Suitability of project M&E systems to support agricultural MRV: The case of the Kenya dairy NAMA

Working Paper No. 231

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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Abstract

Several countries are developing nationally appropriate mitigation actions (NAMAs) in the livestock sector. Compared to research on emission factors, much less attention has been paid to understanding systems for collecting activity data on change in livestock management practices and animal performance. This paper presents a framework for synthetic assessment of MRV systems based on UNFCCC criteria for credible MRV. The framework is applied to case studies of two existing monitoring and evaluation systems in Kenya's dairy sector to investigate the extent to which these systems could be used as the basis for collection and reporting of activity data for a dairy sector NAMA in Kenya. Analysis of the case studies highlights three main findings: (i) codifying data collection, management procedures and roles is important for increasing transparency, while quality control and quality assurance systems play key roles in increasing confidence in data quality; (ii) milk yield is a key indicator used in estimating GHG emissions in the dairy sector, but further research is needed on potential sources of uncertainty and bias associated with different data collection methods; (iii) the involvement of multiple institutions in implementation of the sector-wide NAMA raises challenges related to the consistency and comparability between data collected by different institutions. Options for improvement in MRV practices will be determined to a large extent by the requirements of data users. These issues are not unique to Kenya's dairy NAMA. Further assessment of the quality of activity data and the characteristics of credible MRV systems will support practical improvements in MRV for agricultural mitigation actions.

Keywords

Agricultural NAMA; MRV; Activity data; M&E systems; Dairy

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Contents

Acronyms

AI	artificial insemination
CAVE	community agro-vet entrepreneurs
COP	conference of parties
CDM	Clean Development Mechanism
DFBA	dairy farmers' business associations
EADD	East Africa Dairy Development project
FPCM	fat and protein corrected milk
GHG	greenhouse gas
ICAR	International Committee for Animal Recording
IPCC	Intergovernmental Panel on Climate Change
KSh	Kenyan Shilling
M&E	monitoring and evaluation
MRV	measurement, reporting and verification
NAMA	nationally appropriate mitigation action
NKCC	New Kenya Cooperative Creameries, Ltd.
PO	producer organizations
QA	quality assurance
QC	quality control
UNFCCC	United Nations Framework Convention on Climate Change

1 The relevance of activity data collection systems to MRV of mitigation actions

Of 150 Intended Nationally Determined Contributions (INDCs) submitted by developing countries under the United Nations Framework Convention on Climate Change (UNFCCC), 92 state intentions to reduce greenhouse gas (GHG) emissions from livestock (Wilkes and van Dijk 2017). The effects of mitigation actions are quantified by a change in activities that emit GHGs (e.g. numbers of livestock), emission factors (i.e. emissions per unit of activity), or both. Considerable attention is being paid to measurement of emissions and estimation of emission factors (e.g., Veneman et al. 2016; Pelster et al. 2016). However, much less attention is being directed toward a better understanding of systems for activity data collection. Activity data, including information about farm management activities (e.g. head of cattle of different types, feed ration mixes) and farm performance (e.g. milk yields) are required to inform estimates of changes in emissions over time due to the implementation of mitigation actions. Along with emission factors, activity data are equally essential to the measurement, reporting and verification (MRV) of emission reductions attributable to mitigation actions.

This paper explores two existing monitoring and evaluation (M&E) systems in Kenya's dairy sector to investigate the extent to which these M&E systems could be used as the basis for collection and reporting of activity data in support of credible GHG quantification in a dairy sector NAMA in Kenya. One case study described is a farmer documentation system under development by a Kenyan dairy processor as part of its technical extension activities, and the other is the M&E system of a donor-funded dairy development project (see Annex 1). In this paper, we describe the characteristics of these systems as they relate to credible MRV, but do not evaluate their effectiveness.[1]

Here we develop a synthetic assessment of the systems for MRV and the remainder of this paper is structured as follows. Section 2 describes existing guidance for credible MRV under the UNFCCC, and sets out the criteria against which we assess the suitability of the dairy sector M&E systems. Section 3 introduces a GHG quantification methodology for smallholder dairy projects, which specifies the activity data required for GHG quantification in the dairy NAMA project. The fourth section summarizes the main findings from the assessment of the two dairy M&E systems, highlighting the ways in which these M&E systems do or do not conform to the UNFCCC principles for credible MRV. The final section discusses some key implications of the analysis for MRV of livestock mitigation interventions more generally.

2 Existing guidance on credible MRV under the UNFCCC

Existing guidance on MRV under the UNFCCC refers to both GHG emissions and the effects of mitigation actions.[2] Parties to the UNFCCC are required to report national GHG emissions to the Conference of Parties (COP). Guidelines for reporting by non-Annex 1 developing countries require the use of *Revised 1996 IPCC Guidelines for National GHG Inventories* (IPCC 1996) and the *Good Practice Guidance and Uncertainty Management in National GHG Inventories* (IPCC 2000) for the estimation and reporting of national GHG inventories.

[1] Note also that the initiatives described here have not been confirmed as initiatives under the proposed dairy NAMA.

[2] In the UNFCCC context, the scope of MRV also includes adaptation and support provided and received, but these are not considered further in this paper.

For MRV of mitigation actions, limited methodological guidance has been agreed under the UNFCCC (Wilkes and van Dijk 2017).[3] In general, it is expected that quantification methodologies will be consistent with guidance from the IPCC and other organizations (UNFCCC 2014). Existing approaches under the UNFCCC may also serve as a source of reference, such as the rules of the Clean Development Mechanism, which was established as a mitigation mechanism under the Kyoto Protocol.[4]

2.1 IPCC guidance on MRV and activity data

Under the UNFCCC, developing countries should apply the *Revised 1996 IPCC Guidelines for National GHG Inventories* and the *IPCC GPG and Uncertainty Management in National GHG Inventories* for estimating and reporting their national GHG inventories, "taking into account the need to improve transparency, consistency, comparability, completeness and accuracy in inventories", so that information can be presented in a "consistent, transparent and comparable, as well as flexible, manner, taking into account specific national circumstances" (UNFCCC 2003). The *Revised 1996 IPCC Guidelines* provide detailed instructions on the estimation of GHG emissions from sinks and sources across all sectors and on reporting to the COP. The IPCC's *Good Practice Guidance and Uncertainty Management in National GHG Inventories* (IPCC 2000) was issued to support "the development of inventories that are transparent, documented, consistent over time, complete, comparable, assessed for uncertainties, subject to quality control and assurance, efficient in the use of the resources available to inventory agencies, and in which uncertainties are gradually reduced as better information becomes available." (IPCC 2000: 1.3). These principles were further elaborated in the *2006 IPCC Guidelines*, which were adopted in 2013 for use in reporting by developed countries,[5] but which have so far not been mandatory for developing countries (Table 1). In addition, a further consideration frequently referred to in the IPCC Guidance, but not codified as an explicit principle, is that limited financial and human resources should be targeted most effectively for improvement of GHG inventories over time.

Regarding activity data, the *Revised 1996 Guidelines* give limited specific guidance, though further guidance was provided in the *2006 IPCC Guidelines*. In general, the IPCC guidance promotes the credibility of activity data as part of MRV systems by (i) providing **technical guidance**, (ii) recommending **rules and procedures**, and (iii) by highlighting **institutional arrangements** conducive to good practice in the operation of MRV systems (Wilkes *et al.* 2011). Selected specific IPCC guidance related to activity data is presented in Table 2. The table illustrates that in addition to technical measures to ensure the credibility of activity data collected, quality control and quality assurance activities applied to activity data are a critical aspect of credible MRV. Credibility can be further ensured by institutionalizing procedures roles, responsibilities in the national inventory process.

Table 1: Principles for credible MRV under the UNFCCC

Indicator	Summary
UNFCCC MRV principles	

[3] With the exception of REDD, where more detailed methodological guidance has been agreed. See http://unfccc.int/land_use_and_climate_change/redd/items/8180.php

[4] See https://cdm.unfccc.int/Reference/Standards/index.html

[5] See http://unfccc.int/resource/docs/2013/cop19/eng/10a03.pdf#page=2

Transparency	Assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information
Consistency	An inventory should be internally consistent in all its elements with inventories of other years, e.g. if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks, or, where different methodologies for different years have been used, if it has been recalculated in a transparent manner
Comparability	Estimates of emissions and removals reported in inventories should be comparable among Parties, i.e. agreed estimation methodologies and reporting formats are used
Completeness	An inventory covers all sources and sinks, as well as all gases, included in the IPCC Guidelines, and has full geographic coverage
Accuracy	Estimates should be accurate if they systematically neither over nor under estimate true emissions or removals, as far as can be judged, and uncertainties are reduced as far as practicable
CDM MRV principles	
Transparency	Project documents disclose sufficient and appropriate project-related information in a truthful manner to allow intended users to make decisions with reasonable confidence
Consistency	Projects apply the same methodology over a crediting period, and similar projects in different locations apply the same methodology. Validators and verification agencies apply uniform criteria to the same methodology, to projects with similar characteristics and to data sources.
Conservative-ness	Information can be considered as conservative if the GHG emission reductions or removal enhancements of a project activity are not overestimated.
Completeness	All relevant information for assessment of GHG emissions reductions and the information supporting the methods applied are supplied.
Accuracy	Checking for accuracy means: (a) For quantitative data and information: minimizing bias and uncertainty in the measurement process and the processing of data; (b) For non-quantitative information: minimizing bias in favour of a particular result
Relevance	Information can be considered relevant if it ensures compliance with the CDM requirements and the quantification and reporting of emission reductions achieved by a project activity.

Sources: http://unfccc.int/resource/docs/2006/sbsta/eng/09.pdf; https://cdm.unfccc.int/Reference/Standards/accr_man01_2.pdf and CDM Standard

2.2 Credible MRV in the Clean Development Mechanism

The Clean Development Mechanism (CDM) is one of the few mechanisms under the UNFCCC that has established explicit guidance for quantification of emission reductions due to mitigation actions. The CDM adopted an approach of a rules-based mechanism to establish the credibility of the emission reduction certificates issued by the mechanism. While the IPCC has not given any definition of credible MRV, the CDM validation and verification manual states that: "Information can be considered credible if it is authentic and is able to inspire belief or trust, and the willingness of persons to accept the quality of evidence."

In the CDM, specific technical guidance is provided in GHG quantification methodologies and tools. For the purpose of quantifying GHG emission reductions due to specific mitigation actions, these methodologies and tools are a critical supplement to IPCC guidance. In particular, the IPCC guidance provides no guidance on how to determine the GHG sinks and sources affected by specific mitigation actions. For example, promotion of improved livestock feeding will not only affect enteric fermentation, but may also change the use of inputs in agricultural production of animal feed, and may even affect land use on a larger

scale (Herrero *et al.* 2013). The CDM requires that GHG quantification and monitoring methodologies account for all significantly affected GHG sinks and sources.[6]

The CDM also refers to the need to "reduce bias and uncertainties as far as is practical/cost-effective, or otherwise use conservative assumptions, values and procedures to ensure that GHG emission reductions by sources or GHG removals by sinks are not over-estimated,"[7] implying that cost-effectiveness is a principle that can be applied in MRV-related decisions. For the collection of activity data through sample surveys, the CDM has issued specific methodological guidance, which *inter alia* require that sample surveys achieve a confidence of 90% and a precision of ±10%.[8]

However, the reliability and accuracy of activity data is only one aspect of the credibility of MRV in the CDM. The CDM Standard also sets out rules and requirements that must be followed by projects in order to demonstrate compliance with the standard. These rules codify procedures and the roles of key institutions involved in the operation of the mechanism (see Table 3). Similar to the CDM, other carbon standards in the voluntary carbon market and other compliance markets derive their credibility from a reputation for rigorous assessment of proposed methodologies and projects, for high requirements of the quality of monitoring data used to support emission reduction claims, and for the independence of validation and verification bodies

2.3 Criteria for assessing the credibility of agricultural activity data systems

In the agriculture sector, where a mitigation policy, programme or project may engage with hundreds of thousands of smallholder farmers, accurate quantification of changes in farming activities brought about by project interventions may be financially costly. In particular, costs may be high if new institutions, databases and procedures are set up specifically for MRV of agricultural mitigation activities (Basak 2016). It has been suggested that these costs can be reduced if existing data collection systems, such as agricultural M&E systems, are used to collect activity data (Wilkes et al. 2011). M&E systems were not designed for GHG quantification, so it is pertinent to assess whether existing M&E systems are suitable for MRV of mitigation actions in the agriculture sector.

We suggest that the credibility of agricultural activity data collection as part of MRV systems can be assessed in terms of the extent to which technical operations in activity data collection, rules and procedures, and institutional arrangements reflect principles of credible MRV. The preceding review of criteria for credible MRV suggests that IPCC guidelines are not directly applicable to the MRV of mitigation actions because they were developed for GHG inventories, which do not consider baselines and emission reductions in relation to the baseline, or the selection of GHG sinks and sources to be accounted for. The CDM rules were

[6] The CDM "Tool for testing significance of GHG emissions in A/R CDM project activities" defines insignificant sinks and sources as follows: "The sum of decreases in carbon pools and increases in emissions that may be neglected shall be less than 5% of the total decreases in carbon pools and increases in emissions, or less than 5% of net anthropogenic removals by sinks, whichever is lower". See https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf

[7] CDM standard

[8] CDM (2012) Guidelines for sampling and surveys for project activities and programme of activities.

devised with reference to MRV of mitigation actions, but there is no suggestion in negotiations under the UNFCCC that the CDM rules should be applied to other mitigation

actions, such as NAMAs. Recalling that UNFCCC guidance on MRV of mitigation actions indicates acceptance of the need to consider national circumstances, Table 4 presents a reinterpretation of the principles for credible MRV appropriate to the context of agricultural mitigation actions in developing countries.

Table 2: Specific guidance in IPCC 1996 and IPCC 2006 for credible MRV with special reference to activity data

<table>
<tr><th>Principle for credible MRV</th><th>Technical guidance</th><th colspan="2">Recommended procedures</th><th>Institutional arrangements</th></tr>
<tr><td>Transparency</td><td></td><td rowspan="2">Document and archive inventory material and record QC activities</td><td rowspan="4">Establish a QA/QC plan

Specify QC procedures, QA review procedures, and reporting, documentation and archiving procedures</td><td rowspan="4">Third party QA reviews

Define specific responsibilities and procedures for planning, preparation and management of inventory activities

Ensure other organizations follow applicable QA/QC procedures

Work with qualified agencies or personnel to make use of existing knowledge of representative sampling frames and technical contents and reduce costs</td></tr>
<tr><td>Consistency</td><td>Various methods recommended to deal with missing time series data, incorporating improved data</td></tr>
<tr><td>Comparability</td><td></td><td>Use a well-designed measurement programme with defined objectives, methods, clear instructions for data collection, processing and reporting and adequate documentation</td></tr>
<tr><td>Completeness</td><td>Various methods recommended to deal with incomplete coverage and missing data</td><td>Apply QC activities to ensure data completeness</td></tr>
<tr><td>Accuracy</td><td>use representative sample survey data or census data
Use measurement methods recommended by standards organizations and field tested to determine their operational characteristics</td><td>Apply QC activities to ensure data accuracy and correctness of any calculations</td><td></td><td></td></tr>
</table>

Table 3: Specific guidance in the CDM Standard for credible MRV with special reference to activity data

Principle for credible MRV	**Technical guidance**	**Rules and procedures**		**Institutional arrangements**
Transparency	Information in project documents and monitoring reports must state assumptions explicitly and substantiate choice of data values and methods	Requirement to disclose sufficient and appropriate project-related information in a truthful manner to allow intended users to make decisions with reasonable confidence Standardized templates for project documents and monitoring reports	Codified rules and procedures for accreditation of key actors, for registration, validation and verification of CDM projects and for certification, including completeness checks at registration and issuance	Independent third-party validation and verification by accredited institutions
Consistency	Application of same methodology to comparable activities in different sites Guidelines issued to guide justification of comparable decisions made in different locations	Same methodology must be applied throughout a crediting period; data for different years must be justified		
Conservativeness	Methodologies provide specific guidance, where appropriate, on estimation of conservative values	Conservativeness of claimed emission reductions subject to verification		
Completeness	Methodologies specify GHG sinks and sources to be accounted for	Standardized templates for project documents, including monitoring reports Third party validation of completeness of monitoring plans		
Accuracy	Guidance on sample surveys in CDM activities	Third party validation of accuracy of monitoring plans		
Relevance	Information in project documents and monitoring reports must state sufficient and appropriate project-related information in a truthful manner to allow intended users to make decisions with reasonable confidence	Standardized templates for project documents, including monitoring reports		

Table 4: Proposed criteria for activity data systems as part of credible MRV of agricultural mitigation actions in developing countries

Indicator	Summary
Transparency	Activity data collection, data processing and archiving methods should be sufficiently clearly explained to enable judgment with reasonable confidence by intended users of the reported information (e.g. national agencies involved in reporting mitigation effects) as to the completeness, consistency, conservativeness and accuracy of the data reported
Consistency	The same data collection methods should be used over time and between different locations in the same mitigation action, or if different methods are used in different years or locations, comparability between the methods should be assessed
Conservativeness	Estimated activity data should not lead to systematic overestimation of emission reductions
Completeness	Activity data required for the estimation of all relevant GHG sinks and sources should be collected
Accuracy	Methods for estimating activity data should minimize bias and uncertainty in the measurement process and processing of data as far as practicable

3 GHG quantification in the Kenya dairy NAMA

The objective of the dairy NAMA is to transform Kenya's dairy sector to a low-emission and climate resilient development pathway, while improving the livelihoods of male and female dairy producers (State Department of Livestock 2016). To increase on-farm dairy productivity, one of the main activities is to provide dairy advisory services to smallholder dairy farmers. These services may include technical advice, provision of animal health care and breeding services, and support for improved feeding and housing of cows. The effects of these actions on GHG emissions will be quantified using a "Methodology for Quantification of GHG Emission Reductions from Improved Management in Smallholder Dairy Production Systems using a Standardized Baseline" (FAO and Gold Standard 2016). While it is beyond the scope of this paper to give a full exposition of the methodology, some key features are highlighted because they set the requirements for activity monitoring.

The changes that farmers make in dairy management can effect on-farm emission sources (e.g. enteric fermentation, manure management) as well as emissions in the production, processing and distribution of feed (Figure 1). GHG emissions from activities that are necessary for dairy production and that are directly controlled by dairy farmers need to be accounted for. Thus, emissions from cattle primarily used for beef production and emissions in transport and processing after the farm gate do not need to be accounted for. Furthermore, emissions embodied in farm facilities (i.e. equipment and buildings) were excluded on the basis of analysis suggesting that these emissions are insignificant over the lifetime of the facilities.

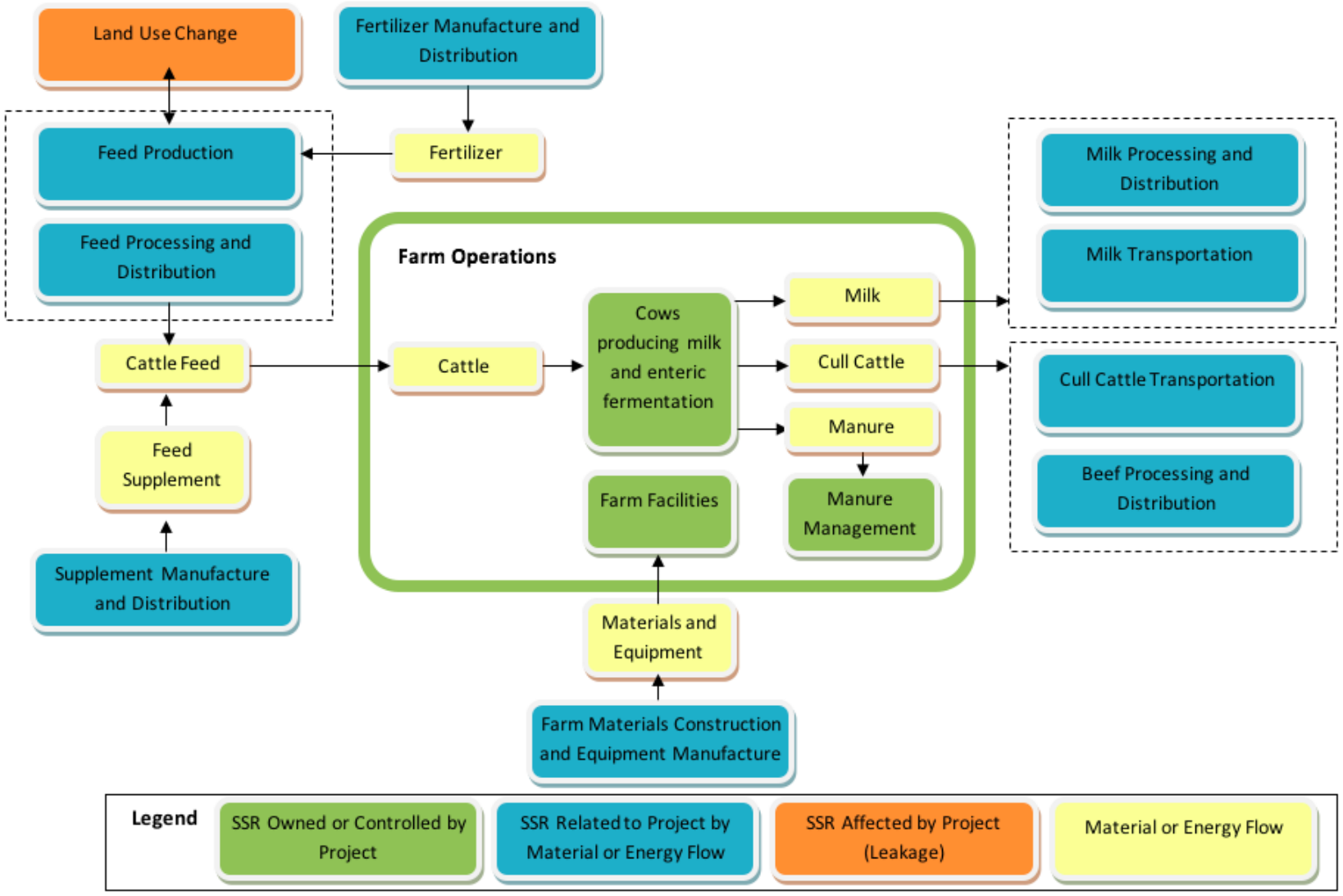

Figure 1: GHG sinks and sources potentially affected by dairy development interventions (FAO and Gold Standard 2016)

Collecting accurate data on various parameters related to each of these sinks and sources for many smallholder farms each time a farm takes part in a NAMA-supported activity and every year thereafter would be prohibitively expensive. The methodology therefore adopts an approach recommended by the CDM to reduce the transaction costs of monitoring, i.e. a standardized performance baseline. In brief, a representative sample survey should be undertaken in the target region that covers all dairy production systems present in the region. In the case of Kenya, the main dairy production systems include intensive zero-grazing systems, semi-intensive production where cows are stall-fed and graze for part of the time, and extensive systems where grazing predominates. For all farms sampled, detailed data should be collected on cattle populations and herd dynamics, feed practices, manure management practices, herd management practices and milk yields. This data is used to estimate the GHG emission intensity of dairy production (kg CO_2e / kg fat and protein corrected milk [FPCM]) for each farm, including GHGs occurring off-farm but embodied in cattle or feed used on-farm. Research has shown that, because energy from feed is used for maintenance of the animal and for the actual production of milk, as milk production increases, the contribution of maintenance emissions decreases relative to the production-related emissions, and there is a negative relationship between GHG emission intensity of dairy production (kg CO_2e/kg milk) and milk yield per cow per year (Gerber et al. 2011; Christie et al. 2011) (see Figure 2).

Using the relationship established on the basis of the regional baseline survey between GHG emission intensity and milk yield per cow per year, GHG emissions can be estimated using data on milk yield collected through project monitoring systems. The change in GHG intensity may be due to change in feeding, herd management, animal health or other practices. From a GHG accounting point of view, it is not necessary to know and quantify the changes in management practice that occurred, because milk yield is taken as a proxy measure for the combined effects of different management practices adopted on each farm. Monitoring GHG emissions from smallholder dairy production can thus be accomplished using data on milk production per farm, number of cows per farm, and the dairy production system used in each farm (e.g. in the case, such as in Figure 1, where different farm types have different relationships between GHG intensity and milk yield). Total absolute GHG emissions can be estimated by multiplying the GHG intensity (kg CO2/kg FPCM) by the total mass (in kg) of fat and protein correct milk produced, and emission reductions can be estimated as the difference between total emissions during a project year minus total emissions if the same amount of milk was produced at the pre-project GHG emission intensity:

$$ER_{P,j,t} = \left[\frac{(BEI_{BS,j} \times Total\ Milk\ Yield_{P,j,.t}) - (PEI_{P,j} \times Total\ Milk\ Yield_{P,j,t})}{1000}\right]$$

Where:

$ER_{P,j,t}$ = Emission reductions for the *j*th farm in project year *t* (tonnes CO_2e)
$BEI_{B,j}$ = Baseline emission intensity for the *j*th farm (kg^{-1} CO_2e * kg $FPCM^{-1}$)
$PEI_{P,j}$ = Project emission intensity for the *j*th farm (kg^{-1} CO_2e * kg $FPCM^{-1}$)
Total Milk Yield$_{P,j,t}$ = total fat and protein corrected milk yield of all individual cows on the *j*th farm in project year *t*
1000 = Conversion from kg^{-1} to $tonnes^{-1}$ of FPCM
BS = index of baseline scenario
P = index of project scenario

In summary, the key variables to be monitored for quantification of GHG emission reductions are the milk yield per cow, or milk production per farm and the number of (dry and lactating) cows per farm.[9]

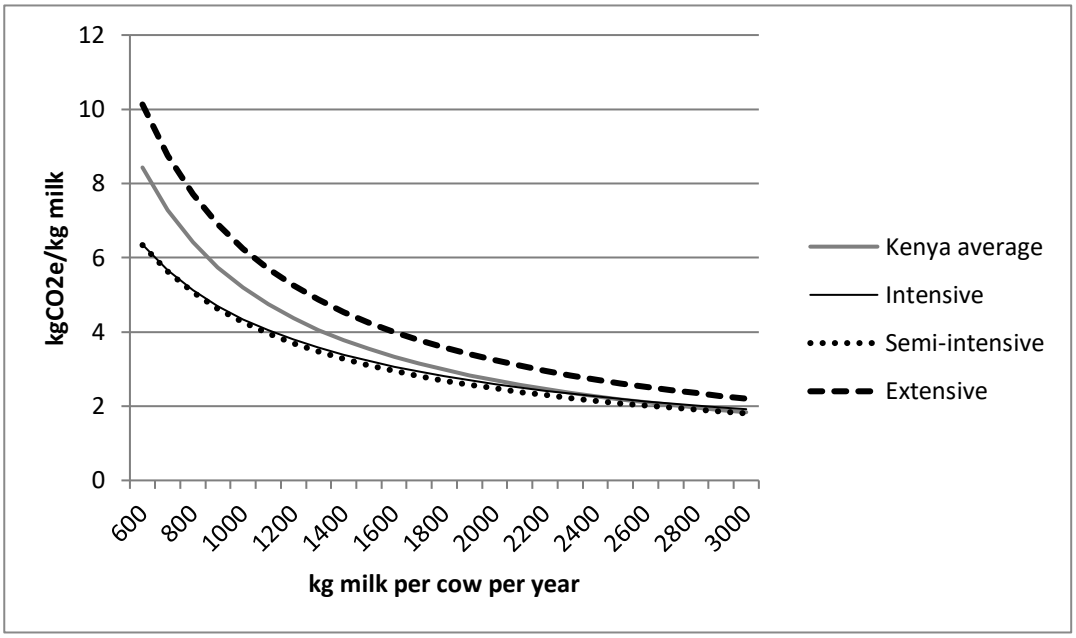

Figure 2: Relationship between milk yield per cow and GHG intensity in different dairy production systems in Kenya

Source: Data provided by C. Opio, UN FAO.

[9] FAO and Gold Standard (2016) also requires that the fate of all cows leaving the farm (e.g. due to mortality, sale, gift, theft or other reason) is recorded. This is not used in GHG quantification, but is intended to enable enumerators to cross-check the cow numbers reported by farmers at each monitoring event.

4 Assessment of existing dairy M&E systems

Two M&E systems in Kenya's dairy sector were selected for analysis to assess their suitability as the basis for MRV in the Kenya dairy NAMA. Each M&E system was described through a case study process using the same information checklist, which was based on the criteria described in Table 4. One case study described is a farmer documentation system under development by New KCC, a Kenyan dairy processor, as part of its technical extension activities, and the other is the M&E system of a donor-funded dairy development project, the East Africa Dairy Development Programme (EADD). Further details of each initiative and its M&E system are given in Annex 1. This section synthesizes the key findings.

4.1 Quality Assurance / Quality Control

Table 4 suggested that activity data collection, data processing and archiving methods should be sufficiently clearly explained to enable judgment with reasonable confidence by intended users of the reported information (e.g. national agencies involved in reporting mitigation effects, or third-party verifiers accredited by a carbon standard) as to the consistency, conservativeness and accuracy of the data reported. In addition, we find that quality assurance and quality control procedures can play a key role in establishing the credibility of data collected.[10]

In the case of the EADD project, data collection, data management and organizational processes of the M&E system are clearly described in the project M&E manual. This describes data parameters, data collection tools, frequency of data collection, methods of data analysis, responsible persons, and related assumptions. The basis of EADD's M&E system is farmers' self-reported farmer records, which are complemented by data from household surveys administered by extension officers and community-based service providers. Data is compiled into a database at the 'dairy hub' level,[11] where it is linked to each individual farmer's registration details. This enables cross-checking between farmer reported data and data included in contracts for milk supply

[10] IPCC (2006) defines quality control as "a system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled", while quality assurance is "a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process" to ensure that data quality objectives are met.

[11] Dairy hubs are producer organizations that collect, bulk, chill and market milk, as well as providing farmers with access to dairy inputs, banking and other services provided by partner organizations (Mutinda et al. 2015).

or service delivery. The M&E manual specifies the responsibilities of staff for checking for inconsistencies in data and ensuring data quality.

In the case of New KCC's farmer documentation system, because the system is still under development, data collection and management procedures have not been fully codified. Standardized data collection formats are being used. Data quality checks are conducted by cross-checking data on hard copy data collection sheets, and then by inspecting data input into software for outliers and cross-checking that the sum of sub-totals equals total values and to identify any other suspect data. If suspect data are identified, the farmer registration form records the name and contact details of the person who filled in the form and of the farmer, so the data can be cross-checked or obtained again. Data from individual farmers are aggregated at the milk collection point. At present, not all milk suppliers are registered in the farmer documentation system, but eventually it should be possible to cross-check aggregated trends in production data from the farmer level with trends in procurement data at the milk collection point, which would add a further internal cross-check on the quality of the reported data. However, the latter data may not be easily made public, as it relates to the commercial interests of NKCC. In terms of roles and responsibilities in the farmer documentation systems, formal roles in the documentation system have not yet been included in contracts between the extension committee and service providers. Furthermore, QA/QC roles and procedures have not been formally defined. Further codification of specific data collection, processing, data management and QA/QC tasks, roles and responsibilities and technical requirements related to each of these would enhance the consistency and completeness of data collected. Codification of data collection rules and procedures would not only be useful for training and reference materials for those involved, but would also enhance the transparency of the documentation system to other stakeholders.

In summary, clear documentation of data collection and management procedures and related roles and responsibilities increases the transparency of data collection systems. Implementation of QC procedures can contribute to ensuring the completeness, consistency and accuracy of the data collected. The documented implementation of QA procedures, such as review of the conduct of QC procedures, can further build confidence that data quality objectives are being met.

4.2 Accuracy of data collection

Both M&E systems documented in the case studies use a census approach, covering all milk producers involved in the dairy development initiative, rather than a sample survey approach. In the case of NKCC's farmer documentation system, which is still under development, once farmer registration is complete for all NKCC's long-term

suppliers, the target population will be fully represented. This will enable each NKCC milk collection point to plan milk procurement and delivery to processing plants based on long-term supply contracts with registered farmers. In the case of EADD's M&E system, data is collected on all suppliers to participating dairy hubs, as this data is essential for payment and accounting purposes in the dairy hub.

In both the NKCC and EADD documentation systems, the critical data on milk yields and herd structure are collected during visits by extension workers (or other business representatives, in the case of EADD) to participating farmers. In the NKCC system, at present milk yields are reported by farmers to extension workers, who record it on data collection sheets, but it is intended to promote record keeping by farmers. In the EADD project system, milk yields are first recorded by the farmer on daily milk recording cards or other data sheets, which is reported to and documented by extension workers during farm visits.

There are several issues to consider relating to the accuracy and bias of milk yield and herd data collected through farmer self-reporting. Issues relate to **measurement accuracy**, **delineation of annualised estimates** as well as **intentional reporting biases** that may arise. The International Committee for Animal Recording has issued internationally recognised standards that can be used as a basis for addressing many of the design challenges that these issues raise (ICAR 2016).

(i) Accuracy of milk yield measurements and estimates: The most commonly used equipment for measuring milk yield in Kenya include hanging scales, non-graduated buckets and aluminium cans. Each of these methods have potential sources of error: calibration and maintenance can affect scales; for buckets and cans, errors can emerge from the estimation of volume based on percentage filled. Guidelines recommend using calibrated equipment with a minimum sensitivity of 250g/250ml, which could utilise flow meters, scales or graduated containers (i.e. marked at 250 ml increments; ICAR, 2016). Furthermore, conversion between volume and weight depends on milk density, which can be highly variable depending on factors such as temperature and fat content.[12] Depending on the variability of milk density, volume and weight measures could be used in tandem in the project area.

The adoption rate of record keeping is typically low for smallholder farmers in Kenya. In the absence of on-farm record keeping, documentation systems need to rely more on project staff, technology and/or estimations. The ICAR guidelines allow for

[12] The East African standard for raw milk gives an acceptable range of 1.026 – 1.038 g/ml at 20°C (EAC 2006).

reporting by official representatives, farmers or a combination of both (ICAR, 2016). Morning and evening milk yields can be recorded on sequential days, and where this is not possible the guidelines provide a method for estimating morning or evening milk yields based on a partial daily measurement. Where farmer reporting is used, the lag time for reporting should be minimised. Farmer recall of milk yields has been tested to some success at the aggregate herd level in Mali, with annualised recall estimates deviating from monitored estimates by as little as 3 percent (Zezza et al., 2014). However, errors may be greater in Kenya, where milk yields are higher. This highlights the need for further research on the accuracy of data collection methods in different contexts.

(ii) Estimating annual milk yields: Further considerations arise when estimating yield over time. The ICAR guidelines recommend using the Test Interval Method, which interpolates daily milk off-take between measurements as their average (ICAR 2016). The frequency of measurement, period of measurement, suckling of calves, and observations of sick animals may all introduce errors and bias into estimates.[13]

The ICAR guidelines allow for daily, weekly, monthly and up to 9-week measurement intervals. A greater interval will tend to overestimate yields. The period of measurement requires reporting on calving date and date dried, and is complicated by calf suckling and cows with an extended lactation. Farmer recall of calving date should be adequate due to the salience of such an event and the limited recall period between visits (de Nicola, 2014; Beegle, 2012; ICAR, 2016). The ICAR guidelines for cattle assume a minimal and consistent weaning date (calf suckling period) after calving. Guidelines on sheep do consider that suckling periods may be long, and recommend monitoring after weaning but before 80 days post-calving. Given the prevalence of extended suckling periods in Kenya, this would imply estimating the annual total of milked milk as a standard, excluding the pre-weaning period). However, this could bias estimates over time if it incentivizes changes in calf rearing practices that are not targeted in the mitigation activity. An alternative would be to collect data on the duration of calf suckling, milk off-take during suckling and milk off-take shortly after weaning, which would enable a more accurate estimate of annual milk yield.

End of lactation can be based on actual drying of the cow, a minimum yield and/or a maximum time period. The minimum yield set in the ICAR guidelines (<3 L/day) is

[13] ICAR guidelines recommend that observations of sick animals that have decreased their yield by 50 percent compared to the previous observation are taken as missing values in the dataset, and may require a repeat visit to ensure enough data for annual estimation.

inappropriate for the smallholder context in Kenya. A locally relevant cut-off could be established instead. Setting a maximum time period until drying would tend to overstate yield[14], but extended lactation beyond this period by some cows would result in an underestimate of annual yield. An alternative would be to record cows' drying dates, and if the lactation period is longer than 12 months, the cow would be excluded from monitoring in the following year, but included in herd register, thus contributing to increased emission intensity for the subsequent year.

With the purchase and sale of animals, herd dynamics further complicates milk yield estimates, particularly in obtaining cow parity; a farmer may not know how many times a purchased cow has calved.

(iii) Intentional reporting biases: Farmers can be reluctant to reveal information on herd size and milk off-take. Herd size may be sensitive information that they wish to keep assets hidden from credit institutions or minimise theft risk. Milk off-take can be sensitive information when farmers wish to sell to the informal market and keep it hidden from other market avenues, such as processors. These factors may limit participation in monitoring or bias responses.

4.3 Opportunities and challenges of diverse data collection systems

Where livestock sector NAMAs have a large geographic scope, or involve promotion of a range of livestock development and GHG mitigation practices, it is likely that several institutions will be involved in NAMA implementation. This raises potential challenges related to the consistency and comparability between data collected by different institutions. For example, each of the M&E systems studied in Kenya has developed or is developing standardized data collection and management procedures. When codified in manuals, these procedures can increase confidence in the ability of each M&E system to collect consistent data. However, differences between institutions in data collection methods and management procedures may result in differences in the reliability and credibility of the data reported.

The options for addressing these issues will be determined in part by the requirements of the data users. If emission reductions due to NAMA implementation are to be certified by a carbon standard, then it must be verified that the full requirements of the carbon standard have been met. MRV procedures applied by all implementation

[14] For example, an assumed 305 day lactation with monthly milk reporting and an end of lactation yield of 3 L / day could result in up to 90 L of error in an annual estimate. If the starting yield was 10 L, this could be as much as an additional 3% on the annual estimate.

partners would have to meet the standard's requirements from the outset. One way to achieve this would be to develop a standardized data collection method for the Kenyan smallholder context, and to train people responsible for data collection in all NAMA implementation partner organisations in use of the method. This would ensure consistency between data collected by different initiatives, and ensure coherence with the requirements of the carbon standard. Further studies of sources of error, bias and uncertainty in the data collected could recommend improvements in data collection methods. If changes in data collection methods occur during project implementation, it should be demonstrated to the satisfaction of the carbon standard's verifying body that the change in method does not tend to overstate emission reductions.

However, from the case studies, we note that the roles of farmers, extension workers and other staff or partners in data collection is determined not by data collection needs, but by the business models for extension service delivery and milk hub operation. Roles and responsibilities in the business model – which determine the costs of data collection – also determine the choice between farmer documentation, verbal reports by farmers or other methods. There is a risk that imposing coherence in data requirements among implementation partners would impose additional costs and potentially incentivize procedures that undermine the credibility of MRV.

If MRV of the NAMA refers to the GHG quantification methodology approved by the carbon standard, but uses other institutions for the key MRV functions, different options for addressing data challenges are available. Within the UNFCCC context, agreed requirements for MRV stress the importance of considering national circumstances, including capacities and resources, and national priorities. Coherence among implementation institutions' practices would be determined by the requirements of national policy makers, and the requirements of funding agencies and their execution agencies. This might leave greater opportunity for improvement in MRV over time. For example, studies could be undertaken in collaboration with each NAMA implementation partner to assess existing QA/QC systems, and to assess the accuracy of milk yield data recorded. Identifying sources of error, uncertainty or bias for each M&E system would enable improved methods to be developed that are suited to each institutional context, and thus to avoid imposing additional costs on NAMA implementation partners' data collection activities. This would support improvements in data quality over time, a practices that is supported in IPCC guidance. Furthermore, the diversity of methods, procedures and institutional arrangements for data collection and management among NAMA implementation partners suggests the potential for cross-learning between initiatives in support of gradual improvement over time.

5 Conclusions

This study analyzed two M&E systems for their suitability as the basis for credible MRV of the Kenya dairy NAMA. Assessment against criteria adopted under the UNFCCC for credible MRV identified the importance of codifying data collection and management procedures and roles in data management processes for increasing transparency. Quality control systems can play key roles in ensuring the completeness, consistency and accuracy of data, while quality assurance systems further increase confidence that data quality is being maintained. The case studies also found that each organization has or is defining a data collection system designed to meet their own purposes, and that decisions affecting choice of data collection method may be driven by the roles and responsibilities of different partners in the dairy development initiative, rather than on data quality considerations alone.

Both M&E systems described use farmer self-reported data on milk yields, and possible sources of error and bias have not been assessed. The accuracy of farmer self-reported milk yields is a key issue that could either be addressed by developing standardized data collection protocols or by undertaking in-depth studies of data quality in each institutional context to support improvement in data quality over time. The extent to which consistency, comparability and coherence among institutions is required depends on users' demands. Users' requirements therefore determine the options and suitable strategies for improving the quality of MRV.

These issues are not unique to the Kenya dairy NAMA. NAMAs are often developed in partnership with multiple stakeholders, and several institutions – including the government, NGOs such as farmer associations, the private sector and banks – may play key roles in the promotion and implementation of mitigation measures. The case studies from Kenya suggest that in many agricultural NAMA initiatives, more consideration should be given to the issue of diversity in data quality collected by different partners, and how this can be managed to ensure accuracy and conservativeness of the overall emission reductions claimed. The quality of activity data available for MRV of agricultural mitigation actions has not been previously assessed. Studies of the reliability and validity of data collection tools will help inform decision-makers of their appropriateness for use in MRV of mitigation actions.

The case studies from Kenya highlight the importance of understanding existing data collection systems and their institutional context for designing credible MRV systems. In particular, the reliability and validity of data collection methods are only one aspect of the credibility of MRV. Codification of MRV procedures, roles and responsibilities, and the implementation of QA/QC procedures can play a major role

in supporting credible MRV. The analysis here assessed the characteristics of two existing M&E systems in relation to criteria for credible MRV, but the operational effectiveness of these M&E systems was not assessed. A better understanding of stakeholders' data quality needs, and institutional and technical issues affecting the operation of M&E systems and the quality of activity data, should not only help inform the design of MRV systems, but also assist stakeholders in improving the availability of good quality data to serve their business needs.

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Annex: Case studies of dairy M&E systems

A. New KCC's farmer documentation system

A.1: General description of the project

1.1 What are the project's stated objectives?

New Kenya Creameries Corporation (NKCC) is Kenya's second largest milk processor. Its predecessor was a wholly farmer-owned corporation, but the New KCC (NKCC) is fully state-owned. It currently processes about 160 million litres of milk per year. NKCC's core business is to procure high quality raw milk from farmers, to process, package and market the milk and milk products (Menjo 2015). Increasing the volume of secure supply is crucial to the company's business success. In the last 3 years NKCC has begun developing an approach to engage with farmers who provide long-term and stable supply in order to increase milk production by farmers and the supply procured by NKCC. This approach provides extension, financial and dairy service support to the farmers. The system is currently being developed in 17 milk catchment areas, and the information presented here is derived from a case study of the Molo milk catchment area in Molo sub-county. The Molo milk catchment area covers four sub-counties in Nakuru county (Kuresoi South, Kuresoi North, Molo and Rongai) and two sub-counties in Kericho county (Kipkelion East and Kipkelion West).[15] The case study presented here (conducted in November 2015) focuses on the extension and related documentation system. This system is still under development, as staff and stakeholders leading the process learn by doing.

1.2 Who funds the project and who implements the project?

The system is funded and implemented by NKCC in cooperation with other stakeholders and service providers in the target locations. The finance derives from a KSh 0.50 deduction from the price of milk (KSh/litre) paid to participating long-term suppliers. In each catchment area there is an extension committee that is responsible for the management of the funds from NKCC and the implementation of the extension and documentation system.

1.3 Who are the beneficiaries?

NKCC estimates that it has about 54,000 supplying farmers. It distinguishes between long-, medium- and short-term suppliers. The focus of the extension services initiative

[15] Many thanks to Samuel Musembi, Andrew Muleki and Dominic Menjo for providing the information on which the case study is based.

is on long-term suppliers, who supply a consistent volume of milk across seasons. These suppliers are given annual contracts stating an annual average milk price, are guaranteed prompt monthly payment and are eligible to access the full range of extension and dairy services support in the programme. Medium-term suppliers make 3 month supply agreements with NKCC, but often change supply depending on seasonal and price factors. Medium-term suppliers may graduate to long-term supplier status after consistently providing milk to NKCC for 6 months. As part of this initiative, NKCC is in the process of registering long-term suppliers. Short-term suppliers have no contract and receive a price based on current market prices. The prices offered to short-term suppliers are lower than what is offered to long-term suppliers.

One key objective of the initiative is to secure stable, long-term supply for NKCC. Hence, only long-term suppliers are eligible to benefit from the services of this programme. As of November 2015, about 18,000 farmers had been registered under the umbrella of long-term suppliers in 17 milk catchment areas, covering parts of 11 counties. The actual contractees are farmer groups, cooperatives and private companies. The majority of their members are smallholders. In Molo district, where the case study was conducted, there were 15 long-term suppliers with just over 1200 farmers registered. 70% of registered farmers have 5 or fewer cows, and the highest herd size in Molo is 39.

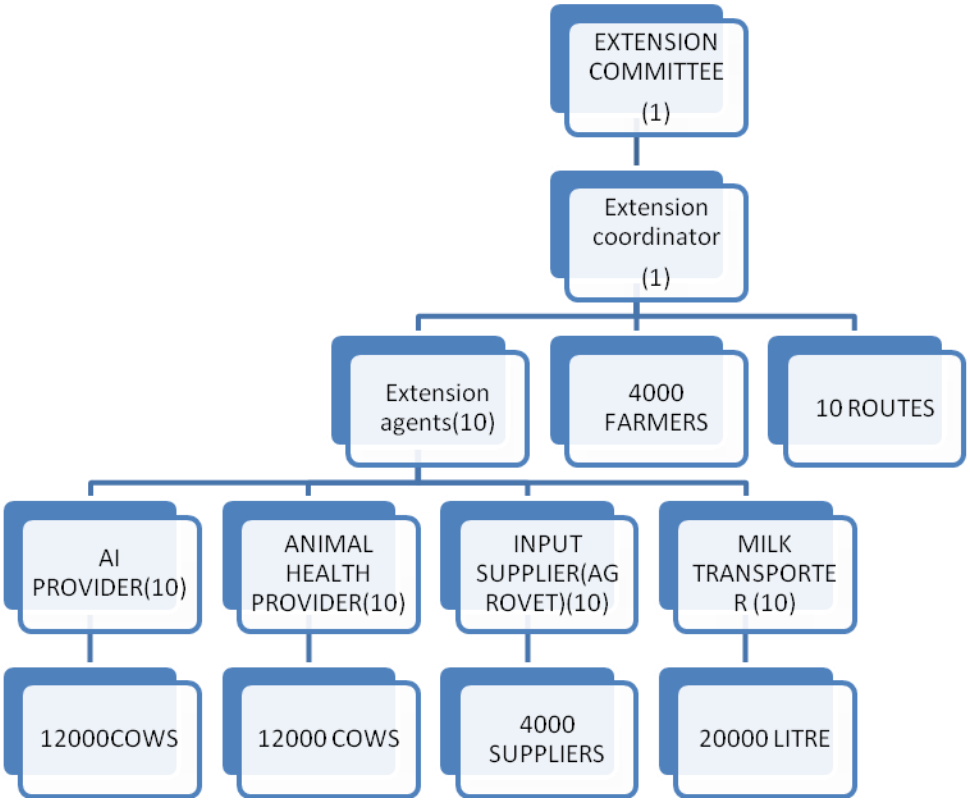

Figure A.1: Overview of the extension system

Source: Menjo (2015)

1.4 What activities are supported by the project?

The extension system is based around 'locations', with each location defined by the milk supply catchment of NKCC's processing plants. In each location, an extension committee is established. Each extension committee has 9 members, including the NKCC plant manager, district livestock officer (as an ex-officio member), and 7 members drawn from the cooperatives or farmer groups. The committee is responsible for recruitment of an extension coordinator, recruitment of extension agents, management of the extension activities and establishment of linkages with other service providers within the catchment area. Each milk catchment area is divided into 10 milk collection routes and an extension agent is hired by the extension committee to coordinate extension activities in each route. The target is for each route to register 400 farmers as long-term suppliers. As of 2015, there were eight established routes within the Molo milk catchment area namely Elburgon, Molo, Olenguruone, Keringet, Kuresoi, Londiani, Chesir/Cheprion and Sirikwa/Baringo, and plans were underway to initiate two more routes for the catchment area. A route needs to deliver a minimum of 2000 litres of milk for an extension agent to be posted to manage its activities.

The extension agents are expected to train farmers and link them to agrovets, AI services, milk collection, animal health services and financial services. The intention is that each registered farmer should receive at least one visit a month from either the extension agent, AI technician, animal health service provider or agrovet input supplier. It is expected that NKCC will sign service provision contracts with all the service providers. However, to date contracts have only been signed with extension agents, milk transporters, and a financial institution. Pilot activities are ongoing regarding contracts with AI, agrovet input and animal health service providers.

During the monthly visit by the extension agent or the service provider they are expected to document ongoing activities within the farms. In cases where an input or service is provided the farmer signs a form indicating the services or inputs received, and NKCC pays the service providers for the services provided through the check-off system. Where producers are organized into farmer groups, cooperatives or companies, NKCC supports service provision using the existing extension services of the organization, if it already exists. If there is no existing extension system, then NKCC will contract service providers to ensure that the services are provided.

A.2: Overview of the M&E system

The documentation system is still under development. As of November 2015, it had two basic components: (i) farmer registration and (b) an individual cow monitoring component. Details of the information collected in each of these components are further described in Section 3. Farmer registration had been completed for 18,000 farmers, while the individual cow monitoring process had begun for about 200 households on a pilot basis. Further development of the individual cow monitoring process is related to further development of the contracting arrangements with dairy service providers as described above. Since the documentation and monitoring system is still under development, there are no written manuals or written procedures to describe the system or guide its implementation.

2.1 What purposes and functions are fulfilled by the M&E system?

The documentation system fulfils a number of functions, which are interrelated in the functioning of the milk supply/procurement and extension system:

For NKCC:

(1) Registration of long-term suppliers provides information on the potential for different locations, routes and suppliers of milk;
(2) The registration and monitoring information enable identification of farmers' general needs for services and inputs, and thus targeting of dairy services or bulk input purchases;

(3) The data management system enables monitoring of service supply by contracted suppliers, which is then used to pay those providers;
(4) It is intended that in the future milk quality monitoring will also enable monitoring of milk quality and targeting of interventions to improve the quality of milk at the farm level.

For extension agents and service providers:

(5) The registration and monitoring information enable identification of farmers' general needs for services and inputs, and thus targeting of dairy services;
(6) The cow monitoring system provides information on calving, lactation status and productivity, enabling targeting of extension advice and dairy services or bulk input purchases;
(7) The data management system documents service supply by contracted suppliers, which is the main basis for payment claims;
(8) Monitoring the activities of service providers for better coordination by the extension agent.

For farmers:

(9) Registration and provision of monitoring information is a precondition for access to extension advice and services;
(10) Monitoring information assists in the identification of needs, problems and issues affecting the household dairy enterprise, and thus the identification of extension advice and dairy services needed;
(11) The availability of cow monitoring data (e.g. on vaccination or de-worming measures taken or reproductive status) enable service providers to proactively provide services to farmers;
(12) Documentation of the services provided by different service providers. This acts as verification for the deduction made on the farmers account through the check-off system.

In addition to the above, data obtained on feed resources and feed gaps are currently being used to explore the potential for NKCC to assist farmers to meet feed gaps with commercially produced feed and fodder.

2.2 Who are the users of the outputs of the M&E system?

At present, the farmer registration component has the following uses and users:

(13) During the current phase of development of the system, data on the number of registered farmers is used by the extension coordinator as an indicator of extension agent performance;
(14) The information in the registration form on numbers of cows, fodder sources, milk output and existing dairy service suppliers is used by the extension

coordinator to understand the general needs for extension and dairy service support of each household. Extension agents can analyze the household data to identify unusual situations (e.g. low yields, fodder constraints) that might need to be addressed.

(15) The aggregate data from farmer registration is used by the NKCC cooling plant to estimate potential milk supply from each milk collection route. This information is used by the plant to plan milk procurement and processing volumes, which are reflected in the long-term supply contracts with suppliers;

(16) The farmer registration form also includes information on the location of each supplier and the distance of each supplier from coolers and bulking points, and can be used by NKCC or other stakeholders (e.g. county government) to identify where there is a need to invest in new coolers or bulking points.

In addition to farmer registration, a feed gap analysis is also conducted for each household. This information can be used by farmers and extension agents to identify options for increasing on-farm fodder production. At present, NKCC is using the aggregate information on feed gaps to identify the total need for additional feed supply of its long-term suppliers, and is exploring options for bulk purchase of feed from commercial feed suppliers.

It is intended that the individual cow monitoring component has the following uses and users:

(1) The system will give data on production per cow. The primary use of individual cow productivity data is to assess whether cow performance is satisfactory or whether underperformance is an indication of an issue in dairy management to address or service provision needs (e.g. mineral salts or other inputs). This assessment can be made by the ***farmer*** or by the ***extension agent*** or ***dairy service provider*** in discussion with the farmer.

(2) The system will eventually enable collection of lifetime data on each cow, for assessment of genetic potential. A potential use of this information is to enable ***farmers*** to provide evidence of the genetic potential of progeny to increase sales value. The data will also be used a basis of registration with the Kenya Stud Book. Plans are at an advance stage to train all the extension agents.

(3) The cow-level data can be used to predict on-heat dates and calving dates for planning of artificial insemination (AI) service provision, and by recording de-worming activities can also inform when follow-up de-worming is required. This aspect of data is to be used by the ***extension agent*** and ***service providers*** to target timely provision of dairy services.

It is also intended in the future that monthly extension visits are also used to take milk samples to measure milk quality parameters. This will help NKCC ensure the quality of supplied milk and help identify suppliers providing poor quality milk. However, due to lack of a Lactoscan analyzer, this work is not conducted yet in Molo district.

2.3 How is M&E organized?

The extension agent in charge of each route is responsible for ensuring that farmer registration is done, and when the cow monitoring work is scaled up from the pilot level, they will also be responsible for ensuring that cow monitoring is done. Currently, farmer registration and the initial establishment of individual cow data sheets is done by extension agents, and also hired agrovet input suppliers, AI suppliers and animal health providers. It is intended that each farm should receive a visit each month from either one of these service providers, and that farmer registration and individual cow monitoring can be conducted by any one of these service providers. Where long-term suppliers have their own extension agents, they are involved in data collection, being hired by the extension committee as extension agents or service providers.

The extension agents are accountable to the extension committee's appointed extension coordinator. The extension coordinator inputs data into spreadsheets and a specially designed software, and cross-checks and analyzes data. Aggregate data are shared with relevant colleagues in the milk plant and in NKCC headquarters.

A.3: Collection of monitoring data, reporting and quality control

3.1 What monitoring data is collected?

Data collection works at two levels: (i) farm household, and (ii) individual cows.

(i) Farm household. The household level data is collected initially through a farmer registration form. This includes basic data on the farm household and its location; cattle herd structure and numbers; land holdings and land area under different fodder types, as well as dairy meal used per day; an estimate of milk output and its uses; information on the distance of the household from key logistical points; and a list of service providers used by the household.

On milk yield, the form records a farmer self-reported estimate of the total weight (kg) of milk produced per day. Although the form records the date of farmer registration, the question on the form does not specify whether the milk output is the current output or an estimate of average output. Also, not noted on the form but reported by extension staff, the output recorded is the morning milk (i.e. that which is supplied to NKCC), and does not include evening milk. The form also records an estimate of how much milk per day is consumed by the household and by the calf, and

how much is sold, also farmer self-reported values but not specifying if these are average or seasonal or current estimates. The average yield of lactating cows is derived after data entry by dividing the reported daily milk produced on each farm by the number of reported lactating cows.

This form is an initial registration form. In principle, this information can be updated during every monthly visit, and when data is input into the farmer registration software, past data is reportedly saved so that changes over time can be measured.

In addition, a feed gap assessment is undertaken. The feed gap assessment is based on the data on cow numbers and land areas under different feed crop types. The data is input into the farmer registration software, and default values specific to the milk catchment area are applied for unit area yields and for balanced diet, providing an estimate of total feed demand by feed type and an estimate of the feed gap for each feed type. The feed types considered are hay, Napier grass or silage, protein fodder and dairy meal.

(ii) Individual cows. Data is also recorded for individual cows. There is a daily milk performance record booklet and a cow lifetime card. The cow lifetime card can be used to record data on cow identification and parentage, reproduction and calving, lactation, and implementation of animal health measures (occurrence of illness, vaccination and de-worming). The intention of collecting this standardized information is to record the information required by the Kenya Studbook so as to support farmers to gain a better knowledge of the performance and genetic potential of their cows, and thus of the cow herd as a whole. In terms of the information on lactation, data is to be recorded on the length of lactation (days), total milk output of each lactation, and milk quality parameters. This information derives from the daily milk performance record booklet. In that booklet, the farmer is to record the daily (morning and evening) milk yield (in liters), and the results of milk content testing.

3.2 How is data collected?

The data on the farmer registration form and individual cow card is collected by extension agents and hired service providers. The extension agents are trained on the data collection to ensure that the information collected is accurate and complete. Once the information is collected, it is submitted to the extension coordinator's office, where the data is input into spreadsheets and the farmer registration software platform. The data from the extension agent is verified by the extension coordinator for any inconsistencies before being entered into excel sheets to ensure accuracy. Data on daily cow milk performance are to be recorded by farmers, and the data can be shared with extension agents for input and analysis.

The overall initiative has the aspiration of improving farmer record keeping, but the

risk that records are not consistently kept is recognized. Thus, it is intended that information on the household and individual cow level will then be updated every month during a visit by either the extension agent or a dairy service provider. Since data recording currently relies on paper forms, systematic data recording and data sharing across the dairy service providers are aspects of the documentation system that still require further development.

3.3 How is data aggregated to the project level?

The farmer registration software records data on individual households, but also has functions to aggregate information by supplier ID, location, milk collection route or whole catchment. This is done on demand by the extension coordinator, but in principle it could be done on a monthly basis. Software for management of individual cow data is still under development.

3.4 How is data reported?

There is no formal system for data reporting. At present, data is used by extension agents, the extension coordinator and plant manager as described above. The data is provided to them from the database by the extension coordinator who manages data input and the use of the software interface. The extension coordinator also reports summary and aggregated data to the head of raw milk procurement at NKCC headquarters. At present, information on additional farmers registered is reported to headquarters every month. There are no formal reporting formats, and at present Excel spreadsheets containing the data are sent by email. Plans are underway to give each farmer feedback on the feed gap analysis for their farm, and other aspects of data reporting to farmers will be further developed in the future.

3.5 How is quality of data checked and assured?

Data quality checks are done by the extension coordinator. Firstly, cross-checking is done on the written forms to make sure that sub-totals equal totals and no other obvious errors are present. Then, when the extension coordinator inputs the data into the software, the input data is created in an excel file, and cross-checking is done to identify outliers (e.g. values way above the average), and to cross-check that the sum of sub-totals equals total values and to identify any other suspect data. If suspect data is identified, the farmer registration form records the name and contact details of the person who filled in the form and of the farmer, so the data can be cross-checked or obtained again.

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B. East Africa Dairy Development project's M&E system

B.1: General description of the project

1.1 What are the project's stated objectives?

The project intends to transform the lives of resource-poor dairy farmers by developing robust dairy value chains; expand and improve market access; and sustainably increase dairy production, productivity and income (EADD, 2014). Farmers are organized into Dairy Farmers Business Associations (DFBAs) or producer organizations (POs), which set up and develop 'hubs' that serve as centres to provide services and support activities needed by member dairy farmers. Hubs activities include affordable and improved production technologies such as artificial insemination, improved feed and diet management and veterinary care, and marketing (including milk bulking and storage in cold chains) (Bisagaya D 2014; Saeed & Nsanganira 2013). In its second phase, EADD also aims to create financial independence and social equality across the dairy value chain.

1.2 Who funds the project and who implements the project?

Funding for Phase I and Phase II of the project was provided by the Bill and Melinda Gates Foundation (BMGF) with grants of USD 50 million and USD 25 million, respectively. Elanco, an animal health division of Eli Lilly and Company, also supports EADD II with a USD 1.5 million gift offered as a dollar-for-dollar match with Heifer International donors' gifts, potentially resulting in an additional USD 3 million funds.

A consortium of five organizations implements the project. Heifer International (HI), the lead implementing partner, is responsible for the overall improvement of dairy productivity and efficiency. Technoserve is responsible for business development and enhanced competitiveness through activities such as technical support and financing chilling hubs. The International Livestock Research Institute is charged with knowledge based learning activities. The World Agroforestry Centre is tasked with providing farmer training on improved feed and fodder, and the African Breeders Services Total Cattle Management handles genetics and breeding.

1.3 Who are the beneficiaries?

EADD I (20008-2013) collaborated with 82 dairy producer organizations directly benefitting 179,000 households in three countries (110 000 in Kenya, 45 000 in Uganda and 24000 in Rwanda). EADD II, which started in 2014, targets an additional 136,000 households and a further 400,000 secondary beneficiaries by 2018, while also expanding its geographic coverage into Tanzania (Baltenweck & Mutinda, 2013).

1.4 What activities are supported by the project?

Farmers are organised into DFBAs/POs, which set up hubs. The hubs provide services required by the farmers with cold storage (chilling plants) being an essential component (Figure B.1). Ninety percent of the initial financing for the hub is provided by EADD. EADD then links the DFBA with financial institutions, which provide the long-term loan to repay EADD. Traditional hubs are rehabilitated by EADD and aim to provide most of the services offered by the modern hubs except milk chilling.

Another key activity is to link producers to processors and help negotiating contracts to improve access to formal milk markets. To increase productivity, the hub establishes an agrovet shop from which farmers can access small loans and/or access inputs (AI, veterinary services, drugs, feed) on credit. The hub also provide savings and credit services. Private sector service providers (e.g. vets) are integrated into hubs and local service providers and volunteer farmers are trained to become trainers.

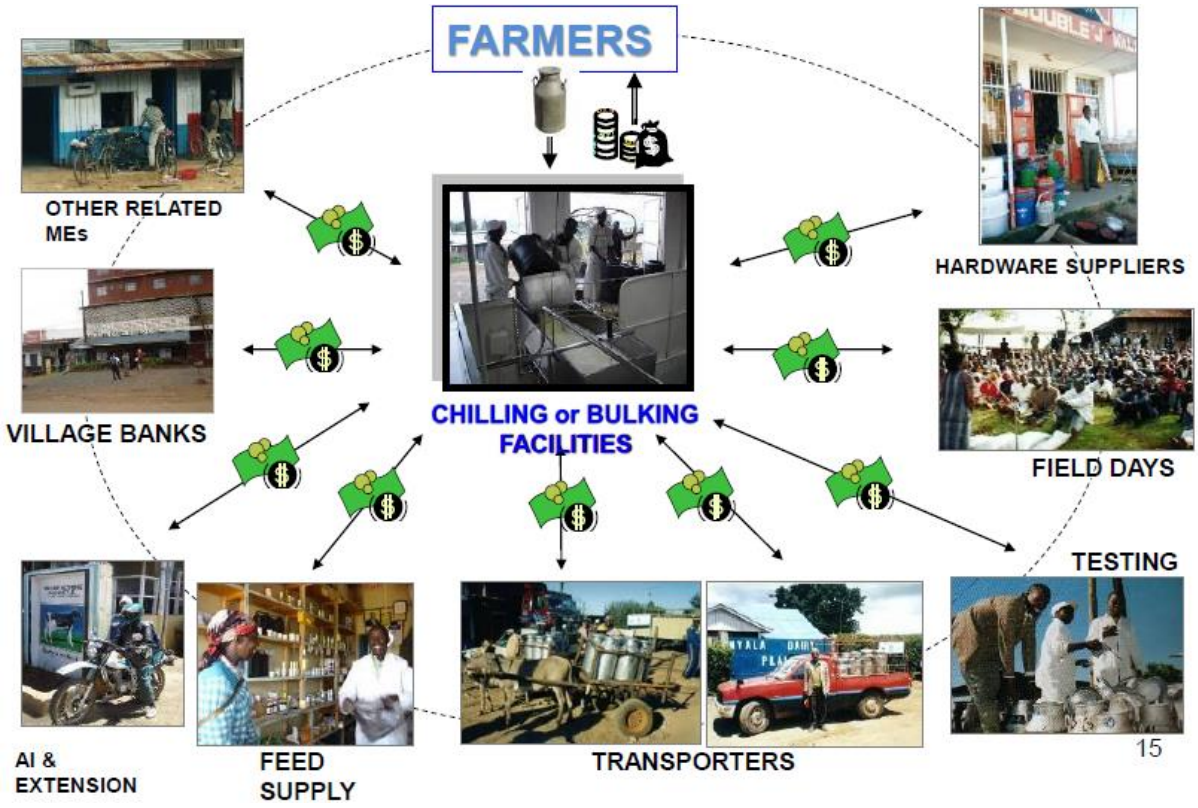

Figure B1: EADD hub model

Source: Worsley, S. (n.d.) Bringing policy to practice: the concept of dairy hubs. *http://www.fao.org/fileadmin/user_upload/drought/docs/2%20%20ILRI%20dairy%20EADD%20hubs%20Final.pdf*

B.2: Overview of the M&E system

The M&E system serves needs of project donors and management and farmers. At the donor and management level, the M&E is useful in informing on the appropriateness

and outcomes of strategies implemented. At the DFBAs level, the M&E system provides information to support decision making.

2.1What purposes and functions are fulfilled by the M&E system?

The EADD M&E systems serves a variety of functions, including monitor progress towards achieving the project objectives and goals; ensuring transparency and accountability; and supporting adaptive management and decision making. Therefore the M&E system does not only look at the results achieved, but also how those results were realized and how results can be potentially used in terms of decision making by dairy farmers, producer organizations, service providers, project staff, donors and other stakeholders. Some further functions of the M&E system are described in the following section.

2.2 Who are the users of the outputs of the M&E system?

Table B.1 illustrates some of the uses that are made by different stakeholders of information from the M&E system.

Table B.1: Examples of EADD M&E system outputs and their applications

Type of information	**Uses**
Farmers	
• Production per cow • Household production • Income from milk production • Assets accumulated	• Diagnose constraints to productivity and opportunities • Design on-farm interventions • Assess effects of interventions on productivity • Track progress towards household development • Understand profitability of activities
Extension team	
• Registration data • Household characteristics • Cow level data (breed, calving rates management, heat dates etc) • Household production data	• Evaluate performance of extension agents • Understand extension needs and potential entry points for intervention • Scheduling of extension visits
Service providers	
• Registration data • Household and cow production data	• Identify constraints to productivity. • Estimate the level of demand for services, planning and prioritizing service provision • Design appropriate products and services
The hubs/PO	
• Registration data • Household level production data • Number of women involved in production • Level of adoption of practices	• Estimate potential milk yield from farmers and aggregate expected supply form each collection route • Identify constraints and plan training for famers • Plan for expected procurement and processing volumes • Improve transparency, assess profitability and long term financial planning. • Evaluate progress towards gender equity

• Shareholding of the PO	• Review progress towards sustainability
EADD Program Staff	
• Aggregate registration data • Household and individual cow production • Hub data (number of farmers supplying, collection volumes, financial records, shareholdings) • Women's participation in value chain	• Inform design and scheduling of specific activities • Asses the intended and unintended impacts of the project • Track progress towards gender equity, PO maturity, and long term financial health • Make decisions on investment needs • Inform decisions on replication or scaling
Researchers	
• Hub data • Household and cow production data	• Identify research gaps and opportunities for intervention • Assess project performance
Governments	
• Hub data • Household productivity • Number of farmers	• Decisions on investment needs • Identify opportunities for policy interventions or guidance

Source: EADD (n.d.)

2.3 How is M&E organized?

The M&E system is organized at three levels: the core M&E team, regional M&E team and the country M&E team. The core team is made up of key M&E regional and country specialist staff and a research team representative. The regional team consists of regional partner representatives and the core team members, and the country team comprises the country partner representatives and the country M&E officers. Reporting for the DFBAs is done by the chilling plant manager, who reports to the cluster leader. Planning, monitoring and evaluation coordinators are responsible for regularly updating and implementing the project M&E system. The coordinators work with technical teams drawn from the various implementing agencies to develop indicators, targets and methods of collecting information for enable decision making. The coordinator reports to the Country Project Manager. At regional level, a working group made up of experts from the partner organizations is responsible for evaluating the various indicators of the project success.

B.3: Collection of monitoring data, reporting and quality control

3.1 What is monitoring data is collected on?

Data is collected on performance indicators. As of 2010, the project had set out 85 farm level and 10 DFBA level milestones and impact indicators (EADD 2010). For example, a number of indicators are used to track progress towards the project outcome 'increase in milk production per household'. These include change in milk volume at household level and per cow; milk volume sold to hubs and other traders; and seasonal fluctuations in milk production at farm level. Data is also collected on

other indicators of income improvement for farmers, hub sustainability, milk quality and gender equity.

3.2 How is data collected?

The process starts from individual households with data being aggregated with every step. Data collection is done at three main levels: (i) individual cow level, (ii) farm household level, and (iii) Hub/DFBA/PO level.

At the individual cow level, data is collected by the farmers using their farm records booklets. Farmers' records will typically have records on cow production and productivity, amount of milk produced, amount of feed consumed, use of artificial insemination and veterinary services.

At the farm household level, information is also obtained from farmers' records. Additionally, extension agents trained by the project collect data from the household level. Resource constraints often mean that there is insufficient extension personnel to cover the entire project site, so Community Agro-vet Entrepreneurs (CAVEs) are relied upon by the extension agents to compile household level data. CAVEs are local businessmen/businesses that offer training, services and inputs to the farmers. They report to the extension agents. In addition, surveys are carried out by research partners in the project or by contracted external organization. These surveys are used to gain a better understanding of particular issues or to evaluate project progress. At household level, information is obtained on indicators such as household demographics, income, asset ownership, herd size, herd dynamics, and breed composition, livestock management practices (including feeding strategies, breeding, vaccination and tit dipping), dairy production, productivity and quality, food security, household coping strategies, access to and farmer satisfaction with services provided by the CAVES, DFBAs/PO and EADD, and household gender dynamics.

DFBA /PO/Hub level-data is collected from two sources. First, data is reported by the extension officers to the extension manager and consolidated at DFBA level. Second, the DFBA/PO also collects data from farmer members. Data typically recorded at the DFBA /Hub level include the number of shareholders or farmers registered with the DFBA, the number of farmer supplying milk to the Hub, the amount of milk procured, prices paid to farmers, and farmers' use of AI, feed and animal health care services.

3.3 How is data aggregated to the project level?

Hub level information (e.g. number of active farmers, total milk, supply, financial, and access to services) is collected by the DFBA by aggregating records from the individual farmer records prepared by extension workers. This hardcopy data is entered into offline databases, which are periodically uploaded to a web-based database for use by the clusters. For hubs that are still developing and do not have the

required data management capacities, hardcopy data is directly transmitted to the cluster, where it is entered into the database. Each cluster compiles a summary report. At the country offices, data is input from the site reports, to produce country data analysis reports. The data is forwarded to the regional offices where the overall EADD data analysis reports are produced.

3.4 How is data reported?

Reporting to the country offices is done through cluster reports, while country offices report to the regional office through Country data analysis reports. Different types of reports are submitted with different periodicity. For example, staff reports are submitted within 10 days after each field visit and are summarized for discussion during quarterly review meetings. Quarterly reports are prepared in a specified format and submitted to the regional office. A half yearly report is also submitted. The regional teams add input into the country half yearly and annual reports, which are then submitted to the headquarters of the lead partner in the consortium. Mid-term and final evaluation reports are also compiled, summarized into a suitable format and made available to stakeholders and the public.

3.5 How quality of data checked and assured?

At each administrative level, specific people are tasked with ensuring the completeness and accuracy of data. At the lowest level, the extension officers oversee and train farmers to make sure the data collected is accurate. Extension officers oversee the CAVEs who also collect data. At the Hub level, records are overseen by the DFBA board of directors, and the hub manager is responsible for quality control. Data at cluster level is under the management of the cluster team leader, while at the country office, overall supervision rests with the country project manager.

The EADD M&E system has built-in checks to ensure accuracy and completeness of information. At the hub level, where data is entered offline and updated to web-based database, the hub manager oversees quality control. At the cluster level, the cluster leader oversees quality control. Within each country, country M&E officers are the main quality controllers, and are responsible for approving data in the main database. Data analysis and management, including quality control, are also done at regional level. External firms are also regularly hired for evaluation activities, which provides an element of external checking to the internal M&E system.

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