Will the Specialization or Involution Thesis Hold for Smallholder Mixed Farming Systems of Harar Highlands? Rethinking Research Direction and Intervention Options for Sustainable Smallholder Agriculture Development in Ethiopia

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Abstract

This study explored trends of farming systems and livelihood options over time, and examined changes in livestock inventory in relation to changes in farm size and socio-economic status of smallholder farmers in the Harar Highlands of Ethiopia. Three districts with different rural population densities (low, medium, and high) were identified. Community level information was collected using participatory research methods. Then a formal survey was administered on 225 households randomly selected from the three districts and belonging to three well-being categories (poor, medium, and well-to-do). Both one-way and two-way ANOVA were used to analyse data. The results showed that farmers changed their livestock inventory (species composition and number) as farm sizes declined, moving mainly from ruminants to non-ruminants. Total livestock holdings varied significantly across districts and well-being groups ($P<0.001$). Livestock holdings per household of all species, except donkeys, declined as rural population density increased and augmented with improvements in socio-economic status. The number of livestock per unit area of cultivated land, however, increased significantly ($P<0.001$) with rural population density, except for sheep and goats. Though livestock holdings declined as farm sizes shrank with significant variations across districts, farmers continued to rear livestock. This was observed even when land sizes declined to less than a hectare per household. In the most populated district, the average livestock holding was 2.21 TLU per household. The conceptual framework, which assumes that as land resources dwindle mixed farming systems will have to specialise into crop or livestock farming units or could face involution, does not seem to be holding for the Harar Highlands of Ethiopia, at least in the near future. Its validity in similar areas will have to be re-examined. Therefore, research priorities and development initiatives in tropical smallholder mixed farming systems must consider the continued importance of the crop-livestock integration even when farm sizes decline significantly. The options of generating crop-or livestock-focused technologies that assume specialisation must be revisited and varieties and breeds or species and cropping and livestock systems that allow improvements for further intensifications of mixed farms must be identified and promoted.

Key words: Khat, crop-livestock integration, diversification, Ethiopia, Harar Highlands, involution, non-agricultural activities, research, smallholder mixed farming, specialisation

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Introduction

Importance and evolution of mixed farming systems

The 2002 World Summit on Sustainable Development held in Johannesburg, South Africa, reiterated the need for an integrated approach to link economic, social, and environmental objectives. It stressed the need for an increasing level of participation of all stakeholders, notably smallholder farmers, to bring about sustainable agricultural development (World Summit on Sustainable Development[1], 2003). Though definitions may vary, sustainable agriculture is understood as one that equitably balances concerns of environmental soundness (resource-cycling, energy and nutrient conserving, promoting biodiversity, balancing pest and predator relationships, cycling nutrients, building up soil fertility, using water efficiently, *etc.*), economic viability (high productivity per unit of land, water, energy, labor, and investment), social equity (justice among all sectors of the society), and the quality of life (including spiritual dimensions) for the farmers and the society as a whole (Allen *et al.*, 1991; Pretty, 1995, 2002; Bell and Morse, 1999; DFID, 2000). Owing to several factors operating at different levels, bringing about sustainable agricultural development in developing countries remains a challenge.

Mixed farming is the most common form of agricultural production system in developing countries (de Haan *et al.*, 1997). World wide, mixed farming systems (MFS)[2] represent 41% of the arable land and provide the vast majority of beef, veal and milk output, and almost 70% of the world rural population is related to MFS (Seré and Steinfeld, 1995). Population pressure on a fixed land area drives agriculture towards intensification primarily through integration of crop-livestock, which involves making trade-offs in alternative uses of land, labor, and capital. This results in different enterprise combination and production techniques, which determine productivity and sustainability of farming systems (McIntire *et al.*, 1992). Factors influencing levels of crop-livestock integration and agricultural intensification include socio-economic factors, demographic variables, infrastructure, farming practices, factor market, technology, and policy environment (Pingali *et al.*, 1987; Winrock,

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[1] www.johannesburgsummit.org . Accessed in May 2008.

[2] Seré and Steinfeld (1995) defined mixed farming systems as livestock systems in which more than 10% of the dry matter fed to animals comes from crop by-products and stubble, or more than 10% of the total value of production comes from non-livestock farming activities. Commonly, however, mixed farming systems are known to exist where both livestock and crop production, including multipurpose trees, take place in an integrated way under the same management unit within the same locality or across different places.

1992). As a result, MFS are agro-ecologically, demographically, socio-culturally, economically, and technologically diverse. The level of crop livestock integration is also a function of environmental differences, factor and input substitution, availability of year round feed supply, the management systems, and alternative investment opportunities available for smallholders (Saleem, 1995). Further understanding of the interactions between people, environment and the crop-livestock sub-system that prevails in the different MFS and their trends over time, is necessary to bring about sustainable improvements (de Haan *et al.*, 1997).

Any system responds to changes (Holing, 1995), so do MFS. MFS evolve in response to population growth, natural vagaries, and other forces of change. The Malthusian perspective assumes an inverse relationship between population growth and food production, but fails to take into account people's capacity to develop technologies and practices that would increase agricultural output. Boserup's (1965) thesis about the process of agricultural intensification, however, considers population growth as a major determinant of intensification and technological change in agriculture. Ruthenberg (1980) also viewed population density as a driving force to invest in land improvements and cropping practices that would increase intensity of cultivation, and adoption of technologies that would increase yield per unit area of land. Not all societies would, however, show growth in agricultural productivity when experiencing population growth and increased market access (World Bank, 1996). Closer examination of peculiarities of the major production systems is, therefore, suggested.

McIntire *et al.* (1992) examined the influence of population growth and access to market on farming intensity and crop-livestock interactions. They reported that with population growth and improvements in market access, the evolution of crop-livestock interaction in an MFS would follow an inverted U-pattern through time. Initially crop farmers and herding communities move towards mixed farming where both crop and livestock are produced within one management unit. With increasing population densities, they assumed, intensive production systems emerge and the opportunity cost of labor rises, leading to increased mechanisation. But increase in opportunity cost of labor does not necessarily lead to increased mechanisation. Then, they argued that, as markets expand and technologies develop further, there is a reverse movement away from integration and farmers move towards specialization. This conclusion appears to have assumed certainty in the benefits of external economies of scale.

A considerable number of scholars believe that technical changes such as fertilisers replacing manure, tractors replacing animals, *etc.* eliminate the cost advantages for a mixed enterprise to provide some of its own inputs (de Haan *et al.*, 1997; Steinfeld *et al*, 1997; CAST, 1999). Pingali *et al.* (1987) further stated that improvements in transport infrastructure encourage intensification by allowing farmers a better price for their produce, thereby increasing returns to labor, which in turn encourage immigration from surrounding regions with higher transport costs. Increased returns to labor do not necessarily entail labor shortage in one area and allow mobility from other areas. Lele and Stone (1989) emphasised that scarcity of productive factors, notably land, alters its price, which in turn results in its more intensive use. Likewise, the Induced Innovation Model of Hayami and Ruttan (1985) accepts that population pressure results in changes in factor proportions. This will lead to the adoption of strategies that will conserve the more and more scarce, and assist the increased use of the more abundant resources, in this case land and labor respectively. The Induced Innovation Model holds that over time technological innovations and institutional changes are geared to make the most use of abundant resources and economise on scarce resources. It attempts to explain the evolution of production technologies in response to resource endowment and institutional factors. Binswanger and Deiniger (1997) point out that other factors such as low or declining market demand and lack of adaptable technologies, appropriate policies, and adequate infrastructure and institutions, discourage farms from making investments and therefore curtail such evolution of farming systems. If adaptable technologies are made available and appropriate policy signals given, increase in rural population density may well lead to a conservationary pathway through increased input use, especially labor, in order to maintain or raise productivity per unit of land. This has already been observed in the Machacos district of Kenya (Tiffen *et al.*, 1994).

With such different theoretical underpinnings, the debate on avenues for the intensification of mixed farming systems continues. One could broadly identify two major positions: the Specialisation or Involution Thesis, and the intensification through integration of crop-livestock systems with other non-farm livelihood options.

The Specialisation or Involution Thesis - The Crop or Livestock Option

In simple terms, the Involution or Specialisation Thesis (summarised in Figure 1) argues that as land becomes scarce, and as demand for food of livestock origin expands rapidly (MFS) in developing countries can't keep up.

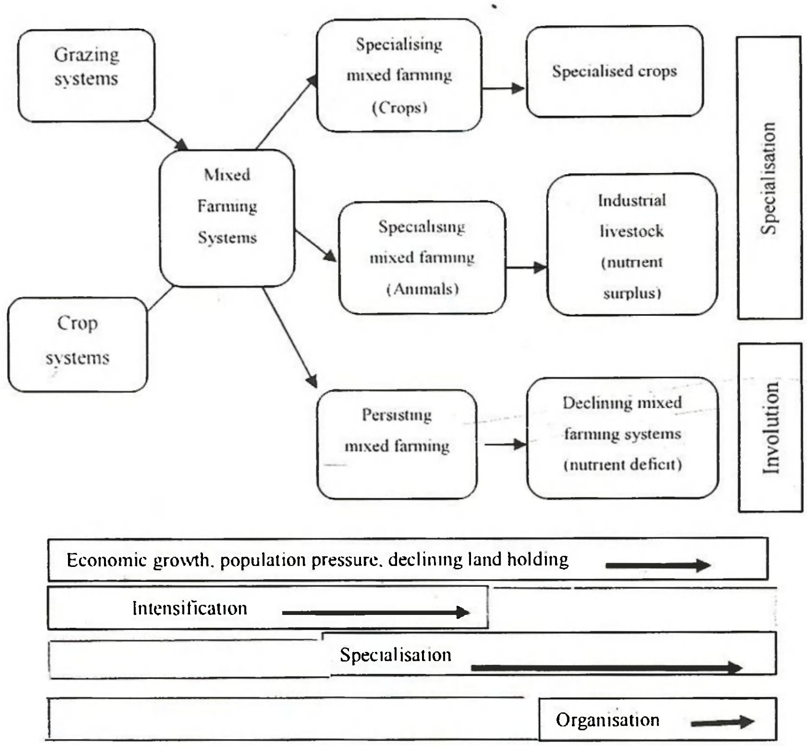

Figure 1. Schematic presentation of the Specialisation or Involution Thesis (Source: Adapted from de Haan *et al.*, 1997).

Thus, prospects for meeting demands for animal foods from tropical MFS are dim (CAST, 1999). Unless these systems evolve towards intensive crop or livestock production systems, they are expected to face involution as land holding will decline with rural population growth to a point where the size will become too small to be a viable farm unit (Ruthenberg, 1980; Steinfeld *et al.*, 1997). As a result, serious investment in livestock-related development activities and adoption of policies that help farmers to move towards intensive production systems are suggested (de Haan *et al.*, 1997).

Delgado *et al.* (1999) assert that if livestock production fails to expand faster than it did in the past (2.0 percent a year for meat and 3.2 percent for milk between 1962 and 1987), sub-Saharan African countries will face massive deficits in meat and milk supplies by 2025. The Winrock report stressed that a 4 percent annual increase in meat and milk production was necessary in sub-Saharan Africa up to 2025 to meet demands of the growing urban population with increasing income.

Proponents of the Specialisation thesis believe that traditional MFS have been at a sustainable equilibrium stage, but several have lost this equilibrium over the last decades because of the pressure caused by fast human and livestock population with a growing demand for animal food products (de Haan *et al.*, 1997). In these situations, benefits from crop-livestock integration decrease and exogenous technical changes are needed (Devendra *et al.*, 1997). Without such changes, further population growth will make it impossible for the traditional MFS to survive. Livestock will become more crowded and farming systems will progressively lose their livestock component (Delgado *et al.*, 1999). This reduces livestock to human ratio and the nutrient balance of farms could become negative. This in turn may lead to a downward spiral of reduced soil nutrient transfer and reduced income opportunities and decline in livestock to human ratios (de Haan *et al.*, 1997). Thus the need for MFS to specialise into either crop or livestock farming units is emphasised.

Trade and technological developments assist the process of specialisation. The integration of global markets and the development of infrastructure and local and export markets facilitate diffusion of machinery, fertilisers, synthetic fibres, *etc.* This will decrease the value of other functions of livestock, increase their food value, and stimulate mechanisation and industrial animal farming. Proponents of the thesis point out that specialization facilitates the use of advanced production and environmental management technologies, and farmers will benefit from economies of scale. Industrial systems are also believed to produce more human food on less land, from less total feed input, with fewer animals and less methane production than other animal production systems (de Haan *et al.*, 1997; CAST, 1999). With industrial livestock systems, however, feed requirements can no longer be met from domestic or farm supplies. This would lead to importation of animal feeds. For most efficient use of imported or expensive feed, farmers will have to resort to imported livestock genetic materials and sophisticated feeding practices such as strategic supplementation, phase feeding, use of feed additives and even synthetic amino acids (de Haan *et al.*, 1997). The principal feed grain, maize, yields much more per hectare than wheat, the number one food grain (CAST, 1999). Diverting grains from animal production direct to human consumption would, in the long term, result only in few increases in total food grain demand (Delgado *et al.*, 1999). As a result, the future is expected to bring about transformation of family based mixed farms into specialised and commercial enterprises in rural areas. Intensification of livestock production systems will thus become necessary and beneficial to smallholder poor farmers. Proponents of this thesis conclude that farms that cannot successfully intensify and move to specialised production systems will face involution (de Haan *et al.*, 1997; CAST, 1999; Delgado *et al.*, 1999).

Further integration and diversification of MFS

Opponents of the Involution or Specialization Thesis stress that many of the arguments forwarded consider smallholder farms as analogous to firms that aim at cutting cost of production through minimising average fixed costs. They emphasise that in many developing countries, small farm sizes limit opportunities for economies of scale, and improved economies of scale may not mean much so long as transaction costs remain high due to underdevelopment of infrastructure. In these countries, high transaction costs remain the major obstacles of agricultural development (Kydd, 2002), which, in some cases, might even lead to diseconomies of scale. Opponents of the thesis underline the importance of accounting for the multiple production objectives of farmers and major factors that influence the evolution of farming systems. Population growth (Boserup, 1965; Ruthenberg, 1980) and agro-climate (Pingali *et al.*, 1987; McIntire *et al.*, 1992) are considered as the major driving forces for the intensification[3] of agricultural systems. Smallholder farmers respond to such forces often through further integration of crop-livestock sub-systems (Devendra *et al*, 1997) and diversification into other livelihood options than moving towards specialisation into crop or livestock farming. The major benefits arising from the integration of crop and livestock production in MFS include: intensification and diversification, food and nutrition functions, employment and income generation, input provision (power and manure), investment and security functions, socio-cultural roles, risk reduction and mitigation, increased productivity of labor and land, and more effective utilisation of available energy in the system (Jahnke, 1982; Devendra, 1993; Saleem, 1995; Sansoucy *et al.*, 1995; Seré and Steinfeld, 1995). Although the relative importance of each will vary with production systems, socio-economic setting, and degree of market integration, these diversified roles of livestock in MFS clearly demonstrate the multiple production objectives of smallholders, which are not only economical but could also be socio-cultural and spiritual. The Involution or Specialization Thesis assumes milk or meat production as sole production objectives of farmers. Adequate understanding and due consideration of these production objectives is necessary to facilitate identification of viable entry points for improvement in MFS.

[3] Pingali *et al.*, (1987) defined agricultural intensification as the evolutionary movement from shifting cultivation to permanent cultivation with multiple cropping systems, though relating intensification to increasing output per unit input of limiting factors would have been more relevant for such discussions.

Besides, proponents of crop-livestock integration point to a number of factors that make the specialization option less practical for Tropical MFS (Anderson, 1991; Devendra, 1993; Saleem, 1995; Sansoucy *et al.*, 1995; Devendra *et al.*, 1997). The following are the major ones:

a) **No conclusive evidence on declining animal productivity in developing countries.** Whether productivity per animal has declined in sub-Saharan Africa over time is yet to be established as reports show varying pictures. Delgado *et al.* (1999) note little increase in productivity per animal during the 1970s and 1980s. The authors argue that dumping of livestock products from developed countries during the late 1970s and throughout the 1980s and 1990s has discouraged production innovation at the local level, as did overvalued exchange rates that favoured imports. On the other hand, a study reported in de Hann *et al.* (1997) showed increases in productivity per animal in the Sahelian regions of Africa over the last 30 years. Further to this, Ayalew (2000) demonstrated that in eastern Ethiopia returns per unit of labor and feed from local goats were higher than returns from crossbred goats. This indicates that the perceived problem of low and declining productivity of local stocks has no conclusive evidence, especially when considered against limiting factors such as feed.

b) **The majority of population continues to be rural**. Though the number of urban dwellers in developing countries is expected to rise significantly, the majority of the population in these countries will continue to be rural-based for the foreseeable future. Having such a large rural population constitutes an important source of demand for continued supply of livestock products, for which MFS are better suited. In MFS outputs of a particular product are less in volume, and can often be used on-farm if they cannot be marketed.

c) **Environmental constraints and uncertainties**. Tropical agriculture is constrained by several vagaries of nature (*e.g.* erratic rainfall pattern, high rate of evapo-transpiration and soil erosion, low fertility levels and organic matter contents of soils, a multitude of pests and diseases) that increase risk. Furthermore, market failures and institutional instabilities are not uncommon. Under such conditions of risk and uncertainty, one of the assumptions of perfect competition, *i.e.* perfect knowledge that has been the foundation of making rational decisions (a core principle in economics) breaks down (Sterman, 1991; Aredo, 1995).

d) **Disease incidence**. The general tendency with specialisation has been to use exotic breeds with higher potential for a particular trait, *e.g.* milk yield.

These breeds are known to be disease-susceptible (Saleem, 1995). In many developing countries parasitic and tick-borne diseases as well as epizootic soil and airborne infectious diseases (*e.g.* anthrax, render pest, food- and-mouth disease, contagious bovine plueropuemonia, *peste des petits ruminants*, African swine fever, *etc.*) manifest themselves rampantly and affect large number of animals. Such diseases limit opportunities for exporting livestock products and live animals. Diseases must, therefore, be controlled to assure farmers that intensification through specialisation would adequately return their investments (Winrock, 1992). This is a necessary condition if wide spread intensification is to take place (Saleem, 1995). Most developing countries, however, have neither been able to develop an effective delivery of veterinary services nor have the ability to maintain effective vaccination and surveillance programmes to control disease outbreaks that could have devastating effects for exotic breeds.

e) **Under-developed marketing systems and low purchasing power of consumers**. Marketing of perishable agricultural and livestock products requires efficient collection, processing and delivery systems. However, the existing market fragmentation, caused mainly by excessively high transport costs, is significant (Delgado *et al.*, 1999). The expansion in Europe and North America of specialised industrial livestock farms, particularly during the last 50 years, was made possible after many years of infrastructure and marketing development. Its success is also attributed to availability of technology, and above all to the high purchasing power of consumers that allowed farmers to use expensive technologies (CAST, 1999). Besides, an increase in household income of urban consumers does not always translate into increased demand for livestock products, as the two do not automatically have linear relationships. Schroeder *et al.* (1995 cited in Delgado *et al.*, 1999) reported that as income increases, consumption of livestock products, especially meat, goes up, particularly in countries with the lowest levels of national income, but as countries become richer the impact of an increase in income on meat consumption gets weaker.

f) **Difficulty to compete**. The increased concentration and vertical integration of input supply, processing and transportation of prod :ts from increased intensification and industrialisation of livestock production in the developed world (especially in poultry, pigs, and dairy production) will result in economies of scale that would make it difficult for smallholders of developing countries to compete. It is not only the issue of reducing cost of production per unit of product that adds to the difficulty to compete, but also the systematic exclusion through a series of graduation requirements from entering the world livestock products marketing system. In some cases, transnational companies overrun small scale livestock development schemes. One example is the case of small-scale broiler producers in the Philippines, quickly ousted by multi-national companies (World Bank, 2001).

g) **Increase in feed demand**. Industrial livestock systems consume about one-third of the total world cereal production (Delgado *et al.*, 1999). Even if the yield per hectare of the principal animal feed, maize, is greater than that of wheat, maize production drains much nutrient from the soil. As a result, a further move to such systems will certainly increase demand for maize, with likely negative impacts on soil fertility levels (CAST, 1999).

h) **Negative environmental externalities**. While MFS have the capacity to internalise environmental costs, the expansion of industrial livestock systems was not without heavy cost on the environment. This has potentially important environmental impacts, if concentrated wastes are not properly managed (CAST, 1999). To this end, strict environmental regulations on environmental externalities (*e.g.* manure production and emission) will become necessary. With increased environmental concerns, it is likely that those who negatively impact the environment will be penalised probably through higher taxes. Higher taxes could make industrial livestock systems in developing countries more expensive, and may also make competition with the often highly subsidised American or European farms more difficult. In MFS, it is known that negative impacts of livestock on the environment are observed mainly when institutional failures and policy loopholes allow over utilisation of public goods. For instance, subsidies for ranches to encourage beef export (*e.g.* in Brazil) and land titling policies that require clearing of land (possibly forest land) encourage deforestation (Nicholson *et al.*, 2001). Similarly, less secure land tenure systems would lead to overgrazing of communal grazing lands. It has been widely known that it is not primarily grazing livestock *per se* that cause degradation of natural resource base, but the sociological, economic and cultural framework governing the land use systems (de Haan *et al.*, 1997). If combined with equitable land policies and regulation that would keep adverse effects of livestock production within tolerable limits, livestock production in tropical MFS can play a role that will enhance its net contribution to human welfare (Saleem, 1995). It also makes a positive contribution to the natural resource base by enhancing soil quality, increasing plant and animal biodiversity, and substituting for scarce and non-renewable resources such as fossil fuels (de Haan *et al.*, 1997).

i) **Food safety**. The other major issue with industrial livestock farming is the concern for food safety. With industrial livestock systems, wider use of processed foods of animal origin and the mode of production itself, increase the chances for outbreak of zoonotic diseases, as was the case of mad cow disease in Europe and viral diseases of poultry in Southeast Asia. This has now become an important concern at international level.

In the light of these biophysical and socio-economic constraints, opponents of the 'Involution or Specialization Thesis', believe that it is further integration of the crop and livestock subsystems of smallholder MFS rather than their specialization into mechanised crop farming or industrial livestock farming units that constitutes an avenue for the improvement of rural livelihoods. The opponents underscore that though it is applicable only to pockets of areas (around urban centres) and for few households (the well-to-do), for the majority of tropical small farmers living in less favourable biophysical environments and operating under high levels of uncertainty and severe resource limitation, promoting industrial livestock systems, opponents emphasise, defies all logic.

If adequate research and development efforts are made, and the correct (*i.e.* ethical and equitable) policies and appropriate market signals are there, MFS could further intensify and continue to be viable production systems. Crop-livestock integration remains to be the most important and environmentally friendly avenue for intensification of agriculture in the Tropics. In virtually all of the Tropical highlands (*e.g.* in the Himalayans hills, East Asia, East Africa, and the Andeans), higher agricultural densities have been sustained by complex and productive smallholder MFS where trees and ponds are also important elements. In the Central Rift Valley Regions of Ethiopia, complex agro-forestry systems support one of the highest rural population densities in the country. More opportunities exist for improving MFS than with specialised farming systems (Pretty, 1995; Saleem, 1995). Examples include reducing nutrient losses from manure through such measures as stall feeding that could double the effective availability of N and P. The environmental and economic stability of mixed systems makes this form of farming in developing countries a prime candidate for technology transfer and development (Saleem, 1995; Sansoucy *et al.*, 1995; Devendra *et al.*, 1997). In areas with low technology, scarcity of inputs and poorly developed markets, the most efficient and sustainable means of increasing off-take from a fixed land base will be mixed crop-livestock systems. In such systems the livestock sector will also adapt and develop into environmentally friendly production system if policy makers provide a corresponding and consistent set of signals, given that research and extension systems, development planners and the evolution of MFS do not move in opposite directions.

Unfortunately, biological and agricultural non-holistic research has largely ignored the full extent of the interactions in smallholder farms (Chambers, 1993). These are mainly the interactions between the crop and livestock subsystems of MFS (Thornton and Herrero, 2001) on one hand and those of the agricultural and non-agricultural activities of farmers (Kydd, 2002) on the other. These interactions hold the key for the sustainable intensification of food production and the improvement of human welfare and natural resource management (Kassa, 2003). Comprehensive multi-sectoral analysis is, therefore, required to account for all roles and functions of livestock in tropical MFS (Devendra, 1993; Preston, 1995; Sansoucy *et al.*, 1995; DFID, 2000) in order to understand all interactions and driving forces influencing the sustainability of these production systems. This has to become one of the main objectives in agricultural research (Pardey *et al.*, 1997).

In light of the importance of MFS as a major livelihood component and the growing concern regarding degradation of the natural-resource base of agriculture, and considering the fact that MFS are complex entities in both structure and function, it might be difficult to find out whether the first or the second thesis will hold true for a given area. Little work has thus far been conducted to study the changes in livestock inventory of farmers (species mix and livestock number) in relation to changes in rural population density (farm size) and socio-economic status of farming households in the Ethiopian Highlands. Consequently, extremely little is known about potential ways of enhancing the role of livestock in the livelihoods of smallholder farmers as their farm sizes decline and their socio-economic statuses change. Thus, this study was conducted to help in filling the information gap and promoting understanding of trends.

Methodology

The Study Area

The Harar Highlands are located in the East Hararghe Administrative Zone of the Oromia National Regional State, Eastern Ethiopia. They are part of the south-eastern Ethiopian Highlands, which fall approximately within a demarcation of 40° 45' to 42° 20' longitude and 8° 50' to 9° 30' N latitude and cover an estimated area of 15,800 sq. km (Getahun, 1980). The topography is characterized by undulating relief and dissected plateaux. The altitudes range between 1,500 and 3,400 m. The most important agricultural zone is the 1,800 to 2,500 m belt. Areas over 2,500 m of altitude represent about 5% of the highlands, and are not as intensively cultivated as the 1,800-2,500 m zone (Poschen, 1987).

The Harar Highlands gradually slope to the Ogaden lowlands in the south and east, and to the Rift Valley lowlands in the north. The rainfall pattern is bimodal with a known dry spell in between, which frequently results in crop failures (Wibaux, 1986). The total annual rainfall varies with districts, from 700 to 1,200 mm. The Harar Highlands are among the most densely populated highland areas of the country. The population of the Eastern Hararghe Administrative Zone is above 2 million. Over 90% of the population lives in rural areas, and its livelihood depends mainly on agriculture. The average rural population density, defined as persons per square km of cultivated land, stands at 530 persons per sq. km, ranging from 460 in Gursum woreda to 1,060 in Deder woreda (Kassa, 2003). This indicates the general population distribution pattern across the Harar Highlands, but rural population density could vary widely within a given district, depending largely on altitude and proximity to markets (Poschen, 1987).

Due to population expansion, farmers in the Harar Highlands own smallholdings (Adinew, 1991). Poor soil fertility, drought, and pests are also cropping limitations (AUA, 1986; Wibaux, 1986) of increasing importance (Mulatu and Kassa, 2001). Government policies on land tenure, and cross-border livestock trade constitute additional uncertainties. In the face of these uncertainties, declining farm size and soil fertility levels, increased incidences of weed and crop pests, and expanding market opportunities, farmers in the Harar highlands have continued to make adjustments in their livelihood strategies (Gebissa, 1997). One of the most important changes brought into the farming systems was the growing integration of Khat and other naturally growing and cultivated fodder trees and shrubs as a way of increasing total farm productivity and income (Mulatu and Kassa, 2001). As a result, the agricultural system has evolved, largely without government support, from grain-based subsistence farming to a khat-livestock-based, market-oriented mixed farming system. The relative importance of Khat to the farm economy varies, to a large extent, on the household's access to irrigation (Mulatu and Kassa, 2001; Kassa, 2009). The crop production sub-system is characterised by multiple cropping, especially mixed and relay cropping of different species of food and cash crops. The major cash crops are khat (*Catha edulis* L.) and coffee (*Coffea arabica* L.), and in some locations vegetables (Wibaux, 1986). Khat is being substituted for coffee because it is more profitable (Kassa, 2009) and less risky (Gebissa, 1997; Mulatu and Kassa, 2001).

Taking into account the similarity in agricultural production and livelihood systems and marked variations in rural population densities across districts and socio-economic status among farming households (Kassa *et al.*, 2002), three districts were selected and the formal farm level in-depth study was conducted during the 2001-2002 production year. The three districts are Gursum, Kombolcha, and Deder representing lower, medium, and higher rural population densities, respectively (Figure 2). The average landholding per household was 1.7, 1.2 and 0.8 ha for Gursum, Kombolcha and Deder districts respectively. Information generated from these three districts is believed to provide a fair picture of the Harar Highlands.

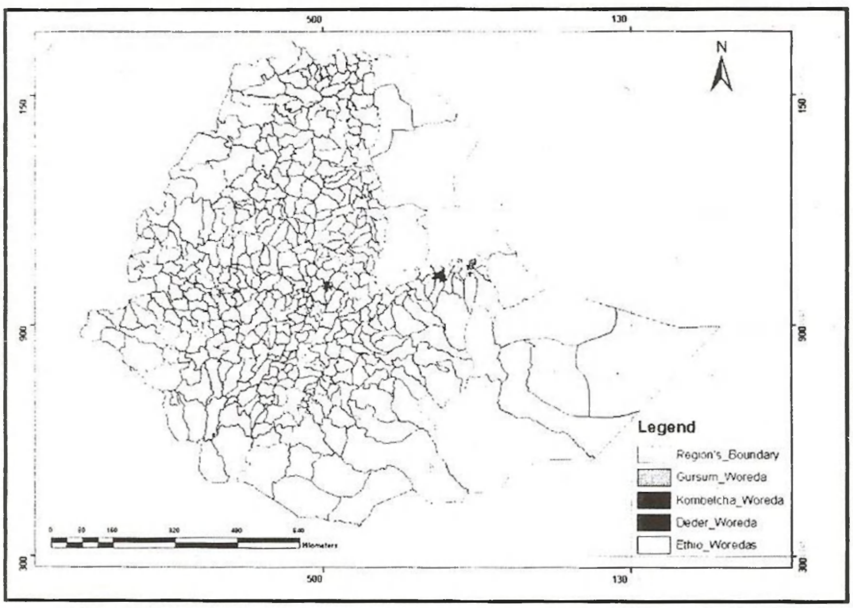

Figure 2. Location map of the three districts.

Methods

A rapid informal survey was conducted in February 2009 where key informant interviews were conducted to reassess the role of khat in the farming system and to depict changes in trends if any in relation to the findings of the study in 2001/02. The study in 2001/02 employed participatory and formal survey research methods. Participatory research methods were used to gather information on the diversity of farmers in relation to livestock holding and socio-economic status in each of the communities involved in the study. These methods helped in gathering information on the diversity of farming households in each of the study areas, and how farmers themselves identify different households into different well-being categories. The information so generated was then used to better design the formal survey. The formal survey was administered to randomly selected sample households using a two-staged stratified random sampling technique (based on woreda and socio-economic status of households. 25 sample households from each of the three well-being categories (poor, medium, and well-to-do) were then selected randomly from the list of farming households residing in each of the selected Farmers' Associations in the three districts. Then a structured and pre-tested questionnaire based formal survey was administered on a total of 225 farming households. Household demographic characteristics and asset inventories including livestock species, types and numbers owned and kept on-farm were collected to determine assets holdings. Data on assets were subjected to one-way ANOVA. Recorded and transformed values on livestock holdings were subjected to two-way ANOVA. The LSD test was used to compare mean values of parameters with significant variations using Minitab Version 12.

Results and Discussion

Household Characteristics

Demographic characteristics of the sample households indicate that in the Harar Highlands the average family size was 6.6, with a total of 3.72 labor units[4] available for livestock production. On average each household owned 1.21 ha of land located in three parcels, and close to half of the cultivated area was allotted for cash crops (Table 1).

Table 1. Two-way ANOVA results demographic characteristics and land holdings of households in the different districts and well-being categories (n = 225)

Parameters		Household Head's Age	Family size	Total labor (LU)*	Number of parcels	Land in cash crops (ha)	Land in food crops (ha)	Cultivated land (ha)
District	α**	0.175	0.036	0.038	0.000	0.000	0.000	0.000
	Gursum	41.00	6.43^a	3.60^a	2.96^a	0.75^a	0.91^a	1.66^a
	Kombolcha	40.90	7.11^b	4.04^b	3.64^b	0.67^a	0.49^b	1.17^b
	Deder	38.00	6.28^a	3.52^a	2.48^c	0.42^b	0.37^b	0.79^c
Well-being	α**	0.460	0.000	0.000	0.000	0.000	0.059	0.000
	Well-to-do	41.20	7.51^a	4.27^a	3.44^a	0.77^a	0.70	1.47^a
	Medium	39.10	6.69^b	3.71^b	2.59^b	0.57^b	0.51	1.08^b
	Poor	39.60	5.61^c	3.18^c	3.05^c	0.50^b	0.57	1.07^b
Interaction	α**	0.256	0.087	0.051	0.525	0.623	0.149	0.179
Grand mean		39.95	6.60	3.72	3.02	0.61	0.59	1.21

* LU stands for labor units for livestock production. Conversion to LU was made using 1.0 unit for ages 18 to 60, and 0.5 for ages 7-17 and over 60 for both sexes.

** $\alpha = P \mid (\mu 1 = \mu 2 = \mu 3) \mid$

Within column consecutive mean values of districts and wellbeing categories with different superscripts are significantly different at $P < 0.01$ on LSD test.

[4] Conversion to labor units available for livestock production in the study area was made using 1.0 units for ages 18 to 60, and 0.5 for ages 7-17 and over 60 years for both sexes, after Wibaux (1986).

There were no significant differences in the age of the household heads across districts (P = 0.175) & well-being categories (P = 0.460). But family size & total labor varied with districts (P<0.05) & increased significantly (P<0.001) with well-being status. Cultivated land and area in cash crops decreased significantly as rural population density rises (P<0.001) and increased with well-being status (P<0.001).

Livestock inventory in relation to farm size and socio-economic status

As regards livestock inventory, on average, a household in the Harar Highlands owned 0.47 donkeys, 2.07 small ruminants, and 2.29 cattle units (CU)[5], amounting to a total of 2.73 Tropical Livestock Units (TLU)[6]. Nonetheless, as indicated in Figures 3 and 4, livestock inventories in the three districts and in the three well-being categories appear to vary markedly.

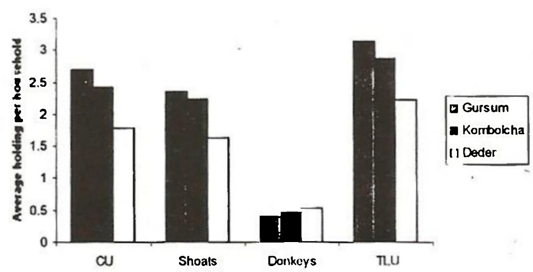

Figure 3. Average livestock holdings per household in the three districts (n=225).

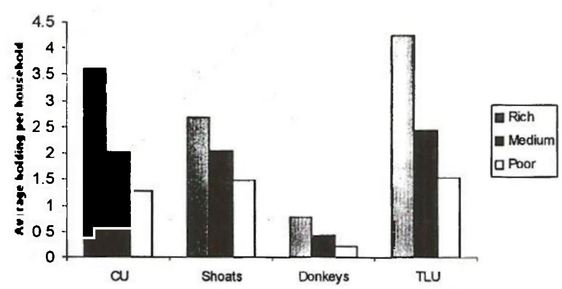

Figure 4. Average livestock holdings per household of the three well-being categories (n=225)

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[5] Conversion to cattle unit (CU) was made using 1.1 units for oxen, 1.0 for cows, 0.7 for bulls and heifers, and 0.2 for calves.

[6] The conversion to TLU was done as 1 CU = 1TLU, 0.1 TLU for small ruminants and 0.5 for donkeys.

The number of small ruminants decreased significantly with increasing rural population density ($P<0.05$), but went up with socio-economic status ($P<0.001$). Likewise, the number of cattle units and the total livestock biomass (measured in terms of TLU) decreased significantly with increasing population density ($P<0.001$), but increased with socio-economic status ($P<0.001$). Donkey holdings per household, however, did not vary with districts ($P=0.368$), but grew with socio-economic status (Table 2).

Table 2. Two-way ANOVA results of livestock holding of households in the different districts and well-being categories (n = 225)

Parameters		Oxen	Cows	Heifers	Bulls	Calves	CU*	Sheep	Goats	Shoats	Donkeys	TLU
District	α**	0.000	0.001	0.096	0.008	0.788	0.000	0.002	0.017	0.023	0.368	0.000
	Gursum	1.19^{a}	0.83^{a}	0.35	0.29^{a}	0.48	2.69^{a}	0.35^{a}	2.00^{a}	2.35^{a}	0.41	3.13^{a}
	Kombolcha	0.41^{b}	1.16^{b}	0.51	0.53^{b}	0.45	2.41^{a}	0.73^{b}	1.51^{b}	2.24^{a}	0.47	2.86^{a}
	Deder	0.51^{b}	0.73^{a}	0.32	0.27^{a}	0.41	1.78^{b}	0.31^{a}	1.32^{b}	1.63^{b}	0.53	2.21^{b}
Well-being	α**	0.000	0.000	0.059	0.001	0.000	0.000	0.077	0.001	0.000	0.000	0.000
	Well-to-do	1.25^{a}	1.37^{a}	0.48	0.53^{a}	0.72^{a}	3.60^{a}	0.59	2.09^{a}	2.68^{a}	0.77^{a}	4.25^{a}
	Medium	0.45^{b}	0.88^{b}	0.43	0.39^{b}	0.35^{b}	2.02^{b}	0.51	1.55^{b}	2.05^{b}	0.43^{b}	2.43^{b}
	Poor	0.40^{c}	0.47^{c}	0.27	0.17^{c}	0.28^{b}	1.27^{c}	0.29	1.19^{b}	1.48^{c}	0.21^{c}	1.53^{c}
Interaction	α**	0.067	0.212	0.758	0.510	0.126	0.097	0.142	0.547	0.562	0.310	0.079
Grand mean		0.70	0.91	0.39	0.36	0.45	2.29	0.46	1.61	2.07	0.47	2.74

* Conversion to cattle unit was made using 1.1 units for oxen, 1.0 for cows, 0.7 for bulls and heifers, and 0.2 for calves.

** $\alpha = P \mid (\mu_1 = \mu_2 = \mu_3) \mid$

Within column consecutive mean values of districts and well being categories with different superscripts are significantly different at $P < 0.01$ on LSD test.

Table 3. Two-way ANOVA results of livestock inventory in relation to land and labor across districts and well-being categories (n = 225)

Parameters		TLU/ ha	TLU/ labor	CU/ ha	CU/ labor	Oxen / ha	Oxen/ labor	Shoats/ ha	Shoats / labor	Donkeys /ha	Donkeys /labor
District	α*	0.000	0.001	0.000	0.001	0.015	0.000	0.290	0.088	0.000	0.508
	Gursum	2.01^{a}	0.94^{a}	1.70^{a}	0.81^{a}	0.76^{a}	0.35^{a}	1.78	0.70	0.27^{a}	0.12
	Kombolcha	2.92^{b}	0.75^{b}	2.45^{b}	0.63^{b}	0.41^{b}	0.11^{b}	2.26	0.58	0.49^{b}	0.13
	Deder	3.09^{b}	0.67^{b}	2.48^{b}	0.55^{b}	0.71^{c}	0.15^{b}	2.29	0.51	0.75^{c}	0.15
Well-being	α*	0.000	0.000	0.000	0.000	0.000	0.000	0.037	0.098	0.003	0.000
	Well-to-do	3.46^{a}	1.11^{a}	2.89^{a}	0.94^{a}	0.92^{a}	0.34^{a}	2.41^{a}	0.68	0.66^{a}	0.20^{a}
	Medium	2.90^{b}	0.73^{b}	2.37^{b}	0.60^{b}	0.58^{b}	0.13^{b}	2.36^{a}	0.62	0.58^{a}	0.13^{b}
	Poor	1.66^{c}	0.53^{c}	1.36^{c}	0.45^{c}	0.38^{c}	0.14^{b}	1.57^{b}	0.49	0.27^{b}	0.07^{c}
Interaction	α*	0.478	0.006	0.419	0.012	0.193	0.010	0.383	0.363	0.626	0.152
Grand mean		2.67	0.79	2.21	0.66	0.63	0.21	2.11	0.60	0.50	0.13

* $\alpha = P \mid (\mu_1 = \mu_2 = \mu_3) \mid$

Within column consecutive mean values of districts and well being categories with different superscripts are significantly different at $P < 0.01$ on LSD test.

Some transformed indexes showed that TLU/ha, CU/ha and donkeys/ha increased with growing rural population density and socio-economic status, and in both cases the variations were highly significant (Table 3). Both TLU/labor and CU/labor decreased significantly with rural population density ($P<0.01$) and increased with socio-economic status ($P<0.001$). Variations among districts in shoats/ha and in donkeys/labor were non-significant, while variations across well being groups were highly significant ($P<0.001$), increasing with socio-economic status ($P<0.001$).

It is important to point out the differences in the relative changes between land and livestock holding per household with changes in rural population density and in socio-economic status. In Deder district, which represents districts with high population density in the Harar Highlands, some farmers reported that they had already stopped dividing lands further for their sons, and the newly married couples had started living with their parents. Some farmers also migrate to other areas in search of farmland. Even under such circumstances, farmers kept on integrating crop and livestock farming even in the face of declining farm sizes, instead of specializing into crop or livestock farming. In Deder district, it is hard to find households with no livestock, and on average farmers owns 2.21 TLU of livestock and 0.8 ha of cultivated land per household. In this district, one could also find some landless farmers rearing livestock, using feed resources they produce on leased in plots. It is also worth noting that in all districts the percent decline in livestock holdings was generally much lower than the percent decline in land holdings (Table 4).

Table 4. Percentage decline in average land and livestock holdings in relation to districts and well-being groups (n = 225)

	Variation in holdings (%)				
	Land	CU	Sheep & goats	Donkeys	TLU
Variation across districts					
Between Gursum and Kombolcha	-29.5	-10.4	-4.7	14.6	-8.6
Between Kombolcha and Deder	-32.5	-26.1	-27.2	12.8	-22.7
Between Gursum and Deder	-52.4	-33.8	-30.6	29.3	-29.4
Variation across well-being groups					
Between WTD and MDM	-26.5	-43.9	-23.5	-44.2	-42.8
Between MDM and POR	-1.0	-37.1	-27.8	-51.2	-37.0
Between WTD and POR	-27.2	-64.7	-44.8	-72.7	-64.0

Donkey holdings showed even an increasing trend with declining land holding. As socio-economic status improves, the relative increase in livestock holding per household was also higher than that of landholding.

Intensification through livelihood diversification and sub-system integration

Non-agricultural activities become increasingly important livelihood strategies

Key informant interviews, field observations, and findings of the questionnaire-based formal survey showed that non-agricultural income generating activities were important elements in the livelihood systems of farmers in the Harar Highlands. It appears that farmers' involvement in non-agricultural activities increases with rural population density. In 31%, 53%, and 62% of households in Gursum, Kombolcha and Deder woredas respectively, at least one member of the family was involved in non-agricultural activities. The major types of non-agricultural activities in which farmers were engaged can be grouped into five categories: (i) working as casual laborer on other farms or for cutting and packing Khat for markets and in some cases for transporting contraband goods (backpacking or using donkeys); (ii) petty trading of Khat (in villages and nearby towns) and other items (in kiosks); (iii) self-employment as carpenter, technician, broker, religious school teacher, traditional healer, *etc.* or being hired by others for such skills; (iv) renting out tractors or machinery such as motor pumps and pipes for irrigation; and (v) other activities such as engaging in handicraft, becoming local government official, as militia, *etc.*). Most of the non-agricultural activities are associated with the marketing of Khat and the cross-border commerce (both of which are likely to be affected by changes in Government policy while the third category that relies on self-employment is still under-developed due to lack of support and limitations in skills farmers have.

The khat-livestock interaction

As khat harvested from plots fertilized by manure fetches higher prices, farmers' demands for manure grew over time (Kassa, 2002). Given the upward demand for manure and greater opportunities for regional trade, the need for keeping livestock on-farm (own or leased) probably increased in recent times, although long-term farm level data are lacking to substantiate this. Livestock ownership should not be equated to the number of livestock physically present per farm in the Harar Highlands, which has in fact declined as land area per household has been decreasing overtime (Poschen, 1987; Adinew, 1991). Declining farm size and expanded allocation of land for Khat reduces feed supply for cattle but boosts demand for manure. This has led to widespread contractual agreements between farmers; those who have the labor and feed but lack the capital to buy will take cattle on lease from those who have more cattle than they could feed. This leasing of livestock helps both parties to match their available resources and generate more income and produce manure. As a result, in what is another kind of intensification through crop-livestock integration, Khat and livestock in the Harar Highlands have become important components of the livelihood system. But livestock roles are shifting from being sources of food and power to plowing to providers of cash income (e.g., livestock fattened primarily for the export market), organic fertilizer (manure), and transport services. The implication of this for research is that instead of maximized single output (e.g. milk) per animal, multiple livestock outputs would be more appealing to farmers. Any interventions to influence the dynamics of the livelihood system should consider crop-livestock integration (complementary and competitive relationship between grain land, Khat land, and pasture land), the growing importance of Khat and livestock and their influence on relative attractiveness of land for different uses, the role of markets, and the growing importance of non-agricultural activities on household income (Figure 5).

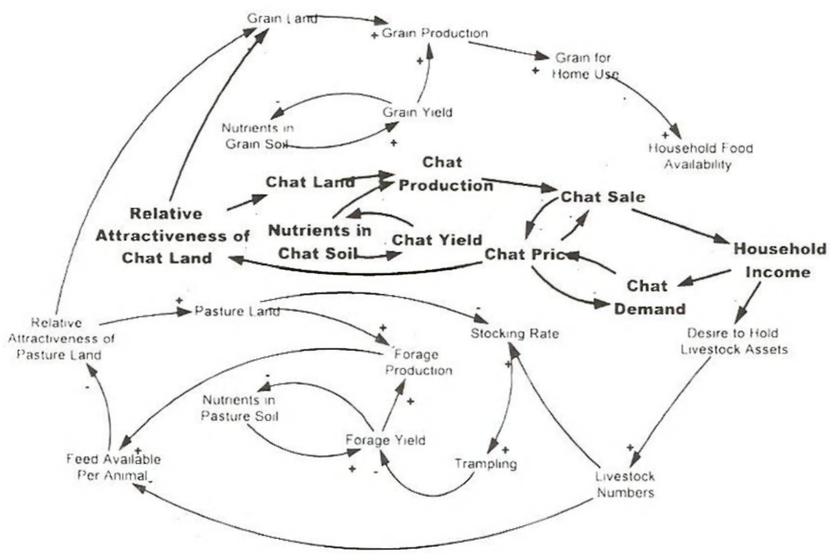

Figure 5. The Crop-livestock system model indicating the role of Khat in the system (Source: Kassa *et al.* 2002).

The crop-livestock model shown above depicts the relationships and feedback loops associated with khat farming. For instance, an upturn in demand for khat leads to a higher price, which in turn increases the attractiveness of land in khat. Besides, improvement in household income increases the desire to have more livestock. A balancing loop also develops. Increase in the volume of Khat sales reduces Khat price. Another impact of increase in the attractiveness in land for Khat is a decrease in land used for grain production, and a reduction in the availability of food for the household. Understanding these relationships is a prerequisite to design intervention options that will be acceptable to farmers (Kassa *et al.*, 2002; Kassa, 2009). We need to emphasize the fact that smallholder farmers often respond to the challenges of resource limitations and increasing household demands with a strategy of intensification through integration, and in ways that are different from that of the policymakers and NGO experts (as reflected in the Involution or Specialization Thesis). Theirs favors crop-livestock integration and diversification into non-agricultural activities. As noted above, such decisions are generally based on available resources and production objectives of farmers and their expectations of policy, weather, production, markets or prices, and income (Figure 6).

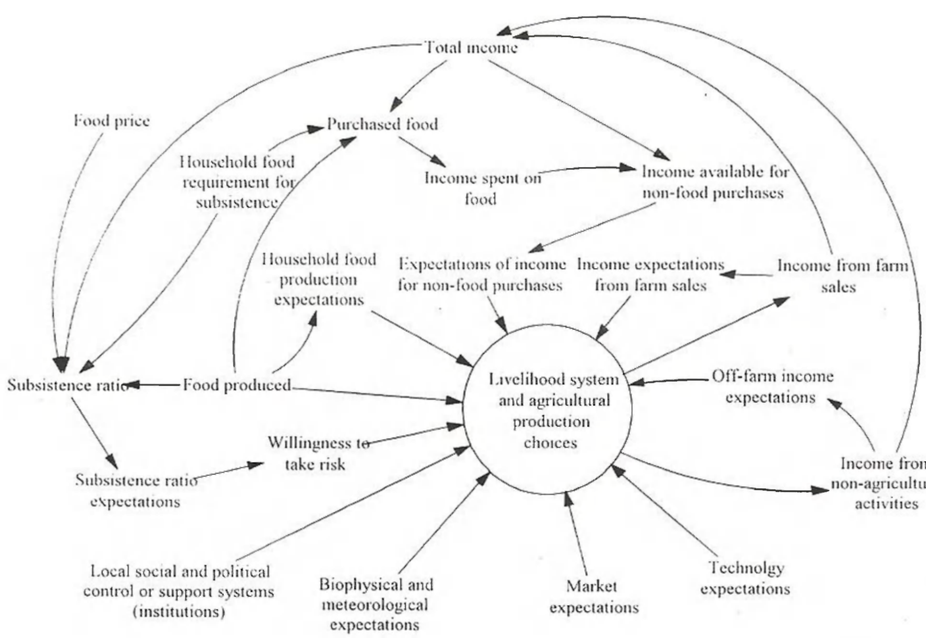

Figure 6. Adaptive expectations of farmers while making production systems choices and management strategies (Source: Kassa *et al*, 2002).

These factors that farmers take into account while making decisions are seldom fully understood by researchers and development planners. Inadequate understanding of resources at farm level and farmers' circumstances and production objectives results in conflicts between mental models: what policy makers and development practitioners suggest and what farmers do, signaling misunderstandings about the crucial importance of interactions that govern farmers' behaviors and changes in their livelihood strategies (Kassa *et al.*, 2002).

More than any other agricultural commodities, khat production has given rise to a fast, efficient market and transport services with a daily flow of price and supply information between producers and the consumer and export market (Adinew, 2005). In recent years, khat export from Ethiopia expanded rapidly beyond the neighboring countries and reached markets in Europe, USA and Asia. Though the cultivation, domestic consumption and export volume of khat has been increasing particularly during the last two decades, no systematic survey has been conducted to estimate the actual expansion, the volume and value of both the export and domestic markets, and to evaluate the short term household and local level economic gains with long term societal costs. Even worse is the lack of country level strategy and an institutional approach to gathering relevant data about the khat culture and generating information that will be used to informing public debate and policy formulation. As a result, production and consumption of Khat and the resulting market chain is growing as an industry by itself with limited or no interest and capacity to managing its trend both at country and international levels. Thus, in concrete terms, little is known as to how best to manage the trend and reduce the associated risks to producers and traders of depending on a single commodity.

Even though the long-term scenarios must be carefully studied, livelihoods in the Harar Highlands have evolved in reasonably positive ways in terms of household income during the past three decades. But as the khat-based household and regional economy is dependent on the export market, any import ban will have a devastating impact on the livelihoods of many in the Harar Highlands. Its impact on the national economy will also be significant. Thus comprehensive studies are needed to study consumption patterns and to identify options where the cash earned from the production and marketing of Khat can also be invested and the regional economy diversified.

Conclusion

Crop-livestock interactions characterize tropical mixed farming systems; and intensification through further integration of the crop and livestock sub-systems and adopting available non-agricultural livelihood options would continue to be important in many developing countries where infrastructures are under-developed and market failures are common. The Harar Highlands of Ethiopia are among the most populated and risk-prone highland areas of the country. An average livestock holding in the Harar Highlands stands at 2.74 TLU, while the average landholding is 1.2 ha per household. The number of cattle, sheep and goats declined significantly with increasing rural population density, while the number of donkeys showed an upward trend. Nevertheless, the number of ruminants and donkeys per hectare of cultivated land grew with increasing population density. In Deder district, which represents the highest population density in the Harar Highlands, some farmers reported that they had already stopped further division of lands for their sons, and their newly married couples are forced to live with their parents. Even in such cases, farmers kept on integrating crop and livestock farming, and on average a farmer owned 2.21 TLU of livestock on 0.8 ha of cultivated land. This confirms that instead of specializing in crop or livestock farming, farmers will continue integrating crop and livestock farming even when farm sizes decline.

The trend of keeping livestock while landholdings decline is not in line with the expectations of the Involution or Specialization Thesis. The findings of this study suggest that the general belief that livestock will be squeezed out of the farming system as landholdings decline does not seem to be holding, as MFS would evolve in response to changing conditions. In conclusion, the Involution or Specialization Thesis is less likely to be applicable to the Harar Highlands of Ethiopia, at least in the foreseeable future. Likewise, the intervention options that are being promoted with the assumption of the thesis need to be carefully examined if need-based research and extension support is to be provided.

Thus, attempts to promote smallholder agriculture must begin with the understanding of farmers' circumstances and survival strategies. In response to changing biophysical, demographic and socioeconomic environment and the growing demand for Khat, farmers in the Harar Highlands shifted towards Khat-livestock integration. As Mulatu and Kassa (2001), Kassa (2009) and Assefa *et al*, (2009) concluded, in the absence of feasible economic alternatives and given demographic pressure and resource limitations, the current evolutionary pathway of the farming system towards a Khat-dominated farm economy was unavoidable. Despite its reported negative effects on health and other social aspects, Khat continues to play important economic and possibly ecological roles for farmers in the Harar Highlands of Ethiopia. Thus, the importance of Khat production and marketing in increasing cash income and in improving household food security of the poor cannot be over emphasized. Khat has been and will continue to play significant role in the livelihood dynamics of people in the Harar Highlands for the foreseeable future.

According to (Wibaux, 1986), Klingele (1998), Mulatu and Kassa (2001) and Adinew (2005), the major factors that contributed to khat-based agricultural economy in the Harar Highlands included growing local and export markets, fast and efficient marketing and transport services, shrinking farm size, declining soil fertility, adaptation of khat to the ecological conditions (the hardy characteristics of the plant to withstand drought and frost, and disease and insect problems), and the low labor and input requirements for its production. The return per hectare of Khat is the highest of all crops in the region (Kassa, 2009). Despite the economic importance of the crop at household and at national levels, research on khat culture remains scanty. The overall socioeconomic aspects of the production, marketing, and consumption of khat must be studied and presented in a systematic way to assist the Government, communities and other stakeholders to make informed decisions (Assefa *et al.*, 2009).

To conclude, addressing the challenge of agriculture in Harar Highlands requires studying the long-term trends in the evolution of agricultural and livelihood systems, especially in terms of their limits and potentials for enhancing human welfare. Interactions among the major sub-systems must be well understood. As the livelihood system is evolving in a more complex way, understanding multiple interactions among key elements of the livelihood system is necessary to come up with acceptable intervention strategies. Unless these are understood and factored in the planning process, research, extension and development efforts will continue to mismatch with farmers expectations and national interests. For countries like Ethiopia, as Kydd (2002) remarks, the dynamics of smallholder agriculture ought to be a central question for research and debates about development. Better understanding of the factors governing long-term behavior of agricultural systems, has both scientific and practical importance in poverty alleviation (Vosti, 1995). It facilitates making informed decisions about the intensification of production systems in ecologically and economically viable ways (Saeed, 1994; de Haan et al., 1997; Sterman, 2000; Nicholson *et al.*, 2001).

Thus, through critical examination of the involution-specialization thesis using a typical case study, it is hoped that this study helps in stimulating individual researchers and awakening institutions mandated for agricultural development in Ethiopia to reconsider the long-standing belief around this thesis. The authors recognize the need for specialised farming to produce more and meet the growing demands. But specialization will succeed only when resources such as land and capital would allow mechanization and ensure economies of scale and where biophysical and technical constraints of production and marketing risks are minimal. As a result, the notion that farmers take up specialization or face involution with shrinking farm size due to population pressure could not come out in Harar Highlands of Ethiopia as this study clearly illustrated. Thus intensification through further integration of farm and non-farm enterprises is the way that farmers follow. This must be recognized, studied and assisted. Stakeholders, such as policy makers, government agencies engaged in agricultural education, research and extension, NGOs, agro-industries, and donors need to recognize this trend and must cover extra miles to ensure that their work and support are relevant to smallholders farmers and their families that constitute the largest share of the Ethiopian people. We all must join hands to come up with an integrated approach to help farmers further intensify their farming systems in sustainable way so that their vulnerability is reduced and their adaptive capacity strengthened to cope with socio-economic, ecological and environmental eventualities.

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