

# livestock Xchange



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## Smallholder competitiveness and market-driven technology uptake

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Smallholders can capture opportunities presented by increasing demands for livestock products due to growing populations, incomes and urbanisation. This is only feasible if smallholders remain competitive. The dominance of smallholders among livestock producers, supplying at least half of total supply of livestock products in our target regions, is strong. This is particularly true in ruminant production (beef, small ruminants and milk) and remains the case in developing country pig and poultry (see Figure 1).

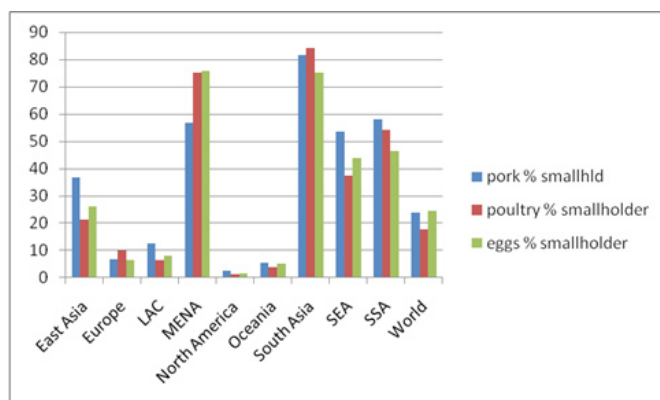


Figure 1. Percentage of pork, poultry and egg production (tonnes) from smallholder systems. Source: ILRI estimates.

However, a prominent group of stakeholders, led by FAO (FAO State of Food and Agriculture, 2009), have already announced the impending death of smallholder livestock systems, regardless of the evidence. At ILRI we are loyal to the evidence, which shows that smallholders will play an important role for decades to come. A number of factors underpin this (see Box 1). Constraints to smallholder competitiveness however still pose challenges. These include rising feed prices, animal disease risks, volatility in output market prices, and increasing demand for high quality products. There are also enormous productivity gaps in smallholder production systems – ranging from 65% to over 300% of observed production in sub-Saharan Africa dairy systems. There are clear opportunities for significant gains in efficiency and performance (ILRI 2009).

The question is: in the context of dynamic markets and technology environments, how can smallholders improve efficiencies and remain viable suppliers of livestock products? Further, how can public policies and investor choices better reflect the clear evidence of the importance of smallholder producers both for supply and for rural livelihoods?

## Box 1. What is smallholder competitiveness and what underlies it?

'Smallness' is seen as the main challenge to smallholder competitiveness, primarily their inability to capture economies of scale. There is widespread perception that small, while 'beautiful', is not efficient. The Economist article on 'The Miracle of the Cerrado' (<http://ilriclippings.wordpress.com/?s=cerrado>) typifies the perception that large scale agriculture is the most efficient way to produce food. Economies of scale occur when larger farm or enterprise sizes allow mechanisation or other processes that replace high-cost labor with equipment, enable greater market positioning to attract high quality and reliable services, and increase bargaining power in markets. These reduce unit costs and raise net returns to production. However, economies of scale are predicated on several factors namely: a) relatively high cost of labor, b) all inputs and resources used are costed at full market value, and c) the only benefits to the enterprise are market-generated through sale of product or service. These are imbedded in any 'enterprise model' of production based on simple profit motivation – a single objective.

As is demonstrated in a number of ILRI studies, all three of these factors typically do not hold true in most smallholder farms. Labor is often the lowest cost and most available resource, family labor and local feed material are typically not fully costed, and, because the livestock enterprise is part of a farm-household, other benefits are captured in addition to the simple cash from sale of product. These include financial benefits from keeping livestock assets, manure for improving soils, animal traction, and sometimes social benefits. Given these conditions, there are rarely any economies of scale - a larger enterprise means hiring labor and buying feed – raising unit costs of production. This is a typical 'household model' of production – multiple objectives (not just profit), and multiple benefits (not just cash). For detailed comparisons of enterprise versus household livestock production models, see Staal et al, 2008.

How is this 'competitiveness' demonstrated in practice? Unit costs of, or returns to production are an important indicator, as demonstrated by the work of the International Farm Comparison Network on dairy (<http://www.ifcnnetwork.org>) which compares farm enterprise data globally, including from North America, Europe and other dairy exporters. The IFCN found that small Ugandan dairy farms had the lowest unit costs of production in the world.

However, unit costs are not the full story. They may overestimate local resource costs, and typically cannot value the other benefits to the 'household' model. The clearest indicator of competitiveness is simply whether small farmers are still operating and producing, and continue to do so even when feed and other costs rise. When factors change, particularly when labor costs rise and rural populations shift to other enterprises, we see small farmers either scaling up or shifting to other enterprises. Then we know that they are no longer competitive. While small farms dominate production, as is currently the case in many livestock systems, we know they are currently competitive. However, they operate in a dynamic environment and research is required to allow small farmers to continue to improve if they choose that pathway.

The research issues point to the need for a) identifying and better targeting options to improve productivity, enhance efficiency, and sustain viability of smallholders and b) generate more and more systematic evidence of smallholder competitiveness and factors underlying it.

### *Smallholders compete strongly against all comers*

Following are some summaries of studies that demonstrate smallholder competitiveness in livestock production. These notably cut across systems and species, including monogastrics where the public perception of smallholder inefficiency is greatest.

*Improving competitiveness of pig producers in Vietnam:* ILRI research<sup>1</sup> with collaborators in Vietnam shows that

strong demand for fresh (not processed) pork and relative efficiencies gained from cost-effective feeding options will likely sustain smallholder competitiveness in pig production. Relatively lower cost/unit of output in household pig producers with small herd size (1-2 sows or less than 15 heads) compared to those with larger herd size (greater than 4 sows or 40 heads) was observed (except in the case of piglet production). This translates to gross margins per kg liveweight of slaughter pigs produced ranging from \$0.23-0.48 among small and medium scale, compared to \$0.29-0.38 for large scale in our sample of household pig producers<sup>2</sup>, suggesting that small producers are no less efficient than large producers. Smallholder

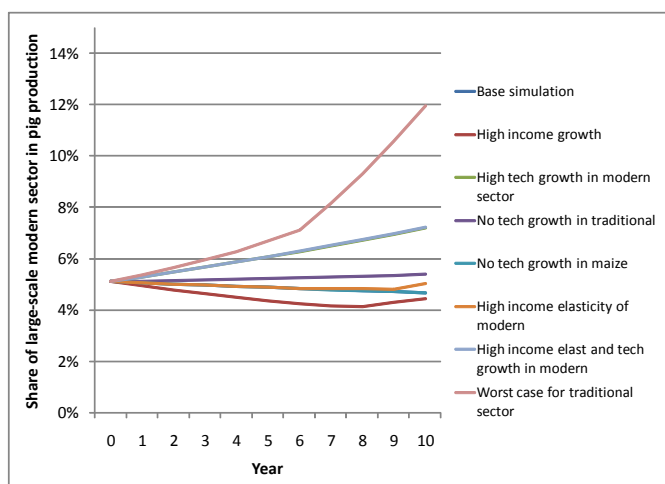
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Producers in an Adjusting Vietnam Market in collaboration with Center for Agricultural Policy-Institute of Policy and Strategy for Agriculture and Rural Development, International Food Policy Research Institute, University of Queensland, and Oxfam.

<sup>2</sup> Based on exchange rate of US\$1=19,000VND at the time of surveys. Differences in gross margins across scale in fattening and full cycle production were not statistically significant.

<sup>1</sup> ACIAR-funded project on Improving Competitiveness of Pig

competitiveness comes from utilizing feed resources that would otherwise be unused or underutilized. Use of own-produced and other low-cost locally available feed resources generates efficiency among smallholder pig producers. They are also less reliant on feed imports in comparison with large-scale pig producers. With these cost-effective feed options, smallholders are more able to cope with volatility in feed market prices, hence creating efficiencies in smallholder systems.



**Figure 2.** Projected share of large-scale pig production in the next 10 years, estimates from Vietnam pig sector model. Source: Pig sector model estimates from ACIAR-funded project on Improving Competitiveness of Pig Producers in an Adjusting Vietnam Market.

Additionally, macro analysis indicates that smallholders will remain the significant suppliers of pork in Vietnam for the foreseeable future. Projections from a pig sector model in Vietnam (Minot et al. 2010) show that even in the worst case scenario of no technology improvement in smallholder, traditional pig systems, only 12% of total output will come from large, industrial pig systems (see Figure 2). For as long as smallholders remain competitive in supplying pork demanded by Vietnamese consumers, there is great potential for them to sustain their significant share in the market.

Our study shows that smallholder household pig producers receive at least half to two-thirds share of the retail price of fresh pork; this suggests fairly strong competitive presence in the fresh pork market. Strong demand for fresh, unchilled pork by Vietnamese consumers will

keep domestic producers competitive vis-a-vis imported pork; that is, chilled and/or frozen imported pork is not a perfect substitute for fresh, unchilled pork. Furthermore, due to the lack of economies of scale in household-based pig production (with the exception of piglet production), efforts to promote large scale pig production may not necessarily improve overall efficiency of the industry.

*Smallholder dairy in contrasting Kenyan systems:* We know that smallholders operate in a wide range of settings and farming systems contexts, with some of the most important variability determined by land holding size, and agro-climatic conditions such as rainfall and temperature. These determine availability of feed resources. They also significantly influence the level of challenge from animal diseases. To better understand dairy farm performance variation across systems, the Smallholder Dairy Project (SDP) conducted a study in three contrasting zones (SDP 2004a):

- Kiambu: very intensive, small farms of less than 1 ha, exclusively stall-feeding
- Nakuru: medium intensity, larger farms of several ha, mix of grazing and stall-feeding
- Nyandarua: low intensity grazing on sizable pasture, herds of less than 10 dairy animals.

From a group of 21 representative farms, detailed production, labor, sales and purchase data were collected twice weekly over a period of 14 months. Analysis of cost of production and profitability showed that farms in all three systems demonstrated strong profitability. They achieved that through different strategies: The intensive Kiambu farms spending most on feed, the largest cost for the least intensive Nyandarua farms was labor. Profits ranged from 28% of revenue in the least intensive farms to 19% of revenue in most intensive Kaimbu farms (Figure 3). It is important to note that these are all *above-normal profits*, meaning that they are in addition to the normal returns to labor which already costed in the analysis. These results demonstrate not only the ability of smallholders to be consistently profitable in contrasting settings, but explain why Kenya's dairy industry is dominated by over 1 million small farmers, while large scale industrial dairy farms remain only a few dozen.

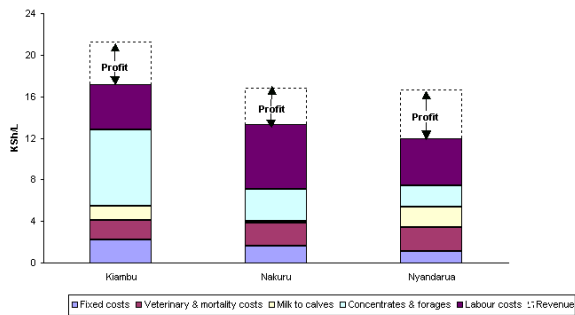


Figure 3: Cost composition and profitability in contrasting Kenyan dairy farms.

*Non-market benefits provide an extra advantage:* Smallholders are also able to capture benefits additional to those from sales of product. Another SDP study surveyed 250 smallholder dairy farms in the same region as the above study, again contrasting intensive, semi-intensive and extension production systems (SDP 2004b).

The focus was on using innovative combination of contingent valuation and econometric techniques to capture the key non-market benefits of dairy production, particularly: The financial value of cattle, which is their savings function, and accrues at the time of sale; the insurance value of cattle, which is their ability to be sold for cash in case of a financial emergency, and accrues every day the cattle are kept; the value of manure in crop production; and in a few cases, the use of cattle for draught power. The results show that these benefits comprise an additional 16% to 21% of value to the producer on top of the market-derived benefits, significantly increasing their ability to produce viably even if market conditions deteriorate.

*Economies of scale in smallholder dairy and poultry in Kenya:* Not only are smallholders profit efficient in dairy and poultry production, but there is little evidence of economies of scale in production. Stochastic frontier analysis of data from Kenya (Omiti et al, 2007) shows that while inefficiency significantly contributes to reduced profitability in dairy and poultry production across all scales, profit efficiency is scale neutral. That is, scale has no effect on efficiency in profitability, suggesting that smallholders are no less efficient in generating profits than their large-scale counterparts. This implies that there is no eminent danger that smallholders engaged in dairy and poultry will be squeezed out of the market for milk and eggs in Kenya. Horizontal coordination through

cooperative societies (whose main functions include marketing and procurement of inputs and services for farmers) enhances efficiency in dairy production. Those dairy farmers who also engage in commercial layers production realize higher efficiency in their milk production activities by using poultry waste as feed for cattle. The underlying factors remain those described in Box 1: Larger producers depend more on purchased inputs and labor compared to smaller producers who depend on farm-household resources. Not only are smallholders profitable, they are just as profitable as larger producers.

## Market-driven technology interventions to increase competitiveness

Smallholder competitiveness can be enhanced through improved technologies and access to these, and market incentives among others drive their effective technology adoption. For some years ILRI has analyzed the factors driving uptake of technology to improve competitiveness; it has also piloted interventions to accelerate that process.

*Integrated farm and spatial analysis to identify uptake factors:* Research in the SDP project applied new econometric tools that combined farm survey data with GIS data to more closely reveal the determinants of improved technology use. Data from random surveys of over 3300 rural households in Kenya that focused on dairy, were integrated with several GIS layers, including agro-climate, access to market and human demographics (Staal et al. 2002). GPS readings for each household allowed separate GIS-derived measures of each of these layers for individual households. These tools were then used to quantify the factors influencing farmer decisions to employ three improved dairy technologies: High-grade dairy cattle, planted fodder, and purchased concentrate feeds.

Results show that level of education of the household head is a very strong determinant of improved technology use, as expected, but sex of household head is not correlated. This indicates that women-headed households are no more impeded from improved dairy technology than male-headed households, an important result underlining the gender-neutral opportunities in dairy. Land holding size is not strongly associated, even with keeping of dairy cattle, which is contrary to common thinking

among many dairy development agents, and indicates that even small land-holders can employ improved technologies. Importantly, the market access factors derived from GIS are very significantly associated with technology uptake. An additional kilometre of feeder road between farm and collection centre reduces probability of dairy cattle uptake by 0.6 percent, so that the tens of additional kilometres that separate some farms from the centres can be expected to reduce uptake dramatically.

Differentiating spatial effects for market access allowed predictions to be made as to policy interventions, such as predicted positive change in probability of adoption of Napier cultivation with simulated upgrading of all-weather roads to tarmac roads (Figure 4). This research points again to the strong underlying ability of smallholders to use improved technology. These new tools allow better targeting of technology interventions as well as predicted outcomes from policies and investment.

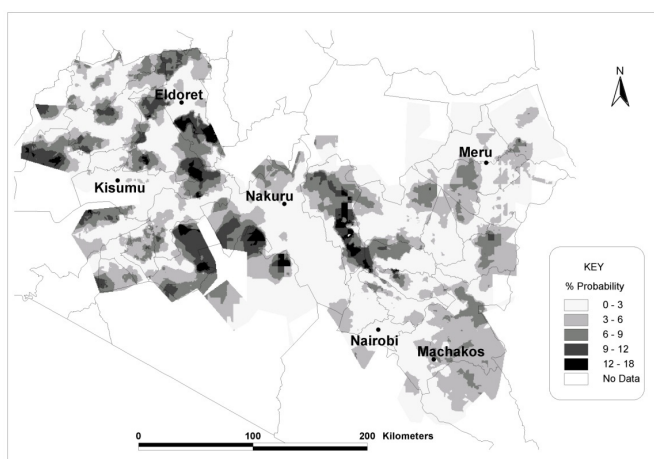


Figure 4: Map of predicted positive change in probability of adoption of Napier cultivation with simulated upgrading of all-weather roads to tarmac roads, based on parameter estimates of GIS-derived variables.

*Improving productivity in sweet potato-pig systems in Sichuan:* ILRI research<sup>3</sup> with collaborators in Sichuan on sweet potato-based feed technology addresses one key constraint in smallholder sweet potato-pig systems, i.e., the seasonal crop shortages that result in fluctuating availability of feed supply to sustain the pig herds. It is estimated that about 6.77 million households are in sweet-potato pig systems in Sichuan, of which some 1.46 million are poor (Huang et al. 2003). These are the

potential direct beneficiaries of this feed technology. Research shows that sweet potato-based feed technologies can generate positive impacts in terms of higher output (2-7 more heads of slaughter pigs produced/year) and/or lower cost/unit output that results to average gross margins of 2-4 Yuan/kg liveweight output sold. These translate to economic benefits and better livelihood opportunities for smallholder pig producers. Sweet potato-based feed technologies provide low-cost feed options, allowing smallholders to accumulate assets through increased herd size, facilitating their transition to more market-oriented pig production (through increased marketable surplus from production). With increasing demand for pork, opportunities are strong to fill the supply gap.

*Improving the productivity and market success of live-stock producers in Ethiopia:* The IPMS project in Ethiopia shows that addressing constraints related to capacity and input and output marketing can enhance smallholder competitiveness. Diagnostic studies identified the key constraints for the development of market oriented live-stock production, namely, capacity constraints related to feed production and animal management, and market constraints related to thin or non-existent input markets, and highly inefficient output markets.

The project sought to improve competitiveness of smallholders through technical capacity building, knowledge development and collective marketing. Using a propensity score matching (PSM) method, a study in a pilot learning district in south western Ethiopia showed that the IPMS approach resulted in 20% higher sheep off-take rate and higher input use intensity. Encouraging results of the IPMS approach were also observed in the development of market oriented dairy and cattle fattening. Numbers of market oriented dairy producers in various IPMS operation districts doubled or tripled. The change in the number of households involved in cattle fattening was even more spectacular, with growth rates of up to 400%.

The IPMS experience shows that participatory identification of key value chain constraints followed by appropriately designed interventions raises the potential for impact.

3 Asian Development Bank-funded project on Improving Productivity of Crop-Livestock Systems in Rainfed Areas of Southeast Asia and South China (CASREN) implemented in five countries in the region (Indonesia, Philippines, Thailand, Vietnam, South China (Yunnan and Sichuan)).

## Conclusions

Sustaining smallholder competitiveness means defining where opportunities to enhance efficiencies can be tapped and viable options identified and tested. Improved technologies in feed, breed, and animal health are critical to transform subsistence, less efficient systems into more efficient, highly-functioning and better performing value chains for animal-source foods to meet consumer demand. ILRI research has shown that appropriate interventions can lead to desired impacts with potential for scaling up when appropriate policies and institutions are in place to facilitate this process. Rigorous empirical evidence will be necessary to inform the policy debate and generate the desired policy impacts to sustain smallholder competitiveness, as well as to encourage increased investments in research for development. ILRI has the mandate and comparative advantage to take a leadership role here, with opportunities for research and collaborative partnerships presented in CRPs.

Will smallholders remain competitive in the changing landscape for livestock development? The evidence so far shows that many smallholders are strongly competitive, but we know they face dynamic circumstances of changing resource costs, new markets demands, and new technologies. The structural transformation of agri-food systems will create new opportunities but also pose challenges to smallholder viability and participation. New developments in information technology present new opportunities to bring research for development initiatives at the forefront of knowledge generation and management that were not feasible decades ago. ILRI and partners can capitalize on these innovations to build on existing smallholder competitiveness to generate knowledge through research that make a difference to the lives of smallholders.

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*On 9 and 10 November 2011, the ILRI Board of Trustees hosted a 2-day 'liveSTOCK Exchange' to discuss and reflect on livestock research for development.*

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