TARI, respectively, Amhara, Oromia, Southern and Tigray Regional Agricultural Research Institute.

Multiplicity of actors and coordination challenges

First, multitudes of heterogeneous actors are engaged in dairy development. There has been continuous ‘pouring in’ of resource by donors, directly through projects and NGOs and, indirectly, through food security and productive safety net and natural resource management programs. A significant amount of public money is also being invested in infrastructural development, human capacity development and dairy research and extension. Nonetheless, there is no mechanism of ‘pooling in’ of resources leading to duplication of efforts and inefficient use of scarce resource. The prevailing performance appraisal and reward systems of organizations further reinforced organizational independence, rather than interdependence.

Secondly, there are various innovative development activities being implemented at grassroots level. Some of these activities comprise community-based forage multiplication and distribution systems, private seed multiplication and marketing; private animal health coverage, rural vet shops; improving milk quality, processing and marketing through building capacity of dairy cooperatives; stimulating local innovation capacities through dairy platforms initiated by IPMS in Ada’a PLW, etc. In addition, most of the rural credit and saving and micro-finance organizations are trying out alternative structural arrangements in order to increase coverage and to reach disfranchised groups. The examples show that there is no ‘scarcity of innovative activities’ in the sub-sector. Rather, collective innovation capacity is scarcer! Functional mechanism rarely exists for systematic experiential learning through process and impact monitoring at organizational and systems levels; and for facilitating scaling up/out of successful experience to achieve wider impact and inform higher level policymaking. The systems failure is effectively blocking experiential social learning process and thereby discouraging achievement of development through continuous incremental improvements/innovations.

Dairy development projects play key roles of financing and facilitation of linkages among actors. Whilst these development projects interact occasionally, the extent of collective engagement among the projects themselves in systematic and continuous experiential social learning and scaling up/out successful experiences is debatable. The effectiveness of similar attempt by EIAR and RARIs to stimulate multi-stakeholders platforms has been constrained by institutional, structural and policy related factors (Teklu, 2007). More often than not, various actors have different and even conflicting motives that drive the interactions. Whilst one partner initiates an interactive relationship for facilitating joint experiential learning and innovation, the other views the interaction as a means of accessing additional resources for routine organizational activities. This difference in motives coupled with lack of shared vision and limited communication has weakened interaction, and gradually led to erosion of trust-based relationships, the prerequisite for taking risk to innovate

Context specificity and the need for policy and development interventions targeting

Dairy production systems are highly complex, risk-prone and diverse spatially and socially. The probability of adoption of technologies is determined by factors such as agro-climate, market access, cattle density, disease incidence and outbreak and other household specific factors (Ouma et al., 2007). In addition, the contribution of commercialization of smallholder dairying to rural development and rural poverty depends on spatial agro-ecological and, more importantly, on socio-economic factors (Costales et al., 2006; Ouma et al., 2007). The conventional linear transfer of technology approaches are ineffective in addressing complex, diverse, risk-averse and

dynamic realities of producers (Chambers, 1983,). The implication is that, ‘one-size-fits-all’ approach doesn’t work. Context specificity in policy support and development interventions is crucial in situations where production systems are highly diverse. Interventions such as technological (feeding, breeding, etc), organizational (milk collection and processing) and institutional (training and certification) are supposed to be systematically targeted spatially on the basis of observations from household survey and GIS (Ouma et al., 2007).

Development policy and strategy

The current rural development policy and strategy of the country has some provisions indicating general direction for livestock development. Dairy Development Master Plan (DDMP) was formulated in 2002 to guide the sub-sector development and has been implemented since then across the regions. The DDMP highlights input and output targets but fails short of indicating roadmap and providing guidelines and principles to inform actual policy implementation on the ground. As de Beer and Marias (2005) argue, the uniqueness of each area means policy and development interventions have to be customized. Whilst general guidelines and principles can be designed at national level, it is neither possible nor appropriate to design a master plan and implement through out the country, or even throughout a province. Local context should dictate the specific content of dairy development plan. The argument is valid to the Ethiopian dairy sub-sector development. ‘*Act locally, think nationally*’ is the motto we would like to underline.

Conclusion and recommendations

The available scanty evidence generally shows that sustainable commercialization of smallholder dairying in Ethiopia offers viable and growing opportunity for rural poverty reduction and sustainable livelihood improvement. Despite the country’s potential and sustained development efforts to get the sub-sector moving, productivity has remained low and subsistence-oriented. A number of interrelated, complex and dynamic economic, technical, policy and institutional challenges have hampered the sub-sector. Technological change is crucial to increase supply responsiveness of producers to the expected rise in demand for quantity and quality. Luckily, it seems though that technological options to address the key technical constraints are readily available, as a result of earlier research efforts in the country and beyond. On the other hand, often inadequate economic incentive discourages technological innovations by dairy producers to produce marketable surplus; and often efforts to achieving sustainable technological innovation is constrained by limitations with respect to systematic targeting of interventions and socio-organizational arrangements (like input and service provision) to support the innovation processes. Further, multitude of actors are engaged in dairy development, source of finance to support the development efforts is diversifying and many potentially useful innovative activities are being carried out at pilot level. Yet, no functional systems are in place for mobilizing resources and coordinating efforts; facilitating the process of collective experiential learning; and ensuring scaling-up and-out of successful experience to achieve wider socio-economic impact and inform policymaking.

Given the daunting challenges facing the sub-sector, government policy has a critical role in an endeavor to achieving sustainable transformation of the smallholder dairy production systems to that of market-oriented and dynamic systems. In this regard, the roles of national and regional governments transcend beyond promulgating economic liberalization and increasing public

investment in human capital, rural infrastructure, dairy research and extension, which apparently have created the fundamentals required for the sub-sector to take-off. Above all, carefully thought-out and evidence-based policy; and participatory and adaptive policymaking through systematic policy learning are indispensable to simultaneously and effectively address the increasing broadened development objectives within a dynamic context and increasingly complex innovation dairy systems.

In conclusion, the impact of decades of research and development efforts that are aimed at moving the Ethiopian smallholder dairying along a sustainable commercialization path has been limited, among other things, by disconnects in the innovation systems. Apparently, there are missing and/or weak linkages between different types and sources of knowledge, technological and non technological innovations, production and market, R&D and actual development challenges, supportive services and real innovation needs of economic agents, public and private actors; and the policymaking-development practice. These challenges are, however, not insurmountable. They can/should be addressed holistically with systems perspective. Admittedly, there are no easy solutions and quick fixes though for addressing such complex, interrelated and dynamic factors contributing to the stagnation of sub-sector performance. Drawing on relevant successful lessons from African and Asian countries as well as emerging opportunities in Ethiopia, we recommend a) improving economic incentives to encourage innovations; b) pursuing value chain approach; c) providing public support to private sector development and private-public partnership, d) engaging in a holistic approach to technological innovations for increasing supply response, e) formulating policy and strategy to guide the sub-sector development, and f) strengthening capacity in local innovation systems with milk value chain perspective as strategic options for consideration by the relevant actors and stakeholders.

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