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Identification and analysis of smallholder producers' constraints: applications to Tanzania and Uganda

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This article puts forward a method for the analysis of constraints faced by developing countries' smallholder producers. It is consistent with theories of constraints, efficient in terms of cost and researchers' time, and accessible to a non-technical audience. A hybrid of workshop discussion and individual data collection, it also draws on data and analyses available in most developing countries. The article presents an application to smallholder livestock systems in Tanzania and Uganda, reporting results and analysis relating constraints to households' characteristics and conditions, and their stated goals. While limitations are identified, it is proposed for application in other development fields.

Cet article propose une méthode pour l'analyse des contraintes auxquelles se heurtent les petits producteurs des pays en développement. Elle correspond bien aux théories relatives aux contraintes, est efficace en termes de coûts et de temps requis de la part des chercheurs, et est accessible à un public non technique. Hybride de discussions dans le cadre d'ateliers et de collecte de données individuelles, elle se sert également de données et d'analyses disponibles dans la plupart des pays en développement. Cet article présente une application de cette méthode aux systèmes des petits éleveurs de Tanzanie et d'Ouganda, et rend compte des résultats et des analyses en reliant les contraintes aux caractéristiques et aux conditions de vie des ménages, ainsi qu'à leurs objectifs déclarés. Bien que des limites soient identifiées, son application est proposée dans d'autres contextes de développement.

En el presente artículo se propone un método para analizar las restricciones enfrentadas por los pequeños productores en los países en desarrollo. Dicho método guarda consistencia con las teorías de restricciones: es eficiente en términos de los costos y tiempos de los investigadores, además de ser accesible para un público sin preparación técnica en la materia. Este estudio se apoya en una combinación de las opiniones surgidas en diálogos en talleres con datos recabados a nivel individual. Además, se apoya en estadísticas y análisis disponibles en la mayoría de los países en desarrollo. El artículo presenta una aplicación realizada en los sistemas de pequeños ganaderos en Tanzania y Uganda; los resultados y análisis relacionan las restricciones existentes con las características, las condiciones y las metas manifestadas por las familias productoras. A pesar de que se identifican las limitaciones de este método, se propone que sea utilizado en otros ámbitos de desarrollo.

Keywords: Aid – Monitoring and Evaluation; Civil society – Participation; Methods

Introduction

The design of development interventions and achievement of impact require an understanding of the constraints faced by the poor. Constraint analysis seeks to identify and prioritise constraints,

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and to advocate change that will enable public and private pro-poor investment to overcome or ease constraints. A constraint is here interpreted as anything that prevents an actor or system from achieving its goal. Diverse methods have been applied to constraint analysis for development purposes. At large spatial scales, development of descriptive methods from desk reviews of the literature form one method (e.g. Salami, Kamara, and Brixiova 2010). Another is direct reference to producers' perspectives via participatory rural appraisal, involving farmers' ratings of pre-specified constraints (Devendra 2007; Meganathan et al. 2010). In the presence of detailed farm-level data, linear programming has been applied to identify binding constraints (Jansen and Wilton 1984; Siegel and Alwang 2005): this approach requires pre-identification of constraints, and their appropriate programming. Econometric methods to estimate agricultural supply responses, using both household and country level data, have been used to identify productivity-enhancing or hindering factors (e.g. Heltberg and Tarp 2002). Data Envelopment Analysis as a two-step approach has been used to combine farm efficiency analysis with statistical identification of the factors associated with low performance (e.g. Gelan and Murithi 2012; Stokes, Tozer, and Hyde 2007).

Constraints can be classified in various ways, spanning the bio-physical, resource, and technical, to social and cultural, and onward to infrastructural and policy related. Their quantification may be subject to both measurement error and substantial variance across any sample. Developing country system and household performance may be complex to measure, as it may represent satisfaction of just a subset of the multiple objectives of smallholder action. Constraints are often not easily observed, and are often confused with their symptoms, such as low productivity: Salami, Kamara, and Brixiova (2010) emphasise the centrality of low productivity to East African agricultural producers' constraints in achieving livelihood improvement. Recognising that productivity is symptomatic of one or more of a number of underlying constraints, occurring in sequence or parallel, those authors go on to identify fundamental categories of basic or "long term" constraints including land, labour, capital, knowledge and information, access to markets, and aspects of the policy environment. The importance of this demarcation is that solutions targeting root causes are likely to be more successful and sustained than are those targeting symptoms.

The task stated above for constraint analysis requires that basic constraints be identified as an important part of the method and be addressed as a consequence of the analysis. In the current article, constraints identified by farmers are referred to as "declared" constraints. All nominated constraints are then classified by their underlying cause, or basic constraint. Thus, a single declared constraint (e.g. high mortality amongst young animals) may be attributed to different basic constraints (e.g. land and water conditions delivering drought; lack of information leading to poor uptake of a vaccination service; policy failure leading to non-availability of vaccine) in different contexts. A further identification issue is that analytical approaches require definitions of what a constraint is not: for the purposes of this paper no medium or actor is a constraint. However, such exclusion requires a basis in examples. "Drought" is an example of a declared constraint for which "land" and "water" would be considered as candidates for the basic constraint. However, "government", "fences", or "too many other farmers using the land" are not constraints as defined here.

This article offers a new method for framing and conducting constraint analysis. It proposes several advantages over the approaches and methods listed above. First, it is field-based and uses a dataset of individual observations, and it can follow sampling approaches to suit diverse purposes and targets. This provides a sound quantitative basis for analysis. Second, the method provides a mechanism for farmers' nomination of constraints, farmers' attribution of declared constraints to basic constraints, and farmers' ranking of their importance. This avoids prescriptive treatment of stakeholders or local conditions, and removes limits on the ranges of data collected. Third, statistical measures of association are used, which avoids specifications that are reliant on

assumptions about constraints' mechanisms and effects. Fourth, the method is an amalgam of data access methods: the strengths of both group discussion and individual survey are retained, and data and analysis from related studies can be incorporated. Lastly, the method is cost effective in terms of generating appropriately sized datasets, across several sites, rather more quickly than surveys or group discussions. As specialists' time is a major component of data collection costs, speed of collection offers a cost advantage.

The article presents the proposed method's application to the identification and characterisation of constraints among samples of Tanzanian and Ugandan smallholder livestock keepers. The first section provides an overview of the method, and the subsequent section presents some results from related studies that are employed to guide the constraint analysis and are examples of the method's capacity for cohabitation with other sources of information. There are then sections providing summaries of the data collected, the constraints nominated, and the results of their further analysis. The final section discusses conclusions. Materials used are available from the authors.

Method

The method entails producer workshops lasting some seven hours, including breaks. At the workshops, single farm household heads steadily complete an individual questionnaire while participating in a guided sequence of activities, including form-filling, focus group discussions (FGDs), and voting-type result generation. The procedure is illustrated in Figure 1. Individual data collection occupies the early stages of the workshop, in plenary-type sessions where paper-based responses to questions on the farm system were collected, and in round-robin events where the workshop participants were split into four groups which each completed individual questionnaires on the four basic constraints (land, labour, capital, and information). FGDs also have participants divided into four groups, according to individuals' experience and skill set with specific domains. FGDs were used to nominate up to four declared constraints associated with each domain, with each linked to one of the basic constraints (land and water, labour, capital, information and knowledge, and where necessary, others – typically infrastructure and policy).

In the final discussion sessions preceding the constraints' rating activity, the findings from each domain session are presented by group representatives to the entire plenary for validation, and the individual farmers are reminded of their (earlier recorded in their individual questionnaires) main goal in production. The final list of (up to 16) constraints is then compiled for individual rating. Based on each individual producer's main goal, a rating is made of the three most severe (most severe, second-most, third-most severe) constraints and the associated linkage to basic constraints. A form is printed and one copy handed to each of the participants. Once completed by ticking the boxes, that copy is permanently attached to the participant's questionnaire.

A small number of products are studied, with single workshops dedicated to individual products. Product selection criteria can vary amongst users, but in general these reflect the products' potential for generation of benefits to smallholder producers. Selection can draw on existing knowledge of consumption or its trends, known retail dynamics and their drivers, and of developmental aspects of the value chain via which smallholder producers participate in markets and generate benefits. Study site selection is based on prominence of the products of interest, social and cultural variables, and proximity to markets deemed accessible for smallholders from physical, logistic, and organisational standpoints.

A workshop can accommodate 35–50 farmers. Participating farmers are pre-selected, based on stratified samples constructed from official lists: strata for sampling address study goals. Participating farmers' names are checked upon entry to workshop against a list of those selected. They are provided with lunch free of charge. Following delivery of a completed questionnaire,

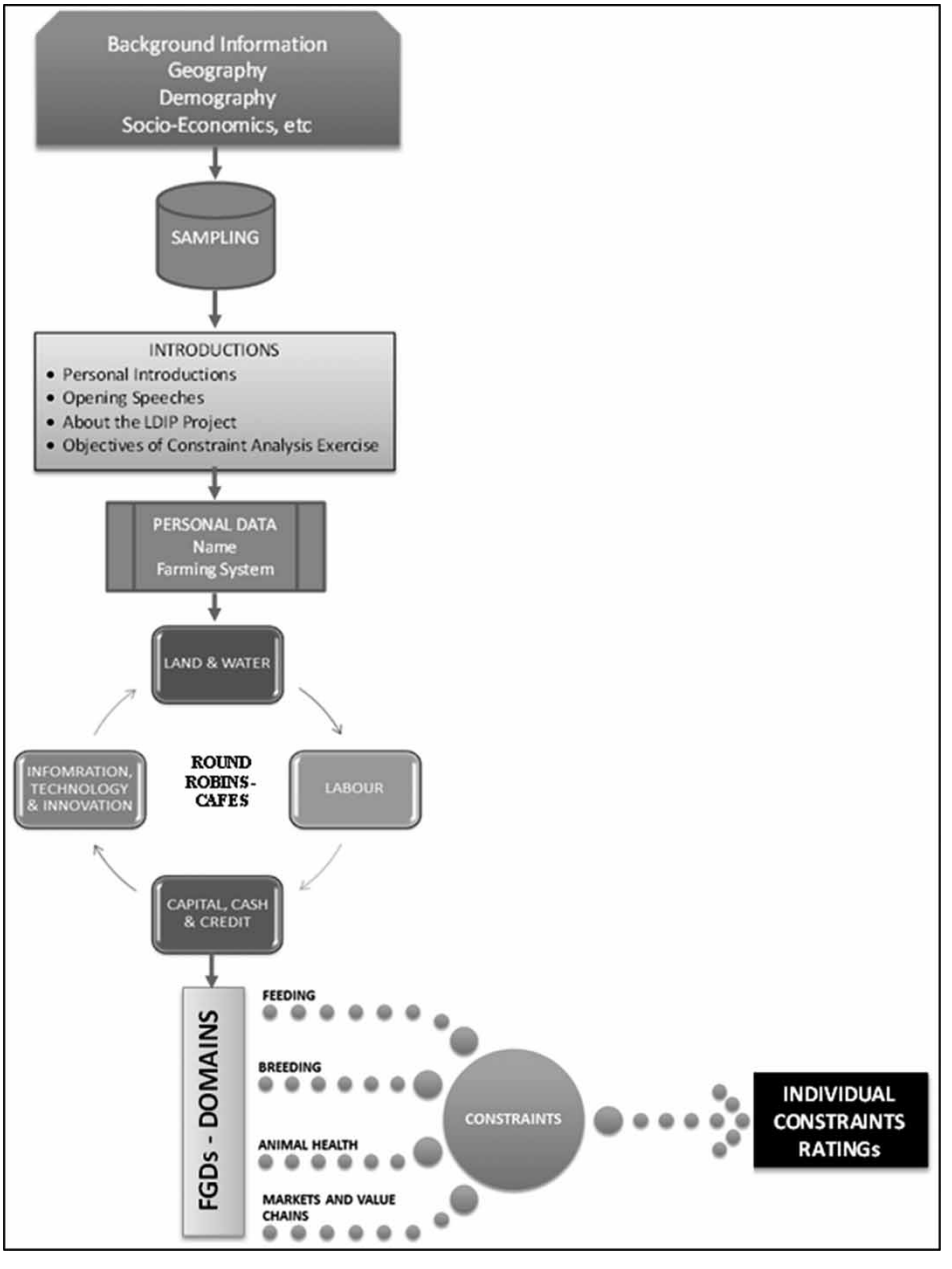

Figure 1. Schematic overview of constraint analysis procedure.

participating farmers are compensated for travel costs incurred. A single facilitator leads the workshop, and is responsible for time scheduling, and the direction of other workshop staff. The technical facilitation is supported by domain (feeds, animal health, breeding, and marketing) specialists. Staff members of local veterinary and extension services, local representatives from government ministries with a relevant production and marketing mandate, and other advisors are called upon to provide input, especially to assist with explanation and support to those

with weak literacy. Such staff also assist with site selection, and with sampling for selection of participants. As workshops last one day, workshops can be done on consecutive days to exploit the availability of key specialists. Overnight data entry enables analysis to start after a single workshop, with feedback and validation possible soon after the workshop.

The questionnaire used is distributed to participating farmers at the beginning of the workshop, in both English and a local language. In addition to an individual copy with the participant's name, contact details on it, an identical PowerPoint is constantly displayed during the workshop. The questionnaire is tested and edited prior to the workshop, and this preliminary phase includes training of the support staff. Support staff are also requested to provide location information on the selected farmer participants, enriching the database by the inclusion of GIS coordinates. Questionnaires focus on:

- Household characteristics
- Household goals
- Characterisation of farm system
- Identification of and ranking of impact of declared and basic constraints
- Characterisation of management within intervention domains (feeds, animal health, breeding, and marketing)
- Mapping of basic constraints onto these four domains
- Ranking of constraints, in relation to household goals.

Example: Tanzania and Uganda

Eight producer workshops were convened in Tanzania and Uganda.[1] The study's purpose was to identify constraints to smallholders' capacity to serve fast-growing retail markets, while also testing the methodology described above. Site selection was based on prominence of the selected products (dairy and pigs, see below), wealth status according to official data at community level, ethnic composition of locations, and proximity to specified markets. Each workshop featured 35–50 dairy or pig producers. Staff members of local veterinary and extension services were present, as well as livestock-related ministries. The participants were a sample of farmers stratified (based on extension officers' records) by type of farm production system, engagement in marketing, gender, age, and ownership of improved breeds of cattle and pigs.

Product selection drew on knowledge of consumption and expenditure trends (via existing household consumption surveys), and retail and value chain development (based on unpublished related work by the authors).[2] This procedure led to the selection of dairy in Tanzania, and of dairy and pig-keeping in Uganda. Nationally-representative production data was also accessed from national household surveys, and regression analysis was used to guide the formulation of questionnaires. Questionnaires featured locally-relevant input on available marketing channels and product mixes, known animal breeds' distributions, and animal disease prevalence. A single principal facilitator and four domain specialists conducted the workshops, with four to six local support staff and two to three data entry staff.

Summary of example data collected at workshops

Tanzania

In Tanzania 115 valid responses were received, evenly distributed across the four districts. Only 4% of the farmers interviewed came from households with a female head, and household size averaged eight people. It is notable that not all participants were household heads, and in

particular a greater percentage of participants were women than were identified as household heads. Close to one quarter of the Tanzanian dairy farmers interviewed reported having no education and 65% had some form of primary education, although this differed (1% level of significance) by district.

Mlale and Mvomero districts featured mostly pure livestock systems whereas Mkalamo and Bungu displayed some cropping (1‰ level of significance). In Mlale in particular, 63% of the farmers interviewed engaged in dairy farming only while 33% were involved in some mix of cattle and crop farming. Relying heavily on grazing, fewer than 30% of those interviewed reported having bought animal feeds for their cattle; virtually none used their own crops or crop residues as fodder. Mlale and Mvomero districts featured households engaging in transhumant herding (89% and 64% respectively), with the animals moving in search of pasture and water. This was significantly different (at 1‰ level) from the situation in Mkalumo and Bungu where 86% and 89% of farmers interviewed had immobile households and dairy enterprises. This difference in feeding system was reflected in the land area held by the farmers. Farmers in Mlale and Mvomero districts also reported using communal pasture land while farmers in Mkalumo and Bungu did not. Water was scarce across all districts: shared watering facilities for cattle were available within 1 km to 57% of Bungu farmers and 45% of Mkalamo farmers whereas they were rarer in Mlale and Mvomero (significant difference at 1% level).

Household herd size in Mlale and Mvomero was significantly larger than that in the two other districts (Table 1), but daily milk production was not. Farmers in all four districts sold their milk to local consumers (88% of sample) and to local vendors (71% of sample). Sales to distant vendors (22%) and to milk processors (15%) were generally not common.

Some 47% of farmers surveyed stated their main goal from cattle keeping as income from milk sales, but this varied across districts (significant at the 1% level). Manure production was also an important goal, mainly professed by Bungu farmers (32% for that location), while in the three other districts, farmers particularly valued their cattle as assets and wealth. These differences reflect both the physical environment (specifically that Mlale and Mvomero have protracted dry periods), the pastoral systems in those two locations as opposed to mixed cropping in Bungu, and ethnic differences between locations.

Funds from the sale of crops and cattle were generally received by men, whereas those from milk went to the women. Further, the decision on spending money from crop sales was reported to lie with men (86% of households) as was the case for money from cattle sales (92%). In contrast,

Table 1. Average household herd size and milk production by district in Tanzania.

	Mean value of variable			
	Districts			
Variables	Mlale (a)	Mvomero (b)	Mkalumo (c)	Bungu (d)
Number of calves born in 2011*	29 (c, d)	29 (c, d)	5	4
Average daily milk production (litres)	13.7	13.4	15.6	5.3
Average daily milk production per dairy cow (litres)	0.76	1.25	8.60	1.07
Average daily milk sold (litres)	9.4	10.11	6.8	2.9
Number of local breed heads in herd	131	108	28	79
Number of cross-bred heads in herd[+]	45	33	2	69
Number of pure-bred heads in herd[+]	6	1	0	-

Notes: * Mean value is significantly different from that of district indicated in parentheses (at 5% level of statistical significance).
[+] Too few observations for Mkalumo and Bungu districts to perform statistical tests.

62% of farmers interviewed declared that the expenditure decision on money from the sale of milk rested with a woman in the household. Moreover, significant differences (at 1‰ level) were observed between districts.

In Mlale, Mvomero and Bungu, 83%, 68%, and 71% of farmers respectively declared that their customers provided to them information about the milk quality desired; only 31% of farmers in Mkalamo had a similar experience (significance at 1% level). Some 70%, 57%, and 75% of customers would accept or reject milk according to quality indicators in Mlale, Mvomero, and Bungu respectively, but only 21% of farmers in Mkalamo faced such demanding customers. Information on crop production, cattle production, hygiene and safety, and on market conditions, was also available to differing degrees in the districts (Table 2).

Uganda – dairy producers

In Uganda, 164 valid responses were received. The general level of education of farmers is higher than that for Tanzania, with just 5% of heads of households without education. From the Ugandan sample, 39% of farmers interviewed were women but only 12% of interviewees came from households with a female head. The average household has seven people. There were 88 dairy producers and 76 pig producers in the sample, evenly distributed between the two geographical locations (52% in Mukono and 48% in Wakiso districts). Production systems feature some crops, but mainly a livestock enterprise (55.5%), although there was some variation.

Among dairy households, 34% of respondents were women, but just 11% of these represented female-led households. A variety of dairy feeding systems was in use (Table 3), and in addition the numbers of dairy cattle and incidence of certain management procedures were reported to fluctuate substantially year-on-year. The level of experience in milk production of these farmers varied between 1 and 60 years, with mean 9 years.

The most frequently stated reason for keeping cattle was the income from milk sales (92% of respondents). Manure production and nutrition and food security of the household were also popular, while income from cattle sales was less important (24% of the sample). The majority of dairy farmers interviewed stated that they would first use the milk for their household consumption before selling any remainder.

The area of land owned by the dairying families varied hugely: 0–2023ha; while the land area under rent varied 1–1011ha. The median area of land owned was 1.2ha, and of land rented was

Table 2. Information received by Tanzanian dairy farmers.

	Percentage of farmers responding "Yes"			
	Districts			
Variables	Mlale	Mvomero	Mkalumo	Bungu
Farmers received information on crop production in the past two years[+]	38.5	19.0	19.0	69.6
Farmers received information on cattle production in the past two years*	54.5	20.0	23.8	69.6
Farmers received information on milk hygiene and safety in the past two years[+]	70.0	5.3	20.0	69.6
Farmers received information on prices, selling and income from milk in the past two years*	11.1	5.3	19.0	54.5

Notes: * Pearson chi-squared test 0.002.
[+] Pearson chi-squared test 0.001.

Table 3. Frequency of main dairy production systems in Uganda.

Type of production system	Percentage of respondents
Cows only grazing on pastures (free-range or tethered)	13.8
Cows mainly grazing with some stall feeding	32.2
Cows mainly stall fed, with some grazing	12.6
Only stall feeding (zero-grazing)	41.4

1ha. The average size of the dairy herd is small: 0.99 animal of local breed, 3.84 cross-bred animals, and 1.85 pure-bred animals. The average number of calves born on the farm in 2011 was just 1.63 with the median number at one calf born. The average reported daily milk yield per dairy cow was 10.2 litres, notably above the median 3.5 litres/cow. The average daily milk production by households was 21.26 litres (median 9 litres). The average daily milk sales were just 15.38 litres (median 6.3 litres).

Cattle breeding, guarding, milking, and sales were all reported to be male activities, as is crop selling. In contrast, milk sales, as well as crop production and harvest, are done by women. Funds obtained from the sale of milk by women are mainly kept by the women and governed by their own purchasing decisions. This contrasts with the situation for crops and cattle sales, proceeds from which are governed by men.

Uganda – pig producers

The sample of 76 pig producers was composed of 44.7% women, although female-headed pig farming households accounted for just 13.2% of the sample. Diverse pig production systems are represented (Table 4) although some 14% of respondents report a blend of piglet and grown pig production. The systems apparently evolve within a given year and, to a lesser extent, between years. Pig producers show greater homogeneity than do dairy farmers in terms of land area, although land owned by the farmers varied 0–6ha. Average herd size is small: 2.36 local, 4.46 cross-bred, and 5.11 purebred animals. The average number of piglets born on the farms is 21.21, with the median number at 13 piglets. The median number of piglets sold in 2011 was four and for grown pigs the number is one. Reported years of experience in pig production range between 1 and 25 years, with mean 6 years.

The reason most frequently given for raising pigs is income from the sales of piglets and grown pigs (92% of the sample). Manure production was second in terms of frequency (70% of the pig producing sample) but was mainly classified as the second or third most important reason for raising pigs. Pigs as assets or wealth were also important (29% of pig producers). Women are the main source of labour for the majority of pig production and marketing tasks, and income from pig production is mostly received and used by the women in the households.

Table 4. Frequency of occurrence of main pig production systems in Uganda.

Type of production system	Percentage of respondents
Own sows, from which farmers sell the piglets	33.3
Do not own sows, but buy piglets to feed and sell for slaughter	20.0
Own sows, from which farmers grow the piglets to sell for slaughter	26.7
In any one year, a mixture of all these	14.7
From one year to the next farmers change from one of these to another	5.3

Analysis of constraints identified in workshops

Tanzania

Constraints identified by workshop participants were coded into 23 categories of "declared" constraints, and their distribution is reported in the lower panel of Table 5. They were also classified by the farmers according to their relation to the five "basic" constraints identified from the literature (Table 5 upper panel).

The most important declared constraints are linked to the basic constraints land and water resources. "Seasonal feed variation", "land shortage or tenure insecurity" and "water shortage – quality and quantity" topped both lists of the most important constraint and the three most important constraints faced by farmers. The ranking of basic constraints also puts land as the most important basic constraint for 43.5% of Tanzanian dairy farmers interviewed. "Animal disease" was also nominated as often as "water shortage", placing it in tied third place of the cumulative declared constraints list. However, it was not considered to be the most important

Table 5. Constraints identified by Tanzanian farmers.

Constraint	Cumulated three first choices (%)	The most important constraint (%)
	BASIC CONSTRAINTS	
Capital	24.1	19.1
Knowledge and information	22.9	15.7
Labour	2.0	0.9
Land	28.1	43.5
Other	10.4	9.6
	DECLARED CONSTRAINTS	
Poor product quality	0	0
Absence of input providers or product buyers	6.7	5.2
Absence of product standards	0	0
Long distance for product sales or input purchase	4.6	2.6
Poor organisation of marketing and input supply	1.4	0.9
Lack of product storage	4.9	5.2
Seasonal feed variation	15.4	22.6
Water shortage – quality and quantity	11	15.7
Lack of feed	1.2	0.9
Poor quality of feed	0	0
Animal disease	11	4.3
Poor or uncertain quality of veterinary drugs	0	0
Lack of capital	0	0
Lack of good quality animals	3.8	3.5
Difficulties in managing improved breeds	2.3	1.7
Inappropriate breeds	0	0
Land shortage or tenure insecurity	12.5	20.0
Lack of training or skills	2.9	0.9
Lack of advisory services	2.6	0.9
Lack of information	0	0
High costs of inputs and services	2.9	2.6
Low incomes from product sales	1.4	0
Poor roads, bridges and infrastructure	2.9	1.7

constraint. Labour is not regarded as a basic constraint by Tanzanian farmers. It was linked to just one of the three most important constraints by 2% of farmers interviewed and was linked to the most important constraint by only one farmer in the sample.

Cross-tabulation of constraints with household-level data reveals that the district where farmers were based had a strong significant relationship (at 1‰ level) with their most important declared constraint. District-related local effects, such as "seasonal feed variation" and "land shortage or tenure insecurity" were particularly prominent for farmers in Mlale, Mkalamo, and Bungu. On the other hand, "water shortage – quality and quantity" was declared as a constraint by Mvomero farmers. Capital constraints were a problem for 46% of Bungu farmers. Knowledge and information were more difficult to get for dairy farmers in Mvomero (29%) and Bungu (21%). Land was seen as the most important basic constraint for 53% of farmers in Mlale and for 62% of farmers in Mkalamo district.

Statistical evidence (5% level) indicates that households' land area owned is associated with the most important declared constraint. Further, households' production strategies were statistically associated (at 5% level) with the constraints identified. A majority of farmers facing capital (81%), knowledge and information (61%) and other (64%) basic constraints mainly employed a sedentary dairy production system. On the other hand, 56% of farmers facing land constraints reported moving their animals in search of pasture and water. Similarly, farmers facing land constraints declared a greater variety of reasons for keeping cattle than did those facing capital or knowledge and information basic constraints – these latter were mainly in the cattle business for the income from milk sales (73% and 82% respectively). Only 27% of dairy farmers facing land constraints were in the business for the income from milk sales; 38% of these farmers with strong land constraints were keeping cattle for the income from cattle sales and 25% for nutrition and food security reasons.

Somewhat weak relationships appeared between marketing channel used and the constraints nominated by households (statistically significant at the 10% level). The majority (77%) of dairy farmers surveyed did not sell products to distant vendors. This proportion was even higher for farmers who declared facing "seasonal feed variation" (85%), "water shortage – quality and quantity" (80%) and "land shortage or tenure insecurity" (91%). Information sources, however, provided a stronger statistical association with constraints nominated. A striking 81% of the farmers facing land constraints declared having no access to information on crop production, while farmers facing other basic constraints were more likely to have access to such information.

No statistically significant relationship could be identified between the declared constraints or basic constraints faced by farmers and the gender of the head of household, their level of education, the farm production system chosen, the number of heads in the herd, water availability, the amounts of milk produced or sold, or the intra-household decisions on allocation of funds from sales of specific items. No relationships were identified associating income levels with constraints identified.

Uganda

The lower part of Table 6 reports the constraints declared by Ugandan farmers during the workshops. The two most important declared constraints are linked to capital, and knowledge and information. "Lack of capital", "lack of good quality animals", and "high costs of inputs and services" topped both lists of the most important constraint and the three most important constraints faced by farmers. The table also shows that labour is not a basic constraint for Ugandan farmers. It was linked to only one of the three most important constraints by just 2% of farmers interviewed and was never linked to the most important constraint declared by any farmer. Furthermore, it was

Table 6. Constraints identified by Ugandan farmers.

Constraint	Cumulated three first choices (%)	The most important constraint (%)
	BASIC CONSTRAINTS	
Capital	49	55
Knowledge and information	38	34
Labour	2	0
Land	7	9
Other	4	2
	DECLARED CONSTRAINTS	
Poor product quality	0	0
Absence of input providers or product buyers	4.7	0
Absence of product standards	3	1.2
Long distance for product sales or input purchase	0	0
Poor organisation of marketing and input supply	6.1	7.3
Lack of product storage	0	0
Seasonal feed variation	6.3	0.6
Water shortage – quality and quantity	0	0
Lack of feed	8.3	5.5
Poor quality of feed	5.7	4.5
Animal disease	0.6	0
Poor or uncertain quality of veterinary drugs	2.4	0
Lack of capital	9.8	20.7
Lack of good quality animals	12.6	23.8
Difficulties in managing improved breeds	0	0
Inappropriate breeds	1.8	1.8
Land shortage or tenure insecurity	1.6	3.7
Lack of training or skills	6.1	4.3
Lack of advisory services	2	2.4
Lack of information	8.7	4.9
High costs of inputs and services	19.7	19.5
Low incomes from product sales	0	0
Poor roads, bridges and infrastructure	0	0

not spontaneously identified as a constraint: labour does not appear in the list of declared constraints in the second part of Table 6.

Cross-tabulation of declared constraints with household characteristics reveals differences (at 10% level of statistical significance) in the basic constraints faced by Ugandan farmers: farmers in Wakiso are more affected by capital constraints (63%) than those in Mukono district (48%). On the other hand, Mukono farmers face more constraints linked to knowledge and information (40%) than do their counterparts in Wakiso (28%). For dairy farmers, district effects were very strongly (1‰ level) associated with constraints nominated: 77% of dairy farmers in Wakiso district declared "lack of good quality animals" as their most important constraint; in Mukono, 48% of dairy farmers declared facing "high costs of inputs and services" as their most important constraint.

Size of land holding is statistically strongly associated with constraints nominated. Those with large land areas (over 1.2ha) cited "lack of feed" and "lack of training and skills" while those with less land cited "poor quality of feed", "lack of capital", "land shortage or tenure

insecurity", and "lack of advisory services". Species (dairy versus pig production) affects the constraints nominated by producers, although with statistical significance at only 10% level. Dairy producers report being more constrained by capital (64%) than are pig producers (45%). Pig producers more frequently reported knowledge and information (42%) or other basic constraints linked with institutions and infrastructure (5%) as constraints, than do their dairy producing neighbours (respectively 27% for knowledge and information and 0% for other basic constraints).

There is a statistical association between farmers' marketing channels and the constraints they face, but this is apparent only as a difference between high-value and low-value outlets. The basic constraints faced by farmers who sell to pork meat retailers or to a milk processing firm are significantly different to those faced by farmers selling to other outlets. Farmers with no sales to these customers claim capital-related constraints (58%) more frequently than do farmers supplying agribusinesses (41%). A more striking difference can be observed for knowledge and information: 56% of farmers who sell to such market-oriented customers face constraints on knowledge and information whereas only 30% of farmers who do not sell to these customers face such constraints. Ugandan dairy farmers declaring "lacking of good quality animals" and "high costs of inputs and services" as their most important constraints were in general not selling to milk processing firms (statistical significance at 10% level).

Input use and access patterns are also associated with households' identification of constraints. Farmers using manure to fertilise their crops tend to face constraints related to capital (56%), while those not using manure nominate constraints linked with information and knowledge (67%). Farmers who do not have access to tap water face more constraints (statistical significance at 10% level) than their counterparts who do have access to tap water. However, the constraints differ: farmers without access to tap water are mainly facing constraints linked to capital (60%) and, to a lesser degree, to knowledge and information (31%) and land (8%). On the other hand, farmers who do have access to tap water nominate constraints linked with knowledge and information (41%) and land (15%).

For dairy farmers, herd size, composition and performance are statistically associated (at 1% level) with constraints nominated. Dairy farmers facing "poor quality of feed", "lack of training or skills", "lack of advisory services", and "high costs of inputs and services" had more than two purebred cows on average. Dairy farmers with fewer than two purebred cows on average declared as constraints "lack of feed", "lack of good quality animals", "land shortage or tenure insecurity", and "lack of information". Number of calves born each year also is statistically significant in association with constraints nominated by farmers (at 10% level): "lack of feed", "lack of capital", "lack of good quality animals", "land shortage or tenure insecurity", "lack of advisory services", and "high costs of inputs and services" are all associated with households which produced less than two calves each year. Farmers citing "inappropriate breeds", "lack of training or skills", and "lack of information" produced more than two calves.

No statistically significant differences were found in terms of basic constraints faced by farmers in relation to the type of production system, gender of the respondent, or to the sex of the head of household. Constraints faced by dairy farmers had no statistically significant relationship with their stated purpose for undertaking the dairy enterprise.

Discussion of main results of the example constraints analysis

Tanzanian (all of them dairy) producers overwhelmingly identified land as the most important basic constraint they face: 43% claimed it to be the most important single constraint to achieving their stated purpose for keeping cattle (Figure 2). Labour was little-identified as a basic constraint, with 15–30% identifying each of capital, and knowledge and information. Around 10%

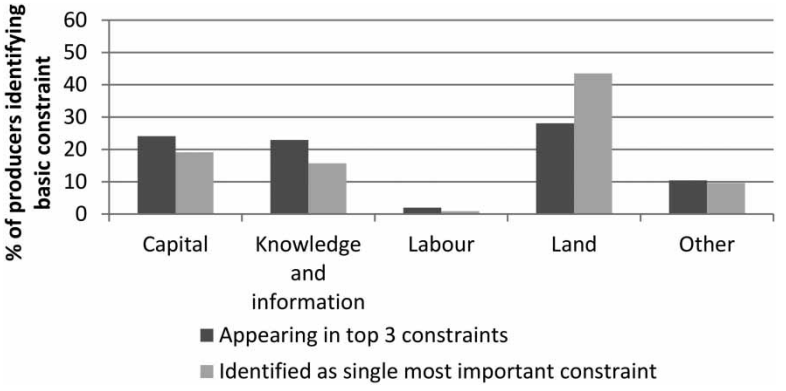

Figure 2. Summary of basic constraints: Tanzania.

nominated "other" basic constraints – primarily policy and infrastructure. Ugandan producers (dairy and pig producers) overwhelmingly identified capital, and knowledge and information as the most important constraints (Figure 3).

Tanzanian producers identified seasonal feed variation, land shortage (and uncertainty over land tenure), and water shortages as the main constraints faced. Although over 10% of Tanzanian producers identified animal disease as a major constraint, less than half this number nominated it as their single most important constraint. Absence of markets (on buying and selling sides) was nominated by about 5% of producers as an important constraint.

Of the Ugandan producers, 20% nominated high costs of inputs and services as their single most important constraint, but for top-three constraints, over 20% nominated both lack of high (productivity) quality animals and a lack of capital. Lack of information, training and skills were nominated by 5–8% of producers. Some 4–8% of producers nominated quantity and quality of feeds, and around 5% nominated poor organisation of the marketing and input supply, and absence of markets – although for the latter constraint no single Ugandan producer nominated this as their single most important constraint.

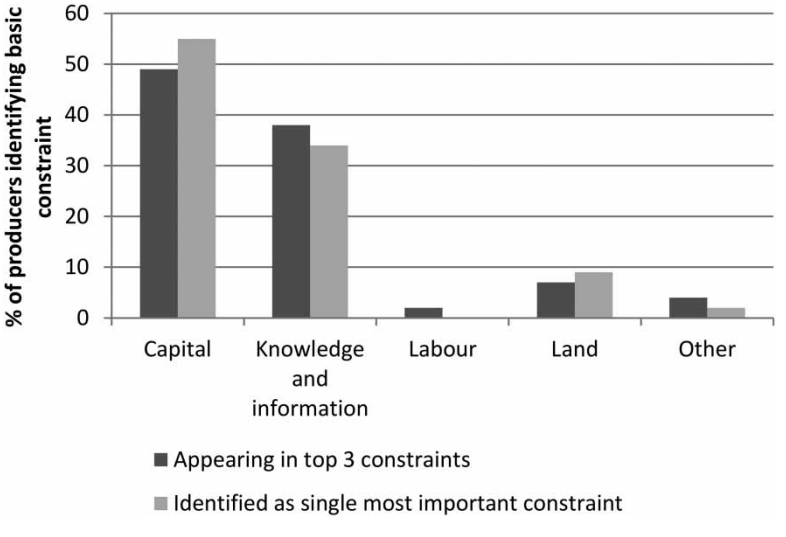

Figure 3. Summary of basic constraints: Uganda.

Although substantial variation was identified amongst the constraints identified by producers, and also among the stated primary purposes of producers, little significant statistical relationship was found between the two. This is to say that, subsistence livestock producers, and those whose main purpose of keeping cattle may be social or for draught power, nominate the same constraints as those producers with commercial goals. Similar findings applied to pig producers in Uganda. This is a remarkable result demanding further examination. One possible explanation is that producers are unable to either articulate their main purposes for keeping animals, or to express them in relation to constraints. If this were found to be the case, the methodology used offers a robust response in that many of the alternative explanatory variables related strongly to producers' main purposes (e.g. proportion of production that is sold, relations between crop and livestock enterprises, nature of the production system, percentage of milking cows within the herd, etc.). As examples, the few statistically significant results identified are that land tenure constraints tend to be associated with multiple uses of livestock; while commercial purposes are associated with capital constraints.

Locality in both Tanzania and Uganda was a strong determinant of constraint nomination. Locality-related variables such as land area, tenure security, and access to water were also influential. Few patterns of constraint nomination emerge that are consistent with herd size. Labour is little-nominated as a constraint (see above), and related variables such as household demographic measures and gender allocations of tasks and responsibilities are statistically unrelated to constraints nominated. In Uganda, small-scale farmers report facing different constraints than do larger ones, irrespective of whether farm size is measured in terms of land area or herd size. These results hold equally for both dairy and pig producers.

In Tanzania the variation in purpose for keeping cattle is significant both between and within locations, for which there are several likely explanations. In Uganda, the farmers mostly cite crop production as the main farm activity, but notably almost all cattle keepers cite sales of milk as the main reason. Diverse production systems are therefore not necessarily less commercial than are specialised ones, even though family nutrition was also a major reason for Ugandan farmers to keep cattle.

Ugandan dairy producers with relatively large numbers of genetically superior cattle nominated different constraints than did those with few such cattle. Ownership of high-quality cattle was associated with constraints on feed quality, lack of advisory services, and high costs. The lower intensity systems associated with local breeds were more frequently constrained by land, information and, unsurprisingly, lack of access to superior animals. In Uganda, dairy and pig producers reported facing different basic constraints (the statistical significance was at 10% level). Dairy producers are more constrained by capital than are pig producers, while pig producers are almost twice as likely to nominate knowledge and information as a constraint, than are dairy producers in the same locality.

The Tanzanian producers' focus on seasonal feed constraints, and on land and water shortages, was most pronounced among those that did not sell to distant markets. This result is expected, as the more remote producers are also located less favourably for both natural resources and markets. For Uganda, market issues influencing constraints nominated by producers were significant. Interestingly, this relationship is most pronounced when pig and dairy producers are considered together, subdivided by market outlet to identify "market-oriented" buyers (selling to retailers for pig sales, and milk processing firms for milk).

For Tanzanian dairy producers there is a correlation between constrained land access and lack of information provision by crop extension services. Although at first glance this is a trivial result (they are specialist livestock producers and do not produce crops), its substance is as an indicator of the limited reach of advisory services. Further, this result reinforces the feed domain sessions' findings that crop residues are little used in Tanzania's drier areas and that producers are ill-

informed about them. Discussions during domain sessions reveal other information shortages: strangely high mortality rates due to lack of use of treatments, and ignorance of the existence of widely available vaccines.

Conclusions

This paper offers a method and procedure for constraint identification and analysis. It details results generated from testing the method on smallholder livestock producers in Tanzania and Uganda. The method offers a theoretically sound basis for analysis because it identifies decision-makers' objectives and allows interpretation of the data on constraints, in the context of those objectives. This is an improvement over methods that assume or ignore individuals' objectives, and so apply an inconsistent consideration of what is, in fact, being constrained. A striking result to emerge when testing the method, however, is that little evidence was found to support the assumption that constraints would be identified differently by farmers with different objectives. Further testing of the method, perhaps with an improved definition of objectives, will reveal whether this feature of the method is in fact redundant. A potential improvement to the method, not readily available to conventional survey methods, is the introduction of assistance to farmers in defining their objectives, which they may well experience difficulty in articulating.

The method recognises underlying (so-called "basic") constraints as the cause of apparent, more symptomatic problems that are referred to here as "declared" constraints. Assignment of declared constraints to basic causes was able to be achieved with farmers with some degree of ease, and this enriched the constraint nomination exercise and subsequent voting which established ratings of the constraints. The advance offered to empirical work on constraints is not only that root causes can be identified, but also that declared constraints can be analysed separately where their mechanism entails separate root causes. From the example data, for example, the multiple basic constraints influencing animal health were able to be identified and different approaches to solutions would appear to suit different localities.

Producers' identification of a large number of self-defined constraints requires some rationalisation by researchers to implement statistical analysis. From some 62 constraints identified in the examples' domain sessions, just 23 declared constraints emerged from coding the open-ended responses. Although this method maintained the principle of allowing producers to nominate their own constraints, it also required some degree of arbitrary aggregation, albeit preserving the linkages to separate basic constraints. Improvements to the method must then streamline and facilitate farmers' constraint identification capacities.

The method's avoidance of pre-defined constraints provides for more original and authentic input by farmers than would conventional ratings from a researcher's list. Further, the new approach employed is the combination of workshop and survey elements, with the goal of securing the benefits of both. Individual datasets are retained by way of survey elements, while calibration of thinking, identification of categories and choices, and consistency in units of measurement are among the benefits of group discussion.

Use of related or extraneous data is advocated in the method, and is employed in the example provided. The initial utility of this approach is in study design: identification of key parameters (such as the products to be studied) and issues to be examined for the relevance of constraints (such as access to high value markets). Subsequently, related data and studies can be employed to help define questionnaire content. A difference the method offers over conventional desk studies is that the information included in the questionnaire is used to measure influences on the impact of constraints rather than to define the constraints.

Financial cost of data collection, and the length of time between study initiation and result generation, are both reduced by this method over either conventional surveys or discussion groups. This result, borne out by the example described, follows from a much more intense use of specialists' time and the simultaneous delivery of 35–50 completed questionnaires in each workshop. Workshops on consecutive days can, as in this example, provide multiples of this number of observations and overnight data entry enables analysis to begin after a single day. The method requires support staff, but for shorter periods than do either field surveys or series of discussion groups, even including training and familiarisation time. For participating farmers, the method occupies an entire day, which is more time than is usually required by a survey or a discussion group.

A disadvantage of the workshop-based method is the loss of survey enumerators' capacity to assess on-farm variables (e.g. presence of specific machinery, identity of head of farm household) both for analytic purposes and to triangulate with other data. In the example used, a likely consequence is a restricted understanding of the nature of the capital and knowledge/information constraints which were nominated so widely, particularly by Ugandan pig producers. On-farm observations would better have been able to quantify relevant variables in each household than did the workshop-based exercise. This calls for better-designed questionnaires, perhaps incorporating proxy variables, than those used in the example. A further concern is that workshop participants may well not be household heads or decision-makers, and this problem was evident in the example by way of gender. Necessary improvements include increased vigilance on sampling and the identity of participants.

As with most field surveys and all discussion groups, the limitations of the method include its reliance on small samples from a small number of locations, minimising national-level inference. The small sample reliance is susceptible to bias in sampling. This problem is likely to be exacerbated by the multiple strata employed in sampling related to the very specific purposes of the analysis. Two avenues of approach appear in this regard: the avoidance of studies that require large-scale sampling integrity; or constant refinement of sampling procedure in association with increased sample size.

A technical issue specific to the method described here is that the workshop participants sit in close proximity to others while completing questionnaires. Moreover, assistance provided by workshop support staff may become repetitive to the extent that pressure is inadvertently exerted to reproduce others' responses. Finally, assistance from local extension staff and other local personalities may influence farmers' responses toward perceived approval. For these problem areas, quality control was applied, but the problem was likely not eliminated.

The method described here is a significant advance in approaches to data collection and to the operationalisation of constraint analysis. The results generated by its application to Tanzanian and Ugandan smallholder livestock systems are sufficiently novel and robust to encourage further application and development of the method. The limitations identified warrant further testing and validation in the field of agrifood production and marketing development. Nonetheless, the method could also be useful for other fields of development to identify the constraints faced by the poor regarding health, infrastructure, and employment.

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The three authors declare being employed by the institution undertaking the work described in this publication at the time of the research.

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Notes

1. Mukono and Wakiso districts of Uganda, and Mlale, Mvomero, Mkalamo, and Bungu districts of Tanzania.
2. Details are available from the corresponding author.

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