

Agricultural Risk Model for Water Scarcity

Klaus Wagner

Landscape structures, functions and management:
response to global ecological change
International Conference on Landscape Ecology,
IALE 2010, Brno CZ

Federal Institute of Agricultural Economics
Marxergasse 2, 1030 Vienna, Austria
+43 1 8773651 7428
Klaus.wagner@awi.bmlfuw.gv.at



Brno 2010_09_05, 1



- Alp Water Scare Project
- Subproject Agriculture
 - Method and project procedure
 - Indicator development
 - Pilot regions application
 - Further steps

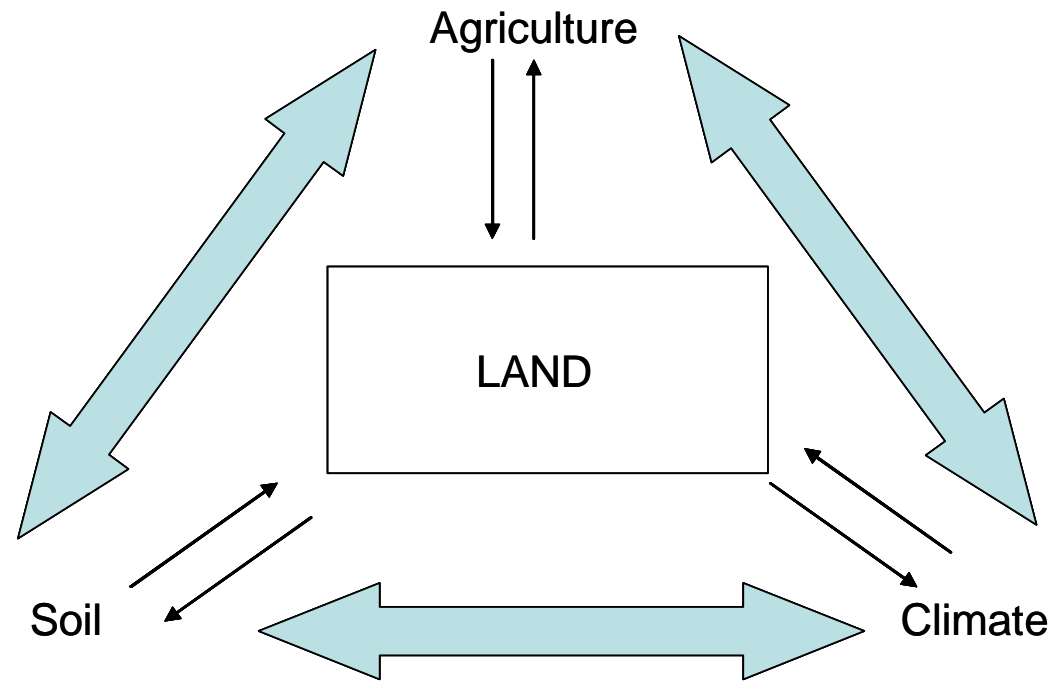
EU Alpine Space project Alp Water Scarce:

- Coordination: Mountain Institute, University Savoy, France
- Topic: Water Managements Strategies against water scarcity under climate change conditions in the alps
- long term monitoring and modelling of water recharge, early warning system for scarcity and imbalance
- 25 pilot regions (A, CH, F, I, SI) 2008 – 2011
- www.alpwaterscarce.eu

Objectives of the agricultural subproject:

- Role of agriculture in an integrated water management system
- Strengthen awareness of water consumption in agriculture (not only irrigation) in changing climate scenarios
- Possibilities for adapted land use
- Interim results: risk model for water scarcity in agriculture

Interrelations



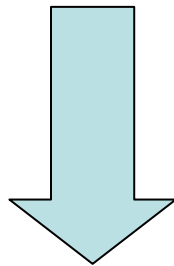
Interrelations, interdependencies, interactions among agriculture, soil, climate conditions

Examples of climate change impacts on agriculture:

- Quantity and quality of crops
 - Heat stress
 - Infestation by pests
 - Vegetation period
 - Degradation of land
 - Availability of nutrients
- Different vulnerabilities of crops

Adapted Ecological Risk analysis:

- Intensity of the Impact (agricultural land use, water consumption)
- Impact sensitivity (natural conditions)
- Impact Risk (climate change also change in agriculture)



- Risk assessment model,
- application in selected pilot regions

Water consumption in agriculture:

- Plant cultivation (classification in 5 classes following FAO Crop Coefficient)
- Irrigation (Plant and regional specific irrigation amounts)

Plant category	Examples of cultivated crops	Water demand	Classification and weight
Spring grain, Grapes Sunflowers	Springwheat, Springrye, Springbarley, Springoats, Millet, Sorghum, Sunflower, Pumpkin, Grapes,	very low	1
Legumes, Maize, Roots, Tubers	Fababean, Soybean, Peas, Maize, Sugarbeets Potatoes	low	2
Winter grain	Wheat, Barley;Oats, Triticale	middle	3
Fruit trees, Berries, Rapeseed	Apples, Cherries, Pears, Apricots, Peaches, Rapeseed, Berries	high	4
Pastures	Rotated pastures, Low input grassland, Meadows	very high	5

Water consumption in agriculture:

- Animal husbandry (guideline values of specific water demand per livestock unit per year)

Livestock category	Water demand (drinking and processing water per stableplace per year in m ³)	Livestock Unit (LU) per animal per year (Lebensministerium 2008b)	Water demand per LU per year in m ³	Classification and weight ¹
Rearing and fattening calf (page 538)	4,4	0,4	11,0	low (1)
Fattening cattle (page 574)	11,5	1	11,5	low (1)
Pigs (20-50kg, Umweltbundesamt 2003)	1,8	0,15	12,0	low (1)
Rearing cattle (page 551)	12,1	1	12,1	low (1)
Fattening pig (page 608)	2,36	0,15	15,7	low (1)
Horses (Umweltbundesamt 2003)	21,6	1	21,6	middle (3)
Laying hen (page 656)	0,09	0,004	22,5	middle (3)
Sheep, goat (Umweltbundesamt 2003)	3,6	0,15	24,0	middle (3)
Breeding sow (page 621)	7,6	0,3	25,3	middle (3)
Suckler cow (page 591)	25,5	1	25,5	middle (3)
Dairy cattle (page 520)	28,5	1	28,5	middle (3)
Fattening chicken (page 671)	0,05	0,0015	33,3	high (5)
Piglet (<20kg, Umweltbundesamt 2003)	0,72	0,02	36,0	high (5)
Fattening turkey (page 686)	0,26	0,007	37,1	high (5)

Soil:

- Capacity of available water in soils (as estimation from soil type, slope, depth...)

Capacity of available water in mm	Risk Classification and weight
<60	very high (5)
60 - 140	high (4)
140 - 220	Middle (3)
220 - 300	Low (2)
>300	very low (1)

Climate:

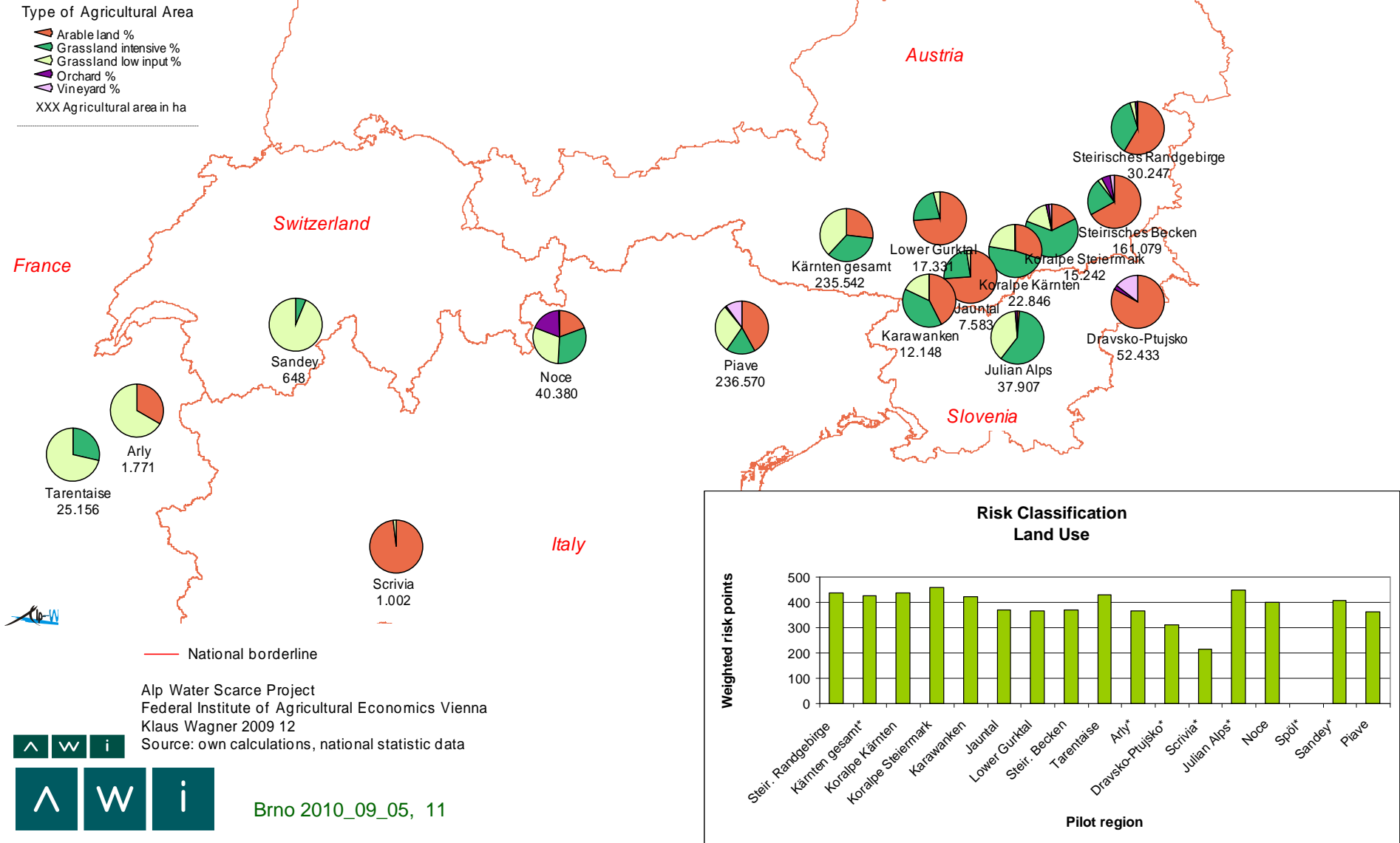
- Aridity index as relation of temperature and precipitation for the current situation
- Climate change scenarios from IPCC, regional adaptations

$$A_m = 3T_m / P_m$$

A = Aridity index
T = Average temperature
P = Precipitation
m= monthly

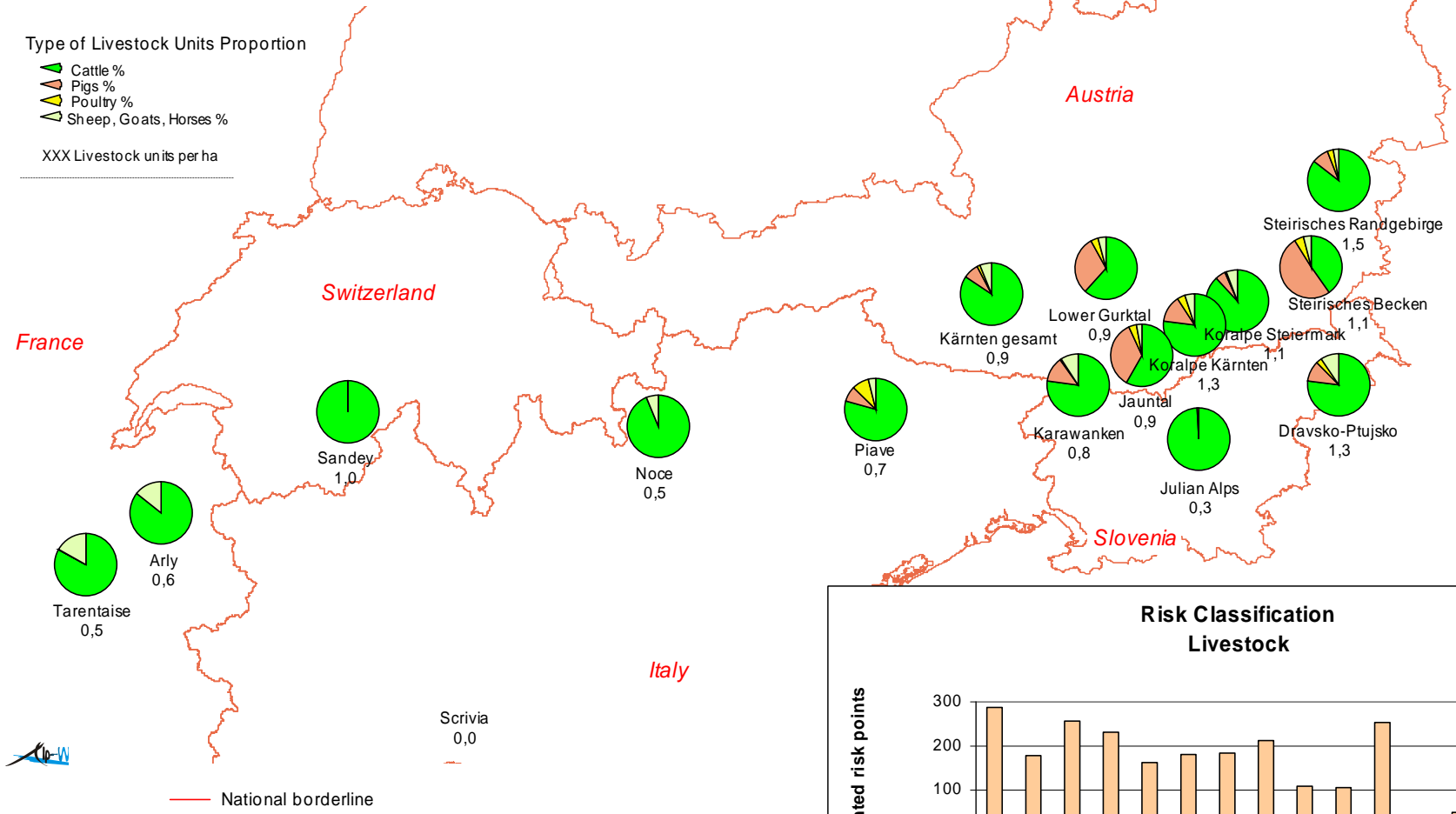
Pilot regions - Land Use

Agricultural Risk Analysis for Water Scarcity Pilot regions - overview



Pilot regions - Animal husbandry

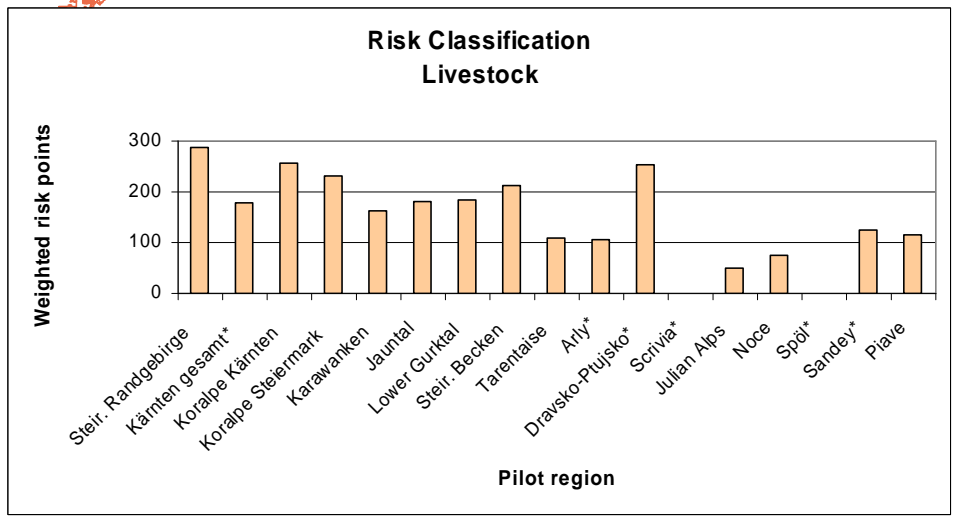
Agricultural Risk Analysis for Water Scarcity Pilot regions - overview



Alp Water Scarce Project
Federal Institute of Agricultural Economics Vienna
Klaus Wagner 2009 12
Source: own calculations, national statistic data



Brno 2010_09_05, 12

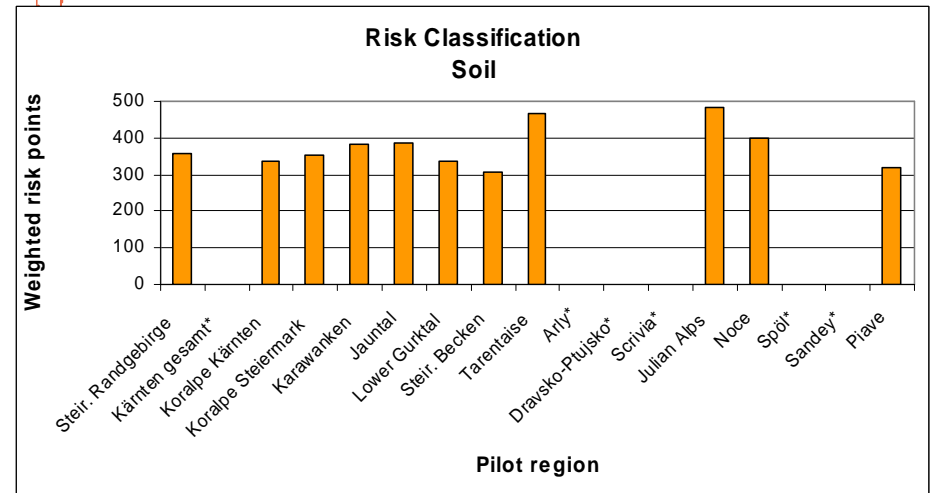
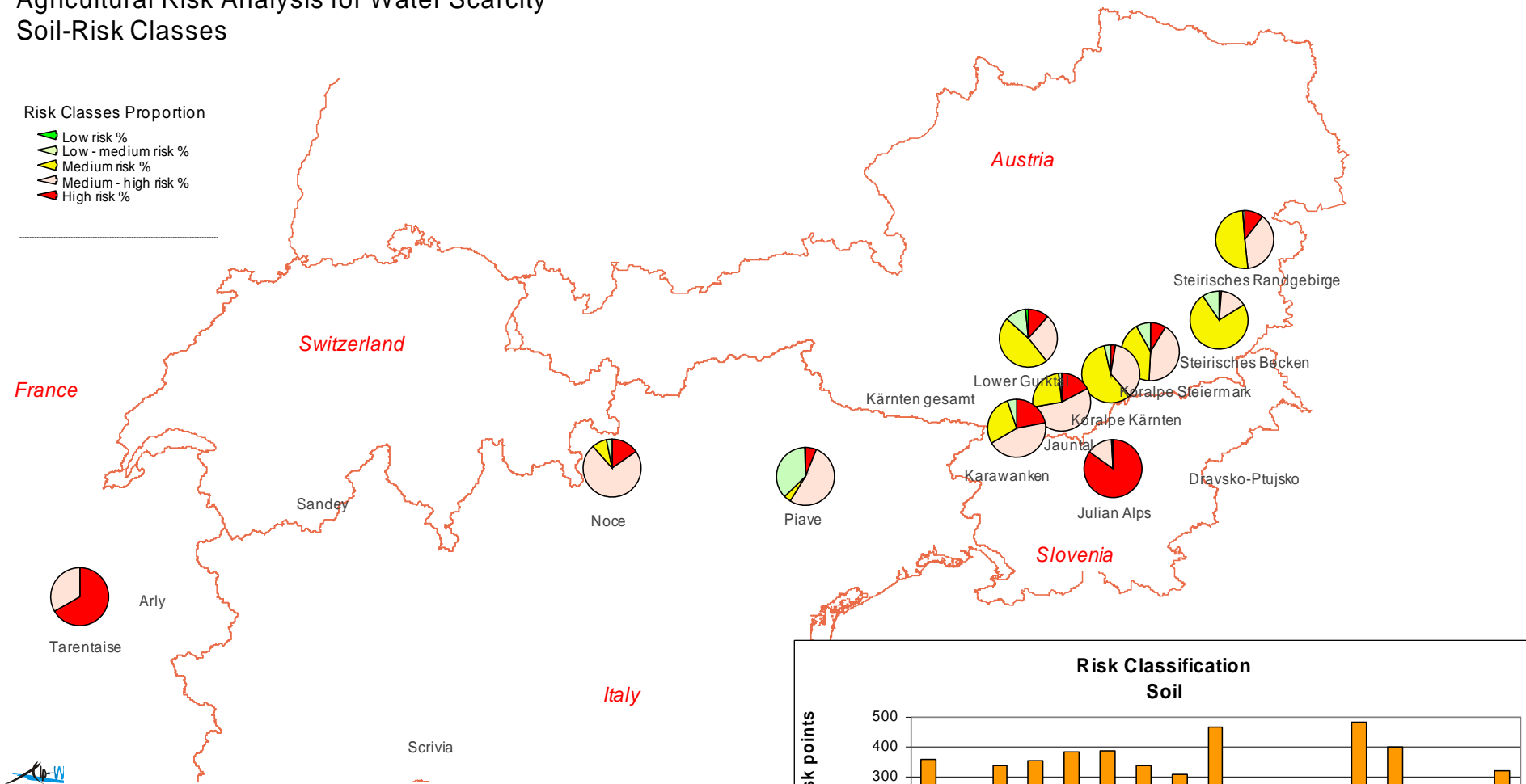


Pilot regions - Soil

Agricultural Risk Analysis for Water Scarcity Soil-Risk Classes

Risk Classes Proportion

- ▲ Low risk %
- ▲ Low - medium risk %
- ▲ Medium risk %
- ▲ Medium - high risk %
- ▲ High risk %



Alp Water Scarce Project
Federal Institute of Agricultural Economics Vienna
Klaus Wagner 2009 12
Source: own calculations, national statistic data

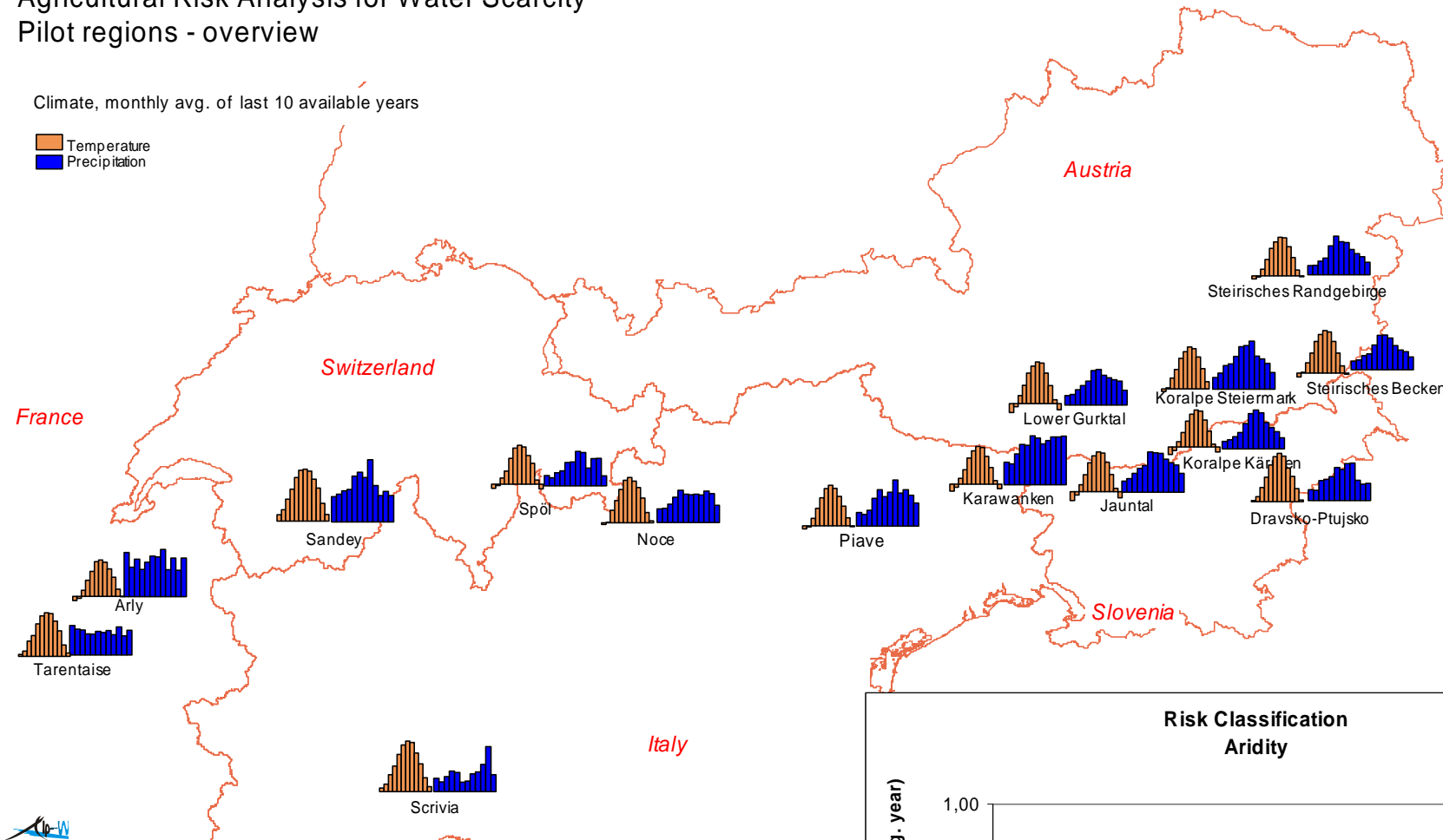


Pilot regions - Climate

Agricultural Risk Analysis for Water Scarcity Pilot regions - overview

Climate, monthly avg. of last 10 available years

Temperature
Precipitation

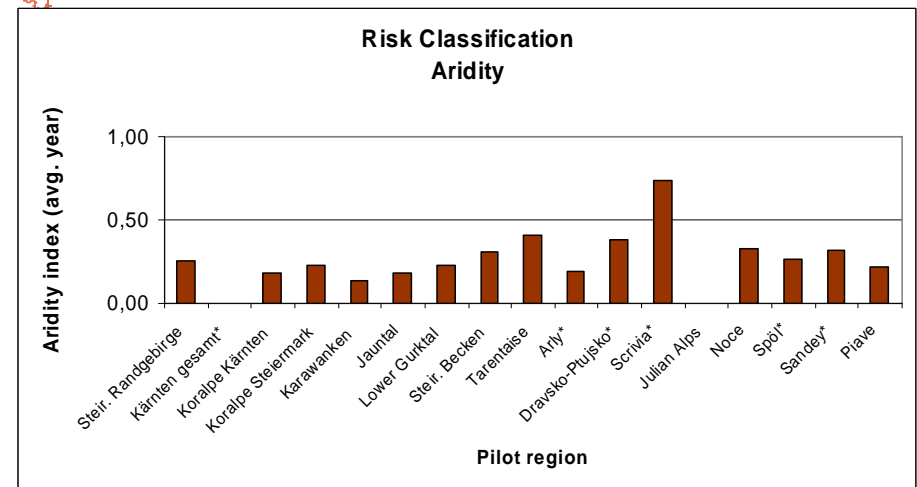


National borderline

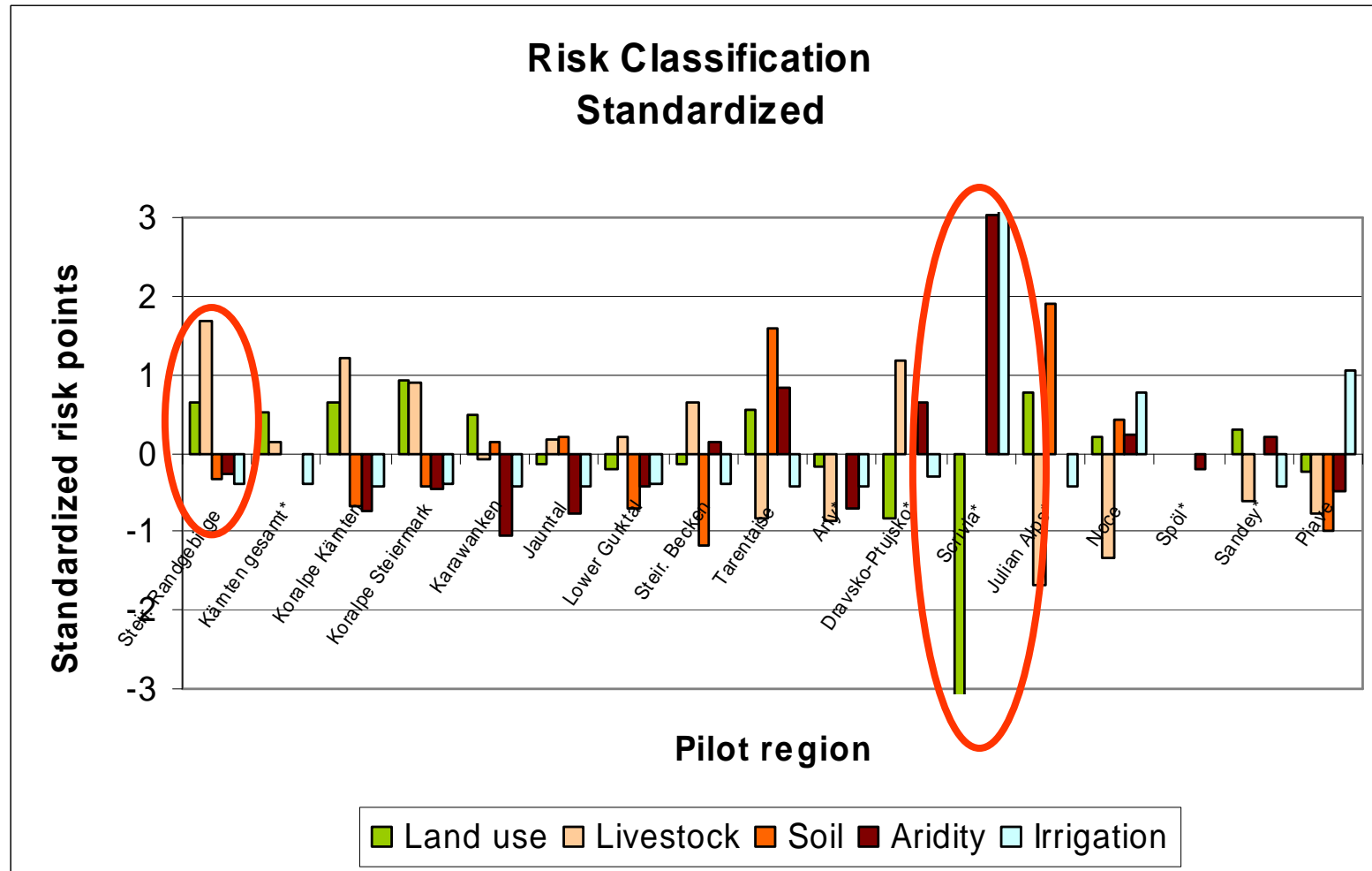
Alp Water Scarce Project
Federal Institute of Agricultural Economics Vienna
Klaus Wagner 2009 12
Source: own calculations, national statistic data



Brno 2010_09_05, 14



Pilot regions - Comprised risk

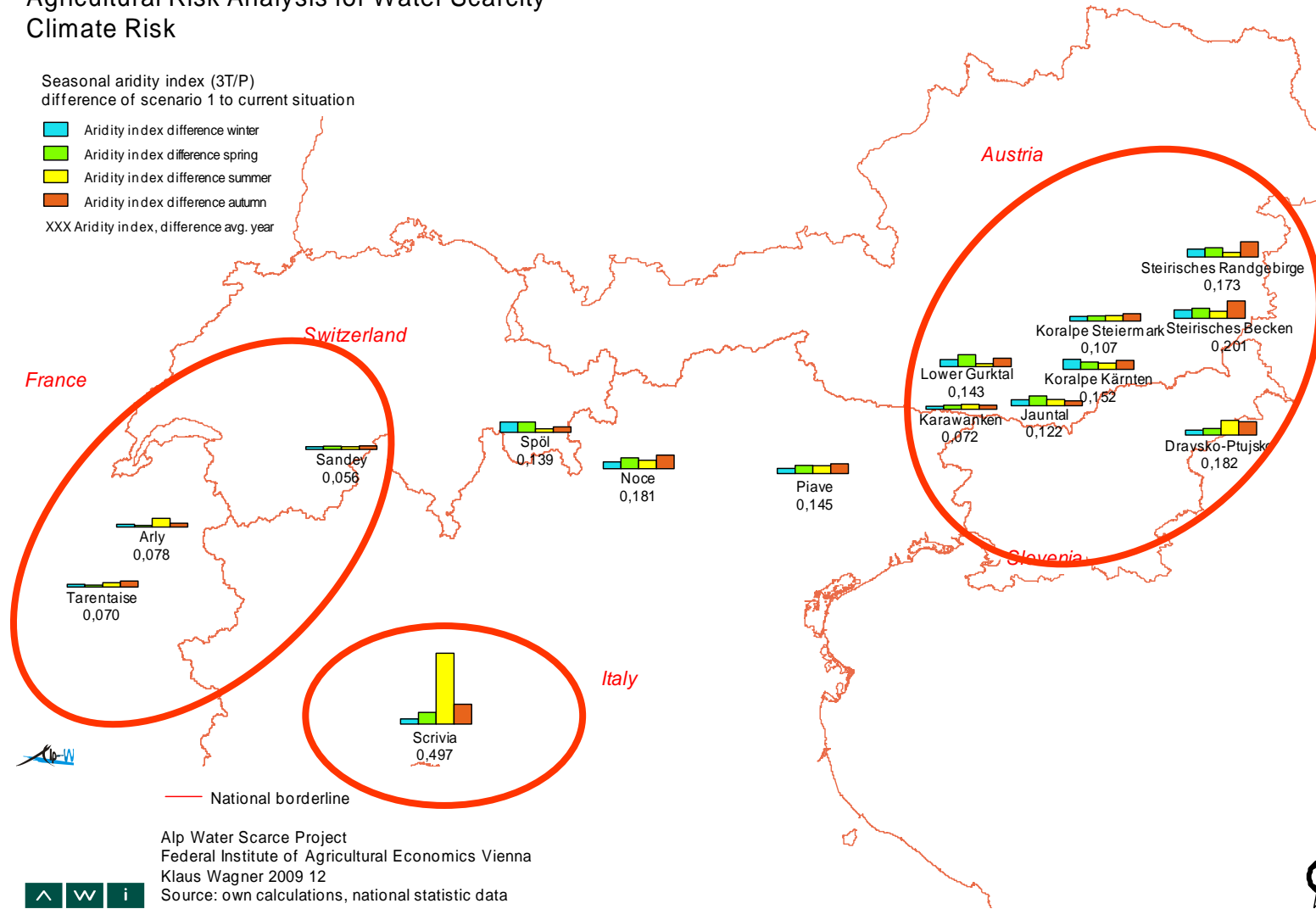


Pilot regions - Climate Change (Aridity) 2050

Agricultural Risk Analysis for Water Scarcity Climate Risk

Seasonal aridity index (3T/P)
difference of scenario 1 to current situation

- Aridity in dex difference winter
- Aridity in dex difference spring
- Aridity in dex difference summer
- Aridity in dex difference autumn
- XXX Aridity in dex, difference avg. year



National borderline

Alp Water Scarce Project
Federal Institute of Agricultural Economics Vienna
Klaus Wagner 2009 12
Source: own calculations, national statistic data



- Integration of climate change and agricultural scenarios in risk patterns (agreed with other project partners)
- Evaluation of agricultural policy measures concerning water consumption
- Potential strategy adaptation and implementation options of measures, economic concerns for agriculture