Evaluation framework of community-based livestock breeding programs

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Abstract

The objective of this paper is to present an evaluation framework to provide guidance for an assessment of the performance, outputs and associated impacts of community-based livestock breeding programs (CBBPs), responding to the need of formalizing the evaluation procedures as it was stressed by FAO. The purpose of such evaluation is to monitor and evaluate on-going activities in CBBPs, to identify challenges and mistakes in the execution of the program, so that appropriate actions can be taken. This evaluation also serves as a guide for funding bodies to measure socio-economic impact on the livelihoods of livestock farmers in order to decide if the program's goals have been met. The evaluation framework is divided into three domains: (1) evaluation of CBBP implementation based on organizational and technical criteria; (2) monitoring of implementation outputs to evaluate genetic improvement at herd/flock level and the consequential changes at the household level and the community at large; and (3) evaluation of impacts to assess improvement in livelihoods of livestock farmers and eventual effects on the environment. For each evaluation criteria, several indicators are provided.

Keywords: *impact assessment, smallholders*

Introduction

In recent years community-based livestock breeding programs (CBBPs) have got some attention and have been considered as a sustainable option to improve livestock production under smallholder conditions and in low-input systems (Kosgey et al 2006, Wurzinger et al 2011, Mueller et al 2015). CBBPs have been promoted as a tool for economic and livelihood development through genetic improvement of livestock and for conservation of local breeds in developing countries (Kosgey et al 2006; Haile et al 2011). Several case studies from the field and their successes, challenges and failures have been reported (SÃ¶lkner et al 1998, Mueller et al 2015), but a systematic evaluation of these programs is missing. Different authors (FAO 2010, Haile et al 2011, Mueller et al 2015) mention the importance of a systematic evaluation of the performance and impact of CBBPs to monitor if the promised changes have been actually achieved. These authors also provide in general terms possible indicators for an evaluation, but without further details on how such an evaluation should be carried out.

An evaluation of a breeding program can serve two major purposes. Firstly, as a quality management tool for implementing institutions to monitor and evaluate on-going activities of a CBBP and to identify possible challenges in the execution of a program. Such an evaluation process can create a learning environment to inspire and help those involved with the program to reflect critically on the progress and learn from mistakes and give ideas for improving the program (IFAD 2002). Secondly, the evaluation can serve as a guide for (external) funding bodies to measure impact on the livelihoods of farmers and other stakeholders along the value chain to justify technical and financial support.

However, different purposes for evaluation require different evaluation criteria (FAO 2010). FAO (2010) recommends that breeding programs be evaluated using technical criteria, socio-economic criteria and a cost-benefit analysis if the objective is profit or return on investment. CBBPs may be evaluated using criteria which are relevant at community level, for example, socio-economic criteria based on livelihood improvement i.e. improvement of food security, welfare and income at household level (FAO 2010, Haile et al 2011). CBBPs are complex in their local contexts and linked to particular socio-economic and cultural dimensions, hence, considerable difficulties may exist in measuring some of the outcomes and impacts that are less tangible than strict economic criteria. To resolve this, additional criteria that account for less tangible and difficult to measure outputs may be used (FA0 2010).

Methods of data collection, protocol and sampling procedures, the appropriateness of data collection tools and sampling procedures to address specific questions has to be assessed. Direct observations, key informant interviews, surveys, focus group, document analysis, monitoring through farmer based recording, mobile data recording using smart phone, use of GPS and remote sensing may be used for data collection in an evaluation process (Blackstock et al 2007).

The objective of this paper is to present an evaluation framework to provide guidance for an assessment of the performance, outputs and associated impacts of CBBPs. This framework offers support in developing an adequate evaluation process by using partly or fully the list of proposed criteria, depending on the purpose of an evaluation.

Evaluation framework

Certain tasks have to be carried out in order to collect evidence to assess the extent that certain goals and objectives of the CBBP are met. The first task is for the stakeholders to identify and decide on the evaluation criteria and indicators. This should be done at an early stage of the breeding program to give enough time to collect data and to document changes that occurred during its execution. The criteria and indicators are best chosen by the participants themselves who may be

involved in the evaluation process at a later stage. Preferably, indicators should be quantifiable, but for some aspects of the evaluation also qualitative indicators could be used. The second task is planning when and how often the evaluation work should be done and the resources that are needed. The evaluation work should be planned and conducted by an internal evaluation team or an external independent expert who is impartial and free from conflict of interests. The advantage of having an internal team conducting the evaluation is that they understand the program well and can assess their own actions and outputs. Having an external evaluator however, provides an opportunity to get an outside view and might address issues that are otherwise overlooked by the implementers (IFAD 2002). Both options allow learning. Participatory evaluation approaches for assessing the relevance and impact of development projects are seen by different authors as an important tool to assess the current status and give room for learning and improvement in the future (Bayer and Waters-Bayer 2002, Berhanu Gebremedhin et al 2010, Catley et al 2013). Lilja et al (2010) emphasize that impact-evaluation processes should foster critical self-awareness, reflection on experiences and learning from mistakes. These processes should be participatory, iterative, interactive and adaptive. A participatory process in the evaluation gives space to the farmers to measure and explain outputs and impacts on their animals and on their livelihoods. It allows the farmers to express themselves and share their own knowledge freely without being interrupted by experts. Farmers may be asked to talk about positive things that make them feel excited being members of CBBP. For example, what changes or contributions CBBP has brought in their lives, what the CBBP mean to them, how it has made them utilize their own internal strengths, capabilities and creativity by carrying out breeding activities as well as their engagement in appraisal, analysis of results and what the findings mean to them. Farmers can discuss with the implementing team mistakes that have been made and develop action plans together. The other stakeholders who facilitate the development work recognize farmers' results of the evaluation and adapt farmers' strategies to improve program performance (Chambers 1994). Therefore the evaluation is a continuous process.

An overview of the evaluation framework is depicted in tables 1b, 1b and 1c. The framework is divided into three main domains: (1) evaluation of CBBP implementation; (2) monitoring of implementation outputs; and (3) evaluation of their associated impacts on livelihoods of farmers and the environment. For each domain a set of criteria, each with a subset of indicators, are presented. The evaluation of implementation focuses on organizational criteria by looking at the major components to ensure effective operation and technical criteria by examining actions performed at relevant steps of the breeding program. The evaluation of program outputs focuses on the genetic improvement of the animals at flock/herd level attained and the consequential changes at the household level and the community at large (Haile et al 2011; Mueller et al 2015). The evaluation of program impacts assesses the changes in socio-economic data of participants and eventual effects on the environment.

Table 1a. Evaluation criteria and possible indicators for community-based livestock breeding programs – Implementation

Criteria	Indicators/explanation
Documentation	• Work plans and budgets and other relevant documents (e.g. agenda and minutes of meetings)

	• Monitoring system in place • Budget allocation, is reasonable and comprehensible
Stakeholders' roles and responsibilities and agreements of partners	• Clear documentation of roles and responsibilities of members (organigram) • Signed agreements and contracts (e.g. Memorandum of Understanding) between different parties • Constitutions or by-laws of farmers' associations
Participation of farmers	• Needs assessment conducted during initial phase • Varying levels of farmers' participation in different steps of the CBBP • Farmers have control over own or donated program funds • Gender representation and roles • Gender equity of distribution
Production system analysis and breeding goal definition	• Alignment with national and regional policies • Baseline data on production system is available for comparison to document changes over time • Assessment of other activities which may interfere with the CBBP • Farmers` choice of breeding objective is indeed the one implemented
Herd book and recording scheme	• Herd book is available electronically or/ and as hardcopy, back-up system is in place

		• Which animals are identified with which method, what traits are recorded and the link to the breeding goal • Recording formats are simple and frequency of recording of different traits is adequate • Quality control in place to ensure completeness of records and to reduce recording errors • Personnel who carry out recording in the field (farmers, field staff), transmission to database and data analysis • Time span for feedback loop (How long does it take to get results back to the field) • Feedback: according to farmersÂ´ educational level, recommendation for management improvement • Farmers are using the information for making (breeding) decisions • Ability to correct pedigree records
Estimation of breeding values (EBV)		• Breeding values are estimated using a correct model • EBVs information are handed to farmers and if farmers understand the relevance of EBVs
Selection and mating decisions	• Available EBVs are used to select animals or farmers use other methods to select animals • Selection of breeding candidates is done in due time (e.g. before major marketing events) • Documentation of each selection event, how many and which animals are selected, selection intensity • Selected animals are indeed being used for breeding purposes as was planned • Management of unselected males such as by castration,	

Evaluation of genetic progress	fattening for sale etc. • Control of inbreeding (mating of related animals avoided) • Evaluation of genetic progress is in the CBBP plan and is done on time • Same breeding goal traits and same biological parameters as in the field are used • Assessment of replacement rate, generation interval and the use of breeding males in years

Table 1b. Evaluation criteria and possible indicators for community-based livestock breeding programs – Outputs

Criteria	**Indicators/explanation**
Animal level	• Numbers of improved animals produced and distributed • Increase in animal products • Improvement in genetic value of traits
Household level	• Improvement in animal management • Increased food • Changes in income • Decision-making • Knowledge, skills and attitudes (number of farmers trained versus those who apply the skills, degreed of satisfaction i.e. how farmers feel the program has impacted their lives
Community level	• Proportion of farmers in CBBP • Controlled inbreeding rate • Control measures for animal health and product quality (e.g. quarantine, product quality check, mortality rates of animals in different age classes) • Breeding association established

Table 1c. Evaluation criteria and possible indicators for community-based livestock breeding programs – Impact

Income, food security & assets acquisition	• More income through sales of livestock and livestock products from the CBBP • Use of income from CBBP to buy food stuff or to cover other household expenses and

	to acquire assets • Gender-sensitive analysis of income distribution within the household • Food security of different household members has improved (e.g. number of days without food reduced, improvement in Food Consumption Score (FCS)) • Increased market demand for breeding animals
Economic sustainability	• Higher CBBP farm gross margin or profitability per household per year due to increased productivity • Savings, investment and access credits to sustain and improve animal production • Revolving fund system in place to generate more income at community level • Better market access
Distribution of benefits	• Distribution of benefits among members of CBBP • Adoption rate of CBBP and dropout rate of participants over given period of time • Distribution of benefits among producers, retailers/ market operators and consumers along the value chain
Management of natural resources	• Conservation of biodiversity through use of local breeds • Actions to mitigate environmental degradation on soil and natural vegetation e.g. management of (communal) pastures
Waste management	• Control measures in place to manage animal excretes and residual water
Control of emissions	• Carbon and water foot prints of CBBP

Evaluation of Activity Implementation

Organizational criteria

Considerable documentation and paperwork is required both at the organizational level and at the farm level. As a first step there is the inventory of relevant documents such as periodic work plan, budget and accounting information for tracking of financial audits, minutes of meetings, agreements and contracts of partners. Data transfer into a meta-database for storage, analysis, interpretation and a feedback loop to the farmers for decision making should be inspected. Regular back-up of data and

access regulations for different people to different data sets should be specified. In addition, a monitoring system on routine procedures for permanent improvement of the breeding program is an additional asset which should be inspected.

Usually, many stakeholders are involved in the CBBP program. It is crucial to evaluate the working group which should be composed of relevant stakeholders, e.g. farmers who are the primary beneficiaries, financial institution, universities to provide education and training, government agencies, extension agencies and market operators. The organigram must clearly indicate the different roles and responsibilities of all individual people (FAO 2010). The commitment of individuals should be supported by signed agreements and contracts between different parties. This approach shows a more formal cooperation and can be instrumental to mitigate the problem of staff turnover as the institution is committed to find an adequate replacement. Written and formally approved by-laws of the breedersÂ´ association for regulation of rights, but also obligations of all members can be considered a key-element to evaluate. Aspects such as exchange of breeding animals, commitment to sanitary regulations, data recording, possible penalties in case of corruption or fraud, structure of the association and election procedures could be elements of these by-laws to be evaluated.

Authors from different disciplines have argued that farmersÂ´ participation in the decision-making processes in research and development projects is vital for the success and long-term sustainability of such projects (Neef and Neubert 2011, Pretty 1995). Participation has also been put forward as a distinctive feature of CBBPs (Haile et al 2011, Wurzinger et al 2011, Mueller et al 2015). Cornwall (2008), based on Pretty (1995), further developed the concept of participation in development. She proposes to achieve *optimum participation* by balancing inclusion i.e. including all relevant stakeholders in a respective activity and depth i.e. their participation in different steps of the process. In CBBPs, the level of farmersÂ´ participation varies in the different steps of the program (e.g. identification of breeding objectives – high participation, estimation of breeding values – no participation). However, optimum participation should be assessed and where there is limited or no direct participation, it must be evaluated if farmers are consulted and informed about all steps and are provided with sufficient information. Gender representation, roles and equity of distribution of benefits must be assessed. It is particularly crucial to avoid gender disparities in CBBP so that women, youth, men, people with disability and elders have equal chances of participation and benefit equally. Various authors have stressed the importance of defining breeding goals in a participatory way so that these goals are relevant for the local community under a given production system (Kosgey et al 2006, Kosgey and Okeyo 2007, Haile et al 2011). Therefore, it should be evaluated if this process was participatory. Routine recording can be either performed by farmers or by trained field staff or in a combination of both. Farmers are engaged in recording of simple variables and helping field staff in handling animals during measurements. Data are usually processed and evaluated by scientists or experts. For example, due to its complexity, estimation of breeding values is done by an expert. However, it should be evaluated if farmers understand the basic underlying principles, which help them to interpret breeding values. Feedback is provided to farmers that allows reflection on performance and supports adjustments and decision making such as use of information for selection of animals.

Technical criteria

The technical criteria follow the logical steps of a breeding program. As a first step a production systems analysis should be conducted and a baseline data should be available. The alignment of the CBBP with national and/or regional policies should be reviewed as it is paramount for the CBBP to have government support to ensure its sustainability. For better follow-up, baseline data should be taken at the start of the breeding program. This baseline data can range from animal management

aspects (e.g. performance level of animals) to economic parameters of farmers (e.g. income from livestock production contributing to household income). It should be cross-checked if the breeding objective determined by farmers is actually the one implemented. If changes are noted, it should be explored if they were made in full agreement with farmers. Haile et al (2011) discussed ways of participatory definition of breeding objectives by farmers, e.g. choice experiment, own-flock ranking and group ranking. Each method complements one another and may be used in combination. Active involvement of farmers in this process ensures that the breeding objective traits reflect the true preferences of farmers.

The availability of a herd book (electronically or/ and as hardcopy) and a back-up system and an established recording scheme must be evaluated to make sure that CBBP is able to track and measure genetic improvement. Routine recording under field conditions is often seen as a bottleneck in breeding programs. Therefore, it should be given close attention. Identification methods of animals (ear tags, collars, tattoos) should be assessed in terms of their performance (weatherproof, easy to read, durability, replacement) related costs and acceptance by farmers. Depending on the breeding objective it should be checked if it is necessary to identify the whole population or only possible breeding candidates under performance testing. It should be checked if pedigrees are recorded routinely and a quality control is done to ensure completeness of records. In addition, the targets set for reducing and correcting pedigree errors are met. The number of traits recorded, simplicity of recording formats, frequency of recording of different traits and their alignment with the breeding objective should be evaluated.

The focus is often on how data comes from the field to the office, but the feedback loops back to the farmers are equally important and should be evaluated. Besides the general feedback, it can be checked if a customized feedback of results of each farm is given to the participating household so that it is motivated to critically reflect on own results. It should also be evaluated how long it takes to get feedback to farmers. It is recommended that feedback is provided in a timely manner and according to farmersÂ´ level of understanding/educational level. It can be assessed if the feedback includes also management recommendations (e.g. on feeding aspects) and confidentiality treatment of the report. Finally, it should be evaluated if feedback information is actually used by farmers for making breeding decisions.

It can be reviewed if breeding values are estimated or if selection is only based on phenotypic appearance and performance. The application of a correct model for estimation of breeding values is another evaluation point. It has to be checked if farmers interpret correctly these breeding values and if they can actually select from an approved list of animals. In case farmers do not use the provided information, the reasons for not doing so should be investigated. Selection based on estimated breeding values (EBVs) alone may not fully address farmer’s preferences and needs which are often complex and changing over time. Some farmers may have preferences for cultural and aesthetic traits therefore combining the use of EBVs with farmers’ traditional selection criteria would improve selection response in all traits of interest. Another aspect to evaluate is the time when selection is done. Selection of breeding candidates must be done in due time, e.g. before major marketing events as major holidays and celebrations in the respective country or before a large number of animals are marketed. This timing of the selection avoids selling of potential animals that would otherwise be used for breeding (Haile et al 2011). There should be documentation of each selection event showing how many and which animals are selected and if selected animals are indeed being used for breeding purposes as planned. There is also the management of unselected males in place such as castration or fattening for sale (Haile et al 2011).

Control of inbreeding by avoiding mating of related animals is also an important criterion. Rates of

inbreeding should be calculated. As a rule of thumb, FAO (2010) recommends that the inbreeding rate should be maintained below the range of 0.5 – 1% per year to avoid risks of genetic disorders and inbreeding depression. Thus, measures to avoid undesirable increases of inbreeding rates should be considered in the program.

Evaluation of genetic progress should be an integral part of each CBBP and genetic trends for economically relevant traits should be assessed on a regular basis. This helps to discover if the program is making progress in the right direction. Selection intensity, replacement rate, generation interval and the number and use of breeding males are indicators of genetic progress.

Monitoring of Outputs

One major limitation of the impact evaluation is that it might be difficult or even impossible to separate improvements achieved by CBBPs from the effects of other activities/interventions (other projects implement) or/and national economic developments when audits of outputs linked directly to CBBP implementation are lacking. Monitoring of outputs could fill this gap. Documents such as farm bookkeeping data, production data, cash balance and invoices of feeds, veterinary medicines and others from the beginning of CBBP or to the time of last evaluation should be checked. There should be consistency of information, e.g. a balance between production volume and sales plus consumption. Information on herd size and pedigree records, selection, animal performance (birth and weights records), purpose of selling or culling, the season they are sold, selling place (farm gate, abattoir or village market) and average price per animal must be assessed. Health records are also important, i.e. animals that became sick and were treated- those that died and those that recovered, cost of veterinary treatment. Feed costs, such as cost of minerals, supplements, cut and carry forage and expenditure on labor per year (hired herdsman) must be analyzed (Njuki et al 2011).

Audits of total numbers of improved animals produced and distributed among farmers and the monetary value of related products sold and consumed by household have to be reviewed. Improvement made in animal management and the genetic value of traits in each generation or in planning period must be assessed. Farmers' management decisions such as management of breeding males, sharing of breeding animals, feeding, culling decisions and markets could influence outputs and efficiency of the CBBP and therefore should be evaluated.

Number of farmers recruited in the CBBP, dropout rate of farmers over time, increased market demand for breeding animals and the establishment of a formally or informally recognized farmers' breeding association may be used as indicators to assess program outreach, its acceptability and how farmers are willing to take upon themselves the breeding work. These indicators are crucial for possible upscaling plans.

Acquisition of knowledge and skills through different forms of training should be evaluated. The transformative learning theory could be used for this purpose as it assesses the ways people acquire new knowledge and the type of acquired knowledge and skills (Mezirow 1994, Taylor 2007).

An indicator for attitude change is the degree of satisfaction i.e. how happy farmers feel the program has impacted their lives and changes in individual mentalities over time (Bohner and Dickel 2011). Attitude refers to an individual mindset or a tendency to behave or act in a particular way to objects and situations depending on experience and temperament (Allport 1935). Understanding members' expectations and attitude towards the CBBP work would therefore determine their willingness to continue to work with the program, their performance and commitment to the CBBP goals. Likewise, greater program commitment increases the degree of members' satisfaction which may lead to

higher individual performance and effectiveness (Linz 2002, Sharma and Bajpai 2010). Attitudes and attitude change may be determined through self-report evaluation e.g. through direct interviews and questionnaires asking questions regarding how happy farmers feel about the program and how it has impacted their lives (Bohner and Dickel 2011, Vatta et al 2011). In practice, farmers may show sign of dissatisfaction by not participating in activities. This may be observed in the rate of turn up at activities, meetings or seminars organized by CBBP which could be lower than expected. In addition, stakeholder's self- reflection after participating in the CBBP field activities and stakeholder's evaluation of events and sharing experiences with farmers could be compared against a baseline study to provide insight about attitude changes of members. Positive attitude changes measure the potential for growth and attracting new innovations as well (Linz 2002).

It should be inspected if there is a control system in place to ensure animal health e.g. records of animal health and treatment on farm, veterinary controls before sale of breeding animals and quarantine measures. Zoonotic diseases are a critical issue in livestock production. All measurements to reduce transmission of diseases from animals to human should be evaluated.

Another important aspect to evaluate is the product quality to improve food safety for consumers. FAO (1998) recommends the application of good animal management practices on farm, good hygiene practices, and analysis of critical hazard control points along the food chain to avoid risks and ensures that the product is free of diseases, pesticides and veterinary drugs residues and heavy metals. It should also be checked if there is a national food policy and national inspection regulation of safety standards and it should be confirmed if the legal authority carries out regular food inspection work. It can be assessed if CBBP farmers are able to trace their products backward and forward in case a product is discovered to be not fit for consumption and to stop its distribution and withdraw the product from the market.

Evaluation of Impact

All forms of livestock production activities generate both positive and negative impacts in areas where they operate (FAO 2002). Establishing CBBPs might have impacts of different magnitudes at local and national levels. To assess these impacts, the evaluator should link outputs discussed above with impacts on livelihood and the environment. It is recommended to use nationally or regionally approved/recognized impact indicators for comparability with the impacts of other projects in the same area or similar CBBPs in different areas.

Livelihood improvement

The driving idea behind the implementation of CBBPs is that ultimately the livelihoods of farmers are improved. The evaluation of livelihood improvement could be based on criteria such as better economic situation of the households and/or improved food security of the household. Food security of household members by gender and age classes can be evaluated using indicators such as food consumption score (WFP/VAM 2008) and the months of adequate household food provisioning (Bilinksy and Swindale 2010). Food consumption score provides insight on consumption frequencies of food types in the last seven days, dietary diversity and their relative nutritional importance at specific country in question, while the months of adequate food provisioning in the last 12 months may offer insights about improved production, food storage, processing and purchasing power. Other indicators to measure food security are household income sources, proportion of income from CBBP livestock, changes in income generated through sales of livestock and livestock products, changes in household food security (measured by food available vs food needs) and the use of income generated by CBBP to buy food stuff or to cover other household expenses, and contribution to asset

accumulation (Dolberg 2008). It should be assessed if changes in consumption patterns of different livestock products have actually resulted in improving nutrition of the most vulnerable groups in the household such as children and elderly people (Ojango et al 2010). It should be explored if there are taboos in the region that forbid women and children consuming animal proteins, which ultimately reduce the direct benefit of improving nutrition and food security at household level (Meyer-Rochow 2009). Selling of high protein food produced on the farm to buy carbohydrate rich food stuff for family meals instead due to lack of knowledge on nutrition may undermine nutritional impact. A gender-sensitive analysis of income distribution and income use within the household may be done by interviewing both male and female household members taking into account the cultural context.

Distribution of benefits among participants of the breeding program, but also along the various stakeholders along the value-chain can be evaluated. Direct benefits for farmers could be the purchase of inputs (veterinary products, services) at a better price as negotiation power of a breedersÂ´ association could be higher. The breeders also have a better bargaining power to negotiate prices as they can pool products for sale. Social benefits of belonging to CBBP breeders association could boost leadership skills, improve social relationship, and build self-confidence and empowerment to making informed decisions and negotiations as reported by Ojango et al (2010). Banks (2000) demonstrates how different stakeholders along the value chains benefit differently from the return of investments in a breeding program.

Environmental impacts

CBBPs can positively contribute to the conservation of biodiversity through the use of local livestock breeds. Through a clear breeding strategy genetic diversity can be either kept at a good level or even raised.

During the farm tours, the evaluator may notice and discuss potential areas of concern with the farmer. The evaluator may ask questions on sources of feeds and their availability; pasture, water and on farm waste management and utilization, as well as production challenges and implemented mitigation strategies to prepare against uncertainties such as changes in land use, drought, famine and changes in market prices (FAO 2010). A tour of the grazing land to examine pasture types, their size, management (e.g. rotational stocking), changes in vegetation cover, soil conditions, damage to vegetation and evidence of practical mitigation actions to improve natural resources offer insights to find out if there is a risk of resource overuse (McIvor and Orr 1991). Changes in vegetation and water stress in communal grazing land can be studied using satellite maps. Growing of fodder crops, supplementation and utilization of crop residues and wastes from food processing reduces feed demand from natural pastures. Control of weeds, reforestation and planting of grass are among other activities to manage pastures adequately. The above management practices may be combined with selection for fast growing animals that reach slaughter age faster during the wet rainy season when feed is plenty. In more intensive production systems management of solids and residual waste water could be an additional factor to be considered in an evaluation.

As a first step, it should be checked if there are any environmental regulations and laws in place. Environmentally friendly practices to manage waste and their efficiency could be evaluated (Parra et al 2013). One possibility is the installation and use of biogas plants on farms for management of excretes. On farm produced gas could be used for cooking, heating, running generators for milking cows, or even for generating electricity (Huerga et al 2014). Besides the energy production, a functional biodigestor system is reported to reduce the release of up to 60 % methane and 33 % carbon dioxide into the atmosphere. This may be quantified as the potential of the biodigestor to reduce emissions into the atmosphere with subsequent greenhouse gas effect (Aguilar and Botero

2006). Different methods exist to determine the carbon or ecological footprint, but also the water footprint of livestock production activities (ISO 2006, Carbon Trust 2007, IDF 2010, Mathews et al 2008, VergÃ© et al 2013). However, these methods usually require very detailed data on various steps of the production and might not be feasible under smallholder conditions.

Conclusions

- The community-based breeding programs are an emerging way to improve livestock populations and the livelihoods of their owners. In order to achieve the largest possible gains, a thorough evaluation is needed.

- This paper responds to this need by summarizing the aspects and criteria of a potential evaluation. Implementing bodies can use it as a management instrument to improve the implementation and funding agencies can use it as a monitoring tool. It shall be noted that such a comprehensive evaluation requires enough resource allocation in terms of human and needs to be well planned.

- An evaluation exercise is a learning opportunity and can help to improve breeding programs. It is a relevant tool to show that the promised benefits for farmers can actually be achieved and proof that livestock breeding is a sustainable intervention strategy.

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