
Carp land: Economics of fish farms and the impact of region-marketing in the Aischgrund (DEU) and Barycz Valley (POL)

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Abstract :

The carp farmers of today face many challenges, with changing consumer habits, drought, losses of fish to avian predators and diseases presenting some of the most widespread threats. Our study has selected two European carp-farming areas as case studies: the Aischgrund in Germany and the Barycz Valley in Poland, where local stakeholders have initiated region-marketing concepts. The carp provides the core identity of these region-marketing. The region-marketing aims to boost touristic attractiveness of the regions and should indirectly support carp farmers in the strained economic situation for carp aquaculture. Notwithstanding, it is unknown, how the region-marketing effects carp farms' economics. Stakeholders were interviewed to explore the establishment and the essence of these region-marketing concepts. Focus groups of carp farmers have informed our sample of representative farms. The representative farm models enabled to compare the costs and profitability of different carp enterprises. Further, the farm models helped to explore the potential impacts and efficacy of region-marketing initiatives introduced in recent years. Our results show that the single grow-out and traditional sale of conventional fresh carp is scarcely profitable. Farmers in both regions struggle with limited options for adaptation or diversification. The difficulties are most pronounced for small-scale peasant carp farms. We consider the potential of labelling as part of region-marketing and future transfer payments that honor the contribution of carp farming to ecosystem services and cultural value (region's identity). In particular for larger-scaled carp farms, region-marketing seems to be a good means of enhancing direct marketing opportunities and generating new income sources via diversification.

Highlights

► The study examines the profitability of carp farms in Polish Barycz Valley and German Aischgrund. ► Representative farm models show that the economic situation of carp farmers is harsh today, in particular for smallholders. ► Fisheries Local Action Groups promote the local economy with the carp as core identity. ► It is discussed what positive impact an increased tourism has towards carp farms.

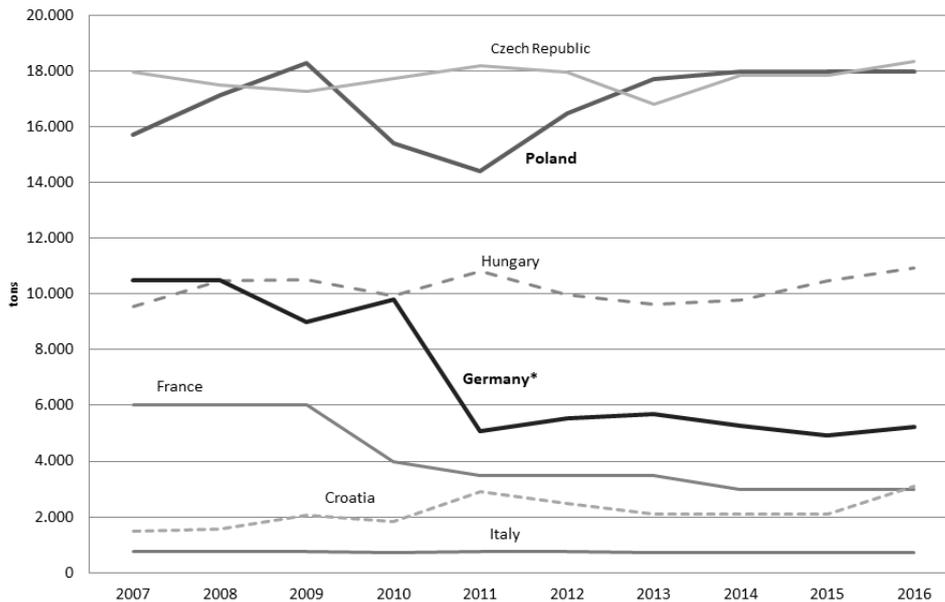
Keywords : Benchmarking, Focus group, Profitability, Protected Geographic Indication (PGI), Stakeholder interviews

36 **1. Introduction**

37 The Common carp, *Cyprinus carpio* is the longest farmed species in European freshwater
38 aquaculture [1,2], with a history dating back almost 1,000 years in Germany and Poland. The Frankish
39 Carolingian dynasty provided systematic support for the construction and maintenance of carp
40 ponds in the medieval era [3,4]. The Cistercian monastic order played a central role in the
41 domestication of carp in Central and Eastern Europe. The monks reared carp as food for periods of
42 Christian abstinence [4,5]. Their extensive polycultural techniques are still used by many present day
43 carp farmers and are seen as a low input aquaculture [6], providing both cultural and ecosystem
44 services [7,8]. Earthen ponds share a common construction method and tend to differ only in scale,
45 stocking density and water source, with the latter most commonly derived from either precipitation
46 or surface water (e.g. a river). Therefore, annual carp production depends heavily on climate. Ponds
47 filled exclusively by precipitation, are known as “Himmelsteiche” or ‘sky ponds’ [9].

48 Today, global carp aquaculture increases and is led by China with a production of more than 3
49 million mt of common carp in 2017 [10]. In contrast, the European carp production oscillates around
50 78,000 mt¹ per year [11,12]. Small-scale peasant farms are the dominant form of carp production in
51 Western Europe, while medium to large-scale farms are more typical in Middle and Eastern Europe.
52 The origins of the disparity lie in a mixture of geographical preconditions (water supply, soil quality
53 and landscape), historical background (smallholder agriculture versus large landowner squirearchy),
54 and from more recent political and economic drivers (such as those between market and planned
55 economies). Within the EU, Poland and the Czech Republic are the largest producers of carp,
56 contributing half of all production, followed by Hungary and Germany (Figure 1).
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Figure 1: Carp production by main producers in Europe 2007 – 2016 [12,13,14]



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*The apparent decline in German carp production is a result of changing survey methods, in which official statistics now only count fish sold for human consumption and not those sold for re-stocking purposes. There is an ongoing discussion in Germany about the validity of current statistics [15], with values for cultured area and the aquacultural production appearing to be underestimated in several regions [16,17].

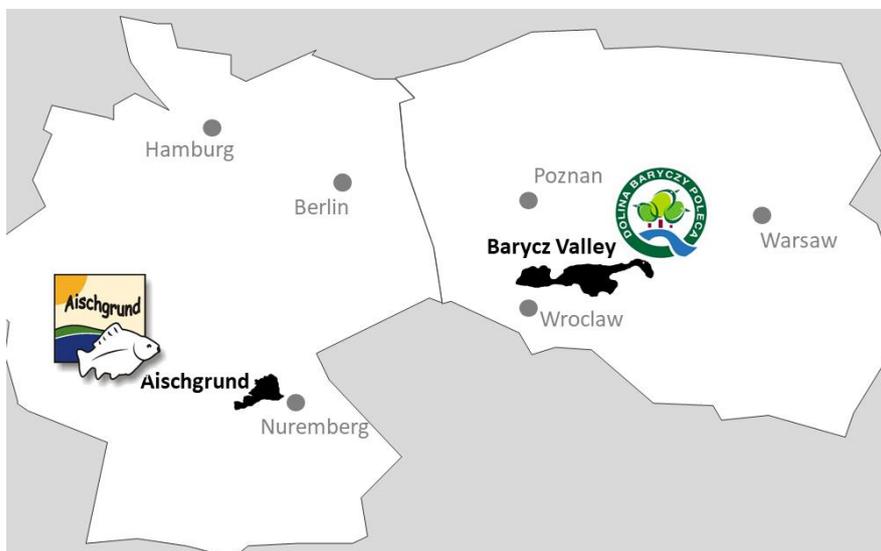
With the exception of the Czech Republic, most markets for common carp within the EU are domestic ones. Poland is the main European market for live carp, with a stable consumption of more than 21,000 mt. Demand has a strong seasonal peak around Christmas, in line with catholic culture. The domestic annual carp production is around 18,000 mt and the total area of ponds amounts to 82,371 hectare (ha) [12,18,19]. Although there is a duty of registration, figures for the exact number of

¹ Unless otherwise stated, all weights given refer to live weight of carp. Tons refer to metric tons (mt).

70 carp farms vary. According to official statistics, the total was only 400 in 2013 [18], while a survey
71 undertaken by Lirski & Myszkowski [19] included interviews with 733 Polish carp farmers,
72 producing fry and fish for consumption and (re-)stocking. Germany is the most important European
73 importer of carp, with a total market of around 7,600 mt in 2015, of which more than 2,600 mt were
74 imported [13]. According to official statistics, German carp production amounted to around 5,000 mt
75 [14]. The majority of carp farms in Germany are small family businesses producing less than 1 mt of
76 carp per year. Although there are almost 3,900 of these small-scale farms, they contribute only 10
77 percent to national carp production [20]. Carp production in Germany is dominated by fewer than
78 200 large farms, the majority of farms are characterized by peasant production (≤ 5 mt). Most carp
79 farms and the majority of production (86 percent) are located in Bavaria, Saxony² and Brandenburg
80 [14]. Although a range of processed carp products are available, the traditional market for fresh
81 slaughtered or live carp to be prepared at home is still significant.

82 In some regions of Europe, such as the German Aischgrund and Polish Barycz Valley (Figure 2),
83 carp farming continues to characterize both local landscape and culture. The Aischgrund lies within
84 Bavaria and is thus also part of Middle Franconia. The landscape incorporates some 7,000 ponds with
85 a total pond area of around 2,300 ha [9]. Most of them date back to the 16th century, and most are rain
86 fed 'sky ponds'. Almost 15 percent of ponds in the region are classified as nature reserves, as special
87 protected area or as Natura 2000 sites. A total of 48 carp farms are located in the Lower Silesia
88 Province (8,493 ha). The river Barycz provides the main water supply. Simultaneously, its valley
89 offers habitat for rare water birds. The Barycz Valley Landscape Park was created in 1996, so the
90 region now comprises both Europe's largest carp breeding center and Poland's largest nature reserve.
91 Carp production has continued in Barycz Valley for over 800 years.

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93 **Figure 2:** Location of the two carp producing study regions of Aischgrund in Germany and Poland's Barycz
94 Valley, with regional emblems (according to LAG Aischgrund, Karpfenland Travel, UNEP/GRID-Warszawa,
95 Partnerstwo dla Doliny Baryczy, not drawn to scale)
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In the Aischgrund, a strong and stable local demand for carp is met mostly by the small peasant carp farms that characterize the region. In the Barycz Valley, 28 private producers and the publicly owned company Stawy Milickie dominate the carp production and provide the national Polish carp market.³

² In contrast to the Bavarian Aischgrund, in Saxony, there are fewer farms (152), but larger-scaled and typically managed on a full-time professional basis [14,4].

³ Stawy Milickie is not an object of our study, because it does not fully take part in the free market economies as public institution.

104 Since the millennium, a marketing concept has been launched as framework for diverse
105 measures in each of the both regions. The concepts aim to increase the regions' profile and
106 attractiveness to visitors. Although the concept of region is gaining public traction, there is no
107 common scientific definition of what the term 'region' might mean [21]. In general geographic
108 parlance, a region is a coherent, medium-sized surface with functional or structural borders [22],
109 enclosing an area in which a certain homogeneity exists. According to the economists Kotler, Haider
110 and Rein [23,24], region-marketing is a coherent programme of communication, promotion,
111 advertisement, and cooperation by collaborating private and public partners, aiming to attract
112 investment from third parties within a defined region. The German geoscientist Tamara Linsteadt
113 further notes: "*Region-marketing is a process and market-orientated concept, which is adjusted to individual demands*
114 *to prepare, initiate and influence the development of a region. Region-marketing serves as communication and coordination*
115 *platform. Region-marketing consolidates regional forces and competences and activates networks to gain a competitive*
116 *advantage over other regions"* [22] (p. 15, transl. Lasner). Region-marketing is a more precisely defined term
117 than the more widely used phrase "regional marketing", which is often also used for marketing local
118 commodities. Region-marketing is more narrowly concerned with the marketing of a region itself
119 [22], through the establishment of a corporate identity [21].
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121 Our study outlines the uncertainties of carp farmers today perceived by local stakeholders in the
122 Aischgrund and Baryzc Valley. Our study further identifies the diverse measures of region-
123 marketing initiated by the stakeholders and try to classify them economically. Data about economics
124 of carp aquaculture is poor in Europe. Aggregated statistics short come in terms of micro-economic
125 information. That is why, our study applied an alternative means of data collection to analyse farm
126 profitability: the typical farm approach according to the *agri benchmark* network [25]. Our study
127 analyses the economics of typical carp farms and discuss how the region-marketing meets the
128 economic needs of carp farms.
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130 The following chapter describes the mixed method approach applied. Chapter three presents
131 the challenges of carp farmers perceived by the stakeholders interviewed in the Aischgrund and
132 Barycz Valley followed by an identification of measures of region-marketing in a first section. The
133 second section of chapter three analyses the economic situation of carp farms with a special focus on
134 the traditional carp grow-out business and discusses the impact of region-marketing. Chapter four
135 concludes what the evaluated farm economics and region-marketing measures mean for the future
136 development of carp farming.

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138 2. Materials and Methods

139 2.1 Expert interviews

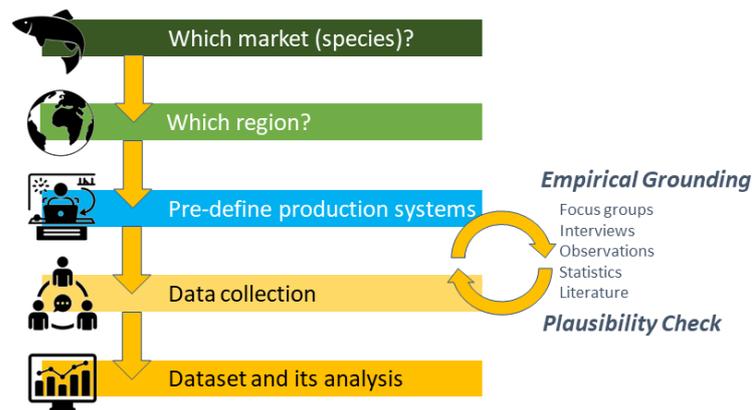
140 In order to explore challenges faced by carp farmers and the measures of region-marketing a
141 purposive sample of 17 experts were interviewed (cf. appendix A). The general aim of qualitative
142 approaches is to explore the diversity of perspectives inside a specific community regarding a
143 particular situation and to explain their sense, rather than measuring variables [26,27,28]. From a
144 sociological point of view, experts are carriers of specific technical, process or explanatory knowledge
145 [29]. This knowledge helps in understanding the complexity of interactions in the research field. A
146 defined expert does not represent a single protagonist, but offers an organization, company,
147 institutional or professional perspective. The experts chosen had different professions; undertook
148 diverse roles within the studied communities and in consequence had specific perspectives towards
149 the region, its marketing and the situation for carp farming. Interviews were conducted in person,
150 one-to-one or as part of focus groups. The experts came from cultural, touristic, nature conservation
151 or carp farming institutions. The qualitative interviews were structured by a guideline. The questions
152 of the guideline addressed the type and activities of the represented institution, the touristic
153 attractiveness of the region and the role of carp farming in the region (cf. appendix B).

154 Some of the chosen experts were local opinion leaders - individuals whose perspectives and
 155 actions have a notable influence on decision-making by other community members. Opinion leaders
 156 play an important role in establishing new ideas [30]. They often hold key positions in their
 157 community, as directors, mayors, principals, industrial patrons etc. The face-to-face interviews lasted
 158 between 30 and 60 minutes. Although the interviews followed a pre-defined structure, interviewees
 159 had still a great deal of leeway to reply, as it is usual in qualitative interview design [27]. The
 160 interviews took place at interviewee workplaces (office, restaurant or carp farm).
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162 2.2 Typical farm approach

163 The typical farm approach is, in essence, a modal one [31,32,33,34], which constructs empirically
 164 grounded “virtual” farm datasets. The method was applied to aquaculture for the first time in 2014
 165 [25]. All economic farm data resulted from close interactions between practitioners and researchers.
 166 The resulting datasets contain a maximum of 243 economic variables. The quantity of variables
 167 permits a high-resolution micro economic analysis, and their coherence serves as an indicator of data
 168 quality (validation). Figure 3 is a schematic representation of the typical farm approach, according to
 169 Lasner *et al.* [25].
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171 **Figure 3:** Scheme of the typical farm approach [25]
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 175 The typical farm approach is about farms’ datasets, which are stable in characteristics, earns
 176 adequate profit, not the best, not the last, not top equipped, but well, which represent a group of
 177 farms using a common production method [31,32]. The farm models base on real costs, investments
 178 and prices. The farm models combine resources, labour and capital as it is established in the
 179 management today [31,34]. The approach concept relies on diverse sources for pre-defining the
 180 selected case (statistics, reports etc.), but the proof of the cases’ characteristics is empirical. Core
 181 element of empirical data collection is the focus group with fish farmers. The majority of interviewed
 182 farmers and their representatives (cf. annex A) also participated in two focus groups which served to
 183 define the economics of typical and good practice carp farms in each region [36]. In doing so, the
 184 coherent picture of a farm model is built up by reaching a consensus among the focus group.
 185 Simultaneously, and in contrast to statistical averages, the defined variables control each other: e.g.
 186 the Feed Conversion Rate (FCR) should meet the volume of fish feed used and the feed costs should
 187 be in line with the feed volume and the feed price etc. Finally the modelled typical farms are double-
 188 checked by fish farmers to real existing fish farms and by researchers to existing knowledge. Once a
 189 dataset of a farm is defined, different economic operations on farm and enterprise level are possible
 190 (e.g. profit and loss account, profitability, sensitivity analysis, economic and physical productivity).
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192 Each modelled farm was issued a farm code, which references the ISO 639 country code, the
 193 FAO 3-Alpha Species Code (ASFIS) and the annual production of the main species of the farm in mt
 live weight (LW). For example, the farm code «DE-FCP-5» refers to a German (DE) carp (FCP) farm

194 model producing 5 mt of carp in a typical year. The allocations used for the indicator report refer to
195 returns of the carp grow-out system (at the farm gate) and the contribution of carp to profit and loss
196 accounts, before tax. Focus group participants were able to provide confident estimates of costs based
197 on their own business experience. Raw data were computed using the *agri benchmark* Fish⁴ simulation
198 abFishCALC, which performs a range of economic efficiency analyses, with particular emphasis on
199 cost calculations. Typical farm datasets consider economic indicators such as productivity⁵; variable
200 and fixed costs⁶; wages⁷; depreciation (calculated linearly); opportunity costs (quantifying the value
201 of self-owned resources⁸); and profitability⁹. The typical farm approach distinguishes three classes of
202 costs, namely cash costs, depreciation and opportunity costs [25]. Short-term (up to 1 year), medium-
203 term (up to 5 years) and long-term (more than 5 years) profitability figures were obtained by
204 subtracting the three cost classes step by step from returns. As the general reference year of the
205 SUCCESS project¹⁰ 2015 has been choosing as the starting point of the presented economic analysis.
206 Unfortunately, this was not a typical year for the Aischgrund region, where carp production was
207 negatively affected by a drought, resulting in productivity losses of up to -20 percent [35]. To maintain
208 comparability, this extreme situation was not considered in our analysis. To analyse the profitability
209 of the four selected carp farms, DE-FCP-5, DE-FCP-20, PL-FCP-90 and PL-FCP-190, our study first
210 describes their cost structures, then looks at the various sale channels currently used by the farmers.
211 In both regions the focus is on carp grow-out, which has formed the core of the carp farming business
212 for decades. However, it is practice in Germany and Poland for larger farms rear their own carp fry
213 and fingerlings for stocking. All costs and prices refer to € per kg LW, unless otherwise stated.

214 Expert interviews and focus groups took place between June 27th – July 1st, 2016 in the
215 Aischgrund in Germany and September 12th – 16th, 2016 in the Barycz Valley. In 2018, the involved
216 fish farmers and carp researchers were again interviewed. Via standardized questionnaire they
217 updated prices and costs of the model farms for 2016 and 2017. In the model the production volume
218 is assumed as stable from 2015 to 2017. While changes in fish and feed prices, wages, interests, land
219 prices were interviewed [36], national price indexes provide general information about the price
220 developments for fixed costs, interest rates, currency rates and replacement values of equipment and
221 facilities [37,38].

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⁴ The German Thünen-Institute coordinates a worldwide non-profit network of agricultural economists and farmers, with experience in the typical farm approach since 2002: *agri benchmark*.

⁵ Annual production, start weight fingerling, finishing weight, loss, Feed Conversion Rate (FCR), permanent labour, casual labour.

⁶ Comprising costs of land or leaseholds, water charges, maintenance (buildings, ponds, machinery and equipment), administration (environmental controls, advisory services, certification, accounting), memberships, insurances, business operations and promotion; feed, fingerling stock, veterinary services (vaccination and drugs), smaller outlays on operational equipment, energy (electricity, diesel vehicles, oxygen) and other variable costs.

⁷ Costs for paid labour and non-wage costs.

⁸ Family labour (calculated as family working hours * wage for qualified local labour), land (own land area * regional land rents) and capital (non-land equity * long-term government bonds interest rate).

⁹ Revenues from aquaculture, farming, additional income, interests on savings and subsidies.

¹⁰ “Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector” (SUCCESS); grant no 635188 of the European Union’s Horizon 2020 research and innovation program; this publication is part of the SUCCESS project; www.success-h2020.eu.

223 **3. Results**

224 The first section presents a picture of the contemporary challenges for carp aquaculture as perceived
 225 by the interviewed stakeholders followed by a description of region-marketing measures established
 226 in the Aischgrund and Barycz Valley. The second section focuses on the economics of typical carp
 227 farms. Costs and profitability of selected carp grow-out operations in Germany and Poland are
 228 compared. Finally the effects of region-marketing's product labelling are analysed.
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230 **3.1 Region-marketing**

231 The opinion leaders of the Aischgrund and Barycz Valley interviewed perceived the carp
 232 aquaculture as the corporative feature of their localities. «The people identify themselves with the carp. We are
 233 a carp region» [39]. The stakeholders emphasized the importance of carp farming for the identity of both
 234 regions [22]. «It's more than just producing fishes. Many people have a heart for the carp culture and the landscape» [9].
 235 Regional initiatives have focused on the maintenance of ponds, on the unique landscape and culture
 236 of the region, on tourism development and on measures to enhance local fish production. These
 237 initiatives have been run by several local stakeholders and entrepreneurs, but carp farming has been
 238 the unifying leitmotiv for each one. The established region-marketing measures address the
 239 enhancement of profitability of both the carp (core product), and the services which are linked to the
 240 carp farming (product environment). "The carp is responsible for keeping these environmental good conditions. If
 241 local people cannot pay to protect the ponds and carp farming, tourist have to pay extra for it" [40]. These provisioning
 242 services incorporate the material and immaterial infrastructures involved in the production of carp,
 243 including those linked to farming (extensive production), marketing and externalities such as the
 244 heritage of fish farming and consumer culture, the pond landscape and its associated biodiversity. "It
 245 wouldn't be such landscapes, no animals to protect without carp ponds" [41].

246 In the Aischgrund, the association Karpfenland Aischgrund e.V. promotes the region and its
 247 links with carp farming [42], while Partnerstwo dla Doliny Baryczy (Barycz Valley Partnership)
 248 performs a similar role for the Barycz Valley [40]. Both associations are closely related to Fishery
 249 Local Action Groups (FLAG), which coordinate activities and applications for funding. Main sources
 250 of funding are EU programmes like the European Maritime and Fisheries Fund (EMFF) or Liaison
 251 Entre Actions de Développement de l'Économie Rurale (LEADER). Table 1 shows the diverse
 252 measures of region-marketing implemented since the 2000s.
 253

254 **Table 1:** Measures of region-marketing and addressed issues in the Aischgrund and Barycz Valley
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Measure	Description	Addressed (main) issue	Region
Fishery Local Action Group	Collaboration of private and public partners to establish a coherent programme of communication and promotion	Organisation of action	
New products	The base innovation introduced is the bone cut carp fillet. It is the starting material for various further processed products like carp sushi, burger, sausages, smoked carp fillets and more	Changed consumer preferences	
Labelling	In 2006, the 'Milicki Carp from Lower Silesia' label was included at the <i>List of Traditional Products</i> by the Polish Ministry of Agriculture. Since 2012, carp from the Aischgrund has been given the EU Protected Geographic Indication label.	Price competition	
Carp museum	Diffusion of knowledge about carp culture among locals and visitors	Regional identity; touristic attractiveness	
Tourist office	Founding of a central contact point for tourists (incl. central webpage); promotion at fairs, food exhibitions and folk festivals	Touristic attractiveness	

Carp events	Season highlights like fish harvest parties or the election of a “carp queen”; all-season activities (angling, walking, bicycle routes, kayaking etc.); establishing of off-season activities	Touristic attractiveness; regional identity; enlarge the carp season	 
Restaurant network	Network of restaurants known as ‘fish kitchens’, exclusively serving labelled Aischgründer carp; outlets in Bavarian metropolises	Price competition; changed consumer preferences; imbalances at the supply chain	
Carp pond guides	Guides presenting the pond landscape to visitors from the perspective of a carp farmer	Touristic attractiveness; additional income	
School teaching	Provision of teaching materials and services for local teachers	Regional identity; changed consumer preferences	
 Aischgrund  Barycz Valley			

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All measures address perceived challenges of the region and/or of carp farming in particular. Although the urgency of problems facing carp farmers may differ from Aischgrund to Barycz Valley, the main challenges mentioned by the interviewees are similar. Carp farms economics are seen as vulnerable towards different market, environmental and social factors. From interviewed experts point of view, market factors are **changing consumer preferences** (increased demand for processed and convenient fish products [11]), **price competition** (price transmission from cheaper Czech imports [13]), and **imbalances within the value chain** (high margins at retailer level vs. low margins at the farm gate). Further and particular in the Aischgrund, where carp farms operate only as additional businesses or hobbies, incentives and willingness to **adopt innovations are limited** [42,30]. Mentioned environmental factors are **high fish mortalities** (due protected predators), **shortage of water** (climate change, hot summers) and **diseases** (e.g. Koi herpes virus [44]). In particular the first was a stressed issue. Predators such as cormorant, grey heron and other wild animals can inflict extremely large losses on hatchery and nursery ponds, with farmers in the Aischgrund reporting up to 75 percent loss of one-summer-old carp.¹¹ Social factors reported by the interviewed experts are a **lack of successors** in the Aischgrund and the **net rural emigration** at Barycz Valley in general. From interviewees’ perspective, the last factor intensifies the lack of successors in particular.

All of the difficulties listed weaken the economic situation for carp farms directly or indirectly, for example reducing return from traditional (wholesale) channels or increasing costs due to high stock mortalities. In combination, these pressures threaten the future profitability of carp farming in both regions. Some of the listed region-marketing measures have helped to translate the nonmaterial cultural services of pond carp-farming into real activities and events with potential to boost the sector in more ways than one. For example, while carp pond tours serve an educational role in transmitting knowledge from carp farmers to the public, they also have touristic appeal when run alongside museum exhibitions and local carp menus. *Local people were not aware that what they got here is valuable for others” [25].* This sensitivity to the production environment of carp has enabled new business opportunities for some carp farmers, who have invested in gastronomy services and accommodation offers.

286 3.2 Economics of carp farms

287 Despite new business opportunities created by region-marketing, the traditional grown distribution
288 to wholesalers is still the main sale channel for Aischgrund carp farmers. For carp farmers in Barycz
289 Valley the sale to super and local markets is still most important. This concentrated composition of
290 the value chain characterises the economics of carp farms in both regions.

¹¹ Carp for consumption needs three summers to reach grown-out size. The hatchery takes plays in the first year and the nursery in the second year.

292 **3.2.1 Gross revenues**

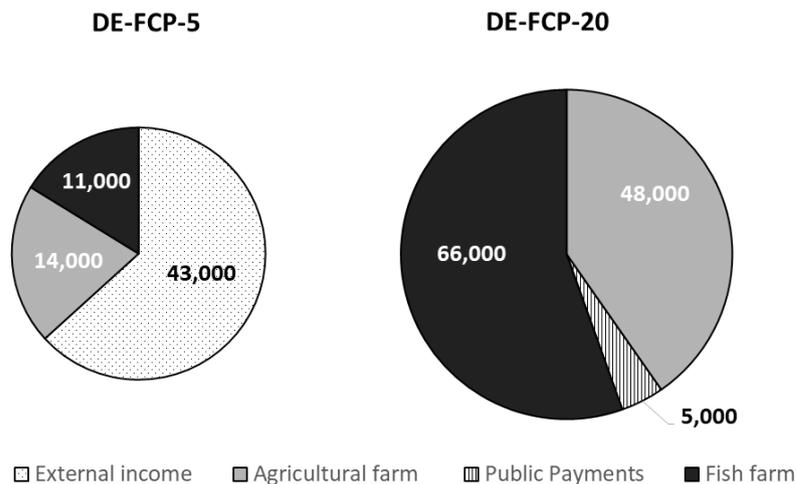
293 Aischgrund carp farms are usually small-scale with less than 5 ha of culture area and very little
 294 in the way of machinery or other assets. On average, ponds have a surface area of 0.4 ha, with around
 295 6 to 10 ponds per farm. Fewer than five farms in the region are larger than 50 ha. It is common for
 296 (agricultural) farmers in Franconia to earn an additional income from carp farming. Often they work
 297 as employees in other sectors or gain income from crop farming. The Aischgrund is located within
 298 the metropolitan region Nuremberg-Erlangen. A couple of international businesses have production
 299 sites here, providing alternative jobs and wealth for the region. A trend of increasing contractual
 300 conservation management agreements between the Bavarian State and carp farmers become is
 301 resulting in an important extra income source for the carp farmers [45], with those who commit
 302 themselves to extensive production methods and low stocking densities benefitting from public
 303 payments (200 €/ha). As members of the agricultural sector, they also benefit from subsidised diesel
 304 prices (0.91 €/l). Figure 4 shows gross receipt sources of the two analysed farms DE-FCP-5 and DE-
 305 FCP-20.

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Figure 4: Gross revenues of selected carp farms in the Aischgrund 2017 (in €)



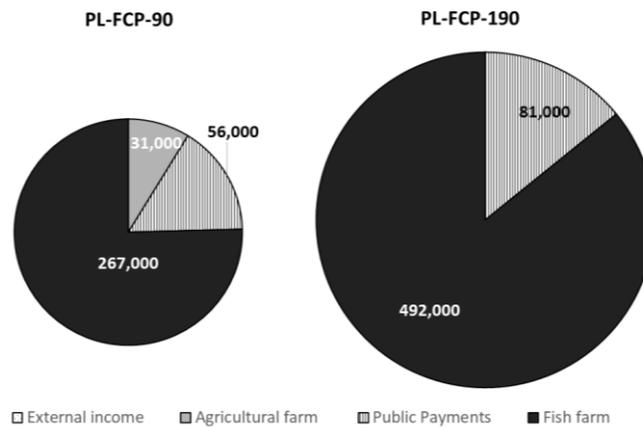
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311 The typical farm DE-FCP-5 represents a type very common in the Bavarian Aischgrund in terms
 312 of structure and economic performance: small, family-owned, specialising in grow-out and an
 313 additional business for the owner. The farm DE-FCP-20 can be seen as an example of a good practice
 314 carp farm, one of relatively few larger scaled operations in the Aischgrund. DE-FCP-20 has an
 315 additional crop enterprise, which also supplies the carp farm with grain as fish feed.

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317 Carp farmers from Barycz Valley often produce crops for carp farm owners and often part of the
 318 land area of aquaculture farms is used for carp feed production (grain). On many medium-sized
 319 farms, grain production delivers more than half of the required volume of feed (mixed grain) for fish.
 320 Two farms in the Barycz Valley were defined by focus group, farmer interviews and farm visits as
 321 typical for a given business scale: the medium-sized intensive cultivated PL-FCP-90 (70 ha fish ponds
 322 and 150 ha arable land) and the large-scale more extensive managed PL-FCP-190 (300 ha fish ponds).
 323 Figure 5 breaks down the normal income sources for each.

Figure 5: Gross revenues of selected carp farms in Barycz Valley 2017 (in €)325
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327 Besides income from fish and agricultural farming, carp farms in Lower Silesia are eligible for
 328 EU area payments for agricultural land. These direct, per-hectare payments are set at a minimal level
 329 because ponds are classified within the worst soil quality category. Nevertheless, income of this kind
 330 plays a larger role in supporting Barycz Valley carp farms than those in the Aischgrund. According
 331 to the Barycz Valley focus group, payments for agricultural land amounted to 236 €/ha in the studied
 332 period 2015-2017. In addition, almost all diesel expenditure was refunded, up to a limit of 19.27 €/ha.
 333 However, diesel is not considered a decisive expense for carp farms' cost structure in general.
 334

335 3.2.2 Cost structure

336 Smaller farms purchase fingerlings for stocking their grow-out ponds, and the expense of doing
 337 so is the most important cost in carp farming (Table 2). In the Aischgrund, stocking costs are greatly
 338 increased as a result of predation by cormorants and other wild animals. Mortality one-summer-old
 339 carp fry, with a final weight of about 25 g each can reach 75 percent (50 percent in Barycz Valley). For
 340 two-summer-old carp fingerlings, with a final weight of 300 g each, the mortality is also high, at
 341 between 50 percent and 60 percent in the Aischgrund (20 percent in Barycz Valley). In consequence,
 342 the **costs for stocking** are significantly higher in the Aischgrund than in the Barycz Valley, where
 343 Stawy Milickie's large pond area deflect the attention of avian predators away from smaller
 344 enterprises and in consequence seems to reduce their fish loss in general. Furthermore, Polish farmers
 345 have invested in predator deterrent measures (e.g. designed fencing, reinforced moats and sound
 346 systems).
 347

348 **Table 2:** Cash costs (€/kg LW) in selected carp grow-out systems 2017
 349

Costs (€/kg LW)	Farm			
	DE-FCP-5	DE-FCP-20	PL-FCP-90	PL-FCP-190
Stocking	0.99	1.04	0.63	0.63
Feed	0.24	0.45	0.58	0.63
Wages	-	-	0.44	0.63
Oxygen	-	-		0.01
Power	-	-	0.04	0.02
Interests	-	0.08	-	-
Other variable costs	0.19	0.09	0.15	0.11
Fixed costs	0.23	0.22	0.47	0.34
TOTAL CASH COSTS	1.66	1.92	2.37	2.08

351 After stocking, **feed** is the second largest cash cost. Carp farmers feed grain to supplement the
 352 natural productivity of ponds. This practice differs markedly from the methods used in other
 353 aquaculture operations in Europe. In the smallest of the model farms, DE-FCP-5, natural pond
 354 productivity meets around 45 percent of feed requirements and there are farms in the Aischgrund
 355 where this figure is more than 50 percent.

356 Carp grow-out is a **labour** intensive system, with feeding, dam maintenance, liming ponds and
 357 harvesting fish is usually done with minimal use of machines and farmers in small enterprises
 358 generally work alone. Their own labour does not constitute a cash cost, but counts as an opportunity
 359 cost, as discussed later. Large farms, on the other hand, have employees and pay wages including
 360 non-wage costs.

361 The importance of **other variable costs** to farm viability should not be overlooked, but interest
 362 payments are generally low, because the investments needed for machines and equipment in carp
 363 farming are relatively small.

364 The most marked differences in **fixed costs** between Aischgrund and Barycz Valley farms are
 365 generally associated with the maintenance of larger farmsteads, with buildings and office operating
 366 costs. Economies of scale mean that such costs tend to be greater for small farms than for large ones.

367 Taking into account the need for regular investment in equipment and facilities on order to hold
 368 or enhance a market position, *agri benchmark* calculate a linear **depreciation** for every asset in a fish
 369 farm in addition to cash costs (Table 3). In reality however, carp farmers in the German Aischgrund
 370 typically continue to use depreciated (old) equipment long beyond the (accounting) lifetime. Even
 371 so, depreciation costs are useful in cost calculations and as a guide to the investment levels below
 372 which a farmer operates at the expense of his/her farm's future. In consequence, our approach
 373 assumes, that 50 percent of the used equipment and buildings are depreciated.

374 **Opportunity costs** for unpaid labour are calculated as fictive salary and are highest in family-
 375 run farms without employees like DE-FCP-5. Meanwhile, opportunity costs for use of a farmer's own
 376 land are calculated as fictive rent for arable land. Our focus groups indicated that rents for ponds are
 377 around 300 €/ha in the Aischgrund and between 280 and 330 €/ha in the Barycz Valley in 2015, which
 378 have increased up to 14 percent in Germany (or 342 €/ha) and in Poland up to 8 percent (or 337 €/ha)
 379 in 2017.

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Table 3: Depreciation and opportunity costs (€/kg LW) of selected carp grow-out systems in 2017

COSTS (€/kg LW)	Farm			
	DE-FCP-5	DE-FCP-20	PL-FCP-90	PL-FCP-190
Depreciation	1.17	0.47	0.49	0.65
Opportunity Costs	1.13	0.60	0.35	0.66
thereof unpaid labour	0.90	0.41	0.26	0.18
Capital	0.09	0.03	0.07	0.08
Land	0.14	0.16	0.02	0.39

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The value of cash costs, depreciation and opportunity costs for different farms can be combined into statements about the short-, mid- and long-term profitability of carp grow-out systems.

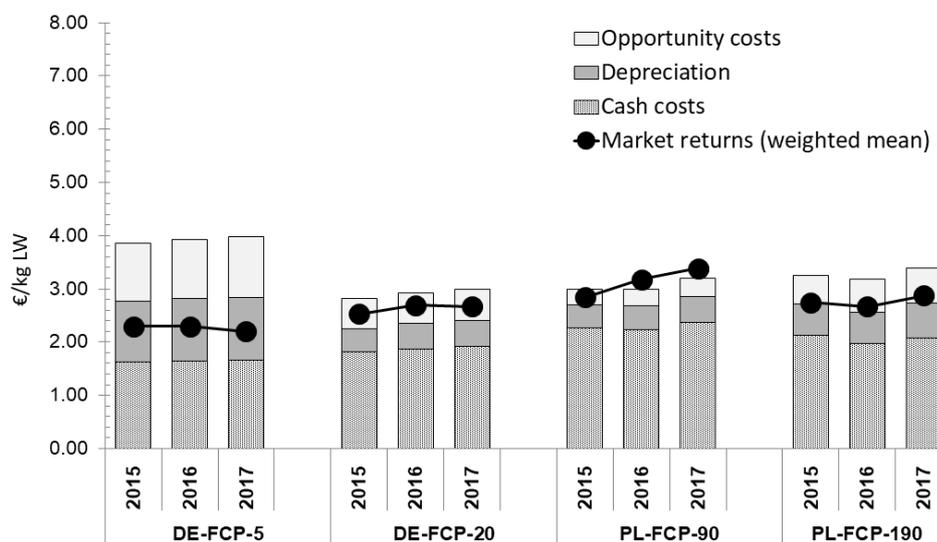
387 3.2.3 Profitability

388 Small-scale carp farmers in the Aischgrund generally lack storage capacity and thus depend on
 389 wholesalers who can purchase all fish immediately after harvest. Such uncomplicated sales result in
 390 low prices for the farmer. In opposite, large-scale farmers are able to store the carp alive in special
 391 ponds after the harvest for weeks. In the Aischgrund, fewer than five carp farms operate on more
 392 than 50 ha, but these few are able to process their own fish, diversify their distribution and product
 393 range. For example, since the millennium, bone-cut carp fillets have become established as a product
 394 in the Aischgrund, alongside traditional carp-halves and are becoming popular as an ingredient for

395 several carp dishes (e. g. carp burger, sausages, crisps). Nevertheless, wholesaling remains the
 396 standard sales route for carp farming. The carp season is from autumn (harvest) to spring (Easter).
 397 According to the focus group and expert interviews, the prices paid by wholesalers and processors
 398 was around 2.30 €/kg LW between 2015 to 2017 in the Aischgrund. Typical small farms as DE-FCP-5
 399 had to cope only 2.20 €/kg LW in 2017 due to price transmission from (Czech) imports and the fact,
 400 that Aischgrund smallholders are price takers in an unbalanced supply chain. The gross margin for
 401 Aischgrund farms, which sell carp to the wholesale, was between 17 and 25 percent, without
 402 considering linear depreciation and hypothetical opportunity costs. The gross margin of wholesalers
 403 supporting retail and gastronomy was 18 percent according to national data [46, 47, 48, 49]. With 55
 404 percent Gastronomy in the Aischgrund had the highest gross margin in the value chain. Some
 405 restaurants sold the fried carp for 22 €/kg and had assumed costs of almost 10 €/kg LW. In the Barycz
 406 Valley, the carp season is very short, mainly for historical and cultural reasons. 90 percent of
 407 production is sold around Christmas time. There is no fish processing industry in Lower Silesia, and
 408 the main product remains fresh, unprocessed carp, which is mainly distributed via super and local
 409 markets. The gross margins for retailers were 36 percent respectively for retailers and local markets
 410 [50]. For the Barycz Valley farms the gross margin was around 30 percent in an average for all
 411 distribution channels, without considering linear depreciation and hypothetical opportunity costs.

412 Taking into account the volumes distributed via each of the different sale channels, weighted
 413 means for returns per kg LW were calculated for each farm. DE-FCP-5 realizes 2.20 €/kg LW, while
 414 for DE-FCP-20, wholesales at 2.30 €/kg LW are boosted by sales to the gastronomy at 4.10 €/kg LW to
 415 realize an average of 2.67 €/kg LW. PL-FCP-90 earns 3.39 €/kg LW and PL-FCP-190 receives 2.88 €/kg
 416 LW on average for their carp. Polish carp prices were higher in general. The figures take into account
 417 payments for agricultural land and refunds on diesel. DE-FCP-5 is the only farm, which does not
 418 benefit significantly from public payments. Figure 6 compares the profitability of the studied German
 419 and Polish carp grow-out systems from 2015 to 2017.
 420
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Figure 6: Cash costs, non-cash costs and market returns (€/kg LW) of selected carp grow-outs 2015-2017



422 The greater the disparity between market return and total costs, the more profitable a farm is. In
 423 all cases, our study farms were able to cover their cash costs, with the larger Polish farms PL-FCP-90
 424 and PL-FCP-190 most profitable from a short-term. In the medium-term however, the Aischgrund
 425 typical small farm DE-FCP-5 is not profitable enough to cover its fictive depreciations, having no
 426 capital for investments beyond its daily business costs. Further, the scale-effect leads to disadvantages
 427 in depreciation (must-have of a base farm equipment independent from size) and price taking for
 428 DE-FCP-5. Without a storage possibility, DE-FCP-5 did not participate in the positive carp price
 429

430 development in 2016 and 2017. Anyway, the results show that small farms like DE-FCP-5 relying
431 solely on carp grow-out and sales of fresh fish will not be profitable in the midterm. Even the German
432 good practice farm DE-FCP-20 operates at the limit of economic viability in long-terms. If public
433 payments of 0.10 €/kg LW would not be considered, the situation for DE-FCP-20 would be harsh. A
434 similar picture emerged with the typical Polish farm PL-FCP-190. Further PL-FCP-190 does not
435 maximize its respective production potential managing the farm only semi-intensive, which leads to
436 a non-optimal relation of declining costs per kg LW. Further, PL-FCP-190 focuses on wholesale
437 distribution, where profit margin had been reduce caused by a weak Polish Zloty in 2016 in particular
438 (currency effect). Only the diversified and intensive managed Polish farm PL-FCP-90 can be seen as
439 significant profitable benefiting from higher carp prices for varied sale channels, but wholesaling and
440 declining costs per kg LW carp optimizing its stocking management. Against that background PL-
441 FCP-90 can be seen as a good practice farm.

442 Given the overall harsh economics of carp grow-out, farmers have three main opportunities to
443 adapt and enhance their situation, namely upscaling operations; introducing vertical integration and
444 diversification. For small farms, upscaling does not necessarily mean acquiring additional new ponds
445 in order to increase production, indeed opportunities to purchase ponds in both regions are virtually
446 non-existent and authorization to construct new ponds is unlikely to be granted. This leaves the
447 formation of production cooperatives as the only realistic means of upscaling for small operators, but
448 this seldom happens, as such businesses lack the necessary resources of capital, time as well as
449 relevant qualifications. Among those who farm carp as an additional activity, there is often little
450 interest in changing the situation at all. Some of the factors influencing costs are beyond the control
451 of small farmers. Increased predator management would reduce the mortality of carp fry and
452 fingerlings, reducing one of the most important cash costs. On the other hand, higher payments for
453 ecosystem services or monetary compensation for fish losses to bird predation could balance the
454 financial equation. This is a thorny management issue with which the interests of carp farmers and
455 nature protection have conflicted for decades, but recent developments in contractual nature
456 conservation in Bavaria hint at a promising new spirit of cooperation between carp farmers and
457 conservationists [45].

458 In contrast to the small-scale farms, large-scale operations in both study regions have already
459 begun to adapt through vertical integration and diversification, for example by developing
460 hatcheries, nurseries, storage and processing facilities, farm shops, fish restaurants and angling
461 ponds. This potential for strengthening direct marketing and increasing visitor frequency are key in
462 attracting potential customers, and it is in these crucial areas that the concept of region-marketing
463 offers most promise, in both the Aischgrund and the Barycz Valley.
464

465 **3.2.4 Effects of PGI labelling in the Aischgrund**

466 While the majority of region-marketing initiatives are hardly to measure in case of their direct impact
467 towards carp farms economics, the 2012 introduced PGI label lead directly to higher prices in the
468 region, wholesaler have been willing to pay for certified 'Aischgründer Carp'. In 2006, the 'Milicki
469 Carp from Lower Silesia' label was developed and included at the List of Traditional Products by the
470 Polish Ministry of Agriculture and Rural Development. Notwithstanding and in contrast to the PGI
471 labelled 'Aischgründer Carp' it has not an effect towards the price negotiations. According to
472 interviewed Polish stakeholders, this non-price effect is caused by the fact, that the produced carp is
473 distributed to the national market first of all and not regionally. Thus, it will not be considered in the
474 following.

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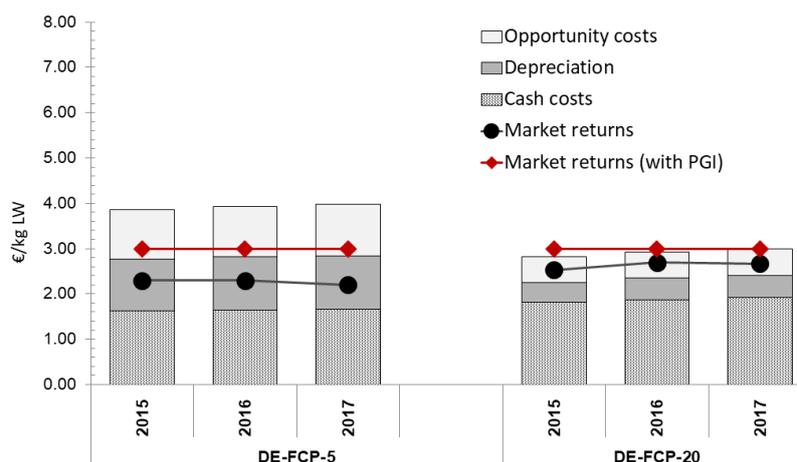
Figure 7: Local brand “Aischgründer Karpfen” with integrated PGI logo used in the Aischgrund [48]



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In 2018, 140 carp farmers operating 550 ponds (500 ha) were given PGI certification [36]. That corresponds to a share of about 15 percent of total carp farmers and 25 percent of total production in the Aischgrund. That is a slight increase of labelled producers since 2015. Furthermore, 40 restaurants were members of the PGI carp distributing network. The wholesaler price for labeled carp in the Aischgrund, has remained stable of 3.00 €/kg LW for carp farmers from 2015 to 2017. These developments infer that there is a certain demand for labelled local carp. There are no additional costs for certifications like licenses for the farmers. Moreover, the producer organizations cover the control cost. The costs of certification are already included in the member fees of the producer organization, whether or not the farmer label his/her carp. Nonetheless, fish farmers have to meet the following pre-conditions for the certification: a lipid content <10 percent in the fish meat and the high-backed phenotype, which characterizes the regional carp race; a max. stocking density of 800 two-summer-old carp per ha; a max. harvest of 1,300 kg three-summer-old carp per ha; grain, legumes or compound feed according to Bavarian regulations for the cultural landscape program as additional feed; good water quality. In fact, these pre-conditions do not effect productivity and reflect the current good production practices in the region. Figure 8 shows, how profitability growths in the case of PGI certified carp farms in the Aischgrund.

Figure 8: Cash costs, non-cash costs and market returns (€/kg LW) of PGI certified carp grow-outs 2015-2017



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In both cases, higher market returns caused by higher prices gained for a PGI labelled carp lead to significant higher profitability. In particular, for the Aischgründer good practice carp grow-out DE-FCP-20, the higher returns ensures its long-term profitability, while the typical smallholder carp grow-out DE-FCP-5 still struggles to cover its opportunity costs. Notwithstanding, the results show, that creating a local certified brand can be seen as a successful opportunity to enhance the overall profitability. Moreover, it enables small-scaled carp farms to directly participant in the benefits of region-marketing.

513 4. Discussion and Conclusions

514 *“Nature like this, like the tiny little ponds and the history behind it, this is something you do not find quite often in Europe*
515 *anymore” [42].*

516 The results of this field study suggest that stakeholders in both regions have a firm grasp of the
517 challenges facing carp farming and a good understanding of how to meet them. Although the
518 Aischgrund and the Barycz Valley differ in the structure and history of their carp farming, they share
519 a focus on traditional grow-out farming and the problem that fresh carp is hardly a profitable product
520 on its own. Carp farmers in both regions struggle with increased costs and low wholesale margins.
521 Changing consumer preferences, price competition, imbalances at the value chain, low levels of
522 innovation, lack of farm successors, high fish losses to predation, diseases, shortage of water and
523 rural de-population are forcing farmers to seek new business strategies. But the options are limited
524 to specialization, vertical integration, diversification or upscaling. Large farms in Poland have
525 specialized their production, allowing them to benefit from scale effects. They mainly address the
526 Polish national market and can reduce costs by intensifying production like PL-FCP-190. For medium
527 farms in both regions (DE-FCP-20 and PL-FCP-90), diversifying and vertical integration by closing
528 carp production cycles is the best option, leading to lower fingerling costs, making operations less
529 vulnerable to diseases and offering the opportunity to sell fish for re-stocking as well as consumption
530 via different sale channels. The carp restaurant network in the Aischgrund enables alternative sale
531 channels and secures the demand. Anyway, opportunities to lower fixed costs and depreciation by
532 upscaling are limited by available pond area. In both regions there is an urgent need to increase the
533 price of carp significantly. According to currently given cost structures in 2017, mean returns of
534 between 3.00 €/kg LW (DE-FCP-20) and 3.97 €/kg LW (DE-FCP-5) are necessary to ensure long term
535 profits in the Aischgrund while in the Barycz Valley, farmers should be looking for mean returns of
536 3.20 €/kg LW (PL-FCP-90) to 3.39 €/kg LW (PL-FCP-190). In case of the Aischgrund, the new market
537 segment for PGI labeled carps meets this necessary partly. However, well-developed direct-
538 marketing is a promising option for medium-scaled farms in both regions. Here, the offer of
539 processed carp products like the bone cut fillet is an already established added value.

540 The interviews and focus groups suggest that significant efforts have been made to prepare carp
541 farming (and the rural area) for the future, though there is room for greater cooperation between
542 stakeholders such as Stawy Milickie and Partnerstwo dla Doliny Baryczy, which currently act more
543 as competitors than partners. While region-marketing is recognized as a promising concept, a crucial
544 question remains as to how the various activities might be converted into extra income with which
545 carp farmers can maintain the landscape and cultural aspects associated with this fragile economic
546 sector.

547 Improved recognition of products at national market level through region-marketing might
548 bring indirect benefits to large farms like PL-FCP-190. Medium-scale farms like DE-FCP-20 and PL-
549 FCP-90 could profit from higher customer frequency, if they are able to further develop direct
550 marketing. The challenge is greater for small farms such as DE-FCP-5 because of the costs involved
551 in adaptation. Such operators are caught in a vicious circle: with carp farming on a small scale being
552 un-profitable in long-terms, it tends to be a sideline business; for which the levels of (re-)investments
553 are very low. If such businesses are not able to work much more closely together to achieve real
554 production, storage and/or marketing cooperatives that shorten supply chains and strengthen their
555 market position, small scale carp farming will be relegated to a hobby activity. But, in the Aischgrund
556 in particular, the loss of these small carp farms and the landscape, heritage and tourism value they
557 impart would be a serious economic, ecological and cultural crisis. A structural change towards fewer
558 larger and more competitive farms would be a likely consequence, as already seen in other agri-
559 business sectors. If there is no re-structuring, and no development of strong cooperatives, the area
560 risks losing the pond landscapes that lie at the core of its region-marketing strategy within a
561 generation. Without the annual production cycle of stocking, dam maintenance, harvesting, liming,
562 draining and re-filling, carp ponds overgrow and turn into fallow land within a few years. Is the cost
563 of maintaining thousands of hectares of carp ponds for their environmental and heritage value alone
564 something the public purse can afford? What would that cost be?

565 A central lesson learned studying the carp case is that remunerating producers for the multi-
566 functional services they provide would certainly increase their profitability while at the same time
567 help in achieving other environmental and social goals. Such measures would well suited to the 2nd
568 pillar of the Common Agricultural Policy (CAP), which rewards services and revitalization of villages
569 in rural areas, includes payments linked to Natura 2000 and the Water Framework Directive and
570 payments for areas facing natural or other specific constraints. More, it is the view of the industry
571 that reformed public funding programs should include compensation payments for fish losses
572 through predation, along the lines of those currently made under the German wolf resettlement
573 programs. Such payments are already applicated in some German federal states [51], but a national
574 strategy is missing. A further private transfer payment could incorporate a visitors carp tax, whereby
575 a small extra payment for each tourist overnight stay goes towards maintaining the iconic landscape
576 and heritage visitors come to enjoy. The latter could be an extension of the PGI regional carp label
577 which is already proving effective region-marketing tool in local restaurants in the Aischgrund.
578 Private payments of this sort could be collected in a fund, which pays small scale farmers a subsidy
579 per pond-hectare in recognition of their contribution towards the attractiveness of the region. Such a
580 scheme would directly link profits in the tourism sector with those of carp farmers on which the re-
581 creational development of the region so heavily depends. A threshold should be established, for such
582 payments because larger farms are better able to profit from touristic development through
583 diversification and thus less in need of support.

584 None of the presented adaptation strategies will solve the problems facing carp farmers, in either
585 of the study regions. Ultimately securing a future for both of these 'carp lands' is likely to require a
586 mix of region-marketing, vertical integration, upscaling and diversification, the rather rapid
587 establishment of farm cooperatives, enhanced predator management, payments for ecosystems (and
588 cultural) services provided and wholehearted and careful collaboration between stakeholders.

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607

608 **References**

- 609 1. *Cyprinus carpio* (Linnaeus, 1758). Cultured Aquatic Species Information Programme of the Food and
610 Agriculture Organization of the United Nations.
611 Available online: http://www.fao.org/fishery/culturedspecies/Cyprinus_carpio/en#tcNA003C
612 (accessed on August 15, 2018).
- 613 2. Currie, C. The early history of carp and its economic significance in England. *Agric Hist Rev* **1991**, 39
614 (2), 97-107.
- 615 3. Mück, W. Überlegungen zum Beginn der Teichwirtschaft im Aischgrund. In *Geschichts- und*
616 *Heimatverein Neustadt an der Aisch* (ed.), *Aischgründer Karpfenmuseum im Kulturreal Altes*
617 *Schloss; Druckerei Münch: Neustadt an der Aisch, Germany, 2013.* (transl. Thoughts about the
618 beginning of carp farming in the Aischgrund. In *History and Homeland Association Neustadt a. d.*
619 *Aisch* (ed.).
- 620 4. Füllner, G.; Pfeifer, M.; Langner, N. *Karpfenteichwirtschaft. Bewirtschaftung von Karpfenteichen.*
621 *Gute fachliche Praxis. Sächsische Landesanstalt für Landwirtschaft: Dresden, Germany, 2007.* (transl.
622 *Carp aquaculture. Farming carp ponds. Best practices. Saxony State Agency for Agriculture).*
- 623 5. Geldhauser, F.; Gerstner, P. *Der Teichwirt; Ulmer: Stuttgart, Germany, 2003.* (transl. *The fish farmer*).
- 624 6. Blanchard, J. L.; Watson, R. A.; Fulton, E. A.; Cottrell, R. S.; Nash, K. L.; Bryndum-Buchholz, A.;
625 Büchner, M.; Carozza, D. A.; Cheung, W. W. L.; Elliott, J.; Davidson, L. N. K.; Dulvy, N. K.; Dunne, J.
626 P.; Eddy, T. D.; Galbraith, E.; Lotze, H. K.; Maury, O.; Müller, C.; Tittensor, D. P.; Jennings, S. Linked
627 sustainability challenges and trade-offs among fisheries, aquaculture and agriculture. *Nat, Ecol &*
628 *Evol* **2017**, 1, 1240-1249. Available online: <https://www.nature.com/articles/s41559-017-0258-8>
629 (accessed on February 1, 2019).
- 630 7. Blayac, T.; Mathé, S.; Rey-Valette, H.; Fontaine, P. Perceptions of the services provided by pond fish
631 farming in Lorraine (France), *Ecol Econ* **2014**, 108, 115-123. Available online:
632 <https://www.sciencedirect.com/science/article/pii/S0921800914003176> (accessed on 1 February 2019).
- 633 8. Hutchinson, L. *Ecological aquaculture. A sustainable solution.* Permanent Publications Hyden
634 House: East Meon, Hampshire, UK, 2006.
- 635 9. Oberle, M. (Head of Carp Farming Department, Bavarian Institute of Fisheries, Bavarian State
636 Agency for Agriculture, Höchststadt, Germany) Interview, June 30, 2016.
- 637 10. FAO. Statistical Query Results. Aquaculture: Quantity (t) 2008-2017. World. Inland waters.
638 Freshwater. Common carp. *Cyprinus carpio*. Available online:
639 [http://www.fao.org/figis/servlet/SQServlet?file=/usr/local/tomcat/8.5.16/figis/webapps/figis/temp/hq](http://www.fao.org/figis/servlet/SQServlet?file=/usr/local/tomcat/8.5.16/figis/webapps/figis/temp/hq_p_9051681111959107287.xml&outtype=html)
640 [p_9051681111959107287.xml&outtype=html](http://www.fao.org/figis/servlet/SQServlet?file=/usr/local/tomcat/8.5.16/figis/webapps/figis/temp/hq_p_9051681111959107287.xml&outtype=html) (accessed on September 6th, 2019)
- 641 11. EUMOFA. European Market Observatory for Fisheries and Aquaculture Products. Case study. Price
642 structure in the supply chain for fresh carp in Central Europe. European Commission, Directorate-
643 General for Maritime Affairs and Fisheries; Publication Office of the European Union: Brussels,
644 Belgium 2016.
- 645 12. FEAP. *European Aquaculture Production Report 2008-2016.* Prepared by the Federation of European
646 Aquaculture Producers (FEAP): Liege, Belgium, 2017.
- 647 13. BLE (Bundesanstalt für Landwirtschaft und Ernährung). Answer of the Federal Office for
648 Agriculture and Food on request of Dr Tobias Lasner, Thünen Institute of Fisheries Ecology. The
649 German Seafood Market, annual data with focus on carp imports from 2000 to 2015. unpublished, 23
650 March 2017.
- 651 14. Destatis. *Erzeugung in Aquakulturbetrieben 2016.* Fachserie 3, Reihe 4.6. Land und Forstwirtschaft,
652 Fischerei. Statistisches Bundesamt: Wiesbaden, Germany, 2017 (transl. *Production of aquaculture*
653 *farms 2016.* National Agency for Statistics).
- 654 15. Klinkhardt, M. *Wieviel Fisch erzeugen wir wirklich? FischMagazin* 2014, 10, 3. (transl. *How much*
655 *fish do we really produce?*).
- 656 16. Oberle, M. Rede: Vergleich der Ergebnisse der Aquakulturstatistik mit denen anderer Erhebungen
657 für den Aischgrund. Speech: Starnberg, Germany, 7. September 2014. (transl. *Comparing results of*
658 *the official German aquaculture statistic with results of a regional data collection for Aischgrund.*
659 *Upper Bavarian Fisheries Day at Starnberg*). Available online:
660 [https://www.yumpu.com/de/document/read/24791182/dr-oberle-bayerische-landesanstalt-fur-](https://www.yumpu.com/de/document/read/24791182/dr-oberle-bayerische-landesanstalt-fur-landwirtschaft-bayern)
661 [landwirtschaft-bayern](https://www.yumpu.com/de/document/read/24791182/dr-oberle-bayerische-landesanstalt-fur-landwirtschaft-bayern) (accessed on February 1, 2019).

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711
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713
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716
17. Rösch, R. (Senior researcher, Fisheries Research Station of Baden-Württemberg, Langenargen, Germany). Phone interview, October 8, 2015.
 18. Ministerstwo Rolnictwa. Available online: <https://www.gov.pl/web/rolnictwo> (accessed on July 5, 2017).
 19. Lirski, A.; Myszkowski, L. Polska akwakultura w 2013 roku na podstawie analizy kwestionariuszy RRW-22. Część II. Komunikaty Rybackie 2015, 1, 12-19. IRŚ, Olsztyn. (transl. Polish aquaculture in 2013 on the basis of RRW-22 questionnaires analyses. Part II).
 20. Destatis. Erzeugung in Aquakulturbetrieben 2013. Fachserie 3, Reihe 4.6. Land und Forstwirtschaft, Fischerei. (transl. Production of aquaculture farms 2013. National Agency for Statistics).
 21. Blotvogel, H. H. Zur Konjunktur der Regionsdiskurse. Info z. Raument 2000, 9/10, 491-506. (transl. Boom of region discourses. Information on spatial development).
 22. Lindstaedt, T. Regionsmarketing und die Bedeutung regionsbezogener Identität. Technische Universität Darmstadt tprints: Darmstadt, Germany, 2006. (transl. Region-marketing and significance of region-identity). Available online: <http://tprints.ulb.tu-darmstadt.de/744/> (accessed on February 1, 2019).
 23. Kotler, P.; Haider, D.; Rein, I. Attracting investment, industry, and tourism to cities, states, and nations. Free Press: New York, USA, 1993.
 24. Kotler, P.; Haider, D.; Rein, I. There's no place like our place! The marketing of cities, regions, and nations. The Futurist 1993, November/December, 15-21.
 25. Lasner, T.; Brinker, A.; Nielsen, R.; Rad, F. Establishing a Benchmarking for Fish Farming. Profitability, Productivity and Energy Efficiency of German, Danish and Turkish Rainbow Trout Grow-out Systems. Aquac Resear 2017, 48, 3134-3148. Available online: <https://onlinelibrary.wiley.com/doi/full/10.1111/are.13144> (accessed on February 1, 2019).
 26. Lasner, T.; Hamm, U. Exploring Ecopreneurship in the Blue Growth: A Grounded Theory Approach. Ann of Mar Sociol 2014, 23, 4-20. Available online: <http://cejsh.icm.edu.pl/cejsh/element/bwmeta1.element.desklight-40e73e54-109b-4275-96ac-1aedd22967d0> (accessed on February 1, 2019).
 27. Bryman, A. Social research methods. University press: Oxford, UK, 2012.
 28. Anderson, M. L. ; Taylor, H. F.. Sociology: The Essentials. Wadsworth, Belmont, CA, USA, 2006.
 29. Bogner, A.; Littig, B.; Menz, W. Interviewing experts. Methodology and practice. Palgrave Macmillan: Basingstoke, UK, 2009.
 30. Rogers, E. M. Diffusion of Innovations. Free Press, New York, USA, 2003.
 31. Zimmer, Y; Deblitz, C. *agri benchmark* Cash Crop: a standard operating procedure (SOP) to define typical farms. Federal Agricultural Research Centre, Braunschweig, Germany, 2005. Available online: http://literatur.thuenen.de/digbib_extern/dk038513.pdf (accessed on February 1, 2019).
 32. Feuz, D.; Skold, M. Typical Farm Theory in Agricultural Research. Econ Staff Paper Ser, 1990, 75, 1-20. Available online: http://openprairie.sdstate.edu/econ_staffpaper/75 (accessed on February 1, 2019).
 33. Walther, S. Determinants of competitiveness of agriholdings and independent farms in Ukrainian arable production. Thün Reports, 15, Johann Heinrich von Thünen Institute: Braunschweig, Germany, 2014. Available online: https://literatur.thuenen.de/digbib_extern/dn053389.pdf (accessed on January 9, 2019).
 34. Isermeyer, F. Methodologies and comparisons of production costs – a global overview. In Sustainability and production costs in the global farming sector: comparative analysis and methodologies; Langrell, S.; Ciaian, P.; Gomez y Paloma, S. Eds.; Joint Research Center (JRC), Scientific and Policy Reports, European Commission: Brussels, Belgium 2012. Available online: <https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/sustainability-and-production-costs-global-farming-sector-comparative-analysis-and> (accessed on January 9 2019).
 35. Speierl, T.; Abt, S.; Schwinger, V.; Kuhlen, K.; Thoma, P. Rückblick auf den Hitzesommer 2015 – Auswirkungen auf die Teichwirtschaft in Oberfranken. Fischer & Teichwirt 2017, 05/2017, 167-170. (transl. Review of the hot summer 2015 – impacts on the fish farming in Upper Franconia).
 36. Oberle, M. Modell Karpfenbetrieb. Personal correspondence, December 14, 2018.
 37. For German farms projection bases on: Destatis. Preise, Fachserie 17 Reihe 1, Preisindizes in der Land- und Forstwirtschaft. Statistisches Bundesamt: Wiesbaden, Germany November 2018 (transl. Prices, Volume 17/1, 7 Price indices in agriculture and forestry). For Polish farms projection bases on indices from the The Agricultural Property Agency (ANR), Central Statistical Office (Statistics Poland)

- 717 <https://stat.gov.pl/en/>) and Institute of Agricultural and Food Economics – National Research Institute
718 (<https://www.ierigz.waw.pl>).
- 719 38. OANDA. Currency converter, exchange rates EUR=PLN December 31st, 2015, 2016, 2017. Available
720 online: <https://www.oanda.com/> (accessed on January 9, 2019).
- 721 39. Kabelitz, K. (Founder and Senior Partner of Homeland and Carp Museum, Neustadt an der Aisch,
722 Germany). Interview, June 30, 2016.
- 723 40. Ozga, I. (Head of Fishery Local Action Group “Partnerstwo dla Doliny Baryczy”, Milicz, Poland)
724 Interview, September 15, 2016.
- 725 41. Śnigucki, P. (CEO of Lower Silesia Landscape Parks Complex, Biodiversity Center, Milicz, Poland).
726 Interview, September 14, 2016.
- 727 42. Schuster, S. (Manager of the Tourist and Marketing Agency “Karpfenland Travel”, Höchststadt,
728 Germany) Interview, June 30, 2016.
- 729 43. Bätzing, W. Nutzungskonflikte zwischen Teichwirtschaft, Naturschutz und Freizeitinteressen im
730 Aischgrund. Probleme und Potenziale bei der Aufwertung des „Aischgründer Karpfens“ zum
731 Qualitätsregionalprodukt. Mitt d. Fränk Geo Gesell **2013**, 59, 81-100. (transl. Conflicts between
732 aquaculture, conservation and leisure interests in the Aischgrund. Problems and potentials by
733 upgrading the „Aischgründer Carp“ to a regional quality product. Journal of the Franconian
734 Geography Society). Available online: <http://fgg-erlangen.de/fgg/ojs/index.php/mfgg/article/view/265>
735 (accessed on February 1, 2019).
- 736 44. Füllner, B.; Wedekind, H.; Oberle, M.; Bräuer, G.; Feneis, B. Untersuchungen zur Bewirtschaftung in
737 der Karpfenteichwirtschaft vor dem Hintergrund der KHV-1. Schlussfolgerungen aus dem
738 Mehrländerprojekt – Teil 1/3. In: Fischer & Teichwirt 2016, 6, 207-209. (transl. Study of carp farming
739 against the background of KHV-1. Conclusions from the intra-federal state project – part 1/3).
- 740 45. Güthler, W. Förderung einer naturverträglichen Teichbewirtschaftung durch das Bayerische
741 Vertragsnaturschutzprogramm. Bayerisches Staatsministerium für Umwelt und Verbraucherschutz,
742 Triesdorfer Fischereitag, Triesdorf, Germany, January 13, 2018. (transl. Supporting a nature-friendly
743 aquaculture through the Bavarian contractual nature conservation. Bavarian Ministry for
744 Environment and Consumer Protection).
- 745 46. Destatis. Zahlen & Fakten. Wirtschaftsbereiche. Land- & Forstwirtschaft, Fischerei. Fischerei. Preise
746 für ausgewählte Fischarten nach Vermarktungswegen 2015 [table]. (transl. Facts & figures. Economic
747 sectors. Agriculture and forestry, fisheries. Fisheries. Prices per sale channel for selected species
748 2015). Available online:
749 [https://www.destatis.de/DE/ZahlenFakten/Wirtschaftsbereiche/LandForstwirtschaftFischerei/Fischer
750 ei/Tabellen/AquaPreise.html](https://www.destatis.de/DE/ZahlenFakten/Wirtschaftsbereiche/LandForstwirtschaftFischerei/Fischerei/Tabellen/AquaPreise.html) (accessed on October 25, 2017).
- 751 47. Oberle, M. Studies and activities aimed at improving the marketing of common carp in Bavaria. 3rd
752 International Carp Conference, Vodnany, Czech Republic, September 3-4, 2015.
- 753 48. Brämick U. Jahresberichte zur Deutschen Binnenfischerei und Binnenaquakultur, 2013-2015. Institut
754 für Binnenfischerei e. V., Potsdam-Sacrow (transl. Annual reports of fresh water fisheries and
755 aquaculture).
- 756 49. Bundesanstalt für Landwirtschaft und Ernährung. Der Markt für Fischereierzeugnisse in der
757 Bundesrepublik Deutschland, 2003-2016 (transl. Federal Office for Agriculture and Food. The
758 German Seafood Market, annual reports). Available online:
759 http://www.ble.de/DE/02_Kontrolle/02_Fischerei/01_Fischwirtschaft/Fischwirtschaft_node.html
760 (accessed March 23, 2017).
- 761 50. Lirski, A.; Hryszko, K. Krajowa produkcja ryb i owoców morza. Rybactwo śródlądowe. Rynek Ryb.
762 Stan i perspektywy, November 2015, 23. IERiGŻ, Warszawa, Poland. (transl. Polish production of
763 fish and seafood. Inland fisheries. Fish market. Status quo and perspectives).
- 764 51. Sächsisches Staatsministerium für Umwelt und Landwirtschaft. Sachsen. Landwirtschaft.
765 Berufsfischerei und Förderung. Härteausgleichsverordnung. (transl. Saxony Ministry for Environment
766 and Agriculture. Commercial Fisheries and Funding. Compensation Payments). Available online:
767 <https://www.landwirtschaft.sachsen.de/berufsfischerei-und-foerderung-13804.html#a-13811> (accessed
768 September 20, 2019).
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APPENDIX A: Experts interviewed in the Aischgrund and Barycz Valley in 2016

Region	Name	Profession	Position	Organisation
AISCHGRUND (DE)	Hans Frischmann	Carp farmer	Head of company	Teichwirtschaft Frischmann
	Bernhard Feneis	Fish veterian	Vice president (FEAP), president (VDBA)	Federation of European Aquaculture Producers (FEAP) and German Aquaculture Association (VDBA)
	Walter Jakob	Carp farmer	Head of association	Teichgenossenschaft Aischgrund, Höchststadt an der Aisch
	Carola Kabelitz	Volunteer	Founder and senior partner	Homeland and Carp Museum, Neustadt an der Aisch
	Christoph Oberle	Carp farmer and restaurant owner	Senior partner	Carp Farm and Restaurant «Die Fischerei », Erlangen-Kosbach
	Dr Martin Oberle	Scientist	Head of department	Bavarian State Research Center for Agriculture, Institute for Fisheries, Department for Carp Farming, Höchststadt an der Aisch
	Gerhard Schmidt	Carp and crop farmer	Head of company	Teich- und Landwirtschaft Schmidt, Höchststadt an der Aisch
	Sandra Schuster	Tourism manager	Manager of agency	Tourist and marketing agency "Karpfenland Travel", Höchststadt an der Aisch
	Wolfgang Städtler	Carp farmer	Employee	Bavarian State Research Center for Agriculture, Institute for Fisheries, Department for Carp Farming, Höchststadt an der Aisch
	Silvia Pertschi	Museum manager	Employee	Homeland and Carp Museum, Neustadt an der Aisch
BARYCZ VALLEY (PL)	Inga Ozga	Tourism manager	Head of group	Fishery Local Action Group "Partnerstwo dla Doliny Baryczy", Milicz
	Lidia Raftowicz	Restaurant manager	Head of restaurant	Carp farm and restaurant Raftowicz, Ruda Żmigrodzka (Zmigród)
	Karol Girus	Carp farmer	Head of company	Carp farm Girus, Możdżanów (Sośnie)
	Jan Krzysztof Raftowicz	Carp farmer	Head of company	Carp farm and restaurant Raftowicz, Ruda Żmigrodzka (Zmigród)
	Robert Lewandowski	Manager	Major	Żmigród town
	Piotr Śnigucki	Manager	Director of park complex	Dolnośląskie Voivodship, Lower Silesia Landscape Parks Complex
	Waldemar Mierzwa	Carp farmer	Head of company	Carp farm Mierzwa, Krośnice (Krośnice)

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Interview guideline for interviewing carp experts

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from economic, culture and tourist sector in the Aischgrund (DE) and Barycz Valley (PL)

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779 1. **General introduction of the SUCCESS project and the case study on carp aquaculture**

780 2. **Specific questions per sector**

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A. Cultural and touristic sector

The institution	<ul style="list-style-type: none"> ▪ First of all, could you please present the history of your institution? ▪ Could you please describe the activities done by the museum/tourist centre/park office? ▪ Who are your project partners? <ul style="list-style-type: none"> - Why do you cooperate with the mentioned partners?
The region	<ul style="list-style-type: none"> ▪ Which kind of clients do visit your region/your museum/your park? ▪ Which is the main season for your visitors? ▪ Why do people visit the region? ▪ Which activities can visitors do in your region? ▪ What are the main barriers for the development of the region?
Carp farming	<ul style="list-style-type: none"> ▪ Please describe the link between carp farming and your region. ▪ What are the touristic activities and cultural events linked to carp farming? ▪ Regarding carp farming, what are the objectives of your institution? ▪ How does the future of carp farming look like in your region?
Outlook	<ul style="list-style-type: none"> ▪ What are the future projects of your institution?

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B. Carp farm sector

History of carp farming	<ul style="list-style-type: none"> ▪ First of all, could you please sum up the history of carp farming in your region? ▪ Please describe the link between carp farming and your region. ▪ In case of carp farming, are there conflicts between different stakeholders in your region? <ul style="list-style-type: none"> - Could you please describe the mentioned conflicts?
Carp ponds and external effects	<ul style="list-style-type: none"> ▪ Please, describe a typical production year in carp aquaculture. ▪ What environmental effects result from carp farming? ▪ How could those effects be measured? ▪ From an environmental point of view, what happens if a carp pond is no longer cultivated? ▪ How is the public perception of these effects? <ul style="list-style-type: none"> - How could the public knowledge about carp aquaculture and its effects be improved?

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785 3. **What image of the carp do German consumers have?**

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4. **What is the general public image of your region?**

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5. **How does the future of carp farming looks like in your region?**

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- Could you please explain the mentioned challenges for carp farming?

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THANK YOU FOR THE INTERESTING INTERVIEW!

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