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Developing adaptive responses to contextual changes for sustainable agricultural management: the role of social capital in the Arborea district (Sardinia, Italy)

Abstract

This article investigates the role played by social capital (in terms of bonding, bridging and linking social capital) in developing adaptive responses to contextual changes (environmental, social and economic) at the local scale. Three questions guided the research: can social capital produce resilience and collective action? Could environmental barriers be turned into opportunities? Can social capital contribute to long-term adaptation to change? Results obtained from a qualitative research conducted in the Arborea district (Sardinia, Italy) show how collective actions to adapt to contextual changes are both results and generators of robust social capital. On the one hand, social capital contributes towards increasing resilience by generating collective responses to contextual changes without compromising the structural functions of the system; on the other hand, the lack of a clear regulatory framework for facilitating the development of local collective adaptive responses, depresses foresight strategies.

Keywords: Arborea district; social capital; collective actions; rural governance; "win win" adaptation strategies.

1. Introduction

The proposed paper starts from the hypothesis that small communities characterised by solid social capital are likely to adapt to contextual changes due to a systemic coordination and cooperation between local and external entities. In order to examine possible outcomes of social capital in terms of adaptive responses to change in agricultural systems, and consequently, in terms of economic growth and development of rural governance systems, this paper focuses on a rural case study represented by the Arborea district (Oristano, central Sardinia, Italy). Arborea constitutive features will be considered under the lens of three forms of social capital (bonding, bridging and linking social capital) as levers for producing collective actions, and consequently, adaptation strategies matched with economic development. Adaptive responses as related to climate, economic and social changes will be interpreted as an emergent property of social capital dynamics, leading ultimately into desirable transformations for responding to crisis.

According to Adger (2003) studying adaptive strategies to change does not only mean to consider global environmental governance, but also the local level in which multiple actors act in order to achieve their goals (in terms of economic, well-being, health, and social benefits). This work aims to discuss the possibility that bonding, bridging (Putnam, 1995), and linking social capital (Leonardi, 1995; Pelling and High, 2005; Wolf et al., 2010) may contribute towards developing strategies of adaptation, by combining both governance systems and civil engagement. Here, we are adopting the definition of governance as those social and political processes that shape the management of farms, agro-food chains, and innovation system (Duru and Therond, 2015). As pointed out by Adger (2001), this means that a governance system should provide action at multiple scales from the bottom to higher levels. Thus, the role of public policy is to create the most favourable conditions to increase social engagement, and therefore participation in developing adaptation strategies to change. Following Manyena and Gordon (2015) social resilience derives from a combination of factors such as “capacity and resources, effective institutions and legitimacy”. All these elements are influenced by socio-political-economic processes that operate simultaneously on different temporal and spatial scales. This means that an equilibrium between the society’s expectations and State actions can be achieved only if spaces of dialogue are provided. At the same time, some forms of civil engagement can spontaneously arise beyond the public policy thanks to a favourable socio-economic configuration. In this direction, as highlighted by Tolbert et al. (1998), when local economic organisations are embedded in the community they can play the same role of churches and associations, serving as forums for civil engagement. When this happens, new forms of adaptive strategies might be generated from the bottom (Koontz et al., 2015).

These considerations bring us to the following questions: Can social capital contribute towards producing both resilience and collective action? Could environmental barriers be turned into opportunities? Can social capital contribute to long-term adaptation to change?

The paper is organised as follows: the first paragraph refers to the definition of bonding, bridging and linking social capital; the second paragraph concerns the interconnections among institutions, social capital and economic growth; the third refers to the methodology used; the fourth presents the Arborea case study; the fifth refers to the environmental crisis as a catalyst for change in the Arborea district; the sixth discusses the results obtained. Finally, some conclusions will be drawn.

2. Social capital, resilience and adaptation outcomes

A large and sometimes contradictory number of definitions of social capital exist which may be summarised in terms of "bonding" (internal ties), "bridging" (external ties), and "linking" social capital ("institutional ties") (Leonardi, 1995; Putnam, 1995; Wolf et al., 2010). Many authors applied the concept of social capital in theoretical construct and empirical research by focusing on the potential benefits of its application. Among a number of definitions, these benefits could be briefly described as: access to information, knowledge, and social control (see Bourdieu, 1986; Burt, 1987; 1992; 1997; 2002; Coleman, 1988; Granovetter, 1973; Lin and Dumin, 1986; Nahapiet and Ghoshal, 1998), solidarity and mutual support in particular in time of crisis at the social or ecological level (Adger, 2003; Adler and Kwon, 2002), engagement and civic sense (see Knack, 2002; Putnam, 1993), sharing of financial risk (Adger, 2003).

The social capital concept has been applied to contextual change-related issues, in particular referring to the capacity of public and private bodies to produce desirable resilience, and then adaptive responses, based on trust, reputation, and reciprocal exchange (Adger, 2003). Tompkins and Adger (2004) argue that both bonding and bridging networks produce greater resilience and ability to adapt. On the one hand, resilience is defined as the capacity of a system to absorb disturbance, buffer change, learn, innovate without changing overall system

function (Adger et al., 2011; Folke et al., 2002; Maleksaeidi et al., 2015); on the other hand adaptive capacity concerns the ability of a system to adapt to these disturbances (Armitage, 2005). Hence, social capital might contribute towards generating resilience, which in turn produces adaptive responses to change. As argued by Carpenter et al. (2001) three properties characterise resilience: (i) the amount of change the system can sustain without being compromised in its structure and function; (ii) the degree to which the system is capable of self-organisation; and (iii) the degree to which the system is capable to learn and adapt. These three properties are also strongly connected to social capital. In fact, as underlined by Scheffer et al. (2000) social networks can play a decisive role in preventing or solving environmental issues if they represent repositories of social capital that can be mobilised. Social networks are supposed to facilitate informal exchange of information, materials and resources (Bernier and Meinzen-Dick, 2014). In this sense, social capital might become a tool for resilience-building in social-ecological systems. In fact, some scholars refer to social capital as the star around which the collective management of resources revolves (Pretty and Smith, 2004): it includes the set of common rules and sanctions, networks and relations of trust, reciprocity and exchanges (Pretty, 2003; Pretty and Ward, 2001). This means that social capital requires and facilitates "a social context with flexible and open institutions and multi-level governance systems" (Folke et al., 2002). The case of Khao Lak in Thailand (affected by the 2004 Indian Ocean tsunami) described by Calgaro and Lloyd (2008) demonstrates how the bonding social capital of the local community was able to produce adaptive responses to change despite a limited governmental capacity to cope with disasters. In fact, the formalisation of local groups in associations allowed the creation of a stronger network of socio-political and financial supports. Social capital has also been applied in studying individuals and community reactions during and after catastrophe. Literature shows how bonding social capital plays a primary role in supporting people affected from disasters, in terms of providing disaster preparation, warnings, supplies, recovery assistance (Aldrich and Meyer, 2015; Hawkins and Maurer, 2010; Heller et al., 2005; Norris et al., 2002). Moreover, bridging social capital might contribute towards providing support through institutional channels (e.g. charitable action from associations or church) (Aldrich and Meyer, 2015). If bonding and bridging social capital may be outcomes of both internal cohesion and connection with the outside, linking social capital is related to the ability of developing connections with institutions (such as e.g. local governments, agencies, banks, service organisations, higher educational institutions), which may facilitate groups both to achieve their goals and to access to power structures. As highlighted by Karn (2004), groups with higher degrees of social capital are characterised by a capacity to provide by themselves a safe, democratic and "healthy" environment through a mutual support system, which simultaneously promotes all forms of social capital (bridging, bonding and linking). Some authors also demonstrated the role of social capital in producing positive effects on the environmental awareness of farmers (Getz, 2008; Munasib and Jordan, 2011). By contrast, Smith et al. (2012) findings show a negative relationship between bonding ties and individuals' willingness to learn about impacts of climate change at the local scale, and positive relationships between weak ties and individuals' willingness to seek information about impacts of climate change.

Only few scholars discussed the role of Governments in creating social capital (Bebbington and Perreault, 1999; Warner, 1999). Macias (2016) refers to trust in government, local and national, as the principal predictor of support for implementing new policies. However, the author underlines that the reinforcement of trust in government is directly connected to the promotion of a greater participation in local decision-making. Pelling et al. (2014) underline the role played by decision-making in determining mode for adaptation, and selecting objects for change. The decision-making process is seen as a result of the individual, technology, livelihoods, discourse, behaviour, the environment and institutions (see also O'Brien 2015).

The interactions among these elements contribute towards defining priorities and an agenda for climate change adaptation. In this direction, following Cox (1998), it is useful to distinguish two kinds of spaces: spaces of dependence and spaces of engagement. The firsts consist of those spaces upon which people and organisations depend for achieving their goals; the seconds are defined by those spaces in which people act for maintaining their advantages. In this, spaces of dependence might limit stakeholders' spaces of engagement due to the difficulty to deal with bureaucratic constraints. In the context here analysed, we contend that social capital plays a primary role, together with natural, economic, human and cultural capitals, in developing collective actions and adaptation outcomes. At the same time, if there is a lack of government support in promoting both participation in decision-making and cooperation amongst different bodies, bonding social capital is not sufficient alone to produce systemic and farsighted adaptation strategies (see also Adger, 2000).

3. Interconnections among institutions, social capital and economic growth

Following Tompkins and Adger (2004), the adaptation capacity of a society depends on social capital, institutions, resources and their distribution. Here, institutions are considered as both "formal" (such as constitutions, laws, charters, and regulations) and "informal" (such as social norms, values, relationships, informal networks) (Rodríguez-Pose, 2013). Literature on the role played by both social capital and formal institutions in economic development have mainly followed two directions. On the one hand, the former literature underlines that trust, networks, social norms, and associational activity are central aspects of successful economies. On the other hand, the institutional literature identifies formal rules as crucial for development (Ahlerup and Olsson, 2008). At the same time, formal and informal institutions can simultaneously work to generate adaptive responses to change. In this, the interaction between institutions ("rules") and organisations ("players of the game") might also influence the evolution of the institutional framework (Rodríguez-Pose, 2013). If institutions define the rules of the game (North, 1990), the organisations, which work within this institutional framework, develop a capacity to take advantages from the context and from their networks. Social networks, together with norms and trust, besides being constitutive features of informal institutions, are constitutive elements of social capital as well (Putnam, 1993). In particular, networks represent the relational capital, which indicates a set of networks established between firms, institutions and people. The relational capital, following Capello and Faggian (2005), allows to develop a sense of belonging and a cooperation attitude, which in turn enhance collective learning and innovative processes. In this sense, formal (norms) and informal (networks) institutions might be seen as generators of social capital, which in turn represents a source of power for stakeholders by creating spaces for participants' mutual support and engagement (Cox, 1998). There exist contradictory results in identifying the impacts produced by formal and informal institutions on economic growth. Findings obtained by Ahlerup and Olsson (2008) show how social networks and trust tend to positively influence economic growth when formal institutions are weak at both micro and macro levels. By contrast, a number of scholars argue that the "rules of the game" are responsible for channelling entrepreneurial activities, thus affecting economic development (Acemoglu, 2004; Baumol, 1990). Tabellini (2010) found that specific cultural traits (such as social capital) positively influence economic development either directly, or indirectly through better functioning institutions. Literature on social capital recognises its role in positively contributing towards economic development and well-being (Woolcock, 1998; Woolcock and Narayan, 2000). In this sense, social capital tends to enhance wealth, controllability, and adaptive capacity, which in turn shape the responses of ecosystems, agencies, and people to crisis (Holling, 2001). In line with this, findings obtained by Deressa et al. (2009) in Ethiopia, show that informal institutions

contribute towards climate change adaptation through sharing both informal financial sources and experiences of adaptation.

In the proposed analysis we contend that communities' social capital enhances collective responses to change thanks to a stock of norms and networks which foster trust, cooperation and social engagement.

4. Methods

The case study area, the rural district of Arborea (Oristano, central Sardinia, Italy), is an intensive area of dairy farming characterised by a per capita milk productivity that is one of the highest in Europe. During the last century, Arborea has been characterised by profound changes. During the years 1920-1930 a huge land reclamation work was carried out. The reclaimed land was colonised in the 1930 by farmers coming from Veneto and Friuli (north-eastern Italy). They created a cohesive community that evolved in a strong cooperative system (unique in the Sardinian context). Dairy cattle production, horticulture (potato, carrot, strawberry, watermelon) and intensive forage production (maize) have become predominant (Cau and Paniconi, 2007). Many other activities take place in this district, including aquaculture and tourism. These features contributed towards creating a "complex district" characterised by multiple stakes in relation to different production activities. Four cooperatives represent the main categories of stakeholders: the 3A and the Produttori Cooperatives involve livestock farmers and farmers; the Fishermen Cooperative; the Bank Cooperative involves savers and investors. The 3A and the Produttori Cooperatives represent the strongest economic bodies at the local level and the majority of local people are simultaneously members of both cooperatives (they are both livestock farmers and farmers). The proposed analysis results from a six-year-long participant observation in the context of a number of activities organised by the NRD (Desertification Research Centre, University of Sassari) in order to gain a comprehensive perspective of the local configuration in socio and environmental terms. The research scheme aimed to record the capability of the Arborea community to build three forms of social capital: bonding, bridging and linking social capital, specifically referring to their internal and external relationships, self-management system, and civic engagement. The participation in community's everyday life, such as cooperatives' meetings, local public events, and farm work allowed to develop a deep consciousness of how Arborea responds to contextual change. Moreover, the qualitative analysis presented here, is based on the observation of a process resulting from the adoption of a variety of interdisciplinary approaches such as:

(i) Analysis of policy documents related to Nitrate Directive application in the Arborea district (throughout the research process); collection of materials on the Arborea historical background and local agricultural practices.

(ii) Interactive workshops with local Cooperatives and farmers aimed at creating new spaces for dialogue and trust building. Since December 2012 interactive meetings with the Produttori Cooperative were addressed to design and then implement the Ichnusa Bubula project (see next paragraphs).

(iii) Semi-structured interviews (at different time) to record farmers' needs, priorities, engagement, experiences and expectations. Farmers were invited to reflect on their past activities and necessary improvements for the future.

(iv) Semi-structured interviews to relevant stakeholders (experts, technicians, professionals etc.) and "ordinary people" in order to capture local community's perception of environment and climate change.

(v) Semi-structured interviews of "No al Progetto Eleonora" activists (in 2014) in order to understand their role within the community.

(vi) Participation of researchers in public events. This allowed researchers to "observe" the "community" from the inside. The communication in the context of "public events"

organised for other purposes aimed both to capture the attention of a wider range of stakeholders, and to inform them about the implications of natural resource exploitation.

5. The Arborea district

In 2005, the Regional Government of Sardinia (Regione Autonoma della Sardegna 01/2005) identified the Arborea district as the unique Nitrate Vulnerable Zone in Sardinia in relation to the nitrate contamination of groundwater, derived mainly from agricultural and livestock activities. In order to reduce the impact of fertilisers and pesticides on the phreatic aquifer and the risk of eutrophication of water the European Nitrate Directive (ND) produced a series of obligations in terms of definition of maximum rates of organic fertilisers (170 kg ha⁻¹ year⁻¹), and the implementation of a code of good agricultural practices. These obligations increased costs for farmers due to the reduction of production, the costs of transportation of excess manure and slurry, and the purchase of mineral fertilisers. The resulting increased costs of production have produced farmers' mistrust in institutions, because they have been forced to adopt the Directive impositions. At the same time, such "perturbation" of the social, economic and ecological system (Adger, 2003) has enhanced the development of new ways to take advantages from changes as discussed in the next paragraphs. Moreover, since 2011 another external threat has pushed the community to become more cohesive. In fact, an Italian petroleum-refining corporation (Saras Corporation), which is also engaged in the electric energy sector, intends to realise a drilling project ("Progetto Eleonora") in the Arborea district to detect the presence of hydrocarbons. Since 2011, a local Commitment, called "No al Progetto Eleonora" (<https://noprogettoeleonora.wordpress.com/>), has fought the drilling project, progressively being able to involve the whole community, including both, the local municipality and the cooperatives, worried about possible economic damages due to a potential environmental degradation. The dispute between Saras and the Local Commitment is partially resolved: in September 2014 the regional agency for environmental sustainability, impact assessment and environmental information system (SAVI) rejected Saras' proposal considering this out of line with the regional landscape planning (resolution n. 36/7, Regione Sardegna, September 5, 2006). However, the controversy may be not completely resolved, because the Saras Corporation filed new objections to this decision. In the meantime, in 2013 the regional government implemented a measure (called "Misura 124", Regional Rural Development Program 2007-2013), which promoted cooperation for the development of new products, processes and technologies in the agriculture, forestry and food sectors. The Produttori Cooperative was able to take advantages from this regional funding by proposing to the NRD team to scientifically support a new innovative project for rural development. The "Ichnusa Bubula" project resulted from a long "social learning" process, which involved the University of Sassari, the Produttori Cooperative and four extensive cattle farms in order to develop a beef production chain based on local resources. As better clarified in the next paragraph, this project enhanced active cooperation between four cattle farms operating in the north of Sardinia, and a fattening centre owned by the Produttori cooperative.

6. Environmental crisis as catalyst for change in the Arborea District

In the Arborea district the application of the European Nitrate Directive (ND) without any negotiation at the local level caused that local stakeholders felt excluded from the decision-making process. In fact, even though the EU Framework Directives result from negotiations between the European Commission, EU Member States and the European Parliament, which are supposed to take into consideration local needs by implementing participatory processes, the lack of a steady consultation of the baseline at the local level throughout the legislative

process caused a discrepancy between ND impositions and local needs. This was particularly evident, in the transposition of the ND into Italian law.

As farmers stated throughout the research, the top-down application of the Directive hindered the possibility to co-manage arrangements and improvements of the regulatory framework. At the beginning of the research process, local actors' felt themselves abandoned by political institutions (at the community/regional/national/European level).

The community showed a very robust internal economic and social organisation thanks to the presence of four main cooperatives. On the one hand, the social and environmental contexts were affected by a crisis derived from the application of the ND. On the other hand, the social and economic capitals were higher at the farmer cooperatives' level: in 2012 the 3A cooperative consisted of 248 members and had a total revenues of 150M (<http://www.arborea.it/>); the Produttori Cooperative included 200 members and had a total revenues of 40M (<http://www.produttoriarborea.it/>). Up to that time, each of these organisations was active within the boundaries of its cooperative, but only little cooperative with other bodies (internal or external to the Arborea district). This is testified by the high degree of participation of members in internal formal and informal meetings organised by the cooperatives while they had scarce connections with other bodies (such as e.g. fishermen cooperative or external economic actors). Moreover, while fishermen cooperative was less interested in cooperating with the University, the farmers' cooperatives were well disposed to start this dialogue. After the application of the ND, conflicts arose among local bodies in relation to their need to access to natural resources. In fact, as highlighted earlier, the nitrate contamination of groundwater derived mainly from agricultural and livestock activities. This damaged in particular tourist and fishing activities in relation to the excessive presence of nitrates that caused excessive eutrophication of water.

With regards to the evolution of the Arborea system described in table 1, it is possible to sum up the salient points of the process: a) at the beginning cooperatives showed a bonding social capital resulting from the supportive (formal and informal) network and a steady dialogue between members and top managers within each cooperative; b) the application of the ND caused a "crisis" and a consequent conflict among local bodies; c) since 2011 the local commitment "No al Progetto Eleonora" has fought the Saras' drilling project in Arborea; d) after the NRD involvement, the farmers' cooperatives and the local commitment recognised some potential advantages from collaborating with the University and other external bodies. Therefore, firstly the "water crisis", and then the "drilling project", might be considered as catalysts for change in Arborea. The role of the NRD in facilitating dialogue among actors and in collaborating for systemic change and local economic growth, by activating learning and action processes, was perceived by stakeholders to be particularly significant since external assistance was not available from other sources (in particular regional and national governments).

In this context, the "Ichnusa Bubula" project (resulted from the above mentioned Misura 124) might be considered as a "win-win" adaptive response (Authors, 2014) to contextual changes. For the first time, the NRD was invited by the Produttori cooperative to scientifically support the development of a beef cattle chain. The cooperative decided to designate its fattening center, at the beginning used for fattening male Friesian cattle (not suitable for meat production), to fatten young calves from hilly areas of Sardinia. This process can be defined as a "win-win" strategy in relation to a number of reasons: the Produttori Cooperative has promoted its fattening centre so far characterised by low incomes; the Produttori Cooperative has reinforced its economic and bridging social capital thanks to the cooperation with external farms; the water issue (here related to the management of the effluents produced by the fattening centre), has become primary to build a new brand based on a sustainable production, health and biodiversity. The water issue was connected to a number of elements along the production process, such as increasing the

efficiency of nitrogen use resulting from the manure; producing forages and feed in irrigable areas (not yet irrigated); protecting the hydrogeological assessment connected to livestock activities in forestry and agro-pastoral areas. In order to deal with the increased costs of production derived from the implementation of the ND, this study also developed an economic estimation of alternative technological solutions for managing manure.

Table 2 reports the main issues emerged during a participatory workshop carried out with the 3A and the Produttori cooperatives, and the wider community in the context of a wider public event (History of Arborea - November 2013). The workshop aimed to identify the main concerns for local cooperatives and how they planned to manage potential resulting impacts. It shows how cooperative management, need for increasing social capital and protection of historical/cultural and environmental heritages represent the main areas of intervention for local cooperatives. Cultural and social capitals were seen as drivers for local economic growth. As a member of the Produttori Cooperative stated:

“One of the most difficult challenges in Sardinia is represented by involving people in common projects [...]. The increase of social capital might produce economic benefits. Arborea is an exception is Sardinia [...] and we do really want to extend our cooperative model at the regional scale. I strongly believe that the agricultural sector might benefit from the adoption of a regional cooperative system” (Produttori Cooperative manager, 2013).

The willingness to create new partnerships with economic actors, universities and policy-makers represents a priority for the Arborea community. In fact, as stated by a manager of the 3A cooperative:

“If we were able to improve our local production system, by creating new synergies with external bodies, research activities and technical support, we would gain a number of social, cultural and economic benefits” (3A Cooperative manager, 2013).

Political support is seen as a key element for improving the local production system, but the lack of confidence in institutions (which in turn derives from past negative experiences such as in the case of the ND application) contributes towards increasing a general frustration. They found difficult to define a strategy of action in this area. Interviews carried out with farmers in 2015 still testifies a lack of confidence in the regulatory apparatus:

“We are limited by a number of regulations that are imposed by the institutions through a top-down approach” (farmer1, 2015).

“We work in vey bed conditions because the Regional Government is too slow in satisfying our requests. We are in an emergency status” (farmer2, 2015).

“There is a big confusion about the actors involved in policy implementation: the Province is the main responsible for implementing these regulations, but also other bodies [...]... the Forest Service, the police... What we really need is a stronger dialogue between public and private bodies in order to share a common strategy and transfer clear and univocal directions to people who work in the agricultural sector” (farmer3, 2015).

At the same time, at the cooperative level the awareness about community’s responsibility towards the environment has increased throughout the project:

“This area [Arborea] was identified as vulnerable, and this is totally our fault. We should not seek for any alibi. However, I strongly believe that the [environmental] situation has been progressively improving” (Produttori Cooperative manager, 2015).

“[When the ND was implemented] There was a coercive imposition, but also a financial support...because financial resources were allocated by the European Community, Region, and State, aimed at improving farms’ conditions. At the same time, farmers understood that the situation was not sustainable anymore. The local territory will benefit from our efforts” (Produttori Cooperative manager, 2015).

On the other hand, the local commitment "No al Progetto Eleonora", also supported by local cooperatives, asked to the NRD to develop new social learning frameworks in order to both involve a larger number of people in their project, and to develop new activities related to environmental education. As stated by members of the "No al Progetto Eleonora" committee, at the beginning they met opposition by both Local Municipality and local community. After a long process of communication and the organisation of a number of interactive activities, which active involved the NRD (as for example round tables and co-learning activities), both the local municipality and the local community started to embrace the environmental issues and to autonomously support the association values:

“I believe that the No al Progetto Eleonora committee has significantly increased the internal social cohesion [...]. The main barrier was represented by the limited knowledge about drilling impacts on the territory [...]. It was a very big effort to make people understand the risks connected to drilling activities” (member of the No al Progetto Eleonora committee, 2014).

7. Social capital and political fragmentation: what consequences on adaptation strategies?

In the Arborea district, two cooperatives (3A Cooperative and Produttori Cooperative) and a local Commitment ("No al Progetto Eleonora"), which work in the area, turn out to be active actors in involving the whole community in collective actions. The community capacity to create networks and new spaces for dialogue within (see the work of No al Progetto Eleonora) and outside the community (see the Ichnusa Bubula project), testifies the community willingness to invest in bonding, bridging and linking social capital. The Arborea case shows that when social capital is high and formalised in organisations and associations people are more willing to take part in collective actions, because they trust that others will do the same (Author, 2014; Pretty, 2003). The Arborea community, thanks to its internal organisations and associations has been able to transform barriers into opportunities by showing a capacity to absorb disturbance, buffer change, learn, innovate without changing overall system functioning (Adger et al., 2011; Folke et al., 2002; Maleksaeidi et al., 2015). For instance, one barrier, represented by the Saras' project, has been turned into the opportunity to create spaces for dialogue and strengthen the community cohesiveness against a common threat. Another barrier, represented by the water dilemma, was turned into the opportunity to develop a jointly project between economic bodies (internal and external to the community) and the University in order to develop a sustainable water management system connected to livestock activities. This is also indirectly producing benefits for fishing activities by reducing water eutrophication due to the more efficient system to process manure and slurry.

At the same time, long-term adaptation strategies, some public goods (such as infrastructural investments), the design of an efficient institutional framework, and community economic growth, can only be provided with the State support (Adger, 2001). This means that the lack of involvement of the local community in decision-making; the complexity of the bureaucratic system; the number of bodies and agencies that work in the agricultural sector in Sardinia and their hierarchical structure, represent constraints to the development of long-term adaptation strategies. Considering the regional management of the agricultural sector it is possible to outline a very fragmented configuration due to the presence of several agencies and bodies characterised by specialised functions: ARPAS (Regional Agency for

Environment Protection); AGRIS (Agricultural Research Agency); ARGEA (Regional Agency for support to the agricultural sector); LAORE (Regional Agency for the implementation of agricultural regional programs and rural development); CRAS (Regional agricultural experimental Centre). This fragmentation contributes towards undermining various critical aspects of the management system (e.g. the transparency, the access to information, the efficiency and effectiveness, the regulatory quality, the participation, the possibility of networking, and the accountability). This happens because farmers find difficult to rapidly and efficiently satisfy their needs of both information and support by the regional Government. In this direction, the Sardinian councillor for agriculture stated that "excessive bureaucracy in Sardinia affects the agricultural sector. The new Rural Development Plan 2014-2020 will work to streamline the bureaucratic process" (<http://www.regione.sardegna.it/j/v/25?s=286998&v=2&c=130&t=1>). The regional political context in Sardinia might be represented as a clepsydra: on one side, there are bottom up forces, on the other, top-down pressures. Both processes are limited in the centre by a heavy bureaucracy, which negatively influences the implementation of new initiatives and measures. As a result, local bodies in Arborea lost confidence in local/regional/national and European governance processes. Farmers, for example, consider themselves as victims of the ND applications because it does not take into account local settlements, arrangements, production systems, and needs. Moreover, the results of the experiments conducted by the NRD agronomists show that the replacement of organic fertilisers with mineral fertilisers did not produced significant reductions in nitrate leaching compared to other fertilisation methods that based on the reuse of manure (Nguyen et al., 2013; Authors, 2011). Furthermore, fishermen keep on complaining about water eutrophication due to the lack of an effective drainage system that should be provided by the regional Government. The last mass fish death occurred in the Santa Giusta pond (located on the border of Arborea) in 2013 and fishermen are still waiting for regional economic compensations. Since the regional government failed to support fishery activities in the area, the low confidence shown by fishermen towards the University might be read as a lack of confidence in institutions in general. The limited social capital of the fisherman cooperative (in particular in terms of bridging and linking social capital) might be read as the main cause of its limited power at the local level. In fact, while farmers adopted a pro-active attitude by developing new synergies with external partners and the University, fishermen did not see any advantages deriving from developing new social networks. This might also indicate that the more frustrated actors are, the more self-excluded tend to be. Following Manyena and Gordon (2015), on the one hand, the lack of bridging social capital may increase internal cohesion and therefore the intra-group resilience; on the other, it may contribute towards creating self-exclusion and competitiveness at the macro level. It appears that the lack of confidence in institutions enhanced a "complaining attitude", instead of pro-active responses. At the same time, fishermen's need for regional financial support, makes them dependent upon those institutions that they strongly criticise. As a result, this vicious cycle produces an increasing complaining which leads fishermen to perceive themselves (and consequently act) as losers. However, in the Arborea context, fishermen indirectly benefitted from the collaboration between farmers' cooperatives and the University. In fact, the Ichnusa Bubula project, at least in part, contributed towards reducing local conflicts by creating favourable conditions for a sustainable use of water resources.

Furthermore, since 2011 the "No al Progetto Eleonora" local committee has been able to involve the Arborea community in the protest against the Saras' drilling project. However, they received a formal response from the regional Government only after 3 years.

At the same time, even though the regional Government promoted cooperation and networks at the local scale, through e.g. the "Misura 124", the delay in allocating funding caused many damages to farmers, who delayed the purchase of the necessary equipment.

The beginning of a steady dialogue between the University and local bodies, and between local bodies and the local and regional governments produced the development of some new spaces of engagement and economic and governance outcomes (the Ichnusa Bubula project for example, and the collective management of the common instance against the drilling project). At the same time, only a limited intervention of political authorities has been recorded, which, otherwise, may reinforce the actual level of social capital. In fact, integrated planning, participation, cooperation, and governance are key words contained in both the regional Plans for Rural Development (PSR, 2007-2013 and PSR, 2014-2020) in Sardinia, but the difficulty to streamline the bureaucracy is still the major obstacle to make the governance process effective, and to go beyond a mere consultation of stakeholders. By contrast, the implementation of the regional "Misura 124" may be considered as both "a product and a producer of social and economic relations" (Warner, 2009) because it contributed towards reinforcing the local community cohesion while connecting this to the rest of the Region and to the University. In the Arborea district, both formal and informal institutions play a decisive role in increasing the resilience of the system. The three forms of social capital contribute towards producing adaptive responses to crisis through collective actions, which in turn protect (No al progetto Eleonora) and increase (Ichnusa Bubula) the local economic heritage (Woolcock, 1998; Woolcock and Narayan, 2000). At the same time, the institutions, intended as the rules of the game, are responsible for supporting cooperation and channelling entrepreneurial activities, thus affecting economic development (Acemoglu, 2004; Baumol, 1990). Hence, the "regulatory framework" produced two controversial effects on the production of collective actions to change: on the one hand, the lack of support from decisional levels contributed to increasing the internal cohesiveness by pushing the local community to self-organise its response to change; on the other hand, it limited the evolution of the system due to a heavy bureaucracy. Finally, the introduction of a measure, which promoted cooperation, produced positive effects in economic terms by enhancing linking and bridging social capital.

8. Conclusions

At least four lessons can be learned from the Arborea case study. First, despite the absence of governments' support, when the bonding social capital is already high at the community level, the contribution of an independent organisation such as the University is crucial to create confidence in institutions. This also produces positive effects in terms of bridging social capital by reinforcing relationships with external actors. Thanks to a bottom-up process (e.g. from cooperatives or local civil committee towards institutional levels) local and external bodies may start to synergistically collaborate in order to achieve mutual economic benefits and defend their natural and cultural heritage.

Second, in line with what literature suggests (Calgaro and Lloyd, 2008), the community social capital might not be decisive if there is a lack of support from top levels and the formal institutions do not accommodate local evolution by modifying the regulatory framework in relation to local needs. The lack of a clear regulatory framework for facilitating the development of local collective adaptive responses, depresses foresight strategies. This means that governments should play a primary role in unblocking, and even promoting and enhancing social capital, by considering the specific needs of local communities. Limited research has been produced on the role of governments in producing social capital. By contrast, governments might promote new spaces for those forms of social capital already existing and spontaneously produced by networks at the local level. This study fills this gap by showing how the implementation of specific policy measures (e.g. the "Misura 124") may be considered as both a result and a producer of bonding, bridging and linking social capital. In fact, the simultaneous intervention of public and private actors contributes towards developing long-term strategies through the cooperation between people and organisations

in order to achieve positive environmental outcomes. This means that on the one hand, the "Misura 124" found its favourable conditions for developing long-term strategies in existing social capital. On the other hand, the same measure contributed towards reinforcing bridging and linking social capital by both promoting connections with other external economic actors, and promoting cooperation with the University.

Third, when social capital is high and formalised in organisations and associations, as for example cooperatives or local committee, people have a degree of confidence adequate to take part in collective actions, because they believe that they will never be let alone by the others. In the case of Arborea, this is attested by the ability of both community and local organisations to transform barriers (environmental, institutional, socio-economical obstacles) into opportunities (Ichnusa Bubula project and No al Progetto Eleonora social committee).

Fourth, while the European Union promotes participative approaches for decision-making, the implementation of Directives, as e.g. the ND, shows how the local baseline was not involved. Furthermore, the fragmentation and difficulties of regional Governments in activating effective governance processes represent a significant constrain for developing adaptation strategies. However, the creation of dialogical spaces (together with experimental findings), through the University's intervention, might produce different kinds of relationships, which simultaneously increase the three forms of social capital (bonding, bridging and linking) by involving multiple actors and bodies that belong to different levels. This paper recognises that as the absence of social capital makes impossible both collective activities and the creation of a resilient system in the face of contextual changes at the community level, so the lack of policymakers' engagement may cause the failure of any long-term adaptation strategy.

In theoretical terms, this research shows how the concept of social capital can be applied to understand the process of development of collective action aiming at responding to contextual change at the micro-scale. The three forms of social capital contribute towards increasing resilience at the community level by generating collective responses to contextual changes without compromising the structural functions of the system. While bonding social capital represents a fertile ground for developing collective action, bridging and linking social capitals contribute towards strengthening the community resilience in the long run. However, bridging and linking social capital are the result of a combination of factors: on the one hand the existing bonding social capital allows the community to recognise the potential benefits deriving from cooperating with external actors (private and public); on the other hand, the institutional environment (in particular the regulatory framework) is responsible for promoting and enhancing external and institutional networks. This research represents a first step in analysing the role of social capital in producing adaptive responses at the community level. Some limitations can be identified in the possibility to both generalise results and replicate the observation scheme in other contexts. In fact, the case study is not representative of regional or national trends. At the same time, these limits also represent the opportunity to develop further research on the relation between social capital and adaptation strategy in other local contexts. A quantitative research might better explain the relation among the considered variables (adaptation capacity; local community; economic bodies; rules and governments). This, for instance, might help to understand why some local actors (such as fishermen) only in part benefited from local social capital. It appears that in the context of scarce resources, the stronger economic organisations (such as in the case of Arborea the farmers' cooperatives) tend to be winners, while weaker actors (fishermen cooperative) tend to remain losers in relation to a number of reasons, as for example the lack of bridging and linking social capital.

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Table 1. Evolution of the Arborea system

Phase	Actors involved	Regulatory framework	Bonding social capital	Bridging social capital	Linking social capital
ND application (2005)	Livestock farmers and farmers (3A and Produttori Cooperatives), fishermen (fishermen cooperative), local community, tourist industry, regional government and regional agencies	EU Nitrate Directive	Conflicts among stakeholders for accessing water resources (e.g. farmers versus fishermen/tourist agencies)	Scarce connections with external bodies (mainly commercial relationships with external markets)	Scarce connections with University; scarce communication with regional government (local bodies beneficiaries of some regional measures); None connections with national and EU institutions
NRD starts research (2009)	Researchers (agronomists, climatologists, economists, sociologists), livestock farmers and farmers (3A and Produttori Cooperatives), fishermen (fishermen cooperative), local community, tourist industry, local municipality, regional government	Regional, National and European research funding schemes	Mutual-support networks within each group of interest thanks to a strong cooperative system.	Scarce connections with external bodies	Formal and informal connections among University, 3A cooperative and Produttori Cooperative (participation of these actors in Regional, National and European research projects)
Drilling Project threat (2011)	Researchers, No al Progetto Eleonora, local community, local municipality, Regional Government, local	Regional Landscape Plan (resolution n. 36/7, Regione Sardegna, September 5, 2006)	New collaboration between the social movement and the whole community against a common threat (home by home activities; public	Involvement of other social movements and external audience dealing with similar issues (mainly	New connections between The No al Progetto Eleonora and University (through the organization of public debates

	economic bodies, other social movements, external audience		debates and cultural events; public meetings with Saras (cooperation)	through social media)	and private meetings)
"Ichnusa Bubula" (2013)	Public and private meetings among members and managers of the Produttori Cooperative, the NRD researchers, and 4 entrepreneurs from northern Sardinia	Regional Rural Development Program 2007-2013 - Misura 124 (cooperation for developing new products, processes and technologies in the agriculture, forestry and food sectors)	Creation of new spaces for dialogue between the Produttori Cooperative and other local stakeholders (fishermen, local community, tourist industry, local municipality) thanks to the organization of public meetings concerning the collective benefits deriving from the project	Cooperation between the Produttori Cooperative and four cattle farms from northern Sardinia	Cooperation with the University for developing a sustainable beef production chain in line with ND prescriptions

Table 2. Main issues emerged during a participatory workshop carried out with the 3A and the Produttori cooperatives, and the wider community in Arborea (November 2013).

Issue	New Directions	Proposed strategies	Lessons Learned
Efficient management of companies	Increase of company size Increase of production rate	Search for new markets on a global scale and diversification of production Investments in marketing strategies	Rational management of resources
Increase of social capital	Collaboration with external companies	New partnerships (following the Ichnusa Bubula model)	Need for more cohesion within the agricultural sector
Lack of policies that promote social cohesion	Consideration of International examples	Partnerships with Universities	Need for enhancing human and social capital
Protection of historical and cultural heritages	Promotion of expert knowledge, competences and skills (keywords: Expertise, Integrity, Transparency)	Increase of the number of “young managers” Organisation of public arenas	
Lack of support by political levels	Creation of new spaces of dialogue	Lack of strategy in this area	Closure by whom? Responsibility of whom?
Learning from past experience	Adaptation to changes	Looking at the past the past to make future choices	Technology and Process Innovation
Environmental Sustainability	Sustainable production	Investments in marketing (to improve the corporate image) Introduction of innovations (sustainable economic growth)	