

Field assessment of rapid market estimation techniques: a case study of dairy value chains in Tanzania

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Abstract

Three rapid market estimation techniques were used to quantify the informal milk market in two Tanzanian municipalities, namely Iringa and Tanga, with reference to producer-based estimates, retailer-based estimates and a stratified consumer survey. The nature of the milk market systems in the two study areas was reflected in the magnitude and dynamics of milk consumption; the informal market was particularly important for a 'subject to deprivation' group in both cases. Producer-based estimates did not account for milk from outside the study area, whereas retail surveys omitted details of the producers' own consumption and their direct sales. Consumer surveys captured the widest variety of informal milk sources but, like retail studies, omitted producers' consumption. Therefore the most accurate rapid estimation of markets for consumable products may be obtained by triangulating producer data with consumer surveys (informal market) and adding reliable (and usually relatively easily obtained) data from processors and retailers to capture trade through formal channels.

Key words: RMA; dairy; rapid market assessment; value chain; poverty

1. Introduction

1.1 Action research on poverty reduction in Tanzania's dairy value chain

The estimation of market size and composition is a primary requirement for the Making Markets Work for the Poor (M4P) approach, inclusive market development, value chain analysis and development, and allied methodologies. Very often, the markets in question have large informal components and are poorly documented, with scarce reliable data. Formal market research techniques are seldom the appropriate means to address this challenge – such services are usually unavailable, or prohibitively expensive and poorly aligned to the development context.

A three-year action research project was initiated in 2011 to study how poverty may be reduced for the participants in dairy value chains in two contrasting Tanzanian municipalities. The objective was to quickly gather key information to inform the design of interventions to upgrade small-scale urban dairy production, examining both formal and informal market channels. In the context of milk, a formal value chain is defined as one whose actors are licensed to handle the product after complying with defined minimum standards of competence in hygienic handling and processing in order to safeguard consumers. This chain is operated with an organised collection system, using well-established mechanisms of bulking (for example, through co-operative societies or agents) and transportation in insulated tankers, after chilling, to factories in which the milk is processed and packaged before marketing.

This paper offers a comprehensive review of dairy development support and the set-up of formal and informal milk markets in East Africa. This review is followed by a brief review of three rapid appraisal methods and a comparison of the results of these methods in the wider context of establishing reliable, rapid and cost-effective research tools for the analytical and diagnostic phases of pro-poor market development projects. The first part describes the importance and market structure of the dairy sector, while the second describes the methodology, including the study area, followed by a presentation of the results and, finally, a discussion of the findings in relation to current practice in market analysis for international development.

1.2 Dairy development support

Studies have revealed great potential for pro-poor growth in the milk sector in East Africa (Jansen 1992; Staal & Mullins 1996). This stems partly from increased investment in small- to medium-scale milk-processing plants by dairy farmers' associations for their own production and that sourced from other producers. In recognition of this potential, there have been concerted efforts to support value chain development within national research systems and through donor-funded projects or programmes. Most of these interventions have centred on the improvement of livestock productivity, enhanced marketing of dairy products and the development of health assurance systems. Evaluation has shown that many such interventions have been limited in their success due to being based upon models derived from industrialised countries, where large-scale production systems, cold-chain pathways and milk pasteurisation and packaging are common, dairy value chains are well co-ordinated and laws and regulations are strictly enforced (Moran 2009; Narrod *et al.* 2009).

It is important to note that dairy value chain interventions in East Africa primarily target resource-poor farmers facing socio-economic and environmental problems that cause variations in milk output and quality. The literature reveals that milk production in these countries cannot be estimated easily owing to the frequent movement of livestock, especially among the pastoralists, and the lack of accurate livestock census reports (Thorpe 1998; Fratkin 2001). Thus, there are few, if any, accurate estimates of the formal and informal milk market size. Kurwijila *et al.* (2006) concluded that informal

channels account for more than 80% of milk marketed in East Africa. This estimate may be conservative – Omore *et al.* (2001) approximated that the informal market accounts for more than 90% of sales in Tanzania, around 83% in Uganda and 85% in Kenya.

Both formal and informal markets source milk predominantly from smallholders (Young *et al.* 2006), with the proportions of output sold into each channel depending largely upon prices offered to the farmers. The variation in supply practices among producers in countries such as Tanzania, where legal contracts between small-scale dairy farmers and milk processors do not exist (Kadigi *et al.* 2013), is likely to be high. East African market liberalisation policies implemented in the 1990s have also influenced marketing patterns. In Kenya, for example, some of the dairy cooperatives that hitherto had been linked to formal channels moved from handling processed to unprocessed milk after market liberalisation (Owango *et al.* 1998; Morton *et al.* 1999). The limitations for estimation of milk market sizes in the region are thoroughly examined in the subsequent sections in order to identify how they may be addressed.

1.3 Rapid market estimation

The increasing emphasis on value for money and results in development projects means that expensive and slow analytical processes are becoming less acceptable and less appropriate. Researchers strive for a balance between, on the one hand, a level of rigor and robustness that permits reasonable levels of confidence in the results and, on the other hand, a degree of efficiency and cost effectiveness that maximises the resources available for interventions.

The approaches to market estimation used in a development context resemble elements of rapid market appraisal (RMA), which is part of market systems research (MSR) used by small and medium-sized enterprises (SMEs) to identify business opportunities and that evolved from participatory rural appraisal (PRA) and uses some of its tools. One of the principles, that ‘optimal ignorance is acceptable’, acknowledges that a complete set of information may not be required, placing the focus upon what information is critical and required for a particular task.

Fleming (1990) holds that MSR has five functions – i) to anticipate and create changes in demand, ii) to shift the supply curves for marketing services downwards, empowering a number of non-specialists to become knowledgeable in market research, iii) to improve market information, iv) to diagnose and change structural components in market systems, and v) to improve inter-industry linkages. These objectives are still closely aligned with current research and capacity-building needs in agricultural development.

1.4 Rapid appraisal and action research

Rapid appraisal techniques lend themselves well to action research, which takes a practical, participatory approach and addresses issues of pressing concern (Reason & Bradbury 2001). Action research approaches are often regarded as interpretive, rather than positivist, although traditional objectivist methods and action research are frequently used to complement one another (Popplewell & Hayman 2012).

2. Methods

2.1 Study areas

The study was conducted in Tanga City, Tanga region, on Tanzania's northeast coast, and in Iringa Municipality, Iringa region, in south-central Tanzania (Figure 1). Milk-collection centres organised by farmer groups are well developed in Tanga, where the Tanga Dairy Development Programme (TDDP) has been supporting the Tanga Dairies Co-operative Union (TDCU), an apex organisation of 10 primary co-operatives in five districts, to promote the joint marketing of milk produced by small-scale dairy farmers to Tanga Fresh Ltd, the country's largest milk processor.

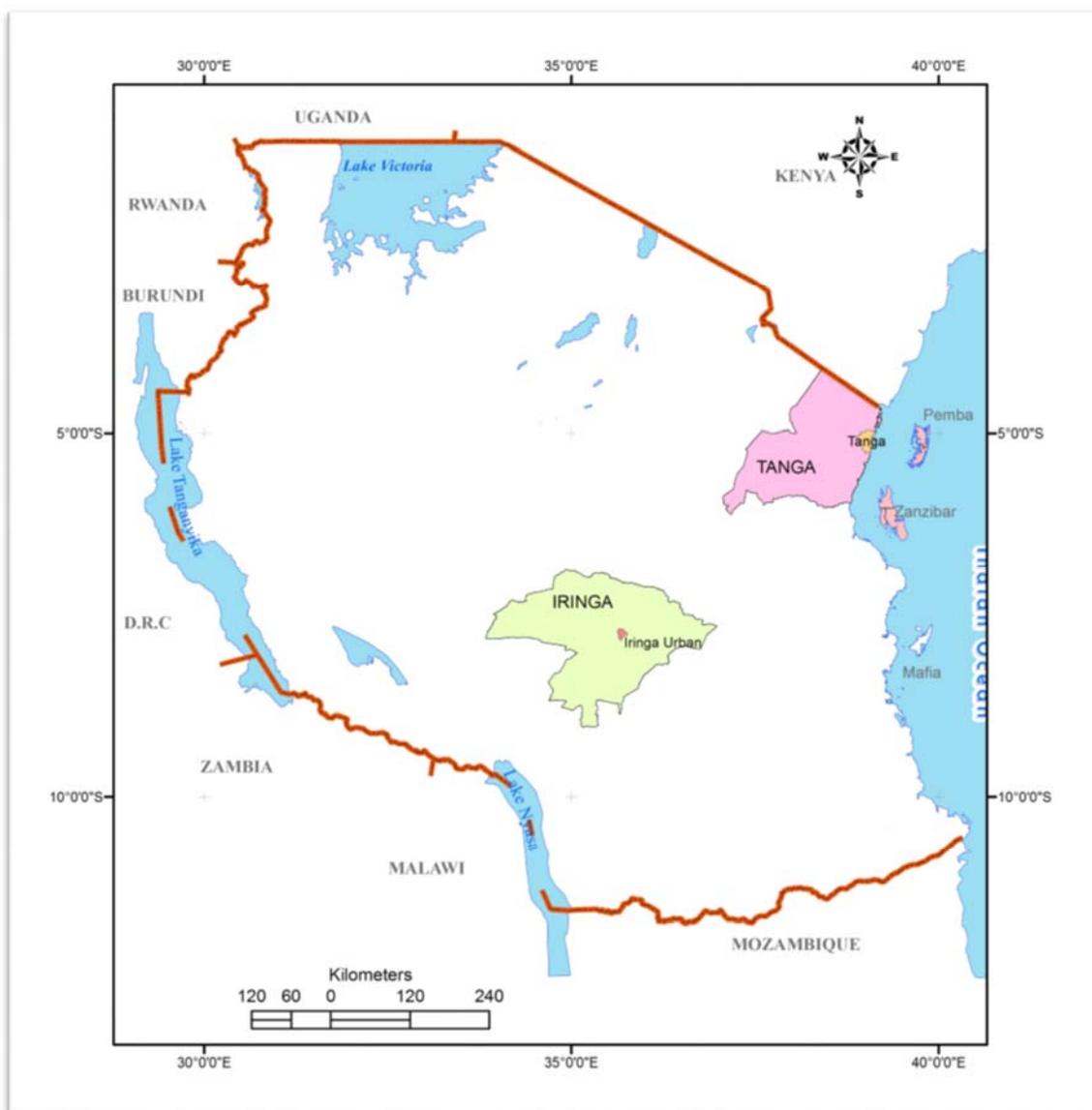


Figure 1: Map of the Iringa and Tanga study areas in Tanzania

In contrast, processors in Iringa Municipality, dominated by ASAS Dairies Ltd, have established their own milk-collection centres. However, the bulk of the output is still sold through informal channels, in which the producer price is roughly double that offered by the processor, despite this practice officially being outlawed by legislation prohibiting the sale of unprocessed milk. The two cases are typical kinds of marketing arrangements found elsewhere in Tanzania.

Ten wards that were actively involved in dairying and milk marketing were purposively selected. In Tanga City, these were Nguvumali, Mzizima, Tangasisi, Pongwe and Makorora. Those from Iringa Municipality were Mtwivila, Gangilonga, Kitwilu, Mwangata and Isakalilo.

2.2 Data collection and analysis

As part of this process, a value chain analysis was performed in each study area. Due to the absence of reliable data in milk marketing, particularly in the informal channel, we estimated market size using three different datasets – producers' estimates, a survey of retail outlets and a consumer survey – for triangulation purposes. The purpose was to pinpoint what is captured and left out in each of these methods, and the implications of such omissions on the estimates obtained.

The formal market in each case was well defined by information from processors on their outputs and distribution patterns. In addition, we used three methods to estimate informal market size: a) producer estimates of supply volumes, b) a retailer survey, and c) a consumer survey. Our aim was to triangulate these three datasets in order to establish the approximate bounds of consumption.

Microsoft Excel was used for the process of extrapolation of the sample data to the estimated whole populations, as described below.

2.2.1 Producer estimates

Data were collected from November 2011 to February 2012. The sample size was established using the formula developed by Fisher (1998). Combinations of proportionate and systematic sampling techniques were used to select respondents. The list of farmers, comprising names of all dairy keepers in the respective wards, were obtained from ward extension officers and served as a sampling frame.

Each respondent completed a questionnaire reporting on details of their seasonal milk output, indicating its quantity and destination. The supply of milk to the informal market was estimated as the sum of quantities channelled to five alternative outlets within the informal market: neighbours; restaurants and hotels; local institutions (for example schools and colleges); informal food shacks (migahawa); and street hawkers/vendors (Equation 1.):

$$\mu_i = \frac{1}{p} \left(\left(v_i \sum_i \bar{c}_i + n_{ij} \sum_{j=1}^5 \bar{x}_{ij} \right) + \left(m_i \sum_i \bar{h}_i + d_{ij} \sum_{j=1}^5 \bar{y}_{ij} \right) \right) \quad \forall i = 1, 2, 3, \dots, N \quad (1)$$

where \bar{c}_i is the average amount of milk consumed at home by farmer i during the wet season; v_i is the frequency of consuming milk during this period; \bar{h}_i is the average quantity of milk consumed from own cows during the dry season; m_i is the frequency of consuming milk during this period; n_{ij} is the number of days the farmer sold milk to market j , while \bar{x}_{ij} is the average amount of milk sold to this market during the wet season. Similarly, d_{ij} and \bar{y}_{ij} represent the frequency of selling milk and the average amount sold to different informal channels during the dry season respectively. Finally, p represents the portion of dairy farmers in this population, and μ_i is an estimate of milk from small-scale dairy farmers channelled to the informal market.

2.2.2 Retailer estimates

A representative sample of milk outlets was surveyed in both urban centres. These included formal small retailers (kiosks), mini-markets and supermarkets, a range of hotels and restaurants, informal food shacks (migahawa) and street hawkers. Each business supplied details of its average seasonal milk consumption, along with the origin and its utilisation of the milk. Sample estimates were extrapolated to the whole population of each business class using frequency figures from municipality

records. An indicator of unprocessed milk from each of the milk retail categories was estimated as an algebraic sum of litres of unprocessed milk from all possible sources (Equation 2):

$$\mu_2 = \frac{1}{p_r} 52 \sum_{i=1}^j \bar{q}_{ijk} \quad (2)$$

where μ_2 is an estimate of informal milk market size (litres/annum); p_r is the proportion of a retailer's category (percentage of the total for that retail group), taking into account the scale of operation/size of the business (e.g. small-, medium- and large-scale retail), and \bar{q}_{ijk} is an average weekly volume bought from source i by a retailer within category j , whose scale of operation is k , to be supplied to different groups of consumers within the informal market. To ease exposition, the retailers considered and respective notations for i, j and k are given in Table 1.

2.2.3 Consumer estimates

A sampling frame of urban consumers was constructed to capture a representative sample, including both individual and institutional buyers (schools and orphanages). Individuals were grouped into three main socio-economic classes – poor, middle class and better off. A multidimensional poverty index (MPI) was used to classify consumers into these socio-economic classes following Alkire and Santos (2010) and Alkire and Eli (2010). This index was computed after identifying and weighting indicators that are related to health (child mortality and nutrition); education (years of schooling and children's school attendance); quality of housing (access to electricity and types of floor); and ownership of assets (radio, television, telephone, bicycle, motorbike, car, truck and refrigerator).

The MPI was required in order to account for variations in milk consumption resulting not only from disposable income, but also from a multitude of underlying factors such as childhood malnutrition; these are indicators of poor uptake of animal-source foods, leading to inadequate nutritional status and higher mortality rates (Ayele & Peacock 2003). Intellectual ability can also shape choices of food and other products. Although there is no consensus on the influence of knowledge (e.g. nutrition knowledge) and awareness factors on food behaviours, many analysts support the view that this knowledge and awareness play a pivotal role in the adoption of healthier food habits (Worsley 2002). Hendel and Nevo (2004) argue that ownership of assets can influence the purchase of perishable products: for example, the optimal strategy for consumers earning low income but owning refrigerators would be to buy more milk when it is cheap to and store it for future consumption. However, consumers without cold storage can fail to time their purchases and to exploit temporal and spatial price fluctuations in the informal milk market.

Interviews took place within institutions, in homes and outside retail outlets. Extrapolation used demographic projections for each town from their respective municipalities. The size of the informal milk market used in this survey was estimated as (Equation 3):

$$\mu_3 = \frac{1}{p_c} 52 \sum_{i=1}^j \bar{C}_{ij} \quad (3)$$

where μ_3 is an estimate of informal milk market size (litres/annum); p_c is the proportion of the consumer category in the population; and \bar{C}_{ij} is an average quantity of milk from source i consumed per week by a consumer within category j .

3. Results

The results (Tables 2 to 7, summarised in Table 8) reveal that the informal market in Tanga is much larger (between approximately one and 2.2 million litres per annum and 6.56 and 10.19 million litres per annum in Iringa and Tanga respectively) – the various sources estimate this magnitude to be around four to 10 times. The former number is most likely to be closer to the truth, given that Tanga's estimated consumer population is 2.4 times that of Iringa, with the tenfold difference most likely a relic of severe underestimation of the market in Iringa in the retail-based survey.

The consumer survey produced the highest estimates in both study areas (up to 2.2 times greater than the lowest estimate). Tanga's smallest informal market estimate was derived from producer data (1.6 times smaller than the largest estimate, derived from the consumer-based study). Retail- and consumer-based estimates were very similar in Tanga, at around 10 million litres per annum.

In all three groups of poverty classifications, those in Tanga consumed more milk than their counterparts in Iringa. In both study areas, the group confirmed as being 'subject to deprivation' consumed the most milk from the informal market. In Iringa, the 'non-deprived' group consumed the least milk from this market, whereas in Tanga the 'deprived' group occupied the position as lowest-volume consumers.

Table 1: Description of retailers included in the retail-based surveys

Source of milk	Retail category	Scale of operation
Small-scale dairy farmers Medium-scale dairy farmers Large-scale farmers Hawkers/vendors	Formal retailers	1 = Small (e.g. kiosk) 2 = Medium (e.g. mini-supermarket)
	Hotels	1 = Small scale (serving continental breakfast) 2 = Medium to big (serving full breakfast)
	Restaurants	No scale/size classification
	Informal food shacks	
Small-scale dairy farmers Medium scale dairy farmers Large scale farmers Other hawkers/vendors	Hawkers and vendors	1 = Small (consumer retail) 2 = Medium (wholesale)

Table 2: Production-based estimates of the informal milk market in Iringa. Estimates are mean and extrapolated annual consumption in litres per sample and estimated populations respectively

Market category	Sample average	Population proportion	Annual volume
Home consumption	328	0.25	19 707
Neighbours	2 184	0.25	131 069
Hotels and restaurants	22 338	0.25	1 340 294
Informal food shacks	3 593	0.19	163 859
Hawkers and vendors	2 685	0.06	38 669
Total	7 057	1.0	1 693 598

Table 3: Production-based estimates of the informal milk market in Tanga. Estimates are mean and extrapolated annual consumption in litres per sample and estimated populations respectively.

Market category	Sample average	Population proportion	Annual volume
Home consumption	39	0.76	124 183
Neighbours	4 414	0.20	3 743 654
Schools and other institutions	19 800	0.02	1 599 231
Hotels and restaurants	13 500	0.02	1 090 385
Total	1 561	1.0	6 557 452

Table 4: Retail-based estimates of the informal milk market in Iringa. Estimates are mean and extrapolated annual consumption in litres per sample and estimated populations respectively

Retail category	No. of retailers	Average volume	Annual volume
Big hotels	8	1 101	8 807
Small hotels	77	109	8 399
Informal food shacks	19	3 242	61 594
Restaurants	9	5 363	48 271
Hawker: wholesale	32	10 311	329 960
Hawker: consumer retail	46	8 270	380 411
Min-supermarket	11	18 124	199 366
Kiosks	14	4 412	61 774
Total	216	5 086	1 098 582

Table 5: Retail-based estimates of the informal milk market in Tanga. Estimates are mean and extrapolated annual consumption in litres per sample and estimated populations respectively

Retail category	No. of retailers	Average volume	Annual volume
Big hotels	4	277	1 109
Small hotels	74	68	5 025
Informal food shacks	121	546	66 039
Restaurants	64	715	45 764
Hawker: wholesale	44	2 613	114 975
Hawker: consumer retail	130	10 756	1 398 303
Min-supermarket	20	890	17 794
Kiosks	258	32 149	8 294 416
Total	715	13 907	9 943 425

Table 6: Consumer-based estimates of the informal milk market in Iringa. 'Unknown' poverty level indicates that some element(s) of the respondents' poverty level could not be established. Estimates are of mean and extrapolated annual consumption in litres for sample and estimated populations respectively

Poverty level	<i>n</i>	Mean	Proportion of population	No. of consumers	Annual consumption
Unknown	28	11	0.21	26 215	356 003
Non-deprived	23	11	0.17	21 222	236 623
Subject to deprivation	53	26	0.40	49 934	1 283 297
Deprived	28	14	0.21	26 215	356 003
Total	132	18	1.0	123 586	2 231 926

Table 7: Consumer-based estimates of the informal milk market in Tanga. 'Unknown' poverty level indicates that some element(s) of the respondents' poverty level could not be established. Estimates are of mean and extrapolated annual consumption in litres for sample and estimated populations respectively

Poverty level	<i>n</i>	Mean	Proportion of population	No. of consumers	Annual consumption
Unknown	9	48	0.07	20 539	985 868
Non-deprived	14	30	0.12	35 210	1 041 147
Subject to deprivation	80	36	0.66	193 653	7 045 081
Deprived	18	25	0.15	44 012	1 114 823
Total	121	35	1.0	293 413	10 186 918

Table 8: Summary of annual informal market volume (millions of litres) estimates and ratios of variation (largest:smallest in the case of different estimation techniques)

Study area	Producer	Retail	Consumer	Variation (largest:smallest estimates)
Iringa	1.69 m	1.01 m	2.23 m	2.2
Tanga	6.56 m	9.94 m	10.19 m	1.6
Variation (Tanga:Iringa)	3.9	9.8	1.6	

4. Discussion and conclusions

4.1 Case studies

It was to be expected from their relative population sizes that the magnitude of Tanga City's milk market would greatly exceed that of Iringa's. However, the degree to which the Iringa retail survey, which did not capture producers' own consumption or their direct sales to neighbours, produced a relatively much smaller estimate than the other means of computation underlines the strong relative importance of these channels. This outcome is consistent with the greater degree of organisation of the market in Tanga, and the relatively high proportion of sales to the formal market (Kadigi *et al.* 2013).

In addition, Tanga producer-based data were likely to be more accurate than those sourced in Iringa due to the relatively high proportion of formal sales and, therefore, the degree of formal record keeping in comparison with estimates in the latter study area that were overwhelmingly based upon recall data.

That all poverty status-classified groups in Tanga consumed more milk from the informal market than in Iringa may be a function of its greater general availability in the former municipality, with higher productivity and more efficient marketing arrangements, both formal and informal.

That the 'subject-to-deprivation' group comprised the greatest informal consumers in both cases may reflect the reliance on the informal milk market for the product, consistent with the status of the 'non-deprived' group in Iringa as the lowest-volume consumers on the informal market. This implies that their requirement for milk was being fulfilled through higher-end processed products.

In addition, the relatively low consumption of milk by the 'deprived' group in both cases may be due to access and affordability issues, with producer prices in the informal market consistently double those paid by processors due to the relatively high demand in the former and the relatively high overhead costs of the latter. Studies conducted elsewhere show the effects of poverty on consumption levels. Fotros and Maaboudi (2011) acknowledge that income inequality has a significant impact on consumption expenditure, although the magnitude of inequality is less in the latter than in the former. Delgado (2003) demonstrated that poor people in developing countries are likely to consume more animal-source foods as their earnings rise above poverty level and locations become urbanised. Similarly, Sebastian *et al.* (2010) found that adolescents in the highest income group consumed significantly more milk than those with incomes at 101% to 185% of the poverty threshold.

These findings strongly underline the continuing high importance of the informal sector, both for i) poorer consumers, who cannot afford the more expensive processed products offered in formal markets, and ii) poorer, smaller-scale producers, whose low output levels favour selling directly to informal channels to take advantage of relatively high prices. Those with greater production use formal channels to dispose of output that cannot be absorbed in informal outlets.

In terms of public policy, the reality we have revealed advocates a more progressive and pragmatic approach to dairy sector development than the official bans on consumer sales of unprocessed milk in East African countries.

4.2 Comparison of market estimation techniques

Each of the three estimation techniques had shortcomings when employed in isolation. Production data do not account for milk from sources external to the study area; retail data do not include own consumption and direct sales by producers from their households, which may be important, as in the Iringa case; and consumer-based surveys also exclude producers' own consumption. In addition, smallholder producer-based data do not reflect the supply of niche informal markets, such as public institutions and hotels, by medium- and large-scale dairy farmers.

Therefore, to produce the most accurate rapid assessment of the market size of consumable products, a combination of methodologies should be used, including:

- Formal market data from key processors and retailers;
- Data from producers – ideally using some kind of diary-keeping approach to improve upon recall-only data – on their own consumption and informal direct sales, for example to their neighbours; and
- A consumer survey designed to represent all important groups of the population and capture milk from all sources, avoiding double-counting of that sourced directly from producers, but allowing the possibility of triangulation of producer estimates of direct sales.

While retail-based estimates are perhaps the least effective quantification tools in cases where resources are particularly limited, they are useful in identifying linkages between the formal and informal markets, along with leverage points for market upgrading and development.

The triangulation process need not be long and resource intensive – in most cases, formal processors are few and well known. Producer data can be collected efficiently by working through co-operatives and other farmers' organisations. In most contexts, useful indicative retail and consumer surveys can be implemented over a one-week period, using students as enumerators in order to keep costs down. Using this approach represents a suitable compromise between unreliable single-source estimates and expensive formal surveys with levels of rigor that do not necessary add great value to programming objectives.

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References

- Alkire S & Eli K, 2010. Multidimensional poverty in developing countries: A measure using existing international data. Mimeo, Oxford Poverty and Human Development Initiative, University of Oxford, Oxford, UK.
- Alkire S & Santos ME, 2010. Acute multidimensional poverty: A new index for developing countries. Oxford Poverty and Human Development Initiative Working Paper 38, University of Oxford, Oxford, UK.

- Ayele Z & Peacock C, 2003. Improving access to and consumption of animal source foods in rural households: The experiences of a women-focused goat development program in the highlands of Ethiopia. *The Journal of Nutrition* 133(11): 3981–6.
- Delgado CL, 2003. Rising consumption of meat and milk in developing countries has created a new food revolution. *The Journal of Nutrition* 133(11): 3907–10.
- Fisher LD, 1998. Self-designing clinical trials. *Statistical Medicine* 17: 1551–62.
- Fleming EM, 1990. Proposal for a marketing systems research approach in agricultural development planning. *Agricultural Systems* 32(2): 97–111.
- Fotros MH & Maaboudi R, 2011. Impact of income inequality on consumption expenditures inequality: A case study of Iranian households, 1966-2008. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1844544.
- Fratkin E, 2001. East African pastoralism in transition: Maasai, Boran, and Rendille cases. *African Studies Review* 44(3): 1–25.
- Hendel I & Nevo A, 2004. Intertemporal substitution and storable products. *Journal of the European Economic Association* 2(2-3): 536–47.
- Jansen HGP, 1992. Dairy consumption in northern Nigeria: Implications for development policies. *Food Policy* 17(3): 214–26.
- Kadigi ML, Kilima FTM, Akyoo AM, Mvena ZSK, Ngetti M, Coles CF & Nombo C, 2013. Choice of marketing channels among urban dairy farmers and its implication on growth of the milk sector in Tanzania. *Eastern and Southern Africa Journal of Agricultural Economics and Development* 10: 1–14.
- Kurwijila LR, Omore A, Staal S & Mdoe NSY, 2006. Investigation of the risk of exposure to antimicrobial residues present in marketed milk in Tanzania. *Journal of Food Protection*, 69(10): 2487–92.
- Moran J, 2009. *Business management for tropical dairy farmers*. Collingwood VIC, Australia: Landlinks Press.
- Morton J, Coulter J, Miheso V, Staal S, Kenyanjui M & Tallontire A, 1999. Provision of agricultural services through co-operatives and self-help groups in the dairy sector of Kenya. NRI Report OVI 3.1, Natural Resources Institute, Chatham, UK.
- Narrod C, Roy D, Okello J, Avendaño B, Rich K & Thorat A, 2009. Public–private partnerships and collective action in high value fruit and vegetable supply chains. *Food Policy* 34(1): 8–15.
- Omore AS, Staal S, Kurwijila LR, Osafo E, Aning G, Mdoe NSY & Nurah G, 2001. Indigenous markets for dairy products in Africa: Trade-offs between food safety and economics. In *Proceedings of the 12th Symposium on Tropical Animal Health and Production*, 2 November. Committee for the Advancement of Tropical Veterinary Sciences, Utrecht University, Utrecht, The Netherlands.
- Owango MO, Staal JS, Kenyanjui M, Lukuyu B, Njubi D & Thorpe W, 1998. Dairy co-operatives and policy reform in Kenya: Effects of livestock service and milk market liberalisation. *Food Policy* 23: 173–85.
- Popplewell R & Hayman R, 2012. Where, how and why are action research approaches used by international development non-governmental organisations? INTRAC Briefing Paper 32, INTRAC, Oxford, UK.
- Reason P & Bradbury H, 2001. *Handbook of action research: Participative inquiry and practice*. London: SAGE.
- Sebastian RS, Goldman JD, Wilkinson-Enns C & LaComb RP, 2010. Fluid milk consumption in the United States: What we eat in America. NHANES 2005-2006, Food Surveys Research Group Dietary Data Brief No 3. Available at <http://ars.usda.gov/Services/docs.htm?docid=19476>
- Staal SJ & Mullins G, 1996. Dairy consumption and its determinants in coastal Kenya. KARI/ILRI Collaborative Research Report, ILRI, Nairobi, Kenya.
- Thorpe W, 1998. ILRI's smallholder dairy systems research: Experiences and lessons from collaborative R&D in eastern Africa. Workshop on Ecoregional Research at ILRI, Nairobi, Kenya.

- Worsley A, 2002. Nutrition knowledge and food consumption: Can nutrition knowledge change food behaviour? *Asia Pacific Journal of Clinical Nutrition* 11(3): 579–85.
- Young J, Hooton N, Muriuki H & Romney D, 2006. Informal traders lock horns with the formal milk industry: The role of research in pro-poor dairy policy shift in Kenya. London: Overseas Development Institute.