RISE – a method for assessing the sustainability of agricultural production at farm level

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In the rural regions of the world, sustainable development[3] is intrinsically tied to sustainable agriculture. Enhancing the sustainability of agricultural production is thus of key importance in the endeavour to achieve the UN Millennium Development Goals. The notion that sustainable agricultural production can only be achieved through communication and coordination processes involving stakeholders from farm to policy level creates a demand for a science-based yet communicable sustainability appraisal (Häni et al., 2008). Yet few tools facilitate holistic sustainability assessments at farm level, and of those that do, most target commercial farms in industrialised countries. While certifiable production standards, e.g. organic agriculture, fair trade or "good agricultural practice" (www.ifoam.org, www.globalgap.org), are of more practical relevance in the South, such compliance-oriented systems need to be complemented by approaches that enable farmers to actively recognise and resolve sustainability deficits of their production in order to enhance their impact.

The Response-Inducing Sustainability Evaluation (RISE, http://rise.shl.bfh.ch), developed at the Swiss College of Agriculture (SHL), aims at closing this gap by providing a farmer- and measure-oriented sustainability evaluation method. The assessment covers agricultural production on a farm within one year and starts with the collection of comprehensive information on ecological, economic and social aspects through a questionnaire-based interview with the farmer. A computer model uses this information to calculate 57 sustainability parameters, condensed into twelve indicators (Table 1). Indicator scores are displayed as a polygon showing farm sustainability at a glance. At parameter level, results are presented in tabular form, which allows for a differentiated appraisal and pinpointing of trade-offs in the concluding feedback discussion. The approach builds on an intensive dialogue with the farmer (Thalmann et al., 2009).

All indicators are composed of state (current situation of the system) and driving force (pressures on the system) parameters. The degree of sustainability of an indicator is calculated by subtracting the sum of driving force parameter values from that of the state parameters. All parameters are rated using a scale from 0 to 100, where 100 indicates the optimum situation in state and the worst situation in driving force parameters. Benchmark values used for normalisation are derived from literature and statistics and can be regionally adapted where necessary (e.g. interest rates, minimum wages). An optimum situation is not achieved by maximising single indicators, but through a balanced bandwidth of all indicators at the highest achievable level. RISE has been applied in collaborative projects, education and training modules, research and development studies involving private industry, political and research institutions, producer organisations and farmers. Some 440 farms in 15 countries, including Côte d'Ivoire, Colombia, Kenya, India and China, have been assessed. Dissemination is achieved through the establishment of national or regional "RISE hubs", sustainability competence centers anchored at appropriate institutions. The following examples highlight how RISE is applied in developing and transition country contexts.

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[3] We use the term "sustainable development" as defined by the World Commission on Environment and Development (1987).

Tab.1. Indicators and parameters of the RISE method for evaluating the sustainability of agricultural production

Indicators	State Parameters	Driving Force Parameters
Energy	• Environmental effects of energy carriers used	• Energy input per unit agricultural land • Energy input per unit workforce
Water	• Water quantity and stability of the quantity • Water quality and stability of the quality	• Water quantity and productivity (crop & animal production) • Risks to water quality (manure, silage leachate, wastewater,…)
Soil	• Soil pH, salinisation, waterlogging, soil sampling • Erosion index	• Pollution by pesticides, acidifying fertilisers & fertilisers containing heavy metals • Tillage-related risks • Salinisation risk • Nutrient mining
Biodiversity	• Biodiversity-promoting practices	• Proportion of intensively used agricultural land • Plot size • Weed control
N&P emission potential	• N & P balance • Manure storage and application	• N & P from organic & inorganic fertilisers (imports / exports)
Plant protection	• Quality of the application • Eco- & human-toxicological risks	• Crop husbandry • Crop rotation
Waste	• Environmental hazard • Methods of waste disposal	• Type and quantity of waste
Economic stability	• Net debt service over change in owner's equity & interest paid • Equity ratio • Gross investment	• Cash flow/raw performance rate • Dynamic gearing • Condition of machines, buildings & perennial crops
Economic efficiency	• Return on assets • Return on equity • Total earned income	• Productivity
Local economy	• Share of regional workforce & salaries • Lowest salary on farm compared to average regional salary	• Raw performance per unit agricultural land
Working conditions	• Emergency/medical care • Provision of potable water • Accommodation & sanitary equipment • Working hours • Wage discrimination • Child labour • Forced labour • Gender	• Continuing education • Encumbering work • Working conditions • Income disparity • Working time to reach minimum salary
Social security	• Social security • Means of subsistence	• Potentially payable salary • Farm succession plan • Legality & documentation of employment

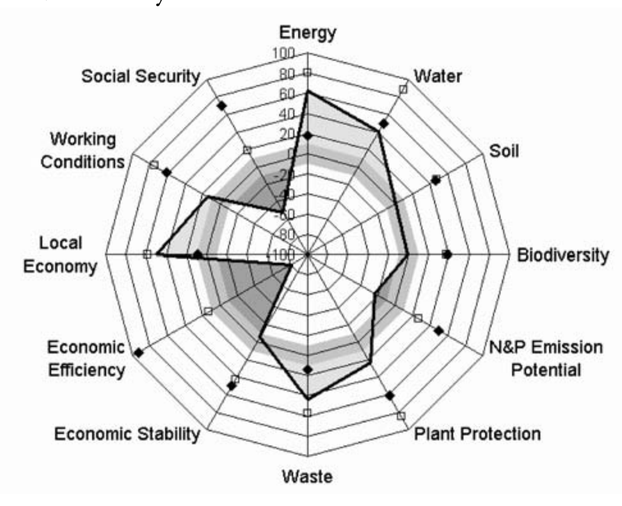
Tackling key constraints to sustainable agricultural production in Armenia

A joint project of the Agribusiness Teaching Centre (ATC), the Armenian State Agrarian University (ASAU) and SHL, funded through the SCOPES program of SDC and SNSF, aimed at creating awareness about sustainability issues with farmers, help them tackle sustainability problems of production, support extension services in focusing consultancy on key sustainability deficits and support politicians in creating an environment favouring sustainable production.

Presentation of RISE results to an Armenian farmer by local RISE experts, 2007.

The collapse of the Soviet Union was followed by the break-up of collective agriculture, which in Armenia resulted in over 330'000 farms, many lacking suitable machinery, access to natural resources and knowledge of good farming practices. A shift from fodder crops, fruit trees, vineyards and industrial crops to staple crops grown for subsistence took place. Crop and livestock yields declined due to inadequate farming practices and lack of inputs. To develop a more sustainable agriculture, the Ministry of Agriculture, together with FAO, designed a "Strategy for Sustainable Agricultural Development" (SSAD).

Figure 1. Summary polygon with mean indicator degrees of sustainability of 202 Armenian farms.



Legend:
☐***State (S)****: 0 pts = problematic situation, 100 pts = good situation;*
◆***Driving force (D)****: 0 pts = low risk, 100 pts = high risk.*
–Degree of sustainability, DS = S – D*: ▒ positive: 10 < x ≤ 100 pts; ▒ border area: -10 ≤ x ≤10 pts; ▒ negative: -100 ≤ x < -10 pts.*

Initial RISE assessments of 13 farms served to test the applicability of RISE under Armenian conditions, translate questionnaire and feedback materials into Armenian and make necessary adaptations. The prestudy testified to the applicability of RISE under Armenian conditions and showed that farmers approved the assessment. A large-scale assessment covering 202 farms was done in the provinces of Armavir, Aragatsotn, Gegharkunik and Shirak. Major deficits relating to N&P Emission Potential, Economic Efficiency and Social Security were revealed, while high sustainability scores were found for Energy, Water, Waste, Local Economy and Plant Protection (Fig. 1). While in many farms, substantial amounts of N and P are excreted by animals, high proportions of these nutrients do not reach crops. Manure is mostly stored on bare ground which allows an uncontrolled leaching of the liquid fraction, and liquid manure is applied by broadcasting regardless of weather conditions and the risk of ammonia volatilisation. Considerable amounts of nutrients are lost through the burning of dried dung during winter. Therefore, soils often suffer from nutrient depletion permitting only low crop yields, despite the large amounts of N and P excreted by animals. Measures should target a reduction of the need to burn dung for heating, e.g. through improved insulation of buildings or construction of small biogas fermenters. While the SSAD suggests that farmers purchase mineral fertiliser using microcredits, more efficient storage and use of farmyard manure would reduce the need for credits in the first place and reduce risks related to indebtedness. Despite the problematic economic condition of most of the farms, the current low level of indebtedness positively stands out and should be preserved. In general, farmers are reluctant to invest into purchasing or maintaining machinery, buildings or irrigation equipment. One of the reasons mentioned was uncertainty relating to the introduction of a value added tax, and a generally uncertain political and economic environment. It may be speculated that improved availability of up-to-date reliable information would foster higher rates of investment and thus higher production efficiency, at least with less risk-averse farmers.

Results of the sustainability survey are now being communicated to farmers, extensionists, administration and donors. A targeted next step will be the launching of communities of practice linking all stakeholders confronted with similar challenges.

Priorities for extension and training to improve the sustainability of smallholder production in Kenya

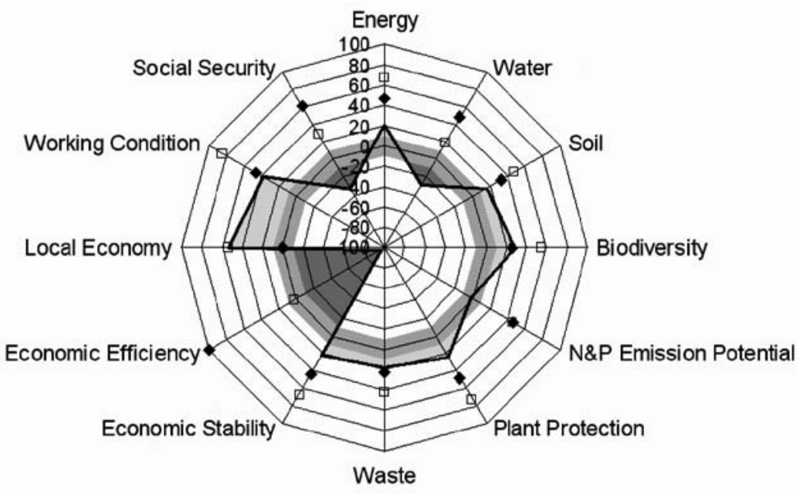
In a collaborative project of CETRAD (Centre for Training and Integrated Research in Arid and Semi-arid Lands Development) and SHL, funded by Syngenta, key sustainability deficits of smallholder agriculture in the Laikipia district of Kenya were identified through RISE assessments and tackled through targeted training modules. The study area is situated at 1600 to 2000 m asl and receives 650 to 700 mm average annual rainfall. Agricultural production on the 0.4- to 2-ha farms is largely for subsistence. The region hosts several large export-oriented horticultural farms, which are key players with respect to off-farm income and water usage. Among the smallholder farmers of Laikipia, poverty and even malnutrition prevail due to low crop yields and recurrent crop failure (Gitonga, 2004). The natural resource base suffers from forest and soil degradation, and water quantities and quality are deteriorating.

A sample of 30 farms was assessed using RISE. The three- to five-hour interviews with farmers were conducted by SHL and CETRAD staff. Results helped pinpoint major bottlenecks concerning water productivity (Water), manure and soil fertility management (N&P Emission Potential), pesticide use and handling (Plant Protection), economic performance (Economic Stability and Efficiency) and social security (Fig. 2). The variability of indicator scores was highest with regard to Energy, N&P Emission Potential, Biodiversity, Plant Protection and Water. High variability can indicate scope for improvement, since a better performance is achieved by some farmers under the prevailing conditions.

In group feedback discussions with farmers, those findings applying to all farms were brought up. Farmers were invited to a farmer's site, a community hall or church. Results of the RISE assessment were presented as polygons showing mean indicator and parameter values, or as selected individual values of general interest. Individual feedback on specific issues was also provided to all interviewed farmers. Farmers throughout appreciated the holistic sustainability analysis presented in the feedbacks. In contrast to precedent trainings that focused on the most common issues, the feedbacks allowed for thematically open discussions. Advantages of working in groups were the lively discussions and the exchange of experience and knowledge that promoted collaborations among the participants. Following the feedback discussions, specific training modules and targeted consultancy for small-scale farmers were offered, demonstration plots set up in fields of interested farmers and field visits

Inspection of a silage pit during RISE assessment of a farm, Kenya, 2006.

Figure 2. Summary polygon with mean indicator degrees of sustainability of 30 smallholder farms in the Laikipia district, Kenya.



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of neighboring farmers organised. Priority domains for training and extension were identified considering the following criteria: (1) strong and direct influence on sustainability issues, (2) relevant to many farmers, (3) positive effect on multiple domains of sustainability, (4) no or acceptable negative side effects, (5) good financial input/output balance, (6) in line with legislation, (7) acceptable to local stakeholders. Training modules i.a. focused on conservation agriculture, manure management, the control of ticks in livestock and basic accountancy.

More than 240 farmers visited one or more training events. It appeared that farmers in the area rarely or never had received any training before and therefore wanted to benefit as much as they could from the offered modules. The extension and training activities are anchored within existing institutional and social structures in order to ensure ownership and lasting acceptance. A second round of RISE assessments after three years will investigate changes in farming practices to assess the impact of the initiated measures on the sustainability of agricultural production.

Outlook

The RISE method has been developed iteratively through a sequence of development, application, evaluation and improvement phases since 2000. While version RISE 1.1 is fully functional and is currently applied in research and development projects e.g. in Mexico and China, efforts to further improve science and software continue. Targeted modifications include e.g. enhanced algorithms for greenhouse gas accounting and the integration of an animal welfare indicator. A further strengthening of participatory component and solutions orientation shall be achieved by increased cooperation with extension and communication experts.

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