From climate perception to action: strategic adaptation for small island farming communities
A focus on Malta

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There is presently enough evidence to say that climate change is indeed occurring. Typical impacts at the global level include the rising global average temperatures of both air and sea, the melting of glacier and polar ice and the rise in the average global sea levels. In the Mediterranean region, precipitation patterns are expected to change, where water availability may fall by 20-30%, under a conservative 2 °C increase by 2100 (Zachariadis, 2012) leading to stressed local freshwater supplies, reduced crop yields and desertification. In addition, the frequency and intensity of floods will also increase since rainfall is expected to become concentrated into more heavy events.

Located in the central Mediterranean Sea, the Maltese islands are prone to a set of climate change impacts that are specific to the region. Local climatological records show a warming trend of both the annual maximum and minimum temperatures, where the incidence of warmer nights is becoming increasingly common (Galdies, 2012). Warmer winters may result in increased outbreaks of pests as more of them become capable of surviving the colder season. Longer summers would also allow insects to develop more efficiently. Local records also show an increased incidence of heat waves, impacting local agricultural activities among other sectors (Galdies, 2015; Galdies et al., 2016), while the increasing number of consecutive dry days suggest increasingly drought conditions. Climate change projections for this small State suggest that climate variability may increase in the future and climate extremes are likely to become more frequent (Government of Malta, 2014). Once the frequency of these impacts start to exceed a certain magnitude they will start threatening the stability of many of the island's economic sectors (Baldacchino & Galdies, 2015), especially agriculture (Government of Malta, 2012).

Baldacchino & Galdies (2015) highlight some of the difficulties that small island states (SIS) tend to have when addressing the impacts of climate change. The 'individuality of costs' is a real governance issue, where the cost of upgrading irrigation infrastructure per capita (or any other infrastructural adaptive measure) is higher than the unit cost for similar works in a larger country, population and fiscal base. Moreover, negative climate change impacts tend to have a disproportionate impact on SIS' GDP when compared to larger states (Barros et al., 2014). Meli (2014) calculates a global 10% profit reduction in both fodder and olive cultivation together with significant detrimental losses by the viticulture sector. Thus the substantial diversification made to date by Malta's agricultural sector can potentially be overturned by the impacts of climate change, if either a 'business-as-usual' approach is taken or through maladaptation because of some inappropriate formulation of adaptation polices. Fortunately, the recent emphasis made at the national level to sustain the growth of the local agricultural sector (Government of Malta, 2016) took into account the need to urgently tackle the impacts of climate change.

Enhancing resilience

Adaptation is one of the climate-related policy options aimed at reducing the negative impacts of climate change on agriculture (Nicholas, 2012). Adapting to a changing climate has been defined as a complex adjustment in human-environmental systems in response to observed or expected climatic changes (Wheeler et al., 2013). Generally, this response may consist of (i) Government programmes and extension services, and insurance, (ii) technological developments, (iii) financial management, and (iv) production practices (Smit and Skinner, 2002), and can occur on different scales ranging at the individual, local or sectoral level (Bryant et al., 2000).

The specific adaptation measures noted in the literature are diverse. These range from more effective planting dates and agricultural practices (i.e., crop diversification, changes in crops grown, planting of 'quick crops', use of drought-resistant varieties, pest control, shifts in planting dates; see Gandure et al., 2013) to adjustment of land use and soil management (i.e., crop rotation, organic soil enhancement, tree planting, water harvesting techniques, irrigation measures, fertilizer application; see Knutson et al., 2011), and other ancillary practices aimed at diversifying farmers' income sources.

In view of the strong link between the constantly increasing trends in carbon emissions and increased global warming, it is essential that adaptive measures be enforced as soon as possible. At the same time, such measures require a committed public and therefore, at some point, an analysis of the public's perception towards climate change becomes crucial.

As far as the agriculture sector of SIS is concerned, studies on the link between farmers' risk preferences and their adaptive behavior influenced by a number of internal and external choices have so far been weak, leading to a mismatch between the perception of farmers and policymakers – a situation that could potentially lead to maladaptation. Galdies et al., (2016) provide an extensive commentary on such a gap in knowledge. In contributing to this new area of research, their study aimed at how small holder farmers in Gozo perceive and experience long-term changes in climate. The scope of the present article is to reflect in more detail their findings, and to go one step further by proposing the type of adaptation strategies and related policies needed.

Local farmers' perceptions

New research in this field has shown how farmers' adaptation to climate change occurs within a socio-ecological context, and that their perception determines the success and ultimate acceptability of adaptation policies, and ultimately their acceptability (Tam and Mc Daniels, 2013). Therefore, understanding farmers' perception of climate change helps to determine their behaviour with regards to any of the ongoing or future local adjustments as a response to a changing climate.

For example, a study conducted by Tucker et al., (2010) showed how local perceptions of climate were found to be critical in guiding policy responses on adaptation for coffee producers in Central America and Mexico. Similarly, the analysis conducted by Maddison (2007) on people's perceptions of climate in a number of African countries assisted the understanding of those processes and factors affecting adaptation that fed into policy decisions. Studies conducted in South Africa and Ethiopia identified the importance of individual instruction, education and awareness building in order to identify adaptation options by farmers (Bryan et al., 2009). In Uttarakhand State (India) the understanding of farmers' perceptions provided opportunities for effective targeting of government resources (Kelkar et al., 2008). Considering the important role of agriculture to the local Gozitan population, a better understanding of farmers' perceptions, adaptation measures and obstacles with regard to climate change is necessary in order to craft the right adaptation policies for this island (Galdies et al., 2016).

The local Gozitan study had two major objectives: to know whether farmers' perceptions are in line with the observed climatic changes at the local scale, and to uncover the typology of these farmers based on their attitude, beliefs and willingness to adapt. It provided a unique opportunity to empirically validate local perceptions of climate change so as to be used for agronomic research, outreach strategies and policy formulation. As expected, farmers' perceptions and responses to climate change tended to be highly confined and context specific. It was found that those who perceive higher risks are less likely to be subject to wishful thinking, fatalism or denials of climate change risk. Moreover, the higher their perception of climate change risks was, the stronger was their adaptive intentions. In contrast, farmers are less likely to adapt when they possess denial of climate change risk and/or fatalism, especially if they are part of the older category of farmers. A link was also found between the will to adapt and profitability, which was especially strong among livestock farmers. Although not studied, increased pressure on farmers to adapt or otherwise can also come from friends, relatives and/or neighbours.

Another original finding involved the uncovering of the main farmer typologies based on their individual perceptions, beliefs and attitudes towards climate change and its local impacts at a time when the number of farmers working on a full-time basis is dwindling. This vocational loss is resulting in increased pressure for changes in land use (EEA, 2015), a detrimental increase of farmland fragmentation (Vella, 2016; fig. 1) and an increasingly non-competitive sector when compared to external markets. This is resulting in a rapid erosion of the traditional socio-cultural fabric of Gozitan society and its rural landscape (EEA, 2015).

Based on the farmers' responses it seems that there is a general need for an 'incremental' type of adaptation, as opposed to a 'transformational' one (Park et al., 2012; Marshall et al., 2012). Whereas the latter is normally opted when a major change in livelihood, location or identity (based on beliefs, attitudes and willingness) is needed because of major shifts in socio-ecological conditions, incremental adaptation is selected on the choice of actions highlighted by these same farmers. In Gozo's case, the current extended farm services have favoured this line of action, and which is already providing some sort of technical and financial support. However, farmers expressed that this could be more focused on climate change adaptation.

Overall, it was easier for most of the local farmers to identify problems rather than to offer solutions, which is probably a reflection of the complexity of the issue dictated by their sense of values, attitudes and beliefs (and a dose of fatalism too) in an increasingly convoluted sector. However, they manage to factor in the need for improved technology, information, knowledge and financial support as the main determinants for a successful adaptive capacity (especially by livestock farmers).

The younger generation of Gozitan farmers were found to be more flexible and adaptable to future plans. A distinct typology has been found for both crop- and livestock farmers (16.2% and 75.4% respectively) who are most likely to invest more, change their crop mix and adopt more efficient infrastructure if they are given the opportunity. In terms of attitudinal constructs, farmers having ecological values are more oriented towards innovations and new technologies, while safeguarding the environment. This typology group also plans to adopt more efficient practices such as improved irrigation infrastructure, a mix of drought- and pest-tolerant crops, etc. The skeptical group of crop farmers (25.2%) is more likely to reduce farming activities, pass farmland to offspring or sell it to third parties (a form of contractive adaptation strategy; Wheeler et al., 2013).

Figure 1

Typical fragmentation of irrigated arable land in Pwales valley, Malta. The largest number of island-wide registered agricultural parcels (n=16300) are between 0.11 and 0.22 hectares and account for 26.14% of the total agricultural land in the Maltese islands (Vella, 2016)

Image source: Google Earth

Local adaptation measures and policy formulation

Based on the findings made by Galdies et al., (2016), the Gozitan farming sector requires a top-down strategy with a mix of 'autonomous' and 'conscious' measures (Bryant et al., 2000), and generally one which favours 'accommodating' strategies (fig 2; Wheeler et al., 2013). Autonomous responses are those occurring at the farm level, such as improved irrigation, adjustments to tillage practices, crop diversification, changing of the growing calendar, use of heat-, salt- or drought-tolerant crop varieties, or buying insurance (to protect against potential loss).

Conscious adaptation, on the other hand, refers to the expressed intervention made at the government level. Conscious adaptation measures have to be backed up by consistent climate-related research and specialized training targeting all farmer typologies identified (especially addressing climate change deniers), reinforced infrastructures, new technologies, and financial support (Bryant et al 2000), all of which have been mentioned in one way or another by Gozitan farmers who participated in the survey.

Coherence in the formulation and application of climate-related policy that deals with climate change adaptation is also fundamental in order to ensure avoidance of sectorial initiatives that may have unintended but negative adaptive consequences (Olivier et al., 2013). A variety of studies have found that the coherent policy outcomes result when there are collaborative processes, connectivity or networks (Clarvis et al., 2014) across scales, departments, and ministries that permit horizontal engagement in the planning and implementation stages of such policies (see Scobie, 2016 for further details).

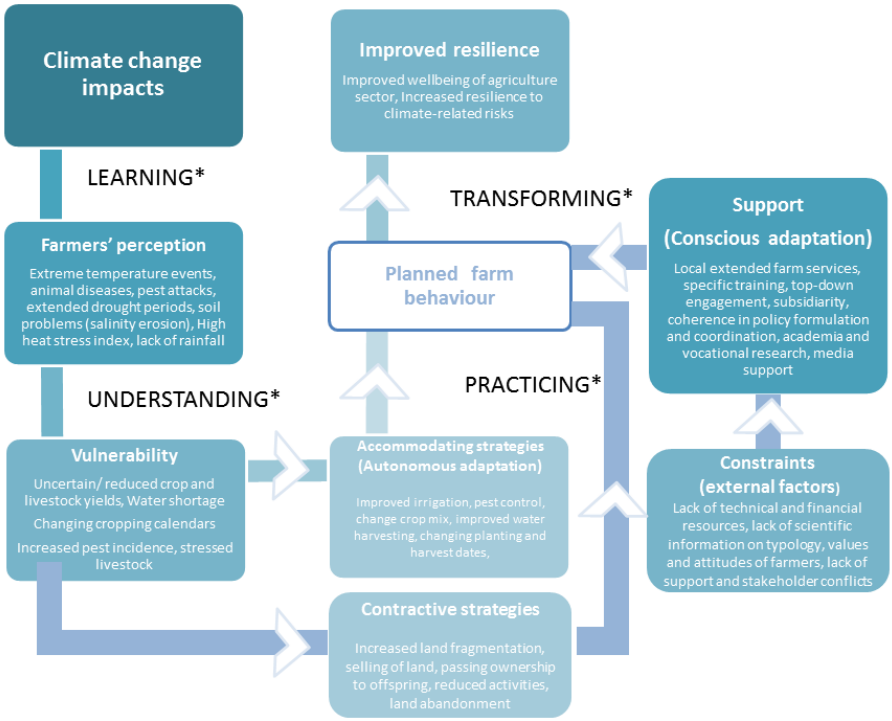
Promoting lower level involvement in decision making and problem solving enables subsidiarity and integrated adaptation policies in a positive way (Clarvis et al., 2014). This may also serve to lessen the existent lack of trust between both ranks. Participation of knowledge platforms such as academia (Briley et al., 2015) and vocational institutions can lead to significant improvement of policy formulation and coordination (Chandra & Idrisova, 2011) through research projects (Cvitanovic et al., 2015a). Various types of media, including radio, television, newspapers, posters, and the internet must be utilized to strengthen such climate change response strategies.

One would hope that these specific recommendations are taken into account when the National Climate Change Adaptation Policy (Government of Malta, 2012) is revised in the coming years. Have there been failures with regards to the effectiveness and sustainability of various adaptation measures, or to those measures that make the Gozitan agricultural sector in particular, less successful and more skeptic of the expected risks? If the answer is 'yes' then these need to be corrected by promoting specialised training, education and extension services, linked to preferential policies designed to motivate young people to go back into agri-business.

In a nutshell, successes and failures obtained with the 2012 climate adaptation policy should be used to improve it. The most important challenge in the coming years is not so much about perfecting the ability to accurately predict our future climate but rather to improve community awareness and its engagement in climate-change mitigation and adaptation strategies.

Figure 2

A proposed climate change adaptation strategy for the farming community in the island of Gozo, Malta



** Cognitive processes (adapted from Nguyen et al., 2016).*

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