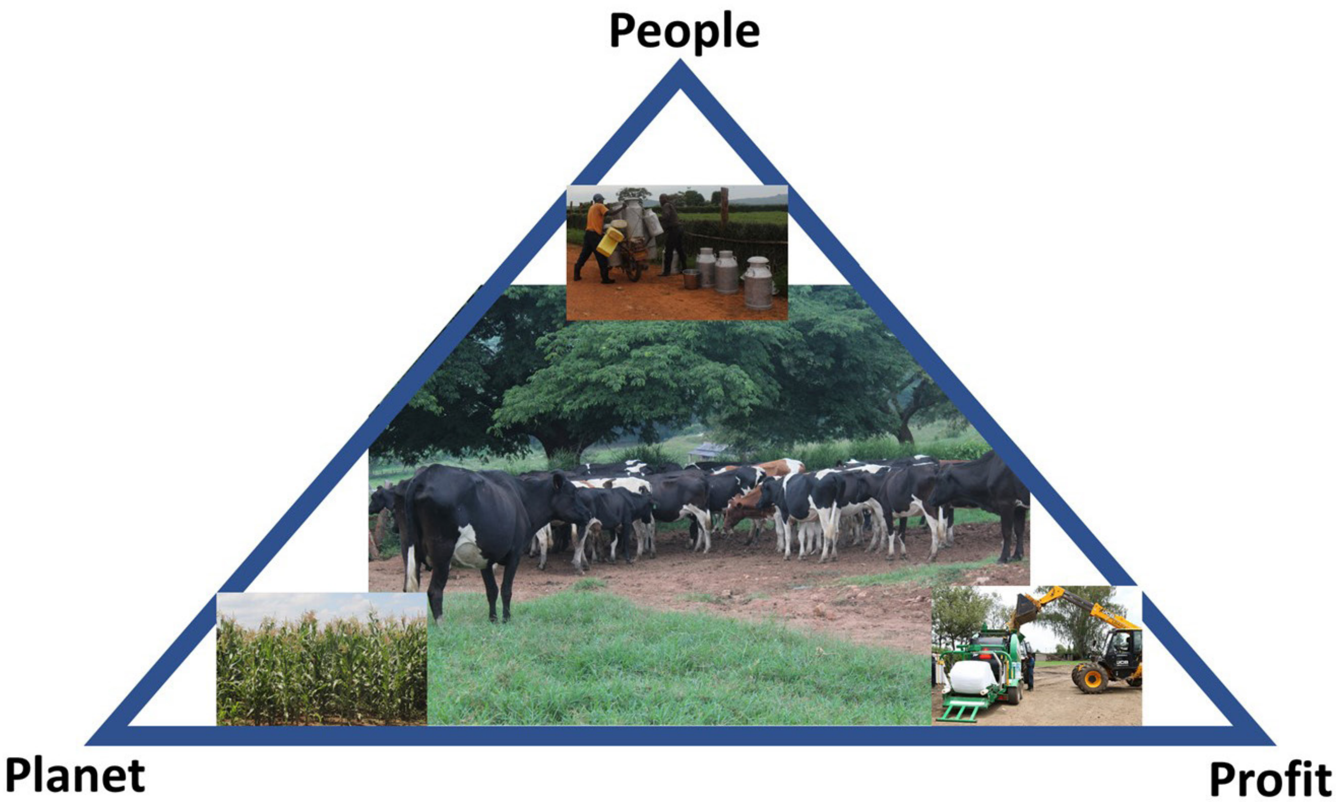

An overview and analysis of integral tools to monitor people, planet and profit sustainability dimensions of dairy development in East Africa

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Report 1277

WAGENINGEN UNIVERSITY & RESEARCH

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NEA DAP Netherlands East Africa Dairy Partnership

NFP Netherlands Food Partnership

Asaah Ndambi, Hassan Pishgar Komleh, Jan van der Lee, 2020. *An overview and analysis of integral tools to monitor people, planet and profit sustainability dimensions of dairy development in East Africa.* Wageningen Livestock Research, Report 1277.

This report is an assessment of the suitability of various sustainability assessment tools to assess the people-profit-planet sustainability aspects of dairy farming systems in East Africa. It applies a literature scan based on suitability criteria that shortlisted 42 tools. This list was further narrowed down to four tools (RISE, IDEA, SAFA and PG), each having potential for further adaptation to the East African context.

This report can be downloaded for free at https://doi.org/10.18174/533370 or at www.wur.nl/livestock-research (under Wageningen Livestock Research publications).

Public Wageningen Livestock Research Report 1277.

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The authors

Summary

Dairy plays a key role in agricultural sector development in East Africa. To keep this growth continual, the Netherlands Food Partnership (NFP) dairy action agenda together with the Netherlands East Africa Dairy Partnership (NEADAP) initiative have requested for a tool that enables stakeholders to assess and monitor the sustainability of dairy initiatives in East Africa. Sustainability helps producers not only to grow their businesses but also to ensure that resources are preserved for use by future generations. Dairy development should not only emphasize on increasing the production, but should also consider different aspects of sustainability including people, profit and planet. Dairy development needs to contribute to affordable safe and nutritious diets, employment and livelihoods and in sustaining the agroecological base.

Sustainable dairy development pathways should address these people-profit-planet objectives simultaneously and their holistic assessment should support practitioners and policy makers reflect on the multiple trade-offs that occur based on the choices being made. There is need for a tool that could support informed discussions on present status, intervention options and the win-wins and trade-offs of these interventions, and also giving recommendations on how best to balance/address trade-offs in dairy farms. It is also important for the tool to consider future climate change impact on well-being, meanwhile public debates on 'the circular economy', 'planet boundaries' and 'dietary shift' in the global North have raised the focus on environmental and health impact of dairy. Meanwhile more consideration is required for resilience, which is becoming more important in the sustainability debate, though not yet covered in some available tools.

A growing number of sustainability assessment tools have been developed to support farmers and policy makers in developing sustainable agriculture. Each tool has strengths and weaknesses and therefore selection of suitable tools for the East African context needs to be carefully done. This study assessed 42 sustainability assessment tools that have been developed and used in different countries to monitor people, planet and profit dimensions of dairy farming. Based on the list of eight criteria developed, four tools were identified with a good potential for use in the assessment of sustainability of dairy farming systems in East Africa.

These tools include RISE, IDEA, SAFA and PG. These were further evaluated on a more stringent triple P criteria focusing on data requirements, simplicity and user friendliness, reliability of results, and effectiveness. Based on this evaluation, it was concluded that the RISE and SAFA could be the most appropriate existing tools for assessing sustainability of dairy farming in East Africa. However, for generating more robust outputs for the East African context, the selected tool would need to be adjusted by removing less relevant and adding new sub-criteria to the list of criteria, and by modification of questions to make them easier understandable, among others.

Video summary: https://youtu.be/waiNAhXj3UI

1 Introduction

Dairy sector development has been a priority for many African and Asian countries over the last years. East African countries have experienced one of the highest growths in milk production in the last decade, offering great opportunities for economic growth and employment (Makoni et al., 2014). As such, dairy development has the potential to contribute to Sustainable Development Goals (SDGs) 1 (no poverty), 2 (zero hunger) and 8 (decent work and economic growth). At the same time, the livestock sector, including dairy, faces severe challenges related to growing demand, food safety, inclusive development, degrading natural resources, greenhouse gas emissions, and environmental pollution. Additionally, over the last years dairy intensification has led to the loss of biodiversity (Power et al., 2013). Sustainable intensification of the dairy sector requires efficient use of natural resources in a sustainable way. Therefore, the long-term sustainability of the dairy farming should be assessed, monitored and documented to safeguard livelihood of future generations (Goswami et al., 2017; van der Lee et al., 2016). In other words, balancing SDGs 1, 2, 8, 12, 13 and 15. This also aligns to the themes of the Food Security policy of the Netherlands ("Op weg naar een wereld zonder honger in 2030: de Nederlandse inzet", 2019).

Smallholders constitute the majority (over 75%) of dairy farmers in East Africa (Salami et al., 2010). Dairy is generally part of mixed farming systems, in which dairy has to compete with crop production. Besides conventional agro-industrial by-products, these farms utilize household wastes, crop residues and sometimes make use of marginal land, communal land and roadside grass for animal feeding. Milk production in smallholder farms can contribute to improving household nutrition and to generating family income and employment of significant numbers of people. However, assuring quality of marketed milk from smallholder-dominated supply chains is challenging and needs to be well managed to avoid public health concerns related with consumption of poor quality milk (Ndambi et al., 2019; Ndambi et al., 2018). Sustainable milk production does not only need to focus on milk production volumes, but also on its quality and safety. However, safety is also affected by climate change (FAO, 2020a).

A global consensus now exists that climate change represents a significant potential threat to the world's well-being and is one of the most important world challenges. At the same time, public debate on 'planet boundaries' and 'dietary shift' in the global North puts environmental and health impact of dairy in the centre of attention. The performance of livestock production vis-á-vis land use, greenhouse gas emissions (GHG), degrading natural resources, zoonoses and resistance against antibiotics needs also to be considered in the global South, where the understandable primary objectives for dairy development are the contribution to nutrition, broad-based economic growth and employment creation.

It is essential for dairy development not to only focus on increasing production, but also to consider different aspects of sustainability including people, profit and planet (triple-P). This would support informed debates involving both North and South, on the future of food production and role of animal production in food security . In line with the three objectives for global food security, dairy development should contribute to: a) affordable, safe and nutritious diets, b) gainful employment and improved livelihoods and c) sustaining the agroecological base (Andeweg et al., 2020). Development pathways that address these objectives simultaneously are challenging, as multiple trade-offs can occur. Trade-offs between environmental and economic aspects, but also trade-offs among different environmental aspects. Sound assessment of the contributions of intervention proposals to people-profit-planet objectives, as well as their possible trade-offs, would enable decision-makers to make further improvements in interventions. These could be assessed as ex-ante scenarios (intended dairy development ideas) or as ex-post farm strategies. For example, such scenarios could address issues like:

- *Production location*: should peri-urban, land-scarce dairy farms close to the end-market be supplied with forage grown elsewhere, or should production be moved to more remote areas where forage can be grown and manure can be recycled?
- *Production system*: should milk be produced extensively in (communal) grazing land, or semi zero grazing systems or zero grazing systems? What are the implications on sustainability for shifting from one system to the other?
- *Level of specialization*: should milk be produced in specialized dairy farms or in mixed farms?
- *Management options*: should investments be made in improved manure management systems? Is it better to keep more low yield robust cows or a few high yield exotic or crossbred cows?

Since triple-P aspects all play an important role in sustainability assessment, it is essential to be able to monitor the performance of and interventions in (smallholder) dairy farming across triple-P indicators. This needs holistic evaluation, for example through multi-criteria decision making (MCDM). MCDM allows for consideration of multiple conflicting attributes. A growing number of sustainability assessment tools have been developed to support farmers and policy makers in developing agriculture in a sustainable way, such as IDEA, RISE, and SIA (De Olde et al., 2016; Gerrard et al., 2012). However, such tools may need further development and specification to make them suitable for application to dairy in emerging economies. The optimized tool is a means to enable informed discussion on the present status of a dairy production system and to provide intervention options for win-win situations. Such a tool should be capable of clarifying the trade-offs of potential interventions, enabling informed discussion by stakeholders and also address the concept of resilience, which has not been sufficiently quantified in several sustainability assessment tools. Moreover, the tool should have an adequate "sphere of influence", it should cover the entire farming system, or should offer the opportunity for its users to define the system boundaries.

This study emanated from initiatives of the Netherlands East Africa Dairy Partnership (NEADAP), which in 2019 developed an action agenda for Dutch dairy development intervention (Andeweg et al., 2020). NEADAP links the Dutch and the East African dairy sectors. The Netherlands Food Partnership (NFP) recognized the need for a tool that enables stakeholders to assess and monitor the sustainability of dairy initiatives. NFP therefore commissioned this assessment, which has as objective to evaluate the suitability of existing tools for assessing the triple-P assessment of dairy farming systems and practices (or scenarios) in Africa and Asia (see Appendix 1 for ToR). This assessment is a first step in developing an integral sustainability assessment tool that will help NFP and its partners in assessing whether and how proposed dairy development intervention scenarios contribute to people-planet-profit sustainable dairy production and are worth scaling. Such potential users include policy makers, multi-stakeholder platforms including public, private and development agencies, and their advisors.

2 Methodology for evaluating sustainability assessment tools

In this section, we describe the approach used to select, evaluate and compare the suitability of various tools for assessment of the sustainability of dairy production systems in East Africa.

Selection of relevant assessment tools involved the following steps:

i. Reviewing literature on dairy farm sustainability tools, preselecting potentially relevant sustainability assessment tools and evaluating the preselected tools for relevance to triple-P sustainability assessment of dairy farming and dairy development interventions (scenarios) in East Africa. This generated a long-list of preselected tools.
ii. Assessing the longlist of preselected tools and further shortlisting the tools based on their availability and appropriateness for triple-P assessment.
iii. In-depth characterization of shortlisted tools, bringing out their strengths and weaknesses for use in triple-P sustainability assessment.

2.1 Literature review

Due to the fact that different terms are used for sustainability assessment in recent literature (e.g. framework, methods, tools), the literature review focused on studies (such as review papers) that referred to sustainability assessment tools. Tools were searched using different databases including Web of Science, Scopus, Science Direct, Google Scholar and related review papers (Arulnathan et al., 2020; Coteur et al., 2020; De Olde et al., 2016). In addition, expert consultations were made to identify different sustainability assessment tools. To shorten the list, only tools that addressed all three sustainability dimensions (environmental, economic and social) were considered. Besides this, criteria for suitable tools were defined, as described in the next section.

2.2 Prerequisites for a suitable sustainability tool for dairy farms in East Africa

The following eight criteria were considered when preselecting tools and further in shortlisting them:

Accessibility: A suitable tool should be freely available to various (potential) users. Potential users should have access and user rights to the tool to support them in decision making.

Reliability: The level of precision of outputs should be good enough for the tool to be used as a support in informed decision making. Repeated running of data in the model for the same scenario should generate similar results, especially in economic indicators. However, since environmental and social issues might be difficult to capture in precise scores, subjective judgements are unavoidable. In some cases, the differences in scoring might be due to local values (e.g. for land, trees, water), which might differ between communities. A good user manual should guide the tool users to be more objective in their scoring, while reflecting their local values.

Adaptability: The tool should be adaptable to suit various scales of production including smallholder farming systems, and should provide room for changing the priority of criteria for sustainability and the weighting of sustainability indicators to suit different contexts. A majority of dairy farms in East

Africa are smallholder farms owning less than five dairy cows and less than 1 hectare of farmland. Suitable tools should be able to model medium and large scale farms, but also smallholder farms which have strong linkages between the farm, family and household as well as integration of crops and livestock enterprises where mixed cropping is the norm, as opposed to monocropping systems.

Efficiency: The tool should be able to generate useful results within the shortest possible time. It should save the user from various forms of redundancy and should strongly contribute to reaching a goal.

Holistic: It should include different dimensions of sustainability (economic, environmental and social) and should show trade-offs between these dimensions when comparing the impact of various interventions.

User-friendliness: The tool should be easy to use and should have simple training options and user guide for different users.

Visualization: The tool outputs should be displayed in a good visual form to enable its users to easily see system trends, identify dynamics and pressure generate informed discussion on present status as well as intervention options, including the win-wins and trade-offs of these interventions and how best to balance/address trade-offs. Tools having polygon graphs or a combination of polygon graphs with traffic lights show a more understandable visual approach to present the results, though the real data behind these illustrations (for example tables) are also important for decisions requiring quantitative information.

Table 1 *Criteria for comparing sustainability assessment tools.*

	No.	Criteria for selection	Description - The tool should be...
Step I	1.	Sustainability dimensions covered (ESE)	Able to generate indicators covering all three (ecological, social and economic (ESE)) pillars of sustainability
	2.	Sectoral coverage	Applicable to multiple sectors (livestock, crop) since most East African farms are mixed
	3.	Level of assessment	Relevant for assessment of dairy farming systems at least at farm level, with an advantage if it goes beyond farm (region or chain)
	4.	Peer reviews on tool	Should be evaluated from a scientific point of view; have peer reviewed articles ore are built on peer-reviewed knowledge within the last decade (2010 -2020).
	5.	Language of tool	The tool should be available in English language to facilitate its use by East African stakeholders
	6.	Suitability for use in East African dairy	Relevant to assess sustainability of dairy farming in East Africa, including assessment of important stakeholders in the dairy value chain
Step II	7.	Availability of tool	The tool should be made available by its developers
	8.	Possibility to create and compare sustainability scenarios	Flexibility in adjusting sustainability indicators and creating scenarios or comparing the sustainability of different farming systems. For example, typical dairy farms could be considered to represent various farming systems. The current farm practices (status quo) could be compared with improved practices (scenarios) such as feed ration formulation. The number of typical farms in a certain region can be adapted according to prevailing farm type variation.

2.3 Steps in shortlisting tools

During a first shortlisting step, all preselected tools were assessed using a framework of six criteria (Step I in Table 1). In a second step, the tools that met these requirements were further assessed. The tools were further shortlisted depending on whether they are made available to other users by their developers and whether they had an option to create scenarios, since it is essential for the tool to be used in comparing farm strategies (see Step II in Table 1). These criteria include, for example, the ecological, social and economic (ESE) dimension of sustainability, which need to be assessed to monitor a balanced contribution to SDGs 1, 8, and 13 and contribute to Dutch Food Security policy.

2.4 In-depth characterisation of selected tools

In a third step, the shortlisted tools were further characterized, bringing out their strengths and weaknesses. To define the criteria for in-depth evaluation, the most important parameters applied in similar studies (Coteur et al., 2020; De Olde et al., 2016) were selected. Four main parameters were used for in-depth evaluation of the remaining tools:

- *Data requirements*: The volume and availability of the required data. This includes the amount and the level of data required by the tool to do a sustainability assessment. Different types of data such as farm and geographical data can be included. The time requirement for collecting the data (e.g. interviewing with farmer) is considered for evaluating data requirement.
- *Simplicity and user friendliness*: The time and skills required to run the tool and the time a user needs to read the manual and gain enough knowledge to run the tool were considered.
- *Reliability of results*: Good and trustful basis to assist decision makers in prioritizing farm strategies and different scenarios. Strong scientific support for developing the tool and application of more quantitative analysis enhances the accuracy of a tool.
- *Effectiveness*: This reflects the relevance of the results and the goals. In other words, effectiveness is the contribution to reaching a goal (sustainability assessment in this case) or the compliance of a tool with the real situation.

Photo: *Mixed Napier and cabbage on a farm in Kenya*

3 Findings

3.1 Review and preselection of sustainability assessment tools

The search of tools through different databases and scientific review papers resulted in a long list of tools from which 42 were preselected. Some tools, such as CoolFarm[1], EX-ACT[2], Rumen8[3], GLEAM/GLEAM-i[4], TAPE (FAO, 2019), Silsoe Whole Farm Model (SFARMMOD) (Annetts and Audsley, 2002), DairyWise (Schils et al., 2007), FarmDyn (Britz et al., 2014), Kringloopwijzer (Schröder et al., 2014), FarmAC[5], HolosNor (Bonesmo et al., 2012) and LEAP (FAO, 2019) were found interesting, but did not meet the criteria for preselection because they did not consider all three dimensions of sustainability. These were excluded from Table 2. Table 2 summarizes the results of the assessment of the tools based on criteria 1 to 6 (Step I). Four tools selected for further assessment are highlighted in green and are further discussed in section 3.2.

Photo: *Dairy herd in Uganda*

[1] https://coolfarmtool.org/coolfarmtool/
[2] http://www.fao.org/tc/exact/ex-act-home/en/
[3] https://www.rumen8.com.au/index.html
[4] http://gleami.org/
[5] https://www.farmac.dk/

Table 2: *Overview of all tools considered in this study*

No.	Tool/ model	Full name	Sustainability dimensions covered (ESE*)	Sector (Dairy, arable, all)	Assessment level	Peer reviewed (Yes/No)	Language	Suitability for use in East Africa	Link and reference
1	AgEES	Assessment based on Environmental, Economic and Social perspectives	ESE	Arable	Farm	Yes	English	No	Rasul and Thapa (2004)
2	APOIA-NOVORURAL	"Weighed Environmental Impact Assessment System for New Rural Activities"	ESE	All	Farm	Yes	Portuguese	No	Rodrigues et al. (2010)
3	ARBRE	Arbre de l'Exploitation Agricole Durable	ESE	All	Farm	No	French	No	Pervanchon (2004)
4	Avibio	AVIculture BIOlogique	ESE	Poultry	Farm, Chain	Yes	Unknown	No	Pottiez et al. (2012)
5	BJCD	Caring Dairy Programme	ESE	Dairy	Farm	No	English	No	http://www.benjerry.com/caringdairy
6	COSA	Committee On Sustainability Assessment	ESE	Arable (coffee & cacao)	Farm	Yes	Unknown	No	COSA (2013)
7	DEXiPM	DEXi Pest Management	ESE	Arable	Farm	No	English/ French	No	https://www6.inrae.fr/means_eng/Multicriteria-assessment-tools/DEXiPM-model
8	DLG	DLG – Zertifikat Nachhaltige Landwirtschaft	ESE	All	Farm	No	German	No	www.nachhaltige-landwirtschaft.info
9	DSI	Dairyman Sustainability Farm Index	ESE	Dairy	Farm	Yes	English	No	Elsaesser et al. (2015)
10	DSR	Driving Force State Response	ESE	All	Regional	No	English	No	OECD (2001)
11	FarmDesign	FarmDesign Tool	ESE	All	Farm	Yes	English	Maybe	Groot et al. (2012)
12	FARMSMART	FARMSMART module	ESE	All	Farm	Yes	English	No	Tzilivakis and Lewis (2004)
13	FieldPrint	Field Print Calculator	ESE	Arable	Farm	No	English	No	www.fieldtomarket.org
14	IDEA	Indicateur de Durabilité des Exploitations Agricoles	ESE	All	Farm	Yes	English/ French	Maybe	Zahm et al. (2008)
15	IFSC	Illinois Farm Sustainability Calculator	ESE	All	Farm	No	English	No	www.ideals.illinois.edu/handle/2142/13458
16	INSPIA	INSPIA platform (European Index for Sustainable Productive Agriculture)	ESE	European agriculture	Regional	No	French	No	http://agridurable.top/fr/les-indicateurs-de-durabilite
17	ISAP	Indicator of Sustainable Agricultural Practice	ESE	Arable	Farm	Yes	English	No	Rigby et al. (2001)
18	KSNL	Kriteriensystem Nachhaltige Landwirtschaft	ESE	All	Farm	No	German	No	Breitschuh (2009)

No.	Tool/ model	Full name	Sustainability dimensions covered (ESE*)	Sector (Dairy, arable, all)	Assessment level	Peer reviewed (Yes/No)	Language	Suitability for use in East Africa	Link and reference
19	LEAF-SFR	Linking Environment and Farming - Sustainable Farming Review	ESE	All	Farm	No	English	No	https://my.leafuk.org/review/home.eb
20	MASFDD	Multi-attribute sustainability function for Dutch dairy farming systems	ESE	Dairy	Farm	Yes	Unknown	No	Van Calker et al. (2006)
21	MAVST	Multi-attribute Value sustainability tool	ESE	Arable	Farm, Regional	Yes	Unknown	No	Dantsis et al. (2010)
22	MESMIS	Framework for Assessing the Sustainability of Natural Resource Management Systems	ESE	Integrated	Farm, Local	Yes	English/Spanish	No	López-Ridaura et al. (2002); Speelman et al. (2007)
23	MMF	Multiscale Methodological Framework	ESE	Integrated	Farm, Local, Regional	Yes	Unknown	No	van Keulen et al. (2005)
24	MOTIFS	Monitoring Tool for Integrated Farm Sustainability	ESE	Dairy	Farm	Yes	Dutch	Maybe	Meul et al. (2008)
25	NZSD	New Zealand Sustainability Dashboard	ESE+ governance	All	Farm, chain	Yes	English	No	Hunt et al. (2014)
26	ODST	On-demand sustainability tool	ESE	Arable	Farm	Yes	Dutch	No	Coteur et al. (2014)
27	PG Tool	Public Goods Tool	ESE	All (public goods)	Farm	Yes	English	Maybe	Gerrard et al. (2012)
28	RAD	Diagnostic de durabilité Réseau de l'Agriculture Durable	ESE	Dairy	Farm	Yes	French	No	Le Rohellec and Mouchet (2008)
29	RISE	Response-Inducing Sustainability Evaluation	ESE	All	Farm & chain	Yes	English	Yes	Hani et al. (2003)
30	SAFA	Sustainability Assessment of Food and Agriculture Systems	ESE+ governance	All	Farm & chain	Yes	English	Yes	http://www.fao.org/nr/sustainability/sustainability-assessments-safa/safa-tool/en/
31	SAFE	Sustainability Assessment of Farming and the Environment	ESE	All	Farm & Regional	Yes	English	No	Van Cauwenbergh et al. (2007)
32	SAI-FSA	Sustainable Agriculture Initiative Platform - Farm Sustainability Assessment	ESE	Arable	Farm	No	English	Maybe	https://saiplatform.org/fsa/
33	SAI-SPA	Sustainable Agriculture Initiative - Sustainability Performance Assessment	ESE	All	Farm	No	English/French/Spanish	Maybe	www.standardsmap.org/fsa
34	ScaIA	Scaling up assessment Tool	ESE	All	Farm	Yes	English	No	Sieber et al. (2015)
35	See Balance	See Balance tool	ESE	All	Product	Yes	English	No	Saling et al. (2005)
36	SIMPATICA	Software to register and analyse crop management	ESE	All	Farm	Yes	Multiple	No	Kuneman et al. (2014)

No.	Tool/ model	Full name	Sustainability dimensions covered (ESE*)	Sector (Dairy, arable, all)	Assessment level	Peer reviewed (Yes/No)	Language	Suitability for use in East Africa	Link and reference
37	SMART-Farm Tool	Sustainability Monitoring and Assessment RouTine-Farm Tool	ESE	All	Farm	No	Unknown	No	www.fibl.org/en/themes/smart-en.html
38	Soil & More Flower	Sustainability Flower Quick Assessment	ESE	All	Farm	No	English	No	www.soilandmorefoundation.org/projects/sustainability-flower
39	STMPT	Sustainability tool for milk production in Tanzania	ESE	All	Farm	Yes	Unknown	Maybe	Munyaneza et al. (2017)
40	SVA	Sustainable Value Approach	ESE	All	Farm	Yes	English	No	Merante et al. (2015)
41	TIPI-CAL	Technology Impact Policy Impact Calculation model	ESE	Dairy	Farm	Yes	English	No	https://ifcndairy.org/
42	TOA-MD 5.0	Trade-off Analysis Model for Multidimensional Impact Assessment	ESE	Agroecosystem	Regional	Yes	English	No	Valdivia et al. (2015)

* ESE refers to sustainability Dimensions (Economic, Social and Environmental).

Among the 42 sustainability assessment tools, six tools, FarmDesign, IDEA, PG, SAFA, RISE and STMPT were shortlisted and assessed in the second evaluation step. Two of these tools (FarmDesign and STMPT) were removed from the selection because FarmDesign focuses more on environmental indicators and less on economic and social indicators. Meanwhile, the STMPT tool was not available through any web link and could not be evaluated further. The remaining four sustainability assessment tools, SAFA, IDEA, RISE and PG, were compared further.

3.2 Brief description of the four selected tools

3.2.1 RISE sustainability tool

Response-Inducing Sustainability Evaluation (RISE) is an interview-based method for assessing the sustainability performance of agricultural products at farm level. It was developed by the School of Agricultural, Forest and Food Sciences (HAFL) of Bern University of Applied Science (Grenz et al., 2012a). RISE covers all three sustainability dimensions in 10 – 12 themes including energy, water, soil, biodiversity, nutrient cycles, animal husbandry, economic viability, farm management, working conditions, and quality of life (Figure 1). Each theme consists of various indicators (four to seven indicators in each theme) and in total RISE uses 51 indicators (Appendix 2).

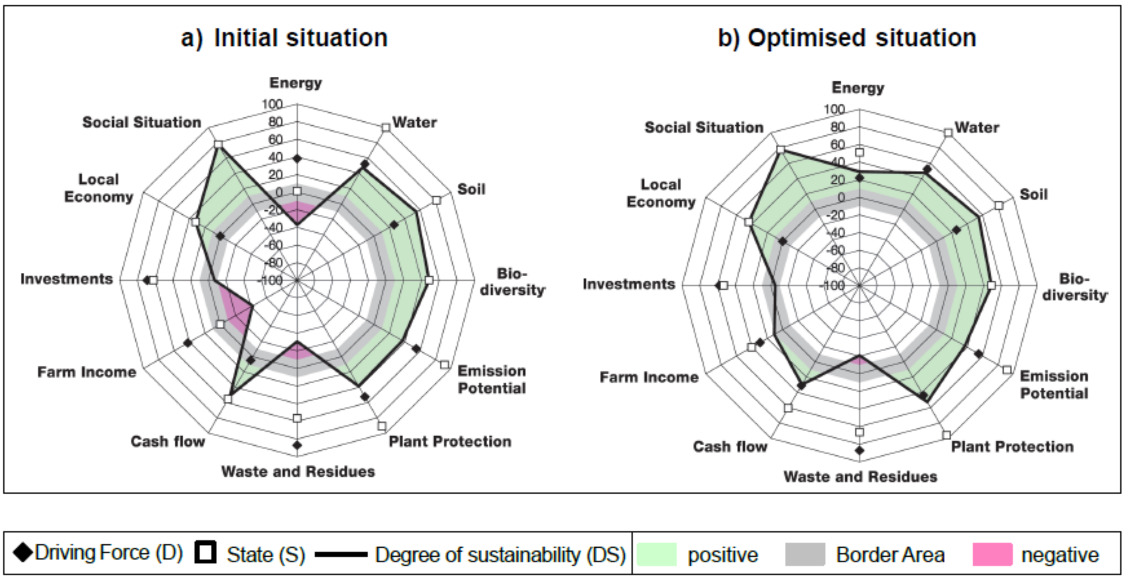

Figure 1 *Example of output from RISE tool - Source: (Grenz et al., 2012b).*

This tool has been used in more than 57 countries, including in East Africa, it has been applied in Ethiopia and Kenya. In the previous version of RISE tool, the degree of sustainability is calculated by the equation $DS=S-D$ where D and S refers to *Driver* and *Status*, respectively. *Status* shows the current situation and *Driver* represents the pressure from the production system on the indicator. In other words, the *Status* shows the current condition of a particular indicator and the *Driver* is a measure of pressure that a production system places on the particular indicator. The higher values for *Status* are desirable while for *Driver* the lower values are favourable. Both D and S are scaled up between 0 and 100. The most sustainable situation is identified by S=100 and D=0; however, challenges arise in case of interventions with high D and low S (Figure 1).

This means that it is possible to compare different scenarios with the current status. RISE assessments should include the following steps (Grenz et al., 2012a):

- Collecting data by filling in the RISE questionnaire.
- Importing data to the RISE tool and calculating the degree of sustainability.
- Assessing four dimensions on three scales (whether they are strong, acceptable, or not favourable for sustainable development). The four dimensions are (a) stability of the social, economic, and ecological framework; (b) farmer's risk awareness, attitudes, and management; (c) grey energy (machines, buildings, external inputs); and (d) animal health and welfare.
- Interpretation of the results in order to develop management practices that contribute to a more sustainable farming system.

In contrast to the previous version, RISE 2.0 and 3.0 normalize the data by transforming them into a scale 0 to 100 through comparison between farm and reference data and using valuation functions. Three types of data including farm, regional and reference data are used in RISE 2.0. Compare to the previous version, the degree of sustainability is determined directly not using the *S* and *D* parameters. Based on the results of RISE, the farmer or policy maker can gain insight into the current status of an indicator and the impact of interventions on the farming system. The key strengths of RISE tool are its broad range of indicators covering the three sustainability dimensions and its ability to consider long term trends and tendencies for a defined farm. Users have the possibility to adjust some of the weighting factors and reference values of the tool. Also, it provides the option to compare a current farm (which could represent a farming system) to its future target based on various scenarios. Weaknesses of this tool are that it requires a trained analyst to visit the farm, it requires long training time as well as long preparation, assessment, calculation and reporting time.

3.2.2 SAFA tool

Sustainability Assessment of Food and Agriculture systems (SAFA) is an international tool with a broad scope (Figure 2) which is applied in many countries. It was used in more than 104 countries during the period from January 2016 to June 2017. The tool has a computer version and also a mobile app (SAFA Mobile App) which is adapted for smallholder farmers (FAO, 2020b). The SAFA tool has been structured based on four levels: dimensions, themes, sub-themes, and indicators (Figure 3). The framework covers four main dimensions of sustainability: environmental, economic, social and governance. In the next level of evaluation, 21 themes are defined, which are further detailed into 58 sub-themes. Each sub-theme includes various indicators, totalling 116 indicators (FAO, 2013). Indicators can be measured by using a performance score on a scale from 1 to 5. The most sustainable practices gain the highest score (5) and unacceptable practices get the lowest score (1). A specific colour is assigned to each score. On an increasing scale, practices are listed as: unacceptable (red), limited (orange), moderate (yellow), good (light green), and best (dark green). To determine the sustainability performance of a farm, the following steps should be taken:

- defining the objectives
- describing the geographical, dimensional and sectoral information
- selection of themes and sub-themes and sustainability indicators
- listing of tools, metrics, and standards for data collection
- providing the required information (farm data),
- Calculate sustainability performance

The main dimensions (environmental, economic, social and governance) are presented in SAFA tool with different colour. As it can be seen in Figure , the blue colour represent the sub-themes for the

governance, green represents the environmental, brown represents economic while orange represents the social dimension of sustainability.
Results of sustainability performance are presented using polygon graphs and colour coding for the different pillars and score levels (Figure 4). A polygon graph is a visual approach to present the results in a more understandable way to the users. Combining a polygon graph with a traffic light approach (as we see in the SAFA tool) helps the users to get more detailed data and compare the modelled results of interventions more easily to the current situation (baseline).

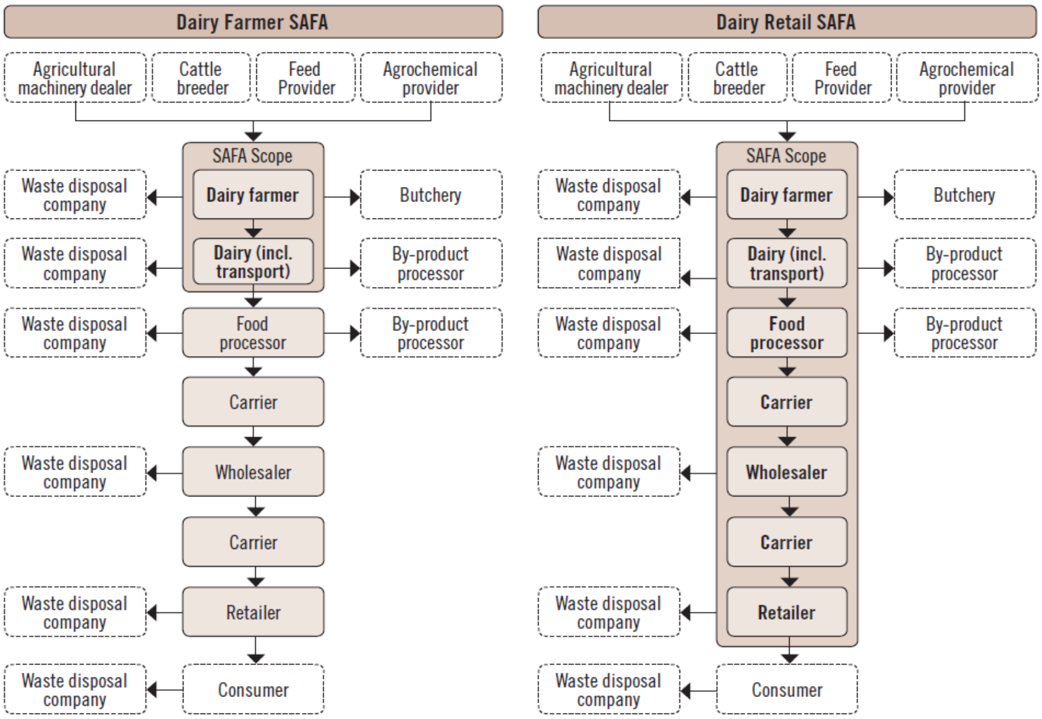

Figure 2 *Examples of SAFA scope - Source: FAO 2014.*

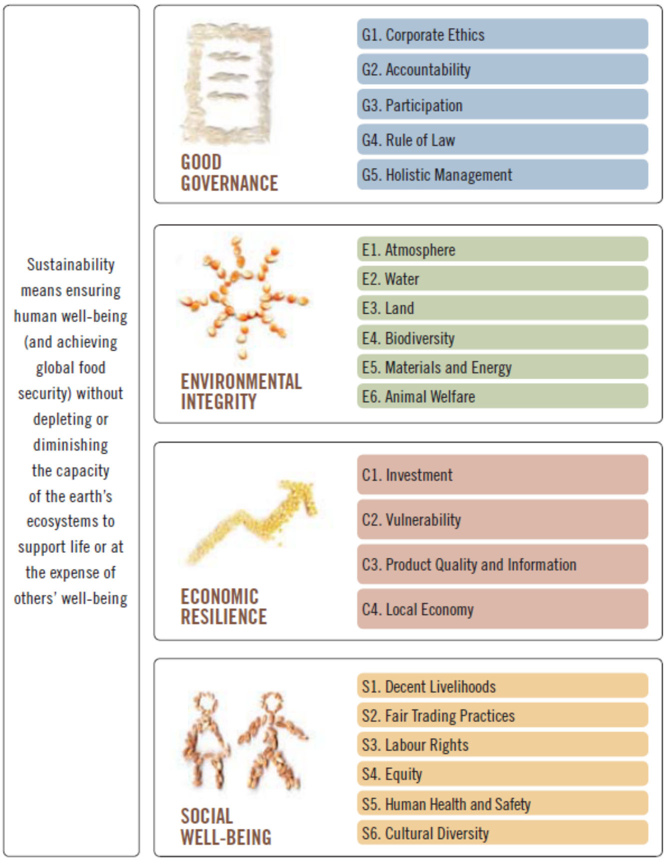

Figure 3 *SAFA sustainability dimensions and themes - Source: (FAO, 2013).*

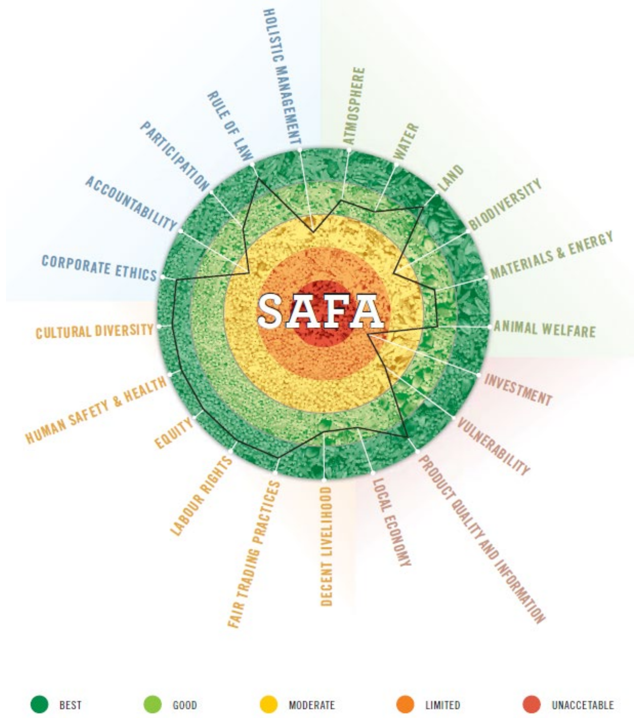

Figure 4 *Example of output from SAFA – formulated in CSR-terms, less in farming system terms - Source: (FAO, 2013).*

The key strengths of SAFA include the very wide coverage of sustainability indicators it can generate and the high level of data correctness. The tool is highly flexible and can be adapted for use in any part of the value chain as well as any region of the world (Heylen et al., 2020). Though the tool already integrates data from other existing sources, its key disadvantage is its requirement of detailed data, which might be difficult to collect. It also includes long questionnaires with complex wordings, making its use restricted.

3.2.3 IDEA tool

The Indicateurs de Durabilité des Exploitations Agricoles (IDEA) tool is a sustainability tool that has been developed based on research work conducted since 1998. The IDEA tool was developed by a multidisciplinary group of French researchers for French case studies. However, it has been further developed in recent years for application in broader studies. To cover the three dimensions of sustainability, 41 sustainability indicators were evaluated for a production system and later versions (IDEA v.4) include 53 indicators (Zahm et al., 2018). IDEA organizes the three normative sustainability dimensions (agro-ecology, socio-territorial aspects and economics) into thirteen components (see Appendix 3). The agroecological dimension is measured using functional diversity, achieving cycling of materials, nutrients and energy flows, restraint in use of resources and ensuring favourable conditions for production, and reduced impact on human health and ecosystems). The socio-territorial dimension is structured around four components (food supply, local development and circular economy, employment and quality of work and ethics and human development). The economic dimension contains four components (economic and financial viability, independence, transferability and overall efficiency). Scoring and weighting the indicators in IDEA was done using a multidisciplinary group of about thirty French experts. The scoring of sustainability is on a maximum of 100 points per sustainability pillar, providing equal weights to the sustainability coverage scales; agroecological sustainability scale (environmental), socio-territorial sustainability scale (social) and economic sustainability scale. IDEA applies a system of ceiling to each component which makes it possible to assess and compare different farm systems (Zahm et al., 2018). IDEA makes it possible to study and compare the sustainability of production systems and of farms within the same production system as well. Like previous tools, results for sustainability assessment are presented using polygon graphs for different indicators.

The key strengths of the IDEA tool are its good coverage of sustainability indicators and the possibility to compare several farms based on different sustainability dimensions (Figures 5 and 6). Different farms or scenarios of the same farm can be easily compared from the tool outputs. It is also relatively easy to handle, and can be run by a farmer with support from an advisor. It requires less time to run as compared to, for example, the RISE tool. The tool is also flexible and can be adapted to fit the local context. The outputs enable a visualization of potentials and weaknesses, which could support in farm management (Marchand et al., 2014).

A major weakness of the method is the equal weighting of scores in the three pillars. This restricts a good visualisation of effects of interventions with trade-offs between the different pillars.

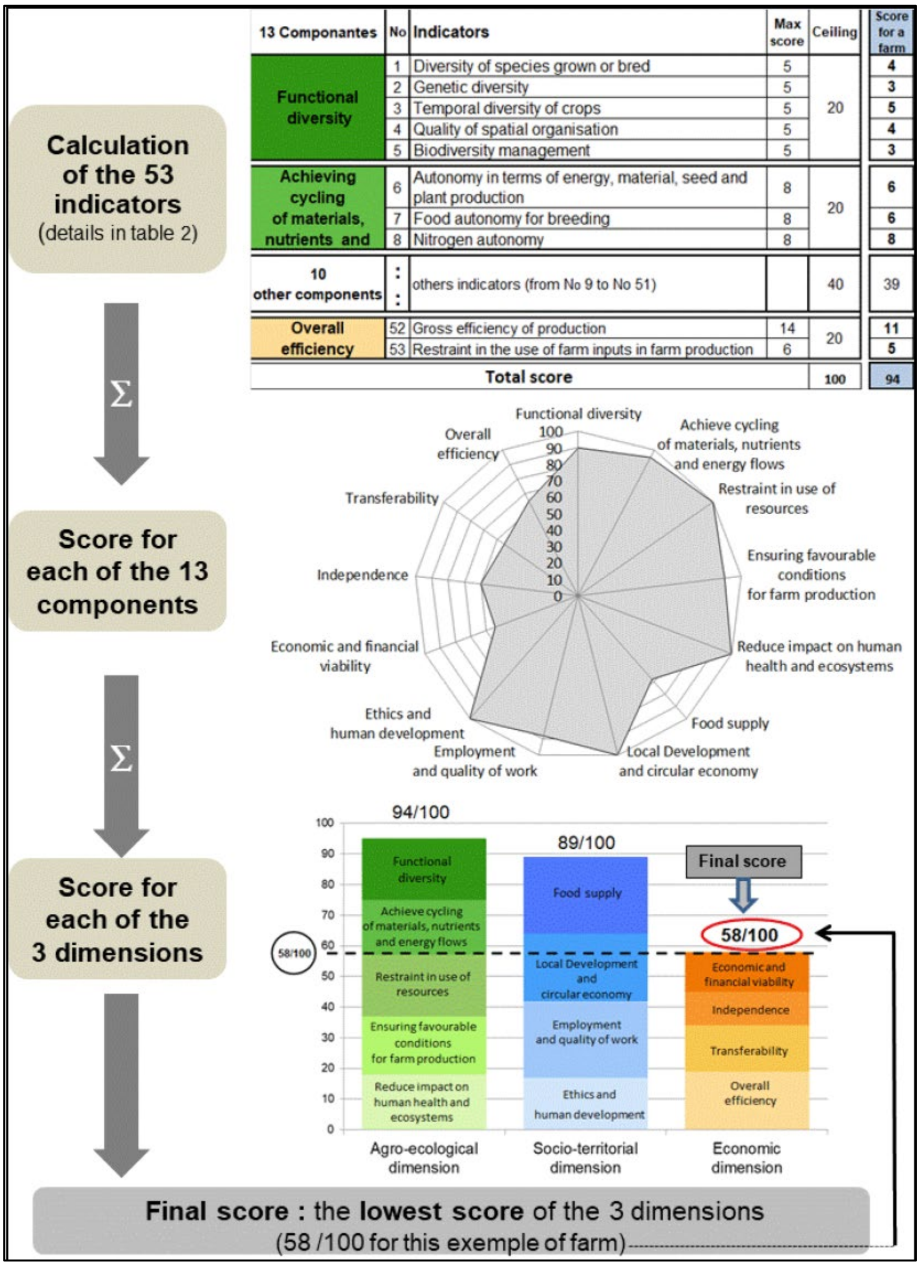

Figure 5 *Overview of the calculation method for IDEA - Source: (Zahm et al., 2018).*

3.2.4 Public Goods tool

The Public Goods (PG) tool has been designed to provide a simple, measurable and accessible way to show the 'Public Goods' that accrue through organic farming systems and the addition of an Organic Entry Level Stewardship (OELS) agreement. The tool is excel-based and can be used to assess public goods provided by a farm. PG helps farmers to identify the areas with potential for improvement, based on 9 sustainability indicators (Figure 7) and 35 sub-criteria. The scoring of indicators is on a scale of 1-5, with 5 being the most sustainable. Also it helps farmers to monitor sustainability changes in farms over time, based on these indicators:

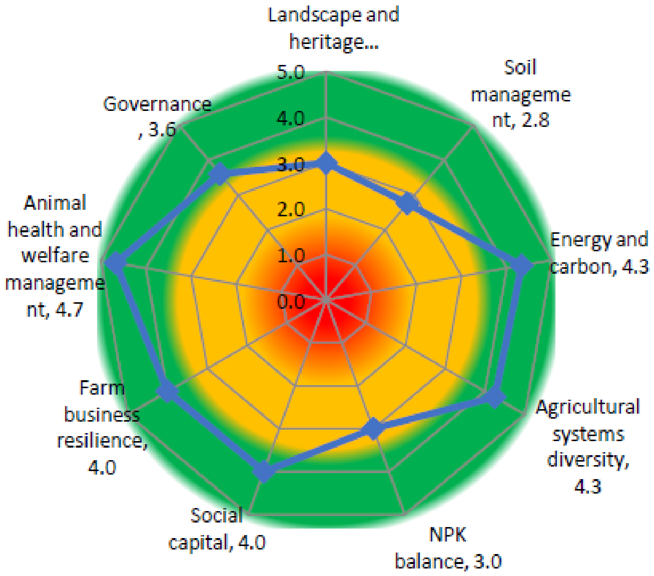

Figure 7 *Example of PG result for a selection of farms - Source: (Gerrard et al., 2012).*

The PG tool is stronger in benchmarking one farm and a possible scenario for it than in comparing several farms at a time. It is stronger in the environmental components and has limited representation of the social and economic components. Changes in farm management, such as feeding practices, might not be properly captured by the indicators. Though the tool is relatively easy to use, some of the questions are difficult for both farmers and advisers to understand. The PG tool has been applied in many European countries as case studies including UK, Denmark, Poland, Italy, and Romania. We didn't find any studies using PG tool in East Africa. However, because of its broad applicability, it could be adapted for use in East Africa.

3.3 In-depth comparison of the four selected tools

The four selected sustainability tools mentioned above were further evaluated based on four criteria: data requirements, simplicity and user friendliness, reliability of the results, and effectiveness (section 2.3). Moreover, implications for adaptation to use in East Africa are discussed, as well as the desirability of including resilience aspects in sustainability assessment.

3.3.1 Comparison on key criteria

Data requirements - To compare the four tools based on the data requirement criterium, we considered some of the findings from De Olde et al. (2016) who conducted an experiment to evaluate and compare different sustainability assessment tools. In the first step of their assessment, sustainability assessment tools were assessed using dummy data. The results showed that RISE, PG and IDEA had a similar level of data requirement which was relatively easy to access. However, SAFA required varying levels of data, ranging from low to high level, depending on the quality of assessment. The time needed for preparation (for data of feeding compositions, crop rotation plan, fertilization plan), assessment (for interviewing farmers with the remaining questions) and reporting (including data cleaning, calculations, interpretation and reporting) was monitored to compare the simplicity and user-friendliness of tools. Results of comparing the tools based on data requirement parameters show that RISE, PG and IDEA need data that is relatively easy to collect. These data mostly was related to farm management and farm monetary data, which can be collected from farmers by interviewing. Compared to the other three tools, SAFA needs different types of data that should be collected. Also, to conduct more accurate analysis, additional data and calculations are required.

Reliability of the results - Sustainability assessment tools can be divided into two categories, depending on the time requirement and output accuracy: (1) full sustainability assessments (FSA), and (2) rapid sustainability assessments (RSA) (De Olde et al., 2016). Although FSA tools require more time for data preparation and running the tool, they present more accurate outputs. In contrast, RSA tools provide less accurate outputs with less time investment. According to this classification, RISE could be placed somewhere between RSA and FSA while IDEA and PG would tend towards RSA. Due to the fact that SAFA can provide both full and rapid sustainability assessment results, its position depends on the available data and desired level of assessment. Another advantage of the SAFA tool is its availability as a mobile app, which can be easily managed in comparison to other tools. In case the aim is a quick overview for policy makers and practitioners on sustainability, a RSA tool would be the most appropriate choice. In this study both FSA and RSA criteria were important, therefore a tool that could run fast and concurrently in conducting a rapid and full sustainability assessment is preferred.

RISE had a higher reliability of outputs than the other tools, as it uses a strong scientific and quantitative approach. Although SAFA was developed by a high number of experts were involved in developing the tool, its rather qualitative scoring procedure leads to less accurate outputs. We note the challenges associated with conclusive judgements on reliability of results especially in deciding on the sustainability of interventions. Therefore, tools that evaluate the sustainability indicators quantitatively were considered to have a more firm scientific approach to determine sustainability.

Simplicity and user-friendliness - There is a trade-off between accuracy and simplicity. Accuracy shows whether the results of an assessment reflect the real situation. It strongly depends on the available data and information. Access to more data provides more accurate results, collecting more data is both time consuming and costly. A sustainability assessment tool that can provide results with different levels of accuracy based on different levels of data requirement is preferable. Only SAFA offers this possibility. For the time required for running the tool, RISE requires significantly more time (because of different scoring methodologies) than the other tools, while SAFA required the shortest amount of time (De Olde et al., 2016). One of the most important advantages of SAFA, compared to the other tools, is the possibility to select desired indicators, thus opting for a quick, intermediate or full assessment. Concerning skill requirements, the time required for learning to use RISE was higher than for the other tools. To use RISE and gain insight of the background calculations, a training given by the tool developer is required. Next to RISE, also SAFA needs much time to study the extensive manual. IDEA and PG require less time due to a more concise manual and easier questions and calculations.

Effectiveness - Looking at the effectiveness of tools, SAFA, was noted to have a high coverage of the subthemes in the other tools (80% in RISE, 58% in PG and 55% in IDEA) and also has a more uniform spread of subthemes per sustainability dimension compared to the other tools (De Olde et al., 2017). It was also shown that RISE best reflects the strengths and weaknesses of the farms.

Therefore, the highest effectiveness was seen in RISE, followed by SAFA and PG, and the lowest was reported for IDEA (De Olde et al., 2016). The methodological evaluation showed that all four tools use a similar structure for weighting and aggregating the results of sustainability assessments. However, the scoring methodologies are different. RISE and SAFA use a set of calculations while PG and IDEA calculate the criteria scores directly from the answers given by the user.

3.3.2 Adaptation to East African conditions

Adaptation to the East African context is crucial in developing the selected Triple-P tool and the selection of indicators is of high importance, considering that the current tools were mostly developed for farming in temperate climates. These indicators need to address East African challenges such as:

- Societal and political pressure to increase local milk production
- Pressure to improve livelihoods where increasing farm revenues is an important component
- Pressure on land – decreasing availability and degradation of arable and communal land
- The largely smallholding farm structure
- Insufficient fodder production and/or conservation leading to low efficiency and high cost prize
- Low nutrient use efficiencies and high nutrient imbalances at farm level
- Reducing biodiversity
- Restrictions due to social structures including gender division

With these challenges in mind, selected sustainability indicators need to consider that sustainable dairy farming systems do not only need to be profitable by producing more milk per hectare, but should be robust and resilient to sustain (or restore) the agroecological base and offer livelihood to farm household on very small landholdings. This affects feed/forage availability, which hence figures as the major cost component in milk production. In the East African context, selection of indicators also needs to consider the inclusion of less resource-endowed families, youth, single-headed households as well as smallholder farms in general to the formal dairy chain. This should also consider gender division of labour and how it will be affected by dairy intensification.

3.3.3 Inclusion of resilience

One additional issue that has not been highlighted in the sustainability assessment tools is resilience. Walker et al. (2004) defined resilience as the capacity of a system to absorb disturbance and reorganize while undergoing change, so as to still retain essentially the same function, structure, identity, and feedbacks. Farming systems need to enhance resilience to be able to cope with change, be they sudden shocks or longer-term stresses (Cuijpers et al., 2014), be they natural, economic, social or political. The more resilient a system is, the more flexible it is to adapt, renew and support its function. This plays a key role in sustainable farming systems, where sustainable use of resources is fundamental in case any disturbances occur and increase vulnerability. Principles for resilience of agroecosystems include promotion of (agro-)biodiversity, nutrient cycling, water flow and storage, prevention of soil erosion, enhancing resistance to diseases and pests, communal action, and animal health and well-being. Because of the importance of the resilience of agroecosystems, we believe it is essential to cover it better in sustainability assessment tools.

Photo: *Commercial silage making in Kenya*

4 Conclusions and recommendations

4.1 Conclusions

This study aimed to assess the suitability of existing tools in benchmarking the sustainability of dairy farming systems and of interventions to contribute to people-profit-planet sustainability of dairy farming in East Africa. This assessment is a first step in developing an integral sustainability assessment tool that will help in assessing whether and how proposed dairy development intervention scenarios contribute to people-planet-profit sustainable dairy production and are worth scaling. Such potential users include policy makers and multi-sector platforms having public, private and development agencies, and their advisors.

A two-step approach was used to select appropriate tools, which resulted in four candidates for an in-depth evaluation – RISE, IDEA, SAFA, and PG. This evaluation showed the following:

1. Data requirements – RISE, PG and IDEA have a higher level of data requirements than SAFA. However, RISE, PG and IDEA input data is relatively easier to obtain than data for SAFA. For RISE, data could be collected from farmers through an interview. Running RISE requires significantly more time than running the other tools, while SAFA requires the least amount of time.
2. Simplicity and user friendliness - RISE requires more time for training and running the tool, followed by SAFA that requires much time to study its extensive manual. PG and IDEA are less time-consuming.
3. Reliability of results – RISE provides more accurate results as compared to the other tools. SAFA applies a rather qualitative scoring procedure that leads to less accurate outputs.
4. Effectiveness – RISE presents the strengths and weaknesses of farms to a high degree, and would be the recommended tool, with SAFA as a fall-back option in case less data and/or time is available and in case a broader sector assessment is desired, which RISE does not cover.

Comparing the pros and cons of RISE and SAFA in some more detail against the seven prerequisites defined in section 2.2., we conclude the following:

- The RISE scores best on *reliability of results, efficiency, replicability* and *visualisation* criteria. It is also holistic in sustainability assessment, but requires adjustments to make it more adaptable (i.e. make indicators, sub-criteria and questions more suitable to the East African context) and to improve its user-friendliness (by reducing the time required to run the tool). The SAFA tool scores best on *accessibility, adaptability* (offers the users the possibility to adjust criteria), *user-friendliness* (although it also has a very long user manual), and *holistic approach* (in terms of multiple sustainability dimensions and in going beyond the farm level), but needs some adjustments to improve its accuracy & replicability (to deliver more precise results while minimizing subjective judgements on qualitative indicators) as well as its efficiency (helping the user attain his goals within the shortest possible time).
- In both tools, a modification of the number and formulation of questions is also recommended, in order to adapt to the social context of East African dairy farming. Obtaining permission from the owners of the tools (Bern University of Applied Science for RISE and FAO for SAFA) will be required to do so. This would also offer the opportunity to get a fuller picture on previous application in East Africa or similar contexts.

In conclusion, either RISE or SAFA could be adapted for assessing the effects of various interventions on the sustainability of dairy farms in East Africa by decision makers from public or private sectors, development agents or farmer organizations in East Africa, who would like to compare and evaluate the sustainability of various interventions. In cases where a rapid and mainly qualitative assessment beyond farm level is required without a high demand for technical knowledge, then SAFA could be adapted and used. The RISE tool could be more suitable in case a more precise, quantitative assessment is required that is farming system-focused and can be extended to cover the dairy chain, and where the desired users of the tool have a good technical knowledge. Of course, a combination of the two tools could be considered, or the use of SAFA tool together with another tool that reflects more details on farm interventions (such as RISE).

Either of these tools would require an adaptation of the indicators and sub-criteria, so that the generated outputs could enable policy makers to compare and evaluate sustainability of various interventions (see Appendix 2 for suggestions on RISE tool adaptation). For the SAFA tool, assessment team members need to be selected who are conversant with East African dairy farming, since the procedure for assessment involves steps of contextualisation of themes and indicators. For example, good governance should also cover elements of the customary law and association with cultural practices.

An important consideration for developing the Triple-P tool for East Africa is its contextual adaptation. This is most important when selecting the indicators for sustainability assessment. These indicators need to address the challenges associated with the pressure to increase local milk production and farm revenues despite the decreasing availability and degradation of arable and communal land and the largely smallholding farm structure. This affects feed/forage availability, which hence figures as the major cost component in milk production. In the East African context, selection of indicators also needs to consider the inclusion of less resource-endowed families, youth, single-headed households as well as smallholder farms in general to the formal dairy chain. This should also consider gender division of labour and how it will be affected by dairy intensification. Sustainable dairy farming systems therefore do not only need to be profitable by producing more milk per hectare, but should be robust and resilient to sustain (or restore) the agroecological base and offer livelihood to farm household on very small landholdings. Therefore, specific internal and external risks related to resilience need to be identified, then related coping and responsive strategies will need to be defined, and then indicators would be generated from them.

4.2 Recommended next steps

As mentioned under objective in the Introduction, these conclusions need further reflection and advice from LNV, NFP and the NEADAP partners. The development of a dairy development focused adaptation of RISE or SAFA will enable these parties in supporting Netherlands-based coalitions to make their expertise available worldwide through responsible interventions, in particular to facilitate informed, context-specific discussions on the win-wins and trade-offs of particular dairy development interventions.

We therefore suggest to continue with Phase 2 of this assessment

Phase 2 of this assignment.

Step 3 – Testing of sustainability assessment in on dairy development in East Africa

a) Developing TORs

Based on the insights gained with this study and the discussion sounding board, TORs will be developed for field testing of sustainability assessment within TIDE (The Inclusive Dairy Enterprise) and BRIDGE (Building Rural Income through Inclusive Dairy Growth in Ethiopia) projects. For this policy makers of Ministry of Foreign Affairs (MFA), the Ministry of Agriculture, Nature and Food Quality (LNV), the Netherlands East Africa Dairy Partnership (NEADAP) partners and experts of knowledge institutes will be consulted. The discussion will include the selection of case studies for sustainability assessment and the selected tools, including the approach and criteria for benchmarking dairy interventions.

b) Testing assessments methodologies trough two cases (TIDE and BRIDGE)

- Discussions with the model developers to reach permissions for adaptation
- Desk run of adapted tool and crosscheck of modelling options
- Identify specific internal and external risks, coping strategies and potential resilience indicators
- Adaptation of selected tool(s) with focus on the indicators, sub-criteria, weighting factors and formulation of questions

c) Discussion and reflection on results and recommendation for further work

Result step 3: Defined sustainability design including criteria for benchmarking of dairy interventions.

Step 4 - Dairy interventions in East Africa with Dutch support will be ranked, based on the defined criteria for sustainability.

- Identifying ongoing and potential dairy interventions in study countries/regions with Dutch interventions (e.g. TIDE in Uganda, BRIDGE in Ethiopia)
- Structuring of feasible sustainable interventions into intervention packages
  Possible interventions/scenarios to test include: replacing existing cash crops by forage crops, specializing fully in commercial dairy, intensifying with high quality purchased roughage, adopting zero grazing, using manure on own farm rather than selling, rental vs own land, hired vs family labor, breeding and herd management options. An example for the BRIDGE project could be: Are farms receiving seed subsidies more sustainable than those without? Or: Are larger peri-urban farms more sustainable then smallholder rural farms? For the TIDE project: To what extent are farms who adopted the TIDE CSA practices more sustainable than other farms in the same district?
- Run selected intervention options in the tool and generate a comparative analysis between them
- Generate evidence-based recommendations for various stakeholders (private sector, NGOs, knowledge institutes, government agencies and farmers/cooperatives).

Result step 4: Piloting of assessing selected intervention packages on dairy farms

Step 5 - The final step will involve a documentation of the tool in a manual with enhanced visualization components to ease its use by other users.

- Development of the tool manual
- Proper documentation of the trade-offs between different sustainability dimensions and generating advisory information on how to deal with these trade-offs
- Training of potential users
- Incorporation of feedback from trainees to the tool and its manual.

The combination of these sub activities will contribute to clear insights and informed discussions on the trade-offs between different sustainability pillars when considering dairy commercialization and intensification in various contexts. The insights gained regarding the assessment of major trade-offs and synergies and on how to organize inclusive dialogue on these will be documented in the form of a guideline.

Result step 5: Visualization and development of manual and advisory guidelines

Step 6 – Designing of follow up and promotion activities such as participation in conferences, meetings and debates and preparing promotion material for use in these events.

Result step 6: Conference presentations, meeting summary, brochures, etc.

In addition to these steps, there will be continuous consultation with international organizations to ensure that our ideas are validated and in alignment with current dynamics in the dairy sector.

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Photo: *Stall-fed dairy cattle in Ethiopia*

Appendices

Appendix 1: TOR for this study

Overview and analysis of existing dairy PPP sustainability assessment tools, in preparation of the development of an integral People-Planet-Profit assessment tool for dairy farms in developing countries

Background

Dairy sector development has been a priority for many African and Asian countries over the last years. East African countries have experienced one of the highest growths in milk production in the last decade, offering great opportunities for economic growth and employment. At the same time, the livestock sector, including dairy, faces severe challenges related to growing demand, food safety, inclusive development, and greenhouse gas emissions and environmental pollution. These challenges require a global trans- formation of the livestock sector.

Smallholders constitute the majority (over 90%) of dairy farmers in East Africa and dairy is generally part of a mixed farming systems, in which dairy has to 'compete with other crops' for scarce land resources. Besides conventional agro-industrial by-products, these farms utilize household wastes, crop residues and sometimes make use of marginal land, communal land and roadside grass for animal feeding Milk production in smallholder farms contributes to improving household nutrition, generating family income and employment of significant number of people, thus contributing to livelihood improvement for millions of people. However, assuring milk quality in smallholder-dominated supply chains usually is an issue related with higher transaction costs for quality assurance and management of small milk volumes from many farmers

A global consensus now exists that climate change represents a significant potential threat to the world's well-being and it will be one of the most important world's challenges in next years. At the same time public debate on 'planet boundaries' and 'dietary shift' in the global North puts environmental and health impact of dairy in the center of attention. The performance of livestock production vis-á-vis land use, greenhouse gas emissions, zoonoses and resistance against antibiotics needs also to be considered in the Global South, where the understandable prime objectives for dairy development are the contribution to broad-base economic growth, creating employment and improving nutrition. For informed debates involving both North and South, it is essential to think and work from a triple P-perspective.

Dairy development should therefore not only emphasize on increasing milk volumes, but also consider other triple-P objectives in the areas of people, profit and planet. In line with the three objective for global food security, dairy development should contribute to: a) affordable safe and nutritious diets, b) gainful employment and improved livelihoods and c) sustaining the agroecological base. Development pathways that address these objectives simultaneously are challenging, as multiple trade-offs occur, where deliberate choices can be made. Sound assessment of the contributions of proposed interventions to people-profit-planet objectives, as well as their possible trade-offs, enable decision makers to make further improvements in interventions. For example, should peri-urban, land-scarce dairy farms close to the end-market be supplied with forage grown elsewhere, or should production be moved to more remote areas where forage can be grown and manure can be recycled?

This needs holistic evaluation, for example though multi-criteria decision making (MCDM) allows to consider multiple conflicting attributes. Since triple-P aspects all play an important role in sustainability assessment, it is essential to be able to monitor the performance of (smallholder) dairy farming across triple-P indicators. The development of the LEAP guidelines for dairy has been an important step forwards, but so far has been insufficiently validated. A growing number of sustainability assessment tools have been developed to support farmers and policy makers in developing agriculture in a sustainable way. Some recently developed tools include SAFA, RISE, the Public Goods tool (Gerrard et al., 2012), and IDEA[i]. However, such tools need further development and specification to be able to applied to dairy in emerging economies and serve the purpose mentioned, e.g. in the identification of suitable indicators. In short, it is essential to develop an integral sustainability assessment tool for dairy farming in East Africa, building on a suitable broadspectrum tool (or combination of tools) already developed. We suggest that the development of such a tool will be guided by the foreseen Dairy Platform under the Netherlands Food Partnership, starting validation with case studies in East Africa.

Objectives

The general objective of this initiative is to develop a tool for assessment of sustainable dairy farming systems and practices that can be scaled to contribute to people-profit-planet sustainability of smallholder dairy farming in East Africa. This integral sustainability assessment tool will help policy makers and practitioners in assessing whether and how proposed interventions in dairy farming systems and value chains of different agroecological and socio-economic settings could contribute to the objectives of food security. The assessment tool also show the 'hotspots' where interventions need improvement or further attention. In this way, the tool will provide support in the actual development [ii] of more sustainable dairy systems.

Specifically, the initiative will:

1. Develop a smallholder dairy farm sustainability tool, using knowledge from and in consultation with existing sustainability platforms such as FAO, SAI, IDF, etc.
2. Benchmark sustainability for dairy farming systems and compare the impact on farm sustainability of various dairy development interventions introduced in ongoing dairy development projects.
3. Test the tool in multi-stakeholder discussions and trajectories.
4. Identify and assess dairy sustainability intervention packages (feed, health and herd management) for typical mixed dairy farms in developing countries, within the context of ongoing dairy development projects.

5. Work closely with parties like the World Bank on exploring how the tool could be used in discussion on climate financing for dairy development.

Suggested approach

Six major steps are envisaged, in 2 phases. This assignment concerns phase 1 (2 steps).

Step 1 - The first step will be to review literature from various sources on sustainability assessment tools for (dairy) farms with a focus on developing countries.

Result step 1: Draft assessment framework with indicators, including data sources, for people, planet, profit assessment specified for east Africa

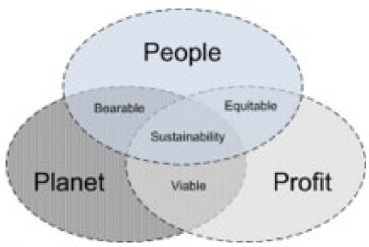

Figure 1: People-planet-profit approach

Step 2 - Major approaches for assessing farm sustainability for dairy farms will be reviewed as well as concepts from existing platforms like the LEAP, SAI, IDF, etc. This will lead, in consultation with these platforms, to an identification of the most suitable approach and indicators that could be used in assessing the sustainability of dairy farms in developing countries. The tool will consider the bottom-line for the people-planet-profit interaction as shown in Figure 1. Examples of possible indicators for these three pillars are shown in Appendix 2 and 3.

Result step 2: Strengths and weaknesses of current tools used in sustainability analysis & suggestions on our proposed tool.

Appendix 2: Current themes and indicators of RISE tool and suggestions for adaptation

Current indicators	Suggestions for adaptation
Soil use Soil management Crop productivity Soil organic matter Soil reaction Soil pollution Soil erosion Soil compaction	Remove indicators on soil reaction and soil compaction since the level of mechanisation is low and compaction is not an issue. Include grazing management, conservation agriculture practices
Animal husbandry Herd management Livestock productivity Opportunity for species-appropriate behaviour Quality of housing Animal health	Include specific indicators for feeding as it is crucial in herd management
Nutrient cycles Nitrogen balance Phosphorus balance N and P self-sufficiency Ammonia emissions Waste management	Include an indicator for nutrient balance
Water use Water management Water supply Water use intensity Risks to water quality	Include water harvesting, rainfall distribution over the year
Energy & Climate Energy management Energy intensity Share of sustainable energy carriers Greenhouse gas balance	Less focus on energy intensity
Biodiversity Biodiversity management Ecological priority areas Intensity of agricultural production Landscape quality Diversity of agricultural production	Less focus on ecological infrastructures
Working conditions Personnel management Working hours Safety at work Salaries and income level	Include job creation by the dairy industry, Include other forms of remuneration such as provision of milk, food and accommodation to workers.
Quality of life Occupation and education Financial situation Social relations Personal freedom and values Health Further aspects of life	Include number of meals per day, diet composition
Economic viability Liquidity reserve Degree of indebtedness Economic vulnerability Livelihood security Cashflow turnover ratio Usage of debt service limit	Consider membership in a SACCO or informal credit group.
Farm management Farm strategy + planning Supply and yield security Planning instruments+ documentation Quality management Farm cooperation	Consider level of education of farm owner or farm manager

Modified after (Grenz et al., 2012a,b)

Appendix 3: Indicators and objectives matrix from the IDEA tool

Source: Zalm et al, 2018

	13 components		53 indicators	Score	Ceiling
Dimension A - 5 components	**Title of components**	**code**	**The Agro-ecological dimension (19 Indicators)**	**Max score**	**Ceiling**
	Functional diversity	A1	Diversity of species grown or bred	5	**20**
		A2	Genetic diversity	5	
		A3	Temporal diversity of crops	5	
		A4	Quality of spatial organisation	5	
		A5	Biodiversity management	5	
	Achieving cycling of materials, nutrients and energy flows	A6	Autonomy in terms of energy, material, seed and plant production	8	**20**
		A7	Food autonomy for breeding	8	
		A8	Nitrogen autonomy	8	
	Restraint in use of resources	A9	Restraint in the use of water and resource sharing	8	**20**
		A10	Restraint in the use of phosphorous	8	
		A11	Energy restraint	8	
	Ensuring favourable conditions for production	A12	Managing use of water	8	**20**
		A13	Ensuring soil fertility	8	
		A14	Ensuring continued health of crops and livestock	4	
		A15	Protecting availability of production equipment	4	
	Reduce impact on human health and ecosystems	A16	Reducing impact of production on water quality	6	**20**
		A17	Reducing impact of production on air quality	6	
		A18	Reducing impact of production on climate change	6	
		A19	Reducing the use of pesticides and veterinary treatment of livestock	6	
			Total		**100**
Dimenion B - 4 components	**Title of components**	**code**	**Socio-territorial dimension (23 Indicators)**	**Max score**	**Ceiling**
	Food supply	B1	Food production of the farm	5	25
		B2	Contribution to world food balance	5	
		B3	Quality of foodstuffs produced	5	
		B4	Loss and waste	5	
		B5	Social, hedonic and cultural links to food	5	
	Local Development and circular economy	B6	Commitment to local contractual environmental initiatives	5	25
		B7	Local market services	3	
		B8	Development of short supply chain or local products	5	
		B9	Protection and development of local resources	5	
		B10	Preservation of local heritage (buildings, local know-how and natural resources)	3	
		B11	Accessibility of space	3	
		B12	Management of non-organic waste	3	
		B13	Participation in innovation networks and collective use of equipment	3	
	Employment and quality of work	B14	Contribution to employment and human resource management	6	25
		B15	Collective work	6	
		B16	Intensity and quality of work	6	
		B17	Reception, hygiene and safety	5	
		B18	Training	5	
	Ethics and human development	B19	Local social action and solidarity	7	25
		B20	Extent of transparency	7	
		B21	Quality of life	7	
		B22	Isolation	7	
		B23	Animal well-being	7	
			Total		**100**
Dimension C - 4 components	**Title of components**	**code**	**The economic dimension (11 Indicators)**	**Max score**	**Ceiling**
	Economic and financial viability	C1	Economic capacity	20	35
		C2	Level of debt	12	
		C3	Structural indebtedness	6	
	Independence	C4	Diversity of production	10	25
		C5	Diversification and contractual relationships	10	
		C6	Reliance on subsidies	6	
		C7	Contribution of revenue from outside the farm	4	
	Transferability	C8	Economic transferability	15	20
		C9	Likelihood of future survival	8	
	Overall efficiency	C10	Gross efficiency of production	14	20
		C11	Restraint in the use of farm inputs in farm production	6	
	Total				**100**

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