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Federal Department
of Economic Affairs DEA
Agroscope Reckenholz-Tänikon
Research Station ART

Doctorate at D-UWIS Environmental Sciences, ETHZ

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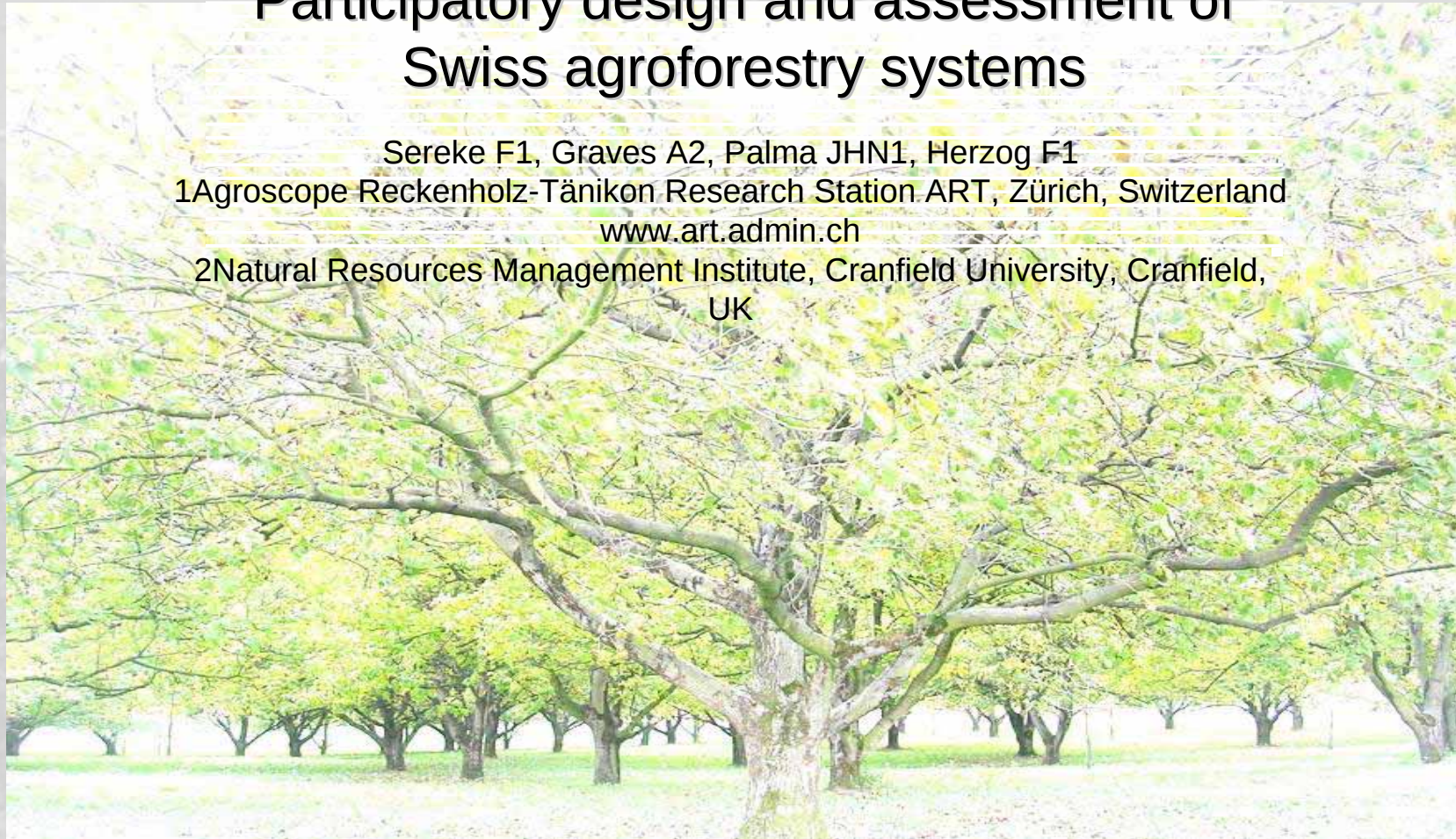
Participatory design and assessment of Swiss agroforestry systems

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Background

Multipurpose land use systems where widespread
in Swiss agricultural landscapes...



Waldweide

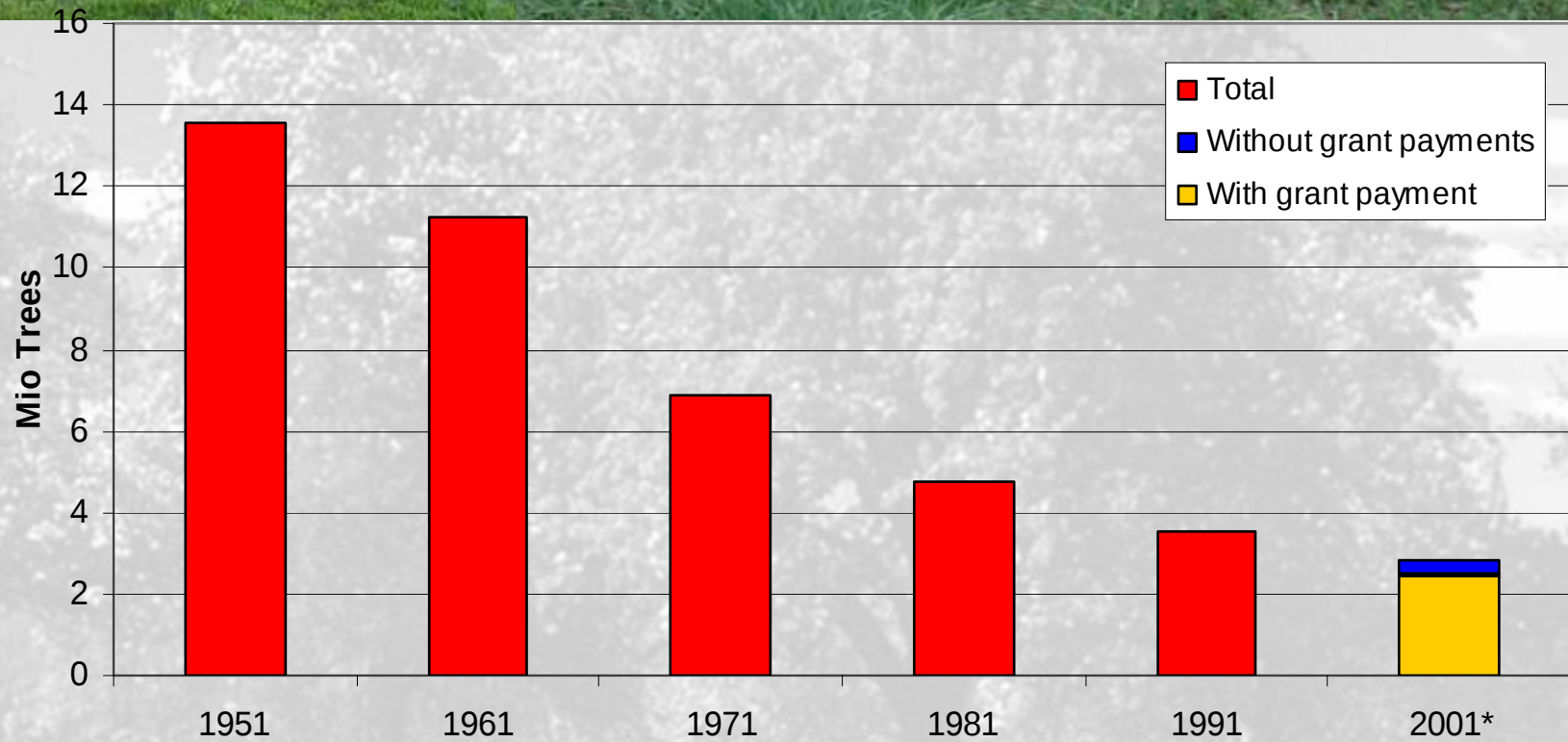


Waldweide



Today





N° of high-stem fruit trees 1951 - 2001, in Swiss agricultural landscapes

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Objectives

PhD title:

**Perspectives for integrating trees into Swiss agricultural landscapes
(Part of the “BAUMGÄRTEN” project)**

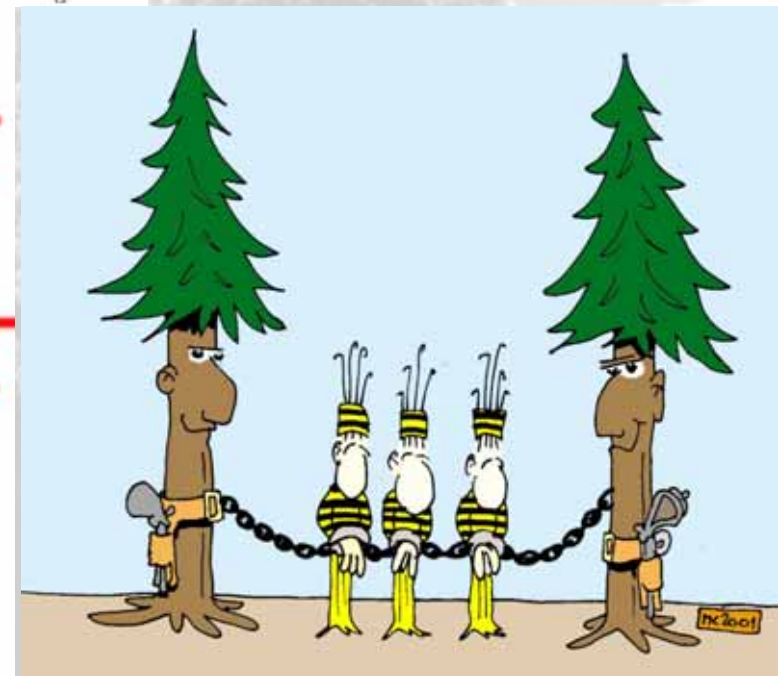
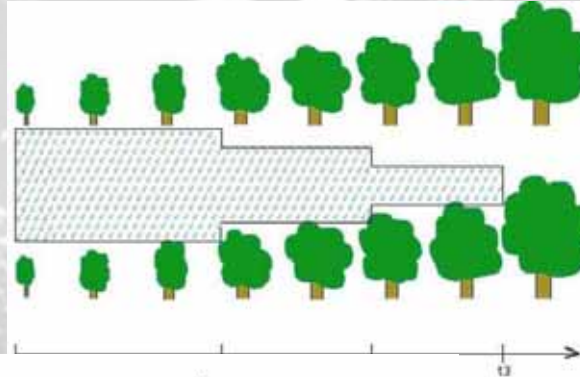
The main objectives of the PhD project are to:

- 1. Identify and design viable **Agroforestry systems (AFS)** for Swiss agricultural landscapes**
- 2. Assessment of productivity and profitability of the AFS**
3. Identify and assess the driving forces for planting trees, in close cooperation with local stakeholders and experts.

The Agroforestry system

AFS in Switzerland

- Silvoarable AFS
- Silvopastoral AFS



venezobres,
France)

The Agroforestry system



Silvopastoral Agroforestry



Many options...



Chestnut + Animals



Sheeps



+ Apiculture

+
Christmas Trees



Ostriches



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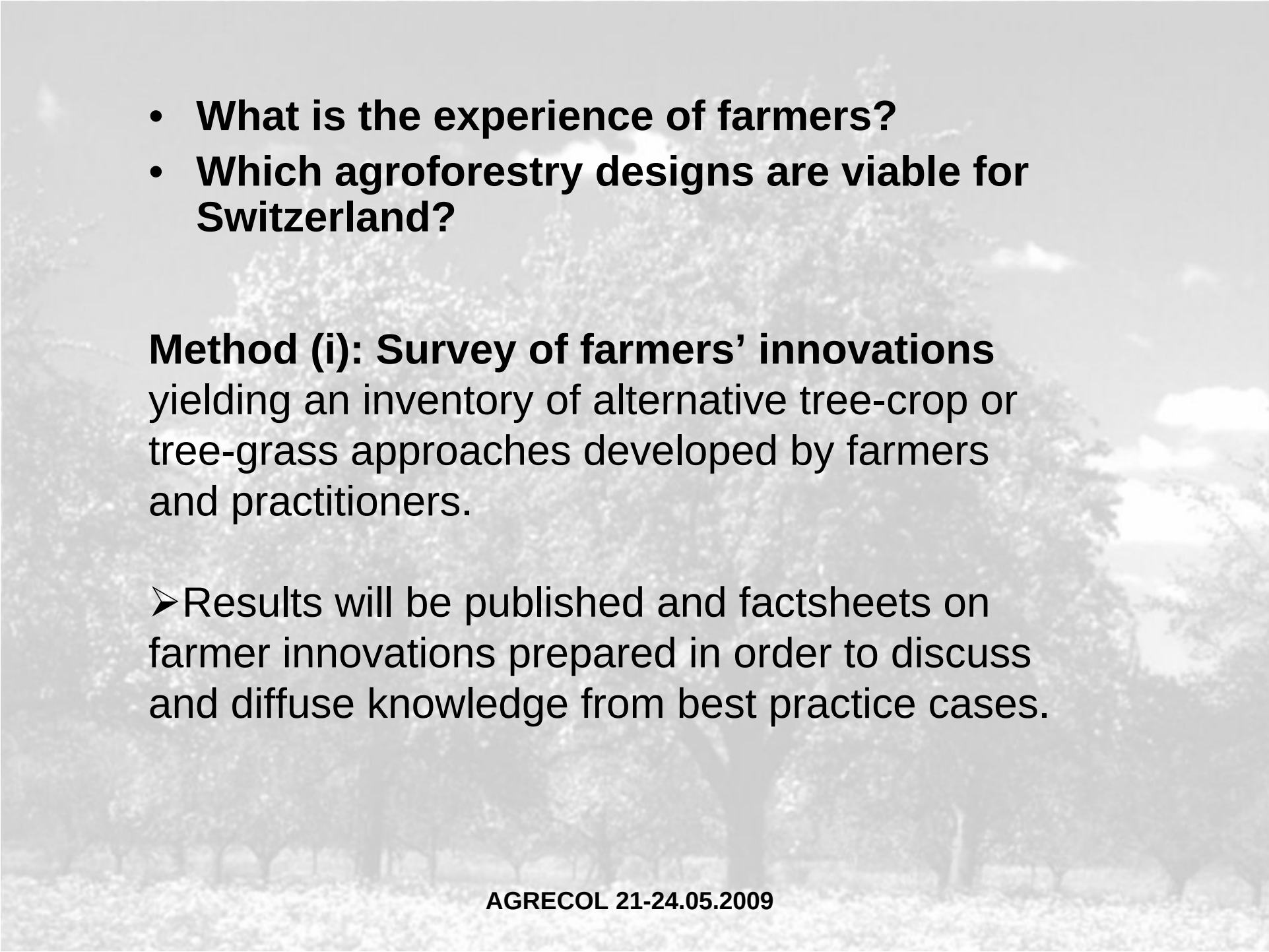
Agroforestry design & management

Objective

- Effective use of natural resources/ reduce competition
- Effective use of labour/ practicable design

1. Site Selection
2. Tree selection
3. Tree density
4. Tree arrangement
5. Crop selection
6. Tree pruning
7. Tree line management



- 
- **What is the experience of farmers?**
 - **Which agroforestry designs are viable for Switzerland?**

Method (i): Survey of farmers' innovations yielding an inventory of alternative tree-crop or tree-grass approaches developed by farmers and practitioners.

➤ Results will be published and factsheets on farmer innovations prepared in order to discuss and diffuse knowledge from best practice cases.

Farmer innovations

- Early results -

Treegardens survey									
ID/Plot	System	Land use	Location	Soil	Stems/ha	Timber	Fruit	Pasture	Crops
TG1	Silvopastoral	EXT	Gempen (SO)	M	94		X	X	Grassland
<i>Tree species: Prunus avium</i>									
TI2	Silvoarable	INT, organic	Möhlin (TG)	B	50		X		Vegetables Cereals
<i>Prunus avium, Malus domestica, Pyrus communis</i>									
TG3	Fruits & Timber	INT	Hörhausen (TG)	M	300-400	X			Grassland
<i>Prunus avium, Juglans regia, Juglans nigra, Pyrus pyraister, Malus domestica, Carya ovata, Sorbus spec.</i>									
TI4	Silvoarable	INT	Seebach (LU)	B	100		X		WW, WB WR, SM
<i>Malus domestica</i>									
TG5	Wild fruit	EXT	Frick (AG)	M	118		X		Grassland
<i>Mespilus germanica, Pyrus pyraister, Rosa canina, Sorbus aucuparia, Sorbus torminalis, Sorbus domestica and Cornus mas</i>									
TG6	Silvopastoral	EXT	Oberflachs (Arg)	M	50		X	X	Grassland
<i>Prunus avium, Juglans regia, Castanea sativa, Malus domestica, Pyrus communis, Prunus domestica, Cydonia oblonga</i>									
TG7	Walnut orchard	INT	Ettenheim (D)	B	100		X		Grassland
<i>Juglans regia</i>									
TG8	Walnut orchard	INT	Truttikon (SH)	B	75		X		Grassland
<i>Juglans regia</i>									
TG9	Silvopastoral ("Selve")	EXT	Breno (TI)	M	75		X	X	Grassland
<i>Castanea sativa</i>									
TG10	Silvopastoral ("Selve")	EXT	Arosio (TI)	M	100		X	X	Grassland
<i>Castanea sativa</i>									
TG11	Silvopastoral ("Selve")	EXT	Brontallo (TI)	M	70		X	X	Grassland
<i>Castanea sativa</i>									
TG12	Silvopastoral ("Selve")	EXT	Vezio (TI)	M	70		X	X	Grassland
<i>Castanea sativa</i>									
TG13	Streuobst	INT, organic	Steinmaur (ZH)	B	70		X		Grassland
<i>Malus domestica, Prunus avium, Pyrus communis, Cydonia oblonga, Pyrus pyrifolia, Mespilus germanica (250 fruit tree varieties)</i>									
TG14	Streuobst	EXT, organic	Nendaz (VS)	M	90		X	X	Grassland
<i>Prunus armeniaca</i>									
TG15	Silvoarable	INT	Blaufelden (D)	B	50	X	X		Cereals
<i>Sorbus species, Prunus avium, Pyrus pyraister, Malus sylvestris, Crataegus sp.</i>									
Better site (B)		Extensive (EXT)		Winter Wheat (WW), Winter Barley (WB),					
Marginal site (M)		Intensive (INT)		Winter Oilseed (WR), Fodder Maize (SM)					

Tree Species



Juglans spp.



Prunus avium

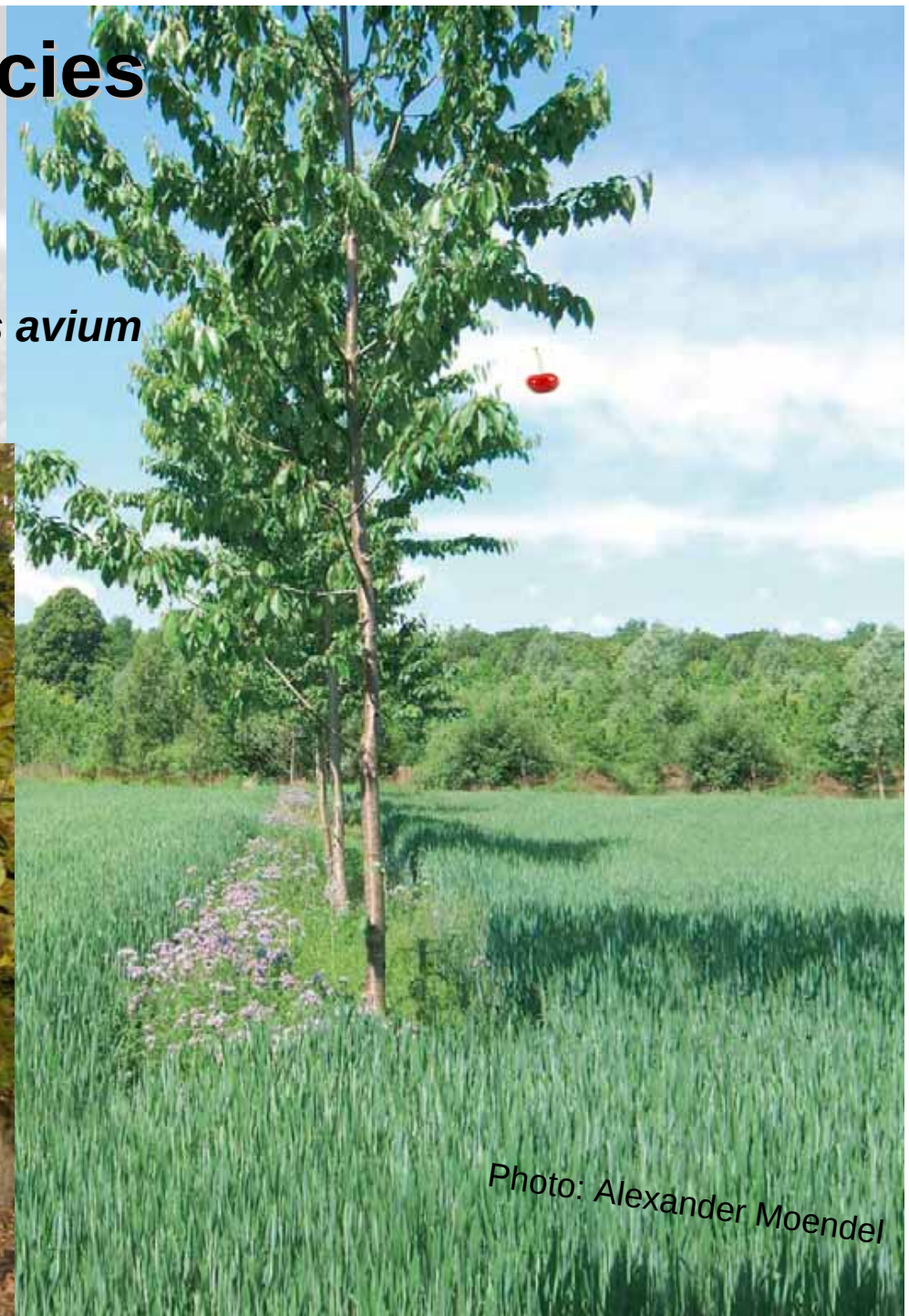
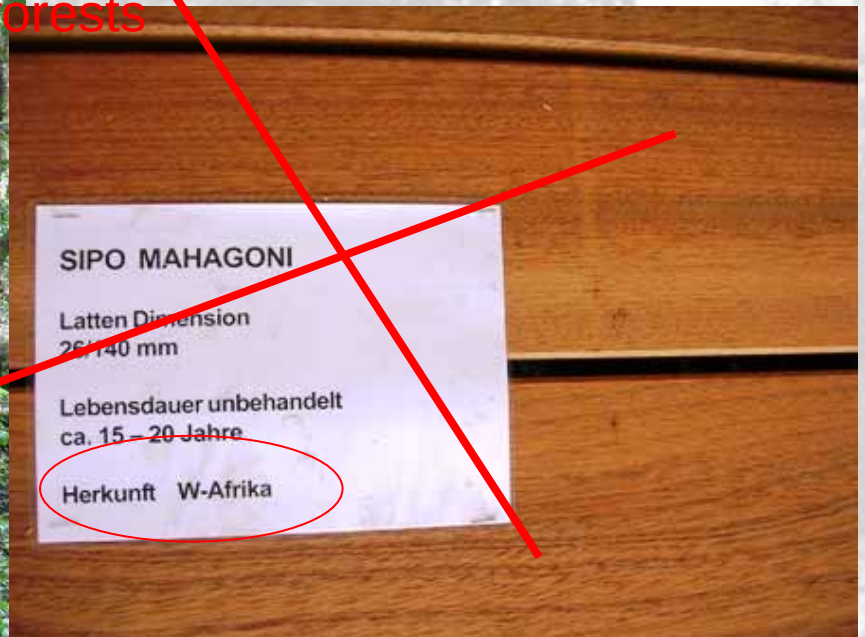
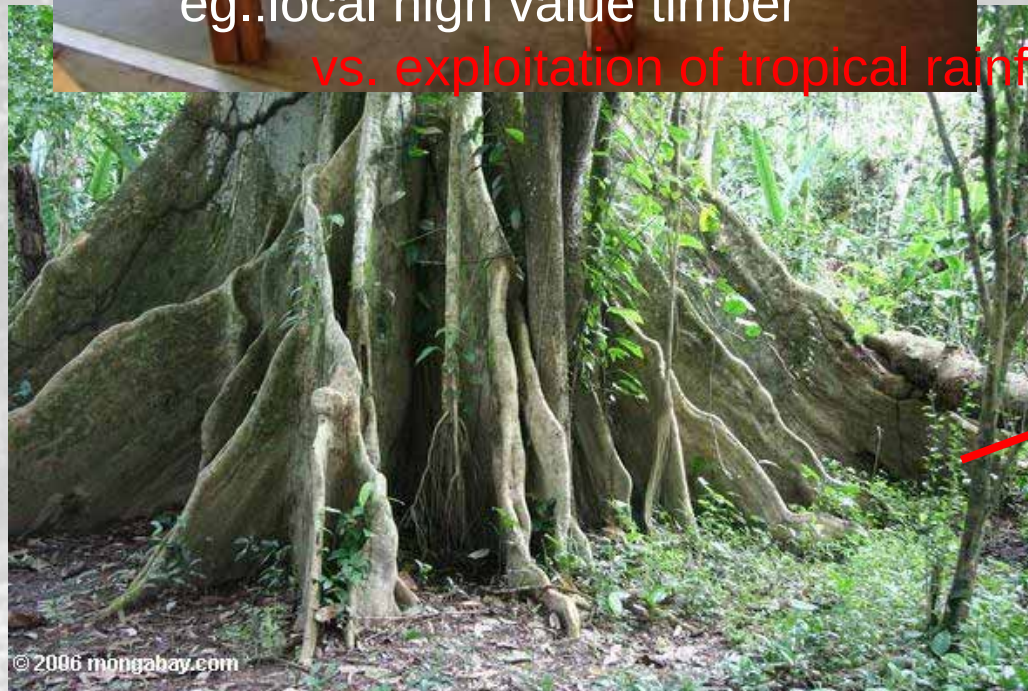


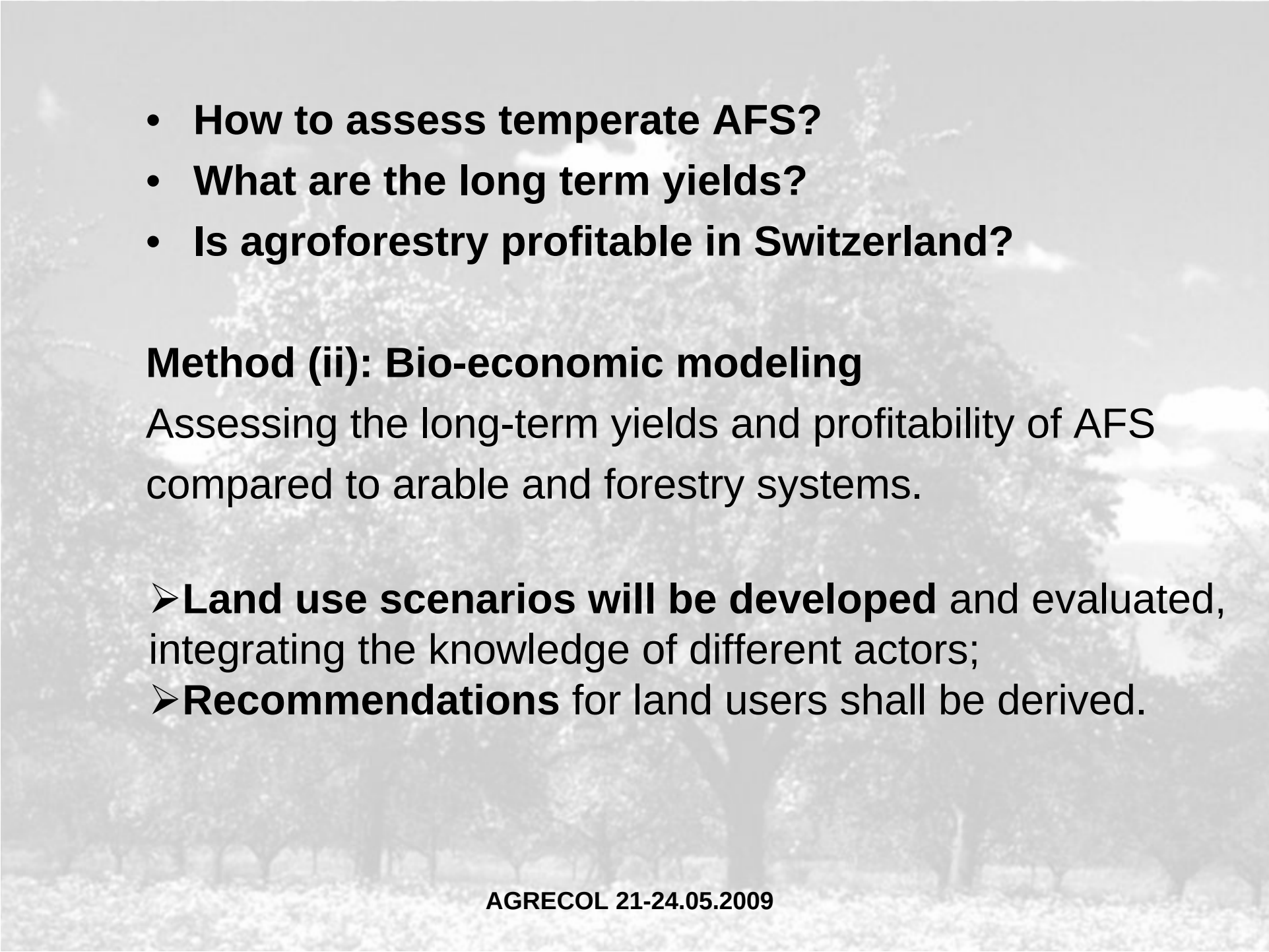
Photo: Alexander Moendel

Castanea sativa



AF promote income from multiple regional products



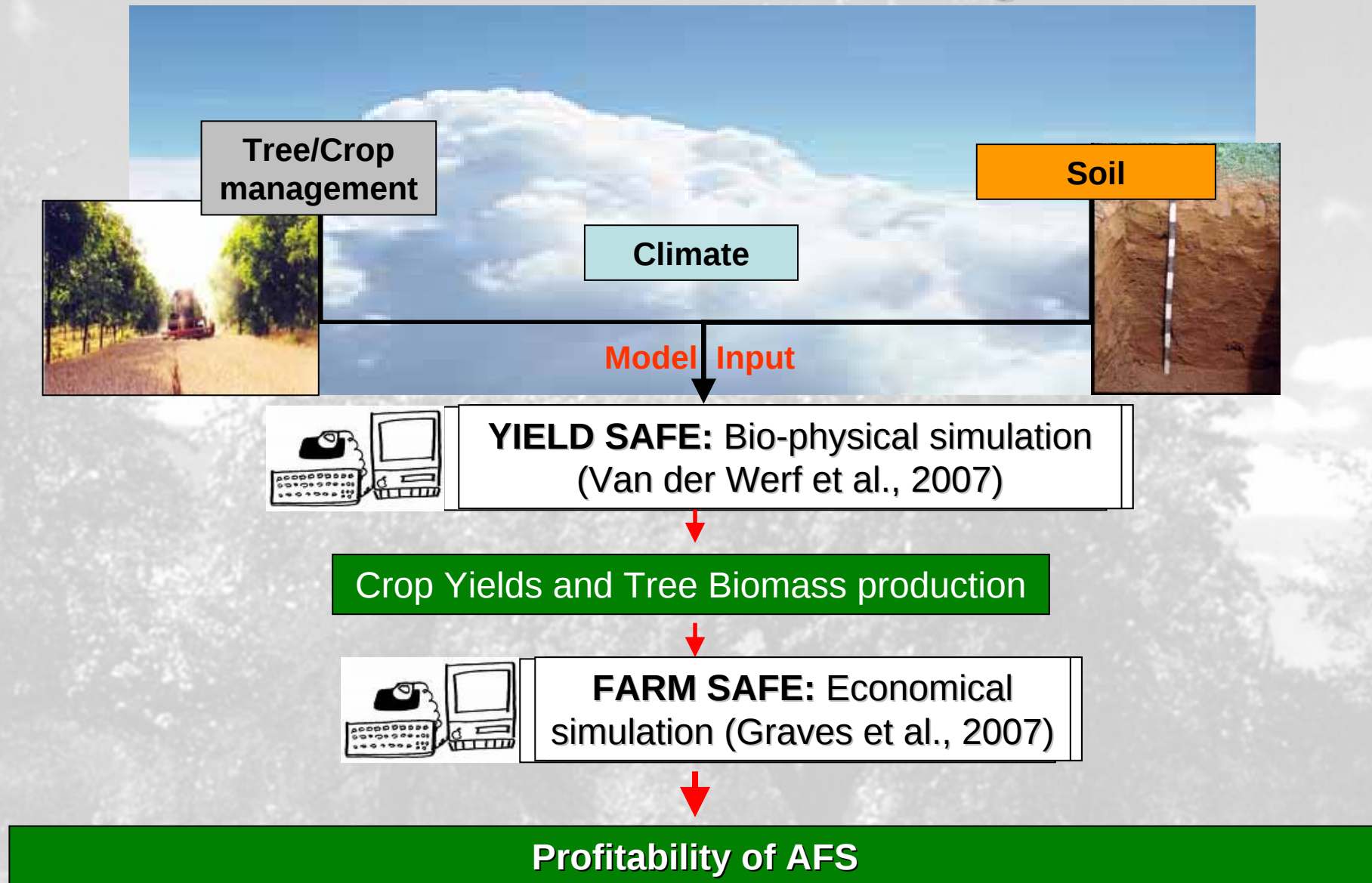
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- **How to assess temperate AFS?**
 - **What are the long term yields?**
 - **Is agroforestry profitable in Switzerland?**

Method (ii): Bio-economic modeling

Assessing the long-term yields and profitability of AFS compared to arable and forestry systems.

- **Land use scenarios will be developed** and evaluated, integrating the knowledge of different actors;
- **Recommendations** for land users shall be derived.

Bio-economic modelling



Design

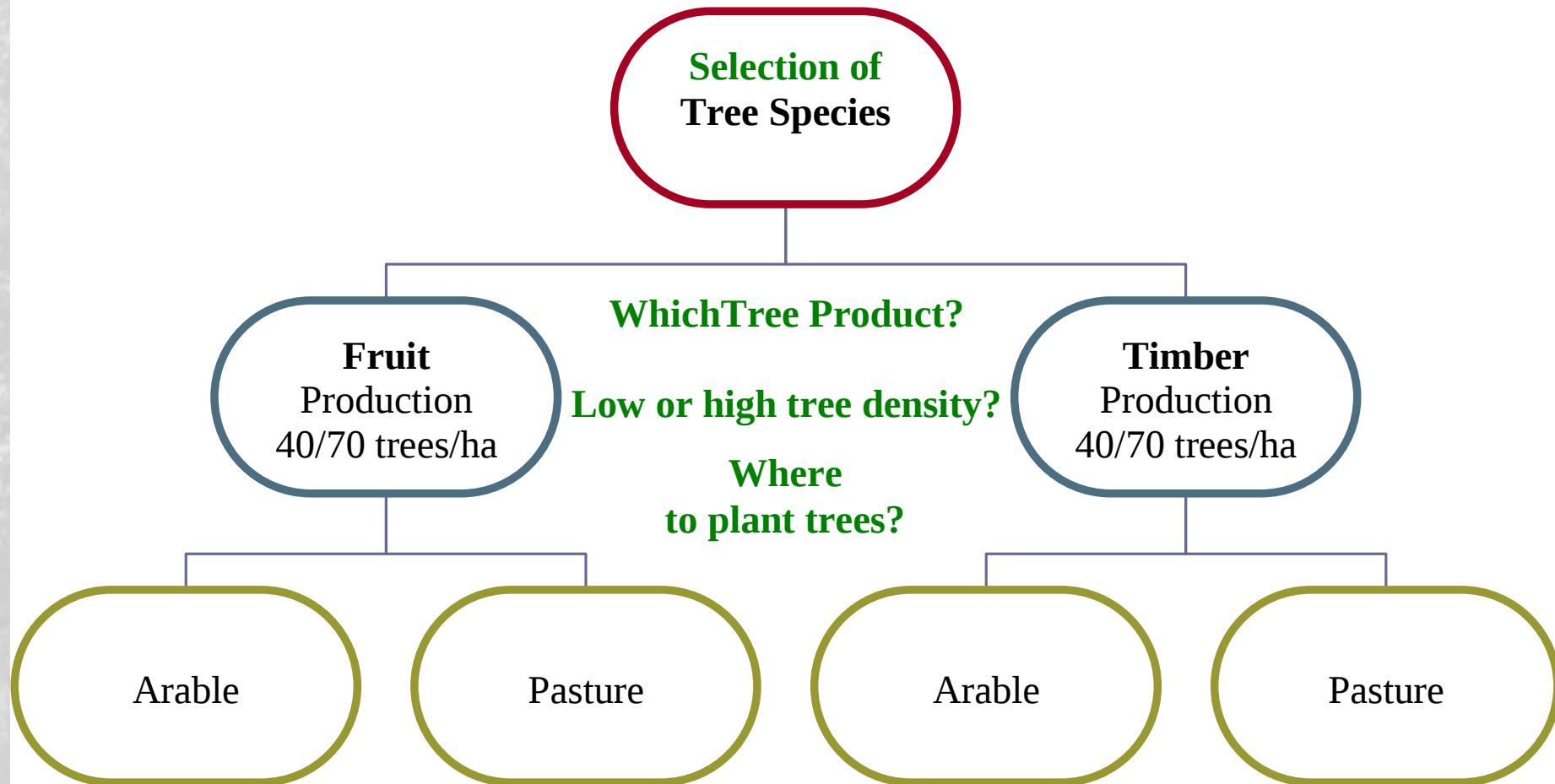


Figure - Tree integration options

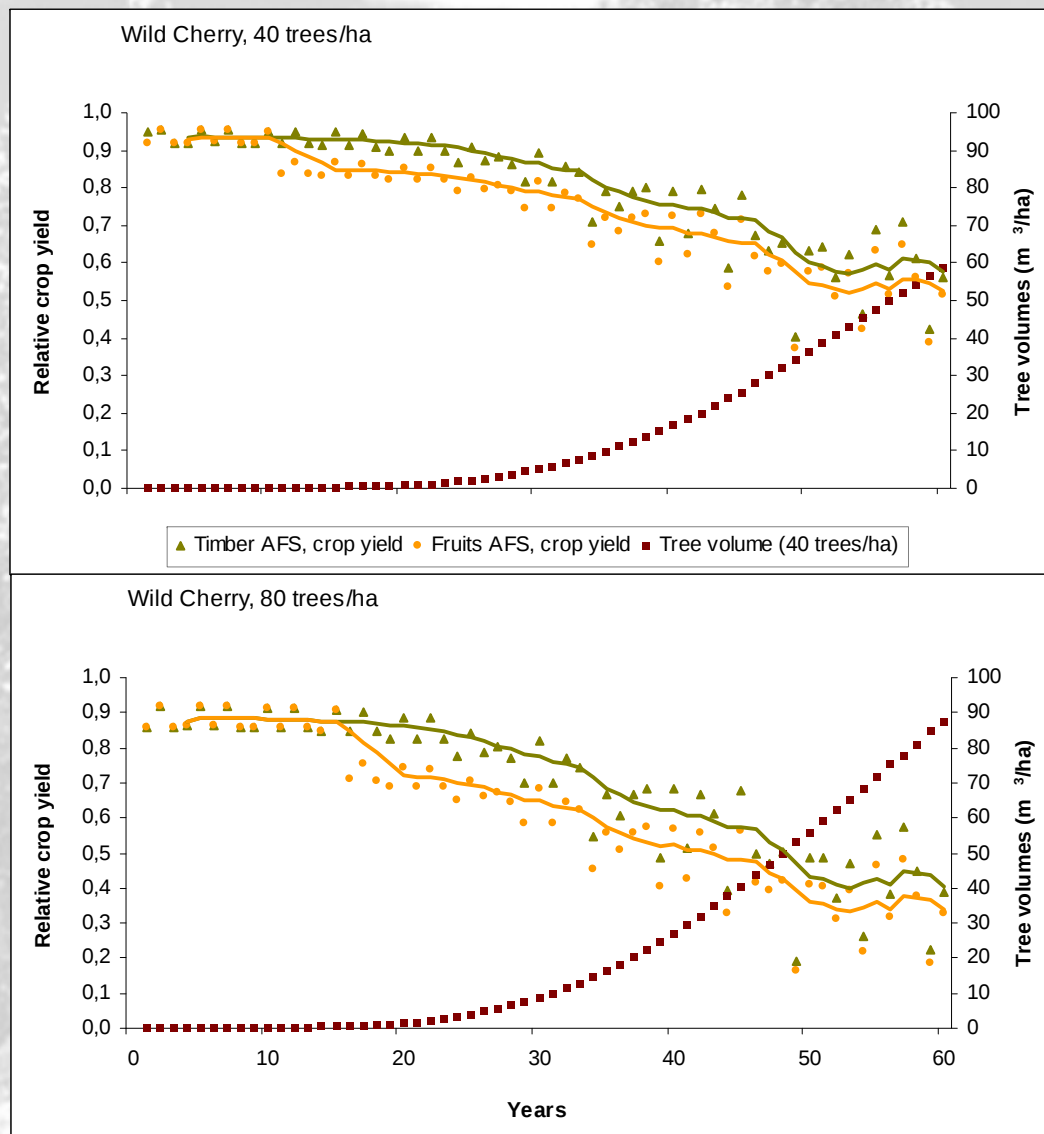
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Design

System	Agroforest				Forest			
	Planting scheme	Intercropped alley	Intercropping area	Density (trees/ha)	Density (trees/ha) Walnut		Wild cherry	
	m	m			initial	final	initial	final
Timber	26x10	24	0.92	40	200	100	800	150
Timber	14x10	12	0.86	70				
Fruit	28x10	24	0.84	40				
Fruit	16x10	12	0.72	70				

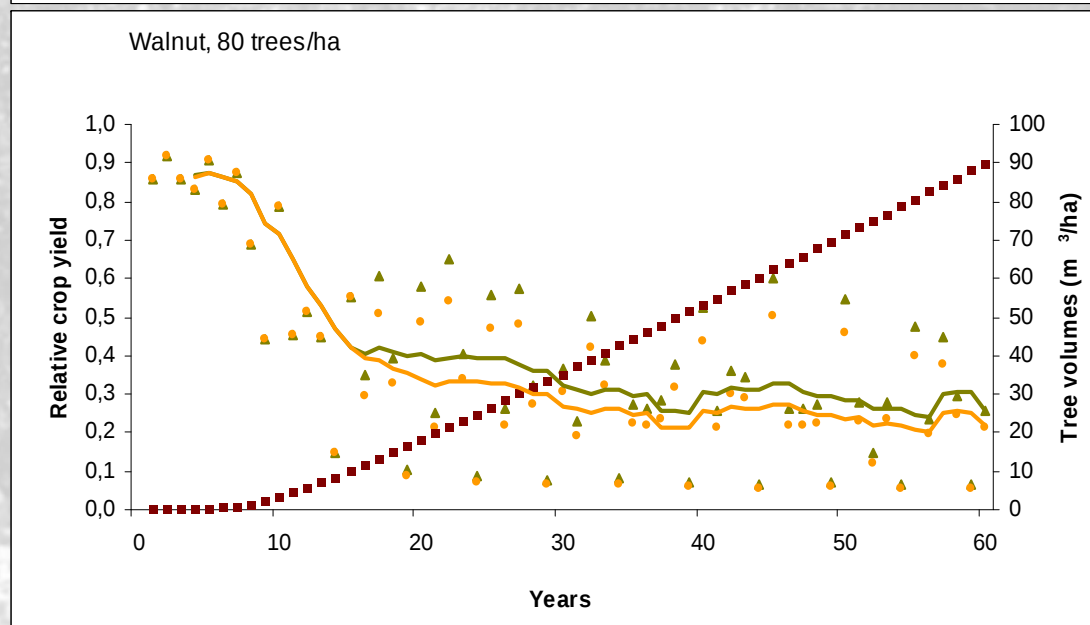
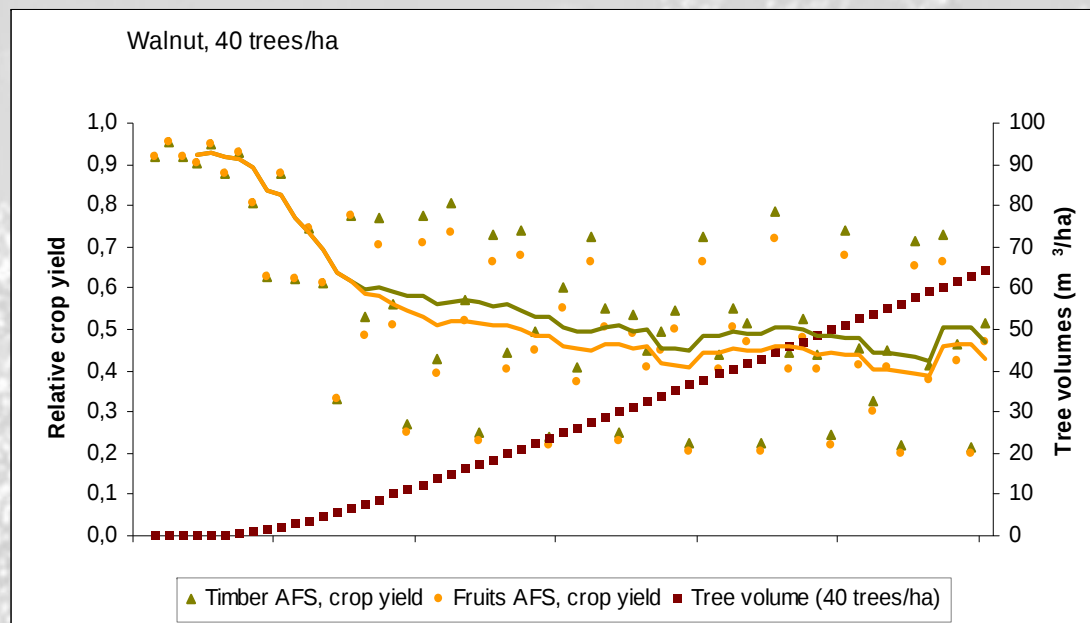
Preliminary simulation results

Yield Simulation



Preliminary simulation results

Yield Simulation



Land equivalent ratio (LER)

LER is the relative land area in pure stands that is required to produce the yields of all products from the mixed system



LER = 1



LER > 1

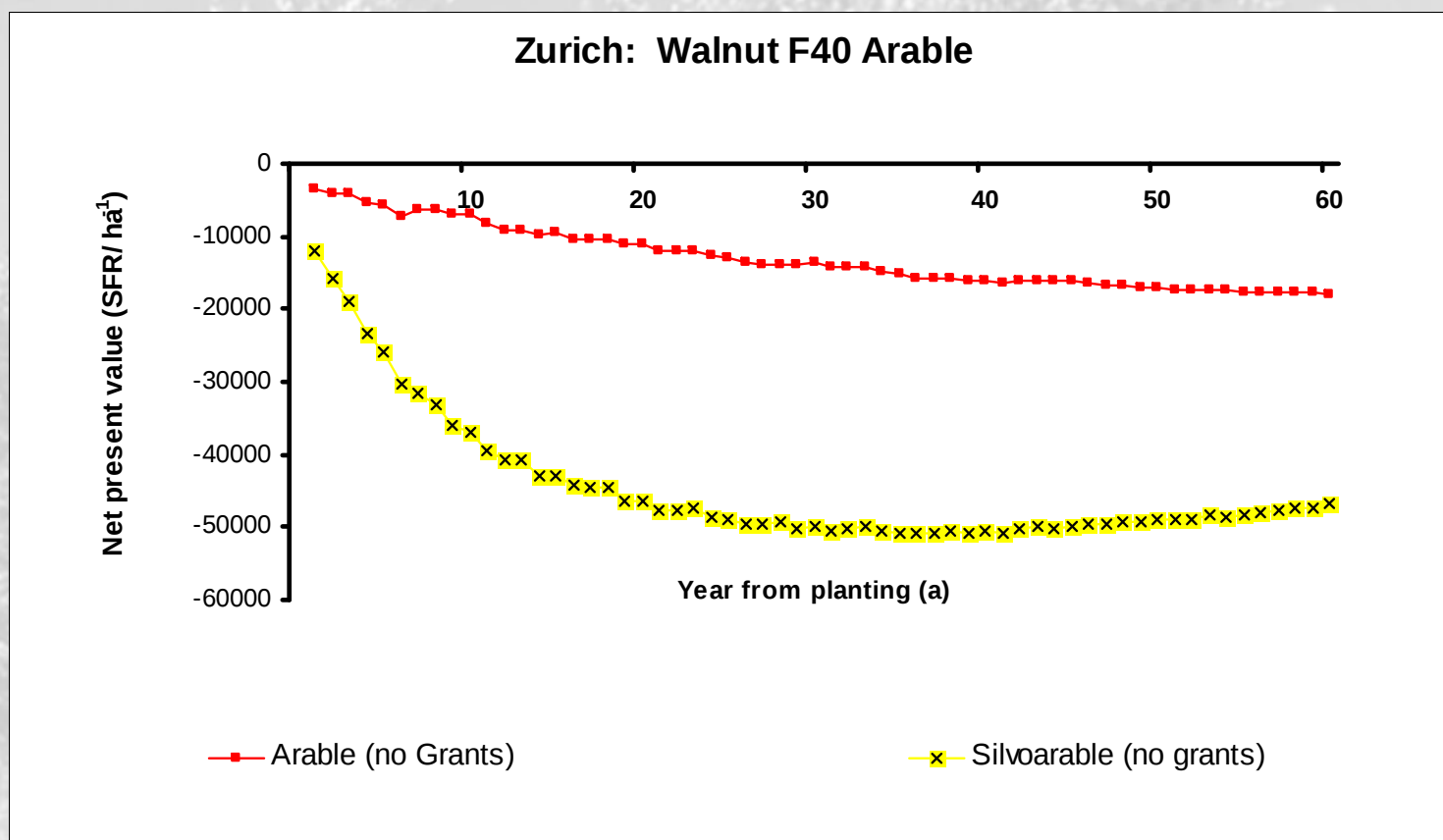
Swiss Wild Cherry systems: LER = 1,06 – 1,35

Swiss Walnut systems: LER = 0.85-1,25
(winter crops > summer crops)

Preliminary simulation results

Economic assessment

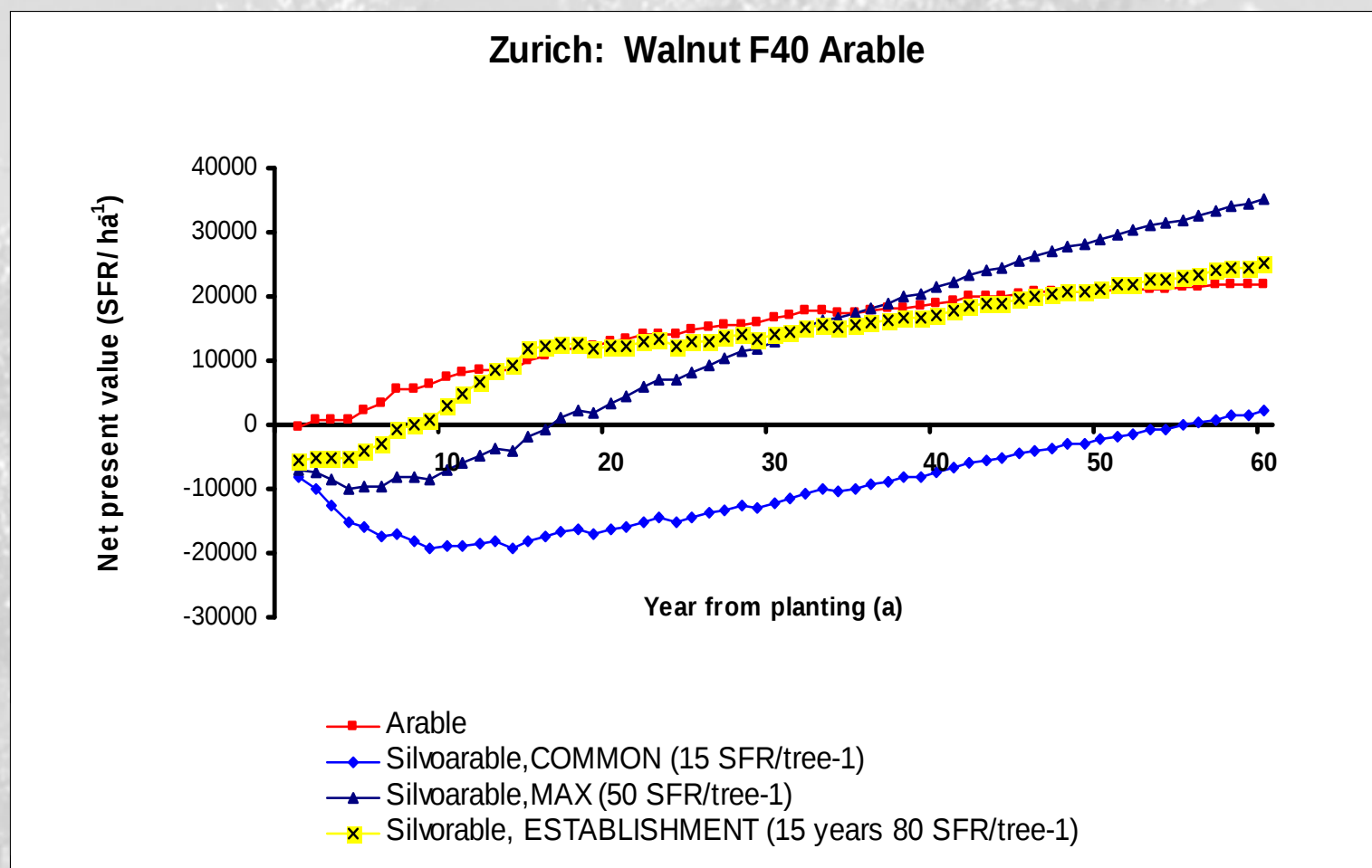
GRANT SCENARIOS



Preliminary simulation results

GRANT SCENARIOS

Beiträge (SFR/Baum ⁻¹)	
DZV	ÖQV
ohne ÖQV	15
mit Qualität	45
mit Vernetzung	20
mit Qualität und Vernetzung	50



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First conclusions & outlook

- Based on the survey and literature a land use database has been established (crop/tree management, climate, soils, costs, revenues and grant regimes)
- Modern AFS were designed based on local management practices
- The Bio-physical model has been calibrated to Swiss conditions and long term yields simulated
- Competition for resources increase with time, management and design play an important role
- LER > 1 in most simulated systems, indicates a more efficient use of resources in AFS compared to pure stands
- Various Economic Land use Scenarios were produced
- Establishment grants are important to make tree planting more attractive
- The expected results should provide more information on tree based farming systems and tree policy

Innovative Treegardens

Chestnut: Tessin (TG9-11)



Apricot: Valais (TG14)



Walnut: Ettenheim (TG7)



Mixed system: Hörhausen (TG3)



Apple: Sursee (TG4)

