Meadow irrigation in the federal state Baden-Württemberg. Portrayal of a nearly forgotten land use system

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Introduction

Meadow irrigation is a form of land use system that has largely been forgotten, although it clearly characterised the landscape until the 1970s. There are various definitions of 'meadow irrigation'. Depending on the inheritance customs and the geographical conditions, meadow irrigation could either be managed by individuals with simple techniques or by co-operatives, which used more advanced constructions on a larger scale.

There is plenty of specialised literature, dealing with the meadow irrigation techniques and management. Contemporary references often served as instructions, which describe exemplary irrigation models favoured by the authors who also encourage the replication of the presented model (e.g. the management instructions by Abel published 1856, using the example of an irrigation system applied in the Röthbuch valley in the Danube region). In the following the aims of meadow irrigation, the techniques and origins, as well as a PhD project about meadow irrigation in the Freiburg valley will be presented.

Aims of meadow irrigation

Meadow irrigation systems, of which some were very complex systems, were applied in order to improve the hay yield. The irrigation of meadows had various effects. The most important was the fertilising effect of the irrigation during spring and autumn. The water carried suspended sediment and dissolved minerals. In springtime the irrigation also served as a protection against night frosts or accelerated the melting of the snow. However, this could only be achieved, if the water temperature was higher than that of the air and soil. If this was the case the vegetation period could be extended successfully[1]. Additionally, the irrigation had a moisturising effect, which was of significance during summertime. Furthermore, it served as pest control. Especially the number of mice could be reduced by means of irrigation.
Irrigation was only done for several hours and never for more than one day. Otherwise it would have been counterproductive, particularly during the summer, because prolonged lack of air would have interrupted the vegetation growth, which was supposed to be enhanced.

Therefore, the rule 'a lot helps a lot' does not apply to irrigating meadows[2].

Technical requirements

Usually, for irrigation water was dammed up and directed to the meadows through a network of mains and drains, which was adapted to the area's geography. The system was designed in such a way that made it possible to distribute the water evenly and also to drain the irrigated meadow again without difficulty. Different techniques were applied depending on the local conditions (especially the gradient of the plots) and the pursued aims of meadow irrigation. The major differentiation is between inundation and overland flow.

Inundation is a very simple method. Water is directed into the meadows, which are bordered by dams to keep the water in place for a certain amount of time until it is discharged again. To ensure better dispersion of the

[1] Endriss 1952.
[2] Abel 1865, Konold & Popp 1994, Ruoff 1880, Schüle & Schwineköper 1988.

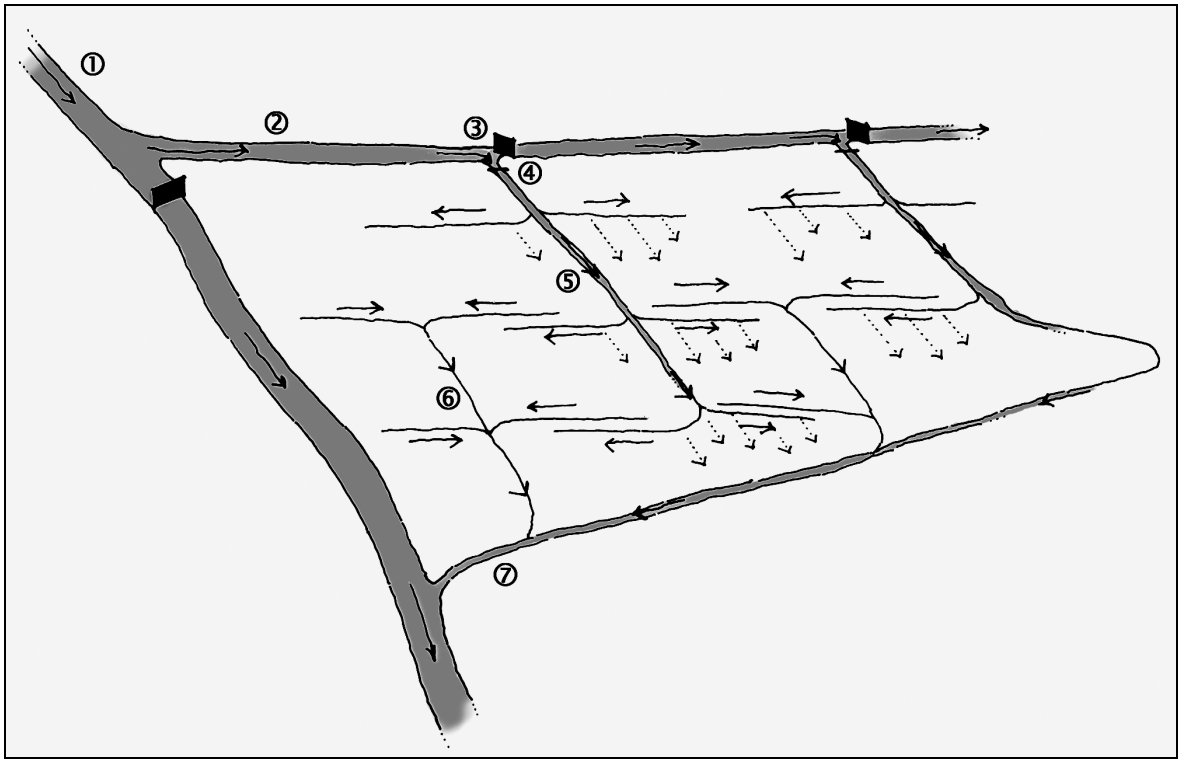


Figure 1: Simplified model of overland flow method according to Schewior 1941.
① river, ② head main, ③ sluice, ④ hatch, ⑤ main, ⑥ drain, ⑦ head drain.

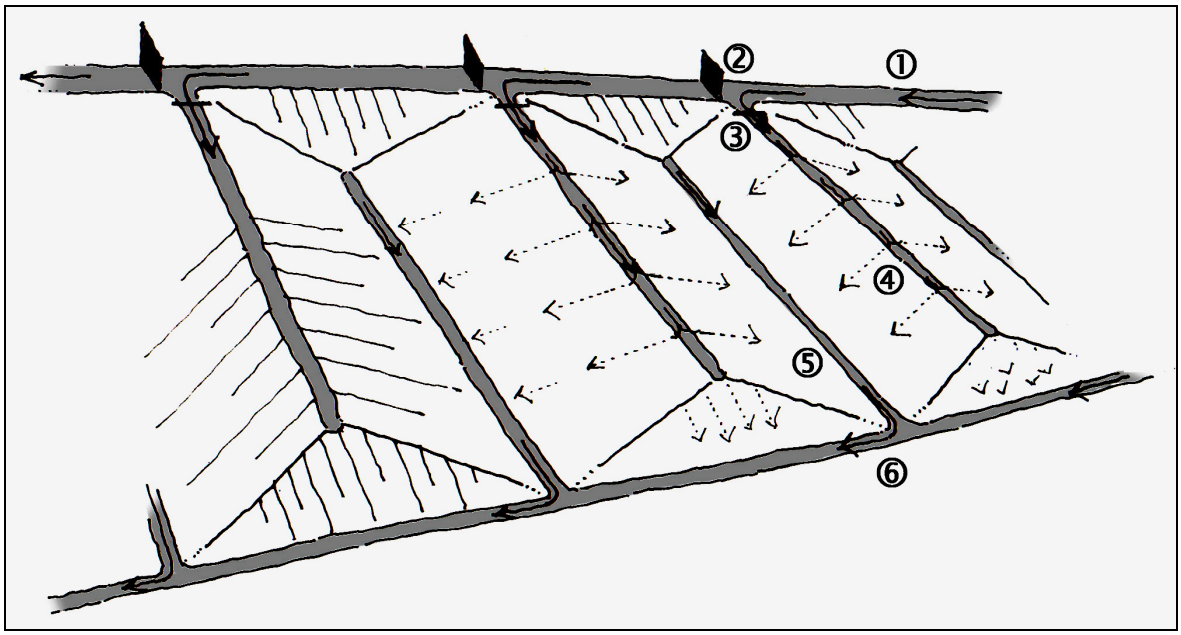


Figure 2: Simplified model of overland flow method according to Rheinstädter 1995 and Schewior 1941.
① head main, ② sluice, ③ hatch, ④ main, ⑤ drain, ⑥ head drain.

water and drainage of the inundated meadow additional small ditches were built.

Overland flow makes use of an area's natural gradient. Water is applied to the meadow at the highest point and flows downhill through a contouring network of irrigation ditches (see fig. 1). Meadow irrigation on hillsides was common practice in the Black Forest. If the gradient was less than the required minimum of 2% so-called artificial structures had to be built (see fig. 2), as was often done in the Danube region[3]. The techniques were adapted to the local conditions[4]. Water captured from the head main is diverted to the meadow through a main at the top of the artificial ridge. From this main, water spills over both sides of the slope until it reaches the lowest parts of the field, where the field is drained of water[5]. Consequently, meadow irrigation had different requirements, depending on the geographical conditions.

History and distribution of meadow irrigation

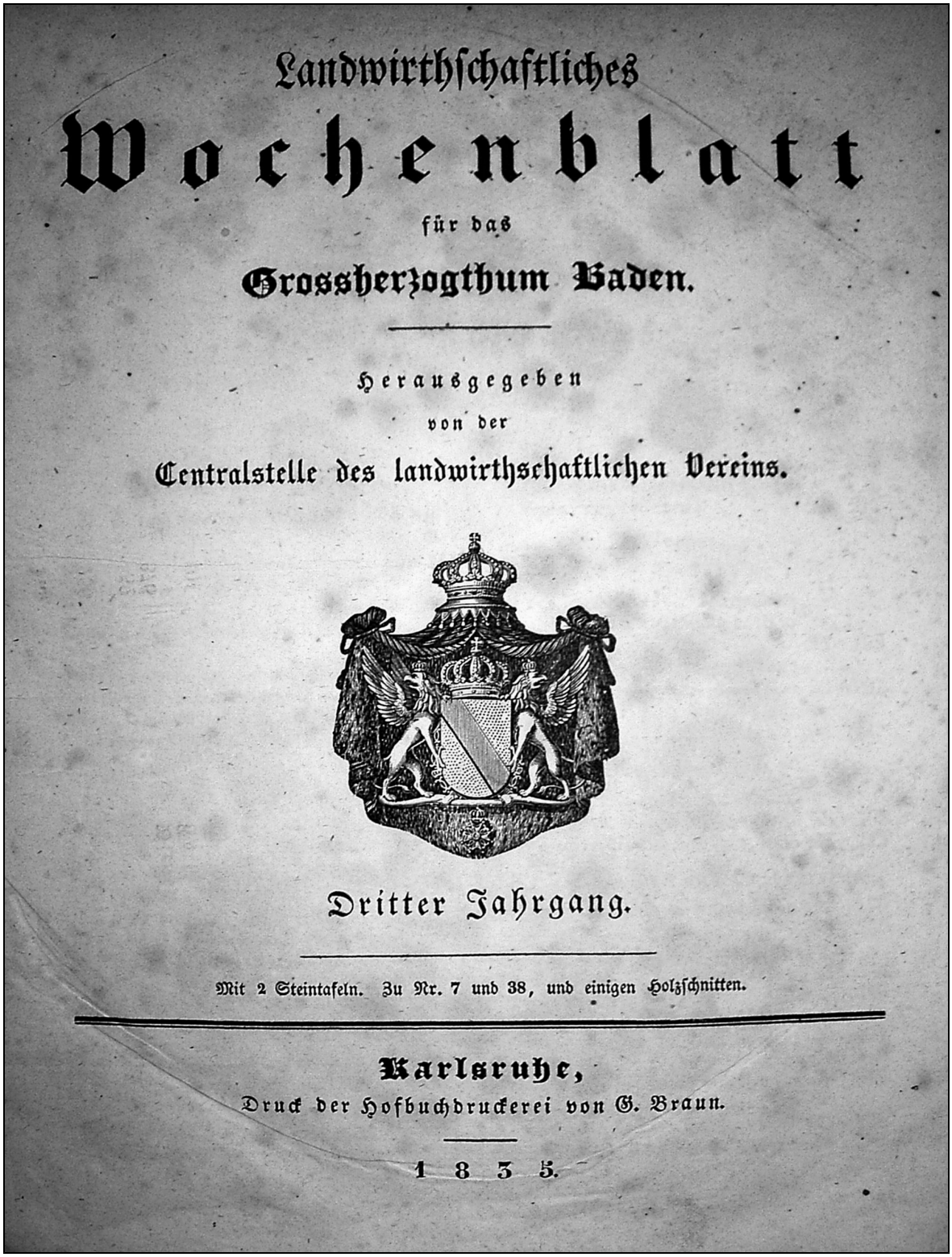
The origins of meadow irrigation are unclear. It was probably a combination of observing the effects of inundations and attempts to imitate the floodings[6]. Records of systematic irrigation in southern Germany date back to the 12th and 13th century (e.g. Endriss 1950: traces of meadow irrigation in the Wiesetal valley, between Feldberg and Basel in the year 1113; Konold & Popp 1994: Mentioning of meadow irrigation along the Danube tributaries between Sigmaringen and Ulm in 1332).

Prime time of meadow irrigation in southwest Germany was in the 19th century. At the beginning of the 19th century agricultural reforms were slowly enforced. Agricultural production was supposed to be intensified since it was unsatisfactory at the time. To improve the situation agriculture was ameliorated[7]. Meadow irrigation was supposed to play an important role in this. Irrigation was seen as the nourishing mother of agricultural land: the hay crop from the irrigated meadows was fed to the livestock. In addition, feeding the livestock all year around enabled framers to keep the animals at the farm and collect their farmyard manure, which was used as fertiliser to improve the yields[8]. The meadow irrigation system was considered to be fairly sustainable because the fertilising effect of the irrigation was believed to be high. At that time, the fertilising effect of the rivers and streams should not be underestimated; bearing in mind that the water, used for irrigation, contained unfiltered sewage[9].

In 1865 Fraas concluded that the development of the meadows in Germany advanced greatly; particularly meadow irrigation stood out against the old techniques of the southern regions[10]. Since the German conditions were not comparable with those of Mesopotamia, he stipulated that 'parapotamic' conditions should be achieved by means of meadow irrigation[11]. 'Parapotamic' (along the rivers) was supposed to be understood as the counterpart of Mesopotamia (between the rivers).

Intensified meadow utilisation was not just supported by the government. Numerous publications about irrigation contributed to spreading the idea. In Württemberg the key agricultural publication was the Agriculture and Forestry Weekly, published by the Royal Württemberg Agricultural Authority. In the Baden dukedom the weekly agricultural news were published by the central office of the agricultural association (see figure 3).

[3] Haberlandt 1879, Konold & Popp 1994, Rheinstädter 1995, Schüle & Schwineköper 1988, Strecker 1923.
[4] Haberlandt 1879, Strecker 1923.
[5] Leibundgut 2004.
[6] Hassler 1995.
[7] Borcherdt et. al. 1985, Konold & Kroll 1994.
[8] Endriss 1952.
[9] Fraas 1865, Ruoff 1880.
[10] Fraas 1865, 199.
[11] Fraas 1865, 445.



Landwirthschaftliches

Wochenblatt

für das

Grossherzogthum Baden.

Herausgegeben

von der

Centralstelle des landwirthschaftlichen Vereins.

Dritter Jahrgang.

Mit 2 Steintafeln. Zu Nr. 7 und 38, und einigen Holzschnitten.

Karlsruhe,

Druck der Hofbuchdruckerei von G. Braun.

1835.

Figure 3: Title page of the collected issues of Baden's weekly agricultural news (of the third year in 1835).

For the construction of an effective irrigation system specialist knowledge was absolutely necessary. Furthermore, trained keepers were required to manage and tend the system in order to ensure successful irrigation. Meadow irrigation demanded a lot of work and tending: apart from the yearly maintenance of the mains and drains, as well as the gradients, the actual irrigation had to be managed. For this purpose co-operatives employed so-called drowners to take care of the more complex irrigation systems[12]. They managed the irrigation according to predetermined schedules. This is of great importance as conflicts often arose over the rights to use water[13]. A look at the weekly agricultural news of that time shows that various courses were offered. These included practical and theoretical education. Meadow cultivation schools were established and meadow cultivation specialists, as well as assistants were trained. The educational measures most likely contributed to a further distribution of meadow irrigation[14].

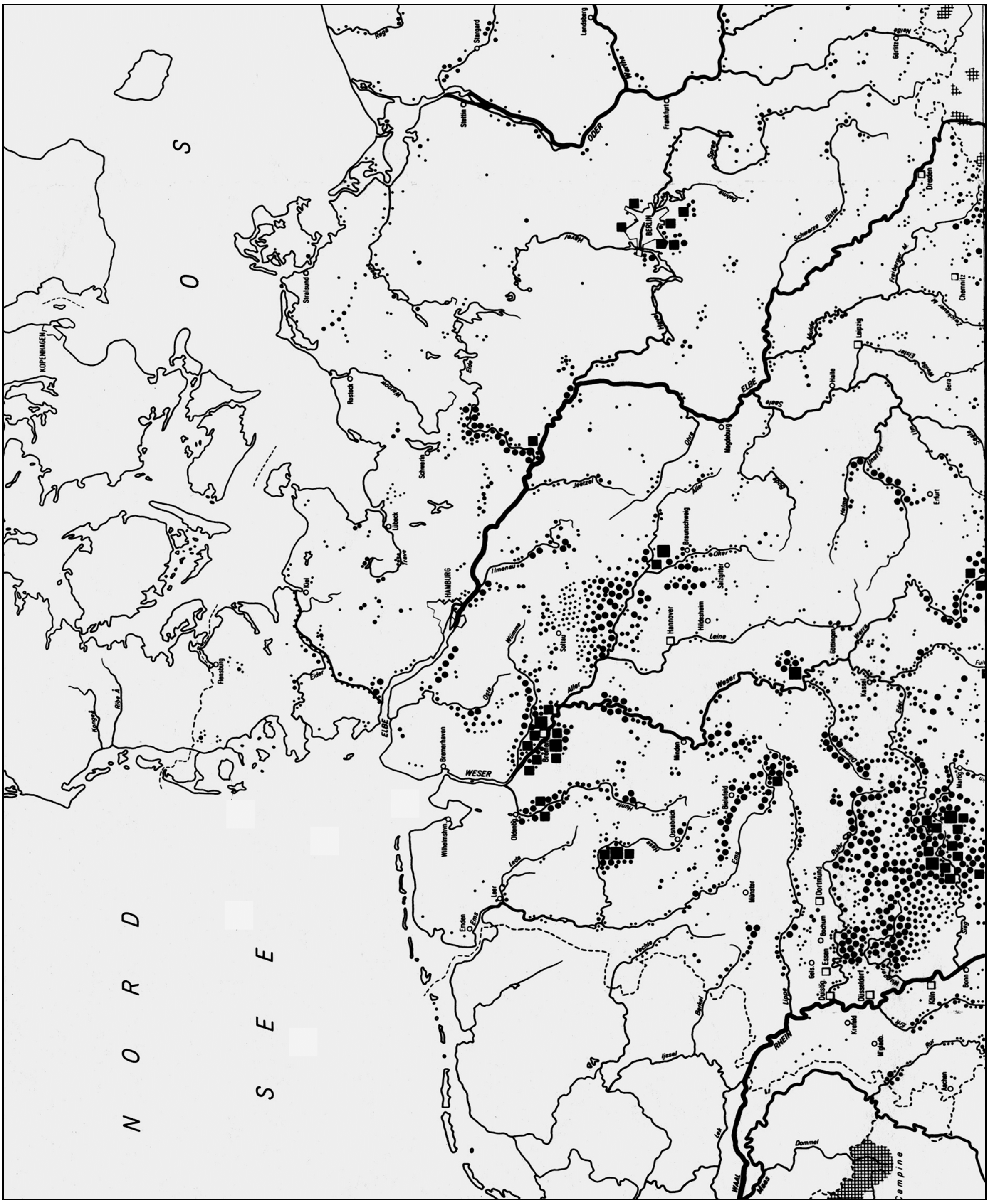
Meadows were irrigated wherever suitable conditions could be found. Apart from the Siegerland region the Black Forest and its neighbouring regions were undoubtedly the areas with the highest number of irrigated meadows. A map of the year 1937 illustrates the distribution of meadow irrigation across Germany, without claiming to provide a complete account (see fig. 4). In present times, names often reveal where meadows were irrigated, if relics of this historical form of land use or written sources are lacking. In the federal state Baden-Württemberg the name 'Brühl' indicates that the meadows of that area were irrigated[15].

In the 20th century meadow irrigation was slowly abandoned due to the lack of skilled workers, as well as because of alternative fertilisers and modern techniques[16]. Relics of meadow irrigation, which did not disappear in the aftermath of the land consolidation, are valuable cultural-historical features of the landscape. Furthermore, valuable habitats developed around the irrigated meadows (for example, numerous former ditches are protected biotopes according to article 24a of the Baden-Württemberg Nature Conservation Law).

Dealing with meadow irrigation today, it becomes clear that this form of land use had a large impact on the aquatic ecosystems. Nowadays it is known that the utilisation of water resources has increased significantly since the early Middle Ages. Therefore, aquatic ecosystems have been subject to increasing changes. The morphology and the mean discharge of rivers and streams have been altered. The consequences of the anthropogenic impacts were not always predictable[17]. In order to assess the present status of aquatic ecosystems it is important to take history into account. Historical analyses of the development of water bodies and their utilisation are necessary for a possibly unbiased assessment of the current conditions of water ecosystems. On the basis of this options for future planning can be developed. Consequently, in accordance with Goethe or Dickens we should deal with the past for the benefit of the present. The current situation can only be understood if earlier developments are considered to avoid an evaluation solely based on today's point of view.

If this is done, changes of the landscape cannot only be reconstructed, but also understood and explained, which may finally serve the future development.

[12] Ruoff 1880.
[13] Loose 1990, Schüle & Schwineköper 1988.
[14] Konold & Popp 1994.
[15] Buck 1931.
[16] Konold & Popp 1994.
[17] Konold 1998.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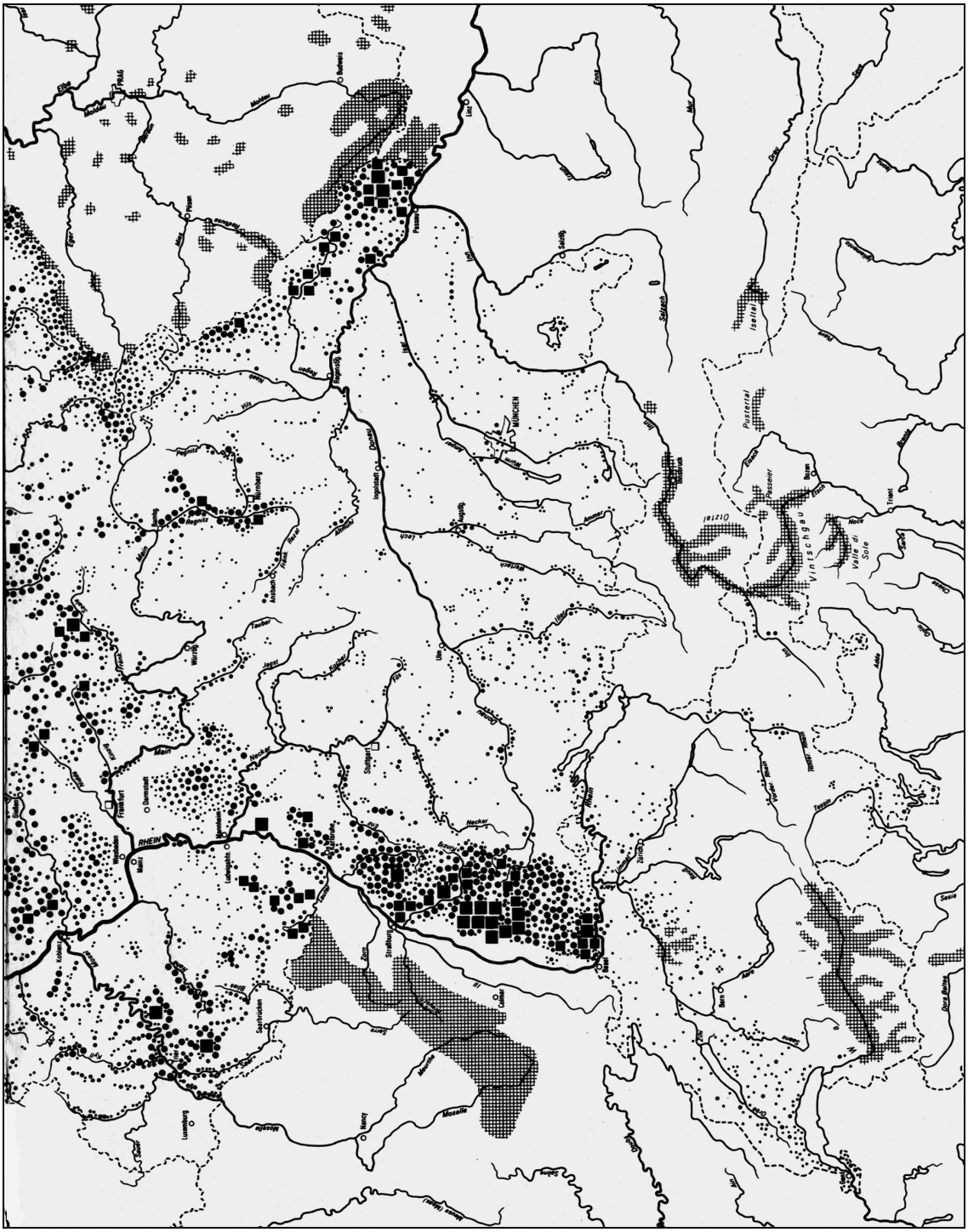

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Figure 4: Geographical distribution of irrigated meadows in Germany and neighbouring countries – part of a map by C. Troll 1937 as shown in Böhm 1990.

PhD project about meadow irrigation in the Freiburg valley

Meadow irrigation represents one of the many land use forms that changed the landscape substantially. As part of the Graduate College 'Formation and Development of Present-Day Landscapes' at the Albert-Ludwigs University in Freiburg, a PhD project conducts research about irrigated meadows found in the Freiburg valley between Freiburg and the Kaiserstuhl region. For the first time meadow irrigation is analysed from a wider perspective. Apart from the changes, which affected the water bodies or the landscape, the research also focuses on the social conditions and regional interconnections.

New approaches will be integrated into the applied historical landscape analysis, as described by Schwineköper[18]. One new aspect is the use of laser scanned data, which will be added to the geographic information system (GIS). Furthermore, results of the historical analysis will be put into relation with the findings of the literature and social research.

To identify the changes of the cultural landscape historical and current maps or aerial photographs are compared. The results will be stored in a geographic information system and supplemented by laser scanned data. Laser scanners are optical measuring systems carried by airplanes. They measure the signals between the laser's sensor and the surface, which reflects the signal. Direct measurements make it possible to create three dimensional digital terrain models (DTM), once the collected data is digitised[19]. The suitability of laser scanned data to detect data about historical landscape structures was successfully tested in a research project conducted by the Institute of Landscape Management of the Albert-Ludwigs-University in Freiburg[20]. It is currently examined to what extend the available laser scanned data contribute to the historical analysis of landscapes characterised by irrigated meadows. The historical relics of irrigation systems are recorded. For the collection of data the methodology presented by Thiem will be modified and applied (cf. Thiem 2004). The information will also be saved into the GIS. Historical records will help to fill information gaps or clarify uncertainties.

In addition to the reconstruction of the changes caused by meadow irrigation the analysis of historical records will also put emphasis on the region's social and political conditions. The role of the location of the irrigated meadows between Freiburg an Kaiserstuhl will be of particular interest because they served as a link between the two areas in many respects.

A qualitative contents analysis of available publications about meadow irrigation will be applied in order to identify the overall conditions. For this purpose the articles of the weekly Baden agricultural news will be analysed. The results will then be combined with the information about the development of meadow irrigation in the research area.

Furthermore, based on the knowledge about the past, recommendations for the future management of the former meadow irrigation systems will be made.

[18] Schwineköper 1997, 2000.
[19] Hug 2003.
[20] Sittler 2004.

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