Identification and Implementation of Adaption Response to Climate Change Impact for Conservation and Sustainable Use of Agro-biodiversity in Arid and Semi-arid Ecosystems of South Caucasus

Assessment of Vulnerability Profile Indices for Georgia

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DRAFT REPORT ON
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1. CALCULATING VULNERABILTY INDICES

Three major vulnerability components

Methodology for selection of vulnerability indicators has been explained in a separate report submitted in February 2012. In accordance with widely accepted approach on vulnerability we have chosen to use the three major vulnerability components:

1. Adaptive capacity of communities to climate change
2. Exposure of communities to climate–hazards
3. Sensitivity of communities to climate–hazard exposures

Sub-components

Each of these three vulnerability components is further divided on sub-components:

ADAPTIVE CAPACITY	**Component**
Social capital	Sub-component
Human capital	Sub-component
Financial capital	Sub-component
Physical capital	Sub-component
EXPOSURE	**Component**
Climate hazards	Sub-component
SENSITIVITY	**Component**
Ecosystems	Sub-component
Communities	Sub-component
Agriculture	Sub-component

Vulnerability indicators

For each vulnerability sub-components, a set of vulnerability indicators has been assigned. These indicators are listed in Table 1.

Vulnerability indicators

Based on the data provided by national experts, vulnerability indicators have been assessed for each vulnerability sub-component. This has been done separately for each of the candidate pilot regions.

1.1 Determining vulnerability coefficients for indicators

Scoring system

How did we score and rank the figures provided by the national experts? And how did we use these to produce vulnerability profile of each candidate pilot region? This can best be explained in the following two examples:

Example 1: highest value is assigned 1.00

Suppose that from the data provided by the national experts on the difference between average annual rainfalls of 1991-2010. vs. 1961-1990., the following results are obtained:

	Region A	Region B	Region C
Difference in rainfall (mm)	77.30	76.20	41.90

We see that Region A has the biggest difference in rainfall, which hypothetically makes it more vulnerable than the other two regions. We assign this region vulnerability coefficient 1.00, which represents the highest vulnerability coefficient (on a scale from 0.00 to 1.00). The vulnerability coefficients for the other two regions are calculated by dividing their rainfall difference values by the rainfall difference for Region A. So the vulnerability coefficient for Region B is 0.99 (= 76.29 divided by 77.30) and for region C 0.54 (= 41.90 divided by 77.30).

	Region A	Region B	Region C
Vulnerability coefficient	1.00	0.99	0.54

In the above example, region with the highest value has been assigned vulnerability coefficient 1.00. However, this is not the rule for each criteria (sub-indicator). For some criteria we'll assign the highest vulnerability coefficient of 1.00 to the region for which we obtained the lowest value. The following example illustrates it well.

Example 1: lowest value is assigned 1.00

Suppose that from the data provided by the national experts on the average monthly salary, the following figures are obtained.

	Region A	Region B	Region C
Average monthly salary (EUR)	150.00	165.00	180.00

In this case, the most vulnerable (at least hypothetically) is not region with the highest figure (as was the case with the difference in rainfall), but the region with the lowest figure (salary). In this case, we assign the highest vulnerability coefficient of 1.00 to the region with the lowest value. In our case it is Region A (again). The vulnerability coefficients for the other two regions are calculated by dividing the salary of Region A with their salaries. So the vulnerability coefficient for Region B is 0.91 (= 150.00 divided by 165.00) and for region C 0.83 (= 150.00 divided by 180.00).

	Region A	Region B	Region C
Vulnerability coefficient	1.00	0.91	0.83

The example of values and coefficients of vulnerability indicators for Georgia are presented Table 1.

Table 1: Values and coefficients of vulnerability indicators for Georgia

Vulnerability category	Type of category	Values derived from figures provided by national experts					Vulnerabily coefficient				
		Gori	Kareli	Sagarejo	Dedophlists.	Gardabani	Gori	Kareli	Sagarejo	Dedophlists.	Gardabani
ADAPTIVE CAPACITY	**Component**										
Social capital	**Sub-component**										
Farm organisations	Indicator	8.33	4.00	0.10	1.00	0.40	0.012	0.025	1.000	0.100	0.250
Female work	Indicator	28.89	60.00	11.48	71.43	70.00	0.40	0.19	1.00	0.16	0.16
Human capital	**Sub-component**										
Education	Indicator	91.00	86.00	91.00	86.00	71.00	0.78	0.83	0.78	0.83	1.00
Agricultural education	Indicator	18.00	8.00	4.00	6.00	25.00	0.22	0.50	1.00	0.67	0.16
Financial capital	**Sub-component**										
Livestock units per capit	Indicator	0.24	0.45	0.65	0.63	0.56	1.00	0.53	0.37	0.38	0.42
Average salary	Indicator	190.48	142.86	190.48	119.05	95.24	0.50	0.67	0.50	0.80	1.00
Physical capital	**Sub-component**										
Infrastructure	Indicator	237,728	128,701	184,021	109,874	620,621	0.38	0.21	0.30	0.18	1.00
Access to market	Indicator	2,614	3,761	11,563	3,840	4,008	0.23	0.33	1.00	0.33	0.35
EXPOSURE	**Component**										
Climate hazards	**Sub-component**										
Temperature increase	Indicator	0.05	0.05	-0.10	0.60	-0.06	0.21	0.21	0.01	1.00	0.06
Ratio of rainy days to dry	Indicator	-0.10	-0.10	-0.10	-0.01	-0.10	1.00	1.00	1.00	0.10	1.00
Droughts increase	Indicator	8.00	8.00	0.10	-5.00	14.00	0.68	0.68	0.27	0.01	1.00

Table 1 (continue): Values and coefficients of vulnerability indicators for Georgia

Vulnerability category	Type of category	Values derived from figures provided by national experts					Vulnerabily coefficient				
		Gori	Kareli	Sagarejo	Dedophlists.	Gardabani	Gori	Kareli	Sagarejo	Dedophlists.	Gardabani
SENSITIVITY	**Component**										
Ecosystems	**Sub-component**										
Plant cover	Indicator	52.30	36.94	79.17	76.47	73.73	0.71	1.00	0.47	0.48	0.50
Land use	Indicator	79.38	93.66	57.06	21.36	28.28	0.27	0.23	0.37	1.00	0.76
No. of varieties	Indicator	144	144	262	262	151	1.00	1.00	0.55	0.55	0.95
Communities	**Sub-component**										
Women	Indicator	42.78	37.69	53.63	49.60	64.74	0.66	0.58	0.83	0.77	1.00
Children	Indicator	3.22	0.96	5.68	3.16	1.67	0.57	0.17	1.00	0.56	0.29
Below poverty	Indicator	15.46	17.21	3.92	5.44	21.00	0.74	0.82	0.19	0.26	1.00
Population growth	Indicator	0.96	1.07	0.96	1.00	0.98	0.89	1.00	0.89	0.93	0.91
Agriculture	**Sub-component**										
Small-scale farming	Indicator	91.67	91.67	100.00	99.00	25.00	0.92	0.92	1.00	0.99	0.25
Rural population	Indicator	65.70	76.09	85.68	68.78	85.01	0.77	0.89	1.00	0.80	0.99
Land degradation	Indicator	100.00	100.00	100.00	100.00	100.00	1.00	1.00	1.00	1.00	1.00
Production	Indicator	86.57	48.77	46.35	27.25	70.10	0.31	0.56	0.59	1.00	0.39
Crop diversification	Indicator	32.44	43.56	10.21	2.05	23.04	0.06	0.05	0.20	1.00	0.09
Irrigation	Indicator	29.08	31.24	9.77	0.43	24.20	0.01	0.01	0.04	1.00	0.02
Agric. workers	Indicator	74.10	45.03	66.60	67.00	90.00	0.82	0.50	0.74	0.74	1.00
Livestock density / ha	Indicator	0.73	1.13	0.73	0.18	0.79	0.65	1.00	0.65	0.16	0.70

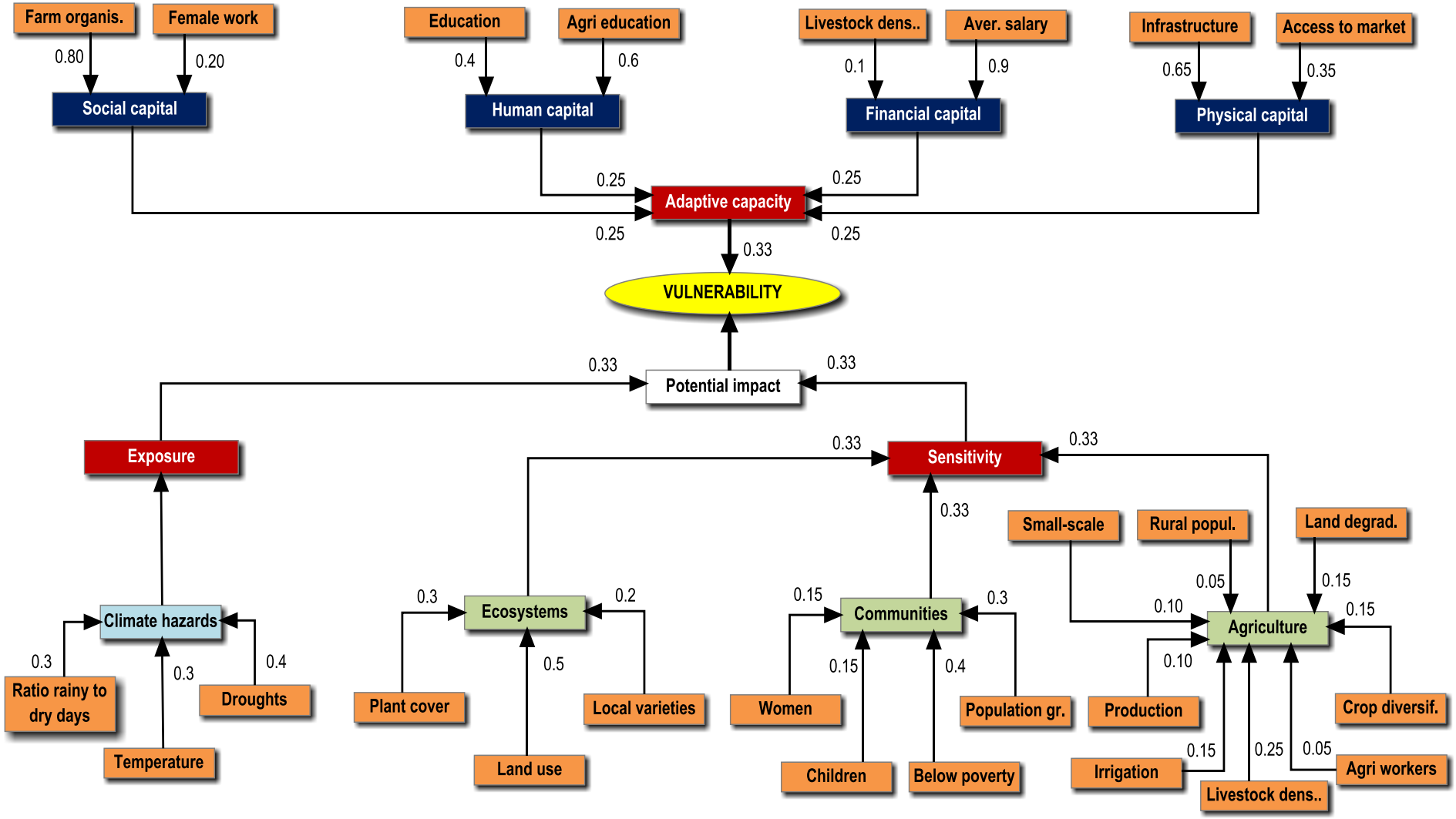


Figure 1: The aggregation of the different indicators towards the overall vulnerability with weight factors used

1.2 Assigning weight factors and determining component indices

Weight factors

The next step is to assign relative importance – a weight factor to each indicator and sub-components. Figure 1 provides an overview of the proposed weight factors. A separate report on methodology explains more in detailed how the weight factors have been determined.

Vulnerability indices

The vulnerability index of an indicator is calculated by multiplying its weight factors by its coefficient (calculated in the previous step). Table 2 shows weight factors, coefficients and indices (indexes) for vulnerability sub-components and indicators for the five proposed pilot regions in Georgia.

Table 2: Vulnerability indices for vulnerability indicators and sub-components for Georgia

		Gori		Kareli		Sagarejo		Dedophlists.		Gardabani	
	Weight	Coefficien	Index	Coefficien	Index	Coefficient	Index	Coefficient	Index	Coefficient	Index
ADAPTIVE CAPACITY											
Social capital											
Farm organisations	0.80	0.01	0.01	0.10	0.00	1.00	0.80	0.01	0.01	0.25	0.20
Female work	0.20	0.40	0.08	0.16	0.01	1.00	0.20	0.40	0.08	0.16	0.03
Subtotal	1.00		0.09		0.01		1.00		0.09		0.23
Total social capital	0.25		0.02		0.00		0.25		0.02		0.06
Human capital											
Education	0.40	0.78	0.31	0.83	0.33	0.78	0.31	0.83	0.33	1.00	0.40
Agricultural education	0.60	0.22	0.13	0.50	0.30	1.00	0.60	0.67	0.40	0.16	0.10
Subtotal	1.00		0.45		0.63		0.91		0.73		0.50
Total human capital	0.25		0.11		0.16		0.23		0.18		0.12
Financial capital											
Livestock units per capit	0.10	1.00	0.10	0.53	0.05	0.37	0.04	0.38	0.04	0.42	0.04
Average salary	0.90	0.50	0.45	0.67	0.60	0.50	0.45	0.80	0.72	1.00	0.90
Subtotal	1.00		0.55		0.65		0.49		0.76		0.94
Total financial capital	0.25		0.14		0.16		0.12		0.19		0.24
Physical capital											
Infrastructure	0.65	0.38	0.25	0.21	0.13	0.30	0.19	0.18	0.12	1.00	0.65
Access to market	0.35	0.23	0.08	0.33	0.11	1.00	0.35	0.33	0.12	0.35	0.12
Subtotal	1.00		0.33		0.25		0.54		0.23		0.77
Total physical capital	0.25		0.08		0.06		0.14		0.06		0.19
ADAPTIVE CAPACITY			**0.35**		**0.39**		**0.74**		**0.45**		**0.61**

Table 2: Vulnerability indices for vulnerability indicators and sub-components for Georgia (continue)

		Gori		Kareli		Sagarejo		Dedophlists.		Gardabani	
	Weigh	Coefficien	Index	Coefficien	Index	Coefficient	Index	Coefficient	Index	Coefficient	Index
EXPOSURE											
Climate hazards											
Temperature increase	0.30	0.21	0.06	0.21	0.06	0.01	0.00	1.00	0.30	0.06	0.02
Ratio of rainy to dry days	0.30	1.00	0.30	1.00	0.30	1.00	0.30	0.10	0.03	1.00	0.30
Droughts increase	0.40	0.68	0.27	0.68	0.27	0.27	0.11	0.01	0.00	1.00	0.40
Subtotal	1.00		0.64		0.64		0.41		0.33		0.72
Total exposure	1.00		0.64		0.64		0.41		0.33		0.72
EXPOSURE			**0.64**		**0.64**		**0.41**		**0.33**		**0.72**

		Gori		Kareli		Sagarejo		Dedophlists.		Gardabani	
	Weigh	Coefficien	Index	Coefficien	Index	Coefficient	Index	Coefficient	Index	Coefficient	Index
SENSITIVITY											
Ecosystems											
Plant cover	0.30	0.71	0.21	1.00	0.30	0.47	0.14	0.48	0.14	0.50	0.15
Land use	0.50	0.27	0.13	0.23	0.11	0.37	0.19	1.00	0.50	0.76	0.38
No. of local varieties	0.20	1.00	0.20	1.00	0.20	0.55	0.11	0.55	0.11	0.95	0.19
Subtotal	1.00		0.55		0.61		0.44		0.75		0.72
Total ecosystems	0.33		0.18		0.20		0.14		0.25		0.24
Communities											
Women	0.15	0.66	0.10	0.58	0.09	0.83	0.12	0.77	0.11	1.00	0.15
Children	0.15	0.57	0.08	0.17	0.03	1.00	0.15	0.56	0.08	0.29	0.04
Below poverty	0.40	0.74	0.29	0.82	0.33	0.19	0.07	0.26	0.10	1.00	0.40
Population growth	0.30	0.89	0.27	1.00	0.30	0.89	0.27	0.93	0.28	0.91	0.27
Subtotal	1.00		0.75		0.74		0.62		0.58		0.87
Total communities	0.33		0.25		0.24		0.20		0.19		0.29
Agriculture											
Small-scale farming	0.10	0.92	0.09	0.92	0.09	1.00	0.10	0.99	0.10	0.25	0.03
Rural population	0.05	0.77	0.04	0.89	0.04	1.00	0.05	0.80	0.04	0.99	0.05
Land degradation	0.15	1.00	0.15	1.00	0.15	1.00	0.15	1.00	0.15	1.00	0.15
Production	0.10	0.31	0.03	0.56	0.06	0.59	0.06	1.00	0.10	0.39	0.04
Crop diversification	0.15	0.06	0.01	0.05	0.01	0.20	0.03	1.00	0.15	0.09	0.01
Irrigation	0.15	0.01	0.00	0.01	0.00	0.04	0.01	1.00	0.15	0.02	0.00
Agric. workers	0.05	0.82	0.04	0.50	0.03	0.74	0.04	0.74	0.04	1.00	0.05
Livestock density / ha	0.25	0.65	0.16	1.00	0.25	0.65	0.16	0.16	0.04	0.70	0.18
Subtotal	1.00		0.53		0.63		0.60		0.77		0.51
Total agriculture	0.33		0.17		0.21		0.20		0.25		0.17
SENSITIVITY			**0.60**		**0.65**		**0.54**		**0.69**		**0.69**

1.3 Calculating the overall vulnerability index

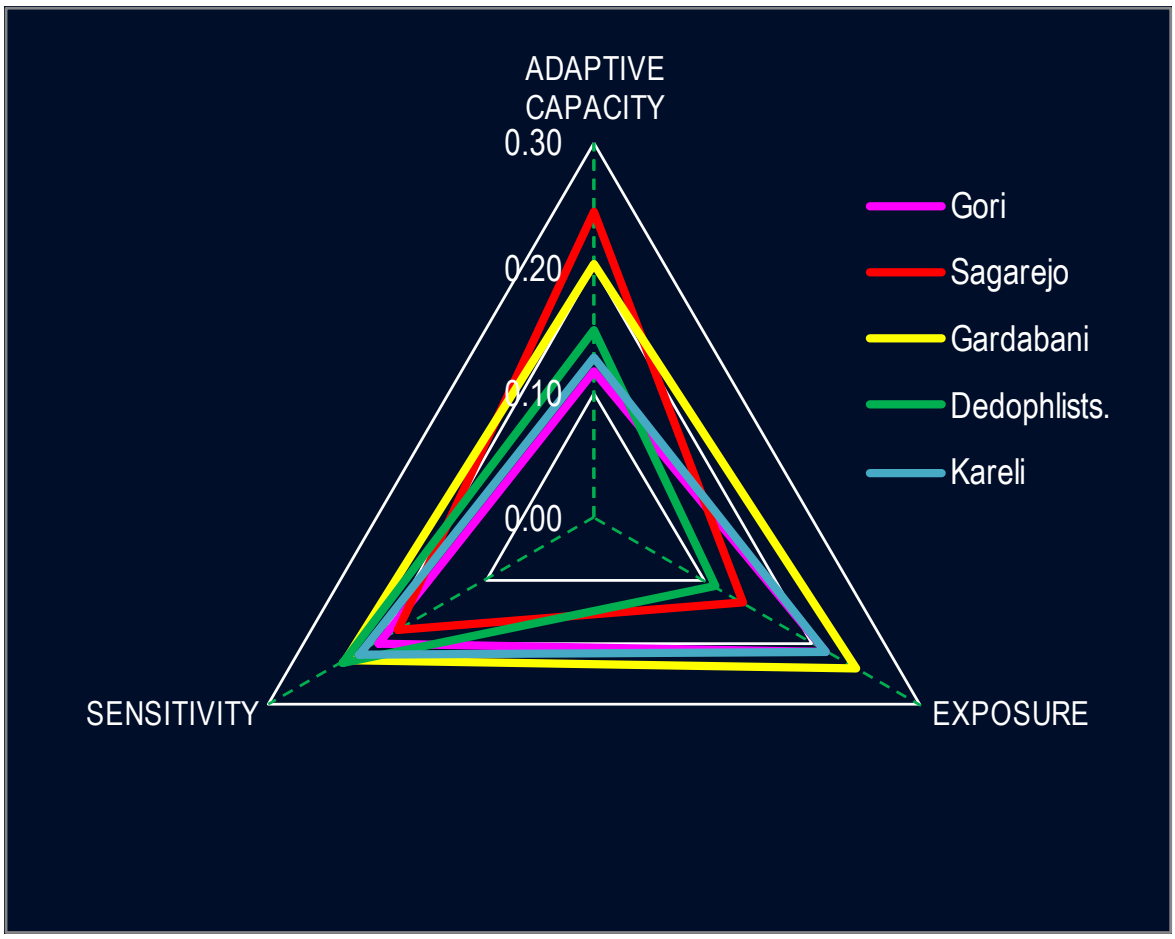
The overall vulnerability index

The overall vulnerability index is made by multiplying vulnerability component indices with their assigned weight factors. The three components are assigned an equal weighting (0.33 each), as shown in Table 3.

Table 3: Component and the overall vulnerability indices for the five proposed pilot regions in Georgia.

	Gori			Kareli			Sagarejo			Dedophlists.			Gardabani		
Vulnerability component	Vulner. Index	Weigh t	Weighted Index	Vulner. Index	Weigh t	Weighted Index	Vulner. Index	Weigh t	Weighted Index	Vulner. Index	Weigh t	Weighted Index	Vulner. Index	Weight	Weighted Index
ADAPTIVE CAPACITY	0.35	0.33	0.12	0.39	0.33	0.13	0.74	0.33	0.25	0.45	0.33	0.15	0.61	0.33	0.20
EXPOSURE	0.64	0.33	0.21	0.64	0.33	0.21	0.41	0.33	0.14	0.33	0.33	0.11	0.72	0.33	0.24
SENSITIVITY	0.60	0.33	0.20	0.65	0.33	0.22	0.54	0.33	0.18	0.69	0.33	0.23	0.69	0.33	0.23
VULNERABILITY INDEX			**0.53**			**0.56**			**0.56**			**0.49**			**0.67**
MOST VULNERABLE			4			2/3			2/3			5			1

The vulnerability indices of the three vulnerability components can be presented graphically for each region:



1.4 Ranking vulnerability indices of the proposed pilot regions

Ranking regions

The proposed pilot regions are ranked according to their overall vulnerability indices. The region with the highest overall vulnerability index is the most vulnerable from the climate change point of view. The least vulnerable region is the one with the lowest overall vulnerability index.

Gardabani is the most vulnerable region

In case of Georgia, with the overall vulnerability index of 0.67 Gardabani is the most vulnerable region (Table 3). Kareli and Sagarejo have both 0.56 points and share second and third place in terms of most vulnerable regions. They are followed by Gori which has 0.53 points. With a vulnerability index of 0.49, Dedophlistskaro seems to be the least vulnerable of all five regions considered.

2. CALCULATION OF INDICATOR VALUES

2.1 Adaptive capacity of communities to climate change

2.1.1 Social capital

Social capital is determined suing two indicators: farm organisations and female work participation.

Farm organisations

The number if collective agricultural ventures (= co-operatives, joint ventures, partnerships, share-holding companies, etc.) are taken as a proxy for private social networks. We assume that in case/time of severe climate hazards, the potential for adaptation is higher by a group, rather than an individual. The coefficient is obtained by dividing the number of co-operatives, joint ventures, partnerships and share-holding companies by the total number of farms. Region with the lowest share of organised farm operations in the total number of farms is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Female work participation

Female work participation is an indicator of the level of development of society. We take the percentage of the employed women in the pilot regions (incl. those employed in (semi)-subsistence agriculture). Region with the lowest percentage of female work participation is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

2.1.2 Human capital

We use two indicators to determine human capital: education level and agricultural education.

Education level

It is worth to notice that in case education level (= secondary school, college and university graduates) of the five regions in Georgia there is not much difference. For this reason and hoping to get more distinction between the regions, primary school is not included in the calculation. Only the summed up percentages of finished secondary school, colleges and universities are used to determine the value of the education level. Region with the lowest value for the education level is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Formal agricultural education

Figures on formal agricultural education (= secondary agricultural school or university) are taken from the Excel files provided by national experts. Region with the lowest formal agricultural education is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

2.1.3 Financial capital

Financial capital is assessed by livestock and average salary:

Livestock units per capita

Livestock is an asset for a family as it provides inputs in various forms (transportation, means of work in agriculture, manure, milk, etc.). In case of disasters or any impact on agriculture, livestock can serve as means of coping mechanism. It can be a source of alternative or additional income for the farmers. Thus, more livestock would indicate higher adaptive capacity. Livestock capital is expressed as the number of livestock units per capita. Excel data on livestock (= number of cattle,

sheep, goats, pigs and poultry) are automatically converted in Excel into so called Livestock Units. The indicator on Livestock units per capita is obtained by dividing Livestock Units by the number of inhabitants. Region with the lowest livestock density is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Average salary

Average salary: regions with higher average salary are assumed to be wealthier and therefore better able to prepare for and respond to adversity. Calculation of values for average salary is explained in Chapter 1.1.

2.1.4 Physical capital

Physical capital is assessed by giving rating to infrastructure development and access to market.

Infrastructure

Infrastructure is calculated in the following way: number of inhabitants is divided by the number of preliminary, primary and secondary schools, as well as the number of colleges & universities, hospitals and Internet connections. This tells us how many inhabitants we have per one school, college, university; hospital and Internet connections. The sum of these numbers makes the infrastructure value. Region with the highest value (= number of inhabitants per one school, hospital, etc.) is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Access to market

Access to market is calculated by summing up values for the farmers' markets and asphalt roads. Farmers' markets value is assessed by:

1. Calculating the number of people living in rural areas (=number of inhabitants multiplied by the percentage of rural population)
2. Dividing above figure with the number of reported farmers' markets.

Asphalt roads are calculated by dividing the area of the region ('000 km^2) with the total number of asphalt road kilometres. Region with the highest access to market value (= number of rural inhabitants per one farmers' market and km of asphalt roads) is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

2.2 Exposure of communities to climate–hazards

In our methodology, systems' exposure to variable/changing climate is defined by the change of temperature, rainfall and occurrence of droughts.

Change in temperature

Change in temperature is expressed as the difference between average annual temperatures of two different periods. Because the availability of historical meteorological data of five regions differs, the two reference periods were determined for each region individually as follows:

		Meteo data available	
Meto station	Municipality	1st period	2nd period
Eldari	Dedophlistskaro	1950-1968	1969-1986
Udabno	Sagarejo	1955-1973	1974-1992
Gardabani	Gardabani	1957-1981	1982-2006
Gori	Gori	1957-1981	1982-2006
Gori	Kareli	1957-1981	1982-2006

The data are taken from the Excel files provided by the national climate expert. Region with the highest change in temperature is considered to be most vulnerable and is assigned factor 1.00.

Ratio of dry to rainy days during vegetation

According to the opinion of Georgian experts, from the perspective of impact of aridization on agriculture, the change in annual rainfall, which was originally proposed to be used as an indicator, is not the most suitable indicator showing the situation with rainfall. Instead it was decided to use another indicator: a ratio of dry to rainy days. It is obtained by dividing the number of dry days (= days with < 0.1 mm rainfall) by rainy days (= days with > 0.1 mm rainfall) during vegetation for the first and the second period. The length of vegetation is crop-and region dependent. Generally, it is determined as a period (days) with the average temperature above 5 degree C. This data is provided by national experts. It is calculated in the same manner as above for temperature. Region with the lowest ratio of dry to rainy days is considered to be most vulnerable and is assigned factor 1.00.

Droughts

Droughts are ideally calculated from the figures on Aridity Index (more about it can be found in the separate report on methodology and the subsequent E-mails on evapotranspiration formulas). However, in case of Georgia precise data on the number of droughts were available for each meteorological station and their respective first and second periods. So we have used this data to calculate the difference between the number of droughts in the second and first period (= sum of the number of droughts in the second period minus that in the first period). Region with the highest value is considered to be most vulnerable and is assigned factor 1.00.

2.3 Sensitivity to climate–hazard exposures

2.3.1 Ecosystems sensitivity to climate–hazard exposures

Plant cover

Plant cover value is calculated as the percentage of permanent grassland (= meadows and pastures) in the total agricultural area. The data are taken from the Excel files provided by national experts. Region with the lowest percentage is considered to be most vulnerable and is assigned factor 1.00.

Land cover status

Land cover value is assumed to be the ratio between forest and agricultural land. It is calculated by dividing the number of hectares under forest with the number of hectares under agricultural land and multiplying this value with hundred. Region with the lowest value is considered to be most vulnerable and is assigned factor 1.00.

No. of local varieties

Originally, it was assumed that an indicator would be the number of threatened butterfly, vertebrate and flowering species of a region. However, in the absence of these data, the number of local varieties is used instead. The data are taken from the Excel files provided by national experts. Region with the lowest number of local varieties is considered to be most vulnerable and is assigned factor 1.00.

2.3.2 Local community sensitivity to climate–hazard exposures

Women

Climate variability is likely to have disproportionate impacts on females as compared to males. Greater reliance of women on natural resource dependent activities such as agriculture is a common feature in many countries. Changes in natural resources due to changes in the climate are more likely to affect women through various direct and indirect means such as water and fuel wood availability. The data on the percentage of women in the total population are taken from the Excel files provided by national experts. Region with the highest percentage is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Children

Children are likely to be more vulnerable to natural disasters and extreme climate change events. The percentage of children between 0 and 7 years old are calculated by dividing their number by the number of total inhabitants. Region with the highest percentage is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Below poverty line households

The data on below poverty line households in the pilot areas are calculated by multiplying the number below poverty line households with four (we assume that they have four family members in average, except for Gardabani where five family members are taken as an average). This is further divided by the number of total inhabitants and multiplied by hundred. Region with the highest value is considered to be most vulnerable and is assigned factor 1.00.

Population growth

Population growth is a stress on the resources. A rapid expansion in population indicates the rising pressure on natural resources and a high vulnerability. The data on the population growth are taken from the Excel files provided by national experts. It was measured as the ratio of population in 2001 vs. the population in 2011. Region with the highest percentage of growth is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

2.3.3 Agriculture

Percent small-scale farms

Small-scale farmers, generally subsistence farmers, are more sensitive to climate change and variability because they have less capital-intensive technologies and management practices. Estimated number of subsistence farms is divided by the total number of farms and multiplied by hundred. This gives us percentage of small-scale farms. Region with the highest percentage is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Rural population

The data on the percentage of rural population in the total population are taken from the Excel files provided by national experts. Region with the highest percentage is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Land degradation

Land degradation is calculated as the number of hectares of degraded land – comprising land:

- With less than 2% soil organic matter
- With pH value less than 5
- Classified as "saline"
- Pasture classified as overgrazed
- Classified as prone to medium to severe erosion
- With >33% surface overgrown with shrubs/bushes
- With >10% surface overgrown with alien species

The area of the above hectares is summed up and divided by the total area of the region. Unfortunately, in case of the five regions in Georgia, there were no reliable data on land degradation. Consequently, in all five regions the population growth is assumed to be the same and all five were assigned factor 1.00.

Agricultural production

Changes in agricultural production are calculated using historical data on agricultural production in the pilot regions, provided by national experts. Both crop and livestock production is taken into account. Production for the respective periods has been expressed in terms of cereal units. One cereal unit is a natural measure allowing comparison of different agricultural produce. It allows comparing not only “apples” and “pears” but also crop and livestock produce. One cereal unit (CU) is equal to nutritional value of 100 kg barley and its specific protein and starch content. Cereal units of other crop products are based on their nutritional equivalent against barley. Sugar beet for instance contains 0.27 CU, oats 0.85 CU, soyabeans 2.6 CU, etc. Cereal units of livestock products are determined as the equivalent of crop cereal units that are (hypothetically) required to produce 100 kg livestock produce (meat, milk, eggs, and wool). Agricultural productivity is assessed by multiplying data on the tonnes of crop and livestock produce with the relevant CU factors for those produce. The CU factors are taken from the German Federal Ministry of Agriculture[1]. The final value is expressed in thousand CUs. Region with the lowest value is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

[1] Statistik und Berichte des Bundesministerium für Ernährung, Landwirtschaft http://www.bmelv-statistik.de/de/statistisches-jahrbuch/kap-c-landwirtschaft/

Crop diversification

An agricultural region with more diversified crops will be less sensitive to climatic variations than for instance a region predominantly growing 1-2 crops only. Crop diversification value is calculated by deducting from 100 percent agricultural area, percentage of area under cereals and permanent grassland. Region with the lowest percentage of diversified crops is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Irrigated area

Percentage of irrigated area out of the total agricultural area cultivated area gives an indication of the dependence on rainfall as well as utilization of surface and groundwater. Data on the number of irrigated hectares of agricultural land were provided by national experts. Region with the lowest percentage under irrigated area is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.

Agricultural labour

The ratio of agricultural workers to the rest of the working population is an important indicator. This is used in order to check if there is a significantly large population having high dependence on agriculture for livelihoods, which is a climate sensitive sector. The percentage of agricultural workers is calculated by dividing the number of agricultural workers with the total number of employed and multiplying it by hundred. Region with the highest percentage of agricultural workers is considered to be most vulnerable and is assigned factor 1.00.

Livestock density per hectare

One of the main threats to pastureland in arid and semi-arid areas is overgrazing. Consequently, regions with high livestock density are likely to have more degraded pastureland and thus be more sensitive to climate–hazard exposures. In order to calculate this indicator, Excel data on livestock (= number of cattle, sheep, goats, pigs and poultry) are automatically converted in Excel into so called Livestock Units. Livestock density is obtained by dividing Livestock Units by the number of hectares of agricultural land. Region with the highest livestock density (= highest number of Livestock Units per ha) is considered to be most vulnerable and is assigned vulnerability coefficient 1.00.