

# The use of subjective indicators to assess how natural and social capital support residents' quality of life in a small volcanic island

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## ABSTRACT

Quality of life is a multi-dimensional concept and it is essentially subjective even if we can often find objectively measurable proxies for it. High levels of quality of life are the results of the interplay of social, economic and environmental aspects that together make people satisfied with their life. People living in small islands can enhance their quality of life through appropriate programs that guarantee the conservation of natural capital, provided by ecosystems, and networks and norms that facilitate good governance and social cohesion. In this paper an integration of natural and social capital subjectively evaluated by people living in Vulcano Island (Sicily Region, Italy) is proposed as a first approximation of the perception of quality of life. This paper explores whether there are differences in such perception between permanent and seasonal residents, who live there only for tourist economic reasons. Results show that the perception of natural capital is high in both communities, while social capital and the quality of life is less perceived by seasonal respect to permanent residents. The results of this research highlight that natural capital and social capital, taken into account independently, provide only a partial vision of quality of life that is strongly dependent on the combination of both. In this respect, a list of potential subjective social–environmental indicators useful to assess the quality of life is proposed.

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## 1. Introduction

Quality of life can be seen as a multidimensional concept (MEA, 2005; Costanza et al., 2008) as it consists of (1) the basic material needs for a good life including access to a secure and adequate livelihood, income and assets; (2) health that depends on interacting genetic, environmental, social, and medical factors; (3) security meaning access to a safe environment, to ecosystem services and to secure rights; (4) good social relations referring to the degree of influence, respect, cooperation, and conflict that exists between individuals and groups; (5) freedom and choice including the ability to acquire, to experience, to fulfil personal choices and to select what someone likes. For this reason, to achieve a high quality of life, human beings need multiple kinds of goods and services (Jacobs, 1995), such as the basic physiological needs (clean air, food, water) as well as many other needs such as freedom, recreation, norms and values, experiences, relationships, on the individual, community, national, and global levels (Chiesura and de Groot, 2003; Costanza et al., 2007, 2008). These needs are essential at personal and at

the collective levels and, when fulfilled, benefit both single individuals and the community, because some aspects of well-being are mainly collective properties of a community, for example resilience to social, economic and ecological shocks or stress (MEA, 2005; Malkina-Pykh and Pykh, 2008). In this context, a good quality of life requires a society that can rely on different forms of capital (de Groot et al., 2010). The essence of the concept of capital is that it is a stock able to generate a flow of good and/or services to human society (Costanza and Daly, 1992; Ekins et al., 2003). In particular, natural capital is the result of a wide range of process through which natural and semi-natural ecosystems and landscapes provide ecosystem goods and services (Daily, 1997; MEA, 2005) now and in the future, to meet human needs (Collados and Duane, 1999; de Groot, 2006; Haines-Young et al., 2006; Costanza et al., 2007; Fisher et al., 2009). Natural capital through their supporting, provisioning, regulating, and cultural ecosystem services, provides both goods that have a market value as food and fuels, as well as non markets goods and services such as recreation and amenities, which are more intangible, and less directly ascribable to economic mechanisms of production and consumption activities. Markets and non-markets goods and services are as much as critical for the sustainability of human society (Porter et al., 2009; Chiesura and de Groot, 2003; Kulig et al., 2010). In addition, human perception of the environment shapes human knowledge of the environment and involves interpretation of events or information

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(Bechtel, 1997). The landscape consists of two basic elements, the biophysical characteristics of an area affected by human activities and analysed through “objective” analysis, and the perception and the value assigned to the environment by people, evaluated through “subjective” analysis (Petrosillo et al., 2007). Humans are active participants in the landscape. They think, feel and act, so they attribute a meaning and a value to specific landscapes and places where they live, work, visit, for different reasons ranging from instrumental value (e.g., places that provide sustenance) to symbolic value (e.g., places that represent ideas) (Brown, 2005).

However, because of many ecosystems are public, goods and services are considered free (Heal, 2000) and people take them for granted, overuse them, and underinvest in them, taking only the benefits (Hardin, 1968; Petrosillo et al., 2009; Lautenbach et al., 2011). For natural capital management and conservation, the development of a high level of social capital is needed, because social institutions, based on trust and reciprocity, and on agreed norms and rules for behaviour, can mediate this kind of unfettered private action.

The definition of social capital has evolved over time, but in the literature there is a growing recognition that social capital stands for the ability of actors to secure benefits by virtue of membership in social structures or social networks and the associated norms of reciprocity and trust (Coleman, 1988; Portes, 1998; Putnam, 2000; OECD, 2001; Kroll, 2011; Kulig et al., 2010). From this perspective, social capital is a multidimensional concept consisting of non material values such as belonging to social networks and social connections, social norms, trust and reciprocity, which influence individual behaviour and interaction among people and make it possible to form a community. Actors establish relations purposefully and continue them when they perceive the benefits provided by these connections (Coleman, 1988). All these components are important basis for sustainable livelihoods (Pretty and Ward, 2001) and can also have powerful effects on people' quality of life (Helliwell and Putnam, 2004; Wills-Herrera et al., 2011).

In this perspective, beyond how well human needs are met it is also important which individuals or groups perceive satisfaction or dissatisfaction in various life domains (Costanza et al., 2007). Quality of life can be experienced and perceived differently depending on the context and situation, because it reflects social and personal factors such as geography, age, gender, and culture (Butler et al., 2005).

Given the recognized interplay between natural and social capitals in supporting subjective quality of life, the primary aim of this paper is to propose a list of subjective social–environmental indicators that can be integrated with the objective ones, traditionally used in environmental assessments. In many Mediterranean islands “permanent residents”, who live on the island for the entire year, share the same space with people that live there from April to October for their involvement in economic activities related to tourism (“seasonal residents”). Therefore, a survey was carried out to investigate residents’ (both permanent and seasonal) perception of quality of life in a small Mediterranean island. In particular, three aspects were taken into account: (1) their perception of natural capital; (2) their perception of social capital; and (3) their perception of the possible risk of losing natural and social capital. Furthermore, the possible statistical differences in the perception shown by seasonal and permanent residents were analysed to investigate whether these two groups can be considered as a single community.

## 2. Insularity and quality of life

It is widely acknowledged in the literature that islands and small islands, in particular, are natural laboratories for the study

of social and ecological processes (MacArthur and Wilson, 1967; Patton, 1996; Vogiatzakis et al., 2008). Small islands, due to insularity, share some drawbacks such as remoteness, limited resources, high dependence on imports, high transportation costs, and susceptibility to natural disasters (MEA, 2005; Vogiatzakis et al., 2008). Small islands are characterized by limited physical size, generally limited natural resources, high susceptibility to climatic changes and natural hazards (hurricanes, storms, droughts, tsunamis, and volcanic eruptions), and relatively reduced fresh water supplies, which depend on sea level changes. In addition, climate forcing such as sea level rise, changes in rainfall distribution, and salinization of coastal aquifers are exacerbated in such systems and are expected to increase with climate change (MEA, 2005). Although insularity is clearly increased by geographic, socio-economic, and political isolation (Granger, 1993), socio-cultural factors are probably more important in defining the insular characteristics of islands (MEA, 2005). Islands are also places where the inhabitants are aware of being islanders, and the sea together with the volcano, if present, permeates the whole island, both physically and culturally.

According to the Amsterdam Treaty, these weaknesses generally make the people living there more environmentally, economically, and socially vulnerable. However, communities can reduce their vulnerability and enhance their quality of life through appropriate actions and programs that guarantee the conservation and sustainable management of natural capital, in terms of renewable and non renewable goods and services provided by ecosystems, and high levels of social capital through networks and norms that facilitate good governance, labour productivity, social cohesion and cooperative action (MEA, 2005).

The Mediterranean Sea hosts numerous small islands among which a volcanic archipelago (Aeolian archipelago), included in the World heritage list as part of the patrimony of humanity because of its exceptional universal value and for its peculiar volcanic aspects (Rossi et al., 1996). Living in a volcanic island can affect both negatively and positively the lives of people (Dominey-Howes and Minos-Minopoulos, 2004) because of the risk associated with an active volcano threatening the lifestyle of people, and, on the other hand, for the benefits such as fertile soils, minerals, hydrothermal water and power, and the beauty of volcanic landscapes, which represent important ecosystem services (MEA, 2005).

In addition to the natural capital, we can argue that social capital, i.e. the sense of belonging to a community, plays a relevant role in keeping people living in a volcanic island. The landscapes of Mediterranean islands are a mosaic of many land-cover and coastal types and are characterized by exceptional cultural elements (Vogiatzakis et al., 2008). For this reason, they can provide important ecosystem services, such as food, fibre, pollination, climate regulation, habitat, recreation, and cultural heritage (Costanza et al., 1997; Daily, 1997; Hein et al., 2006; Raymond et al., 2009). Insularity leads to strong linkages between ecosystem services and inhabitants and among inhabitants as well (MEA, 2005). In particular, a volcanic island, by offering beautiful landscapes for several tourist activities such as geothermal spas and climbing the crater, provides many cultural ecosystem services with economic benefits to inhabitants (Eagles et al., 2002). Consequently, traditional activities that have been shaping island landscapes, such as mining, agriculture, and wood cutting (Dominey-Howes and Minos-Minopoulos, 2004), have been almost fully replaced by tourist activities in the last 50 years (Colin and Baum, 1995; Margaris et al., 1996; Ioannides et al., 2001; Kousis, 2001; Petanidou et al., 2008). As a consequence, tourism, driven by natural capital and cultural heritage, supports the economic development of an island but, meanwhile, it is the main threat to natural and social capital (Petrosillo et al., 2006; Lacitignola et al., 2007, 2010).

### 3. “Objective” and “subjective” indicators of quality of life

During the last few decades, various indexes have been proposed by public policy institutes, government agencies, and news media to measure quality of life, even if the advantages and liabilities of each of them have not been systematically evaluated and compared (Hagerty et al., 2001). The evolution of the meaning and measurement of quality of life has broadened from an initial concern about income, towards a multidimensional understanding of quality of life emerging from the evaluation of multiple needs on the individual, community, national, and global levels (Costanza et al., 2007) and that, beside material dimension of welfare, encompasses also immaterial aspects of the living situation like health, social relations or the quality of the environment (Schmitt and Noll, 2000).

Two main scientific approaches for measuring quality of life have been usually adopted: one based on “objective” social indicators, and the other based on the measurement of self-reported levels of happiness, pleasure, fulfilment and subjective well-being (SWB) (Diener and Suh, 1997; Diener and Lucas, 1999; Easterlin, 2003; Vemuri and Costanza, 2006). The first is mainly focused on measuring physical health status, and personal income (Malkina-Pykh and Pykh, 2008) and other information gathered by the institutions routinely, based on frequency or physical quantity from the municipal or governmental institutions and organizations which may include standard of living. The second approach, instead, is concerned with individuals’ subjective experience of their lives (Land, 1996), psychological responses, such as life satisfaction, job satisfaction, and personal happiness. The measurements of these subjective indicators are essentially personal and based on the individual’s perception of one’s well-being and responses obtained in sociologic surveys and investigations (Shin and Johnson, 1978). Diener and Suh (1997) provide convincing evidence that subjective indicators are valid measures of what people perceive to be important to their happiness and well-being.

In Table 1 examples of “objective” and “subjective” social indicators are reported.

However, quality of life is not only given by social and/or economic parameters and it is essentially subjective even if we can often find objectively measurable proxies. Per capita Gross Domestic Product (GDP), for instance, is often used since it measures the flow of goods and services produced within the market and some ‘nonmarket’ production such as defense spending by the federal government and nonprofit spending on emergency housing and health care. However statisticians and economists reject GDP because many important social and economic activities are not considered by GDP measurements, such as volunteer work, social capital formation within healthy family units, the costs of crime and an increasing prison population, and the depletion of natural resources (Costanza et al., 2009). One alternative to GDP is the Index of Sustainable Economic Welfare (ISEW), which features a

series of adjustments to GDP to account for social factors affecting welfare as well as environmental issues and long-term sustainable use of natural resources. Another indicator that has been debated within the scientific community and used by governments and non-governmental organizations to more closely measure sustainable economic welfare is the Genuine Progress Indicator (GPI) (Talberth et al., 2007). It goes beyond measuring the quantity of economic activity to include details about resource stocks, social capital, income distribution, and other non-marketed economic activity, by incorporating changes in environmental conditions.

However, as soon as we try to modify GDP to bring it closer to some wider and more integrated conception of well-being, i.e. the ISEW, we are back to subjectivity in deciding which aspects need to be added to or subtracted from GDP (Levett, 1998). In literature there is the recognition that most commonly used socioeconomic and environmental indicators are either difficult to use in policy or fail to comprehensively reflect social well-being and environmental sustainability (Bagstad and Shammin, 2012).

High levels of quality of life are the results of the interplay of social, economic and environmental aspects that together make people satisfied with their life. In this context, Costanza et al. (2007) proposed a list of human needs to be used as the basis for generating a set of indicators for quality of life specifying that the ability of humans to satisfy these basic needs arises from the opportunities available and constructed from social, built, human and natural capital (and time).

### 4. Materials and methods

#### 4.1. Study area

Vulcano Island is the most southerly of the Aeolian Islands (Fig. 1) located along the northern coast of Sicily, in Italy. It is the third largest island and covers an area of 2070 ha. About 1555 ha of the territory, has been declared a Site of 24 Community Importance (European code: ITA030027) called “Vulcano Island”, and it is part of a Special Protection Area (European code: ITA030044) called “Aeolian archipelago – marine and terrestrial area”. In the past, the island was frequently evacuated due to volcanic activity that periodically took place. The last eruptions occurred in the period 1888–1890. Nowadays, the activity is limited to fumaroles and the presence of sulphurous mud is appreciated for its therapeutic properties. Therefore, during the years new economic activities have progressively repopulated the island. The current population is about 500 inhabitants.

People live mainly in the “Piano” area, characterized by scattered houses and agricultural areas, near the port area, where most of the economic and tourism activities of the island are located, and in peninsula of Vulcanello (Fig. 1). According to the statistics provided by the Aeolian Regional Tourist Service, tourism shows the typical peculiarities of seaside tourism registering during the summer more than 140,000 tourists visiting the island, mainly by day-trips, where the volcano represents the most important tourist attraction. Tourism activity is the main driving force characterizing the area both from the economic and employment point of view. From this perspective, every year many people move from the nearby Sicily region to Vulcano Island (period April–October), because of their involvement in economic activities related to tourism. Therefore, they represent seasonal residents (about 200) in addition to permanent residents.

#### 4.2. Data collection and analysis

Questionnaires were administered randomly through personal interviews to residents (permanent and seasonal) during May 2010.

**Table 1**  
Examples of “objective” and “subjective” indicators to measure quality of life.

|                         |                              |
|-------------------------|------------------------------|
| “Objective” indicators  | Life expectancy              |
|                         | Crime rate                   |
|                         | GDP (Gross Domestic Product) |
|                         | Poverty rate                 |
|                         | School attendance            |
| “Subjective” indicators | Sense of community           |
|                         | Sense of safety              |
|                         | Happiness                    |
|                         | Relationship with family     |
|                         | Social cohesion              |
|                         | Hobbies and club membership  |

Source: Modified after Rapley (2003).

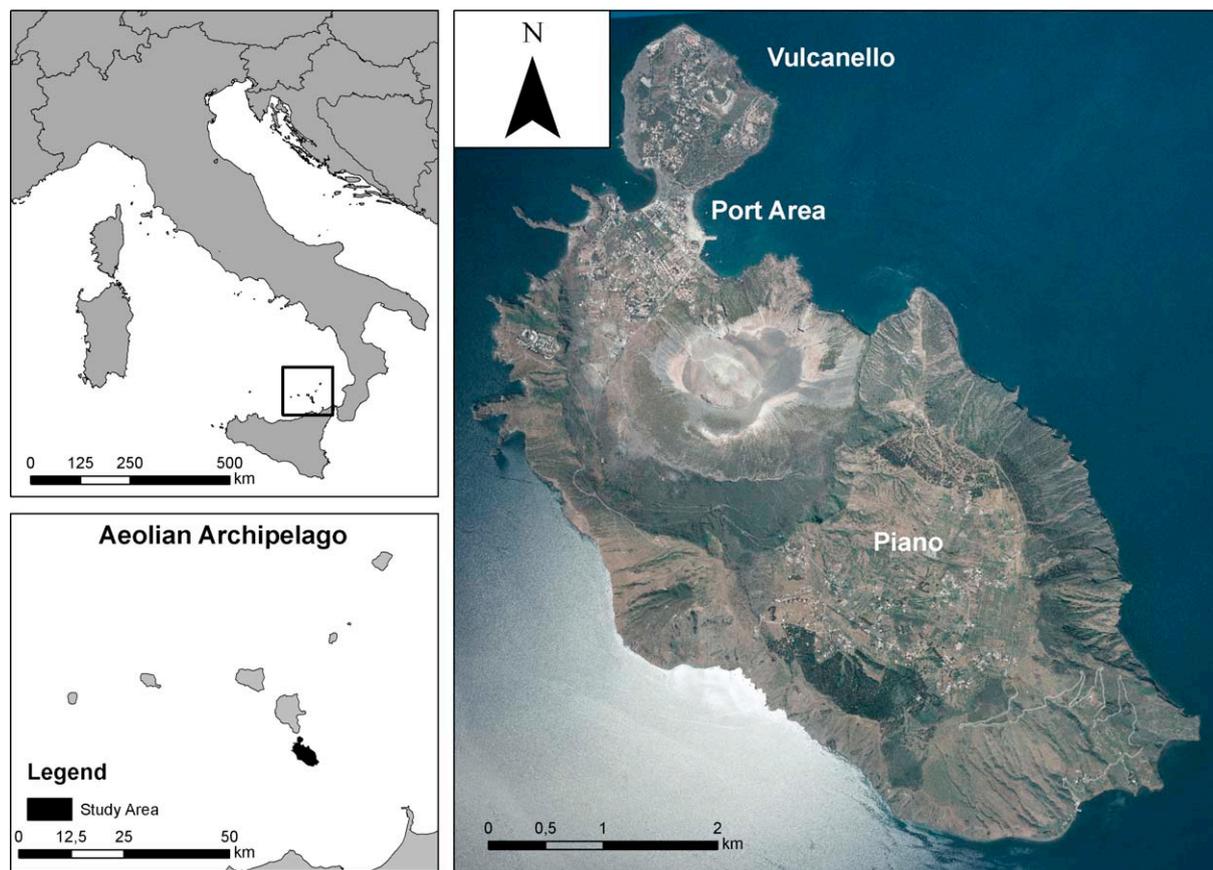


Fig. 1. Study area: Vulcano island, located in Aeolian Archipelago, Sicily region, southern Italy.

People interviewed once were not interviewed again. Before the survey, the questionnaire was pilot tested and six questionnaires were distributed to people in the study area to establish whether the language and the structure of questions were adequate and easily understood. Consequently, the original version of the questionnaire was properly revised and the final version of a pre-coded questionnaire, structured in one general, and three specific sections, and one final question, was used during each interview lasting from 20 to 30 min. The questions were selected taking into consideration the scientific literature (Land, 1996; Levett, 1998; Brown, 2005; UK Audit Commission, 2005; Paton et al., 2006; Raymond et al., 2009) reporting the main aspects characterizing natural and social capitals. In particular, the general section consisted of six questions aiming at characterizing the sample of interviewees. The first specific section was organized in nine questions concerning the values associated by residents (permanent and seasonal) to island such as aesthetic, recreational, economic, cultural, therapeutic values, to investigate their perception of the natural capital of the island. The second section regarded the perception of social capital with six questions focused on the perception of both type of residents about their life in the community, reciprocal relationships, and the interactions between permanent and seasonal residents. The third specific section was focused on permanent and seasonal residents' perception of possible natural risks associated with the presence of a volcano and their preparation for possible volcanic events, constituted by seven questions. Finally, a single direct question was included to investigate how living in Vulcano Island can affect people's perception of their quality of life. The five possible alternative categorical answers to each question were read to interviewees by interviewers who, at the same time, ticked the recorded answer. Preferences and

perceptions of respondents were, subsequently, rated using a five-point Likert scale, from the most negative (score 1) to the most positive (score 5), to allow statistical analysis. Questions were structured in order to characterize the profile of both typology of residents in terms of gender, age, education level, place of residence, job and type of resident (seasonal and permanent), and to collect quantitative data to address the specific purposes of this research.

Since every year during the period April–October, many people (seasonal residents) live in Vulcano Island because of their involvement in economic activities related to tourism, they represent an additional group sharing the island with permanent residents. The three interviewers distributed questionnaires simultaneously in the three most urbanized island areas (Vulcanello, Port Area, and Piano, Fig. 1), to make sure to meet the highest number of residents (permanent and seasonal), avoiding tourists. People were not always cooperative with some refusals. A total of 91 usable questionnaires were collected. 60% of the sample is represented by permanent residents and 40% by seasonal residents. The representativeness of the sample is not possible to be accurately determined, because the number of permanent residents that live on the island is officially 500, but some of them were not interviewed for their young age, and some others officially declare the island as their place of residence only to obtain economic (tax) advantages, even if they do not live there. Therefore, the real number of permanent residents is less than 500. In addition, there are not official census data regarding the number of seasonal residents, even if some informal estimates report that they are more or less 200.

We made a statistical analysis of residents' (permanent and seasonal) profile to explore the dependence of traits like gender, age, education level, place of residence, and type of resident,

concerning the perception of natural capital, social capital, natural risks, and quality of life. To this purpose a Fisher's exact test for  $r \times c$  contingency tables (Sokal and Rohlf, 1995) was performed and the statistical software R (R Development Core Team, 2010) was used to test each answer independently, using a fixed type one error of 0.05.

## 5. Results

### 5.1. Resident's profile

A total of 91 questionnaires were collected over the total population (about 700 inhabitants) living in Vulcano Island. The socio-demographic characteristics of respondents (gender, age, education, type of resident, place of residence) are shown in Table 2. Male outnumber female respondents, with a peak of respondents in the age class of 31–60 years. Most people interviewed (48%) have a secondary school education and a primary school education (36%), while few respondents got a college degree (16%). According to the place of residence 18% of residents (permanent and seasonal) live in Vulcanello, 23% in Piano and the majority of respondents (59%) live near the Port Area, where economic activities are concentrated. 92% of respondents have a job and their economic activities are mainly related to tourism. Permanent residents represent 60% of the sample.

### 5.2. Perception of natural capital

Regarding the value interviewees have associated with natural capital, the results show that respondents value the entire landscape characterizing the island, seen as a mosaic of different land-covers and coastal areas. In particular, they identify an "aesthetic value" (Fig. 2a), appreciating the scenery and beauty of the landscapes, and an "existence value" (Fig. 2b), because they consider the island of value just because it exists, independently from human uses. In addition, they recognize a "biological value"

(Fig. 2c), because they are aware that the island provides places for a variety of plants, animals, and an economic value (Fig. 2d), because they are conscious that the island provides several economic opportunities. Most of respondents perceive a "recreational value" of the island (Fig. 2e), recognizing that it provides places for outdoor recreational activities, and many of them perceive also a "therapeutic value" (Fig. 2f), because they consider that the island can make people feel better, both physically and mentally. There is a disagreement in the responses related to "life sustaining value" (Fig. 2g), because only some respondents believe that the island supports and maintains the quality of air, soil and water, while the others do not recognize this value. In this second case, they probably are influenced by the sulphur smell. The same discrepancy occurs when both "subsistence value" and "cultural value" are considered (Fig. 2h and i). For what concerns "subsistence value", only few respondents consider the island able to provide enough food and materials to sustain the lives of people. This is reasonable, since this aspect represents a typical limiting factor of living in a small island. The "cultural value" divides the respondents into two groups: those who believe that people in Vulcano Island can continue to pass down wisdom, traditions and a particular life style, and those in complete disagreement with this viewpoint.

Therefore, from the responses shown in Fig. 2 it is clear that both permanent and seasonal residents are able to recognize the different values that could be associated with the island for its recognized importance as patrimony of humanity.

The statistical analysis highlights significant differences in the interviewees' responses for the trait "type of residents" (permanent and seasonal) in two cases: therapeutic and cultural values (Fig. 2f and i). These results depend on a higher percentage of negative responses given by seasonal rather than permanent residents in valuing the island as a therapeutic and cultural place. These differences can be explained, probably, by the shortest period of permanence of seasonal residents, since their stay on the island is limited to the summer tourist season, when the high number of tourists could mask somehow cultural traditions, the life style of permanent residents, and the possibility of relaxation.

**Table 2**

Respondents' profile in terms of gender, age, education, place of residence, job, and type of resident (permanent or seasonal).

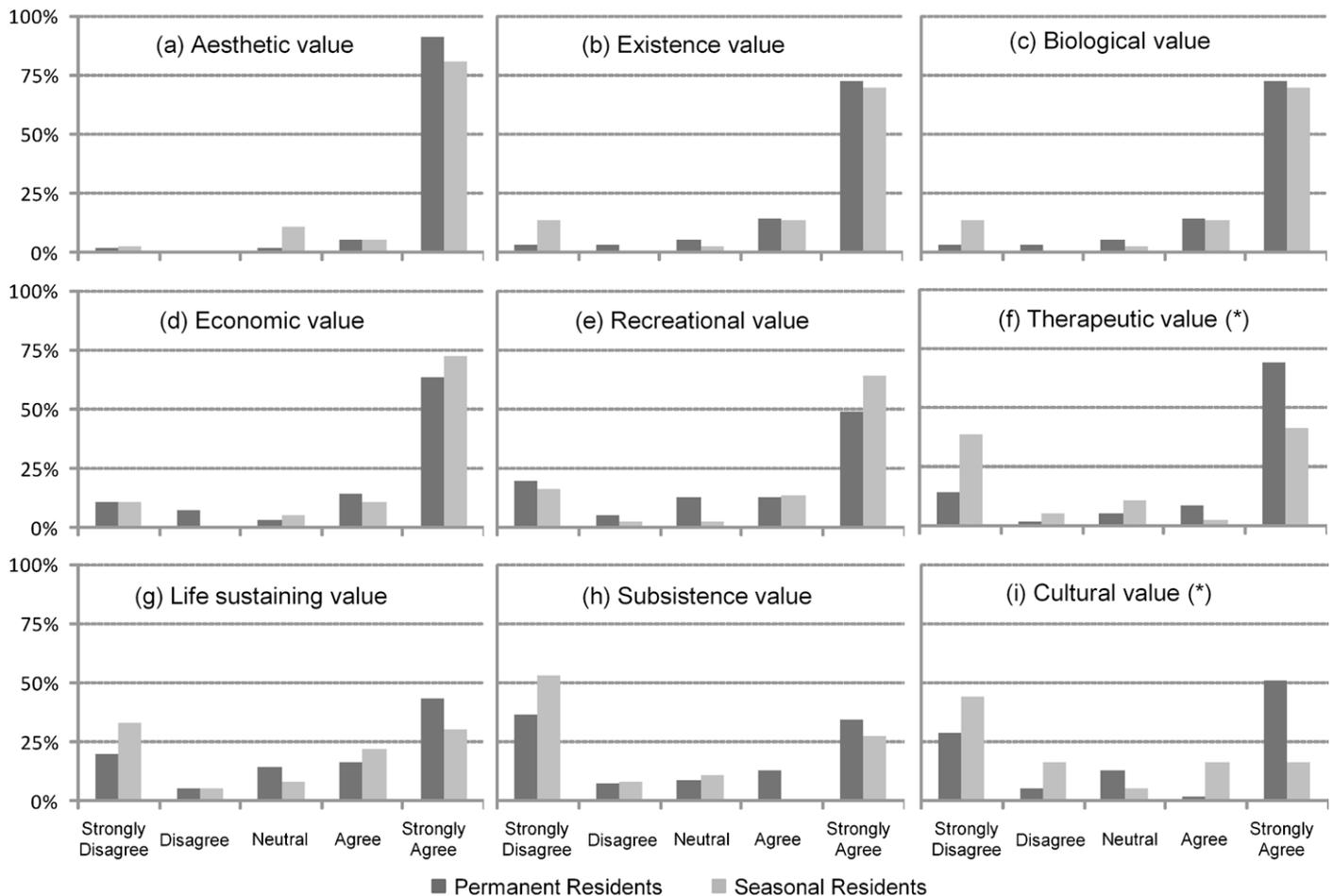
| Social descriptors        | %  |
|---------------------------|----|
| <b>Gender</b>             |    |
| Male                      | 54 |
| Female                    | 46 |
| <b>Age</b>                |    |
| <30                       | 31 |
| 31–60                     | 56 |
| >61                       | 13 |
| <b>Education</b>          |    |
| Primary school            | 36 |
| Secondary school          | 48 |
| University                | 16 |
| <b>Place of residence</b> |    |
| Vulcanello                | 18 |
| Port area                 | 59 |
| Piano                     | 23 |
| <b>Job</b>                |    |
| Employed                  | 39 |
| Freelance                 | 34 |
| Hotel-restaurant workers  | 11 |
| Retired                   | 8  |
| Student                   | 3  |
| Unemployed                | 5  |
| <b>Resident</b>           |    |
| Permanent                 | 60 |
| Seasonal                  | 40 |

Total number of respondents = 91.

### 5.3. Perception of social capital

The evaluation of the perception of social capital includes different aspects: the strength of the relationships of each respondent, seen as part of the community network, the perception of reciprocal relationships, and the interactions between permanent and seasonal residents. The percentage distribution of answers to the questions related to social capital is shown in Fig. 3. A split is evident in the answers regarding how much they feel themselves as part of their community (Fig. 3a and b). Most of them feel that they do not have any influence over what happens in their community (Fig. 3a) but, at the same time, about half of respondents state that they have an active role in keeping their community integrated (Fig. 3b).

The reciprocal relationships among people can be another aspect characterizing the social capital of such island, strengthened by the presence of an active volcano that represents a possible risk to people's lives. As regards the perception of respondents that other people can help them if necessary, it is possible to show that the majority of respondents are confident that their family (Fig. 3c) and their community (Fig. 3d) will help them if needed. The answers to the question concerning the interactions between permanent and seasonal residents show that most people surveyed perceive a good relationship between them, highlighting a good integration between the two groups (Fig. 3e). The last aspect related to social capital, is represented by cultural and social activities, because they are clear chances for cultural exchange and socialization. As shown in Fig. 3f, most of the respondents perceive that there is a lack of activities that support social relations among people.



**Fig. 2.** Percentage distribution of alternative categorical answers to the questions related to the perception of natural capital for permanent and seasonal residents (strongly disagree = 1; strongly agree = 5) and the results of statistical analysis for the trait "type of resident", number of total respondents = 91, \**p*-value < 0.05.

The statistical analysis highlights significant differences in the interviewees' responses for the trait "type of residents" (permanent and seasonal) in the case of questions related to feeling part of the community (Fig. 3a and b), and in the case of the question related to the interactions between permanent and seasonal residents (Fig. 3e). In particular, statistical analysis attests that seasonal residents perceive to have less influence on what happens in the community and to have a less active role in keeping the community integrated than permanent residents. The results of the statistical analysis related to the interactions between permanent and seasonal residents can be due to the difficulties of seasonal residents to feel themselves as part of a small and closed community, which is the case of a community of permanent residents living in a small volcanic island.

#### 5.4. Perception of natural risk related to the presence of a volcano

To determine the general level of perception and knowledge of volcanic hazards and risks with which permanent and seasonal residents live every day, the interviewees are asked questions related to the volcano. In particular, the aim of this part of questionnaire is to evaluate whether they consider any risks occurring in the near and far future, and their preparation for possible volcanic events. Fig. 4a and b shows that most of respondents are confident that a possible future volcanic event will be damaging and their forecasts are not exaggerated.

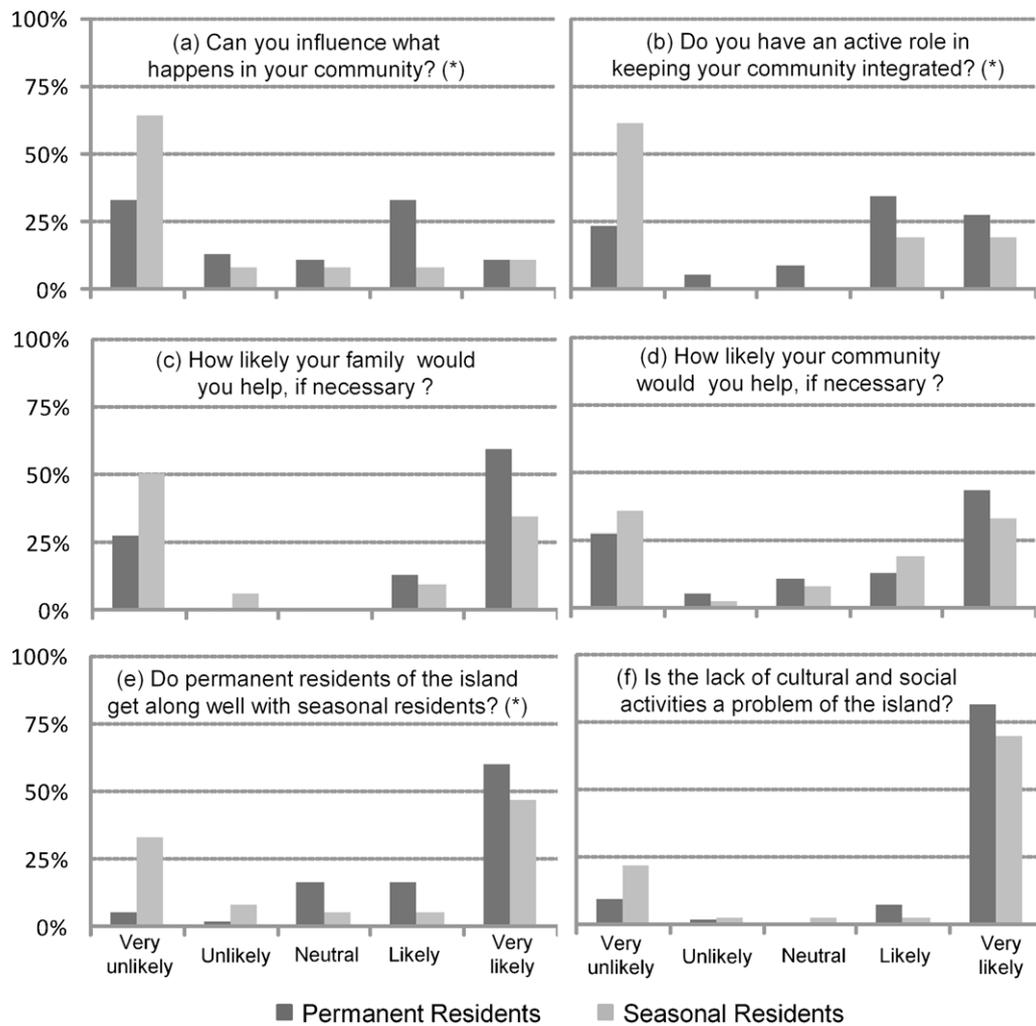
As often it is highlighted in social studies dealing with environmental risks, people tend to consider the place where they live

more secure than others. In this case, the presence of an active volcano is an evident risk, which threatens not only the environment but also the safety of people living there. However, respondents tend to shift the risk to the future. As shown in Fig. 4c, most of the interviewees do not consider possible that an eruption could happen in the short term (one year), while they judge very likely a volcanic event during the next 100 years (Fig. 4d). Finally, even if the majority of respondents consider a future volcanic event to be possible, many of them do not intend to increase their knowledge and ability to respond to such an event (Fig. 4e). However, what it is really surprising is that most of respondents do not know about the existence of a general emergency plan for the evacuation of the island in case of volcanic events (Fig. 4f). The results of the statistical analysis show that there are not significant differences among answers in the perception of possible natural risks related to the presence of the volcano.

#### 5.5. Perception of quality of life

Fig. 5 shows how living in Vulcano Island can affect permanent and seasonal residents' quality of life. The perception of respondents is diversified, but most of them feel that living in this island positively affects their quality of life; only a small percentage of interviewees feel that it has a negative effect on their lives, while the others declare that living in a small volcanic island does not have any influence on their quality of life.

The statistical analysis highlights significant differences in the interviewees' responses for the trait "type of residents" (permanent



**Fig. 3.** Percentage distribution of alternative categorical answers to the questions related to the perception of social capital for permanent and seasonal residents (very unlikely = 1; very likely = 5) and the results of statistical analysis for the trait “type of resident”, number of total respondents = 91, \* $p$ -value < 0.05.

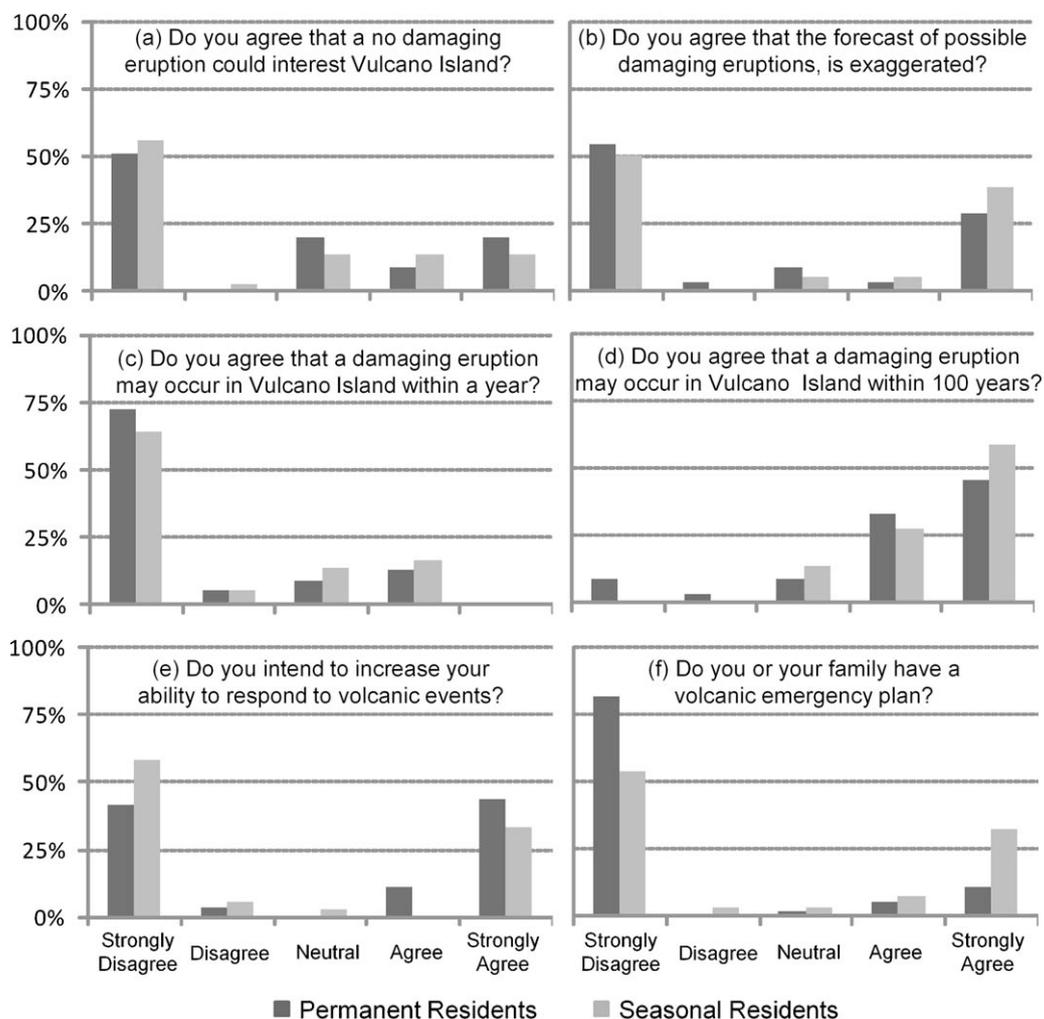
and seasonal). In particular, seasonal residents consider their quality of life affected less positively by living in Vulcano Island than permanent residents. This is probably due to the relatively short period they spend on the island, which is encumbered by numerous tourists.

## 6. Discussion

Typically island inhabitants perceive the condition of insularity as an element that implies many disadvantages (Vogiatzakis et al., 2008), like the strong dependence on imported food and water, difficult access to education and health services, high transportation costs and susceptibility to natural disasters. Surprisingly, these limitations do not seem to affect negatively the quality of life of people living in Vulcano Island. In addition, the presence of a volcano, which makes the island more vulnerable to the consequences of a possible volcanic eruption, is not perceived as a threat to their safety (Fig. 4). Risk perception is an important component of risk mitigation (Gaillard and Dibben, 2008; Petrosillo et al., 2008) because unless people perceive the risk associated with a hazardous event, it is highly unlikely that they will be motivated to deal with the consequences (Paton et al., 2006). From this perspective, collecting information on social capital, which includes the “sense of safety” (UK Audit Commission, 2005), becomes important as the community can play a crucial role in mitigating the risk and enhancing

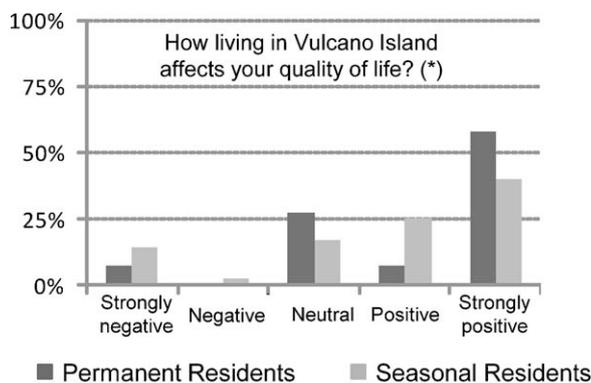
their environmental security (Müller et al., 2008; Petrosillo et al., 2010) and their quality of life (Sturtevant and Jakes, 2008; Kumagai et al., 2004). Investigations on social relationships and on the sense of community, which make possible to predict whether the community will cooperate during a catastrophic event, are the basis for evaluating the quality of life of people and their capability to better address possible environmental crises. However, the perception of social capital is diversified among respondents, with a lower perception of social capital shown by seasonal compared to permanent residents (Fig. 3). This is probably related to the period during which the seasonal residents live on the island that corresponds to the tourist season.

On the other hand, there is a greater agreement between permanent and seasonal residents on the values associated to natural capital (Fig. 2). This can probably be explained because the island provides a flow of natural capital, and the insularity exacerbates the dependence of people on ecosystem services (MEA, 2005). In this context, both types of residents show a high perception of the ecosystem services provided by the island, identifying which of them are essential in supporting their quality of life (Fig. 2). For example, the association of a biological value to the island suggests that respondents consider the island rich in terms of biological diversity and, thus, it can provide some supporting services (soil formation, primary production, nutrient cycling). Several respondents also value the island for its capability of life



**Fig. 4.** Percentage distribution of alternative categoral answers to the questions related to the perception of natural risk for permanent and seasonal residents (strongly disagree = 1; strongly agree = 5) and the results of statistical analysis for the trait "type of resident", number of total respondents = 91, \* $p$ -value < 0.05.

support, perceiving the benefits provided by regulating services (pollination, water and climate regulation). In addition, most of the interviewees recognize the recreational, aesthetic and therapeutic role of the island, meaning that permanent and seasonal residents perceive the non-material benefits obtained from natural capital, including cultural ecosystem services. They perceive that inspirational, aesthetic, and recreational services provided by



**Fig. 5.** Percentage distribution of alternative categoral answers to the questions related to the perception of quality of life for permanent and seasonal residents (strongly negative = 1; strongly positive = 5) and the results of statistical analysis for the trait "type of resident", number of total respondents = 91, \* $p$ -value < 0.05.

the island are important not only for their therapeutic value (physical and mental), but also for their considerable economic value. Since most of people living in Vulcano Island are engaged in economic activities related to the tourist sector, it is evident that cultural ecosystem services attract many tourists and represent the main source of income for permanent and seasonal residents alike, affecting positively their quality of life. A small percentage of respondents perceive the island important for "provisioning ecosystem services". On the contrary, many of them recognize that a small island could not have much variety in terms of climate or soils, and for this reason it should be not able to produce some crops or products (Royle, 2001). Overall, respondents' perception of ecosystem services highlights that they somehow can recognize the value of the place where they live, independently of the type of residents. Therefore, what makes the difference is the level of social capital that is not perceived by seasonal residents. Social capital, in terms of social cohesion, sense of safety (in this case the presence of a volcano), relationships with friends and/or family, seems to be one major reason that keeps permanent residents living in the island during the whole year. Therefore, these two types of residents cannot be considered as a single community.

Obviously, in dealing with a volcanic island there are different aspects that are interlinked, such as living in a small island, the presence of a volcano, the presence of a single economic driver (tourism). These interdependencies make difficult to evaluate how their combination influences the answers of the interviewees

**Table 3**  
Proposed list of subjective social–environmental indicators to measure quality of life.

|                            | UK Local quality of life indicators<br>(Key areas)* | Indicators from this research<br>(Key areas) | How to measure<br>(examples)   |
|----------------------------|---|--|--|
| “Objective”<br>indicators  | Social capital                                      | Community safety                             | 1. Domestic burglaries per 1000 households;<br>Violent offences committed per 1000 population;<br>Theft of vehicle per 1000 population;<br>Sexual offences per 1000 population.  |
|                            |   | Community cohesion and involvement           | 1. Election turnout  |
|                            |   | Culture and leisure                          | 1. The % of population within 20 minutes travel time (urban-walking, rural-by car) of different sports facility types  |
|                            |   | Economic well-being                          | 1. % of the working-age population that is in employment<br>2. Job density   |
|                            |   | Education and life-long learning             | 1. The proportion of young people (16–24 years olds) in full-time education or employment  |
|                            |   | Health and social well-being                 | 1. Age standardized mortality rates for: a) all cancers; b) circulatory diseases; c) respiratory diseases;<br>2. Infant mortality;<br>3. Life expectancy at birth (male and female)  |
|                            |   | Housing                                      | 1. The total number of new housing completions;<br>2. House price to income ratio.   |
| “Subjective”<br>indicators | Natural capital                                     | Transport and access                         | 1. % of residents who travel to work by: a) private motor vehicle; b) public transport; c) on foot or cycle;<br>2. % of residents travelling over 20 km to work.   |
|                            |   | Environment                                  | 1. The proportion of developed land that is derelict;<br>2. Levels of key-air pollutants;<br>3. Carbon dioxide emissions by sector and per capita emissions;<br>4. Daily domestic water use (per capita consumption)<br>5. % of river length assessed as: a) good biological quality; b) good chemical quality;<br>6. The volume of household waste collected and the proportion recycled<br>7. % area of land designed as sites of special scientific interest in favourable condition;<br>8. The area of land designed as a local nature reserve per 1000 population |
|                            |   | Community safety                             | 1. % of people who say they feel safe in the area where they live  |
|                            |   | Community cohesion                           | 1. % of residents who think that people being attacked because of their skin, colour, ethnic origin or religion is a very big problem in their local area;<br>2. % of residents who think that the presence of seasonal residents is a problem in their local area.<br>3. % of residents who think that their local area is a place where people from different backgrounds get on well together<br>4. % of residents who think that they can influence decisions affecting their local area   |
|                            |   | Culture and leisure                          | Cultural events and social activities<br>1. % of residents who think that for their local area the following have got better or stayed the same: a) activities for teenagers; b) cultural facilities; c) facilities for young children; d) sports and leisure facilities; e) parks and open spaces   |
|                            |   | Economic well-being                          | 1. % of residents who think that for their local area tourism represents an economic driver  |
|                            |   | Social well-being                            | 1. % of residents who think that their family or their community will help them if necessary   |
| Natural capital            | Natural capital                                     | Transport and access                         | 1. % of residents who think that for their local area, over the past three years: a) public transport has got better or stayed the same; b) the travel or traffic congestion has got better or stayed the same   |
|                            |   | Aesthetic value                              | 1. % of residents who think that their local area presents a valuable scenery  |
|                            |   | Existence value                              | 1. % of residents who think that their local area is of value just because it exists, independently from human uses  |
|                            |   | Biological value                             | 1. % of residents who think that their local area provides places for a variety of plants and animals  |
|                            |   | Life sustaining value                        | 1. % of residents who think that their local area provides and maintain the quality of air, soil and water   |
|                            |   | Subsistence value                            | 1. % of residents who think that their local area provides enough food and materials to sustain the lives of people  |
|                            |   | Cultural-recreational value                  | 1. % of residents who think that people living on their local area can continue to pass down wisdom, traditions and their life style;<br>2. % of residents who think that their local area provides places for outdoor recreational activities.  |

\* Source UK Audit Commission, 2005.

by strengthening or weakening the perception of the different aspects. However, the volcanic island represents just an example (natural laboratory) where it is easier to test the use of the social–environmental subjective indicators.

Several attempts have been done in trying to measure quality of life in practice. A good example is the UK Local quality of life indicators, useful to support local communities in becoming sustainable (UK Audit Commission, 2005). They cover ten areas, including the environment, crucial to determine the local quality of life, where some of them are subjectively and the other objectively measurable (Table 3). Given the highlights of the research and what reported in the literature concerning the importance of stakeholders' knowledge in landscape assessment and in mapping indicators for landscape services (Fagerholm et al., 2012), a first list of possible subjective social–environmental indicators is proposed (Table 3). This list is the result of the integration between the subjective and objective indicators proposed in the UK Local quality of life set and those proposed in this research, mainly focused on taking into account the importance of the perception of natural and social capital in determining the perception of people' quality of life.

From Table 3 it is evident that the UK Local quality of life indicators do not take into account the objective valuation of natural capital, which cannot be given only by the area of land designed as a local nature reserve or by the % area of land designed as sites of special scientific interest in favourable condition. In addition, the same set of indicators does not consider the “subjective” side of natural capital valuation.

Therefore, objective indicators should need the same efforts to be better identified, even if there are recognized examples of integrated indicators such as ISEW and GPI. They include social aspects in addition to economic–environmental aspects, but at the moment they presents some limitations mainly related to (Costanza et al., 2009): (1) how to value items that are not regularly reported in monetary terms – i.e. volunteer labour, (2) the subjectivity in defining which expenses are beneficial and need to be added to the total and which are detrimental, (3) how to quantify environmental costs. Therefore, objective indicators should not be only a measure of economic quantity, but also of the economic quality including social and environmental well-being, becoming the real support of environmental management strategies that enhance the quality of life for future generations.

In addition to traditional performance indicators (objectively measured), the proposed set of indicators provides a comprehensive list of key areas, which local authorities should take into account to review, justify and set local objectives and priorities for sustainable development of local areas. This is in agreement with the specific case of the study area as part of UNESCO World Heritage List. It requires the involvement of local communities, and asks local managers to protect and manage this patrimony in a sustainable and adaptive way, taking into account both the cultural and environmental conservation and the enhancement of local people' quality of life.

## 7. Conclusions

In a rapidly changing world, islands are both unique and highly vulnerable places, because they support distinctive cultures and landscapes where “natural experiments” can be carried out. Their small size, however, limits their development options and often results in environmental impacts, with particular reference to ecosystem services. In the international literature it is now increasingly recognized that natural capital is the basis for economic development (Gómez-Baggethun et al., 2010). Recently, social capital has also been considered as a potential source of

economic prosperity (Roseta-Palma et al., 2010), because it consists of features of social organization, which can improve the efficiency of a society by facilitating coordinated actions (Putman, 1993). The results of this paper has highlighted that If natural capital and social capital are taken into consideration in isolation, each of them provides only a partial vision of the quality of life, which is instead given by the combination of both of them. In addition, quality of life is not only the result of the economic income, but it depends on the comprehensive objective and subjective well-being of people (Vemuri and Costanza, 2006; Costanza et al., 2008). In such a context, the use of objective indicators alone, like GDP, cannot give a comprehensive view of people's quality of life. From the “subjective” viewpoint, as demonstrated in this case study, in addition to the perception of natural capital, social capital seems to be crucial in determining the quality of life for permanent residents. The same goes for the “objective” viewpoint, where better indices to measure quality of life are needed, able to integrate socio-economic and environmental aspects.

Therefore, we suggest that decision-making process should take into consideration the improvement of quality of life of inhabitants as based on a form of economic development that does not affect negatively ecosystem goods and services (natural capital). Such a kind of development should also consider whether and how much people perceive their needs to be reachable and, in doing this, whether they consider their neighbourhoods of help (social capital).

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.ecolind.2012.08.021>. This data includes Google map of the most important areas described in this article.

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