A local approach towards fishing governance

This paper contributes to the literature on the local approach to fisheries governance with a comprehensive and integral procedure to address local fishing community profiles, using local level fishing, socioeconomic, demographic, tourism and geographical data from official statistics sources; and covering the entire process, from the definition and identification of fishing communities (FC), going through the description of the full ecosystem of FC using key variables from the local fishing profiling, up to the prioritization of FC, so as to identify those with the strongest linkage to the fisheries, without neglecting the analysis of their potential singularity in relation to non-fishing communities. Hence, the paper pursues four interrelated objectives: 1) to identify and describe the ecosystem of Spanish FC; 2) to prioritize FC so as to determine how *fishy* they are; 3) to characterize the hard core or top FC by means of the ranking resulting from prioritization, and a local level set of geographic, demographic, socioeconomic and tourism indicators; 4) to analyze potential singularity of FC.

The identification (1) requires the adoption of a quantifiable definition of FC and a suitable aggregation level. Like Nielsen et al. (2000), Moniz et al. (2000) or Hangh and Pardy (2000), we consider that the appropriate aggregation level is the local, because it is at this level where the dependence on fishing is greater, heterogeneities become more evident, and the social dimension is more perceptible; notwithstanding that local fisheries governance systems may be more operative when it comes to achieving socioeconomic objectives (Low et al. 2003; Ostrom et al. 2007). Conversely, defining a FC is a non-trivial task, as evidenced by the notorious attention that the term itself has received in the literature (see among others, Apostole et al., 1998; Brookfield et al., 2005; Jacob et al., 2001; Brookfield et al., 2005; Clay and Olson 2007; el Valle and Astorkiza, 2022). The multidimensional nature of complex socioeconomic, ecological, cultural, institutional and ethnographical interactions that the term encloses, makes difficult to translate into numbers the real essence of what a FC is, beyond the visible connection to the fishing industry and its infrastructure elements (Jacob et al. 2005; Olson and Clay 2001; Robinson et al. 2003, 2005; Hall-Arber et al. 2001; del Valle and Astorkiza, 2022). For the purpose of this paper, FC will be identified with official Spanish municipalities (MU) having, either, a fishing vessel port (VP) or a landing port (LP). A VP requires, at least, one vessel officially registered on it, while the requisite to be catalogued a LP is to have an official and local first sale market of fish with effective landing records. Since all the Spanish LP are as well VP, the requirement for a municipality to be classified as a FC is that it has at least one fishing vessel officially registered in the fleet census.

The description of the ecosystem (1) made up by each and every Spanish FC stands on the choice of a set of local level key fishing related variables within the local FC profiles, including the number of vessels (NV), the gross tonnage (GT), the number of fishers (NF), the quantity (LANQ) and value (LANV) of the fish landed, the number of new vessels (≤ 10 years old) (NEW), the average age of the fleet (mAGE), the artisanality coefficient (proportion of artisanal vessels in relation to the total number of vessels (ART), the proportion of fishers with respect to the total number of workers affiliated to the social security (NF/SS), the proportion of fishers with respect to total population (NF/POP), and the demographic and geographic features proxied by NUTS1 level which groups the Spanish autonomous communities based on their geographical location (GEO), the degree of urbanization (DEGURBA), the functional urban areas (FUA) and sea bathing the FC (SEA).

Besides the usual descriptive statistics tools, and taking primarily advantage of the economic literature of market concentration and economic inequality (Kolm (1969, 1976a, b); Atkinson, 1970; Sen, 1973; Hannah and Kay, 1977; Davies, 1989; Cabral, 2000; De Bandt and Davis, 2000; Bikker and Haff, 2000; Bhattacharya and Das, 2003; Alvaredo et al., 2017; among many others), we are using concentration, leadership and inequality indices to analyse the distribution of key fishing related inputs {NV, GT, NF, NEW, LANV, LANQ} of the ecosystem made up by the Spanish FC. Concentration indices have been largely employed in the literature of industrial organisation (Hilden- brand and Paschen 1964; Finkelstein and Friedberg 1967; Theil 1967), corporate diversification (Jacquemin and Berry 1979; Palepu 1985; Hoskisson et al. 1993), regional industrial diversification (Hackbart and Anderson 1975; Attaran 1986), organisational theory (Saviotti 1988) and ecological diversity (Magurran 1988, del Valle et al. 2018). Inequality indices are widely used in social science including a wide spectrum of studies on the distribution of income (Ram 2015; Chongvilaivan and Kim 2016;Bui, Nguyen, and Pham 2017), health issues (De Maio 2007; Alcalde-Unzu, Ezcurra, and Pascual 2009; Morita et al. 2018; Saito et al. 2020, Gutiérrez et al. (2021), education facilities (Quadrado, Loman, and Folmer2001), sports results (Borooah and Mangan 2012), demographic behaviour (Bleha and Ďurček 2019; Pagliacci 2019), natural resources use (Duro, Schaffartzik, and Krausmann 2018; Gutiérrez and Inguanzo 2019; Cetrulo et al. 2020; Tang et al.2020) and pollutant emissions (Xia, Wang, and Ji, 2019; Bolea, Duarte, and Sánchez-Chóliz 2020; Pakrooh et al. 2020). Specifically, we are assessing concentration ratios (CR_k) (Bain, 1959), relative shares (RS), Herfindahl–Hirschman index (HHI) (Hirschman, 1945; Herfindahl, 1950), Hall–Tideman index (HTI) (Hall and Tideman, 1967), Shannon entropy (EN) (Shannon, 1947) concentration indices and Gini (GI) (Gini, 1912) and Theil (TI) (Theil 1967) inequality indices. Additionally, taking advantage of the decomposability property of TI (Shorrocks, 1980; Shorrocks et al.,1984), we will calculate how much of the inequality observed among FC can be explained by differences between NUTS1 level Spanish regions (GEO) (Tb), and how much by differences across FC within each region (Tw). A noteworthy review about concentration and inequality measures can be found in Baumgärtner (2004), Jost and Tungurahua (2006), Cowell (2011) and Eliazar (2018). Notice that, depending on the background, concentration indices are often designated in different terms, although they indeed follow an identical mathematical formulation (del Valle and Astorkiza, 2018).

To assess the relevance of fishing in each of the FC (2) we will take advantage of composite indicators (CI). CI have been increasingly recognized as a useful tool to policy analysis and public communication, because ccompiling multiple individual indicators (each with its own complex environment) into one clear and understandable CI that provides a ranking, helps in comparisons, facilitates interpretation, and setting priorities (OCDE, 2004; 2008; Nardo eta al, 2005; Cherchye, et al., 2011; Shen et al., 2011). It is not surprising that CI have been used in a number of different socio-economic areas, such as, the evaluation of local government performance (Prieto and ZofIo, 2001; Zafra-Gomez et al., 2010; Klaveren and Witte, 2014), the evaluation of government agencies (Takamura and Tone, 2003), the evaluation of the national health system (Smith, 2002; Kwon, 2003), the evaluation of social inclusion policies at EU level (Cherchye et al., 2004) or the European labor market analysis (Storrie and Bjurek, 2000). CI have also been used for the analysis of country performance and internal market policies through macroeconomic indicators (Lovell, 1995; Lovell et al., 1995; Cherchye 2001; Cherchye et al. 2005), for the construction of an environmental and ecological performance indicator (Zhou et al., 2007; Bellenger and Herlihy, 2009; Lo, 2010; Sahoo et al. 2011; Rogge, 2012; Zanella et al., 2013), and for the calculation of the Human Development Index (Mahlberg and Obersteiner, 2001; Despotis, 2005; Cherchye et al., 2008). To the best of our knowledge, this is the first application concerning fisheries socioeconomics in general, and FC in particular.

The determination of the weighting scheme deserves special attention, since no uniformly agreed methodology exists to weight individual indicators before aggregating them into a CI. Sometimes, weights are determined subjectively based on expert judgement. However, a common practice is to assume equal weights for all individual indicators. These basic practices have been the focus of much of the criticism on CI. This paper follows the benefit of the doubt approach (BoD) (Melyn and Moesen, 1991; Cherchye et al, 2007), a non-parametric weighting method that enables a flexible and endogenous data-based assignment of weights derived from the maximization of the relative value of the composite indicator of each decision-making unit (FC). Specifically, we are using the robust m-version of the directional distance function model (Zanella et al, 2015; Rogge et al, 2017; Fusco et al., 2021) to allow for the accommodation of desirable (DI) and undesirable inputs (UI) in the generation of CI, and their related composite performance scores. This version of the CI score (rBoD) is robust in the sense that it corrects for the potential presence of FC with outlying and/or extreme performance data values by means of Monte Carlo simulations (Vidoli eta al 2015). To avoid the complications derived from the endogenous selection of zero (optimal) weights for a significant quantity of individual indicators and FC, the inclusion of additional weighting constrains will be also considered by imposing non-zero minimum weights for each performance indicator (crBoD). Thus, two versions of the robust BoD model in presence of bad inputs are used to derive their related scores, namely, the robust (rBoD) and the constrained robust (crBoD). These robust scores are constructed including {LANV, NV GT, NF, NEW} as desirable inputs (DI) and {mAGE} playing the role of an undesirable input (UI). DI display a monotonic behaviour with respect to the vigour (connection) of the FCs concerning fishing. Hence, the higher these values, the greater the strength and potential resilience of the FC. On the contrary, mAGE is a bad input, a signal of weakness for the perpetuation of fishing activity. Therefore, the subset of fishing related individual indicators included in the formation of the composite index is rv_{CI}={LANV, NV, GT, NF, NEW, mAGE} {t=2019). For completeness, we are also calculating the Mazziota-Pareto index (MPI) (Muro et al., 2011), the geometric mean (WGM), the Mean-Min Function (MMF) (Casadio et. al, 2013) and the CI based on the Wroclaw taxonomy method (WR).

Once FCs have been prioritized using CI, and particularly by means of crBoD, we will focus on the subsample of the Top 50 FC (T50) to address how the true and unquestionable Spanish FC are (3) with regard to a set of socio-economic, demographic and tourism variables. Additionally, the prioritization provides the basis for discriminating between genuine FC and testimonial (or semi virtual ones). The former will be proxied by the T50 and the latter by Last 50 FC (L50). T50 represent 61% of NV, 87% of GT, 68% of NF, 73% of NEW, 90% of LANQ and 85% of LANV. Conversely, L50 barely account for the 2% of NV, 0.2% of GT, 1.4 of NF, 0% of NEW, 0.003% of LANQ and 0.01% of LANV. Finally, we will focus on the singularity analysis of FC (4) with respect to non-fishing Spanish municipalities (nFMU) and non-fishing coastal municipalities (nFCC). For this purpose, taking as a reference all Spanish municipalities, we will concentrate on the outliers in the right tail of the distribution of key socio-economic, demographic and tourism variables and testing whether the proportion of outliers differs in FC and non-fishing communities.