PUBLIZIERBARER ENDBERICHT

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A) Projektdaten

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Projektübersicht

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1 Executive Summary

Österreich ist gekennzeichnet durch einzigartige und multifunktionale Kulturlandschaften. In den letzten Jahren gab es einige Untersuchungen zur Bewertung von Klimawandelfolgen auf die landwirtschaftliche Produktion und möglichen Anpassungsmaßnahmen. Wenig bekannt sind hingegen mögliche indirekte Konsequenzen von Veränderungen in der Landwirtschaft auf Erholungsnutzung und Biodiversität. Aktuelle agrarökonomische Studien fokussieren auf wirtschaftliche Kennzahlen (Profitabilität, Liquidität und Stabilität) und kaum auf Faktoren wie Heterogenität der Betriebe. Unter der Annahme, dass die Landwirte selbst die wichtigsten Entscheidungsträger in Hinblick auf Klimawandelanpassungen sind, sollte dieses Projekt aufzeigen, wie sich Strategien und Fördermaßnahmen unter verschiedenen Rahmenbedingungen, wie Risiko, Marktentwicklung oder regulative Maßnahmen, auswirken können.
Im ersten Schritt wurden zwei potentiell vom Klimawandel betroffene Testgebiete nach meteorologischen Kriterien ausgewählt. Dann wurden Klimwandelszenarien auf Basis der IPCC SRESA1B Emmissionsszenarien berechnet. Im dritten Schritt wurden die ökonomischen Rahmenbedingungen für die Landwirte in den Testgebieten erhoben und in Stakeholderprozessen durch weitere wichtige Daten, wie tatsächliche Preisentwicklung bei Marktfurcht, Kurzumtrieb und Schweinezucht, oder Bewässerungsmöglichkeiten, ergänzt. Auf Basis der meteorologischen und agrarökonomischen Szenarien wurden gemeinsam mit Stakeholdern individuelle Fragebögen für die beiden Testgebiete entwickelt. Der innovative Ansatz in dieser Studie war die Methode der Befragung („Stated choice survey“), die Auskunft gibt über Präferenzen bzw. Kompromisse, die Landwirte zur Klimawandelanpassung eingehen, in Abhängigkeit u.a. von Förderungen, Änderungen in der Produktivität oder regionalen Besonderheiten.

Ergebnisse und Schlussfolgerungen aus dem Projekt:
Agro-ökonomische Strukturen und ihre Empfindlichkeit bezüglich Klimawandel: Die beiden Testgebiete unterscheiden sich stark in Hinblick auf Agrarstrukturen, Klima und potentielle Klimawandelszenarien. Das Testgebiet March-Thaya-Auen wird von 733 Landwirten bewirtschaftet, mit Betriebsgrößen von durchschnittlich 63 Hektar auf Böden mit meist hoher Standortgüte. Die wichtigsten Kulturen sind hier Winterweizen, Sommergerste, Zuckerrübe und Winterraps. Teile des Gebietes werden regelmäßig überschwemmt. Dort könnte in Zukunft – aus agroökonomischer Sicht – verstärkt Kurzumtrieb mit Pappel und Weide attraktiv werden. Der Klimawandel könnte hier zu einer Verlängerung der Vegetationsperiode führen. Die zu erwartende Zunahme der Temperatur und Verdunstung stellt dann kein Problem, sondern eher eine Verbesserung dar, wenn bewässert werden kann. Im unmittelbaren Bereich der March-Thaya-Aue nimmt die Hochwassergefahr zu.
Im Unterschied dazu ist das Testgebiet in der Südoststeiermark im Raum Feldbach durch 835 Betriebe gekennzeichnet, mit einer deutlich niedrigeren durchschnittlichen Betriebsgröße von 13 ha. Betriebe mit Schweinemast dominieren. Durch den hohen Anteil an Veredelungsbetrieben wird auf rund 70 % der Ackerflächen Mais angebaut. Weiterhin ergab die agroökonomische Analyse nur 13 % Marktfruchtanbau und 6 % Dauerkulturen wie Obst und Wein. Die meteorologischen Analysen im Hinblick auf den Klimawandel ergaben eine zu erwartende Zunahme von Temperatur, Verdunstung, Trockenheit und Wassermangel. Zusätzliche Belastungen werden durch Wasserstress und Hagel für Mais- und Kürbisanbau erwartet.

Einstellung der Landwirte gegenüber Klimawandel: Die meisten Landwirte in den beiden Testgebieten nehmen bereits erste Anzeichen des Klimawandels wahr, wobei diese Wahrnehmung in der Steiermark signifikant höher als in Niederösterreich ist. Beobachtete Effekte (zB. Trockenheit) entsprechen den wissenschaftlichen Szenarien.

Agrarökonomische Trends unter den Bedingungen des Klimawandels: In Niederösterreich zeichnet sich ein Strukturwandel ab, der aus der Sicht der befragten Landwirte zu größeren Einheiten durch Erwerb oder Zupacht führt. Parallel dazu ist ein Trend zu Intensivierung und Spezialisierung zu beobachten. Ein weiterer Umstieg von konventionellen Anbaumethoden zur biologischen Bewirtschaftung ist unwahrscheinlich. Erstaunlicherweise

ergeben sich keinerlei Unterschiede zwischen Haupt- und Nebenerwerbsbetrieben. Die Spezialisierung und Intensivierung fördert auch die Bewässerung, die als wichtige Anpassungsstrategie an mögliche Klimawandelfolgen gilt.
Im Testgebiet der Steiermark werden die zukünftigen Entwicklungen und Trends sehr stark von der Betriebsgröße beeinflusst. Große Betriebe wollen auch in Zukunft systematisch den Marktfruchtanteil erhöhen. Alle Betriebstypen setzen weiterhin auf den Anbau von Kürbis. Aufforstungen werden dagegen fast ausschließlich von Nebenerwerbsbetrieben und Betrieben unter 5 ha Größe beabsichtigt. Der Wechsel in andere Betriebszweige (z.B. Wein, Obst) ist offenbar zu aufwändig und setzt Spezialisierungen voraus.

Auswirkungen der klimawandelbedingten Anpassungen auf kulturelle Ökosystemleistungen:
In einem zweistufigen Ansatz sollte überprüft werden, ob die traditionelle Kulturlandschaft für den Landwirt so wertvoll und erhaltenswert ist, dass er auf intensivere Nutzungsmöglichkeiten durch Klimawandel verzichten würde. Hierzu wurden zunächst Landschaftsbildpräferenzen abgefragt. Für die March-Thaya-Aue gilt, dass die typische artenreiche Wiesengesellschaft der Aue nur mäßig präferiert wird. Die ästhetischen Präferenzen liegen bei intensiven Nutzungen mit Getreide, Rübe und Maisanbau. Diese Tendenz wird auch durch das choice experiment bestätigt. Von einem Verlust an artenreichen Bausteinen der Kulturlandschaft ist bei besseren Wachstumsbedingungen (Wärme und Bewässerung) auszugehen.
In der Steiermark ist die Präferenz für vielfältigere Landschaftsbilder höher, insbesondere dann, wenn man diesen Landschaftsausschnitt nicht bewirtschaftet. Bei Eigenbewirtschaftung werden Bilder mit hohem Maisanteil präferiert. Auch hier werden tendenziell auch im choice experiment die ökonomischen Chancen genutzt.

Möglichkeiten und Effektivität von Agrarförderungen und Umweltmaßnahmen:
Das choice experiment ergab für die March-Thaya-Auen in Niederösterreich eine starke Dominanz des Deckungsbeitrages für die Marktfrucht. Die traditionelle Grünlandbewirtschaftung, aber auch bei Klimaerwärmung möglicher Kurzumtriebsanbau, werden in diesem Fall in ihren Anteilen deutlich zurückgehen. Selbst eine sicher nie mögliche theoretische Erhöhung der Naturschutzförderung für diese Auewiesen von 1200 Euro ÖPUL WF-Förderung ändert insbesondere die Ansicht traditioneller Betriebe nicht. Auch bei den Großbetrieben ergibt sich keine Ausrichtung an der Naturschutzförderung. Risiken des Weltmarkts und hohe Schwankungen dort zeigen stärkere Wirkungen als die Förderpolitik im Naturschutz. Die Betriebsgröße zeigte sich hier durchwegs als irrelevant. In der Steiermark wurde die Situation bei den Veredelungsbetrieben im Bereich der Schweinemast näher betrachtet. Auch hier wurde versucht, eine (fiktive) Prämie zu integrieren, die Diversität in der Landschaft erhält und die Gefahr der Ausbreitung von Schädlingen durch den Klimawandel und wärmere Bedingungen einschränkt. Diese sog. Klimaprämie war im Fragebogen verbunden mit Fruchtfolgeauflagen. Je weniger Eigenfläche die Betriebe haben, desto eher lehnen sie eine Prämie ab. Signifikante Unterschiede ergaben Betriebe über und unter 25 ha. Es zeigt sich, dass dieses agrarpolitische Steuerungsinstrument, das hier in gestaffelter Form angeboten wurde, nur bei den Großbetrieben (hier über 25 ha) wirkt.

Zusammenfassung und Ausblick

Damit zeigt sich insgesamt, dass der Klimawandel auch bei Steuerung durch den Staat Auswirkungen auf die Kulturlandschaft haben wird. Sind Intensivierungen möglich, werden diese tendenziell wahrgenommen und Ökosystemleistungen, Tourismus und Biodiversität beeinflusst. Förderungen können Entwicklungen nur steuern, wenn ihre Höhe angemessen ist. Bisher übliche Zahlungshöhen, vor allem im Vertragsnaturschutz (ÖPUL) werden bei den möglichen klimawandelbedingten Ertragssteigerungen nicht ausreichen. Bei Einsatz von Förderungen ist deren Wirksamkeit bezogen auf verschiedene Segmente und Betriebstypen zu beachten. Ohne eine auf die regionalen Bedingungen angepasste Strategie ist zu befürchten, dass die attraktiven kleinräumigen Strukturen in der Agrarlandschaft, und damit ihr Potenzial für Erholungsnutzung und Tourismus, verloren gehen. Dieser Trend dürfte auch die Biodiverstität betreffen, und sollte eine Diskussion über alternative Optionen im Naturschutz auslösen.

2 Hintergrund und Zielsetzung

1. Initial situation / motivation for the project

Austria is characterised by many versatile cultural landscapes, which create an added value for the entire region. These landscapes usually serve multiple purposes: in addition to being a means for agricultural production, they also offer a range of ecosystem services, and provide the backdrop for recreational and touristic landscape experiences. The cultural landscapes and the many factors that influence their quality (e.g. location and policy like agricultural subsidies) have already been researched extensively (Kantelhardt, 2003; Ahrens & Kantelhardt, 2007; Röder et al., 2006). It is likely that climate change will significantly alter agro-economic use patterns (Kromp-Kolb et al., 2007), which challenges the current standard predictions for future agricultural land-use. In recent years, several attempts were made to assess the risk of future climate change effects on crop production and to search for adaptation measures for agricultural systems (Eitzinger et al., 2009; Marrachi et al., 2005). The climate change predictions in these models usually involved potential future constraints on agricultural production, triggered by limited availability of water and/or increased temperature, while the potential for new types of agricultural production has so far been ignored (Soja & Pacual- Rodriguez, 2010). Even less is known about the potential indirect effects that the impending changes in the primary agricultural production sector will have on other uses in rural landscapes, such as recreation and biodiversity. Recent research commonly applied predictive models to illustrate the future of cultural landscapes. The influence of climate change in these studies was usually based on qualitative expert opinion only (Eitzinger et al., 2009; Freyer & Dorninger, 2010; Kromb-Kolb et al., 2007; Tappeiner et al., 2007; Hiess, 2002). Qualitative expert opinion research typically analyses the opinion of a few experts and assumes, that these narrow estimations are sufficient to represent the complex business decisions that farmers face. Several agro-economic and tourism studies have shown that these models are severely insufficient (Pröbstl & Wirth, 2010). Current agro-economic studies concentrated on economic ratios (profitability, liquidity, and stability) and usually ignore non-economic factors such as tradition or family structure. Several of these agro-economic studies (e.g. Kantelhardt et al., 2009), as well as studies regarding landscape change (e.g. Pröbstl & Zimmermann, 2010) identified a strong heterogeneity among farmers. Farmers, the crucial decision makers, who ultimately determine the type of production systems implemented and landscape patterns visible, do not necessarily strive to maximise income or economic return when framing conditions change. Grothmann and Patt (2005) noted, that existing agriculture and climate change research largely ignored the personal perception of adaptation opportunities and necessities (Grothmann & Patt, 2005: 44f). Other studies concluded, that providing information on climate change does not necessarily lead to changes in behaviour, as behaviour further depends on other factors such as tradition incentives (including perverted incentives), knowledge about alternatives, and other social context (Freyer & Dorninger, 2010; Cialdini, 2005, 2007).

2. Objectives of the project

This research aimed to go beyond existing expert based models and apply an innovative, interdisciplinary approach, which was thought to increase the current understanding of the procedures necessary for implementing agricultural climate policies. Based on the assumption that farmers are the crucial decision makers when it comes to the implementation of climate change policy, this project planned on developing an integrated model of farmer behaviour that considered various potential future scenarios of climate regimes, varying socio-economic conditions, and different policy regimes.

The main objectives can be summarized as follows:

- Interdisciplinary discussion and identification of potential new types of agricultural land use under the conditions of climate change
- Understanding of individual agricultural operations' perception of climate change and the associated possible advantages and disadvantages with regards to crop cultivation and other land use options
- Visualization and discussion of possible effects of climate change induced land use changes on recreation and tourism

- Insight into decision-making process of farmers and explicitly into the impact of incentives and possible structural policies

3. Activities performed within the framework of the project

The project was based on two central activities. First, key players (chamber of agriculture) were selected at the beginning of the project to determine essential questions and to receive advice during test site selection. Second, test regions were defined in several interdisciplinary meetings. Only regions with the potential for significant changes in the future were considered. Regional climate change scenarios, based on results of the ENSEMBLE project, provided the background for the selection. Also, the Austrian RCM scenarios, developed through the "reclip:century" project, constituted an important input. Figure 1 shows the framework of the study and illustrates the most important steps of the project: Project partner BOKU-MET developed detailed scenarios for the selected test regions. Based on literature (e.g. Eitzinger et al., 2009) and these scenarios, farming opportunities, such as short rotation forests in the March-Thaya floodplains or the shift to wind and fruit cultivation in Styria, were discussed. This expert based discussion built the basis for the development of the specific surveys; one for each test site. The main findings of the questionnaire should describe farmers' perception of climate change and their planned adaptation strategies. Adaptation strategies were analysed considering other influencing factors such as expected price level, financial risks, natural risks, and environmental and agricultural policies.

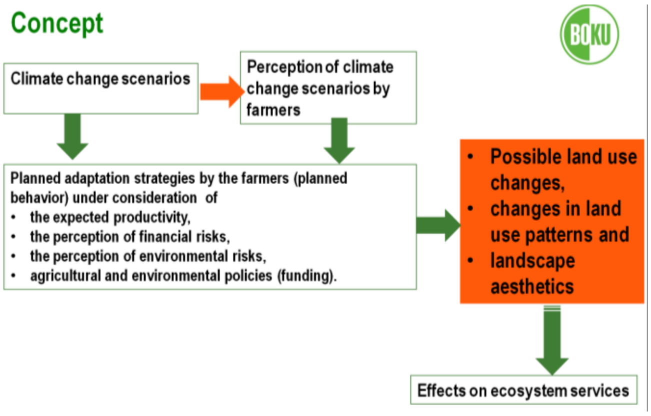

Figure 1. Project framework

An important tool embedded into the complex survey was the choice experiment (see Section B 5 for details on methodology).
Overall, 148 farmers in the March-Thaya floodplains (80% main occupation, 20% secondary occupation, 13% biologically managed) and 91 farmers in Styria (70% main occupation, 30% secondary occupation, 2.3% biologically managed) were surveyed through this elaborate technique. The results allowed for the discussion of possible consequences for future land use, land aesthetics, and overall landscape structures. The survey further revealed, whether and how land use changes might be influenced or averted by a certain policy such as climate change incentives or contracts for conservation purposes. As shown in Figure 1, the findings were discussed with local stakeholders, representatives of the ministry of environment, and members of the chamber of agriculture, in order to define potential impacts on agriculture, tourism, and ecosystem services.

3 Projektinhalt und Ergebnis(se)

WORK PACKAGE (WP) 1 - Project management and coordination

The Institute of Landscape Development Recreation and Conservation Planning (ILEN) was solely responsible for WP1. The objectives of the WP contained the overall project coordination, the synchronization of interactions between partners, the organisation of meetings and workshops, the compilation of reports to the Climate and Energy Funds, and the creation and management of a data exchange platform. The project coordination will be completed after the final revision of the report. Meetings were held frequently and all partners contributed to said meetings, the interim report, and the final report. The interim report was handed in at the end of January 2012, reviewed over a period of two months, and the final submission occurred at the beginning of March 2012.

Milestones of WP 1
- ☑ Coordination of partner and stakeholder meetings
- ☑ Ongoing project management and knowledge transfer
- ☑ Report coordination

WORK PACKAGE 2 - Selection of test regions and data collection

All three partners participated in the selection of suitable test regions, in which landscape changes are likely to occur due to the agricultural structure and climatic conditions, and the data collection regarding climate data and agricultural economic data in the test regions, as well as GIS data. In order to collect suitable data, the research team underwent a literature research, analysed data of ZAMG statistics and InVeKoS, the INVEKOS-GIS/Hofkarte, and meteorological observations. The first analytical step of the project included the development of general predictions about future climate conditions within Europe, and particularly Austria, by the Institute of Meteorology (MET). The developed scenarios mostly draw upon results of the ENSEMBLE project and upon recent publications by Eitzinger et al. (2009).

General trends of warming and precipitation within the next decades

The global near-surface temperature is expected to follow the past trends of warming. This general warming can be observed by comparing the average near-surface temperature of 2021-2050 and 2071-2100 to the period of 1961-1990.
The overall annual mean temperature in Europe will rise up to approximately 2°C by 2050 and up to 3.5°C (more than 4.5°C in the northern regions) by 2100. A temperature increase of up to 4°C is likely to be expected during the summer months in Southern Europe, as well as the southern parts of Austria by the end of the century (van der Linden & Mitchell, 2009).
Precipitation predictions for Europe show two clearly separated regions with invers developments. By the end of the century, annual precipitation, primarily in Southern Europe and the Iberian Peninsula, will gradually decrease. At the same time, precipitation in the northern parts of Europe, particularly in Scandinavia and Russia, will significantly increase (van der Linden & Mitchell, 2009). Central Europe and the Alps will become a transition region with no significant change in the annual precipitation. According to recent prognoses, the decrease of precipitation in Europe will be more pronounced in summer. Therefore, a significant reduction of precipitation during summer can be expected by the end of the century in Austria (van der Linden & Mitchell, 2009).Through further literature and data analysis, suitable test regions within Austria were selected. From an agro-economics point of view, it was crucial to choose typical regions with regards to land use and farm structure. In addition, the selected regions should incorporate grassland regions dominated by crop farming and mixed regions. The sample within the regions further included small, part-time farms, as well as large full-time farms. In the end, the region around the Marchfeld and the March-Thaya floodplains in Lower Austria and a region in southeast Styria were selected.
Subsequently, the analyses of the agro-climatological conditions and climate scenarios in the regions were

conducted by MET. The analyses of the climatological conditions were based on observations by the Austrian weather service (ZAMG), while the effects of the climate change on the specific situation within the test regions draw upon agricultural impact assessments derived from research projects like ADAGIO or CECILIA.

Climate conditions in the selected test regions

The climate in the Marchfeld and the March-Thaya floodplains can be described as hot and dry in summer and cold with less snow in winter. During summer months, low humidity and minor dew formation are typical. The annual mean temperature for the period of 1971-2000 was 9.5°C (Figure **2**). This temperature is based on meteorological measurements of the meteorological station Fuchsenbigl, provided by the Austrian weather service (ZAMG, 2011). The summer months June, July, and August were the hottest months throughout the year, with temperatures around 17.6°C, 19.5°C, and 19.4°C respectively (ZAMG, 2011).
Annual mean minimum and maximum temperatures between 1971 and 2000 were 5.4°C and 14.5°C respectively. Within this period, 11.8 days were hot days (daily temperature above 30.0°C) and 83.8 days were frost days with most of them (22.9 days) occurring in January.

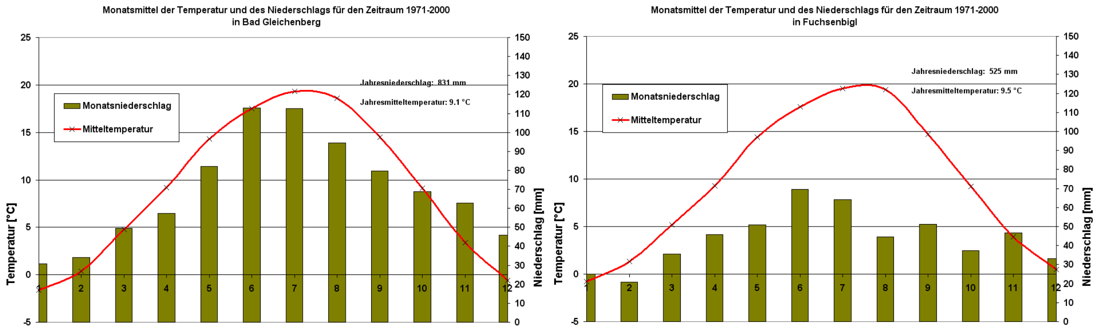

Figure 2. Medium average temperature and precipitation per month during the period 1971-2000 in Bad Gleichenberg (left) and Fuchsenbigl (right) (image provided by authors, data provided by ZAMG, 2011)

Total annual precipitation added up to 525 mm during the period of 1971 to 2000 with a slide peak in the summer and a second peak in the fall. The highest amount of rainfall in a single day (60 mm) occurred in the summer. On 14.6 days, precipitation lay below 10 mm, which occurred most frequently during June (2.5) and July (2.0). Thunderstorms were recorded on 20.64 days/year, most of them in May (3.48) or June (5.00). The meteorological station in Fuchsenbigl documented 1.19 hail or sleet days (ZAMG, 2011).

In the region Feldbach/Wegner Net in the Southeast of Styria, the annual mean temperature at the meteorological station Bad Gleichenberg was 9.1°C (Figure **2**). This value is based on measurements provided by ZAMG. The hottest months were June, July, and August with mean temperatures of 17.5°C, 19.3°C, and 18.6°C respectively. The number of hot days with a temperature maximum above 30.0 °C was with 7.4 days significantly lower than the values reported in Fuchsenbigl. This difference is due to more frequent convective processes and shade in the early afternoon. On average, 109.4 days per year were frost days (Tmin < 0°C), which were significantly more days than recorded in the March-Thaya floodplains. Most of these frost days in Bad Gleichenberg occurred in January (27.6 days) (ZAMG, 2011).
Average annual precipitation added up to 831 mm (more than 50% higher than in the March-Thaya floodplains) (Figure **2**). The highest daily precipitation (110 mm) occurred in summer. On 26.9 days, total precipitation laid equal to or blow 10 mm (more than double than in the March-Thaya floodplains). Most of these days occurred in May (10.8) and June (11.9). The number of days with thunderstorms was with 33.94 days relatively high, with most of them occurring in May (5.43), June (7.43), July (8.14), and August (7.07). The number of hail or sleet days was slightly higher (1.43 days in sum) than in Fuchsenbigl (ZAMG, 2011).

Climate scenarios in the selected test regions

The local climate change scenarios were based on different RCM scenarios from the FP 6 ENSEMBLES project. The climate change signal for temperature, precipitation, and radiation were produced for the two time frames 2011-2040 and 2036-2060 (relative to 1961-1990) on a monthly base. In the upcoming decades, the global climate will change. These changes will also be recognisable in Austria and the selected test regions. Studies by Strauss et al. (2008) showed that by 2038 Fuchsenbigl is most likely to experience a temperature increase from 609+/-059°C to 726+/-059°C compared to the period of 1975 to 2006. Likewise, temperature maxima would rise from 1479+/-089°C to 1610+/-072°C by 2038 in relation to the same time period. Therefore, it can be expected that the temperature rise experienced of the past 32 years will continue linearly for the next 32 years.
In the long term, precipitation is likely to increase in winter and decrease in summer. A study by Formayer (2007) analysed the influence of climate change on temperature in Lower Austria. In comparison to the period from 1971 to 2005, the temperature sum increased from 2383°C to 2582°C in 2050 (Eitzinger et al., 2008). Moreover, the vegetation period is likely to be extended from 228 to 245 days and the dormant season will therefore decrease from 137 to 120 days in the same period of time (low climate sensitivity). The study also showed, that the overall sum of temperatures is likely to increase by 8% (2025 and 2050 at lower climate sensitivity) to 36% (2050 and high climate sensitivity).
In the March-Thaya floodplains, new structural measures will be required due to future flooding during winter months. The summer is likely to experience a reduction in flood risk. Total annual precipitation will remain equal to today’s levels. In Southeast Styria it is likely that intensive and heavy precipitation, as well as hail events in summer will increase. Increased precipitation and decreased snowfall are expected in winter. Severe precipitation is likely to become more frequent yet, no reliable statement concerning other extreme events (e.g. wind storms) can be made. The temperature increase by 2°C until 2050 will most likely cause significant changes of land use in the March-Thaya floodplains. These changes will, for instance, include an increase in water use due to increased evapotranspiration, which will result in a higher heat and water stress. The annual mean precipitation will remain constant, but a shift in the annual precipitation cycle is expected. The precipitation in fall and winter will increase and decrease during spring and summer (Eitzinger, 2010; Gerersdorfer & Eitzinger, 2010). These combined effects will lead to noticeable effects in agricultural production as, except for cereals, all cultivations in particular summer cultivars (like soy, corn, and sugar beet) in the March-Thaya floodplains are based on irrigation (Eitzinger, 2010; 2011). The heat stress is likely to be especially severe in the second half of summer due to the shift in the precipitation and vegetation period and the increase in evapotranspiration.
Temperature induced yield reductions can be balanced out or even compensated by the CO_2 fertilizing effect (Eitzinger, 2010). The summer drought will reduce the yield stability, especially in the non-irrigated regions in both test sites (Eitzinger et al., 2009).
The length of the vegetation period will clearly increase by 12 (2025 low climate sensitivity) to 32 days (2050 high climate sensitivity) (Eitzinger et al., 2008). Until 2050, the vegetation period for permanent crops will, on average, start 14 days earlier. The yield of winter grain will benefit from this development, while summer grain yields decrease. Also, higher spatial differences in yield will occur due to the spatial variability of soils concerning water store capacity (Gerersdorfer & Eitzinger, 2010; Eitzinger et al., 2008). Potential yield will decrease in grassland, animal fodder, and biomass production. Additional changes will occur in viniculture (Prettenthaler & Formayer, 2013), as well as in the frequency and types of pests and diseases (Eitzinger et al., 2008). Overall, yield will in fact increase, yet volatility of these yields will also increase due to more extreme weather situations.
In the cooler regions of the March-Thaya floodplains a new trend towards an increased corn and soy cultivation is observed. Farmers are likely to shift to high yield cultivars of soy, which is much easier and cheaper than a shift to permanent cultivars.

Milestones of WP 2

- ☑ Selection of suitable test sites
- ☑ Understanding of actual climate conditions
- ☑ Understanding of climate change scenarios of both test sites
- ☑ Data collection for the two test sites including climate data, GIS-Data, soil quality, and structural data concerning farm management, administration, etc.

WORK PACKAGE 3 - Development of agro-economic models for climate scenarios

WP3 was dedicated to the development of scenarios regarding climate change and land use change in the selected test regions. Furthermore, the WP lead to the identification of relevant decision criteria as input for the discrete choice experiment, simulating land use decisions of farmers in the selected test regions. The local climate change scenarios developed in WP2 by BOKU-Met were transformed into consequences on agriculture and forestry using the actual agro-climatological conditions and impact assessments. Existing and new agricultural production systems were examined based on their applicability under the predicted climate situations. Economic parameters like investments necessary for the implementation of new technologies, price developments, and the future design of the CAP, as well as social aspects and potential consequences for the farm as a whole were considered. The latter point needed to be considered to guarantee suitability of a (new) production scheme into the existing farm system regarding effort capacity and competences of the farmer.

<u>Economic situation and agricultural scenarios of the March-Thaya floodplains</u>

<u>Current situation:</u>

The March-Thaya floodplains cover three municipalities in the "Kleinproduktionsgebiet[1] March" and ten municipalities in the "Kleinproduktionsgebiet Östliches Weinviertel". Overall, the total area of communities within the test region comprises 45,200 ha. 11,700 ha are of high nature conservation value (designated as Ramsar area and Natura 2000 site)), and 33,000 ha are used as agricultural land. The region is characterised by high-yield and low precipitation. The site quality in the region tends to increase from North to South (Figure **3**).

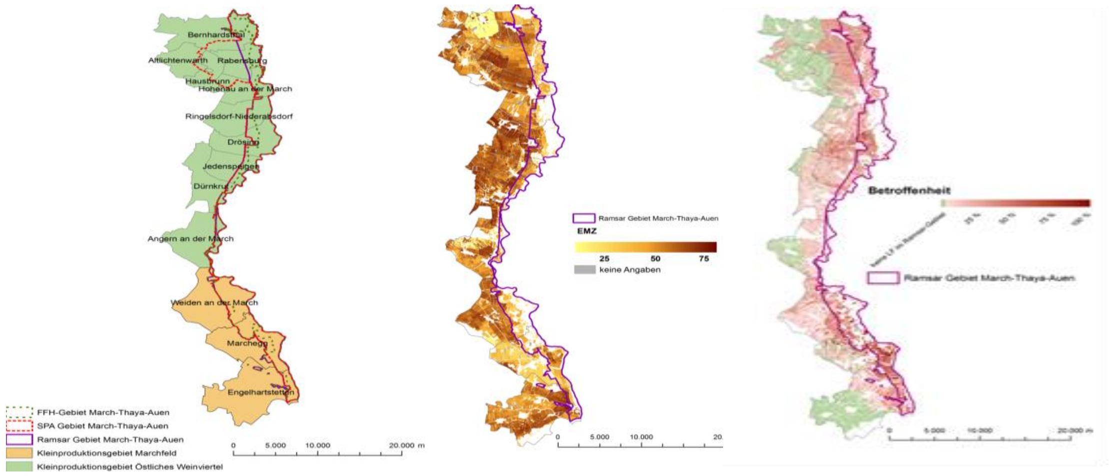

Figure 3. Municipalities „Kleinproduktionsgebiet" and soil quality (EMZ) of March-Thaya floodplains

<u>Climate change scenarios:</u>

Differences in the ownership structure in the northern and southern part of the test region were recorded. Small, heterogeneous farms are frequent in the South, while farms with a size of 100-500 ha cultivate a large portion of the arable land the North. The majority of farms have only a small portion of their land located within

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[1] Small production area (geographical unit, which covers regions with comparable site qualities and other agricultural production conditions)

the Ramsar area. Permanent grassland is found almost exclusively within the floodplains of the Ramsar site. The average proportion of grassland is 12% in the Ramsar site and 3% in the total area. Crop rotation is dominated by winter wheat and spring barley. Sugar beets also have a very important position in the crop rotation system. Furthermore, the production of corn has increased significantly in the recent years.
Gandorfer and Kersebaum (2009) confirmed, that climate change may not necessarily have a negative impact on agricultural production within the study region. It is expected, that water shortage and drought occur more frequently within the rather dry region. Nevertheless, it is projected, that the change of the underlying conditions can be easily compensated through the adjustment of plant cultivation management strategies. Existing irrigation technology can still be used, as ground water supply will still be available. Yields may even increase due to the combination of an extended growing season and an optimization of irrigation systems.

Overall, it is expected that the uncertain market and agricultural policy framework outweigh the effects of climate change. Therefore, the effects of climate change on land-use focus primarily on indirect effects like the individual adaptive strategies of farmers to changing conditions in agricultural policy, which are implemented as a reaction to climate change. Table 1 shows the status quo of arable land and its cultivation in the floodplains.
The development of cash crop cultivation income is modelled on the basis of the status quo crop rotation, the yields for the various producer price levels (Table 1), and the site-specific assumptions regarding to the revenue impacts of climate change and irrigation. Table 2 illustrates the gross margin (GM) depending to climate change and irrigation.

Table 1. Assumptions to "arable land" of March-Thaya floodplains

	Share of crop rotation (%)	Earning level (t/ha)	minimum (EUR/t)	Producer price Median (EUR/t)	maximum (EUR/t)
GLÖZ A/ flower strips	8 %	-	-	**-**	-
winter barley	4 %	7	132.6	**149.9**	198.8
sunflowers	4 %	4	287.6	**353.5**	462
durum	5 %	7	265.7	**258.2**	310
winter rye	5 %	5,2	130.1	**158.3**	214.4
winter rape	7 %	4,5	350	**331.7**	393.2
sugar beet	8 %	100	37.5	**39.4**	42.5
summer barley	19 %	5	185.2	**173.3**	263.8
wheat	40 %	8	151.2	**179.5**	232.2

Table 2. Economic development of cash crops in regards to climate change and irrigation (irrigation I: low irrigation; irrigation II: intense irrigation) in the March-Thaya floodplains

	Max	**GM Median**	**Min**
Status quo	1102	623	310
Yield reduce by 30% WITHOUT irrigation	622	287	68
Yield reduce by 15%% WITHOUT irrigation	856	448	182
Earning compensation through irrigation I	897	417	104
Earning compensation through irrigation II	994	515	202
Yield increase by 5 % through irrigation I	961	458	129
Yield increase by 5 % through irrigation II	1059	555	227
Yield increase by 10 % through irrigation I	1040	512	168
Yield increase by 10 % through irrigation II	1137	610	266

Changes in existing frameworks, particularly in the climate-oriented funding instruments, bear the potential to completely change the current land use, which will no longer be based on present crop rotation. Considering special support programs and farm risk management measures, the cultivation of "natural grassland" or energy wood could become attractive in the nature sensitive area of the Ramsar site. The cost of short-rotation plantations and permanent grasslands are shown in Table 3 and Table 4. The significant differences in short-rotation economy are dependent on price level, yield level, and harvesting. In general, it is clear that harvesting with wood chip harvesters guarantees the highest efficiency. In an extensive, permanent grassland management, 50 to 175 € per ha can be achieved.

Table 3. Economy of short-rotation in dependence to price yield level and earning technology in the March-Thaya floodplains

Mechanisation	Price wood chips (EUR/ t dry matter)	Yields (t_{atro} /ha/ year)		
		8	10	12
High degree of mechanisation	60	36.6	*106.0*	175.4
	80	178.4	283.3	388.1
	100	320.2	460.5	600.8
High degree of mechanisation	60	-258.8	-263.2	-267.7
	80	-117.0	-86.0	-55.0
	100	24.8	91.3	157.7

Table 4. Economy of extensive grassland

GM Min	GM Max
75 Euro/ha	250 Euro/ha

Economic situation and agricultural scenarios of the Feldbach region

Current situation:

The second study area, the "Wegener Netz", covers 14 municipalities in the east of Styria. The area stretches over 176,000 ha in total and incorporates 7,400 ha of arable land. The agricultural land-use is concentrated in the valley bottoms, while the slopes are mainly used for grassland, vine, and fruit cultivation (Figure **4**).

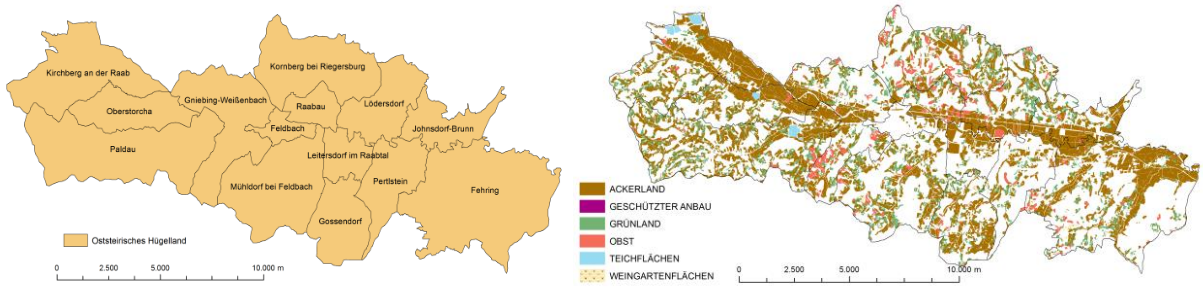

Figure 4. Municipalities and agricultural land use in southern Styria

Figure **5** show the share of corn on total arable land and the livestock density in the region. The production in the valleys concentrates on corn, pumpkin, and rapeseed grown as winter-cover crop. The share of corn in crop rotation is very high in the east and decreases to the west. The livestock intensity in the region is very high.

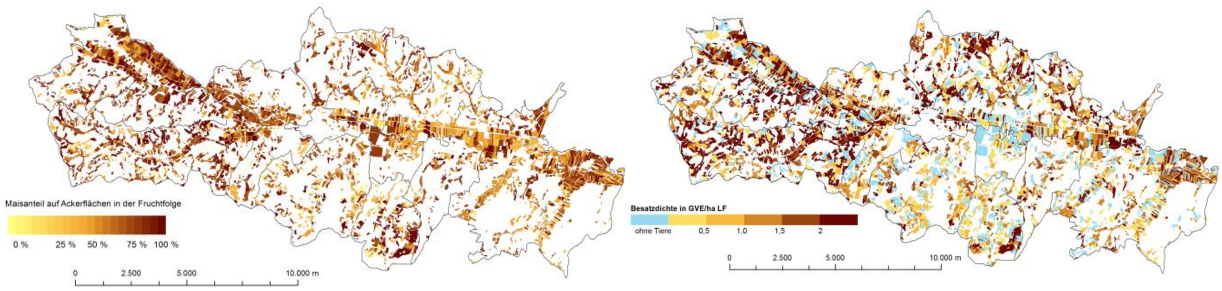

Figure 5. Share of corn and livestock density in LU/ha in southern Styria

The typical farm in southern Styria is a pig or poultry farm, which cover more than 50% of the total agricultural land. Farm sizes in the region range from 15 and 50 ha (18.6 ha average). Large farms over 50 ha are rare. A spatial distribution of farm size structure between the valley and slopes is observable. Small farms with a total farm size of less than 5 ha mostly exist on slopes. Pig farming is a key driver of the intensive land-use in form of corn cultivation in the valleys. Corn is used almost exclusively as fodder on pig fattening farms. The remaining agricultural land is used for the cultivation of forage and cash crops. The share of corn in the crop rotation adds up to about 75%. Grazing livestock farms cover 17.2% of the total agricultural land. The share of permanent crops in total agricultural land is about 50%. Cash crop farms cover 13% of the agricultural land. A small amount of farmers (6%) are farming fruit and/or wine. The average size of this type of operation is about 10 ha.

Climate change scenarios:

The climate change scenarios for this region project an increase in the average temperature and a decrease in precipitation. However, additional irrigation measures, which may offset the deteriorating situation, are not applicable because of the poor water availability in the region. Changes to current conditions may have three direct impacts on land use: (1) reduction of corn yields due to rainfall reductions, (2) diverse effects on oil pumpkin cultivation due to heavy precipitation, and (3) improved cultivating options to produce temperature affine fruits and viticulture.

1) Reduction of corn yields due to rainfall reductions

The decline in corn yield has a significant impact on pig, poultry, and grazing livestock farms. A decline in corn yield will require massive adaptation in land use. The following measures are possible:

- Expansion of corn to 90% and compensation of shortages through corn purchases
- Restriction of corn production and switch to feed grain production
- No change of cultivation but short-term reduction of livestock
- Give up pig and poultry production and convert to cash crop production
- Leasing of additional land

A decline in corn yield will make the additional foraging necessary for grazing livestock (GL) farms. The adaptation potentials differ for small- and large-scale GL farms:

Small-scale GL-farms:	Large-scale GL-farms:
• Abandonment of livestock farming	• Cultivating clover instead of corn
• Cultivating clover instead of corn	• Increase cultivating agricultural land

Cash crop farms will also face effects of corn yield reductions. The following trends are expected: little or no change in crop rotation (incorporates a rise in corn prices) or reduction of corn production and switch to grain.

2) Effects on oil pumpkin cultivation by heavy precipitation

Adaptions in oil pumpkin cultivation, as a response to the risk of heavy precipitation, mainly affect cash crop farms. The following adaptation strategies are possible: little or no change in the crop rotation (incorporates a rise in oil pumpkin prices) or reduction of pumpkin cultivation and switch to grain.

3) Improved cultivating options to produce temperature affine fruits and viticulture

The predicted increase in temperature can significantly improve the possibility to cultivate temperature-adapted fruit and viticulture. However, the possibilities to profit from these circumstances are limited due to path dependency.

The discussions shows that shifts from pig farms to permanent crops such as wine or fruit cultivation are not likely to happen for several reasons: wine and fruit cultivation needs a special training, professionalism, and experience. Therefore, only experienced farmers may increase fruit and viticulture. The amount of wine acres within the EU cannot be expanded, which further limits the likelihood of a shift.

WP 3 identified relevant decision criteria for the discrete choice experiment. These criteria include salient attribute levels that are likely to influence farmers' land use decisions.
A workshop with selected stakeholder in the two test regions and a meeting with the advisory board built the basis for pre-tests and selection of the attributes.

Milestones of WP 3

- ☑ Detailed insight and scenarios in economic situations and agricultural scenarios under conditions of climate change for both test sites
- ☑ Analysis of economic alternatives and potential shifts
- ☑ Definition of crucial attributes that are likely to influence farmers at the two test sites
- ☑ Workshops with selected stakeholders

WORK PACKAGE 4 - Development of survey and discrete choice experiment and implementation of the survey in the test regions

WP 4 was devoted to the development, pre-testing, and conduction of the farmer and agricultural operation survey. In addition to questions regarding farmers' perception of climate change and various other behaviour-influencing factors (e.g. supporting policies and programs, time budget, and land use traditions), the survey contained the stated choice model; the core of the analysis. Stated choice models are behavioural models that recognize that complex decisions are based on several factors considered simultaneously and ask respondents to identify the trade-offs they are willing to make between different factors within the choice task. These models assume, that individuals behave in ways that maximize their utility and their relative satisfaction for a particular alternative (Louviere et al., 2000). The discrete choice experiment (DCE) aimed to explain farmers' land-use decisions in the face of climate change in the two test regions and possible agro-economic adaptation strategies. The DCE further examined programmatic factors landowners may consider in general and in the context of climate change and agro-economic conditions when they decide to participate in an incentive program (e.g. financial incentives, technical assistance, contract duration, etc.). Attributes for the DCE were identified in WP3 and differ for the two test regions. All attribute levels were created and refined based on current literature, previous research in the target areas, expert opinion, focus group sessions, and the findings of WP 2 and 3.
Attributes and levels for the March-Thaya floodplains DCE are shown in Table **5**. Due to the diverse future impacts on the different types of management, the DCE provided the option to choose between cash crop, short-rotation, and grassland cultivation.
Farmers in the March-Thaya floodplains were asked to select one of the three cultivation alternatives based on the premise that they are cultivating a 3 ha large and partially flooded area within the floodplains. In order to select their best-fit alternative, farmers had to trade-off all attributes simultaneously and take non-existing potential future funding schemes and fluctuations into account.

The DCE for the Feldbach test region differed significantly from the layout of the March-Thaya floodplains DCE as it consisted of two parts. The first part (4 DCEs) contained a trade-off between two pig fattening scenarios. The second part (2 DCEs) aimed to investigate if farmers would temporarily switch to cash crop cultivation if the revenue for hogs would decrease and the cost for fodder be at maximum price. Table 6 contains the levels for choice task 1 (pig fattening trade-off) and choice task 2 (pig fattening and cash crop trade-off).

Table 5. DCE attributes and levels for the March-Thaya floodplains

	Alternative A	Alternative B	Alternative C
Type of management	**Cash crop** cultivation	**Short-rotation** cultivation	**Grassland** cultivation
Gross margin per ha per year	• 300 € • 450 € • 750 € • 1200 € • 1650 €	• 150 € • 375 € • 550 € • 725 €	• 75 € • 150 € • 250 €
Environmental premium per ha per year	• None • Greening premium 50 € • Greening premium 150 €	• None • Climate premium 50 € • Climate premium 100 € • Climate premium 150 €	• ÖPUL WF-funding 300 € • ÖPUL WF-funding 600 € • ÖPUL WF-funding 900 € • ÖPUL WF-funding 1200 €
Duration of cultivation obligation	• 1 year	• 15 years • 20 years • 25 years	• 7 years
Potential price fluctuations	• Low • Medium • High • Very high	• Low • Medium • High	• Low
Likelihood of complete crop failure	• Every 2 years • Every 3 years	• Every 10 years • Every 25 years	• Every 5 years • Every 10 years • Every 15 years

Table 6. DCE attributes and levels for DCE 1 and 2 in Styria

	Choice Task 1	Choice Task 2	
	Pig fattening	**Pit fattening**	**Cash crop**
Fodder costs per hog (carcass weight 95 kg)	• 53 € • 60 € • 67 € • 75 €	• 67 € • 75 €	• 200 € expected revenue for corn • 240 € expected revenue for corn
Revenue per hog (carcass weight 95 kg includes sales tax)	• 135 € • 145 € • 155 € • 165 €	• 135 € • 145 €	• 180 € expected revenue for cash crops • 220 € expected revenue for cash crops
Annual climate premium (crop rotation regulation) per ha per year	• 0 € - max. 75% corn; 1x in 4 years no corn • 150 € - max. 66% corn; 1x in 3 years no corn • 300 € - max. 60% corn; 2x in 5 years no corn • 450 € - max. 50% corn; 1x in 2 years no corn	• 0 € - max. 75% corn; 1x in 4 years no corn • 150 € - max. 66% corn; 1x in 3 years no corn • 300 € - max. 60% corn; 2x in 5 years no corn • 450 € - max. 50% corn; 1x in 2 years no corn	• 0 € - max. 75% corn; 1x in 4 years no corn • 150 € - max. 66% corn; 1x in 3 years no corn • 300 € - max. 60% corn; 2x in 5 years no corn • 450 € - max. 50% corn; 1x in 2 years no corn

The surveys were pre-tested with stakeholders and other non-specialists to guarantee comprehensibility and ease of operation. In the March-Thaya floodplains, a total of 147 farmers completed either the online or the paper survey during the months of January to September 2012. In southeast Styria, 91 farmers responded fully to the online or paper survey between April and October 2012.

Milestones of WP 4

- ☑ Development of full list of attributes for each test site
- ☑ Development of two different questionnaires with choice models
- ☑ Workshops with target groups/stakeholder in test regions to promote the surveys

WORK PACKAGE 5 - Visualization of the results and Discussion of Policy Options

WP 5 focused on data exploitation through simple and multivariate analyses and latent class analyses based on the DCEs, and on the visualization of the results for the two different landscapes. Furthermore, this WP aimed at highlighting potential policy implications.

Survey Results March-Thaya floodplains

Farm structure

The 147 surveyed famers cultivated a total of 11,226.9 ha land with an average acreage of 76.3 ha. For the majority of participants (N=116, 81%) farming was the main livelihood (full-time farmers) while 19% (N=28) farmed as a secondary occupation (part-time farmers). Most farms were conventionally managed, whereas 13% (N=19) managed their farm biologically.
If farmers owned the cultivated land, the mean arable acreage was 42.7 ha. The arable acreage was significantly smaller when the property was leased or rented (36.3 ha). Further differences in arable acreage were found comparing full- and part-time farmers.

Respondent structure

The majority of farmers were between 36 and 55 years old. All age categories were represented in the sample (Table 7). Almost 2/3 of all participants over the age of 50 already had a successor (Table 8).

Table 7. Age of participants

Age	Percentage
under 25 years	6.8 %
26-35 years	10.8%
36-45 years	31.1%
46-55 years	25.8%
56-65 years	14.9%
over 66 years	0.7 %

Table 8. Successors of farmers over the age of 50

Successor	Percentage
Yes	73.9%
No	17.4%
Eventually	8.7%

Premiums substitutions and interest in future contracts

Almost all farmers participated in the ÖPUL program (99.3%). Only a small number of farmers (N=35, 24.1%) receive premiums over 400 Euro, while the majority (N=110, 75.9%) receives less than 400 Euros. A little over one third (34.5%) of all farmers do not have existing nature conservation contracts. Most of the existing contracts regard the closure of arable land, the conservation of meadows or ley farming, or other contents.
If current contracts expire, 48% of farmers would be willing to set up new contracts. Over half of all farmers are either undecided (30%) or would not sign new contracts (22%). Reasons for indecision include missing compensation (10.1%, N=15), excessive administrative effort (8.8%, N=15), lengthy contract periods (8.1%, N=12), insufficient equipment (2%, N=3), insufficient consultation (1.4%, N=2), or too short contract periods (0.7%, N=1).

Likelihood and type of land use changes

Most farmers (dependent on land-use between 82.1% and 97.8%) are not planning on changing the land-use within the next five to ten years. Most of the planned changes are smaller than 5 ha. The most likely change on areas under 5 ha concern the change to perennial energy crops (16.4%), the renewal of ÖPUL (14.3%), and the switch to annual energy crops (13.6%). Compared to land-use changes on areas under 5 ha, changes over 5 ha are unlikely. Areas over 5 ha may be newly irrigated (5.7%), or farmers will decide to pull out of (4.4%), or renew (3.6%) ÖPUL. Less than 3% (N=4) of farmers are likely to apply other land-use changes on areas over 5 ha (Figure 6). The most unlikely land-use change was transforming grasslands into fields.

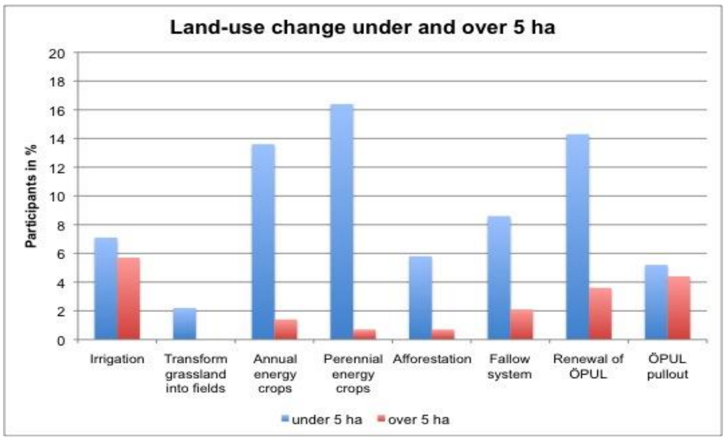

Figure 6. Land-use change under and over 5 ha

Analysing full- and part-time farmers shows, that both groups primarily do not plan on making any changes to their land-use (full-time: 82.1-98.2%; part-time: 80-100%).

Future farm development

Based on Figure 7, it is more likely that farmers will expand their farm, intensify farming, or specialise on a particular crop than reduce or demise the amount of acreage, change to a different management model (i.e. conventional, biological), or terminate business. Full-, as well as part-time farmers follow the same trend with full-time farmers stating each future development as being more likely than part-time farmers. No statistically significant differences were found between full- and part-time farmers.

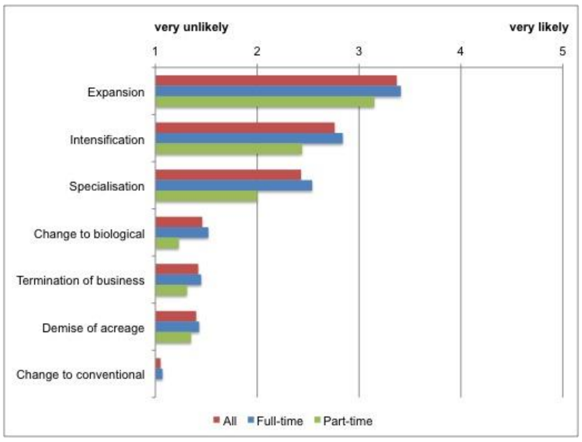

Figure 7. Potential future farm development

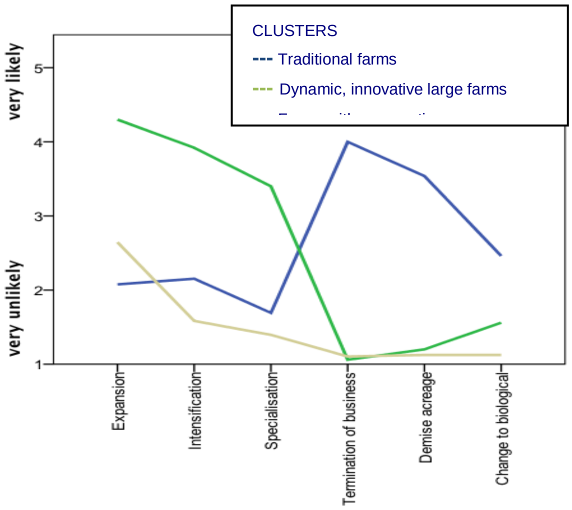

Figure 8. Mean likelihood of development

The connection between the future development strategies was analysed through a cluster analysis. A 3-cluster solution emerged from the hierarchical cluster analysis as the most justifiable and interpretable classification. Figure 8 shows, how future development items relate to the three clusters (Traditional clusters N=14 (9.5%), Dynamic, innovative large farms N=68 (45.9%), Farms with perspective N=66 (44.6%)).

Recent cultivation

1. Crops

The dominating type of cultivation is cash crop cultivation. Over 95% of farmers stated to cultivate a minimum of one (full-time famers average: 76.4 ha; max: 199 ha) or two ha (part-time farmers average: 55.9 ha; max: 165 ha) of cash crops. Further types of frequently cultivated crops include wine (29.1%, average 6.21 ha), hay meadow (single reaping; 23.0%, average 4.7 ha), and ley farming (11.5%, average 7.8 ha).

2. Livestock

Only 10% (N=13) of the surveyed farmers kept additional livestock.

Perception of climate change and adaptation strategies

The majority of farmers (64.2%) already recognise the first effects of climate change, while 7.5% expect to see effects later on, 25% are undecided if climate change will even occur, and 2% do not believe in climate change. Farmers who do not believe in climate change evaluate the climate change debate as scaremongering and point out that climatic changes go beyond the anthropological records. Nevertheless, 74.3% of farmers believe that climate change will have some kind of effect on agriculture in Lower Austria. These effects include weather extremes, freak weather, more flooding, increase of temperature leading to hotter summers and winters, severe droughts, increasing fluctuations of temperatures, heat waves, a decrease in precipitation so that irrigation systems will be necessary, uneven distribution of precipitation, longer drought periods, more and new pests, changes in crop rotation, altered cultivation potentials, and changes in harvest times.

Landscape preferences and potential future changes

Farmers evaluated ten images of compartmentalized and large-scale landscapes regarding their attractiveness. Results can be separated into three main groups: images with good, mediocre, and weak impression. Most images made a mediocre impression (N=5) and only one picture (Picture 1) was rated with a weak impression. Only minor differences exist between full- and part-time farmers (e.g. picture 5, 7, 8, and 10) (Figure **9**).

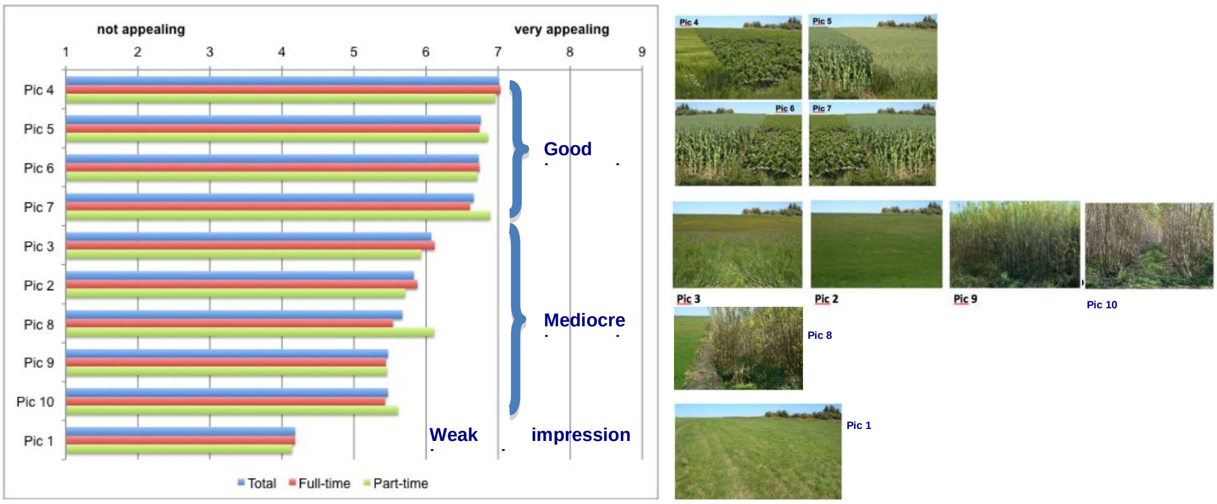

Figure 9. Preferences of future landscapes

Future entrepreneurial decisions of farmers

Based on the decisions of the farmers in the discrete choice experiment, a latent class model was calculated that identified various farmer segments that differ with regards to their preference for farming scenarios under various climatic conditions. It was possible to model trade-offs between various attributes and to develop different scenarios based on possible agro-economic impacts, climatic conditions, and different policy options. A decision support system (DSS) explains how the various attributes influence each other in the farmers' decisions. The DSS shows the differences between the three known classes traditional farm, dynamic, innovative farm, and farms with perspective.

Main outcome and landscape prognosis for the March-Thaya floodplains

The analysis of the images and the future development showed a significant trend towards a more intensified land use. To answer the overall question about potential influences of climate change on land use (including enhancements of production opportunities), we used the DSS, which was based on the choice experiment results. The DSS underlines the findings from other analyses. Even on small areas (i.e. 3 ha) that have been dominated by grassland in the past, but will experience flooding within a few years, the probability of a high contribution margin of cash crops (e.g. corn) will undoubtedly lead to an intensification of the land use. This shift to a more intensive land use would even occur if the contribution margin of grassland would be subsidized with 600 €/ha for conservation purposes. In this case (Figure **10**), more than 50 % would still prefer cash crop. Explicitly traditional farms are less sensitive on incentives and conservation funding.

	Marktfrucht	Kurzumtrieb	Grünland
Deckungsbeitrag	€ 1,650	€ 725	€ 250
Umweltprämie	keine	Klimaförderung € 100	€ 600 ÖPUL WF-Förderung
Bindung	1 Jahr	15 Jahre	7 Jahre
Schwankung	gering	gering	gering
Ausfall	alle 3 Jahre	alle 10 Jahre	alle 15 Jahre

	Marktfrucht	Kurzumtrieb	Grünland
Alle	56.36%	27.09%	16.56%
Tradition. Betrieb	85.30%	12.62%	2.09%
Dynam. Großbetrieb	61.25%	25.02%	13.73%
Betrieb m. Perspek.	46.73%	31.11%	22.15%

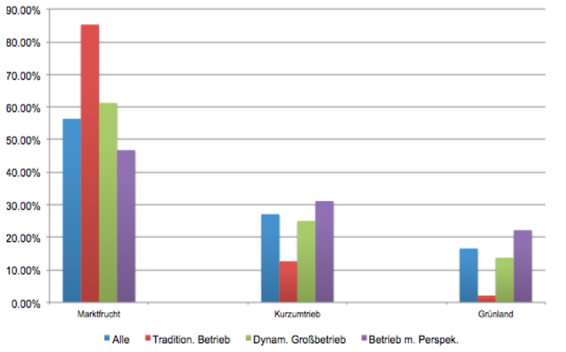

Figure 10. If the contribution margin for cash crops is high, short-rotation and grassland remain less attractive

An increasing risk of flooding, significant funding, and average contribution margins for cash crop enhance the opportunities for short rotation (Figure 11).

	Marktfrucht	Kurzumtrieb	Grünland
Deckungsbeitrag	€ 1,200	€ 725	€ 250
Umweltprämie	keine	Klimaförderung € 100	€ 600 ÖPUL WF-Förderung
Bindung	1 Jahr	15 Jahre	7 Jahre
Schwankung	sehr hoch	gering	gering
Ausfall	alle 3 Jahre	alle 10 Jahre	alle 15 Jahre

	Marktfrucht	Kurzumtrieb	Grünland
Alle	29.46%	43.78%	26.76%
Tradition. Betrieb	64.51%	30.45%	5.04%
Dynam. Großbetrieb	28.21%	46.36%	25.43%
Betrieb m. Perspek.	23.04%	44.95%	32.01%

Figure 11. Fluctuations and risks (e.g. flooding) are likely to decrease the preferences for cash crops

Survey results Feldbach region

The substantial diversity and segmentation of farm types forced us to focus on one type only, as influencing factors and attributes in the choice experiment would otherwise differ for each type and would not allow for an informative result. We decided to address the largest farm type: pig farmers.

Farm structure

Surveys were sent to almost 400 farmers (300 mail surveys, 82 online surveys) and 91 farmers returned completely filled out and legitimate surveys. The 91 surveyed famers cultivated a total of 3,913.6 ha land with an average acreage of 43.5 ha, which is far less than in the March-Thaya floodplains. For the majority of participants (N=64, 70.3%) farming was the main livelihood (full-time farmers), while a little less than one third of participants (N=27, 29.7%) farmed as a secondary occupation (part-time farmers). Most farms were conventionally managed (97.8%) and only 2.3% (N=2) managed their farm biologically.
If farmers owned the cultivated land, the mean arable acreage was 21.5 ha, which was a little less than cultivated properties that were leased or rented (21.5 ha). Further differences in arable acreage were found comparing full- and part-time farmers.
Respondent structure

The majority of farmers were between 25 and 35 years old. This predominantly young cluster may be explained through the surveying method, as students of a local agricultural school were asked to engage their parents or grandparents in the survey and support their answering process. Nevertheless, all age categories were represented in the sample (Table **9**). Almost 1/3 of all participants over the age of 50 already had a successor (Table 10).

Table 9. Age of participants

Age	Percentage
under 25 years	40.0%
26-35 years	12.2%
36-45 years	16.7%
46-55 years	22.2%
56-65 years	8.9%

Table 10. Successors of farmers over the age of 50

Successor	Percentage
Yes	23.1%
No	5.5%
Eventually	20.9%
Not answered	50.5%

Premiums substitutions and future contracts

The majority of farmers receive a premium between 201 and 360€ (68.1%), but do not participate in ÖPUL (60.2%). Only 14.3% receive a premium above 360€. Only 40.2% (N=32) participate in ÖPUL. Table **11** shows the distribution of premiums among full- and part-time farmers.

Table 11. Premium by full- and part-time farmers

	under 360 €	over 360 €	ÖPUL
Full-time farmers	81.0% (N=47)	18.9% (N=11)	41.9% (N=26)
Part-time farmers	91.7% (N=22)	8.4% (N=2)	34.6% (N=9)

A little over one third (34.1%) of farmers do not have existing nature conservation contracts. Most of the existing contracts regard the conservation of meadows or fields.
If current contracts expire, less than a third (24.6%) of Styrian farmers would be willing to set up new contracts. Most farmers are either undecided (32.8%) or would not sign new contracts at all (42.6%). Reasons for the indecision include missing financial compensation (84.6%, N=22), too many controls (61.5%, N=16), excessive administrative effort (46.2%, N=12), lengthy contract periods (42.3%, N=11), integration into corporate structure is difficult (42.3%, N=11), too much work (30.8%, N=8), contractual penalties are too high (26.9%, N=7), insufficient equipment (11.5%, N=3), or other reasons (7.7%, N=2).

Likelihood and type of land use changes

Most farmers (dependent on land-use between 51.1% and 85.6%) are not planning on changing the land-use within the next years. Most changes are planned on areas under 2 ha. The most likely changes on areas under 2 ha include afforestation (20.0%), an increase of pumpkin cultivation (15.6%), and an increase or introduction of other cash crops (15.6%). Changes to land-use on areas over 2 ha concern the introduction or increase of other cash crops (17.8%), the increase of pumpkin cultivation (14.4%) or the introduction of annual energy crops (7.8%). While the least likely land-use change under 2 ha was the alteration of ÖPUL-contracts (renewal of ÖPUL 2.2%; withdraw from ÖPUL 2.2%,) areas over 2 ha will most likely not experience a land freeze or a renewal of ÖPUL (both 1.1%).

Future farm development

Based on Figure 12, it is more likely that farmers will expand their farm, intensify farming, or increase livestock farming than reduce or terminate livestock cultivation, change to a different management model (i.e. biological), or demise acreage. Full-time farmers also indicated that it is quite likely that they will switch to a conventional management model. Significant differences between full- and part-time farmers on a 5% level exist for the likelihood of additional land leases ($t=2.047$, $p=0.044$) and on a 10% level for the likelihood of changing to a conventional management model ($t=1.959$, $p=0.067$).

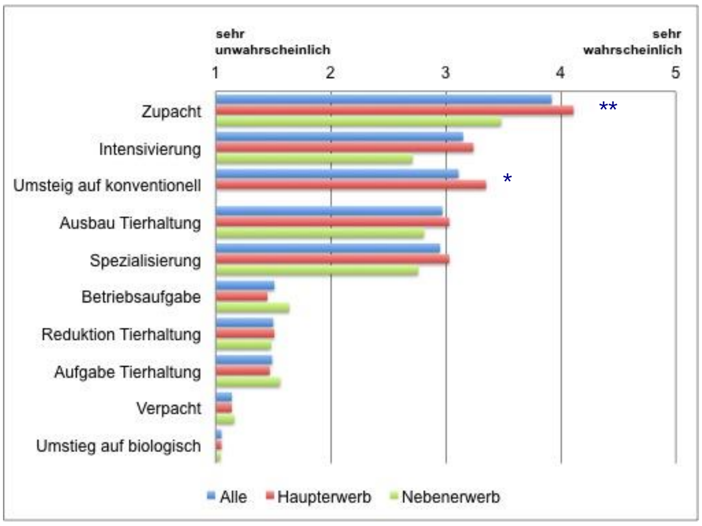

Figure 12. Potential future farm development
*** indicates significance at a 5% level, * indicates significance at a 10% level*

Recent cultivation

1. Crops
Every farmer indicated to cultivate corn on an average area of 27.8 ha (min. 0.7 ha, max. 103 ha; full-time average: 23.8 ha; part-time average: 16.0 ha). Further types of frequently cultivated crops include pumpkin (59.3%, average 5.4 ha), other cash crops (39.6%, average 6.7 ha), and hay meadows (single reaping; 28.6%, average 2.6 ha). The cultivation of other plants (i.e. cottonwood, horse radish, barley, multiflora beans, Christmas trees, rapeseed, rye, bell beans, etc.) was the least applied cultivation method (4.4%, average 14.0 ha).

2. Livestock
A total of 91.2% of the surveyed farmers kept additional livestock.
On average, 82.7% of pig fodder is produced on the individual farm. Full-time farmers produce 81.5%, part-time farmers an average of 86.1%.

Expansion of livestock cultivation
Most farmers (66.0%) consider an expansion of livestock cultivation (pigs). However, only 28.6% would able to expand beyond the current boundaries and 35.2% indicate to be restricted in their expansion. For one fifth of the farmers, it is impossible to expand. Most frequent restrictions for expansion concern the position of the farm (within village area, municipal boundaries, distance to other properties), unavailable areas (no areas available, restricted farm acreage), and issues with neighbours (abutting owners, odor nuisance, restrictions through the federal immission control act). Overall, farmers enjoy pig farming and they believe in their

significant contribution to Austria's food supply and cultural landscape. Only a few farmers state that pig fattening becomes less of a profitable occupation.

Perception of climate change and adaptation strategies

The majority of farmers (70.0%) already recognise the first effects of climate change, while 12.2% expect to see effects later-on, 13.2% are undecided if climate change will occur, and 4.4% do not believe in changes. Farmers who do not believe in climate change state that older people know of previous climate changes. Nevertheless, 60.0% believe that climate change will have some kind of effect on agriculture in Styria. These effects include changes to the time of cultivation, crop rotation, and type of cultivation, soil erosion, increasing aridity and droughts, changes in revenue, a reduction of spruce due to bark beetles, changes in crop protection, a plummeting of aquifers and subsequent water scarcity, changes to crop variety, an increase in weeds and pests, and an increase in severe weather events.

Landscape preferences and potential future changes

Farmers evaluated five images (Figure 14) of compartmentalized and large-scale landscapes regarding their attractiveness and their desire to cultivate these landscapes on a scale from 1 (low attractiveness and no cultivation desire) to 9 (very high attractiveness and high cultivation desire). All images tended to leave a similar mediocre impression (Figure 13). Full-time farmers tended to prefer picture 2, while part-time farmers favour picture 5 and 1. All farmers indicated that they would prefer to cultivate image 2 above all other images, followed by images 3 and 5. Image 4 was the least desired cultivation land (Figure 15).

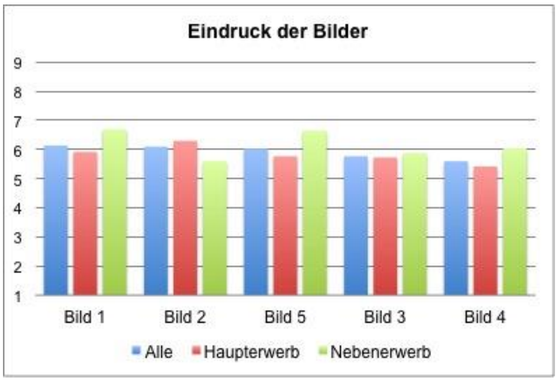

Figure 13. Impression of landscape images

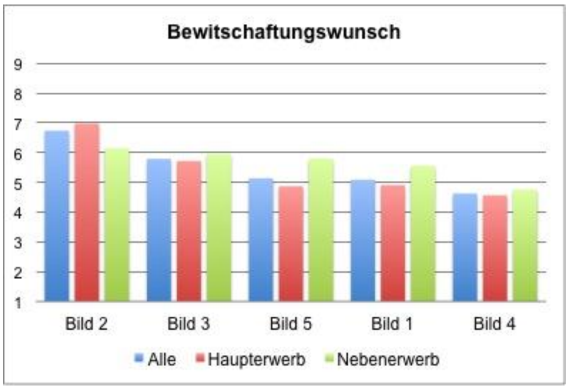

Figure 15. Desire to cultivate land on image

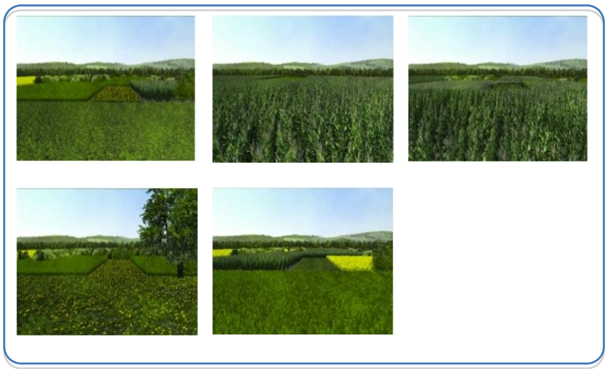

Figure 14. Landscape preferences images

Main outcome and landscape prognosis for the Feldbach region

The choice experiment investigated interactions of fodder costs, the revenue per hog, and (an invented) annual climate premium, which aimed at regulating crop rotation. The results revealed a significant difference between large (> 25 ha) and smaller (< 25 ha) farms. The incentive (climate premium) only seemed to have a significant impact on larger enterprises (Figure 16). Smaller farms are probably less flexible regarding the small amount of land, as any area is needed to cultivate corn. The dependency on corn is so strong, that other attributes only have minor effects on farmers' decisions. Therefore, no current opportunities exist to successfully steer the overall development through political instruments such as a voluntary climate premium for crop rotation. The average farm size in the region is currently about 13 ha. However, the trend points towards an increase in the size of units. This change will potentially lead farm sizes, whose rotation and diversity may be positively influenced. A potential (forced or voluntary) shift from corn to grains may further support the preservation or even trigger a slight increase in diverse landscapes with different use patterns.

	Alternative A	Alternative B
Futterkosten	67.00 €	53.00 €
Erlös pro Mastschwein	135.00 €	135.00 €
Jährliche Klimaprämie	0.00 €	150.00 €

	Alternative A	Alternative B
All	40.6%	59.4%
C1 - Eigenfläche unter 25 ha	47.2%	52.8%
C2 - Eigenfläche über 25 ha	0.3%	99.7%

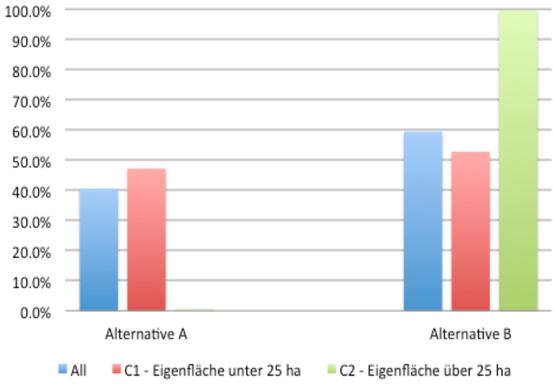

Figure 16. Highly influencing climate premium

Milestones of WP 5

- ☑ Survey and latent class analysis
- ☑ Development of decision support system
- ☑ Workshops with target groups/stakeholder in test regions to promote the surveys

WORK PACKAGE 6 - Dissemination and Knowledge Transfer

WP 6 is devoted to dissemination and knowledge transfer. This included dissemination through workshops in each selected test site, which included farmers, agricultural operations, stakeholders, regional and federal policy makers, as well as the interested public. Workshops, presentations, and publications are listed under "4 Utilization".

Milestones of WP 6

- ☑ Reports and workshop in the test regions
- ☑ Presentation of results on national and international conferences
- ☑ Publications in national and international (scientific) journals

4 Schlussfolgerungen und Empfehlungen

Overall, the results illustrate that, under the conditions of climate change, landscape changes are likely to entail negative effects for ecosystem services, biodiversity, and recreation. The trend to a more intensive land use is supported by the results of the future planning options, the segmentation, the landscape evaluation, the reduced interest in conservation contracts, and the findings in the Decision support system (DSS).

The following findings haven been derived from the project by the project team:

The results combine climate change and agro-economic scenarios for the selected test regions with the analyses of perceptions and plans of individual agricultural operations. This interdisciplinary approach shows, that the extent to which farmers are able to adopt new agro-economic options vary considerably between the test sites depending on climatic, edaphic, and socio-economic conditions.
For the Lower Austrian test site, the results illustrate, that, under the conditions of climate change, landscape changes are likely to entail negative effects for ecosystem services, biodiversity, and recreation. The trend to a more intensive land use is supported by the results of the future planning options, the segmentation, the landscape evaluation, the reduced interest in conservation contracts, and the DSS. Variances in the predicted development may only occur if the international market changes or fluctuations in the cash crop contribution margin increase. These changes would foster a more traditional land use, increase the likelihood of environmental funding, or even cause a shift to short-rotation. If the wet meadows or other marginal land should remain unchanged, the funding has to be significantly higher than today or/and should be combined with legal protection (e.g. nature conservation areas). It cannot be expect that traditional land use remains the same under changing conditions and shifting contribution margins.

The land-use patterns and ownership structures differ significantly between Styria and the March-Thaya floodplains. Whereas in the MTA the farming styles are quite uniform, in Styria they vary considerably between the valleys and the adjacent hills. This diversity may maintain the biodiversity in the future. Additional trends point towards an increase in the amount of pumpkins cultivated for seeding oil and towards a diversification of the corn-oriented production.
The trend of part-time farmers and those who intend to give up farming to increase afforestation will further contribute to the diversification of the landscape patterns. Climate change and its subsequent effects such as extreme weather conditions and the increase in frequency and types of diseases and pests are very likely to impact agriculture in the region. During the project, the ministry of environment already introduced requirements for crop rotation to reduce the corn monoculture and consequently the distribution of these treats. As the intensity of use will remain the same for other products such as grain or pumpkins, the impact on ecosystem services in Styria will remain consistent. The touristically important aesthetic quality and attractiveness of the landscape will remain the same or slightly increase. Biodiversity will (if at all) only be marginally influenced. Planned afforestation (with site-specific trees) might have a positive effect. Overall, potential effects of climate change will not lead to negative landscape changes, but to a positive trend to a more diverse landscape as preferred by the farmers themselves.

In summary, the following results and conclusions can be drawn from the project:

1. Agro-economic structures and their vulnerability to climate change

The two test sites differ significantly regarding their agro-economic structure and potential, their climatic conditions, and their potential climate change scenarios. The test site in the March-Thaya floodplains is managed by 733 farmers with an average size of 63 ha, mostly with excellent soil conditions.. The most frequently planted crops include fall wheat, spring barley, sugar beets, and winter oilseed rape. Parts of the region are regularly flooded. From an agro economic point of view, these parts may become more attractive in the future for poplar and willow cultivation. Climate change is likely to extend the current vegetation period.

The expected increases in temperature and evaporation may even generate improved conditions if irrigation systems are deployed. Within the immediate realm of the March-Thaya floodplains, the flood hazard is likely to increase. In South-east Styria, the district of Feldbach, 835 farms cultivate a total of 10 940 ha, 5 662 ha of which lie within the study area. The average farm size of 13 ha is significantly lower than in the March-Thaya floodplains. Farmers typically cultivate pigs and usually a certain percentage of their required fodder, which results in a corn production on 70% of arable acreage. Only 13% of the land is used to cultivate cash crops, and only 6% account for permanent crops such as fruits or wine. The meteorological analysis adverted to an increase in temperature, evaporation, droughts, and water shortages. Additional strains for corn and pumpkin cultivation are caused by water stress and hail.

2. Farmers' perception of climate change

The majority of farmers in the two test regions already perceive first effects of climate change. The awareness is significantly higher in Styria than in Lower Austria. Listed effects (e.g. draughts) are in both cases in line with the scientific scenarios.

3. Agro-economic trends under conditions of climate change

In Lower Austria, the trends in farm development point towards prospectively larger farms that emerge through future acquisition or leasing of arable land. Concurrently, a trend towards intensification and specialization can be observed. A switch from conventional to biological cultivation methods is unlikely. Surprisingly, no differences exist between main and secondary occupation farmers. Specialization and intensification is likely to further promote irrigation, which is considered to be an important climate change adaptation strategy. In the Styrian test region, future development and trends are heavily influenced by the size of the farm. Larger farms plan to systematically increase the share of cash crops. All farmers will still rely on pumpkin cultivation. Afforestation is exclusively envisaged by secondary occupation farmers or farmers with a farm size below 5 ha. A shift to another cultivation type (i.e. wine or fruit cultivation) seems too costly or requires extensive specialization.

4. Effects of agricultural climate change adaptation on cultural ecosystem services

A two-step approach aimed to investigate if the traditional landscape is of such high value for the farmers, that they would spare these landscapes in case cultivation would be intensified through climate change. Therefore, we asked farmers to indicate their preferences for different images of arable landscapes. In the March-Thaya floodplains, the aesthetic preferences are set on intensive grain, turnip, and corn cultivations. Typical, species-rich meadows of the floodplains are only moderately preferred. These tendencies are also reflected in the Choice experiment. It can be assumed that species-rich components of the cultural landscapes will be lost due to improved conditions for cultivation (e.g. increased temperature and irrigation). In Styria, the preference for diverse landscapes is significantly higher, in particular if these landscapes are not cultivated. If the farmers are asked to indicate their cultivation preferences, they frequently select images with a high share of visible corn area. The choice experiment indicates that Styrian farmers would also make use of the economic opportunities.

5. Options and Efficiency for agro-economic and environmental policy

The choice experiment revealed a strong dominance of value for the contribution margin of cash crops in the March-Thaya floodplains. Traditional grassland cultivation and short rotation cultivation (made possible through the effects of climate change) are therefore very likely to decrease in the future. Even an improbable increase of the environmental premium to 1200 € (ÖPUL WF premium) will have no impact on traditional farmers or larger farms. Risks of the world market and high price fluctuations show a higher impact on famers than any environmental premium. The size of the farms seemed irrelevant for farmers' decisions. In the Styrian test regions, pig farms were surveyed exclusively. Here, too, a premium was introduced (climate premium) in order to maintain diversity and reduce the risk of pest distribution triggered by climate change and warmer conditions. The climate premium was linked in the survey to crop rotation constraints. Significant differences exist between farms with fewer than 25 ha and farms with more than 25 ha. Farmers with smaller sized farms are more likely to reject this kind of premium while farmers of larger farms (more than 25 ha) seem to react to this premium (arranged in a staggered manner).

Future steps:

We plan to publish the findings in international journals. We are in discussion with the Institute of Landscape Planning in Hannover, Germany to integrate the findings in a joined new research proposal on international level or just in Germany. We communicate the findings in further Austrian publications.

The following other target groups can draw relevant and interesting conclusions from the project results and can continue working on that basis:

The project adopted a trans-disciplinary approach, involving stakeholders and advisors from the agricultural chambers and the ministry throughout the project. Thus, there was a continuous policy input from the project into the current program planning within the development of the next rural development period (after 2013). Inputs were given at stakeholder and advisory board meetings, conferences, and workshops. Inputs were also provided to the ministry for the development of the new Austrian biodiversity strategy (and possible contributions from the agricultural sector) at several workshops throughout 2013.

Projektdetails

5 Methodik

5.1.1 Methods: Meteorology

The methods used to assess the impact of climate change on agriculture decision-making processes include an in-depth literature research and agro economic analyses of meteorological data, which are based on observations of the Austrian Metrological Service (ZAMG, 2011).
The regional climate scenarios developed during this project are based on results of the ENSEMBLE project. Additional expert interviews were undertaken.

The Institute for Meteorology used data and results from publications and other comprehensive modelling projects (i.e. ADIAGO or CECILIA; see ADAGIO, 2011 and Eitzinger et al., 2009 for further details). Relevant studies were conducted using the biophysical process model EPIC, the dynamic plant growing model DSSAT v.4 02, AG Boden ("AG soils") and long-term weather data and projections (to 2038/2050). Climate scenarios, among others, were based on the global circulation models CSIRO, HadCM and ECHAM under the assumption of certain emission scenarios such as SRES-A2 (Strauss et al. 2008; Thaler et al. 2008).

5.1.2 Methods: Agro-economy

The analyses of economic effects of land use changes under different climatic conditions in the project regions were based on analyses of INVEKOS-data (i.e. official state administration and controlling system data) and conducted in MS Access. Data were analysed for regional farm structures and other production parameters such as farm type, farm size, livestock system, crop structure, crop rotation, yield, etc. GIS was used for analyses and cartographic illustrations.

The following sources were consulted to calculate economic effects of land use changes on farm basis:

- „LfL Deckungsbeiträge und Kalkulationsdaten" (LfL, 2011),
- „Materialsammlung Futterwirtschaft. Daten, Fakten und Berechnungsgrundlagen zu den Kosten der Grundfuttererzeugung und der Futterwirtschaft" (Dilger & Faulhaber, 2011),
- „Deckungsbeiträge und Daten für die Betriebsplanung" (BMLFUW, 2008),
- „Daten für die Betriebsplanung in der Landwirtschaft" (KTBL, 2008).

Detailed information on short crop rotation (yield calculations and production techniques) was extracted from „Sachstandsbericht zum F+E Vorhaben: Agroforstwirtschaft" by Eckstein et al. (unpub.)

5.1.3 Stated Choice Methods – Discrete Choice Experiment

The farmer questionnaires build upon climate and agro-economic data and scenarios, developed in the first steps of the study. Only a few methods are deemed suitable to evaluate the impact of currently non-existing scenarios (situations which are likely to arise in the future due to climate change effects) through a questionnaire. A stated preference method, and more precisely a discrete choice experiment (DCE), is particularly appropriate to evaluate these future scenarios, as it derives individual preferences based on the stated choice behaviour under varying and hypothetical scenarios (e.g. impact of funding; increased yield through prolonged cultivation periods) (Pröbstl-Haider & Haider, 2013). In addition, it allowed for a combined analysis of multiple aspects and the analysis of these hypothetical (future) attributes and scenarios alongside existing adaptation strategies. In addition, risks and uncertainties were projected and incorporated into the evaluation of all attributes. Many studies found, that choice experiments build a suitable basis to model intended behaviour, which can be combined with additional information ("covariates", e.g. mindsets and characteristics) in a latent-class analysis. This DCE provided an insight into the complexity of farmers' decision finding process for a variety of farming options. In addition, the questionnaire simulated various agricultural options and incorporated potential effects of climate change.

In a choice experiment, the proband selects a preferred scenario out of multiple scenarios for several times, which allows for a use value analysis of each attribute of the scenario (Louviere et al. 2000). The analysis of the DCE is based on random utility theory and assumes that individuals seek to maximise utility in their decisions (McFadden, 1974; Ben-Akiva & Lerman, 1985; Louviere et al., 2000). Utility maximization implies that, when confronted with sets of alternatives, an individual will choose the one alternative that will maximize her/his utility. Random utility theory simply reflects the uncertainty that researchers have about understanding aspects of the choice process. This uncertainty results in a stochastic (probabilistic) model for predicting choices.

The random utility theory suggests that the overall utility can be displayed as a function with an observable deterministic component (Vi) and an unobservable random (error) component of utility (εi):

$$Ui = Vi + \varepsilon i \qquad (1)$$

An individual will choose alternative i if Ui>Uj for all i#j. Modelling is conducted as an aggregate stochastic process, in which the probability of choosing alternative i out of the finite set C is:

$$P(i|C) = Pr[U_i > U_j] = Pr[V_i + \varepsilon_i] > Pr[V_j + \varepsilon_j], \forall j \in C \qquad (2)$$

Choice models are typically analysed with a multinomial logit model (MNL) to model the probability for the choice of alternatives (McFadden, 1974). The MNL produces regression estimates, the so called part-worth utility (PWU) parameters for each attribute:

$$P(i|i \in M) = \frac{\exp(X_i, \beta)}{\sum_{j=M} \exp(X_i, \beta)} \qquad (3)$$

In this function, the probability of choosing alternative i from all possible scenarios (M) equals the exponent of all the measurable elements of alternative i over the sum of the exponent of all measurable elements of all alternatives, j. The alternatives consist of the vector of explanatory variables (X) and the parameter vector to be estimated (β).

To be able to better explain choice behaviour of the respondents and to account for the heterogeneity of preferences, the MNL can be converted into a mixed logit form, such as the latent class model (LCM). The LCM is a semi-parametric variation of the MNL. It is assumed that the overall population consists of a finite number of heterogeneous segments and that each individual can be assigned to a group. This classification maximizes homogeneity within classes and heterogeneity between classes. The variables determining class membership refer to unobserved characteristics of the respondents (e.g. socio-demographics, attitude, knowledge). The latent class model combines a choice model with a probabilistic approach to determine an unobserved (i.e. latent) class membership of individuals (Boxall & Adamowicz, 2002; Vermunt & Magidson, 2005). The latent class model estimates regression estimates (part worth utilities, PWU) for each class separately. Within one class, the probabilities for all scenarios included (M) can be described by the mixed conditional logit model:

$$\pi_n(i) = \sum_{s=1}^{S} \left[\frac{\exp(\alpha\lambda_s Z_n)}{\sum_{s=1}^{S} \exp(\alpha\lambda_s Z_n)} \right] \left[\frac{\exp(\mu_s \beta_s Z_i)}{\sum_{k \in C} \exp(\mu_s \beta_s X_k)} \right] \qquad (4)$$

The first term describes class membership to s segments where λ_s is the class specific vector. The second term describes the MNL of equation 3. α und μ are scaling parameters (Boxall & Adamowicz, 2002; Greene & Hensher, 2003; Vermunt & Magidson, 2005). The model is based on simulation (Train, 2003), as software for Latent Gold Choice 4.0 (Vermunt & Magidson, 2005) was used, which produces regression estimates (PWUs), standard errors and z-scores for each attribute level. Statistical differences were assessed interpreting z-scores and the Wald statistic. Robust estimates can be obtained by dependent observations (several choice sets per person).

Better results were accomplished through a known classes analysis based on the self-evaluation of the farmers and the size of their property.

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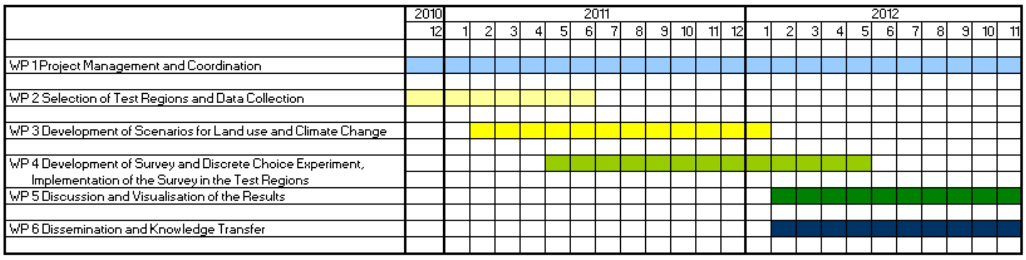
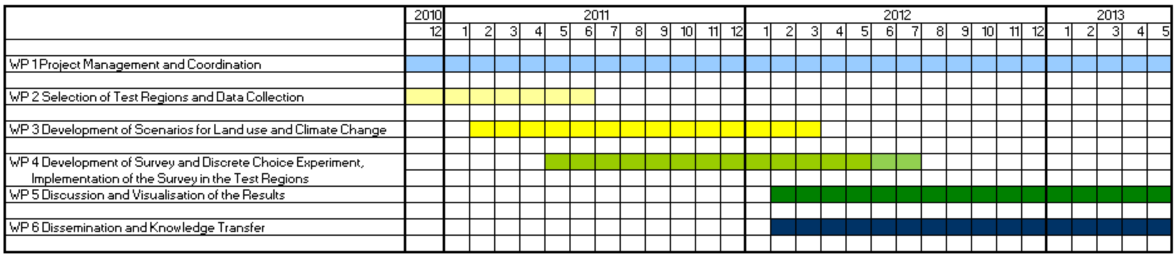
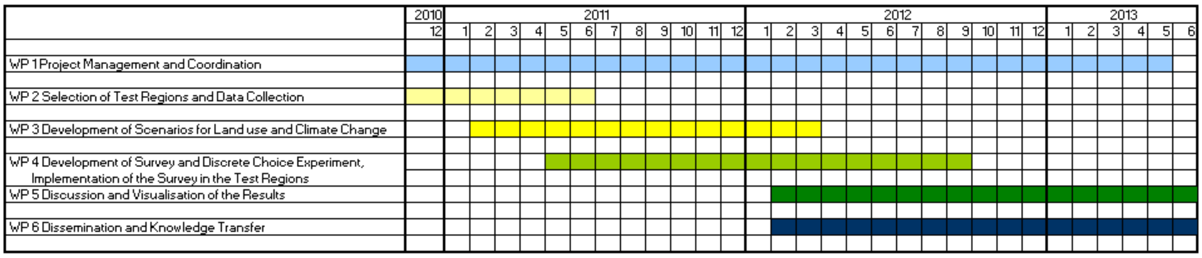
6 Zeitplan







7 Publikationen und Disseminierungsaktivitäten

Publications

1. Pröbstl-Haider, U. (2013). ÖPUL ohne Aufgeld ist zu wenig. Blick ins Land – Das Magazin für den ländlichen Raum. Heft 4 2013.
2. Pröbstl-Haider, U. (2013). Verändert der Klimawandel die Landwirtschaft?. Die Landwirtschaft – Die Zeitung der NÖ Landes-Landwirtschaftskammer. St. Pölten. Heft 5 2013.
3. Kurzinformation mit Abbildung. Der Fortschrittliche Landwirt. Heft 6 2013.

Publications in preparation

1. Publication in “Ländlicher Raum” (online Journal of the ministry)
2. Publication in an English SCI Journal (TBD; currently under discussion: Agriculture, Ecosystems and Environment, etc.)
3. Publication in “Naturschutz & Landschaftsplanung”

Presentations

1. Pröbstl-Haider, U.; Kantelhardt, J. & Formayer, H. (2013). Integrated landscape prognosis under the influence of climate change. 14. Österreichischer Klimatag – Klimawandel Auswirkungen und Anpassung sowie Vermeidung. Wien Austria. 4.-5.5.2013.

2. Pröbstl-Haider, U.; Kantelhardt, J. & Formayer, H. (2013). Integrated landscape prognosis under the influence of climate change. 19th International symposium on society and resource management (ISSRM). Estes Park Colorado USA. 4.-8.6.2013.

Workshops

1. Internal workshops oft he project team: (9 times)
2010: 8.12.
2011: 1.2., 17.3., 10.5., 7.7., 5.9., 28.9., 25.10.
2012: 17.2.

2. Advisory board meetings:
16.11. 2011 Meeting and questionnaire pretests
07.12. 2011 Presentation and discussion of preliminary surveys
15.01.2013 Presentation and discussion of project results in Lower Austria
28.01.2013 Presentation and discussion of project results in Styria

3. Transdisciplinary workshops and presentations:
18.10.2011 Presentation of the project proposal for cooperation with the National Agricultural Chamber (Vienna)
19.1.2012 Presentation and testing of t he March-survey with regional and local representatives of the Agricultural Chamber (Drösing)
24.1.2012 Second part of Presentation and testing of t he March-survey with regional and local representatives of the Agricultural Chamber Markthof)
9.3.2012 Presentation and testing of t he Styria-survey with regional and local representatives of the Agricultural Chamber and farmers (St.Stefan/Rosental)
11.3.2013 Presentation and discussion of March- Results in Lower Austria (Hohenruppersdorf)

4. Inputs for agri-economic policy and development at workshops and conferences:
14.2.2011 Wintertagung des Ökosozialen Forum (Vienna)
2.12.2011 GAP-conference of Netzwerk Land (Vienna)
13.2.2012 Wintertagung des Ökosozialen Forum (Wien)
22.5.2012 Presentation of inputs for rural develpment (LE 2020, Perchtoldsdorf)
28.11.2012 Strat.at2020 Biodiversity Workshop der ÖROK (Vienna)
7.3.2012 LE 2020 Dialogtag (Vienna)
10.4.2013 Biodiv.Strategy and agriculture-Workshop (Vienna)