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Down to Earth

Regional report year 1 – Neckar-Alb

Environmental risks related with depopulation and ageing population in rural areas

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Abbreviation List

Term	Description
%	Percentage
°C	Degrees Celsius
e.g.	For example
BW	Baden-Württemberg
DWD	Deutscher Wetterdienst
BUND RV NECKAR-ALB	Bund für Umwelt und Naturschutz Deutschland Regionalverband Neckar-Alb
EAFRD	European Agricultural Fund for Rural Development
FVA	Forstliche Versuchs- und Forschungsanstalt
GDP	Gross Domestic Product
ha	Hectare
Mio.	Million
IHK	Industrie und Handelskammer
km, km²	Kilometre; Square kilometre
LEADER	Liaison Entre Actions de Développement de l'Économie Rurale"
LEP	Landesentwicklungsplan
LoKlim	Lokale Kompetenzentwicklung zur Klimawandelanpassung in kleinen und mittleren Kommunen und Landkreisen
LUBW	Landesanstalt für Umwelt Baden-Württemberg
NGO	Non-Governmental Organisation
p, pp	Page, Pages
PV	Photovoltaik
ROG	Raumordnunsgesetz
RVNA	Regionalverband Neckar-Alb
SWOT	Strenghts, Weaknesses, Opportunities, Threats
UNESCO	United Nations Educational, Scientific and Cultural Organization

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Executive Summary

This report seeks to portray the results of the findings that were obtained by the Regionalverband Neckar-Alb (Regional Association Neckar-Alb) in the framework of the "Down to Earth" project on the topic complex concerned with "environmental risks and the challenges posed by depopulation and ageing population".

The first chapter of the report is an introduction to the local context of the region. After a brief description of the geographical features of the Neckar-Alb region, the results of an analysis deals with the population dynamics and the economic situation of the region are presented. The results show that the population in the region has constantly increased during the last decades, mainly due to international and intranational migration. With more than 50,000 businesses and a regional GDP of 28.362 Mio. Euro in 2021, the Neckar-Alb region can be considered an important centre for automotive and mechanical engineering, textile industry, health industry and information and communication technology among others. It becomes obvious that agriculture is also of importance for the Neckar-Alb region, since it covers about 45 % of the area in the region and is considered an important provider of food for the local population (Statistisches Landesamt 2023a; Statistisches Landesamt 2023b).

In a next step, the major challenges that the region currently faces have been summarized. Regarding depopulation and ageing population, it was found that depopulation is not a major challenge in the Neckar-Alb region. However, a loss of population can hence be observed in some remote rural communities of the region where it is associated with skilled workers shortage, lack of company succession, reduced local supplies and lack of basic services such as specialized shopping centres, medical centres or day care centres for children. In contrast to depopulation, it was found that an ageing population and the demographical change pose severe challenges to regional planning in the region. Due to a constant rise in life expectancy and low birth rates, the trend of an ageing population is unbroken in the region as of now. This is closely associated with problems in labour markets, health care systems and company succession among others.

Moreover, the report states that many challenges that the region faces can be attributed to environmental risks. In this regard, six major fields have been identified that pose risks on the sustainability of the region, namely (1) temperature increase and heat events, (2) drought periods, (3) heavy rains, floods and storms, (4) loss of biodiversity, (5) forest damage and (6) soil erosion and landslides. Throwing a glance at temperature increase and heat events, temperature levels have been particularly high in the region since 2000 and temperature records have regularly been broken. Since 2000, 16 out of 20 years counted to the warmest on record, causing a comparatively high number of hot days and heat waves exerting negative effects on human health, forestry and agricultural production. Drought periods are considered another risk for the region since the turn of the millennium and is widely perceived to have adverse effects on the water balance and on the harvest quantities of major crops. Aside from these, heavy rainfall events, floods and hailstorms have additionally turned out as risks for the Neckar-Alb region. While heavy rainfall is commonly associated with drainage overflow and flood damage, strong winds and hail can cause severe damage with fabric, trees, power lines, crops, and houses. On top of these, forest damage and the loss of biodiversity are regarded as environmental risks persisting in the Neckar-Alb region. Forest damage due to drought periods, pests (e.g., bark beetle infestations) and storms is widely perceptible in the region. Forestry statistics reveal that at present about 46 % of the forest area in Baden-Württemberg show significant damage (FVA, 2022). The ongoing loss of biodiversity places an additional risk on the Neckar-Alb region, since it reduces the quality of ecosystems and impairs ecosystem functions. Over the last 50 years, the number of originally occurring species has declined sharply, even though many activities for biodiversity conservation have been established in the region. Finally, soil erosion and landslides have been identified as additional environmental risks in the Neckar-Alb region.

The second chapter of the report serves to present the results derived from the SWOT analysis to get better insight into the region's strengths, weaknesses, opportunities, and threats in relation to environmental risks and the challenges posed by depopulation and an ageing population. Since depopulation plays a minor role in the region and since there are only few connections between environmental risks and demographic change, the focus had been set to an overall analysis of environmental and demographical issues. The

comprehensive SWOT-analysis shows that several topics are of relevance for the Neckar-Alb region such as biodiversity and nature protection, water supply, heavy rainfalls, flooding, heat management, forestry, agriculture, land use, competition for land, environmental compensation, settlement development, mobility, renewable energies, skilled worker shortage and environmental education. To bundle up the findings, the results include a synopsis that mentions the most important issues of the region in addition to the points stated by the stakeholder group.

The third chapter of the report serves to describe the existing legal and regulatory framework at the national, federal, and regional level that addresses environmental risks and demographic change in rural areas. In this context, important laws, policies, and planning instruments are portrayed that have been established to mitigate these challenges. With a particular focus on the Neckar-Alb region, the legal and regulatory framework described includes the Spatial Planning Law (ROG), the State Development Plan (LEP), the Climate Protection and Climate Change Adaptation Act, the Regional Plan Neckar-Alb, and the Neckar-Alb Landscape Structure Plan.

The fourth chapter is dedicated to portraying good practices like successful initiatives, projects and programs that have been implemented in the region to address the environmental risks associated with depopulation and an ageing population. Accordingly, a variety of initiatives (e.g. the Swabian Biosphere Reserve or renewable energy initiatives) that have proven effective in tackling these challenges are presented. Regarding Baden-Württemberg, three initiatives have been highlighted, namely the Petition of the people on land protection “Let Ländle Live”, the knowledge portal “LoKLIM” or the “Baden-Württemberg Water Supply Master Plan and Flood Strategy”. These activities have been complemented by another 6 initiatives which are considered to have a strong impact in the Neckar-Alb region.

The fifth chapter serves to describe proposals for improvements. Several strategies and measures are identified that can be used to mitigate environmental risks, promote sustainable development, and minimize the adverse effects of demographic change in the Neckar-Alb region. Regarding environmental risks, the report highlights the importance of implementing the measures described in the state strategies that have been set up in

field of climate protection and climate adaptation, nature and biodiversity conservation, forest management, agriculture, heat mitigation and flood prevention. With a focus on sustainable development and demographic change it highlights the importance of implementing the measures described in the Regional Planning Strategy on Sustainable Development and in the Sustainable Development Strategy Baden-Württemberg.

Finally, the last chapter draws a conclusion based on the key findings and insights derived in the previous sections. By addressing the urgency of environmental risks associated with depopulation and ageing population in the region, it seeks to provide recommendations for policy development and future action planning. The Neckar-Alb region is an attractive region with good working opportunities, regeneration options and connectivity to urban areas, which however faces considerable challenges regarding environmental risks and climate change. As a result, there needs to be a transformation – environmentally and socially.

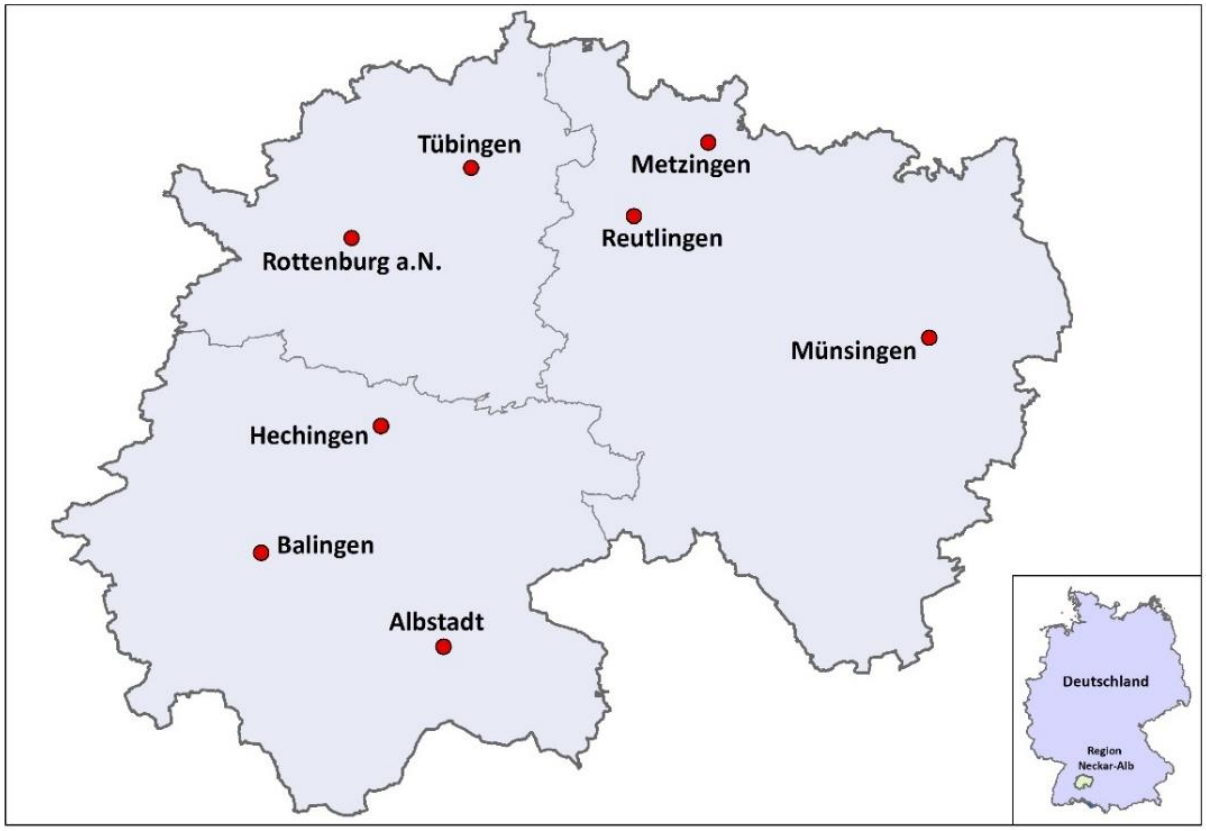
The report concludes with the need of adaptation to new technologies in farming and forestry in order to cope with the challenges of climate change. On top of this, the region has to come to terms with ageing population and skilled worker shortage that keeps up the economy and shape town structures. The competition forland clearly shows how environmental risks are connected to demographic change. Therefore the needs of young and old have to be balanced and the overuse of land needs to be solved to reduce environmental risks. In the Neckar-Alb region, the main fields of action refer to climate adaptation, renewable energy upgrade and value creation. By minimizing environmental risks, improving services and creating new income opportunities, municipalities in rural areas can enhance sustainability for future generations. Furthermore, there is a valuable chance with renewable energies, since they provide financial support to the locals, while producing ecologically clean energy. To guarantee a prospering region is thus considered the key to sustainable development. All in all, the Down to Earth project and the findings of this regional report will be incorporated into the new regional plan Neckar-Alb that sets the basis for the development of the region. Regional or local project may emerge with the lessons learned within this analysis of environmental risks and the challenges posed by depopulation and ageing population.

1 Introduction

1.1 Geographic Features

The Neckar-Alb region is formed by the three districts of Reutlingen, Tübingen and Zollernalb. The region is one out of twelve spatial planning regions in the federal state of Baden-Württemberg. In the Neckar-Alb region 66 towns and municipalities are located. The cities of Reutlingen and Tübingen, located about 40 km south of the state capital Stuttgart, form the regional centre. Other important towns in the region are Albstadt, Balingen, Hechingen, Metzingen, Münsingen and Rottenburg a. N. About two thirds of the area are characterized as rural areas, whereas one third can be considered urban agglomerations (Regionalverband Neckar-Alb 2023).

Figure 1 - The Neckar-Alb region; source: RVNA



The Neckar Alb region comprises a total land area of 252.917 ha. In 2022, 15.0 % of the land area in the region was used for settlement and traffic, 44.9 % were agricultural land,

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37.8 % were classified as forestland and 2.3 % were assigned to other types of land use (Statistisches Landesamt Baden-Württemberg 2023a).

The landscape of the Neckar-Alb region is characterized by the Swabian Alb in the South and a stratified landscape in the foothills of the Swabian Alb in the North/Northwest. The special attraction of the Neckar-Alb region lies in its diversity. Urban areas with a high population density in the lowlands contrast with quiet, rural areas on top of the Swabian Alb. With regard to vegetation, wide parts of the region are used for agricultural purposes. Large forest areas can be found in the Schönbuch and Rammert areas. In addition, extensive orchard meadows alongside the foothills, as well as terraced vineyards, juniper heaths and hedgerow areas constitute the main features of the regions landscape. A special locality in the Neckar-Alb region is the municipality-free area of the former military training area near the municipality of Münsingen.

Table 1 - Basic Information about the Neckar-Alb Region; source: Statistisches Landesamt Baden-Württemberg 2023a; RVNA 2023

Indicator	Numbers
Area	246.454 ha (2022; data without Gutsbezirk Münsingen)
Number of Towns & Municipalities	66
Universities	7
Number of Students	35.343 (Winter semester 20/21)

1.2 Population Dynamics

According to the Statistisches Landesamt Baden-Württemberg 2023a, a total of 717,734 residents were living in the Neckar-Alb region in 2022. This is an increase of 9,225 people or 1.3 % compared to the previous year. Between 2000 and 2022, the total population of the region has increased by about 38,000 persons or 5.6 %. The main reason for the population increase can be considered a result of intranational and transnational migration (IHK 2022). According to the latest data available, the population density in the region accounted to 291 persons/km in 2022.

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Table 2 - Data on Population in the Neckar-Alb Region; source: Statistisches Landesamt Baden-Württemberg 2023a

Indicator	Numbers
Inhabitants	717,734 (2022)
Annual Population Growth Rate	1.3 % (2022)
Population Density	291 Persons/km² (2022)

1.3 Economic Sector

The economy in the Neckar-Alb region is strongly influenced by the nearby metropolitan area of Stuttgart. The region is widely considered an important economic centre for automotive and mechanical engineering, textile industry, health industry, tourism, timber industry, biotechnology, medical technology, as well as for information and communication technology in Germany (IHK 2022, p. 31). There are seven universities, including one of excellence. With more than 50,000 businesses located in the region, the Regional Gross Domestic Product (GDP) totalled 28,362 Mio. Euro in 2021 (Statistisches Landesamt 2023b; Stadt Münsingen 2023). Focusing closer at the economy in the region, the most important sectors are the service sector and the manufacturing sector which contributed the largest shares to the regions' overall GDP. The same holds true for employment. In 2021, the Neckar-Alb region offered employment for 280,615 persons, while the unemployment rate was only 3.7 % (Statistisches Landesamt 2023c). Referring to another statistical data set on employment, it becomes obvious that for the period 2000-2021 about 67.2 % of all employees in the Neckar-Alb Region were working in the service sector, 32.0 % in the manufacturing sector and 0.9 % were involved in the agricultural sector (Statistisches Landesamt 2023d).

Table 3 - Data on the Economy and on Employment in the Neckar-Alb region; source: Statistisches Landesamt 2023b, Statistisches Landesamt 2023c; Stadt Münsingen 2023

Indicator	Numbers
Number of Businesses	> 50,000
Regional GDP	28,362 Mio. Euro (2021)
Regional GVA	25,660 Mio. Euro (2021)
Number of Employed Persons	280,615 (2022)

Unemployment rate	3.7 % (2021)

Focusing on the agricultural sector separately, it must be stated that agriculture is yet of major importance for the Neckar-Alb region, since it covers large parts of the land area and is considered an important provider of food for the local population. According to the Statistisches Landesamt 2023e, a total of 2,074 farms were counted in the Neckar-Alb region in 2020. The average size of the farms was 47.6 ha, with farm sizes unevenly distributed. About 4.9 % of all farms were smaller than 5 ha, while 18.9 % were 5 - 10 ha, 46,7 % were 10 - 50 ha and 29.5 % were larger than 50 ha. Of all farms in the region, only 25.3 % were main farms, whereas 74.7 % were considered sideline farms. In the Neckar-Alb region, the total area used for agricultural purposes covered 98,711 ha, which is about 45.0 % of the Regions total land area. Looking at the different types of land use, 46.0 % of the agricultural area were used as farmland, while 53.7 % were permanent grassland and about 0.1 % were used for the cultivation of orchards.

Table 4 - Number of Farms and Farm Area; source: Statistisches Landesamt 2023e

Indicator	Numbers
Number of Farms / Agricultural Enterprises	2,074 (2020)
Proportion of Main Farms	25.3 % (2020)
Proportion of Sideline Farms	74.7 % (2020)
Agricultural Area	98,711 ha (2020)
Mean Farm Area	47.6 ha

For the Neckar-Alb region, the tourism sector became more and more important during the last decades due to its diverse landscape and attractions like art and culture, thermal baths or natural and historical sceneries. Since 2004 an ongoing trend of increasing overnight stays and a growing number of guests from abroad can be recorded (IHK 2022). Even though the Covid-19 Pandemic hit this sector hard in 2020 with a loss of over 50% , the number of overnight stays bounced back vastly in 2022 to over 1 718 200, which almost reaches the level before the pandemic that numbered 1 918 750 (Statistisches Landesamt Baden Württemberg 2023h).

1.4 Challenges faced by the Neckar-Alb Region

1.4.1 Depopulation and Ageing Population

As the data presented in section 1.2 shows, depopulation is not a major challenge in the Neckar-Alb region. For the past decades, population statistics reveal a steady increase in the number of residents in the region. As a result, the total population in the region has increased from 552,747 in 1970 to 717,734 in 2022 (Statistisches Landesamt Baden Württemberg 2023a). This is a rise of about 29.8 % or 0.57 % per annum during that period. Accordingly, the region does not face the risk of depopulation on a large scale. Nevertheless, population loss and/or negative net migration balances across municipal borders can be observed with individual municipalities in the region over the last few decades (e.g. with individual municipalities located on the Swabian-Alb). This means that there are some remote rural communities that suffer from the move away of young residents to the urban centres. This in turn this can lead to problems such as skilled workers shortage, problems with company succession, reduced local supplies and lack of basic services (e.g. specialized shopping centres, medical services, or day care centres).

Looking at the age structure of the population in the Neckar-Alb region, it becomes obvious, that an ageing population and the demographical change pose severe challenges to regional planning in the region. In 2022, the average age of the population in the region was 43.6 years. Throwing a glance at the age groups in the age pyramid of 2021, the data show that 17.4 % of the population were younger than 18 years, while 61.9 % were between 18 and 65 years and 20.7 % were older than 65 years (Statistisches Landesamt Baden Württemberg 2023f).

Table 5 - Demographic Data; Source Statistisches Landesamt 2023f

Indicator	Numbers
Average Age of the Population	43.6 (2022)
Population < 18 years	17.4 %
Population ≥ 65 years	20.7 %

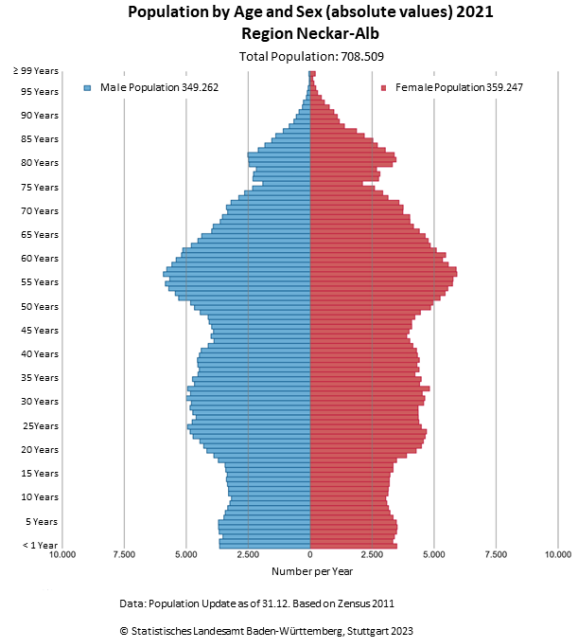

Figure 3: Population by Age and Sex 2021 Region Neckar-Alb; source: Statistisches Landesamt Baden-Württemberg, Stuttgart 2023

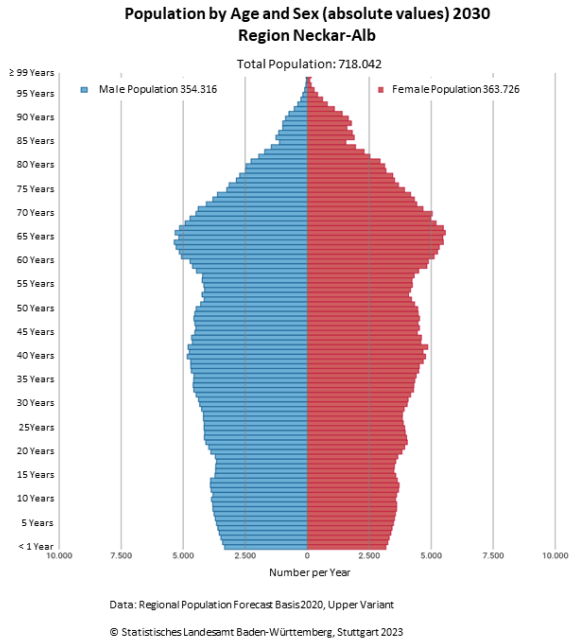

Figure 2: Population by Age and Sex 2030 Region Neckar-Alb (Forecast); source: Statistisches Landesamt Baden-Württemberg, Stuttgart 2023

Due to a constant rise in life expectancy and low birth rates, the trend of an ageing population is unbroken. This is closely associated with a variety of problems in the labour markets, health care systems and company succession among others. According to the IHK Skilled Workers Monitor 2022, there will be a regional shortage of up to 61,000 workers and skilled workers, including assistants until 2035 (IHK 2022). Accordingly, the economic sectors are currently unable to fill vacant jobs and apprenticeships in the region.

1.4.2 Environmental Risks

Based on an initial review of literature and on internal discussions, six major fields of environmental risks have been identified that have negative effects on the Neckar-Alb region. A study of an environmental organisation shows that in the past 10 years 81.8 % of the municipalities asked in the Neckar-Alb region had suffered from heavy rain events, 45.5 % from heat periods/droughts, 45.5 % from floods and 18.2 % from hailstorms (BUND RV NECKAR-ALB 2023).

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In the section that follows, the identified environmental risks that are of importance for the Neckar-Alb region are portrayed in detail.

(1) Temperature increase and heat events:

Climate change is not only a global problem but can also be observed in the Neckar-Alb region. The climate data of the DWD 2023 shows that in all regions of Baden-Württemberg, including Neckar-Alb, the mean annual temperature has risen since weather records began in 1881. Since the turn of the millennium, temperature levels have been particularly high in the region and temperature records have regularly been broken. Since 2000, 16 out 20 years counted to the warmest on record (cf. LUBW 2023a).

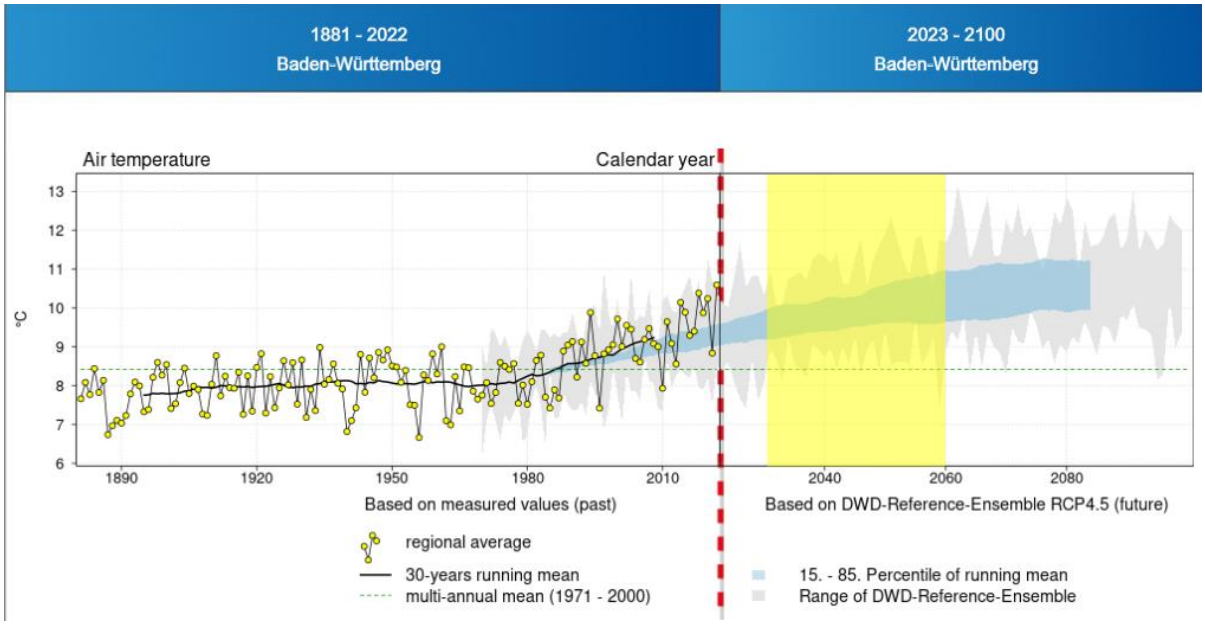

Figure 4: Air Temperature in Baden-Württemberg 1881-2022; source DWD 2023, Deutscher Klimaatlas

The year 2022 has broken climatic records in several regards. With an average of 10.6 °C, 2022 was warmer than any other year in Baden-Württemberg (cf. LUBW 2023a). In addition, the summer of 2022 was also an extreme event in Baden-Württemberg in terms of heat days (days with a maximum temperature of more than 30° C) and heat waves. With 21.7 hot days in relation to the land area, the summer of 2022 ranked third regarding the total number of heat days after the years 2003 and 2015. Moreover, twice as many heat days were registered compared to the reference period 1993 - 2022. Likewise, heat waves (periods with more than 3 consecutive heat days) occurred several times in June, July, and August (LUBW 2023a, LUBW 2023b).

For the near future, the regional climate models presented by the LUBW show a further increase in temperature. The range of the increase of the mean annual temperature ranges from 0.8 °C to 1.8 °C compared to the average in the reference period in Baden-Württemberg. It can be assumed that such years, which are considered extreme today, will be the norm in the future (LUBW 2023a; Ministerium für Umwelt, Klima und Energiewirtschaft BW 2023a, p. 6). The figures that follow show a climate projection of rising temperatures in the region of Neckar-Alb.

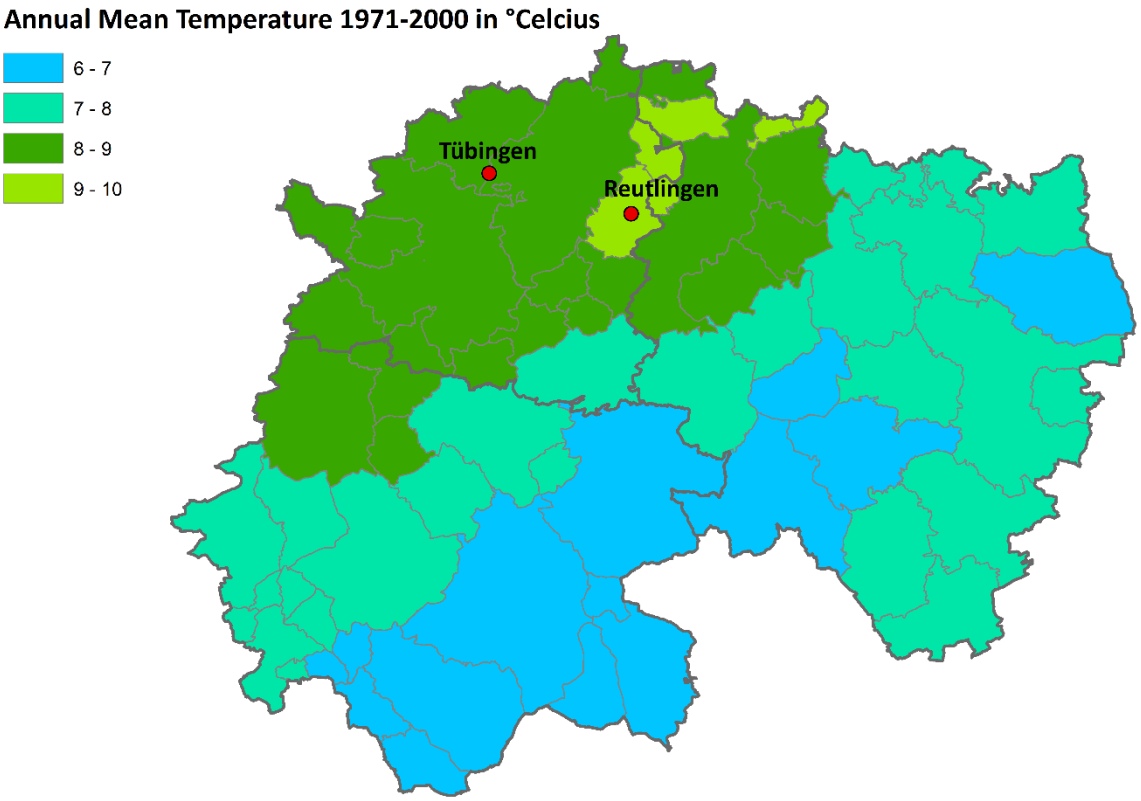

Figure 5: Annual Mean Temperature 1971-2000; data source: LUBW

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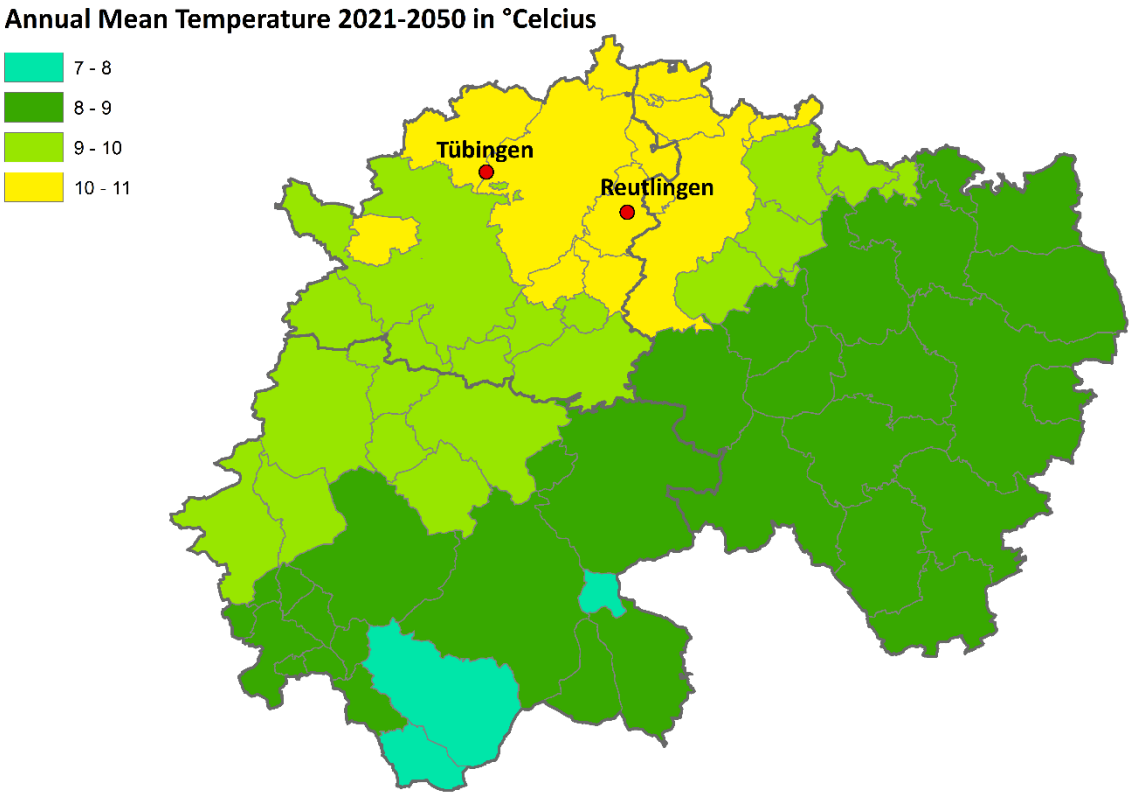

Figure 6: Annual Mean Temperature 2021-2051; data source: LUBW

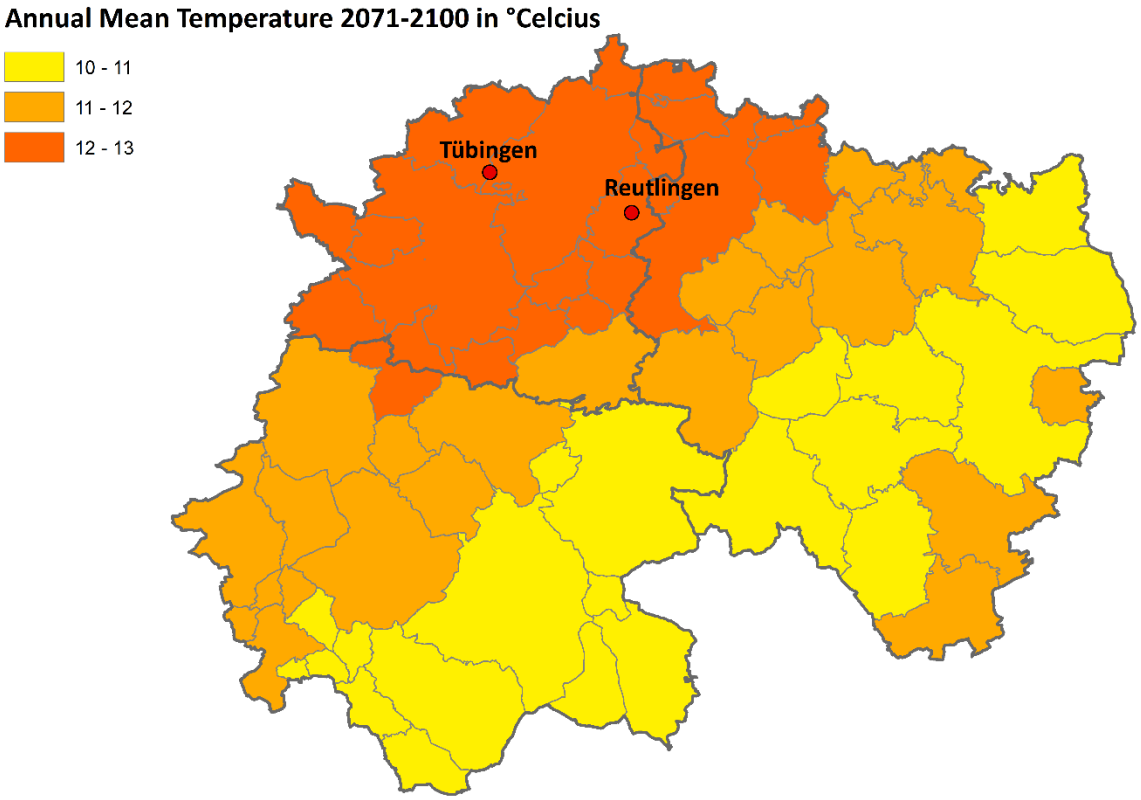

Figure 7: Annual Mean Temperature 2051-2100; data source: LUBW

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(2) Drought Periods

Drought periods are another environmental risk that have been increasingly recognized in the Neckar-Alb region in recent years. Droughts are perceived to have negative effects on the environment and the economy. They have an influence on the water balance, cause low water levels in rivers, promote the drying out of soil layers near the surface, support soil erosion, make plants and trees more susceptible to pests and diseases and adversely affect the harvest quantities of major crops (Ministerium für Umwelt, Klima und Energiewirtschaft BW 2023a, p. 9pp).

Figure 8: Drought affecting soil; source: RVNA

In Baden-Württemberg, the mean annual precipitation is about 940 mm (mean annual value for the years 1881-2019) (LUBW 2023a, p. 18; METEO PLUS 2023 based on data of the DWD 2023). In the case of Baden-Württemberg, it is to note, however, that the precipitation variability is very high, such that the distribution of precipitation varies highly between seasons and between different years of observation. Focusing on the last decades, precipitation does not show a linear trend. Much rather, there were clear temporary fluctuations in the annual precipitation amounts. Moreover, the distribution of the annual precipitation in Baden-Württemberg is strongly dependent on the relief. With regard to the Neckar-Alb region, the precipitation is generally higher in the foothill areas of the Swabian Alb than on the Swabian Alb plateau.

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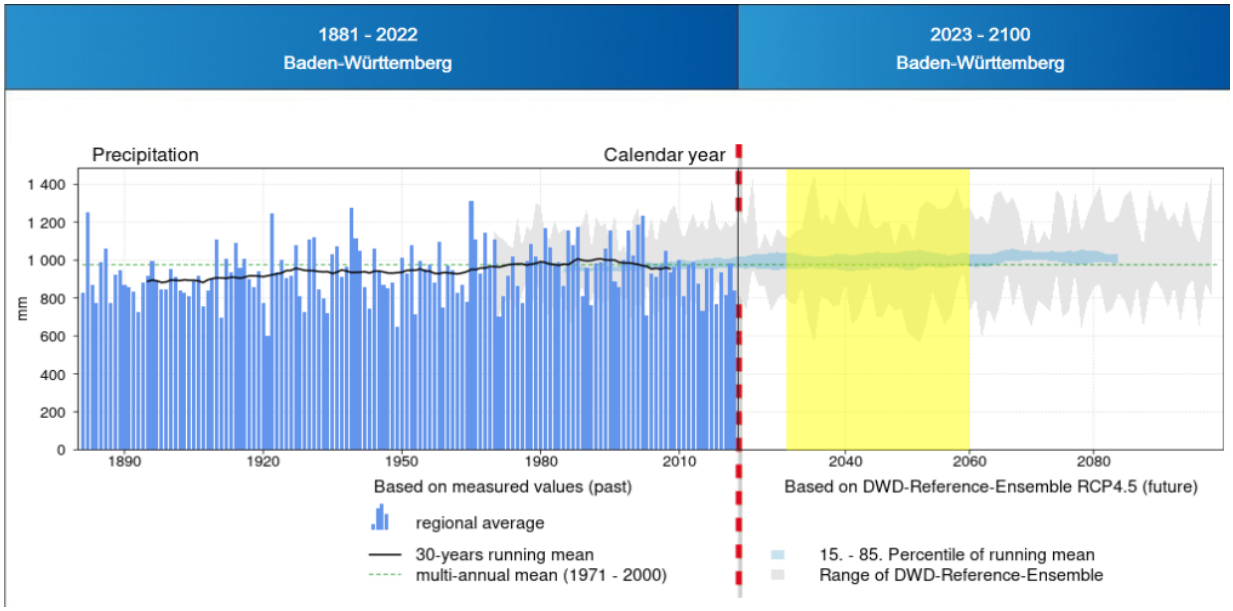

Figure 9: Precipitation in Baden-Württemberg 1881-2022; source: DWD 2023, Deutscher Klimaatlas

Referring to droughts, there has been a downward trend in the volume of precipitation in Baden-Württemberg since the turn of the millennium. Almost half of the years after 2000 were below the long-term average of 940 mm (1881 - 2019). While precipitation has tended to increase in the winter months, summers have tended to become drier (LUBW 2023, p. 18). This trend can mainly be observed in southern parts of Baden-Württemberg, such as the Neckar-Valley and the Swabian Alb.

(3) Heavy rains, floods and storms

Aside from less precipitation during summertime, heavy rainfall events are also problematic in the Neckar-Alb region. They are mostly temporally and locally limited convective precipitation events with high precipitation intensities. About 50 % of flood damage in Baden-Württemberg is attributed to such heavy rainfall events (Ministerium für Umwelt, Klima und Energiewirtschaft BW 2023a, p. 12). As a result of strong rains, groundwater levels can rise, and areas with low surface runoff can be flooded. On top, existing drainage systems can be overloaded and carried materials can cause damage with local infrastructure. According to the Gesamtverband der Versicherer (GVD) 2023, a total of 3,593 heavy rainfall events have been counted in Baden-Württemberg in the period 2001-2021. As a result, heavy rainfall has caused insurance damage to residential

buildings in Baden-Württemberg amounting to around 925 Mio. Euro over the last two decades.

Aside from heavy rains, storms and hail are other extreme weather phenomena that pose environmental risks on the Neckar-Alb region. Strong winds can cause severe damage with fabric, trees, and power lines, while hail can lead to severe destruction of crops, agricultural areas, cars, houses, and roofs.

Figure 10: Storm in Mössingen; source: RVNA

Figure 11: Flooding of a river in Balingen, source: RVNA

Although extreme weather events are difficult to predict and cannot be assigned in all cases to climatic changes, the increase in their intensity and frequency is well documented. According to the DWD, extreme weather events are expected to become more frequent and more severe because of the worldwide trend of global warming.

(4) Forest Damage

At present, the forests in the Neckar-Alb region are facing great challenges. The effects of climate change have left marks in the forest and the consequences of drought, pests and storms are widely perceptible (Landesforstverwaltung BW, p. 1). In addition, the risk of forest fires poses another threat to the local forests. The poor state of the forest in Baden-Württemberg and the Neckar-Alb region is also reflected in the FVA Waldzustandsbericht 2022. In 2022, the crown condition of over 7,000 forest trees and more than 30 forest tree species in Baden-Württemberg was investigated on behalf of the FVA. The report shows that 46 % of the forest area in Baden-Württemberg shows significant damage. Among the conifers, pine trees reveal the highest needle loss of 33 %, followed by spruce, fir, and

larch, with around 25 % and douglas fir showed a needle loss of about 21 %. Spruce has been severely affected by persistent drought and repeated bark beetle infestations. Needle loss in fir increased mainly in younger trees, because they react more sensitively to dry phases. Looking at deciduous trees, ashes had the highest percentage of leaf loss at 43 % due to the fungal pathogen of ash shoot dieback. The foliage loss in oak was 34 %, and that in beech 32 %. As a result, today about 58 % of all beeches are considered to be significantly damaged. For oaks, the proportion of damaged trees totals even to 71%, which is more than for any other tree species (FVA 2023).

(5) Loss of Biodiversity

In the Neckar-Alb region, a loss of biodiversity can be observed, mainly due to human activities. The loss of biodiversity places a risk on the Neckar-Alb region, since it reduces the quality of ecosystems and impairs ecosystem functions. According to the Federal Government of Baden-Württemberg, the state is the habitat for approximately 50,000 animal and plant species. Over the last 50 years, the number of originally occurring species has declined sharply, even though many activities for the biodiversity conservation have been established in the region. The reasons for the ongoing loss of biodiversity appear to be manifold. On the one hand, there are increasing temperatures and shifts in precipitation that led to changes in local habitats and species composition. On the other hand, there are land use changes and competing forms of land use that negatively affect species richness. In addition, low variety agriculture and the widespread use of crop protection agents exert negative impacts on the composition and the diversity of plants, birds, mammals, and insects. In the medium term, species diversity is expected to decline in both terrestrial plants and aquatic habitats (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023, p. 15 pp; Staatsministerium Baden-Württemberg, 2023).

(6) Soil Erosion and landslides

Soil erosion can also be identified as an environmental risk in the Neckar-Alb region. In the case of soil erosion, particles are removed by gravity, wind, or water, thereby affecting the soil. When heavy rains or strong winds hit uncovered soil, material can be transported downslope or through the open landscape. In the process, soil erodes and is deposited elsewhere. As a result, Nutrient-rich, humus-containing topsoil is lost, especially on the

hilltops or upper slopes. Erosion thus limits the quality and the function of soils, pollutes water bodies, and damages infrastructures (Umweltbundesamt, 2023).

Landslides are other degenerative processes which can be observed in the Neckar-Alb region. It is the steep slopes of the Swabian Alb in particular, where landslides and mass movements have occurred frequently in recent years, sometimes causing considerable damage to houses, roads, forestry, and agricultural areas among others. One of the most prominent examples for a landslide in the Neckar-Alb region is the landslide in Mössingen in 1983, which affected a total area of about 0.6 km² (BIBUS 1996). At this event, four million cubic meters of earth and debris with a total weight of over eight million tons began to move within only a few hours and massively affected the landscape (STADT MÖSSINGEN 2023).

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2 SWOT-Analysis

In this section an analysis of the region's strengths, weaknesses, opportunities, and threats (SWOT) in relation to environmental risks and the challenges posed by depopulation and an ageing population is presented. Since depopulation is a minor issue in the region and there are only a few direct connections of environmental risks and demographic change, an overall analysis on the environmental and demographic topics was conducted. Rather than conducting a general SWOT analysis, a topic-based analysis was realized to dig deeper into the regional context. In the end, a comprehensive overview of the findings was compiled. Next to significant research, this section also includes the input gathered in the stakeholder group meeting in July 2023. The stakeholders were from the Regional Association of Neckar-Alb, LEADER Mittlere Alb, Biosphere Reserve Swabian Alb, Regierungspräsidium Tübingen, Reutlingen District Farmers' Association and the Municipality of Pfronstetten.

2.1 Biodiversity and Protected Nature

A **strength** of the Neckar-Alb region is the high number of protected areas (37 % of the region) such as the Biosphere Reserve Swabian Alb, fauna flora habitat areas, bird protection zones or the nature parks Schönbuch and Obere Donau. Its nature, biodiversity and environmental quality is unique due to the significant differences in altitude and due to a high degree of geological and site diversity. However, as a result of climate change, its quality can easily shift. Many species and habitats in Baden-Württemberg are already endangered in their population and distribution (**threat**). The stakeholders addressed that the designation of nature reserves goes hand in hand with their maintenance, which however needs time and municipal resources. To prevent environmental risks, it is crucial to protect the present natural areas, but its inefficient maintenance can be seen as a **weakness**. Therefore, many organizations and projects were established that focus on environmental issues and land use such as the regional habitat network plan and the Biosphere Reserve Swabian Alb (**strength**).

With changing climate, mild winters and hotter summers new habitats emerge, resulting in the spread of invasive species that endanger the native natural environment (**threat**).

For example, the asian tiger mosquito recently spreads in Baden-Württemberg and with that a so far unnoticed health risk increases, since the non-native mosquito is a potential vector of tropical diseases (ZAK, 2023).

2.2 Water Supply

As a karst landscape, the Swabian Alb in the south-eastern part of the Neckar-Alb region is an area shaped by water. Precipitation water quickly seeps into the cracks and pores of the limestone, resulting in little water being available on the surface (**weakness**). Until 150 years ago, the water supply for the population in the Swabian Alb was only possible by collecting rainwater until the modern water supply was established in 1870. During the hot summers of the last decade, for example, the karst water level of the Swabian Alb dropped. In the very rainy year of 2021, on the other hand, precipitation water flowed through the Swabian Alb within a very short time, causing flooding along the areas where the water resurfaces. This illustrates the **threats** that climate change can have for the Swabian Alb and its water balance.

The result of a groundwater balance modelling for the entire southern German region shows that the average groundwater recharge has decreased significantly since the last century. So far, it is only evidence for possible dangers in water supply for the future (**threat**) (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023b). As a consequence of drought, some federal states in Germany have now obliged farmers to pay a fee for irrigation in order to save water. In the Neckar-Alb region this is not yet the case but can be considered a prospect for future water management (**opportunity**) (SWR, 2023).

Farmers are still managing without irrigation, but the question is for how long. The striking drought in June and July, combined with temperatures well above 30 degrees, has fuelled the discussion about climate-related changes in agriculture (ZAK, 2023). Some counties in the Neckar-Alb Regions have imposed temporary water withdrawal bans due to the drought in recent summers (Landratsamt Tübingen, 2022). However, agriculture is only responsible for about 2.5 % of Germany's nationwide water withdrawals. According to the Statistisches Landesamt, around 506,500 ha of open land were irrigated in 2019 - little compared to 16.6 Mio. ha of agricultural land in Germany. But the trend is increasing.

According to the calculations of the statistics authority, the irrigated area has increased by 36 % since 2009. For the first time in recent times, there were municipalities whose wells dried up even in the green valleys of Neckar-Alb (Umweltbundesamt, 2022). As it has been noted in recent years, many streams in the Neckar-Alb region are drying up. These were fed by springs whose water flowed through the karst soils from the Alb plateau and reappear on the Alb ridge. Since there are more periods of drought, less water reaches the springs.

2.3 Heavy Rainfalls

When it comes to heavy rainfall events, no regional spots exist in the Neckar-Alb region, but it is a **threat** that needs to be observed. This is because storm-like downpours can lead to dramatic flooding anywhere in the region, even far away from water bodies. In hilly or mountainous terrain, such as the Albtrauf, the water largely flows away on the surface of the terrain as so-called flash floods. Such flash floods have high flow forces and can carry large amounts of material (such as wood, hay, and silage bales) and eroded materials such as soil or debris. Heavy precipitation can also cause flooding on the flatlands of the Swabian Alb. As the large amounts of water lie mostly above the design limits of the sewer networks, they can quickly submerge large areas. In particular, buildings and infrastructure in the depressions can be significantly damaged. Those effects are especially dangerous for small villages, wherefore risk prevention management needs to be implemented (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023). This can be observed as an **opportunity** and there are already some municipalities that implemented heavy rain hazard maps.

With the increasing occasions of heavy rain fall events, soil erosion will intensify. This widespread phenomenon in the Neckar-Alb region limits the quality and the function of soils. Landslides can be considered additional events that prevail at the steep slopes of the Swabian Alb, having the potential of causing considerable damage to buildings, roads, and forest areas among others. Soil erosion and landslides are therefore considered as an environmental **threat** in the Neckar-Alb region.

With those happenings the challenge of natural hazard preparedness arises. The elderly people are more vulnerable towards natural disasters such as floods, storms, or wildfires.

Evacuation and emergency response systems might need to be adapted to cater to an ageing population. Since the settlement density of the Neckar-Alb region is comparable high, even in rural areas, the disaster preparedness and the emergency vehicle supply in the Neckar-Alb region is relatively good and can be seen as a **strength** throughout the rural areas.

2.4 Heat Management

The climatic changes that will shape the Neckar-Alb region in the near future, and which were described as risks for the region include heat stress due to the increased number of summer and hot days. Thus, the number of days with a temperature of 25 °C and more tripled. The number of days with a temperature of 30 °C or more increased by 5 times over the last decades. In addition, a totally untypical trend for the region - the tropical nights, will increasingly affect the region. The number of days when the temperature does not drop below 20 °C even at night clearly influenced the region in the last period (**threat**) (LoKlim, 2019). In addition to the warm temperatures in summer, there was little to hardly any rain for weeks. In the district of Reutlingen, all barbecue areas were closed, and caution was advised for private barbecues. Farmers were also complaining of massive yield losses of up to 50 %. Furthermore, the danger of forest and wildfire increased especially in the summer months.

In the stakeholder group meeting health risks due to rising temperatures were mentioned when it comes to demographic and climate change.

Align with an increasing mortality through heat comes the future ageing of the population. Researchers forecasted that at the end of the century 12,000 additional cases of deaths will be counted in Germany, of which about 5,000 will be attributed to the increase of heat days. With that, the heat-related illness costs are estimated to rise to about 1 % at the end of the century. Half of those increased health costs will refer to the consequences of heat days and the rest to the ageing of the population (Umweltbundesamt, 2022).

In the Neckar-Alb region many towns and villages set up heat action plans. This became a significant **strength** in the last decade. Despite a growing awareness of climate risks and many initiatives, there is still a lack of action in the region. The inconsequent

implementation can be classified a **weakness** regarding the environmental risks that the region faces at present.

2.5 Forestry

An ageing population might face challenges in sustainable forest management practices. Proper management is crucial for biodiversity conservation, preventing forest fires, and maintaining ecosystem services.

Stakeholder groups in Neckar-Alb addressed the health of the forest as a crucial topic when it comes to climate change and adaption. The results of the Forest Status Report 2022 are worrying and indicate a **threat**. Almost half of the forest area in the state of Baden-Württemberg shows significant damage. Therefore, it is important to achieve the set climate protection goals, and at the same time adapt forest management to climate change (Staatsministerium Baden-Württemberg, 2022).

One challenge that is associated with this issue is the different ownership of forest areas. 40 % of the forest in the country is owned by the municipalities and corporations. 36 % is privately owned by around 260,000 private forest owners. One quarter of the forest area (24 %) is owned by the state of Baden-Württemberg (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023).

The state of maintenance plays a role, especially in private owned forests. If it is possible to motivate private forest owners to enhance the quality of their forest, there will be a big **opportunity** to reduce environmental risks. For example, it is of high importance on how much residual wood lays in the forest, since that is especially relevant in connection with forest fires. Even though Germany is not yet a forest fire country, the danger of larger wildfires and forest fires is increasing significantly (**threat**). Although we are well positioned in Baden-Württemberg in terms of fighting forest fires, climate change is affecting us in almost all areas of life. We need to prepare for extreme weather conditions and be better equipped against forest fires (Staatsministerium Baden-Württemberg, 2022).

2.6 Agriculture

Due to the specialisation of agricultural businesses in the federal state of Baden-Württemberg, one or a few products are often decisive for the success or failure of a

business. The Neckar basin is one of the biggest regional heat spots. Effects of heat stress and drought, especially temperatures above 30 °C affect the yield and quality of most crops. The agriculture in the Neckar-Alb region has a strong focus on horticulture, fruit, and wine production (**strength**). Agricultural areas are particularly vulnerable areas with regard to potential damage, as possible reductions in yield and quality of important crops have a particular impact on the total income (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023).

Damage caused by extreme weather events is also increasing in agriculture. In 2021, heavy rain and hail led to considerable losses. Such extreme events are particularly damaging in combination with drought, as the run-off of fertile soils and the leaching of nutrients can be particularly high on dry soils. Heavy rainfall events and longer dry phases therefore place higher demands on catchment areas and storage volumes for rainwater utilisation and, at the same time, on nutrient management (**threat**) (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023).

The change of the vegetation period can be considered a risk and an **opportunity** at the same time. The length of the growing season in the region has increased by an average of 2 weeks over the last 30 years (LoKlim, 2019). While the longer growing season allows for better harvests, the high temperatures in winter and fall can be problematic for the quality and yield of products. Another **threat** for agriculture is the quickness of the development of winter tongues, then they become more susceptible to frost damage pests and plant diseases (LoKlim, 2019).

Organic farming can be seen as an **opportunity** in this case. In Baden-Württemberg it is gaining importance and helps to improve the protection of species and to prevent biodiversity loss. Furthermore, this type of farming can be more flexible in adapting to the effects of climate change (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023).

2.7 Landscape of the Neckar-Alb Region

Orchard meadows

Preserving the landscape and strengthening biodiversity in rural areas though orchard management is another **strength** found in Neckar-Alb. Unfortunately, orchard meadows are in danger since the economic value is quite low compared to the workload of maintenance. The orchard meadows are all managed for own use, as a private task or as a sideline. However, orcharding as a family project often no longer fits in with the mobility of the younger generation and other interest orientations and leads to an ageing of orchard managers (**threat**). In fact, the consequences of climate change and demographic change are weakening the precious orchards. The selection of robust varieties for new plantations which considers the consequences of climate change for the respective location alleviates the situation to some extent. To prevent environmental and demographical consequences this is an **opportunity** for the agricultural heritage and livelihood in the Neckar-Alb region.

Sheep farming on the Swabian Alb

For centuries, flocks of sheep have roamed wide meadows and barren soils of the Swabian Alb and have significantly shaped the landscape of this region (**strength**). The preservation and maintenance of this special cultural landscape and the cultural heritage of past centuries is also shown by the recognition of South German transhumance and herding sheep farming by UNESCO as Intangible Cultural Heritage in 2020. Due to a lack of successors in this business, the biodiversity and environmental integrity of the region is in danger (**threat**). Securing the future of this ecological and environmental business is one of the main challenges that the region faces (Biosphärengebiet Schwäbische Alb, 2023).

2.8 Environmental Education

In the Neckar-Alb region many initiatives - private and public - offer environmental education services. This was pointed out by the stakeholders as one of the big **opportunities** of the region. All age groups have access to education and training opportunities. Topics such as climate change and biodiversity are at the centre of many

educational programmes and projects. The Biosphere Reserve Swabian Alb, the Nature Park Schönbuch, the Nature Park Obere Donau, as well as initiatives from local nature or agricultural associations are helping to deal with environmental risk prevention and help educating young people in rural areas. They provide education on the natural environment, climate hazards, species conservation and sustainable living among others.

2.9 Land Use

2.9.1 Different Types of Land Use and Competition for Land

As a conclusion of the first stakeholder meeting, all topics addressed with regard to environmental risks and demographic change in the Neckar-Alb region have in common that they are affecting land use issues and the balance and use of space. To ensure a sustainable future, the challenge of the high demand and overuse of land needs to be solved. Land taking becomes a problem especially when individual municipality expand their areas and grow together to form unstructured, ribbon-like settlements (**weakness**). The last two generations took up as much new settlement area as all 80 generations before. Industrial estates are built on fertile farmland, housing estates are displacing valuable natural areas and biotopes on the outskirts of towns and the quality of life is declining. Green belts are disappearing, and the increasing urban sprawl is lengthening journeys to work or to local recreation areas, while in many villages, town centres are becoming deserted. The consequences of settlement expansions are an impeded air exchange and increasing smog pollution in these places. In rural areas, this mainly affects valley locations, of which there exist plenty in the Neckar-Alb region. There, the impacts (heat, smog) will be intensified as a result of climate change (**threat**).

The change in agriculture in the region (loss of more than 70 % of farms since 1979) has so far had only a small impact on the landscape in rural areas. Apart from some afforestation, agricultural land has remained in cultivation through purchase or lease. Due to the increased global demand for biomass and bioenergy the use of farmlands is under pressure. In recent years, the increasing importance of biomass for energy production has led to conflicts with food and feed production, species, biotope, landscape, and water protection (**threat**). Agricultural use has been intensified and consequences often have revealed a negative impact on species and habitats (Regionalverband Neckar-Alb, 2013).

2.9.2 Environmental Compensation Areas

Environmental compensation areas are an important measure in the field of nature conservation and environmental planning in the region of Neckar-Alb. They help to compensate for the negative impacts of construction projects, infrastructure projects or other human activities on the environment. They serve to compensate for losses of natural habitats, biodiversity and ecological functions caused by such interventions (**strength**). This was a main topic discussed by the local stakeholders. In the Neckar-Alb regional context, the idea of compensation areas refers to the fact that compensation should take place on site or in the vicinity of the intervention site. The result is, however, that open space is in additional competition with the use of compensation areas for densified space (**weakness**). Rural areas therefore face the pressure of urban areas and of stakeholders who do business in agriculture.

2.10 Mobility and Local Supply in Rural Areas

Services of general interest in a decentralised settlement structure are closely connected to demographic change. When services for daily needs disappear, inner cities degenerate, and people move away. For the elderly population who is not very mobile, this can have serious consequences, as there are people who can no longer take care of themselves (**threat**) (Regionalverband Neckar-Alb, 2013).

The ecological transformation of transportation is an important challenge for Germany and many other countries. The car is often the preferred vehicle in rural areas especially when it comes to reaching workplaces, shopping centres or health care facilities. To reduce the environmental impact, public transport especially in rural areas is key. In rural regions, the distances are often longer than in urban areas. By the stakeholders this was pointed out as a **weakness** but also as an **opportunity**. The main challenge with providing an environmentally friendly mobility for every age group is to make it accessible. Especially elderly people who cannot cover long distances by foot or by bicycle, have to contend with longer distances to the next stop, often combined with strenuous inclines. Furthermore, they struggle with digital offers. As a result, it is often not possible for them to access sustainable mobility services without barriers, nor is it possible for them to get around comfortably with few transfers. At the same time, people in rural areas do not live

as close to each other, In addition, young, still very mobile people often move away from small settlements to the vicinity of the next largest cities. The current lack of alternative mobility options reinforces the development of car-centred structures. Many rural areas often (still) lack an adequate and comprehensive network of charging stations for electric cars, such that many people continue to rely on combustion cars (**weakness**). But with current projects such as the Regional-Stadtbahn Neckar-Alb or civic busses, there is much potential for improved mobility in Neckar-Alb (**opportunity**) (Kooperationsprojekt der Regionalverbände Hochrein-Bodensee und Neckar-Alb mit dem Ministerium für Verkehr Baden-Württemberg, 2023).

2.11 Renewable Energies

The energy transition in Germany is affecting rural areas as well. All regional stakeholders are affected, or partly affected by this topic. Since Germany turned their back on nuclear energy, more space is needed for decentralised renewable sources of energy. In Baden-Württemberg, 1.8 % of the area must be provided for wind power and 0.2 % for solar energy (Klimaschutz- und Klimawandelanpassungsgesetz 2023). This means that in the districts of Tübingen, Reutlingen and Zollernalb, a total area of around 4,500 ha of land for wind parks and around 500 ha for ground-mounted solar power plants will be secured for regional planning. The first area outlines are to be available in 2023 and the procedures are to be completed by the end of 2025. One challenge with this is to find the balance of benefits and burden sharing between urban and rural areas. With the energy transition, the focus of energy production shifts towards open spaces in rural areas since there is limited space in densely populated areas. Because of the energy transition in rural areas, there are **opportunities** for development due to locational advantages such as large land potentials. By means of the targeted use of these areas for environmentally friendly energy production, rural communities can improve their own economic basis and intensify and regionalise value creation. Often municipalities in rural areas struggle with their available budget, impeding local investments on social and other infrastructure. Generating regional added value and new financial resources opens prospects for the development of regional projects to improve services of general interest and sustainable living (Domhardt & Grotheer, 02-03/2022). Until today, there are hardly any wind parks in the Neckar-Alb region and only a few solar energy projects. The rural areas of the three

districts of Neckar-Alb are facing many challenges managing the land provision for the energy transition.

2.12 Skilled Worker Shortage due to Demographic Change

The shortage of skilled workers was the most intensively discussed topic of the stakeholder meeting. This shortage is largely triggered by demographic change and continues to be one of the greatest challenges that affects the entire economy of the region (**threat**). The average age has risen by four years since 2000. The great demand for qualified skilled workers can only be met through successful skilled labour immigration: For this reason, the regional economy is in favour of further adapting accompanying structures and seeks to speed up the professional recognition and visa procedures for skilled workers from abroad with professional qualifications (IHK Reutlingen, 2022).

2.13 Synopsis of the SWOT-Analysis

Figure 12 - Synopsis of the SWOT Analysis; source: own compilation

Strengths

- Diverse Landscape protected nature, biodiversity, landscape and environmental quality (2.1)
- Environmental organizations and regional habitat connectivity plan (2.1)
- No regional spots on heavy rainfalls (2.3)
- Disaster preparedness and emergency vehicle supply in rural areas (2.3)
- Heat action plans and climate change programmes (2.4)
- Not yet a region known for wildfires (2.5)
- Strong agriculture business of horticulture, fruit and wine production (2.6)
- Orchard meadows preserving landscape and biodiversity with sustainable farming (2.7)
- Environmental compensation areas serve to compensate losses of natural habitats, biodiversity and ecological functions caused by such interventions (2.9)

Weaknesses

- Inefficient maintenance of the protected areas (2.1)
- Local water supply → import needed due to little surface water (2.2)
- Growing of awareness and lack of action about environmental risks (2.4)
- Agricultural specialization on only few products can cause risk of failure (2.6)
- Land taking and competition of land use → Decreasing open space due to settlement expansions boosts environmental pollution(2.9)
- Densification of population concluding to higher competitiveness and use of farmlands under spatial pressure (2.9)
- When services for daily needs disappear, inner cities degenerate, people move away and elderly who are not mobile anymore cannot take care of themselves (2.10)
- Low offer and accessibility for environmentally friendly mobility in rural regions for every age group and long distances (2.10)
- Lack of alternative mobility options, young people move away to larger cities dure to lacking public commuting options. (2.10)

Opportunities

- Possible measures for irrigation to save water supply (2.2)
- Risk prevention managements and heavy rain hazard maps (2.3)
- State of maintenance in private owned forests (2.5)
- Change of vegetation period can bring new agriculture products to mid-European latitudinal lines (2.6)
- Organic farming (2.6)
- Orchard management and Sheep farming on the Swabian Alb preserves nature and prevent environmental risks (2.7)
- many initiatives — private and public — offer environmental education services (2.8)
- To reduce the environmental impact, public transport especially in rural areas is key (2.10) → local mobility projects like the Regional-Stadtbahn and civic busses
- Environmentally friendly energy production generates added value and improved economic basis of rural areas (2.11)

Threats

- Endangered and invasive species, increasing health risks (2.1)
- Declining groundwater (2.2)
- Storm-like downpours can lead to dramatic flooding anywhere in the region (2.3)
- Soil erosion and landslides at the steep slopes of the Swabian Alb (2.3)
- Tropical nights, drought → Elderly people are highly effected by environmental changes and increasing heat (2.4)
- Partially poor conditions of forests and tree population, forest damage (2.5)
- Increasing danger of wildfires (2.5)
- Heavy rain and hail damages infrastructure and agriculture (2.6)
- Aging orchard meadow manager and shepherds can't preserve the Swabian Alb cultural heritage due to lacking sucession (demographic change) (2.7)
- Higher demands on catchment areas and storage volumes and nutrient management need due to changing precipitation phases (2.6)
- Change of vegetation period causes damage and problems (2.6)
- Dry periods leading to higher evaporation rate and increases erosion and water demand (2.6)
- Skilled worker shortage due to demographic change resulting in economic decline (2.12)

3 Legal Framework

3.1 National and State Level

The federal government provides the spatial planning law (ROG), which defines the principles of regional planning at the national level. Every planning instrument that is developed at a lower planning level, should follow this national law on form.

The next planification level is the 16 German federal states. The federal government law (ROG) obliges the federal states to create a plan regarding the territorial development of the specific state (LEP). This instrument contains a mix of specific development objectives, spatial definitions, and general guidelines for further planning in the federal states, but also for the regions (regional planning) and for the municipalities (municipal planning).

3.1.1 Landesentwicklungsplan Baden-Württemberg (State Development Plan)

The State Development Plan Baden-Württemberg was adopted in 2002. It is legally binding for measures, planning and decisions of public authorities. Currently a new plan is in preparation that will provide guiding principles for the future spatial development of the federal state. The basic objective of the State Development Plan Baden-Württemberg is the regulation and control of spatial development to secure a sustainable quality of living and prosperity. This is aimed through the spatial consideration of the natural resource base, the needs of the people, business interests, interests of the residential location, the primary functions of agriculture and forestry and design options supporting future generations. It contains models of spatial development by determining spatial categories, guidelines for settlement development, spatial requests, infrastructure development, as well as fundamentals for open space guaranty and use.

3.1.2 Klimaschutz- und Klimaanpassungsgesetz Baden-Württemberg (Climate Protection and Climate Change Adaptation Act)

On February 1, 2023, the state parliament of Baden-Württemberg passed the Baden-Württemberg Climate Protection and Climate Change Adaptation Act. This law intends to

further develop the Climate Protection Act of Baden-Württemberg from July 1, 2013, which was amended in 2020 and 2021. According to the Ministerium für Umwelt, Klima und Energiewirtschaft 2023c, "...the further development of the law underlines the fact that, as climate change progresses, the ambitious efforts in climate protection must also be supplemented more strongly than before by measures to adapt to the unavoidable consequences of climate change ("climate change adaptation")". With this law, the state is thus complying with the requirements of the Federal Constitutional Court, according to which the state objective of environmental protection in the Basic Law obliges not only the federal government but also the federal states to protect the climate. Accordingly, climate change adaptation must be ensured in addition to climate protection measures.

The central elements of the Baden-Württemberg Climate Protection and Climate Change Adaptation Act are the climate protection targets for the years 2030 and 2040, which set the direction for the state's future climate policy. In this regard, the Act sets clear targets to reduce greenhouse gas emissions. These have to be reduced by at least 65 % by 2030 compared to total 1990 emissions, and net greenhouse gas neutrality ("climate neutrality") is to be achieved by 2040 via incremental reductions. Moreover, the state government uses regular monitoring to check whether the climate protection targets have been achieved. If it becomes apparent that these will be missed, the state government will decide on additional measures (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023c). Finally, the Climate Protection and Climate Change Adaptation Act also suggests concrete measures for climate adaptation. These include municipal heat planning and the obligation to install photovoltaic systems on newly constructed buildings and in fundamental roof renovations, for example.

3.1.3 Approaches to Minimize Land Takeover

Regarding the designation of new areas for settlement and traffic, the German government has formulated a target of less than 30 hectares of new land use per day in 2030. The net zero land taking target shall be met with regard to Germany as a whole until 2050 (BMUV 2023). For the federal state of Baden-Württemberg, this results in a subordinate target of less than 3 hectares of new land use per day for the year 2030. The

long-term goal for Baden-Württemberg is a net zero land taking until the year 2035 (Ministerium für Umwelt, Klima und Energiewirtschaft, 2023b).

In line with these policies, the Building Code of Germany requires the economical and careful use of land. It obliges municipalities to take advantage of opportunities for internal development, which means making areas usable again and closing gaps between buildings. Accordingly, the state contributes with various measures and instruments to sustainable spatial and settlement development as well as to demand-oriented land allocation in the municipalities. In addition to legal regulations and a broad range of funding, these include numerous initiatives and networks that the state supports in particular.

3.2 Regional Planning and Local Government Structure

The regional planning level divides the 16 federal states into a total of 120 planning regions. The major task of regional planning is creating a link between the political goals and the planning reality at the local level. Based on the state development plan (LEP), the regional plans concretise the LEP goals and implement them in relation to the respective planning area. The objectives and principles must be observed or taken into account by all public planning authorities, especially by the municipalities in their urban land use planning.

The Neckar-Alb Regional Association, founded in 1973, operates as a politically controlled public corporation on a federal and state legal basis. The association assembly with its 62 members from the 3 districts of Tübingen, Reutlingen and Zollernalb is the main organ that decides on all matters of the regional association. The highest decision-making body of the municipal regional association is the association assembly. Its members are sent out for five years by the councils of the districts. Since the Neckar-Alb Regional Planning Association is in charge of a whole region and not only of a city, it cooperates with diverse municipalities, cities, towns, and villages.

The lowest level of spatial planning is municipal planning. In Germany, a municipality can use the land-use plan and the development plan as spatial planning elements. The municipalities are responsible for creating and implementing these plans within the framework of local self-administration. They are subject to the local supervision of higher

administrative authorities and, in the case of a development plan, to the control of standards by the judiciary.

3.2.1 Regional Plan Neckar-Alb

The Regional Plan Neckar-Alb provides legally binding guidelines for the development of settlement, open spaces and infrastructure that are laid down in the regional plan. The regional plan is thus the central planning instrument for reconciling the different land use requirements in terms of sustainable municipal spatial development. It contains the spatial use map (Figure 12) and the text section with principles and objectives of spatial planning. The present Regional Plan was adopted in 2013 and modifications were made in 2017, 2019 and 2021. Currently a modification of the regional renewable energy chapter is in progress. The Regional Plan 2013 provides the framework for sustainable development in the Neckar-Alb region for the next 10 to 15 years. It is legally binding for measures, planning and decision-making of public authorities and coordinates public participation in the legal process, usually in written form. In this plan, many actors are involved or affected: various authorities at several administrative levels, especially the municipalities in the context of communal urban land use planning, interest groups, associations and chambers, industrial and commercial enterprises, NGOs, and the public (Regionalverband Neckar-Alb, 2013).

Figure 14: Regional Plan 2009 - Spatial Planning Map; source: RVNA

3.2.2 Landschaftsrahmenplan Neckar-Alb (Neckar-Alb Landscape Structure Plan)

Pursuant to Article 10 of the Federal Nature Conservation Act and Article 17 of the Nature Conservation Act of the State of Baden-Württemberg, the regional associations shall prepare a landscape structure plan and update it in accordance with new developments. In this context, the objectives, requirements and measures of nature conservation and landscape management, including recreational provision, are to be presented and justified for the respective planning area and the objectives and principles of the nature conservation laws are to be implemented. The landscape structure plan has no legally binding effect. The corresponding specifications only become legally binding when they are incorporated into the regional plan and approved by the highest spatial planning and federal state planning authority. The present plan was adopted in 2011 and will be updated every 15 years.

4 Good Practises and other Experiences

4.1 Federal State of Baden-Württemberg

4.1.1 Petition of the People on Land Protection “Let Ländle Live”

Land taking is destroying cultural landscape and species-rich nature. In order to persuade state politicians to take effective measures to protect land, more than 15 organisations and associations have launched a petition. Every day, 6.2 ha of land are built in Baden-Württemberg (as of 2021). The state parliament and thus the state government are to commit themselves to achieving binding upper limits for the new consumption of land and to anchor them in law. In addition, the protection of particularly fertile soils is to be improved. In the case of industrial land, the municipalities should commit themselves to cooperate to avoid unnecessarily generous land use (Ländle leben lassen, 2023).

4.1.2 LoKlim: Knowledge Portal and Climate Data on Municipal Level

The project "Local Competence Development for Climate Change Adaptation in Small and Medium-Sized Municipalities and Districts" (LoKlim) was developed in the framework of a planning workshop together with actors from the field. The aim of the project is to accompany municipal institutions and actors in the planning and implementation of local-specific adaptation processes. For this purpose, application-oriented instruments for the concrete development and expansion of competences and capacities for adaptation to climate change in small and medium-sized municipalities and districts in Baden-Württemberg are being developed. The project is based at the Institute for Environmental Social Sciences and Geography at the University of Freiburg. The team follows an interdisciplinary approach and has many years of experience in applied research on climate change impacts and societal transformation (LoKlim, 2019).

4.1.3 Baden-Württemberg: Water Supply Master Plan

The Water Supply Master Plan project pursues the goal of a sustainable drinking water supply that will continue to provide drinking water of good quality and with a high level of

supply security at a reasonable price under the responsibility of the municipalities with sustainable resource management and the priority use of local water sources. For this purpose, the core infrastructure of the public water supply in the state is surveyed, which, in addition to facilities for water extraction and treatment, also includes central elements of the supply network, such as elevated tanks and supply and interconnection pipelines. To estimate the development of the supply, a forecast for the time horizon 2050 is made with the help of the expected range of groundwater recharge (climate projections). In addition to the annual water demand, the peak water demand during dry periods is also considered, as bottlenecks can occur especially during these periods. Furthermore, the supply security of the infrastructure is recorded and evaluated (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2023a).

4.1.4 Flood strategy Baden-Württemberg

The strategy for dealing with floods in Baden-Württemberg aims to ensure that all stakeholders are aware of the risks and develop, coordinate and implement measures. As part of the flood strategy, detailed flood hazard and flood risk maps were published in 2014 and updated in 2022. These cover around 12,000 kilometres of water bodies and form the basis for selecting measures to reduce flood risk in the federal state. On municipal level, detailed flood risk maps and risk assessment maps have been prepared and updated. Here, statements can be found on the number of inhabitants potentially affected by floods, on areas and objects. A central Internet portal for the flood strategy (www.hochwasserportal.bw) bundles all statewide information and contains links to map services, reports on measures and publications, as well as information about floods and heavy rainfall events in Baden-Württemberg. Further a guide "Municipal Heavy Rain Risk Management" was published to show municipalities what they can do to counter the risk of heavy rain fall events (Ministerium für Umwelt, Klima und Energiewirtschaft BW, 2022).

4.2 Region Neckar-Alb

4.2.1 Biotopverbund Neckar-Alb (Regional Habitat Network Plan Neckar-Alb)

In intensively used landscapes that are heavily characterised by settlements and traffic routes, as it is often the case in Germany, suitable habitats for wild animals and wild plants are often isolated. The aim of a biotope network is to ensure that separated parts of the

landscape (often protected areas that provide habitats for wild animals and plants) are connected to each other, so that the landscape can be traversed by them, and genetic exchange is possible. In practice, this includes the preservation and development of the remaining habitats on the one hand, and the implementation of measures in the intermediate areas to create or improve the conditions for the dispersal and migration of animals and plants on the other. At present, the Neckar-Alb Regional Association is working on an actualisation of the regional habitat network concept. In the further regional planning process, the regional biotope concept will also be the basis for coordination with other spatial demands from settlement development, transport development and land use among others (Regionalverband Neckar-Alb, 2020).

4.2.2 Biosphärengebiet Schwäbische Alb (UNESCO Biosphere Reserve Swabian Alb)

As a model region for sustainable development, the pursues the UNESCO Biosphere Reserve Swabian Alb overarching goal of combining ecological, economic, and social interests under the guiding principle of nature conservation-oriented and sustainable regional development. This goal and this integrative approach are fulfilled by means of an

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intensive participation of many actors and numerous sustainable model projects in various fields of action.

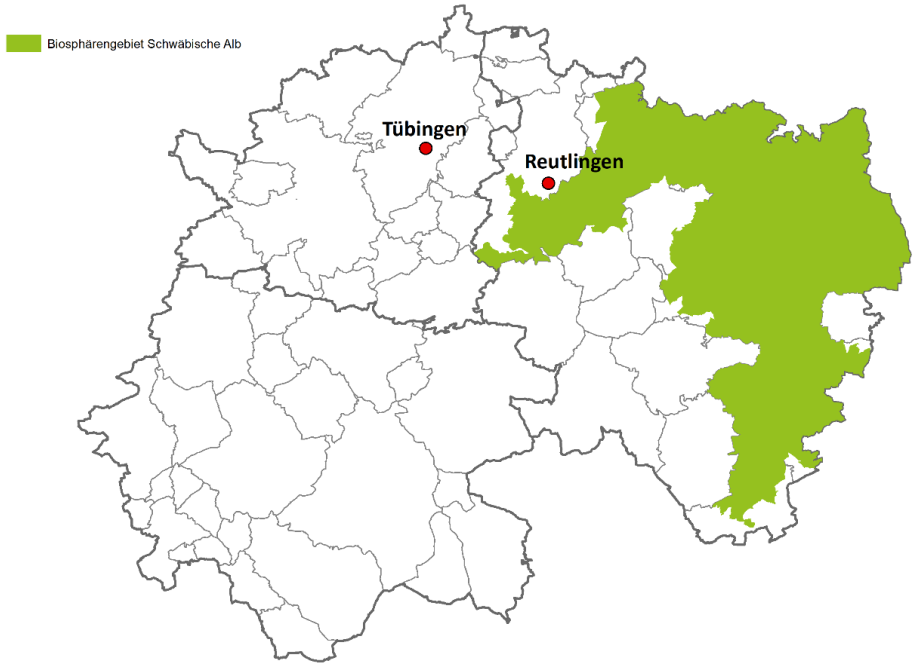

Figure 15: UNESCO Biosphere Reserve Swabian Alb in the Neckar-Alb region; data source: RVNA

Around 150,000 people live in 29 towns and municipalities on an area of approx. 85,300 ha. The biosphere reserve is exclusively set in the rural part of Neckar-Alb and is the driving force of rural development. Innovative ideas are developed and tested in this area on how people and nature can coexist on an equal footing. Within the framework of many sustainable projects, the basic idea of "living and managing in harmony with nature" is successfully implemented in the UNESCO Biosphere Reserve Swabian Alb in intensive cooperation with numerous partners and stakeholders. Approximately 20.000 annual tourists add value to the whole region, building a stable and sustainable economy that is guaranteeing jobs and helping to sustain people in rural settlements (Biosphärengebiet Neckar-Alb, 2023).

4.2.3 Climate Action Plans

Many municipalities in the rural district of Reutlingen have already published information on summer heat and floods. Furthermore, some of them have an integrated climate

action programme to reduce environmental risks and fight climate change. In the table beneath, so far known actions are listed.

Measure	Municipalities
Urban Climate Analysis:	Reutlingen, Tübingen, Pfullingen
Heavy rainfall hazard map:	Albstadt, Dettingen a.d. E. Dußlingen, Eningen unter Achalm Gomaringen, Gönningen, Kirchentellinsfurt, Kusterdingen, Metzingen, Nehren, Neustetten, Ofterdingen, Pfullingen, Rangendingen, Reutlingen, Riederich Rottenburg, Sonnenbühl, Wannweil
Climate protection management:	Bad Urach, Tübingen, Münsingen, Reutlingen
Climate-adapted forest conversion:	Engstingen, Pfronstetten, Grabenstetten
Information about heat waves and floods:	Almost all municipalities
Heat action plans	District of Zollernalb

Table 6 Climate action plans Neckar-Alb

4.2.4 Renewable Energy in Rural Areas of Neckar-Alb

Since renewable energy can profit rural areas in financial concerns, it can lead to prospering rural areas with innovative characteristics, while supporting sustainable development and generating jobs for future generations.

Wind energy

At present, two wind parks are under construction. In Sonnenbühl Hohfleck, five turbines hub height 140 m and 126 m rotor diameter will be generating environmentally friendly energy. Furthermore, the Gomadingen Planwald, including 5 turbines with hub heights of 165 m and rotor diameters of 170 m will be approved in August 2023. This project is from regional significance since neighbouring municipalities are seeking the expansion of the wind park area. More projects will come and add value to rural municipalities.

Solar parks

Agri-Photovoltaics (Agri-PV) refers to a process for the simultaneous use of land for agricultural crop production (photosynthesis) and PV electricity production

(photovoltaics). With the double use of land, it covers a broad spectrum in the intensity and type of agricultural use and in the additional cost of PV system construction. Thus, Agri-PV increases land efficiency and enables the expansion of PV power while preserving fertile arable land for agriculture, sometimes even in connection with the creation of species-rich biotopes. In the Neckar-Alb region currently some AGRI-PV projects are implemented. One of them is the solar park in Trochtelfingen. On 12 ha agricultural area used for 3,000 hens with the option to expand to 4,000 laying hens, 14,000 modules will produce about 11 megawatts of solar power.

4.2.5 LEADER Mittlere Alb (LEADER Middle Swabian Alb)

LEADER Mittlere Alb is a funding programme of the European Union (EAFRD) that aims to strengthen and develop socio-economic structure with regard to environmental and climate protection also including biodiversity aspects. It is implemented in partnership with the state of Baden-Württemberg and follows a bottom-up approach. The regional development concept of the Middle Swabian Alb was developed with great citizen participation. Many innovative projects are being implemented within the LEADER region focusing on demographic (e.g. housing projects or cross-generational places), geo-economic (e.g. regional products) and infrastructural (e.g. mobility or digital offers) aspects. All projects are based on the transversal objectives such as climate protection and adaptation, cooperation and scientific exchange, digital transformation, as well as inclusion and equal opportunities. An essential part of the implementation of the regional development concept is the promotion of projects in the LEADER action area (LEADER Mittlere Alb, 2022).

4.2.6 Sustainable Integration of International Professionals

The consequences of demographic change, as well as the currently very acute shortage of skilled workers, bring challenges, but also opportunities. Migration and integration continue to increase and gain importance, especially when regarding the labour market and the need for skilled workers. Many companies see this need, but also the additional work and challenges associated with hiring foreign workers or trainees. Especially in small and medium-sized enterprises and handicraft businesses, which are typical for the

Swabian Alb, there is hardly any of the necessary knowledge and skills that would be required for a sustainable integration of international skilled workers.

One project was initiated by the Diakonieverband Reutlingen. It has offered companies in the Swabian Alb region cooperation over a period of 2.5 years in order to provide sustainable support for the integration of (future) international skilled workers. With the help of two staff positions within the project, a placement level is created between employers and employees (LEADER Mittlere Alb, 2019).

The regional chamber of industry and commerce (IHK) also has a project in place to help with the recruiting of skilled workers from foreign countries called “Hand in Hand for International Talents”. The project successfully brings international skilled workers from Vietnam, Brazil and India together with companies in the Neckar-Alb region. The skilled workers have at least two years of working experience, a certified German level of B1 and a vocational qualification that is at least partially recognised (IHK, 2023).

5 Proposals for Improvement

Today's planning should enable future perspectives, and the development of the region should be oriented towards the principles of sustainability. Based on current technical developments, solutions are to be found that make the region not only economically, but also ecologically and socially strong and unique. The Regional Association Neckar-Alb (RVNA) aims to meet social and economic demands, to protect the natural foundations of life, to strive for a high quality of life and environment and to keep corresponding design options open for future generations. Disadvantages in age group-specific infrastructure facilities must be prevented and adequate access to the basic functions of living, working, education and supply must be guaranteed in all areas and for all population groups in the Neckar-Alb region. Comprehensive framework conditions need to be created to lead young people back to rural areas, make them settle there or prevent them from migrating in the first place. Furthermore, ensuring balanced spatial development within a decentralized settlement structure is one of the main aspects of the work of the RVNA. At both the local and the supra-local level, efforts must be made to concentrate and bundle settlement and infrastructure development.

The topics of climate adaptation, environmental risk prevention and challenges of demographic change need to find higher relevance in the restructuring of the regional plan Neckar-Alb. It may be possible to create a new chapter or section focusing on these future challenges and describe how to tackle them within a planning horizon. Some regional projects have already been started to create a new basis for this plan, like the regional habitat network plan, the spatial planning for renewable energies or the regional mobility projects. Furthermore, the cooperation with universities and research centres can enforce technological development and innovation regarding the challenges of environmental risks and demographic change.

5.1 Measures and Strategies to Mitigate Environmental Risks

When thinking about measures and strategies that can be used to mitigate environmental risks in the Neckar-Alb region, a number of options have been identified. To give an overview, the individual measures and strategies are listed in the paragraphs that follow:

Measures against environmental risks:

- Adjustment and management of grassland stands Research, conservation and use of old agriculturally relevant species or varieties
- Use of diverse crop types and variety selection in agriculture
- Optimise fertiliser systems
- Improve soil protection
- Conservation, protection, and restoration of wetlands
- Revitalisation of watercourses
- Establishing and optimizing irrigation to be prepared for heat events and droughts
- Fire protection measures
- Risk management in agricultural enterprises on environmental risks
- Optimising flood protection in municipalities
- Landscape ecology measures for flood protection, heavy rainfall protection and promotion of biodiversity
- Preserving and strengthening protected areas
- Maintenance measures to stabilise habitats and species particularly threatened by climate change
- Forest monitoring
- Processing climate data
- Expand environmental education and research
- Create more acceptance and knowledge of sensible measures

Strategies to mitigate environmental risks:

- Implementation of the measures suggested by the Forestry Strategy Baden-Württemberg
- Development of consultancy concepts for forest owners and owners of nature reserves on the sustainable maintenance of the areas.
- Implementation of the measures suggested by the Climate Protection and Climate Change Adaptation Strategy Baden-Württemberg
- Development of heat and flood prevention programmes with local specific maps

- Implementation of the Nature Conservation Strategy Baden-Württemberg
- Implementation and preparation of regional programmes, plans and concepts to prevent environmental risks
- Reconciliation and Harmonization of programmes and measures

5.2 Measures and Strategies to Promote Sustainable Development and Minimize the Effects of Demographic Change

When thinking about measures and strategies that can be used to promote sustainable development and minimize the effects of demographic change in the Neckar-Alb region, a considerable number of options have been identified. An overview on the individual measures and strategies are listed below:

Measures:

- Securing the local supply in rural areas
- Local mobility offers: When planning and choosing the location and design of services of general interest, accessibility and sustainable forms of mobility should be taken into account, instead of only planning the accessibility by car.
- Promotion of sustainable tourism
- Improve cooperation between municipalities
- Regional land management and securing spaces
- Managing the balance of competing uses
- Favourable residential conditions must be used in a resource-conserving manner
- Sufficient and attractive job, education and supply opportunities are to be provided in appropriate proximity to the place of residence
- Quality of life requires infrastructure measures for healthy nature, mobility, compatibility of family and work, education, and medical care.

Strategies:

- Implementation of the measures of the Sustainable Development Strategy Baden-Württemberg
- Regional Planning Strategy on Sustainable Development: Model of decentralised concentration

6 Conclusions

The Neckar-Alb region is characterized by a diverse landscape structure, an attractive cultivated landscape and a high quality of life, providing attractive living and working conditions, regeneration opportunities, mobility services and connectivity to urban areas. Due to the immense challenges of climate change, which are threatening these strengths, there needs to be a transformation – environmentally and socially. The challenges of Neckar-Alb are mainly connected to the element of water, ranging from extreme weather conditions such as thunderstorms, hail, and down pours, to heat, drought and safe water supply. In rural areas the agriculture needs to adapt new technologies and diversify their food production to sustain reasonable and fruitful harvests. German forests are in poor condition such that the CO_2-storage is in danger, wildfires may occur, and the ecological functions are degrading. Among that, there is another issue to tackle: the ageing population that keeps up the economy and shape town structures. Only few young people stay in villages or aim for farm takeovers. Additionally, skilled workers are urgently needed in rural areas to help realizing the sustainable development and transformation. The competition of land clearly shows how environmental risks are connected to demographic change. If open spaces are used for housing, biodiversity suffers; the risk of flooding is increasing in denser areas, and this is affecting the environment and the overall landscape. Land taking and the overuse of land needs to be solved and the needs of young and old people need to be in balance. In the Neckar-Alb region the fields of action lie within climate adaptation, renewable energies, and value creation. With the adaptation to environmental risks, municipalities can prepare for future generations, passing on precious knowledge. Furthermore, there is a valuable chance lying in renewable energies, since they provide financial support to the locals, while producing ecologically clean energy. To guarantee a prospering region the keys are sustainable development, as well as raising social and political awareness about environmental risks. All in all the findings of this regional report will be incorporated into the new regional plan Neckar-Alb and regional or local projects may emerge with the lessons learned within this analysis.

7 References

Biosphärengebiet Neckar-Alb. (2023). Von https://www.biosphaerengebiet-alb.de/ online source (28.08.2023)

Biosphärengebiet Schwäbische Alb. (2023). Schäferei online source: https://www.biosphaerengebiet-alb.de/schuetzen-entwickeln/schaeferei (28.08.2023)

BIBUS, E. 1986: Die Rutschung am Hirschkopf bei Mössingen (Schwäbische Alb) – Geowissenschaftliche Rahmenbedingungen – Geoökologische Folgen– Geoökodynamik 7: 333–360.

BMUV (2023): Flächenverbrauch - Worum geht es? online source: https://um.baden-wuerttemberg.de/de/umwelt-natur/bodenschutz/flaechenverbrauch (24.08.2023)

BUND RV NECKAR-ALB (2023): BUND RV-Umfrage zu kommunalen Anpassungsstrategien an den anthropogenen Klimawandel in der Region Neckar-Alb. online source: https://www.bund-neckar-alb.de/projekte-aktionen/auswertung-der-bund-umfrage-zu-kommunalen-anpassungsstrategien-an-den-anthropogenen-klimawandel-in-der-region-neckar-alb/

Domhardt, H., & Grotheer (02-03/2022): Energiewende – Potential für die Regionalentwicklung in ländlichen Räumen. Nachrichten der ARL.

DWD (2023): Deutscher Klimaatlas. online source: https://www.dwd.de/DE/klimaumwelt/klimaatlas/klimaatlas_node.html

Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg (FVA) 2022: Waldzustandsbericht 2022. online source: https://www.fva-bw.de/fileadmin/publikationen/wzb/wzb2022.pdf

Gesamtverband der Versicherer (GVD) (2023): Starkregenbilanz. online source: https://www.gdv.de/gdv/medien/medieninformationen/starkregenbilanz-2002-bis-2021-bundesweit-12-6-milliarden-euro-schaeden-137444 (23.08.2023)

IHK (2022): Neckar Alb in Zahlen 2022. online source: https://www.reutlingen.ihk.de/fileadmin/user_upload/www.reutlingen.ihk.de/Standortpolitik/Allgemein/PDF-Dateien/2022_Neckar-Alb-in-Zahlen.pdf. (17.08.2023)

IHK (2023): Internationale Fachkräftegewinnung: Hand in Hand for International Talents. online source: https://www.reutlingen.ihk.de/region-neckar-alb/internationale-fachkraeftegewinnung/ (31.08.2023)

Kooperationsprojekt der Regionalverbände Hochrein-Bodensee und Neckar-Alb mit dem Ministerium für Verkehr Baden-Württemberg. (2023). *Empfehlungen zur Mobilitäts- und Siedlungsentwicklung in ländlichen Räumen.*

Landesforstverwaltung (2021): Waldstrategie Baden-Württemberg 2050: Auf dem Weg zur Waldstrategie – Bericht zum Waldstrategie-Prozess. Stand 14. Januar 2021.

Ländle leben lassen. (2023). Online source: https://www.laendle-leben-lassen.de/ abgerufen

Landratsamt Tübingen (2022). Amtliche Bekanntmachung des Landkreises Tübingen. online source: https://www.ammerbuch.de/fileadmin/Dateien/Amtliche_Bekanntmachungen/2022/2022-07_LRA_T%C3%9C_befristetes_Wasserentnahmeverbot.pdf abgerufen

LEADER Mittlere Alb. (2019). Moving Migration. online source: https://leader-alb.de/moving-migration/ abgerufen

LEADER Mittlere Alb. (2022). Regionales Entwicklungskonzept. online source: https://leader-alb.de/wp-content/uploads/2022/11/REK-LEADER-Mittlere-Alb-2023-2027_Stand-22.07.2022.pdf

LoKlim. (2019): Lokale Klimaanpassung. online source: https://lokale-klimaanpassung.de/lokales-klimaportal/#close (26.08.2023)

LUBW (2023a): Monitoringbericht 2020 zur Anpassungsstrategie an den Klimawandel in Baden-Württemberg. Stuttgart. online source: https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-

um/intern/Dateien/Dokumente/2_Presse_und_Service/Publikationen/Klima/Monitoringbericht-2020.pdf

LUBW (2023b): Wieder ein Rekordjahr – So sonnig und warm wie noch nie. Eine klimatische Einordnung des Jahres 2022 für Baden-Württemberg.

Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg (2022) Strategie zum Umgang mit Hochwasser in Baden-Württemberg. online source: https://www.hochwasser.baden-wuerttemberg.de/

Ministerium für Umwelt, Klima und Energiewirtschaft BW (2023a): Strategie zur Anpassung an den Klimawandel in Baden-Württemberg. Fortschreibung. Stand Juli 2023. Stuttgart.

Ministerium für Umwelt, Klima und Energiewirtschaft (2023b): Versiegelung eindämmen und lenken. online source. https://um.baden-wuerttemberg.de/de/umwelt-natur/bodenschutz/flaechenverbrauch (23.08.2023)

Ministerium für Umwelt, Klima und Energiewirtschaft BW (2023c): Klimaschutz- und Klimawandelanpassungsgesetz Baden-Württemberg. online source: https://um.baden-wuerttemberg.de/de/klima/klimaschutz-in-bw/klimaschutz-und-klimawandelanpassungsgesetz-baden-wuerttemberg (25.08.2023)

Regionalverband Neckar-Alb (2023): Die Neckar-Alb Region. online source: https://www.rvna.de/Startseite/Region+Neckar_Alb.html (18.08.2023)

Regionalverband Neckar-Alb (2013). Regionalplan Neckar-Alb.

Regionalverband Neckar-Alb. (2020). Biotopverbund Neckar-Alb. online source; https://www.rvna.de/Startseite/Regionalplanung/regionaler+biotopverbund.html abgerufen

RVNA (2023): *Teilfortschreibung Wind- und Solarenergie*. online source: https://www.rvna.de/Startseite/Regionalplanung/teilfortschreibungen.html

Staatsministerium Baden-Württemberg 2023: Mit dem Sonderprogramm Biodiversität die Grundlage unseres Lebens retten. online source. https://www.baden-

wuerttemberg.de/de/bw-gestalten/nachhaltiges-baden-wuerttemberg/naturschutz/biodiversitaet (29.08.2023)

Staatsministerium Baden-Württemberg 2022: Wie erreichen wir die Netto-Null beim Flächenverbrauch? online source: https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/wie-erreichen-wir-die-netto-null-beim-flaechenverbrauch (22.08.2023).

Staatsministerium Baden-Württemberg. (2022). *Lage der Wälder in Baden-Württemberg ist besorgniserregend*. online source: https://www.baden-wuerttemberg.de/de/service/presse/pressemitteilung/pid/lage-der-waelder-in-baden-wuerttemberg-ist-besorgniserregend (28.08,2023)

STADT MÖSSINGEN (2023): Mössinger Bergrutsch. online source: https://www.moessingen.de/bergrutsch (24.08.2023)

STADT MÜNSINGEN (2023). Region Neckar Alb. online source: https://www.muensingen.de/de/Wirtschaft/Region-Neckar-Alb (17.08.2023)

Statistisches Landesamt Baden-Württemberg (2023a): State Statistical Office. Bevölkerung, Gebiet und Bevölkerungsdichte. online source: https://www.statistik-bw.de/BevoelkGebiet/GebietFlaeche/01515020.tab?R=RV41 (17.08.2023).

Statistisches Landesamt Baden-Württemberg (2023b): State Statistical Office. Bruttoinlandsprodukt und Bruttowertschöpfung. online source: https://www.statistik-bw.de/GesamtwBranchen/VGR/20013001.tab?R=RV41 (17.08.2023).

Statistisches Landesamt Baden-Württemberg (2023c): State Statistical Office. Beschäftigte seit 1999 nach ausgewählten Wirtschaftsbereichen. online source: https://www.statistik-bw.de/Arbeit/Beschaeftigte/03025015.tab?R=RV41 (17.08.2023).

Statistisches Landesamt Baden-Württemberg (2023d): State Statistical Office. Erwerbstätige. online source: https://www.statistik-bw.de/Arbeit/Erwerbstaetige/ (18.08.2023)

Statistisches Landesamt Baden-Württemberg (2023e): State Statistical Office. Agrarstruktur. online source: https://www.statistik-bw.de/Landwirtschaft/Agrarstruktur/05015025.tab?R=RV41 (18.08.2023)

Statistisches Landesamt Baden-Württemberg (2023f): State Statistical Office. Altersstruktur. online source: https://www.statistik-bw.de/BevoelkGebiet/Alter/01035410.tab?R=RV41 (18.082023)

Statistisches Landesamt Baden-Württemberg (2023g): State Statistical Office. Bevölkerungspyramiden. online source: https://www.statistik-bw.de/Bevpyramiden/ (21.08.2023)

Statistisches Landesamt Baden-Württemberg (2023h): Tourismus Baden-Württembergs im Kalenderjahr 2022. Online source: https://www.statistik-bw.de/Service/Veroeff/Statistische_Berichte/355222001.pdf

SWR. (2023). *Klimawandel und Wasserverbauch in der Landiwrtschaft*. Von Sollten Landwirte in Baden-Württemberg einen Wassercent zahlen? online source: https://www.swr.de/swraktuell/baden-wuerttemberg/landwirte-in-baden-wuerttemberg-wassercent-ausnahmen-100.html (28.08.2023)

Umweltbundesamt 2023: Erosion – jede Krume zählt. online source: https://www.umweltbundesamt.de/themen/boden-flaeche/bodenbelastungen/erosion-jede-krume-zaehlt#undefined

Umweltbundesamt. (2020). Bewertung klimawandelgebundener Risiken: Schadenspotenziale und ökonomische Wirkung von Klimawandel und Anpassungsmaßnahmen.

Umweltbundesamt. (2022). Wasserressourcen und ihre Nutzung. online source: https://www.umweltbundesamt.de/daten/wasser/wasserressourcen-ihre-nutzung#die-wasserressourcen-deutschlands

Walheim, P. (22. 08 2023). Für Reiserückkehrer nur lange Hosen. Schwäbisches Tagblatt.

ZAK. (22. 08 2023). Für Reiserückkehrer nur lange Hosen. *Zollernalb Kurier*. Author: P. Walheim

ZAK. (25. 08 2023). Die Plage von Dürre und Hitze. *Zollernalb Kurier*. Author: Uwe Jauss