Sustainability of agricultural production in Armenia

Analysis of the current situation and improvements through farm advice and the facilitation of policy action to adapt framework conditions using the RISE (Response-Inducing Sustainability Evaluation) model

Aragats mountain 4090m, Armenia

Interim report
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1. SUMMARY

From March to December 2006 a pilot study was performed in five different regions on 14 mixed and dairy farms in Armenia. The aim was to test the applicability and outcome of the sustainability evaluation tool RISE (Response-Inducing Sustainability Evaluation) under Armenian conditions, to adapt the questionnaire and feed the database with country and region specific data. The RISE assessments were done by the ICARE (International Center for Agribusiness Research and Education) with support and feedback of the SHL (Swiss College of Agriculture).

The farms assessed were over all quite large farms (average 42 ha) and are clearly above average Armenian farms size (1.3 ha). The farmers in the sample represented a rather prosperous and market oriented guild of farmers. This is also reflected in the general good performance of the economic indicators of the RISE assessments. However during the review process of this study by SHL some financial adaptations had to be done. For instance the RISE minimal wage was increased considerably, which affects the profitability of the farms strongly. In the results section of this report at hand such adaptations are not yet considered but they are discussed and in the upcoming large-scale study they will find implementation.

At individual indicator level mainly the *Biodiversity* indicator showed results in the red area of the RISE polygon, pointing towards a number of problems regarding this topic. An explanation for these results on the Biodiversity indicator can be found in the comparably high production intensity on almost the entire usable agricultural area (UAA) of a majority of farms in the current sample. The other RISE indicators that are attributed to the natural resources turned out in what is considered to be the border area (*Water* and *Soil*), indicating a more thorough analysis of the individual parameters might be required to show strengths and weaknesses, or even in the green area (*Energy*) of the individual indicators.

Just like on most ecological parameters, economic constraints appear to exert great pressure on many parameters of the social indicators. At indicator level this pressure is not so obvious for the *Working Condition* indicator, which is mainly presenting values in the green area of the polygon. However, looking at individual parameters, problems appear then for example in such sensitive areas like employees' working time or further education. Also the *Social Security* indicator of the summary polygon is located in its border area. This is often caused at individual farm level by inadequate salaries and a lack of social securities that can comprise insurances as well as private solutions that provide protection from a loss of income in case of an unexpected event.

Most of the farmers were quite excited to receive a scientific assessment of their farm's operations where many strengths and weaknesses are clearly classified. Furthermore, the model provided them with a sort of "portfolio" visualizing their various sustainability issues. Many of the surveyed farmers were surprised to learn about their costs and profits caused by their practices as none of them had any bookkeeping and RISE provided them rough information about the economic constituency of their farm evaluation.

RISE proved to be a suitable tool for the holistic evaluation of Armenian farmers' sustainability. It has to be stressed that applying RISE not only targets a more rational use of the natural resources (energy, water, soil, biodiversity) and improved management practices (reduced emissions, proper crop protection and waste management). Through its holistic approach the tool also covers the most important economic and social aspects. Economic stability and financial efficiency of farms (including adequate income) and the economic impact on the local economy (e.g. employment generation) as well as social security and working conditions in the agricultural sector are covered by the tool. These aspects are particularly important in a country where agriculture is in transition like in Armenia.

By establishing the basis for research (through data collection at farm level) improvements of farming practices are directly initiated in the feedback discussions between advisors or extension agents and farmers. The development and implementation of training modules by Armenian team members at ICARE and the Armenian State Agrarian University will raise

awareness with students, scientists and extension services on the complexity and importance of sustainability issues in agriculture.

2. BACKGROUND

The process of agricultural transition in Armenia is similar to that of other transition countries in general. Like many transitional countries of Europe and Central Asia (ECA), a major problem in Armenia, during the transition period, was a breakdown in the relationships of farms with input suppliers and output markets. Thus many farms and rural households face serious limitations in accessing essential inputs (feed, fertilizer, seeds, etc.) and selling their products (Swinnen, 2005).

After the collapse of the former state and collective farms, established food processors in Armenia and in other former soviet republics have lost guaranteed, state directed supplies and demand. They have had to establish their own relationships to effectively acquire agricultural raw materials.

The market-oriented reforms introduced in 1991-92 comprised the privatization of many productive resources and organizations. Armenia was one of the former soviet republics to privatize agriculture during 1991-92: after independence followed the legislation necessary for the privatization of land when roughly 70% of arable land and agricultural output changed hands to individual peasant farms (Lerman & Mirzakhanian, 1999). Although by 1993 GDP declined to 47% of its 1990 level, and then gradually recovered to 68% in 2000, agricultural output did not show any significant declines during transition remaining stable from 1990 to1997 and increased thereafter (Bezemer & Lerman, 2003). In recent years the share of agriculture in the GDP comprised of roughly 20-25 percent. During the last decade of the 20th century, Armenia transformed from an industrialized state to one that is, to a significant degree agrarian again (Lerman, 2003). The break-up of collective agriculture in Armenia resulted in over 338'000 diversified farms, with lack of suitable machinery and equipment, water for irrigation and knowledge of good farming practices. The average farm size is 1.4 ha, divided into an average of three parcels of land. It is estimated that 88% of the farms are smaller than two hectares. Agriculture is very dependent on irrigation; half the total arable and perennial area is currently irrigated. The country suffers from ecological degradation in various respects.

Since the collapse of the Soviet Union, the Armenian agriculture is facing severe problems, particularly with regard to marketing farm produce. Levels of food consumption for a large percentage of the population fell far below the poverty line. A major shift has taken place to the cultivation of basic food crops; for self-consumption (cereals, potato) at the expense of fodder crops, fruit trees and vineyards as well as industrial crops. As a result the Armenian small-holder agriculture has been transformed into a mixed crop/livestock farming system. Therefore, crop and livestock production yields are low based on the use of small quantities and poor qualities of agricultural inputs and inadequate farming practices.

Agricultural production in Armenia is well below its potential. In order to improve and develop efficient and sustainable agriculture the Ministry of Agriculture together with the FAO designed a "Strategy for Sustainable Agricultural Development" for Armenia (MoA/FAO 2002, 2004). The strategy has the following objectives:

- to achieve real income growth of farmers through increased agricultural productivity in a sustainable manner;
- to provide opportunities for real income growth of off-farm rural poor; and
- to improve the food security of the urban population of Armenia, especially the poorest segments.

The project at hand resulted from the recognition that several components of the above-mentioned strategy are within the scope of the Response Inducing Sustainability Evaluation RISE (Häni et al., 2003). The RISE tool allows a sustainability evaluation at farm level. It’s a system oriented tool assessing the farm enterprise in a holistic way based on 12 indicators covering ecological, economic and social aspects based on more than 70 parameters (Studer et al., 2005).

Focal points in the "Strategy for Sustainable Agricultural Development" where the RISE tool can be considered to be a very useful tool to analyze, monitor and improve the current situation, and therefore helps to achieve the objectives of the strategy are for instance: development of crop and fodder production, implementation of advanced agro-technical rules, mitigation of agricultural risks, development of technical services, formation of experimental model farms, identification of optimal farm size, and increase the area for perennial seedlings. Through its dual benefit of (1) facilitating/inducing improvements at the farms level and (2) allowing for the identification of potentials and bottlenecks at larger scale, the use of RISE allows for simultaneous research and development on the ground.

The overall goal of the RISE in Armenia project is to

- introduce the RISE sustainability assessment tool to Armenian agriculture and improve the situation through direct advice at farm level and
- provide a sound basis for farm decision-making towards framework conditions fostering sustainable production in Armenian agriculture.

3. THE RISE-METHODOLOGY

3.1. WHAT IS RISE?

The Response-Inducing Sustainability Evaluation (RISE; http://rise.shl.bfh.ch) is a computer-based tool that allows assessing the sustainability[1] of agricultural production and trends hereof at farm level (early warning system). The holistic sustainability assessment follows a systems approach and covers ecological, economic and social dimensions. The tool identifies strengths (potentials) and weaknesses with regard to sustainability, hereby providing the farmer with a testimonial on one side and the identification of intervention points for improvement on the other. RISE thus not only aims at diagnosis, but rather at the initiation of measures to improve sustainability of agricultural production. As a monitoring tool RISE can visualize trends and developments over time on individual farms as well as within sectors or catchment areas, thus providing information about primary production in raw material supply chains.

3.2. STATE - DRIVING FORCE – DEGREE OF SUSTAINABILITY

Each indicator contains parameters that either outlines the state (S) of the system and others that describe a pressure on or driving force (D) within the system, driving it in a certain development direction. State parameters have a value between 0 (worst case) and 100 (best case). Driving force parameters are also computed on a scale between 0 and 100, but since they are valued as a negative pressure on the system 0 depicts the best case and 100 the worst (biggest pressure). The Degree of Sustainability (DS) is calculated as DS = S – D (Figure 1).

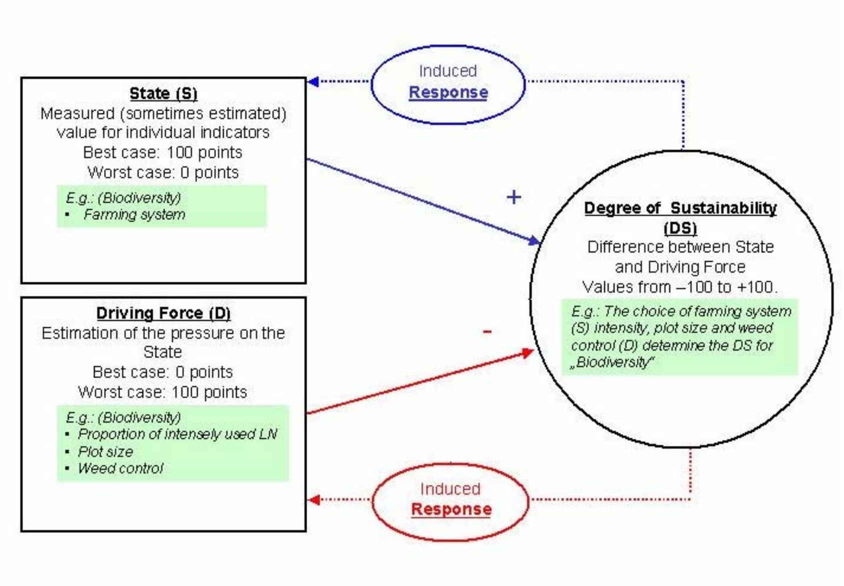


Figure 1: Methodology to calculate the degree of sustainability.
The Degree of Sustainability (DS) is calculated as DS = S – D.
Source: Studer et. al. (2006)

[1] **Sustainable development** *allows a life in dignity for the present without compromising a life in dignity for future generations or to threaten the natural environment and endangering the global ecosystem* (Häni et al 2002). This definition is based on the Brundtland Report (WCED 1987), but has been augmented by two more dimensions: "human dignity" and "environment" (Stückelberger 1999).
Sustainable Agriculture adopts productive, competitive and efficient production practices, while protecting and improving the environment and the global ecosystem, as well as the socio-economic conditions of local communities (SAI 2003, adapted), in line with the principles related to human dignity.

3.3. THE RISE-INDICATORS AND PARAMETERS

The output of the RISE model is designed in a way that the farmer can easily determine where problems exist and, thus, where interventions might lead to improvements (Figure 2). The sustainability polygon depicts twelve indicators covering ecological (natural resources, management), economic and social aspects fundamental to the sustainability of agricultural production.
Approximately seventy state and driving force parameters, calculated from many more factors, result in the following twelve RISE indicators, which can be categorised in four areas:

- Natural Resources
  - Energy
  - Water
  - Soil
  - Biodiversity
- Management
  - N&P Emission Potential
  - Plant Protection
  - Waste
- Economy
  - Economic Stability
  - Economic Efficiency
  - Local Economy
- Social Situation
  - Working Conditions
  - Social Security

For every indicator, the state (current situation) and driving force (pressure on the system) are determined separately, each calculated from different parameters (for the list of parameters and indicators see Annex 1). A total of about seventy parameters are individually valued in the model output, allowing the farmer to identify quite accurately strengths and weaknesses regarding the sustainability of production and where to intervene to improve the situation of his enterprise. The indicators are depicted in a spider web graph ("RISE sustainability polygon") allowing for a quick interpretation of the strengths (green area with DS>10) and weaknesses (red area where DS<-10) regarding the sustainability of the farm (Figure 2). Individual indicators are considered sustainable if the degree of sustainability is above +10, the whole farm/system is considered sustainable if no indicator has a degree of sustainability below -10. An optimal situation regarding the sustainability of the farm is not achieved by individual maxima on single indicators but much more through a balanced bandwidth of all indicators (at highest possible level) (Studer et. al. 2006).

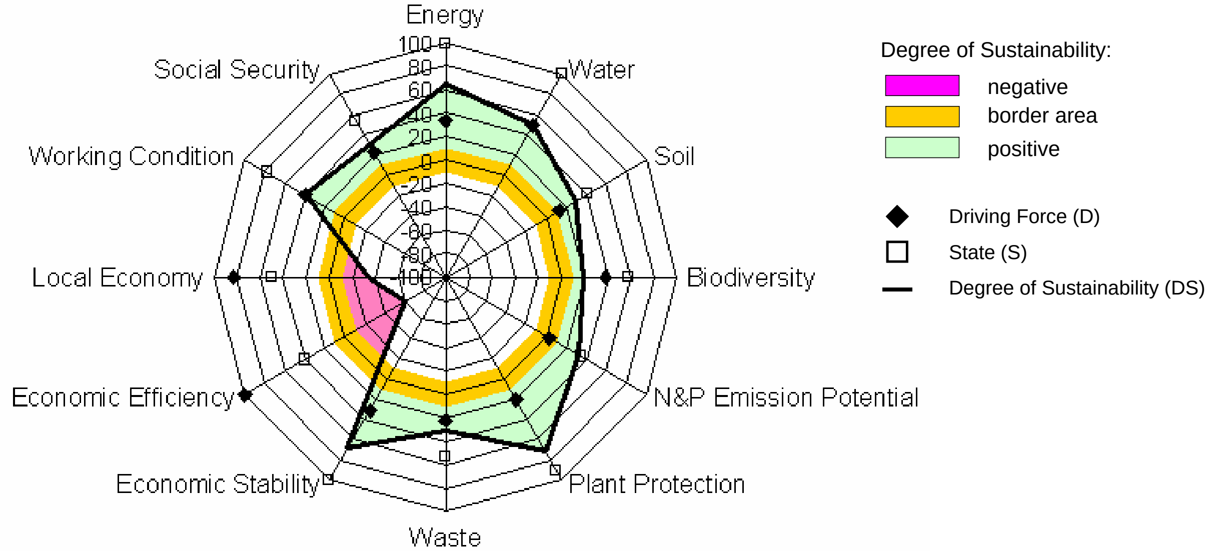


Figure 2: Sample RISE sustainability polygon.
The bold line connects the values of the Degree of Sustainability of the twelve indicators. The Degree of Sustainability is calculated by subtracting the value of the Driving Force from the value of the State.
Source: Studer et al. (2006)

3.4. RISE-EVALUATIONS

The RISE sustainability evaluation is based on data collection at farm level using a comprehensive questionnaire. After computer-aided calculation of the parameters and indicators, a feedback discussion of the results with the farmer takes place, yielding ideas for potential measures to improve the current situation (Figure 3).

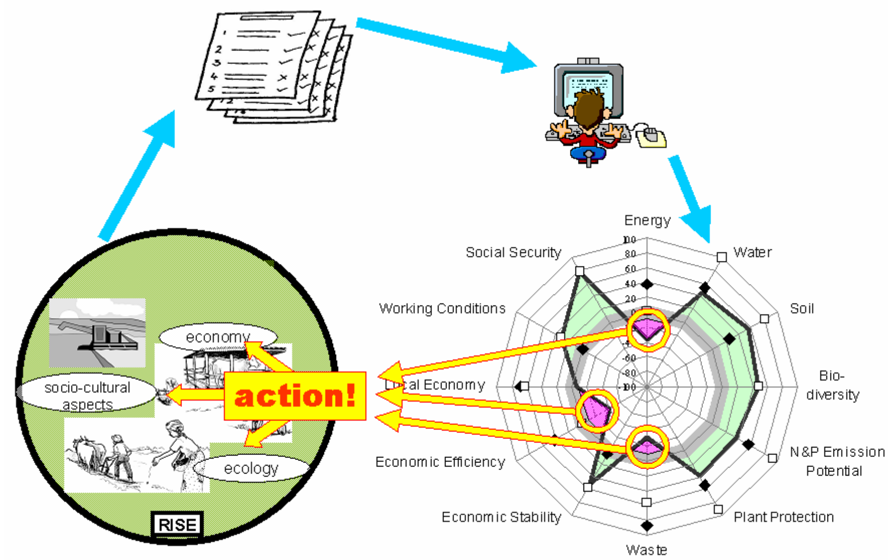


Figure 3: Principle method for a Response-Inducing Sustainability Evaluation RISE
Source: Studer et al. (2006)

The holistic sustainability assessment covering ecological, economic and social dimensions not only aims at diagnosis, but first and foremost at the initiation of reflection and measures to improve sustainability of agricultural production. The tool identifies strengths (potentials) and weaknesses with regard to sustainability, hereby providing the farmer with a testimonial on one side and the identification of intervention points for improvement on the other. Thus, the feedback to the farmer (farm manager) represents an integral part of each RISE assessment.
Besides inducing improvements at farm level, RISE – being based on a database – can be used to assess groups of farms (e.g. different farm types, in defined areas, sectors or catchment areas, etc.) and thus provide valuable information at higher scale. In this way, RISE not only allows for benchmarking and comparison (spatially and temporally), but also for the identification of framework conditions particularly conducive or unfavourable for sustainable production. In large-scale studies RISE unfolds one of its particular strengths: while collecting the information required at higher scale, RISE simultaneously provides added value and benefit at the farm level through assessment analysis and feedback to the farmer, thus offering a dual benefit at different levels.
Repeated RISE assessments facilitate visualizing trends and developments over time and can thus serve as a holistic monitoring tool at farm level or higher scale, i.e. for farmers as well as for decision-makers and managers. Furthermore, RISE allows assessing the impact of changing framework conditions or of specific measures taken (such as policy or legislative changes, interventions by projects, etc.). RISE may also represent a holistic tool for strategic planning in that it can depict the effects of specific measures ex-ante and thus visualize different scenarios. This may be relevant to whole-farm planning, but all the more so for ex-ante impact assessment at higher scale, e.g. in the context of development projects or in connection with planned policy changes.

4. INTRODUCTION OF RISE IN ARMENIA

4.1. CAPACITY BUILDING AND EVALUATIONS

In order to introduce the RISE assessment tool to Armenia, two Armenian team members, received an intensive, one week training in interview techniques and data processing in Zollikofen, Switzerland funded by the SCOPES Joint Research Project program.
Back in Armenia, the Armenian team started the search for farmers interested and willing to participate in a primary RISE evaluation for the pilot project. The initial plan was to start with a sample of dairy farmers. The first round of data collection was very difficult due to a severe winter in the region that left almost all roads to the main dairy regions closed because of the heavy snow. During that time the team alternately worked with the Swiss partners on questionnaire revision and adaptation. Then, in late spring the Armenian team eventually found interested farmers in the Tashir and Shirak regions. During the first few visits the team realized that the interview was a relatively time consuming and tedious process. The interviewer had to explain almost every question and parameter to the interested farmers, sometimes even the reason or idea behind such questions asked. Nevertheless the farmers were not willing to spend extended periods of time at once, although knowing that the evaluation eventually is being done for them, free of charge and could be useful for them to evaluate their strengths and weaknesses. The team had to make several visits in order to be able to complete one full interview.
Once the interview process had been complete, the data was entered into the RISE computer program provided by the Swiss team. Although the interview process was tedious and time consuming the same could not be said for data entry. Thanks to already constructed sub-databases, lists of inventory, machinery, animal, crops, etc. in the computer program, it was possible to decrease the time needed for data entry significantly. The data was also reviewed and evaluated by the Armenian researchers for consistency and integrity.

The RISE program has now been tested successfully on dairy farms in different regions of Armenia. Although the results are preliminary and cannot be generalized, apparently RISE has proven to be suitable for a holistic evaluation of Armenian dairy farmers' sustainability. It is expected that the project will have a significant impact on the sustainability of agricultural production and the entire agricultural sector in Armenia. It has to be stressed that applying RISE not only targets a more rational use of the natural resources (energy, water, soil, biodiversity) and improved management practices (reduced emissions, proper crop protection and waste management). Through its holistic approach the tool also covers the most important economic and social aspects. Economic stability and efficiency of farming (including adequate income) and its effect on the local economy (e.g. employment generation) as well as social security and working conditions in the agricultural sector are covered by the tool. These aspects are particularly important in a country like Armenia. A meticulous strength of the application of RISE is that it allows for the dual benefit of simultaneous research and development (i.e. improvements) on the ground. By establishing the basis for research (through sustainability assessments at farm level) improvements of farming practices are directly initiated in the feedback discussions between advisors or extension agents and farmers. The development and implementation of training modules by Armenian team members at the Agribusiness Teaching Centre will raise awareness with students, scientists and extension services on the complexity and importance of sustainability issues in agriculture.

Farm sample

The goal of this first phase of the project was to assess the applicability and reliability of the RISE methodology and problems with analysis in Armenia under a broad range of conditions. By assessing a limited number of Armenian farms, performance and perceived value of the RISE tool in Armenia was evaluated and possibly required adaptations to RISE were accomplished. Important factors for the selection of the farms was, that farmers were

interested and motivated in doing the RISE assessment and that they were more or less familiar to agronomic and financial terms. It was important as well to have quite complex farms in the sample (e.g. animal and plant production, employees) in order to be able to test all aspects of the RISE tool. Due to these preconditions mainly large and commercially orientated farms have been chosen (Table 1). However there is a large variation of the of the farm size (UAA) comprising a group of 4 farms with UAA below 5 ha, 5 farms with UAA between 9 and 15 ha, 3 farms around 65 ha and two farms with UAA of 115 resp. 210 ha.
At that stage of the project there was no focus in getting a representative sample for any type of farms.

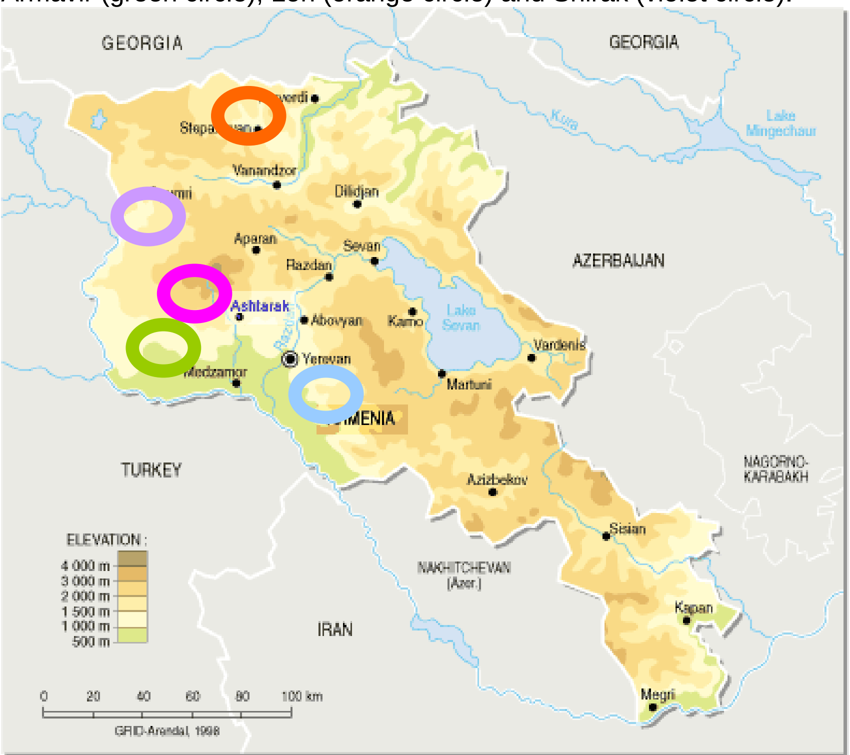
Table 1: Set of characteristics of the selected farms (year of reference: 2005).

Farm No.	Region	Farm type	Farm area (ha)	Large animal units (LAU)	LAU per ha	Work forces	Raw performance	Calc. profit/loss
8	Argatsotn	Mixed farms	115	92.9	0.81	1.9	13656.1	-2114.9
9	Argatsotn	Mixed farms	10	110.2	11.02	1.4	21412.8	2123.8
14	Argatsotn	Mixed farms	15	22.6	1.51	10.6	32228.5	6873.4
2	Ararat	Mixed farms	9.8	12.2	1.24	2.7	10092.4	983.3
11	Ararat	Mixed farms	1.25	2.3	1.80	0.5	2731.2	523.2
12	Ararat	Mixed farms	76.2	17.7	0.23	0.6	9062.2	5201.7
1	Armavir	Mixed farms	1.1	12.2	11.05	4.4	4282.6	-806.6
10	Armavir	Mixed farms	4	20.3	5.09	5.0	4107.8	-3368.7
3	Lori	Dairy	5	17.2	3.44	5.4	3823.7	-173.8
4	Lori	Dairy	12	23.2	1.94	1.6	3583.4	125.5
5	Lori	Dairy	210	68.9	0.33	8.4	87399.2	-48204.3
6	Lori	Dairy	65	17.0	0.26	4.8	19446.3	3704.4
7	Lori	Dairy	61.3	27.0	0.44	2.1	25564.3	10084.5
13	Shirak	Mixed farms	9.3	15.6	1.68	0.3	4807.0	787.2

Source: RISE database

Study regions

Figure 4: Map of Armenia with the five study regions: Argatsotn (pink circle), Ararat (blue circle), Armavir (green circle), Lori (orange circle) and Shirak (violet circle).



Source: www.armenianteens.com/armenia_map.php

Aragatsotn marz (state) occupies 9.3% of the land territory of the Republic of Armenia (RA). The population of the marz comprises 4.3% of the RA total population in 2005. While 76.3% of its population (as of January 1st, 2006) resides in rural settlements; it is the highest percentage of rural population among RA marzes. Aragatsotn marz includes the territories of Ashtarak, Aparan, Aragats and Talin. Ashtarak, Aparan and Talin being towns of the marz and there are further 117 rural settlements. Three motor highways of republican importance: Yerevan-Ashtarak-Talin-Gyumri, Yerevan-Ashtarak-Spitak and Yerevan-Armavir-Karakert-Gyumri run through the territory of the marz.
The share of industry of Aragatsotn marz in 2006 in total volume of industrial production in relation to the RA comprised of 1.2%, in the volume of gross agricultural produce 7.2%, in retail turnover 0.9%. Industry and agriculture are well developed in the marz. Industry is specialized in the manufacturing of food products and beverages, precious articles and exploitation of mines for building materials. The geographical position and climatic conditions of the marz are favourable for both plant growing (grains, potatoes, perennial grasses, and forage crops) and cattle breeding. The center of the marz is Ashtarak with 20'700 inhabitants at the end of 2005.
Agricultural lands in the marz in 2006 constituted 136,667 ha and the region provided 35.5 million AMD of agricultural output in current prices in 2005. Retail turnover in the marz in 2005 was 8141.2 million AMD in 362 retail outlets. The average nominal monthly salary is 39.295 AMD and 1,500 unemployed people in 2005. The consumer price index in 2005 was 97.6.

Ararat marz occupies 7% of the territory of the Republic of Armenia. The population of the marz comprised 8.5% of the RA total population in 2005. While 24.9% of the population (as of January 1st, 2006) resides in urban settlements. The marz borders to the southern part of the capital city Yerevan and in the territory of the marz is the Khosrov reserve which is between 1600 and 2300m above sea level high. Ararat marz includes the territories of Artashat, Ararat, Vedi, and Masis and there are further 94 rural settlements. Motor highway of republican importance is Yerevan– Yeraskh–Kharabagh and the railway Yerevan – Yeraskh run through the territory of the marz.
The share of industry of Ararat marz in 2006 in total volume of industrial production of the republic comprised 7.1%, in the volume of gross agricultural produce 13.2%, in retail turnover 1.2%. Industry and agriculture are developed in the marz. Industry is specialized in the manufacturing of food products (processing of fruits and vegetables), beverages (production of wine and brandy), and tobacco. The geographical position and climatic conditions of the marz are favorable for growing many varieties of fruits and vegetables and for animal breeding as well. The marz is one of the major suppliers of grapes, apricots, tomatoes etc. in the country. The center of the marz is Artashat with 25.100 inhabitants at the end of 2005.
Agricultural lands in the marz in 2006 constituted of 88.700 ha, out of which 27.225 ha are arable In 2005 there were 3 wholesale markets for agricultural produce in the marz. Retail turnover in the marz in 2005 was 9694.8 million AMD from 692 retail outlets. Consumer price index in 2007 was 108.2.

Armavir marz occupies 4.2% of the territory of the Republic of Armenia. The population of the marz comprises 8.7% of RAs total population in 2005 while 35.5% of the population (as of January 1st, 2006) resides in urban settlements. Armavir marz includes the territories of Armavir, Vagharshapat and Metsamor and there are further 95 rural settlements. Motor highways of republican importance are Yerevan – Gyumri and Yerevan – Tbilisi.
The share of industry of Armavir marz in 2006 in total volume of industrial production of the republic comprised 4.3%, the volume of gross agricultural produce 15.2%, retail turnover 1.6%. Industry and agriculture are well developed in the marz. Industry is specialized in manufacturing of food products (processing of fruits and vegetables), beverage (production of wine and brandy), and tobacco. The geographical position and climatic conditions of the marz are favorable for growing many varieties of fruits and vegetables and for animal breeding. The marz is one of the major suppliers of grapes, apricots, tomatoes etc. in the country. The center of the marz is Armavir with 32.300 inhabitants at the end of 2005.

Agricultural lands in the marz in 2006 constituted of 79.049 ha, out of which 39.339 ha are arable. In 2005 there were 2 wholesale markets for agricultural products in the marz. There were 450 retail outlets in 2005 in Armavir marz. There were 3880 unemployed people in 2005. Consumer price index in 2007 was 110.7.

Lori marz is the third largest marz by its territory in the republic (it occupies 12.7 % of the RA territory) and the second largest by its population (after Yerevan city). It is situated in the North of the republic and borders with Georgia. RA general railway runs through the central part of the marz. RA Lori marz covers the regions of Spitak, Stepanavan, Tashir, Tumanyan, Gugark and the towns of Vanadzor, Spitak, Stepanavan,Alaverdi, Tashir, Akhtala, Tumanyan, Shamlugh. The population of the marz comprised 8.8 % of the total population of the republic as of 2005. About 58.8% of the population is town dwellers. The 1998 Earthquake, the epicenter of which was a little bit North from Spitak, hit large parts of the present day territory of the marz. The earthquake measured 9-10 on the Richter scale in Spitak town and in Kirovakan it was an8 on the Richter scale. Shocks lasted for 40 seconds and razed all construction of Spitak to the ground, 8000 dwellings tumbled down in Kirovakan, 30 buildings and 2500 houses in Stepanavan, while the regions of Gugark, Tumanyan and Tashir suffered greatly. The reconstruction works began immediately after the earthquake with financial and physical assistance received from a number of countries around the world and numerous tender-hearted people. During the last 15 years new dwellings, schools, industrial constructions, and cultural centers were built in the marz.
The share of industry of RA Lori marz in 2005 in total volume of industrial production of the republic comprised 5.5%, in the volume of gross agricultural produce 10.5%, in retail turnover 2.2%. The center of the marz is Vanadzor with 105.500 inhabitants at the end of 2005. Agricultural lands in the marz in 2006 constituted of 213,797 ha and the region provided 51.8 million AMD in agricultural output in current prices in 2005. Retail turnover in the marz in 2005 was 19585.1 million AMD from 900 retail outlets. Average nominal monthly salary was 42.818 AMD and 21.800 people were unemployed in 2005. Consumer price index in year 2005 was 99.5.

Shirak marz is situated in the north-west of the republic. It borders with Turkey and Georgia. The marz covers Artik, Akhuryan, Ani, Amasia and Ashotsk regions. It includes 3 towns: Gyumri, Artik, and Maralik and 128 more rural settlements. The marz occupies 9% of RA territory. The population of the marz comprised 9.1% of RA total population in 2005, of which 60.9% are urban. RA Shirak marz inherited its name from the Shirak province of Ayrarat land of historical Armenia. Being at an altitude of 1500-2000 m above sea level (52 villages of the marz lie at 1500-1700 m above sea level and 55 above 2000 m), the marz is the coldest region of Armenia, where the air temperature sometimes reaches -46 degree Celsius in winter.
The main railway and automobile highway connecting Armenia with Georgia pass through the marz' territory. The railway and motor-road networks of Armenia and Turkey are connecting there.
The international airport is situated in the RA Shirak marz, which provides air connection with CIS countries and has a facility to receive any type of airplane. On the Akhuryan River, bordering with Turkey, the Akhuryan reservoir was built. It is the biggest of RA by volume (526 mln.m3). The destructive Spitak earthquake on 7 December 1988, took thousands of human lives and has caused big destruction of the Shirak marz economy, in particular in Gyumri town. Up until the earthquake the marz was only second to Yerevan city in the republic by its development level and economic capacity. However, after the earthquake the marz' economy endured a deep drop. The earthquakes consequences were destructive: in seconds powerful factories had been turned into ruins, thousands of dwelling houses, schools, hospitals had been destroyed. A large number of cattle were buried under the ruins in many villages. From 1989 until 1991 big reconstruction work was conducted with a purpose to liquidate ruins with the assistance of almost all soviet republics, many foreign countries and international organizations. Now the marz' economy and industrial capacities are slowly recovering.

The share of industry of Shirak marz in total volume of republican industrial production comprised of 2.1% in 2005, in volume of gross agricultural output 10.0%, in retail turnover 1.9%. The leading branches of industry of RA Shirak marz are production of food, including beverages and production of other non-metal mineral products. Tufa and pumice of Artik and Ani are well known. Grain farming and cattle breeding are also well developed in the marz. The center of the marz is Gyumri with 148.300 inhabitants at the end of 2005.
Agricultural lands in the marz in 2006 constituted of 165.737 ha and the region provided 49.3 million AMD in agricultural output in current prices and 2005. Retail turnover in marz in 2005 was 13978.9 million AMD from 747 retail outlets. Average nominal monthly salary was 41.222 AMD and 26.900 people unemployed in 2005. Consumer price index in year 2005 was 99.2.

5. PILOT CASE STUDY

5.1. Results

Looking at a first summary polygon of the pilot case study it can be stated that the degree of sustainability across the 12 RISE-indicators is in general quite homogeneously distributed while at a rather low level (Figure 5).

The economic indicators of most farms in this case study can be found in the green area of the polygon indicating a good economic stability and financial efficiency. Although most of the farms have good financial results several farms are suffering from substantial economic problems (Figure 6). This fact has somewhat been masked by the weight given to the well performing farms. It is furthermore important to look at the results at parameter level because more specific, individual risks of various farms may be covered by the good mean values outlined. Results at parameter level are summarized in chapter 5.2. It must be underlined at this point that the generally good financial results of the farms analyzed stand in strong contrast to the commonly low profitability of Armenian farms. The farms of this pilot study represent a more commercial oriented and prosperous guild of farms. In the review process of this pilot project study we recognized that the value of the minimal wage, which sets the scale to a large extend for all economic indicators, was set at a too low level. The RISE minimal wage is defined as the wage that is needed to cover the basic needs of an average Armenian family. To the basic needs are attributed: food, energy, house keeping, cloths, shoes, education, personal hygiene, rent, interests (mortgage) transportation, taxes, and social securities (health care, old-age pension scheme, unemployment insurance, and disability insurance). The value for the minimal wage had to be changed from $40 to $340 USD per month, which considerably changed the outcome for some economic parameters.

In the RISE model the minimal wage is an important value because it is used in a number of parameters part of the social and economic indicators. For instance it is used to determine the value of the wage entitlement – a standardized estimation of the living expenses of the farmer. For the calculations in the current report this adaptation of the minimal wage have not yet been considered. It can therefore be expected that the social and economic indicators are currently overvalued and that the recalculated degrees of sustainability of these indicators must be lower and could also end in the red area of the polygon.

On the summary sustainability polygon for the pilot case study depicted in Figure 5 currently the only red area is found on the *Biodiversity* indicator. A majority of the farms *Biodiversity* indicator turned out in red area indicating a number of problems regarding this topic. An explanation for this result must be found in the relatively high production intensity of most farms of the sample on almost the entire usable agricultural area (UAA). The other RISE indicators that are attributed to the natural resources turned out in what is considered to be the border area (*Water* and *Soil*), indicating a more thorough analysis of the individual parameters might be required to show strengths and weaknesses. Of the natural resources indicators only the Energy indicator showed a result in the green area of the summary polygon.

Indicators depicting aspects of resources management outlined a somewhat mixed picture. *N&P Emission Potential* indicator appears to be calculated commonly in the border area due to a disproportional nutrient production on some farms, whereas the *Plant Protection* and *Waste* indicators are showing better results. Low amounts of waste, only few types and an appropriate, external disposal raised the values for the *Waste* indicator.

Just like on most ecological parameters, economic constraints appear to exert great pressure on many parameters of the social indicators. At indicator level this pressure is not so obvious for the *Working Condition* indicator, which is presenting values in the green area of the polygon. However, looking at individual parameters, problems appear then for example in such sensitive areas like employees' working time or further-education. Also the *Social Security* indicator of the summary polygon ends up in the border area. This is often caused at individual farm level by inadequate salaries and a lack of social securities that can comprise insurances as well as private solutions that provide protection from a loss of income in case of an unexpected event.

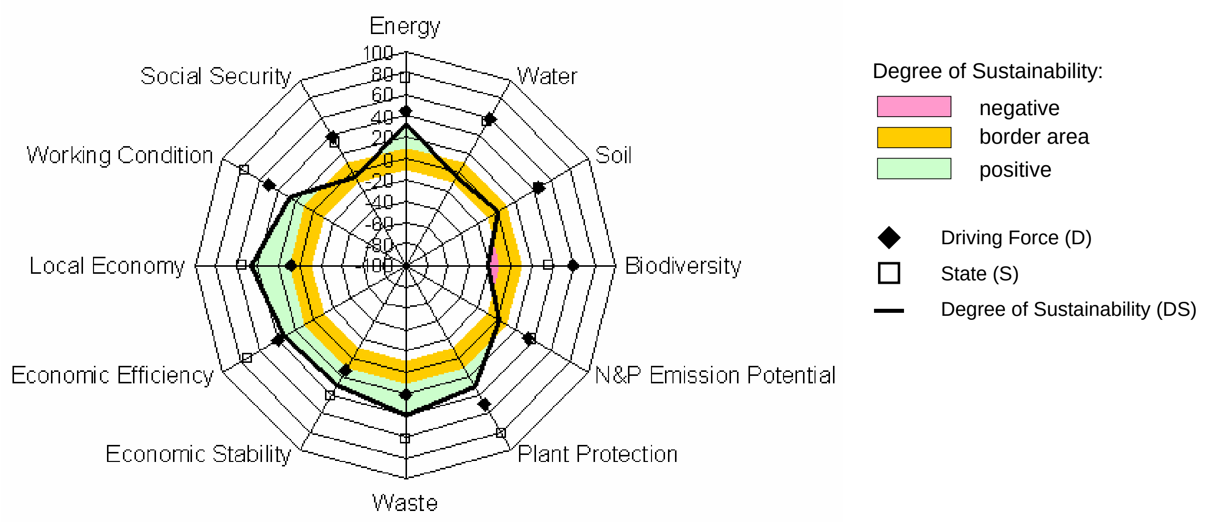


Figure 5: Summary sustainability polygon of the 14 pilot case study farms.
Displayed are mean values of the State, Driving force and Degree of Sustainability of the14 assessed farms. The bold line connects the values of the Degree of Sustainability of the twelve indicators.

In the sustainability polygon mean values are shown. Individual results can differ considerably from the mean. Figure 6 and

Table 2 show the distribution of individual values of the pilot case study sample. The values calculated for the *Water, Emission Potential* and *Economic Efficiency* indicators of the farms were quite heterogeneously distributed compared to the other indicators. Particularly narrow appears the distribution of sustainability values at the *Local Economy* indicator.

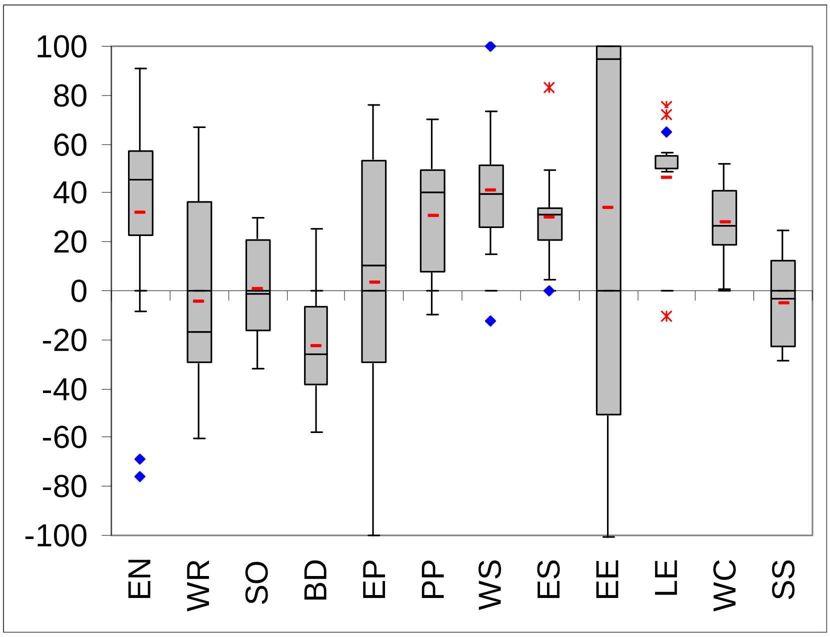


Figure 6: Boxplots of the Degree of Sustainability (DS) and distribution of the 12 RISE-indicators assessed on the 14 farms in Armenia.
Mean values are indicated as red horizontal lines, outliers as squares/crosses.
The degree of sustainability is visualized on a scale between minus 100 (worst case) and plus 100 (best case). Abbreviations: Energy (EN), water (WR), soil (SO), biodiversity (BD), N&P emission potential (EP), plant protection (PP), waste (WS), economic stability (ES), economic efficiency (EE), local economy (LE), working conditions (WC), social security (SS)

Table 2: Degree of sustainability of the individual farms analyzed (n=14).
The colour code corresponds to the one of the RISE polygon. Abbreviations: Usable agricultural area (UAA), Mixed dairy (MD), Dairy (D), Energy (EN), water (WR), soil (SO), biodiversity (BD), N&P emission potential (EP), plant protection (PP), waste (WS), economic stability (ES), economic efficiency (EE), local economy (LE), working conditions (WC), social security (SS)

Region/ Farm	Farm type	UAA (ha)	EN	WR	SO	BD	EP	PP	WS	ES	EE	LE	WC	SS
Aragatsotn_01	MD	115	47	-23	-9	-56	69	50	22	48	-34	-11	28	5
Aragatsotn_02	MD	10	-76	41	-27	-55	40	-4	15	25	98	56	19	13
Aragatsotn_03	MD	15	-8	2	-18	-39	50	48	37	33	100	52	20	12
Ararat_01		9.8	20	-30	-22	-35	3	38	21	33	92	50	14	-5
Ararat_02		1.25	56	-60	-32	-29	-11	5	58	28	100	75	33	-1
Ararat_03		76.2	79	-50	27	-37	18	55	40	33	100	-11	52	-21
Armavir_01		1.1	88	-24	-8	-14	-100	16	100	4	-64	50	26	-23
Armavir_02		4	90	-60	6	-23	-80	70	42	0	-92	51	29	13
Shirak _01		9.3	28	67	5	5	-27	44	39	83	100	50	19	-29
Lori_01	D	5	-69	41	20	-5	-71	-10	38	29	-56	50	9	-26
Lori_02	D	12	42	51	30	10	-30	-8	73	19	32	49	44	-28
Lori_03	D	210	43	23	-10	-58	55	43	-12	0	-100	65	49	-20
Lori_04	D	65	53	-27	21	25	76	29	53	33	100	50	1	13
Lori_05	D	61.3	57	-11	24	-9	57	52	47	49	100	72	46	24
Mean		**42.5**	**32**	**-4**	**1**	**-23**	**3**	**31**	**41**	**30**	**34**	**46**	**28**	**-5**

5.2. *OBSERVATIONS ON SELECTED RISE PARAMETERS*

As explained in chapter 3.2 the values calculated for the State (S) and the Driving Force (D) of individual indicators are aggregated values from a number of parameters (Annex 1). Individual parameters may vary considerably and therefore it is quite possible that single parameters of concern might be masked by an overall good appearing mean value of other parameters. Therefore it is essential not only to pay attention to the results at indicator level but also to amplitudes at parameter level.
In the following section of this report a limited selection of parameters from the models 68 complex parameters is being discussed.

5.2.1. Energy

The *Energy* indicator is a measure for the amount of, and how efficient, energy (fuel, electricity) is being used on the analysed farm. Furthermore, the quality (renewability of used resources, their environmental load, etc.) is evaluated.

The degree of sustainability on the *Energy* indicator of most sample farms is calculated in the green area of the sustainability polygon (Figure 6). However at parameter level the DP2 of many farms appears problematic, indicating high energy use per work force or in other words a low energy-efficiency per work force. The low energy requirement of two farms (Armavir_01, Armavir_02) can be explained by the low level of mechanization.

Figure 7 shows that there is no clear pattern regarding the differences at farm level between the five case study regions.

Interestingly enough, the indicator for energy use per UAA (DP1) ends up to be in the green area of the RISE polygon, indicating good energy efficiency for the energy use compared scaled on the productive land.

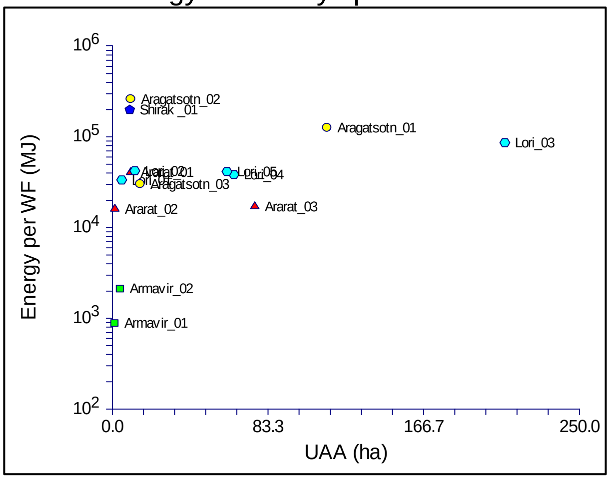


Figure 7: Energy use per work force (WF) in comparison to usable agricultural area (UAA).

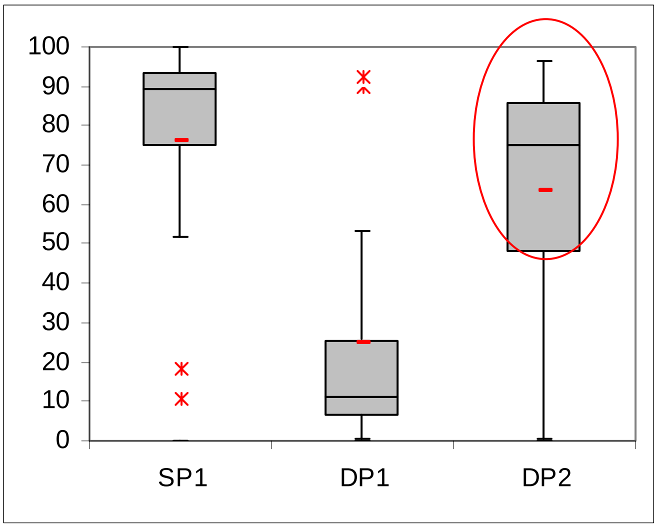


Figure 8: *Energy* indicator: State (SP) and Driving force-parameters (DP).

SP1: Environmental effect of the used energy carrier
DP1: Energy-input per hectare farmland
DP2: Energy-input per work force

Note that for **state parameters** *high* values indicate a *positive* situation and *low* values a *negative* one. Whereas for the **driving force parameters** it is vice versa (*low* values indicate *low* a pressure and *high* values *high* pressure).

5.2.2. Water

On the one hand the *Water* indicator displays a number of risks to the water supply in respect to the quantity and the quality of water used, on the other hand the efficiency of the water used in a global context is being scaled.

Many (sub-) parameters of this indicator show poor values for the overall sample. For a successful and sustainable agricultural production stable water supply is often crucial. Many farmers in the pilot case study sample rate their water supply as “not stable” (SP1). This would indicate that water availability or quality is decreasing or has become more unpredictable. Most of the farmers have an of-farm water supply. They complained that water supply became worse within the last years which is mainly attributed to the fact of deteriorating infrastructure.

The water productivity compared at a global scale, measured on the DP1 of the water indicator, show the farms of this sample with a rather poor performance mainly due to comparatively low yields. Furthermore, the parameters measuring risk for water pollution due to livestock entering water bodies (DP2a1), manure storage (DP2a2), high manure concentration (DP2a3), waste water and its treatment (DP2c), water protection measures (DP2d) indicate a relatively high risk on various farms of the sample. Therefore measures to improve the conservation of water resources might want to be evaluated carefully in consideration of the feedbacks.

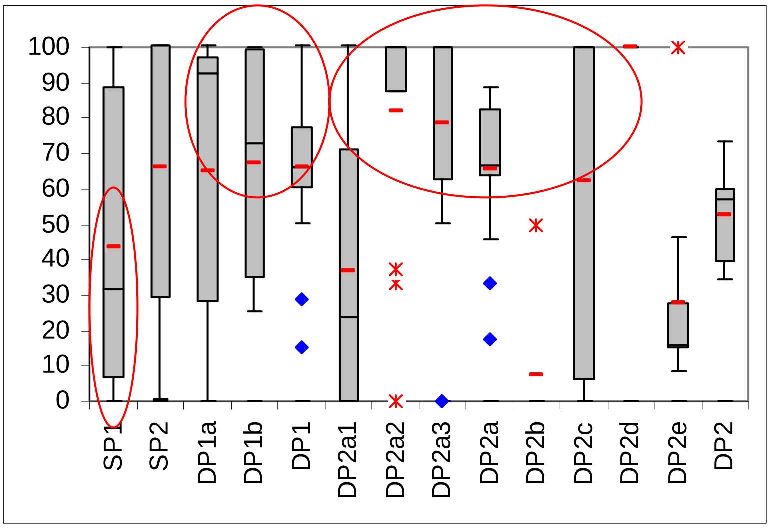


Figure 9: *Water* indicator: State (SP) and Driving force-parameters (DP).
SP1: Water quantity and availability (based on the farm manager’s point of view)
SP2: Water quality and stability of the quality (based on the farm manager’s point of view)
DP1: Water quantity and productivity:
DP1a: Water usage and productivity for plant production
DP1b: Water usage for animal husbandry
DP2: Risk factors for the water quality
DP2a: Water pollution by manure
DP2a1: Livestock in open water
DP2a2: Manure storage
DP2a3: Places with high manure concentration
DP2b: Water pollution by silage leachate
DP2c: Waste water production and treatment/disposal
DP2d: Water protection by soil conservation/cultivation
DP2e: Soil permeability (nutrients / pollutants)
Note that for **state parameters** *high* values indicate a *positive* situation and *low* values a *negative* one. Whereas for the **driving force parameters** it is vice versa (*low* values indicate *low* a pressure and *high* values *high* pressure).

5.2.3. Soil

The *Soil* indicator provides information about the condition of the soil as well as the endangerment of the soil fertility through pollution and mechanical loadings.

On the *Soil* indicator most of the analysed farms find their values in the so-called border area (Figure 6). A lack of (analytical) knowledge regarding the soil’s condition (SP1), such as the nutritional state or soil acidity, has been observed among the farmers of the pilot case study sample, which is considered crucial for decision-making e.g. in terms of fertilization and demand-oriented practises within the RISE model’s indicator calculation. A parameter indicating an issue that should also be more rigorously observed is DP3 (salinization due to irrigation without appropriate drainage). Within the sample there are a number of farms that irrigate without having appropriate drainage. This may lead to salinization and a decrease in soil fertility.

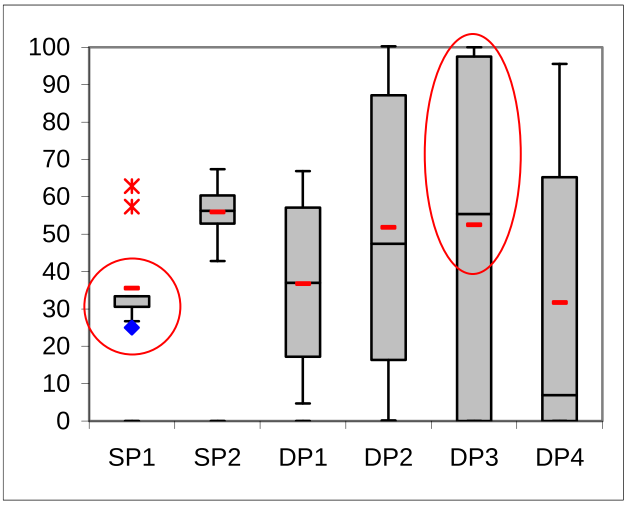


Figure 10: *Soil* indicator: State (SP) and Driving force-parameters (DP).
SP1: Soil pH, salinization, water logging, soil analyses.
SP2: Erosion index
- Visible erosion
- Erosion risk
DP1: Proportion of farmland treated with pesticides, acidifying fertilizers or fertilizers with heavy metals.
DP2: Intensity of soil tillage
DP3: Salinization due to irrigation without appropriate drainage
DP4: Nutrient depletion

5.2.4. Biodiversity

Based on the farmers' field management and the intensity of cultivation at plot and crop level the consequences on floral and faunal biodiversity are evaluated on the *Biodiversity* indicator of the RISE model.

The *Biodiversity* indicator is the only indicator of the RISE model that shows a result clearly in the red – and therefore not sustainable – area of the polygon for the pilot study sample of farms. Looking at the indicator for the farming system (SP1), a relatively high intensity of agricultural production and according practices can be observed while there are only very few areas extensively used (DP1). Extensively used land is important for the biodiversity and serves as a refuge for many species of flora and fauna. But the creation of extensively used areas contradicts the strive to enhance agricultural productivity. The protection and maintenance of biodiversity can be considered as a positive externality or multifunctional merit, which the farmer could be compensated for by society (government) for the loss of income due to extensification.

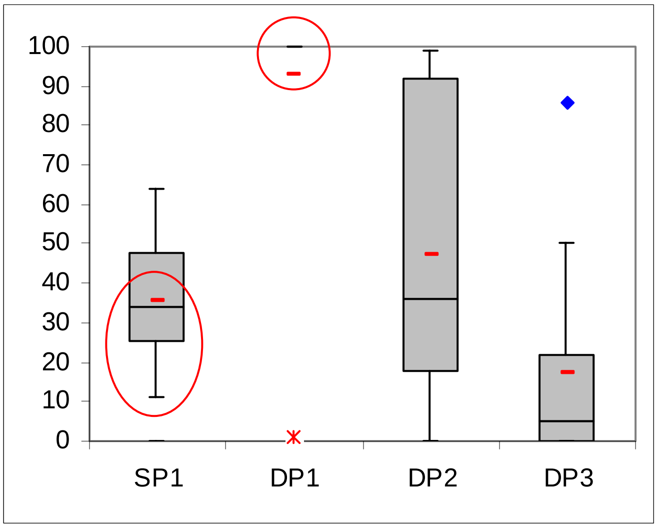


Figure 11: *Biodiversity* indicator: State (SP) and Driving force-parameters (DP).
SP1: Biodiversity promoting farming system
DP1: Proportion of intensely used farm land (usable agricultural area) of the total farmland
DP2: Plot size
DP3: Intensity of weed control

5.2.5. N&P Emission Potential

With this indicator the nitrogen and phosphor emissions to air and water due to manure and mineral fertilizer application is being rated. A nutrient balance on the basis of nutrient production compared to the demand by the crops cultivated is calculated; in addition the quality of manure storage and the application methods are being rated.

Among the sample farms there are some with very high stocking rates of about 11 large animal units (LAU) per ha UAA. Such intensive animal production has a high potential for environmental pollution due to the production of large amounts of N&P beyond the nutrient demand of the cultivated plants. From the economic point of view the overproduction of manure while not using nor exporting it must be seen as a waste of valuable resources. Improvements could go in the direction that farmers from the proximity might require and even pay for the manure of such intensively producing farms.

In the course of preparing this report, it was recognized that nutrients from the animal husbandry in the region of *Argatsotn* were not included in the nutrient balance and therefore some of these farms actually even have a far higher nutrient production (red arrows in Figure 12) than calculated.
The above problem demonstrates how important a reliable controlling and careful data verification (ideally through support by the RISE-core group) is to prevent from inconsistent results and misleading conclusions.

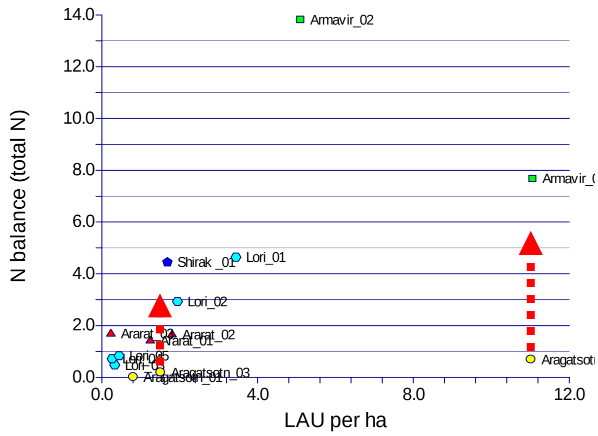


Figure 12: Relationship between N-balance (N-production and N-demand from crops) and stocking rate. (LAU per ha UAA). Red arrows indicate that farms from the region Argatsotn actually have a higher value for the N-balance.

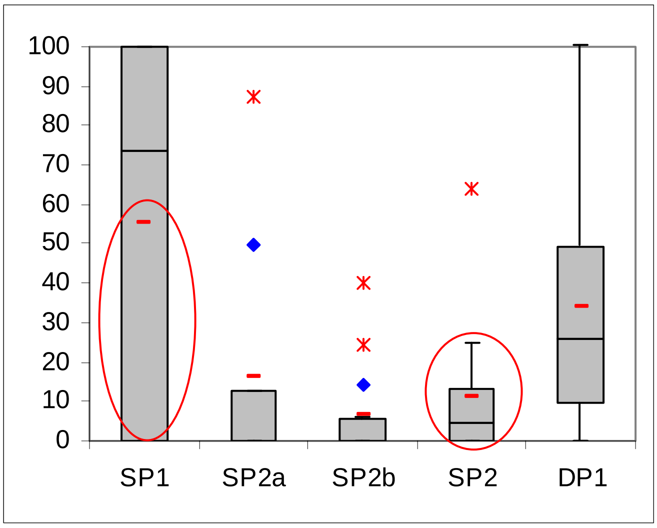


Figure 13: *N&P Emission Potential* indicator: State (SP) and Driving force-parameters (DP).
SP1: N & P balance by production & demand
SP2: Organic manure
SP2a: Manure storage
SP2b: Application method
DP1: Quantity of N & P from organic and inorganic fertilizers (import - export)

The low SP2 values of the indicator signify (Figure 13) that manure storage and the application techniques carry the risk for nitrogen and phosphor emissions. By investing e.g. in manure storage facilities that prevent liquid manure from percolating into the soil the emission risk could be reduced.

5.2.6. Plant Protection

Parameters of the *Plant Protection* indicator cover the quality of application, environmental and human-toxicological risks, the cropping system and crop rotation.

The interviewed farmers declared to have a good knowledge about the appropriate application of plant protection products. Further they ensure to full functional capability of the used apparatuses.

Elements for improvement may be rather found in the (sub-) parameter covering the cropping system (DP1). There are for instance a quite large number of farms (8 of 14) that treat the entire agricultural usable area with pesticides (DP1b). This increases the intensity level of the production system, which was already observed at the biodiversity indicator and DP1e of this indicator. However, the intensity aspect in the plant protection indicator is considered not to be as severe as the average amount of used pesticide per hectare is rather low (average 0.4 l active ingredient/ha). Nonetheless by creating zones with no pesticide applications, overall intensity could be lowered.

Farmers stated that resistance traits against diseases or pests of the different varieties are not considered in their selection of the varieties cultivated (DP1c). As resistance traits may help reducing the use of chemicals, the reasons for this behaviour have to be analyzed in more depth.

Another point that has to be followed is the use of pesticides following a quite fixed plan (DP1d). With the goal of optimizing the pesticide treatments and consequently lowering the direct costs on farm, the use of prognosis systems and treatment of pest and diseases after reaching specific damage thresholds further has to be considered.

According to the RISE-analysis the practiced crop rotations on the arable land is considered to be adequate to a great extend. However on some farms a very cereal pronounced rotation is practiced which gives a high potential for specific diseases. Together with specialists e.g. from extension services this point should be discussed.

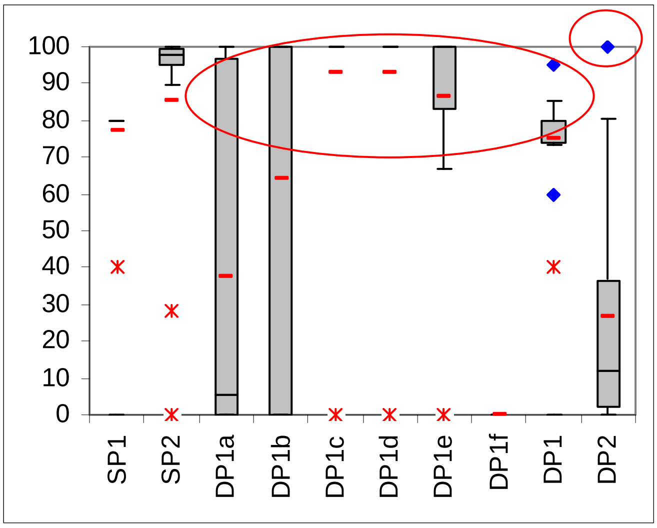


Figure 14: *Plant Protection* indicator: State (SP) and Driving force-parameters (DP).
SP1: Application
- Education of the handler
- Apparatus check
- Storage of plant protection products
- Compliance with waiting period
- Adherence of buffer zones along waterways

SP2: Environmental and human-toxicological risks (effects on non-target organisms, persistence, acute toxicity, chronic toxicity
DP1: Cropping system
DP1a: N-Fertilization (over-saturation)
DP1b: Proportion of farmland treated with pesticides
DP1c: Variety selection
DP1d: Damage threshold, prognosis, selection of active ingredients
DP1e: Biodiversity
DP1f: Bonus for further relevant measures
DP2: Crop rotation

5.2.7. Waste

The *Waste* indicator provides information about the amount of waste produced and whether it is disposed farm internally or externally; furthermore covering the recycling of waste.

In the *Waste* indicator most farms from the Armenian pilot project sample show good values. On most of the farms only low amount of waste are being produced while disposed appropriately. However, the disposal of certain waste types (e.g. carcasses, batteries) should be examined more thoroughly.

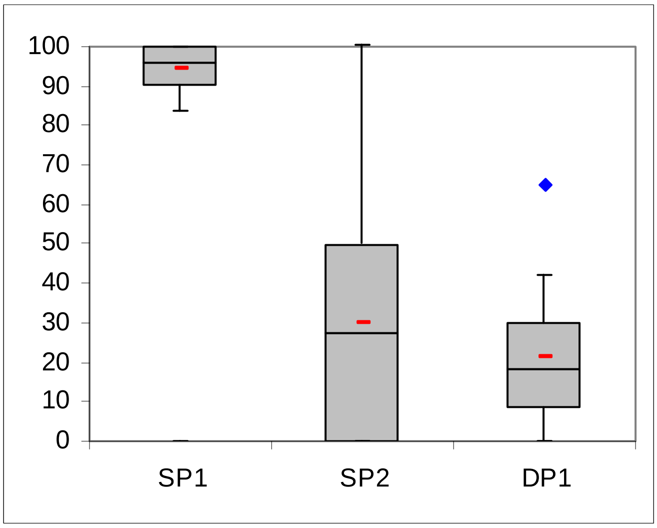


Figure 15: *Waste* indicator: State (SP) and Driving force-parameters (DP).
The *Waste* parameters:
SP1: On farm waste disposal
SP2: Off farm waste disposal
DP1: Waste produced on the farm (type and quantity)

5.2.8. Economic Stability

The *Economic Stability* indicator informs about the long-term ability of a farm to ensure liquidity and profitability of the operation; also in the case of an unexpected event. The structure of the capital, the financial flexibility and liquidity of the farm and - on the basis of age and state of mechanization, buildings and permanent crops - the possible investment needs are taken into consideration.

Farms of the Armenian pilot project sample show overall a relatively stable economic situation. As mentioned in section 5.1 minimal wage had been set at a too low level for the pilot study. The minimal wage must be increased from $40 USD to $340 USD. An advantage of the farms from this specific sample was that almost all of them did not have substantial debt or therefore debt service. On the other hand an investment lag could be observed which may develop into a potential risk for the financial stability of the farm. Over aged machinery and old buildings frequently hamper efficiency.

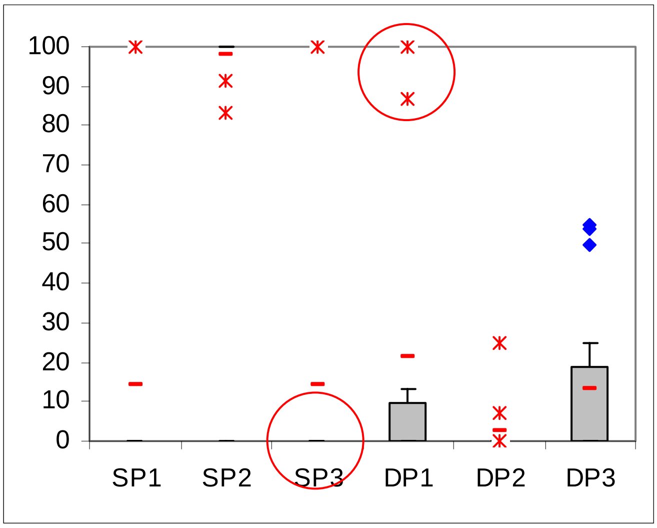


Figure 16: *Economic Stability* indicator: State (SP) and Driving force-parameters (DP).
SP1: Net debt coverage ratio
SP2: Equity ratio
SP3: Gross investment
DP1: Cash flow/raw performance rate
DP2: Dynamic gearing
DP3: Condition of the machines, buildings and permanent crops

The hesitation to make investments to renew and maintain machinery and buildings is obvious. One of the reasons mentioned were the uncertainties relating to the introduction of the value added tax (VAT). This observation is in line with identified priorities of Haykazyan and Pretty (2006), who state that prerequisites for launching investments in asset building in Armenia would be reliable property rights.
In Figure 17 average values of 13 of the 14 farms are summarized. One farm (Lori_03) has been excluded from this figure because its financial performance lied completely outside of the scope of the other farms of this sample. The raw performance for the farms in this specific sample is assumed to have been completely underestimated – and consequently also the calculated profit - as external deliveries and the change in value of stocks had not been included. In the further course of the project these positions will be assessed as well.
Furthermore, for the parameter SP3 (gross investment) adaptations in the RISE-instructions must be made. So far, the inventory had only been recorded if the farmer intended to replace specific items. As mentioned above though the situation is that no one planes to replace his assets and therefore replacement values for all farms were very low or even inexistent

evaluated. In the large-scale assessment it now is planed that all assets will be recorded and instead of a replacement value a market value will be determined.
In Armenia machinery and buildings on most farms are generally old. However, general practice is that assets are depreciated within a very short time. In consequence all farms of the pilot study have no depreciation at all although lifetime of the assets is usually very high. In the large scale assessment the standardized approach will be adapted so that all machinery will be linearly depreciated over 15 years and buildings over 30 years.

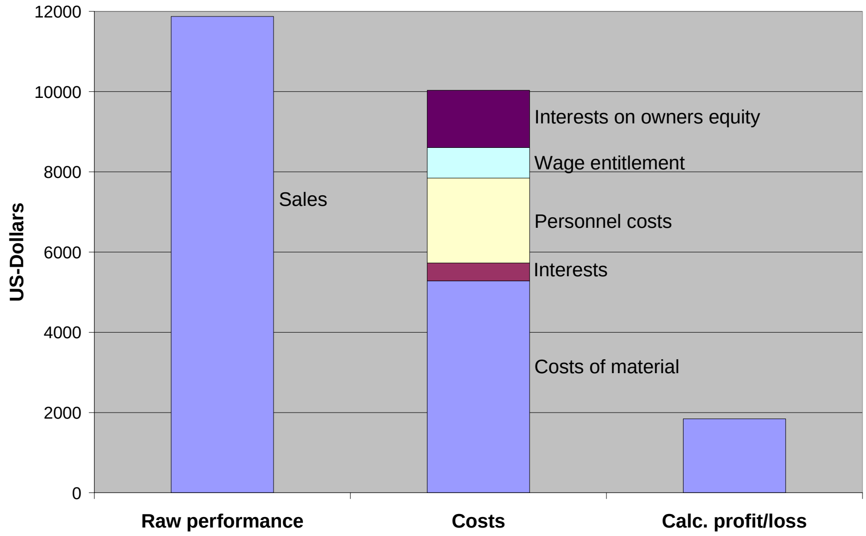


Figure 17: Average values of the income statement of 13 farms analyzed.

5.2.9. Economic Efficiency

To measure the competitiveness and consequently the economic fitness of the farm this RISE indicator compares the financial performance to the available financial and human resources.

The mean value of this indicator on the summary polygon is located in the green area – similar to the *Economic Stability* indicator above. However in contrast to the *Economic Stability* the sample of Armenian farms selected displays a much larger variation on the indicator (Figure 6) and in particular at parameter level (Figure 18).
A general characteristic and strength displayed by the RISE analysis for the farms of the pilot project sample is the low level of debt. Most farms do not have any debt at all. The main reason for this lies in high interests for loans in Armenia. The lack of affordable credit also explains the low level of investment on many farms, identified on the *Economic Stability* indicator. Poor results scored on SP1 and SP2 of the *Economic Efficiency* indicator by farms of the sample can mostly be explained by the highly calculated losses of some farms *(calculated net profit/loss = operating income - interst on debt - lease - rent - calc. interest on owners equity - wage entitlement - personnel cost)*. As mentioned above, in the large-scale study minimal wage and the production costs will rise considerably and will result in a decline of the profitability.

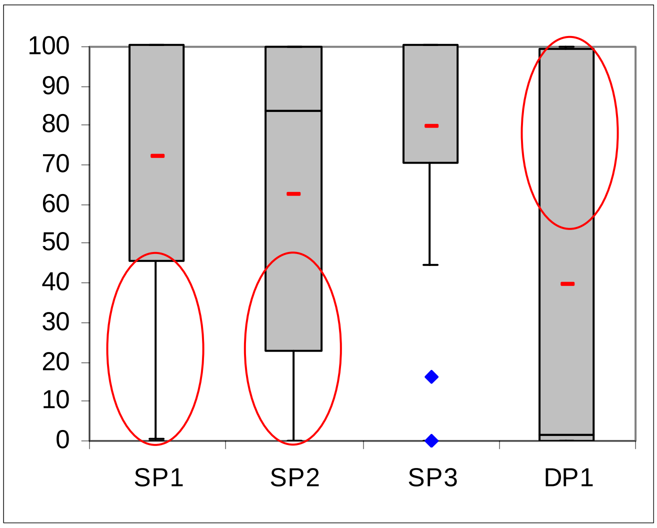


Figure 18: *Economic Efficiency* indicator: State (SP) and Driving force-parameters (DP).
SP1: Return on assets
SP2: Return on equity
SP3: Total earned income
DP1: Productivity

By correlating the calculated profit/loss to the usable agricultural area of the farms a possible explanation for the results was checked to further look for an explanation of the picture found. Considering all farms in the pilot project sample a very good fit of 97.7% can be reached with a quadratic function (*Calculated profit/loss = -1053 + 267*UAA - 2.3*UAA²*) (fig.). In other words, with an increase of UAA (farm size) there is also a rise in profitability. But then the two largest farms (Lori_03 (210 ha); Argatsotn_01 (115 ha)) showed a substantially lower performance in this aspect compared to the average of the sample. This could indicate a constraint for large farms in the sample. A calculation based on the pilot project sample would therefore indicate farms with about 60 ha of UAA might reach a peaking profitability, whereas larger farms then show a decrease in calculated profit/loss.

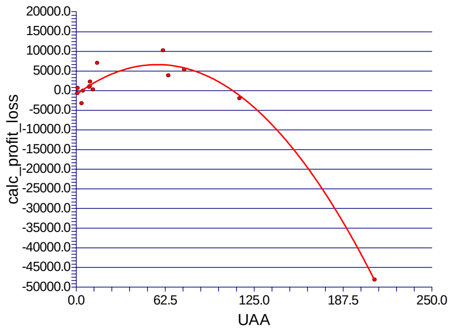


Figure 19: Quadratic function of calculated profit/loss in relation to usable agricultural area (UAA) (n=14).

However, when excluding the two largest farms (Lori_03 (210 ha); Argatsotn_01 (115 ha)) from the sample a positive correlation between UAA and the calculated profit / loss can be observed (fig.). The linear model calculated results in a R^2 of 50 % (Calculated profit/loss= 38 + 95*UAA).

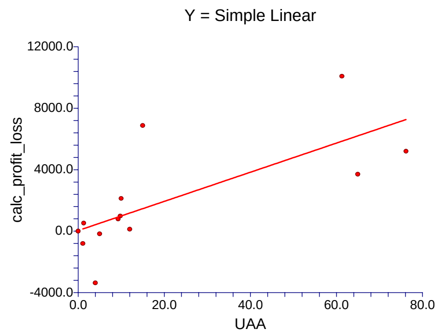
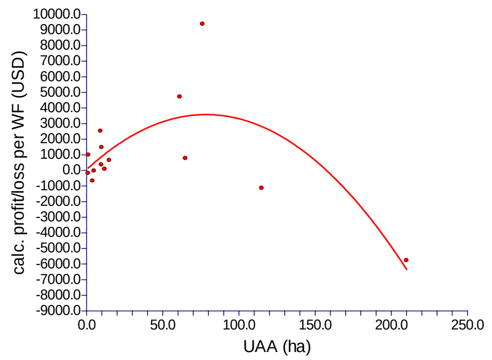


Figure 20: Linear function of calculated profit/loss in relation to usable agricultural area (UAA). The two largest farms have been excluded (n=12).

However for a farm manager the sheer number calculated as "calculated profit/loss" may be of minor relevance. In fact he/she might be more interested in optimizing the "profit per work force" as this gives him/her information about the efficiency and profitability of the work forces on his/her farm.

Again a quadratic function provides a relatively good fit of 54 % (*Calculated profit/loss per WF = 57 + 90*UAA – 0.57*UAA*^{2}), indicating that there might be an optimal farm size of about 80ha for the pilot project sample. Interestingly the farm size lays 20ha above the value for the "calculated profit/loss". This indicates that profitability is increased and work efficiency is higher on larger farms.



Again, it has to be emphasized that the farm sample is not representative for any group of farms. Therefore, explanations about parameters such as region, farm type, size etc. are not possible so far and must not be made. However, the results show that the RISE-method may provide some more interesting and important information when increasing sample size. The large-scale study could provide a good basis for future decision-making at farm level but also at higher levels.

Further, results from this pilot study may also indicate that there could be some very interesting correlations between the size of farms in Armenia and their social as well as economic performance on the RISE indicators.

5.2.10. Local Economy

On this RISE-indicator the contribution by, and the potential of the farm for the local economy is being displayed. Elements considered are the origin of the working forces and the levels of salaries, the attractiveness of the farm in respect to the salaries paid and the performance of the farm in relation to its usable agricultural area (UAA).

With the exception of state parameter 2 (the lowest salaries paid on the farm compared to the regional average gross income), all *Local Economy* parameters are showing good (considered sustainable?) values. However, the very poor *salaries* paid to the person with the lowest wage may indicate a low attractiveness of the farms from the pilot project sample for the regional working force (Figure 21). In competition with other jobs farms may have a problem to recruit adequate working force in the future if salaries are not adapted. However, if also taking the bad result of the disparity parameter into consideration (Working Conditions indicator; Figure 22) it might be concluded that farmers may have some financial scope to react to the bottleneck in their human resources. A lack of alternative job opportunities could have led to the very low wages paid to some employees of the farm sample.

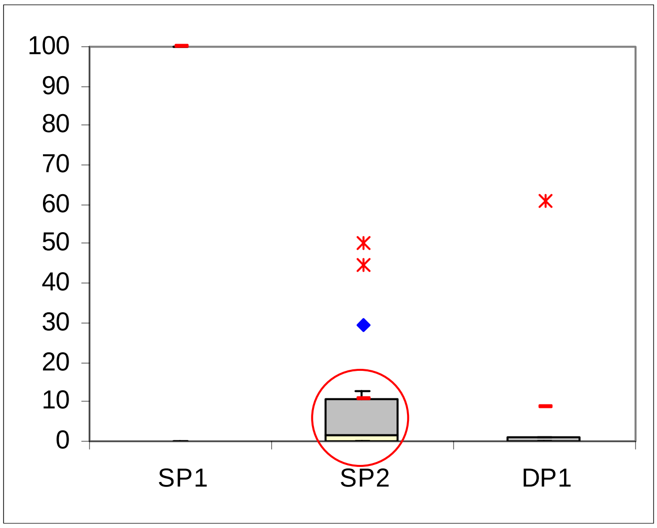


Figure 21: *Local Economy* indicator: State (SP) and Driving force-parameters (DP).
SP1: Share of regional working forces and salaries
SP2: Lowest salary on farm compared to the regional average gross income
DP1: Raw performance per ha farmland and year

5.2.11. Working Conditions

Elements considered in the indicator *Working Conditions* are health and equity aspects, organisation of the work, contentedness of the work force and securing basic human rights.

At individual indicator level the results for the working conditions indicator of all farms are located in the best cases in the yellow border area of the RISE polygon (Figure 5). However, specific issues of concern have been identified on the parameters measuring working time (SP4) and education.

Although the weekly working hours are mostly rather moderate in international comparison, many workers are every day on the job and this throughout the entire year, without any holidays at all (Figure 22).

As mentioned above, it was further found that only few farmers participated in further education or offered it to their employees. Further education is a crucial point for the transfer of knowledge and therefore for the improvement of sustainable production in the agrarian sector.

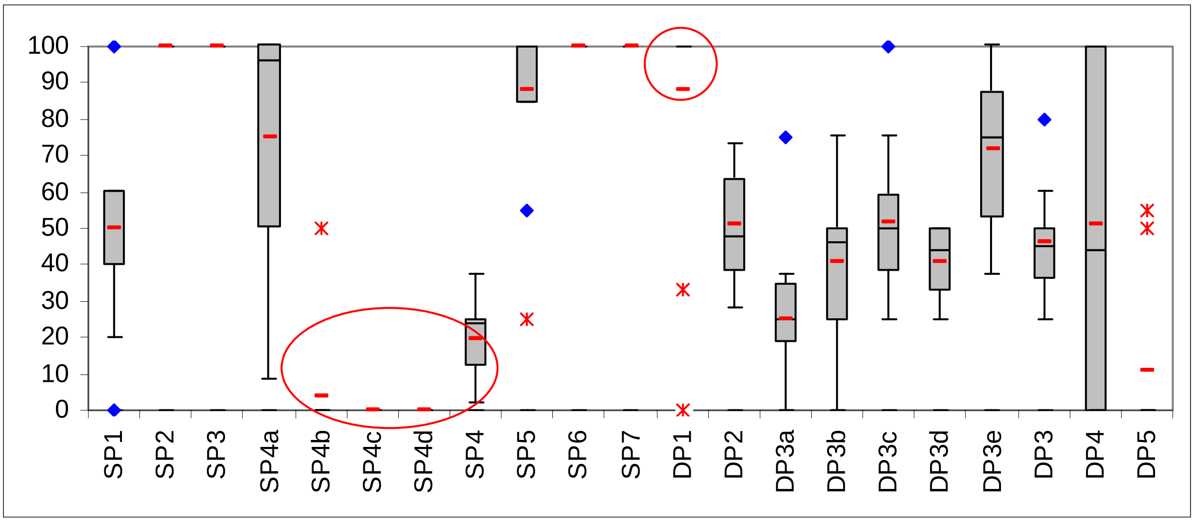


Figure 22: *Working condition* indicator: State (SP) and Driving force-parameters (DP).
SP1: Emergency/medical care on site
SP2: Provision of potable water
SP3: Accommodation and sanitary equipment
SP4: Working hours
- SP4a: Hours per week
- SP4b: Days per week
- SP4c: Weeks per year
- SP4d: Compensation

SP5: Wage discrimination
SP6: Child labor
SP7: Forced labor
DP1: Continuing education
DP2: Encumbering work
DP3: Working conditions assessed based on the point of view of workforce
- DP3a: Leisure time
- DP3b: Compensation
- DP3c: Pleasure
- DP3d: Working atmosphere
- DP3e: Labour unions

DP4: Disparity of income
DP5: Working time for reaching minimal wage

5.2.12. Social Security

This indicator assesses factors of *Social Security* provided by a farm to its work force. The main focus in the RISE model is put on the level of salaries, the potential of the farm to pay adequate salaries, farms succession planning and the legality and documentation of the employment of farm employees.

A lack of most social securities from institutional as well as private sources has been observed for the farms of the sample (SP1)(Figure 23). Developing farmer awareness for social security should be discussed in the follow-up feedbacks. Such a result is surprising considering the generally good financial situation of many farmers. It might therefore be the case that such instruments and structures are either not available or unknown; possibly they are substituted by cultural structures. The financial and social findings have to be discussed carefully.

Basis in the RISE model for an adequate wage assumes the possibility of a life above the poverty line, meaning that basic needs such as food, cloth, social securities, etc. for an average sized family of the region are covered. The pilot project sample displays that by far not all farms are paying adequate wages to employees or to the family work force (SP2).

With the exception of one farm none of the sample farms had working contracts between the farmer and the employees.

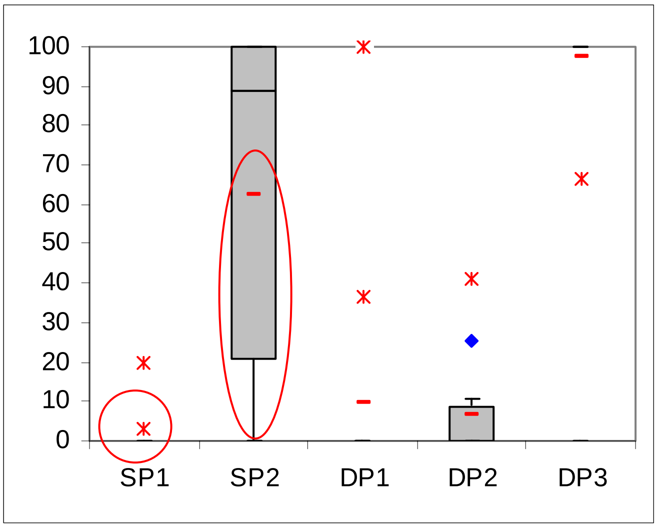


Figure 23: *Social Security* indicator: State (SP) and Driving force-parameters (DP).
SP1: Social security
SP1a: Precaution (compulsory and voluntary solutions) for retirement, unemployment, health, accident and disability
SP1b: Protection from dismissal in case of sickness, accident or maternity
SP2: Means of subsistence
DP1: Potentially payable salary
DP2: Farm succession plan
DP3: Legality and documentation of employment
DP3a: Residence permit status of employees
DP3b: Employment contract
DP3c: Working permit

5.3. REACTIONS OF THE FARMERS

Most of the farmers were quite excited to receive a scientific evaluation of their farm's operations where many strengths and weaknesses were clearly classified and the model provided them with some kind of "portfolio" of their issues. In spite of this, there were some complains that the project seemed to be rather a research project than to have a real impact on welfare of the farms. It has to be stressed that farmers in this study only got a rough feedback of their results. To give a more detailed advice unfortunately lied outside the scope of the pilot study. However, at the large scale study the initiation of measures will be a main target in order to achieve significant impact.

Many of the surveyed farmers were surprised to learn about their costs and profits because on practice none of them had any bookkeeping and RISE provided them with rough information about the economic constituent of their farms.

Furthermore the impression arose that farmers often did not have enough authority when applying for a credit and that they cannot clearly present their plans in order to receive a loan. The hope of some farmers was then that RISE specialists could coordinate efforts towards a low-interest credit and clearly present the future business opportunities for certain projects due to the fact that specialists (economists, agribusiness specialists, agronomists etc) judgment is rather accepted. This attitude can also be useful for international and local donors who provide grants or any other kind of assistance.

Even without the expectation of loans farmers would like to receive recommendations for future development in a more organized and prioritised form.

Some concepts (like biodiversity, buffer zones etc) were absolutely new to farmers and their reactions were quite positive towards learning and using those concepts/tools in practice.

Another request was that the farmers receive the feedback forms in Armenian language. This will require some further translation work but appears to be extremely useful and should be an essential part of the large-scale project.

5.4. GENERAL REMARKS AND CONCLUSIONS

In the described pilot project the RISE model had been positively tested on mixed and dairy farms in different regions of Armenia. Although the results are preliminary and cannot be generalized, one thing is quite obvious: RISE proved to be a suitable tool for the holistic evaluation of Armenian dairy farmers' sustainability. It is expected that the project will have a significant impact on the sustainability of agricultural production and the entire agricultural sector in Armenia. It has to be stressed that applying RISE not only targets a more rational use of the natural resources (energy, water, soil, biodiversity) and improved management practices (reduced emissions, proper crop protection and waste management). Through its holistic approach the tool also covers the most important economic and social aspects. Economic stability and financial efficiency of farms (including adequate income) and the economic impact on the local economy (e.g. employment generation) as well as social security and working conditions in the agricultural sector are aspects covered by the tool. These aspects are particularly important in a country where agriculture is in transition like in Armenia. A particular strength in the application of RISE is that it allows for the dual benefit of simultaneous research and data collection while providing direct extension service to the farmers on the ground (i.e. improvements). By establishing the basis for research (through data collection at farm level) improvements of farming practices are directly initiated in the feedback discussions between advisors or extension agents and farmers. The development and implementation of training modules by Armenian team members at the International Center for Agribusiness Research and Education and the Armenian State Agrarian University will raise awareness with students, scientists and extension services on the complexity and importance of sustainability issues in agriculture.

ANNEX

Annex 1: Indicators and parameters used in RISE to evaluate the sustainability of agricultural production

Dimension	Indicator	State Parameter (SP)	Driving Force Parameter (DP)
Natural resources	**Energy**	SP1: Environmental effect of the used energy carrier	DP1: Energy-input per hectare farmland DP2: Energy-input per work force
Natural resources	**Water**	SP1: Water quantity and availability *SP1a: Based on the farm manager's point of view* *SP1b: Based on the data of WaterGAP* SP2: Water quality and stability of the quality *SP2a: Based on the farm manager's point of view* *SP2b: Based on water analysis*	DP1: Water quantity and productivity: *DP1a: Water usage and productivity for plant production* *DP1b: Water usage for animal husbandry* DP2: Risk factors for the water quality *DP2a: Water pollution by manure* *DP2b: Water pollution by silage leachate* *DP2c: Waste water production and treatment/disposal* *DP2d: Water protection by soil conservation/cultivation* *DP2e: Soil permeability (nutrients / pollutants)*
Natural resources	**Soil**	SP1: Soil pH, salinization, water logging, soil analyses. SP2: Erosion index *SP2a:Visible erosion* *SP2b:Erosion risk*	DP1: Proportion of farmland treated with pesticides, acidifying fertilizers or fertilizers with heavy metals. DP2: Intensity of soil tillage DP3: Salinization due to irrigation without appropriate drainage DP4: Nutrient depletion
Natural resources	**Biodiversity**	SP1: Biodiversity promoting farming system	DP1: Proportion of intensely used farm land (usable agricultural area) of the total farmland DP2: Plot size DP3: Intensity of weed control
Manage-ment	**N&P emission potential**	SP1: N & P balance by production & demand SP2: Organic manure *SP2a: Manure storage* *SP2b: Application method*	DP1: Quantity of N & P from organic and inorganic fertilizers (import - export)
Manage-ment	**Plant protection**	SP1: Application *SP1a: Education of the handler* *SP1b: Apparatus check* *SP1c: Storage of plant protection products* *SP1d: Compliance with waiting period* *SP1e: Adherence of buffer zones along waterways* SP2: Environmental and human-toxicological risks (effects on non-target organisms, persistence, acute toxicity, chronic toxicity	DP1: Cropping system *DP1a: N-Fertilization (over-saturation)* *DP1b: Proportion of farmland treated with pesticides* *DP1c: Variety selection* *DP1d: Damage threshold, prognosis, selection of active ingredients* *DP1e: Biodiversity* *DP1f: Bonus for further relevant measures* DP2: Crop rotation
Manage-ment	**Waste**	SP1: Potential as environmental hazard SP2: Waste disposal	DP1: Waste produced on the farm (type and quantity)
Economy	**Economic stability**	SP1: Net debt service over change in owner's equity and paid interest SP2: Equity ratio SP3: Gross investment	DP1: Cash flow/raw performance rate DP2: Dynamic gearing DP3: Condition of the machines, buildings and permanent crops
Economy	**Economic efficiency**	SP1: Return on assets SP2: Return on equity SP3: Total earned income	DP1: Productivity
Economy/ Social situation	**Local economy**	SP1: Share of regional working forces and salaries SP2: Lowest salary on farm compared with the regional average gross income	DP1: Raw performance per ha farmland and year
Social situation	**Working conditions**	SP1: Emergency/medical care on site SP2: Provision of potable water SP3: Accommodation and sanitary equipment SP4: Working hours SP5: Wage discrimination SP6: Child labor SP7: Forced labor	DP1: Continuing education DP2: Encumbering work DP3: Working conditions assessed based on the point of view of workforce DP4: Disparity of income DP5: Working time for reaching minimal wage

Dimension	Indicator	State Parameter (SP)	Driving Force Parameter (DP)
Social situation	**Social security**	SP1: Social security *SP1a: Precaution (compulsory and voluntary solutions) for retirement, unemployment, health, accident and disability* *SP1b: Protection from dismissal in case of sickness, accident or maternity* SP2: Means of subsistence	DP1: Potentially payable salary DP2: Farm succession plan DP3: Legality and documentation of employment *DP3a: Residence permit status of employees* *DP3b: Employment contract* *DP3c: Working permit*

Annex 2: Individual State (S), Driving Force (D) and Degre of Sustainability (DS) values for all 21 farms assessed with RISE Armenia

Individual farms

		Energy			Water			Soil			Biodiversity			N&P Emission Potenial			Plant Protection			Waste			Economic Stability			Economic Efficiency			Local Economy			Working Condition			Social Security		
Region/farm	**LN**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**	**S**	**D**	**DS**
Aragatsotn_01	115.0	95	49	47	50	73	-23	38	47	-9	11	67	-56	69	0	69	90	40	50	52	30	22	67	18	48	66	100	-34	50	61	-11	81	54	28	38	33	5
Aragatsotn_02	10.0	18	94	-76	100	59	41	47	74	-27	19	74	-55	50	10	40	40	44	-4	44	30	15	33	8	25	98	1	98	56	0	56	81	62	19	46	33	13
Aragatsotn_03	15.0	51	60	-8	67	65	2	44	62	-18	27	66	-39	50	0	50	88	40	48	75	38	37	33	0	33	100	0	100	52	0	52	72	52	20	46	34	12
Ararat_01	9.8	72	52	20	7	37	-30	45	67	-22	24	60	-35	46	43	3	85	47	38	63	42	21	33	0	33	94	2	92	50	0	50	79	64	14	29	33	-5
Ararat_02	1.3	84	27	56	0	60	-60	62	94	-32	33	62	-29	41	51	-11	87	83	5	75	17	58	31	2	28	100	0	100	75	0	75	83	50	33	46	47	-1
Ararat_03	76.2	100	21	79	0	50	-50	42	16	27	29	66	-37	23	5	18	90	35	55	49	9	40	33	0	33	100	0	100	50	61	-11	78	26	52	13	33	-21
Armavir_01	1.1	92	4	88	29	53	-24	47	55	-8	36	50	-14	0	100	-100	54	38	16	100	0	100	33	29	4	36	100	-64	50	0	50	76	50	26	13	36	-23
Armavir_02	4.0	93	3	90	27	87	-60	40	33	6	35	58	-23	2	81	-80	90	20	70	48	6	42	33	33	0	8	100	-92	51	0	51	79	50	29	46	33	13
Shirak _01	9.3	84	56	28	99	32	67	47	41	5	52	47	5	13	40	-27	90	45	44	47	9	39	100	17	83	100	0	100	50	0	50	75	56	19	8	36	-29
Lori_01	5.0	11	80	-69	100	59	41	37	17	20	36	41	-5	0	71	-71	69	79	-10	48	10	38	33	4	29	42	98	-56	50	0	50	72	63	9	23	49	-26
Lori_02	12.0	86	45	42	100	49	51	47	17	30	55	45	10	13	42	-30	90	98	-8	75	2	73	28	8	19	84	52	32	50	1	49	81	37	44	13	42	-28
Lori_03	210.0	92	48	43	75	52	23	42	53	-10	21	78	-58	67	12	55	88	46	43	53	65	-12	33	33	0	0	100	-100	65	0	65	81	33	49	47	67	-20
Lori_04	65.0	93	40	53	50	77	-27	59	37	21	64	39	25	88	12	76	88	59	29	77	25	53	33	0	33	100	0	100	51	1	50	62	61	1	46	33	13
Lori_05	61.3	97	40	57	63	74	-11	44	19	24	56	64	-9	67	9	57	90	37	52	66	19	47	67	18	49	100	0	100	72	0	72	80	34	46	47	22	24
Mean	***42.5***	***76***	***44***	***32***	***55***	***59***	***-4***	***46***	***45***	***1***	***36***	***58***	***-23***	***38***	***34***	***3***	***81***	***51***	***31***	***62***	***21***	***41***	***42***	***12***	***30***	***73***	***39***	***34***	***55***	***9***	***46***	***77***	***49***	***28***	***33***	***38***	***-5***

Region means

Aragatsotn Mean	***46.7***	***55***	***67***	***-13***	***72***	***66***	***6***	***43***	***61***	***-18***	***19***	***69***	***-50***	***56***	***3***	***53***	***73***	***41***	***31***	***57***	***32***	***25***	***44***	***9***	***36***	***88***	***34***	***55***	***53***	***20***	***32***	***78***	***56***	***22***	***43***	***34***	***10***
Ararat Mean	***29.1***	***85***	***33***	***52***	***2***	***49***	***-47***	***50***	***59***	***-9***	***29***	***63***	***-34***	***36***	***33***	***3***	***87***	***55***	***32***	***62***	***23***	***40***	***32***	***1***	***32***	***98***	***1***	***97***	***58***	***20***	***38***	***80***	***47***	***33***	***29***	***38***	***-9***
Armavir Mean	***2.6***	***93***	***4***	***89***	***28***	***70***	***-42***	***43***	***44***	***-1***	***35***	***54***	***-19***	***1***	***91***	***-90***	***72***	***29***	***43***	***74***	***3***	***71***	***33***	***31***	***2***	***22***	***100***	***-78***	***51***	***0***	***51***	***78***	***50***	***27***	***29***	***35***	***-5***
Shirak _01	9.3	84	56	28	99	32	67	47	41	5	52	47	5	13	40	-27	90	45	44	47	9	39	100	17	83	100	0	100	50	0	50	75	56	19	8	36	-29
Lori Mean	***21.9***	***79***	***40***	***39***	***50***	***54***	***-4***	***46***	***51***	***-6***	***34***	***58***	***-24***	***27***	***42***	***-15***	***80***	***43***	***38***	***60***	***17***	***44***	***53***	***14***	***38***	***77***	***34***	***43***	***53***	***10***	***43***	***78***	***52***	***25***	***27***	***36***	***-8***

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