BEtter Water-management for Advancing Resilient-communities in Europe

Action D4 – Assessment of socio-economic impact accounting for the hydrologic effectiveness of the interventions

Report about ex-ante flood-related damage evaluation

Covering the project activities from 03/09/2018 to 31/12/2019

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Beneficiary Data	
Name Beneficiary:	Comune di Santorso
Project manager:	Antonio De Martin
Postal address:	Piazza Aldo Moro 8 36014 Santorso (Italy)
Telephone:	+39 0445 649510
E-mail:	antonio.demartin@comune.santorso.vi.it
Project Website:	http://www.lifebeware.eu/

Data collection and report drafting	
Partners involved:	TESAF and COMSAN
Scientific Project Head for TESAF:	Prof. Vincenzo D'Agostino
Action D4 Scientific Manager:	Prof.ssa Edi Defrancesco

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Glossary, Abbreviations, Acronyms

BEWARE	BEtter Water-management for Advancing Resilient-communities in Europe
COMSAN	Municipality of Santorso
COMMAR	Municipality of Marano Vicentino
NWRMs	Natural Water Retention Measures as classified by the Office International de l'Eau (www.nwrm.eu)
SUDS	Sustainable Urban Drainage Systems
TESAF	Dipartimento Territorio e Sistemi Agro-Forestali, Università degli Studi di Padova
Floods	All events in which water inundates lands not normally covered by water (directive 2007/60/EC, 2007) (Salvati et al., 2014[1])

[1] Salvati et al. (2014), Perception of flood and landslide risk in Italy: a preliminary analysis, *Nat. Hazards Earth Syst. Sci.*, 14, 2589–2603.

1 Executive summary

According to the available information in the administrative databases, in the timespan 2010-2019, 18 and 6 flood-related events occurred in the municipalities of Santorso and Marano Vicentino (Italy), respectively. To assess the overall damage caused by those events to both private and public assets, the following damage components were estimated:

- Defensive actions, i.e. measures undertaken by public authorities, fire brigades, volunteer organizations or private agents as an immediate response to each event, aiming at minimizing damage (e.g., remedial, clean-up, and mitigation). Defensive costs occur in the aftermath of the adverse event;
- Restoration actions, aiming at re-establishing the ex-ante conditions of the assets (including both premises restoration and furniture/equipment repair or replacement). Restoration costs generally follow in time the defensive actions;
- Prevention actions undertaken by either public or private agents, in order to reduce future risks (hence, to minimize damage from future events). Prevention costs imply investments that may cover longer timespan.

Overall, the damage amounts to €1.3 million, although this estimate could have been underestimated, given some limitations in the available datasets. Indeed, some key figures about damage components are unavailable (in particular, we exclude from this amount the prevention costs incurred by private households). In the context of the BEWARE Project, this amount could be considered as a conservative ex-ante estimate of the damage caused by floods in the two municipalities.

The average unit damage to private assets is equal to € 4,274, when considering households and firms affected by the adverse events in the observed period. Moreover, the public costs (defensive, restoration, and prevention costs) equals € 141 per each resident family in the two municipalities. In addition, it could be noticed that defensive and restoration costs show an upward trend over the ten-year timespan under consideration in this analysis. Figures are increasing, although several costly defensive interventions have been implemented.

2 Adverse natural events and affected structures (2010-2019)

In order to evaluate damage caused by flood occurrences, we carried out a preliminary analysis on the floods that occurred in the municipalities of Santorso and Marano Vicentino from 2010 to 2019[2]. In comparison to the previous report (Report about ex-ante data collection, 31/05/2019), we have also included the two events that occurred in July and August 2019, in Santorso. Both events were so severe that a public state of emergency (*richiesta di stato di emergenza*, according to the Italian regulation) was issued. Table 1 reports the updated annual distribution of the events that was recorded in the administrative databases of the two Municipalities.

Table 1. Number of floods recorded in the administrative databases of the two Municipalities of Santorso and Marano Vicentino that caused damage to public and private assets.

Municipality		**Santorso**				**Marano Vicentino**			
Type of asset		Total	Only public	Only private	Public & private	Total	Only public	Only private	Public & private
Years	**2010**	2			2	4	3		1
	2011								
	2012	2			2	1			1
	2013	1			1				
	2014	2			2				
	2015	1		1					
	2016								
	2017					1			1
	2018								
	2019	3	1	1	1				
	frequent events	7		5	2				
Total number of events		18	1	7	10	6	3	0	3

To assess economic damage, we considered floods affecting both private buildings (houses and industrial facilities) and public structures (e.g., public buildings, parking lots, roads). We referred to the municipal-level administrative records, reporting affected assets and any public or private measures undertaken in response to each event aiming at minimizing damage (i.e., defensive actions). As a consequence, the amount of overall damage to private buildings could have been underestimated, if a household did not report the occurrence of an adverse event to the local administration.

[2] According to ISTAT, on Jan. 1st, 2019, the overall population of Marano Vicentino was 9,513 inhabitants (748 inhabit. per sq.km) and the overall population of Santorso was 5,734 (434 inhabit. per sq.km).

3 Material and methods

To assess damage and its cost components, we considered three different types of action and their related costs:

- *Defensive actions*, i.e. measures undertaken by public authorities, fire brigades, volunteer organisations or private agents as an immediate response to each event, aiming at minimising damage (e.g., remedial, clean-up, and mitigation). Defensive costs occur in the aftermath of the adverse event;
- *Restoration actions*, aiming at re-establishing the ex-ante conditions of the assets (including both premises restoration and furniture/equipment repair or replacement). Restoration costs generally follow in time the defensive actions;
- *Prevention actions* undertaken by either public or private agents, in order to reduce future risks (hence, to minimise damage from future events). Prevention costs imply investments that may cover longer timespan.

While detailed information is available for damage to public and productive assets, official datasets not necessarily return detailed data on damage to residential buildings. Thus, damage assessment to residential buildings follows a twofold procedure, which distinguishes the events occurred until May 2019 and the two events occurred in 2019 Summer.

For the severe events in 2019 Summer in Santorso, damage assessment can rely on the official damage claim, collected and provided by the local public administration. Official reports return detailed information on the damage claims, according to the citizens' applications for public grants.

Conversely, for those events until May 2019, we have information on the occurrence of each event (e.g., the event damaging a basement), but we often lack a detailed monetary quantification of damage. When official information on the incurred costs was unavailable, these costs have been estimated, through a direct survey. In order to increase the accuracy of the analysis, we carried out a questionnaire-based sample survey and we have involved households living not only in the municipalities of Marano Vicentino and Santorso, but also in the surroundings. In more detail, we considered the area of Altovicentino (Figure 1). Collected information allows us providing more robust average estimates for the following types of assets, which were usually damaged after heavy rainfalls:

- underground basements with cellars, i.e., a room of the house – located under the level of the ground – which is used only for storing goods and other household's belongings;
- garages, for parking cars, motorbikes or other vehicles and/or for storing other belongings;
- living rooms, located either underground (underground basement) or at the ground floor: in the Veneto Region, it is easy to observe underground floors fully furnished with sofas, tables and chairs, TV sets…;
- other parts of the dwellings (e.g., courtyards and gardens), located at the ground floor.

In order to properly assess damage in this case study, we have also considered a fifth type of assets that are often damaged after the occurrence of a flood: motor vehicles. Unlike the previous types of

assets, they do not represent the premises of a building. In fact, they are movable properties. We decided to include them into the analysis, due to their large unit value.

The survey was administered in two different ways:

- during public presentations of the BEWARE project. To avoid any possible biased answers from respondents, the survey was administered at the beginning of any meetings;
- online, by means of a Computer Assisted Web Interviewing (CAWI). To avoid double-counting errors, the CAWI survey included an explicit question about the participation of the respondent to any of the public presentations of the BEWARE project. If so, the questionnaire was not administered.

In particular, citizens were asked if they had had direct experience of floods in the last 10 years, causing damage to their own property. If so, they were asked to indicate: i) the number of times the damage occurred; ii) the monetary cost they incurred (encompassing defensive, restoration, and prevention actions undertaken, if any); iii) the hours spent either by the family or by public authorities for defensive actions. The labour cost (even the family one) was valued at its opportunity cost: indeed, the standard unit cost of a worker was taken as reference (*Prezzario Regionale per i lavori pubblici*, Veneto Region, 2019). The cost related to the equipment used for remedial actions (e.g. pumps) was also considered. This cost was estimated according to the same source (Veneto Region, 2019).

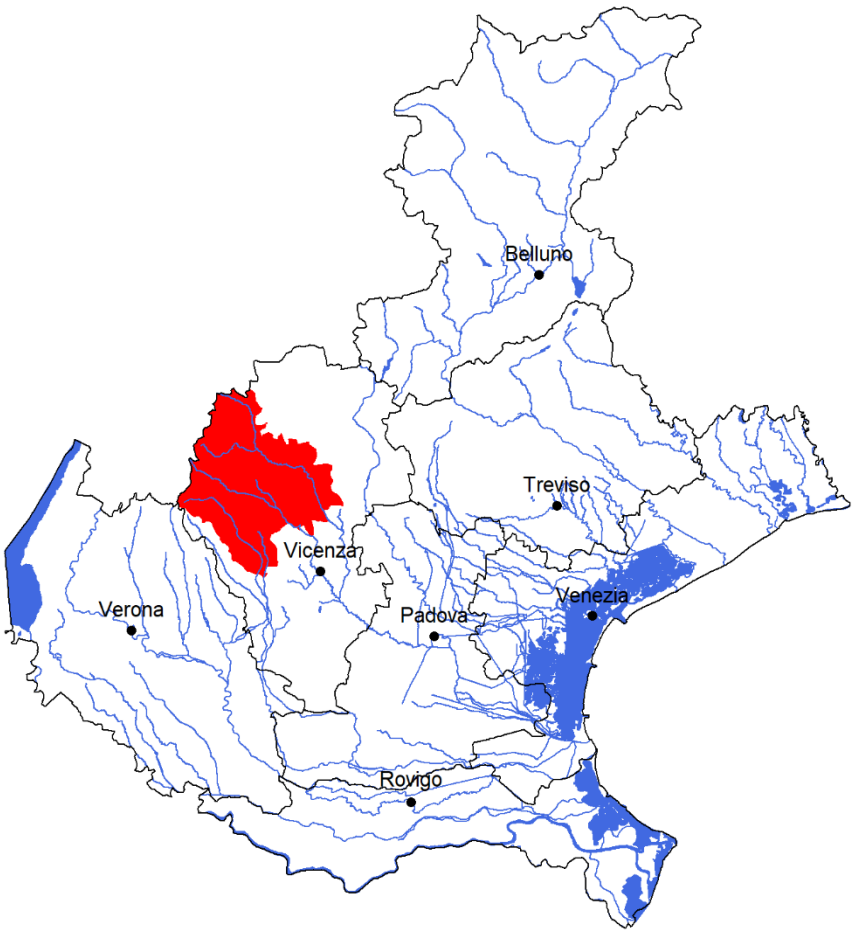

Figure 1 – The Altovicentino area (in red colour), in the Veneto Region

Overall, 265 persons answered the survey. Despite the focus of the BEWARE project on the municipalities of Santorso and Marano Vicentino, participants from the two municipalities just represent 60.7% of the total respondents (45.2% and 15.5%, respectively). Remaining 40% of the respondents come from other municipalities in the Veneto Region (Figure 2). Around 16% of the respondents have experienced direct damage to their own properties.

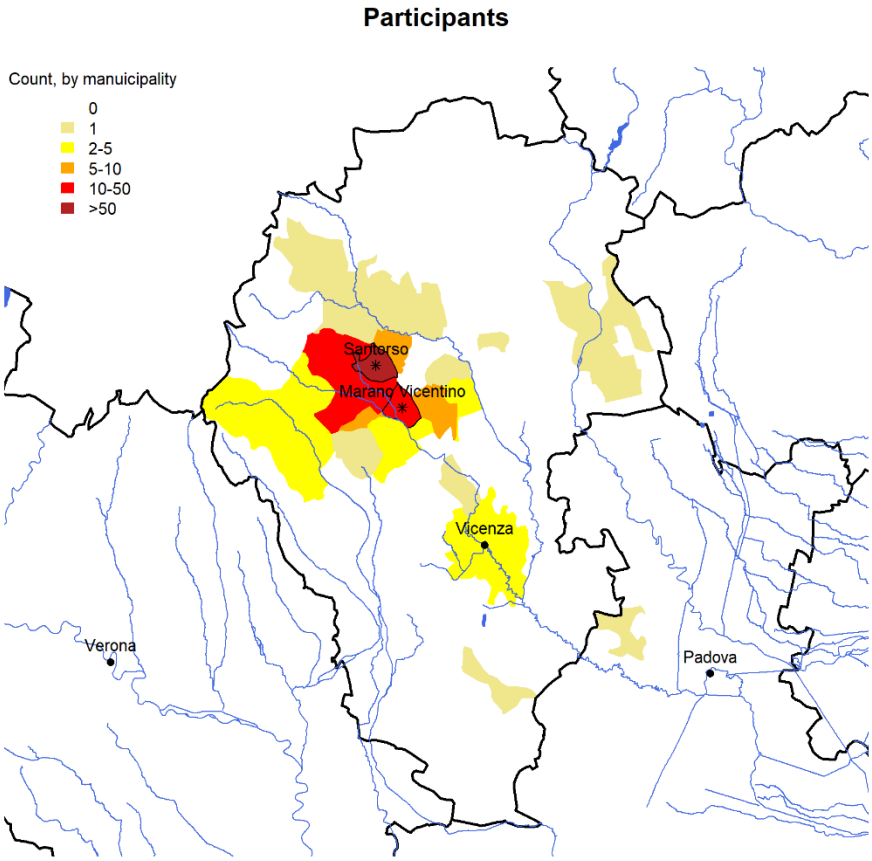

Figure 2 – Respondents to the survey, by municipality (a blow-up of the Altovicentino area)

According to the BEWARE Project's goals, ten farmers in the area were also interviewed, about the damage they incurred due to both heavy rainfalls and droughts.

Regardless the year of the adverse event occurrence, all the damage cost components were expressed at 2019 prices, using the index numbers of the cost of construction of buildings in Italy, as provided by ISTAT (2019).

4 Overall flood-related damage assessment

Table 2 returns the assessment of the overall damage caused by flood occurrences in Marano Vicentino and Santorso in the timespan 2010-2019. The damage amounts to €1.3 million. This includes defensive and restoration costs for both private and public assets, as well as the only prevention costs incurred by the public. Indeed, the amount of private prevention costs is difficult to estimate, since the administrative datasets are rather incomplete on this subject. However, to have an estimation of these private costs, families that undertook defensive investments spent on average € 301 per household.

It has to be noticed that our estimate of the overall damage in the two municipalities could have been underestimated, given the aforementioned limitations in the available datasets, which may miss some key figures about damage components. Consequently, in the context of the BEWARE Project, €1.3 million could be considered as a conservative ex-ante estimate of the damage caused by floods in the two municipalities.

A breakdown of those damage components is shown in Figure 3. If we exclude the overall prevention costs, the defensive and restoration costs account for more than € 0.8 million, namely 61% of the total damage. The average unit damage to private assets is equal to € 4,274, when considering households and firms affected by the adverse events in the observed period. Moreover, the public costs (defensive, restoration, and prevention costs) equals €141 per each resident family in the two municipalities (according to ISTAT 2011 Census data).

Table 2. Assessed damage components to private and public assets, by municipality and year.

					Defensive and restoration costs (2019 prices)		Prevention costs (2019 prices)
Municipality	**Year**	**No. events**	**Households**	**Firms**	**Private assets**	**Public assets**	**Public expenditures**
Marano Vicentino	2010	4	3	0	7,104.67	2,103.82	0.00
	2012	1	13	0	17,992.08	90,948.70 *	0.00
	2017	1	61	3	212,009.07	6,660.10	111,124.54
	Total	**6**	**77**	**3**	**237,105.83**	**99,712.61**	**111,124.54**
Santorso	2010	2	1	0	6,419.88	0.00	0.00
	2012	2	0	2	25,296.48	739.79	3,098.74
	2013	1	0	0	0.00	4,294.73	17,587.37
	2014	2	5	2	45,259.55	8,629.54	92,962.11
	2015	1	0	0	0.00	0.00	0.00
	2019	3	5	2	124,070.91	240,374.00	294,000.00
	frequent events	7	6	1	6,303.41	0.00	0.00
	not specified	2	0	0	0.00	1,867.41	0.00
	Total	**20**	**17**	**7**	**207,350.22**	**255,905.47**	**407,648.22**
TOTAL		**26**	**94**	**10**	**444,456.05**	**355,618.09**	**518,772.77**

* this figure also includes restoration actions for events occurred in 2010.

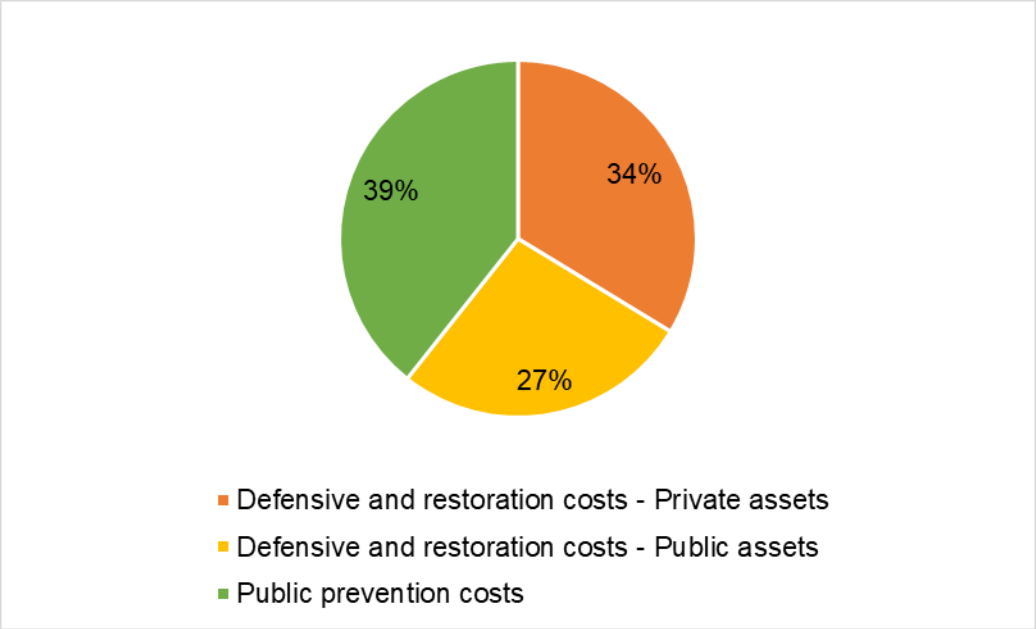

Figure 3 – Overall damage, by component

Moreover, it could be noticed that defensive and restoration costs show an upward trend over the ten-year timespan under consideration in this analysis. Firstly, in the latest years both Santorso and Marano Vicentino experienced a growing number of affected households. Secondly, when considering both public and private defensive and restoration costs, these damage components have been increasing since 2017 (Figure 4). This has occurred, although several costly defensive interventions had been implemented.

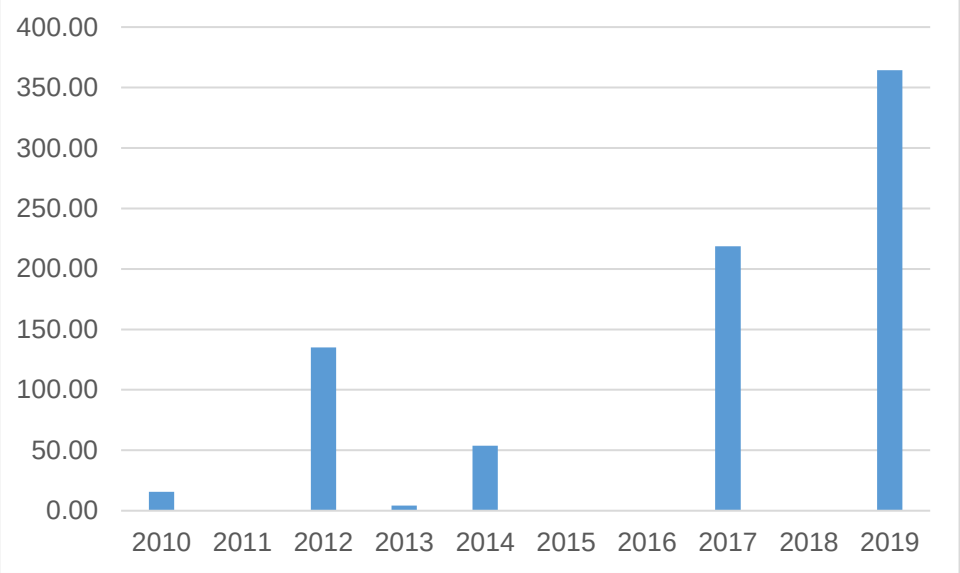

Figure 4 – Trend of the defensive and restoration costs in the two municipalities (000 €)

The above-mentioned figures do not consider the defensive and restoration costs, due to flood occurrence, incurred by farmers. According to the survey, most of the interviewed farmers reported

damage due to flood occurrence, whose costs amount to €59,184 (defensive and restoration costs, only). However, these figures only refer to the sample of farmers, while no information is available about the occurrence of flood-related adverse events to the overall farms located in the two municipalities.

6 References

ISTAT (2019). Numeri indici del costo di costruzione di un fabbricato residenziale – Italia. http://dati.istat.it

Veneto Region (2019). Aggiornamento del Prezzario regionale 2014 per il 2015 – 2016 – 2017 – 2018. https://www.regione.veneto.it/web/lavori-pubblici/prezzario-regionale