

WORKPACKAGE T3, ACTIVITY T3.3

**DEVELOPMENT OF A TRANSNATIONAL ADAPTATION
PLAN FOR INTEGRATED LAND-USE MANAGEMENT**

**D.T3.3.1 LOCAL APPLICATION: RECOMMENDATIONS OF
OPTIMAL STRUCTURES FOR SUSTAINABLE LAND USE**

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1. Introduction

GOWARE - CE “Transnational Guide towards an Optimal Water Regime” represents one of the main outputs of PROLINE-CE Project. It has been developed for supporting different types of stakeholders interested in water-related issues management (e.g. preserving water quantity and quality, improving flood risk protection). GOWARE works as an interactive and ready-to-use Decision Support Tool (DST) and it has been specifically designed for working both off-line (as Excel-based tool) and on-line (as web-tool). It supports stakeholders in addressing decision-making process by selecting, prioritizing, and promoting the most suitable Best Management Practices (BMPs) for the protection of water resources and the mitigation of the flood events impacts in Central Europe area.

GOWARE allows selecting and ranking the BMPs by performing two stages of analysis: in the first one, a scoping analysis, specifically devoted at the definition of the User’s requirements, is operated by selecting four filters (Land Cover/Use - forest, agriculture, wetland, grassland; urban/industrial/transport settlements and general water management measures for heterogeneous landscapes; Topographic Settings - plain, mountain or both; Adaptation Target - single or combined among water quantity, water quality, and flood risk mitigation; Planning Time Horizon - Operational - day-by-day, Strategic - up to five years). The definition of these options allows filtering the BMPs and extracting the most suitable ones among those included in a dedicated catalogue of 92 practices. In the second stage of the analysis, the selected BMPs will be ranked accounting for the relative importance that the User assigns to the following characterization criteria: water protection functionality, cost, implementation time, robustness, multi-functionality.

In order to prioritizing the BMPs, GOWARE adopts the Analytic Hierarchy Process (AHP), an analytic method of analysis that permits putting together quantitative scores (ranging from 1 to 5, where “1” stands for low functionality, high cost/benefit ratio, long implementation times, low robustness, reduced multi-functionality while “5” stands for best-performing conditions) provided by expert judgments about the characterizing criteria with User-defined quantitative scores of relative importance (odd value ranging from 1 to 9, where “1” indicates that the criteria have the same importance and “9” indicates that the considered criterion is absolutely more important than the another one), provided by comparing the criteria two-by-two. In this way, it is possible to obtain the ranking of the suitable sub-set of BMPs and to identify, therefore, tailored solutions for the management of the User’s issues.

Accounting for the quantitative values assigned by the User to indicate how much one criterion is more important than another one (pairwise comparisons), the AHP methods allows generating the comparison matrix $A_{n \times n}$ that will be used to calculate the weight values of each single criterion, defining the so-called priority vector (w). Furthermore, in line with the State-of-the-art, GOWARE incorporates an analytical technique for checking the consistency of the User’s evaluations in order to minimize some drawbacks recognized in the AHP approach (e.g. rank reversal issue).

A detailed description of the models and methods implemented in GOWARE is provided in D.T3.2.1 “Roadmap to transnational adaptation for integrated land use” while D.T3.2.2 represents the Engineering’s and User’s Guides supporting the DST use. D.T.3.3.1 provides an exhaustive review



of feedbacks, remarks and suggestions provided by stakeholders and collected during the GOWARE web-tool testing carried out at national scale by Project Partners.

This deliverable can be considered as a catalogue of specific recommendations and it is aimed at optimizing and improving the capacity for the implementation of the proposed web-tool within the organizational and political level.

Although it was initially intended as a series of national deliverables one for each Project Country, releasing a consistent and homogeneous report permitting a clearer and straighter comparison respective organisations respective organisations among the approaches and findings has been considered a more effective way to handle the issue.

This deliverable is arranged as following: in Section 3, the analysis of data collected from preliminary Users' applications of the GOWARE web-tool is shown; in Section 4, the general information about the national surveys and the stakeholders engagements is indicated; then, results and feedbacks review shown in Sections 5-6 respectively, and finally, conclusions and future developments are reported in Section 7.

2. The survey

The testing phase, carried out in June, has been organized independently in each Project Country during dedicated meetings and workshops. It has involved different categories of national stakeholders and potential end-Users. Their feedbacks have been collected by means of a dedicated web-questionnaire composed by 5 questions and 4 facultative suggestions, here reported:

- 1) Are the filters appropriate to identify the main context of interest?
If not, please suggest us how to improve them.
- 2) Is the procedure provided for pairwise comparison clearly understandable?
Please suggest us any potential improvement for this stage
- 3) Does the relative weighting system match your expectations?
- 4) Are the ranked "Best Management Practices" able to address the issue of your interest?
Do you find the result useful and appropriate?
Please provide us some suggestions to improve the inventory of BMPs (e.g. measures missing or not correctly labelled)
- 5) Do the "Additional details" provide interesting information for your purposes?
Please provide us some suggestions to improve the content of "Additional information" associated to BMPs

Web survey is accessible via a link provided at the foot of the page or externally at <https://forms.gle/S577zhXaQQZpYngaA>. To simplify feedbacks' collection, Polish partners preferred providing a translated version of the web survey



(<https://forms.gle/QMqnjQgncVD18BGx5>); however, these compiled surveys have been processed together with the other ones.

3. Preliminary applications of GOWARE web-tool

In June, after the release of the GOWARE web-version (available at <http://proline-ce.fgg.uni-lj.si/goware/>), in the different Project's countries, several key Users have been approached to gather feedbacks and suggestions about the usability and usefulness of the tool. The answering of the questionnaire (§2) and the provision of personal details about expertise and respective organisations was absolutely voluntary and required before getting access to the direct download of the results concerning the selected BMPs (definition, ranking, information about the regulatory framework and relevant scientific experiences). In this perspective, about 30 people provided such information during the testing phase. Nonetheless, the link (and the collection) is still active and it will also permit tailoring the tool according to the requirements of the main Users.

By analysing the collected information, it has resulted that Users that have already used GOWARE web-tool work in the following fields:

- Environmental studies (7)
- Civil engineering studies (6)
- Agriculture studies (4)
- Geography studies (3)
- Biology studies (3)
- Geology studies (2)
- Hydraulic engineering studies (1)
- International relations studies (1)
- Social sciences studies (1)

Furthermore, most of the people who used the tool were affiliated with researching and governmental institutions while very few people (5) have not provided this information.

The form permitted collecting also information about the vector of relative weights (w) resulting by the adoption of AHP approach to define Users' specific relative relevance of the five criteria selected for ranking the suitability of BMPs (see Table 1).

In detail, by aggregating all the individual priorities evaluated from the collected 28 judgments, 4 synthetic priority vectors have been calculated:

1. the vector of the minimum values
2. the vector of the maximum values
3. the vector of the arithmetic mean - w_{mean1}
4. the vector of the geometric mean - w_{mean2}



In Table 1 are reported the statistical values of the relative weights for each criterion.

As shown in the following vectors, it is possible to note that the mean values (w_mean1 and w_mean2) are almost similar:

$$w_mean1 = (0.25, 0.17, 0.19, 0.21, 0.17)^T$$

$$w_mean2 = (0.23, 0.15, 0.18, 0.20, 0.16)^T$$

From the obtained weights emerged that “Water protection functionality”, intended as the BMPs effectiveness for addressing the main adaptation target in terms of protection of water resources (quantity or quality) and flood risk mitigation, has proved to be the most relevant aspect taken in consideration by Users. Furthermore, “Robustness” also has gained a high weight (mean values: 0.21 and 0.20) revealing a strong interest of the stakeholders in the capacity of the measures to cope with different external potential damaging factors not planned in design phase or perfectly recognizable (e.g. climate change or land use change).

The results obtained from the web-survey are almost in line with the ones estimated during the second Project Round Table (held in Budapest in February 2019, see O.T3.1). In that test-phase, in fact, the aggregation of the individual priorities (40) estimated from all the User’s judgements has allowed estimating the priority vector “W” (as geometric mean) from which emerged that “Functionality” gained a very high relative weight, followed by “Multi-functionality”:

$$W = (0.31, 0.12, 0.10, 0.15, 0.19)^T$$

Specifically, according to 90% of the answers provided by the participants in the Round Table, “Water protection functionality” resulted to be more relevant than the cost of the measure as well as 85% of the people assumed that this criterion is more relevant than the time necessary for the implementation of the measure. Furthermore, almost 60% of the participants indicated that water protection functionality is more relevant than BMPs robustness and multi-functionality (respectively 25 and 24 participants).

Table 1 - Minimum, maximum and mean (arithmetic - w_mean1 and geometric - w_mean2) values of the weights calculated for each criterion accounting for the 28 individual vectors estimated from the Users’ applications.

	Minimum values (w_min)	Maximum values (w_max)	Mean values (w_mean1)	Mean values (w_mean2)
Functionality	0.06	0.43	0.25	0.23
Cost	0.04	0.32	0.17	0.15
Implementation time	0.08	0.33	0.19	0.18
Robustness	0.09	0.50	0.21	0.20
Multi- functionality	0.05	0.23	0.17	0.16

A relevant aspect emerged from the analysis of the results concerns the number of people who do not provide a specific judgment to each criterion. In fact, it has resulted that 12 Users



(corresponding to 43% of all the people who used the web-tool) have used the web-application without indicating the score values and therefore without providing judgments about the factors that are more relevant in their specific context of analysis. In this case, the five criteria gained the same weight (0.2).

4. Stakeholders engagement

The main arrangement information regarding the surveys carried out in each country involved in the Project are summarized in Table 2. In general, the meetings have included a short presentation of the involved stakeholders, a short presentation of the Proline-CE Project, and the detailed illustration of GOWARE web-tool with some practical examples concerning how to use it. Furthermore, the meetings included a time slot for compiling and delivering the web-survey (Fig. 1 - Fig. 3). Furthermore, Project documentation (e.g. brochures and flyers) was also delivered to the participants.

Table 2 - General information about the meetings organized in each Project Partner for promoting the stakeholder engagement in the GOWARE web-tool testing phase.

Italy
The Italian test phase has involved three stakeholder categories: i) HERA (an Italian multi-utility and Water Supplier); ii) Consorzio della Bonifica Parmense-Land Reclamation and Irrigation Board (a local Consortium); iii) Emilia-Romagna Region-Service for Water, Air and Physical Agents Protection; (a regional authority). The meeting with Consorzio di Bonifica Parmense and HERA took place at their headquarters, during face to face meetings with Arpae team, on June 14 th and July 3 rd 2019, respectively. The testing process with the Emilia Romagna Region was held during a video conference meeting with Arpae Team on June 27 th 2019.
Austria
The Austrian test phase has involved two end-Users (one from the Municipality of Waidhofen/Ybbs and another one from the Vienna City Administration) that have been directly interviewed. Their responses have been uploaded on the web-platform.
Slovenia
The Slovenian testing phase has been carried out on June 19 th 2019 at the Slovenian Water Agency and at the public utility JP VOKA SNAGA on July 22 nd 2019.
Hungary
The Hungarian test phase has been organized by HOI and carried out in Budapest on June 18 th 2019. It has involved national and regional waterworks companies. In detail, during the event, the following institutions were represented: Herman Ottó Institute Nonprofit Ltd, National Water Directorate, Szent Istvan University, National Meteorological Service, Szolnok Water and



Sewer Works, Middle Tisza District Water Directorate, Tisza Regional Waterworks, Institute for Soil Sciences and Agricultural Chemistry, Centre for Agricultural Research, Hungarian Academy of Sciences. The web-survey has been completed 5 times.

Croatia

The Croatian test phase has involved four institutions, whose representatives remotely tested the GOWARE tool and filled the questionnaire: Croatian Waters (ASPs in Proline-CE project), Oikon Ltd (the Institute of applied ecology), Aqua Kem Ltd, Ministry of Environmental Protection and Energy. Further direct interviews have involved the Imotska Krajina waterworks, Izvor Ploče water supply, and the HGI-CGS Department of Hydrogeology and engineering geology.

Poland

In Poland, the stakeholders' engagement phase has been carried out by means of e-mails in which the Project and GOWARE-DST have been briefly explained; moreover, links to the tool and web-survey (in Polish) have been supplied. Six interviews have been returned from the national and regional authorities directly related to land and water management and protection.

Germany

The German test case has been carried out by sending out the link to the web-survey to all stakeholders engaged throughout the Project lifetime. In total, positive feedback have been collected from six persons, out of which 3 are from the Bavarian Farmer Association and 3 are from the Water Authority of Munich (WWA Munich).

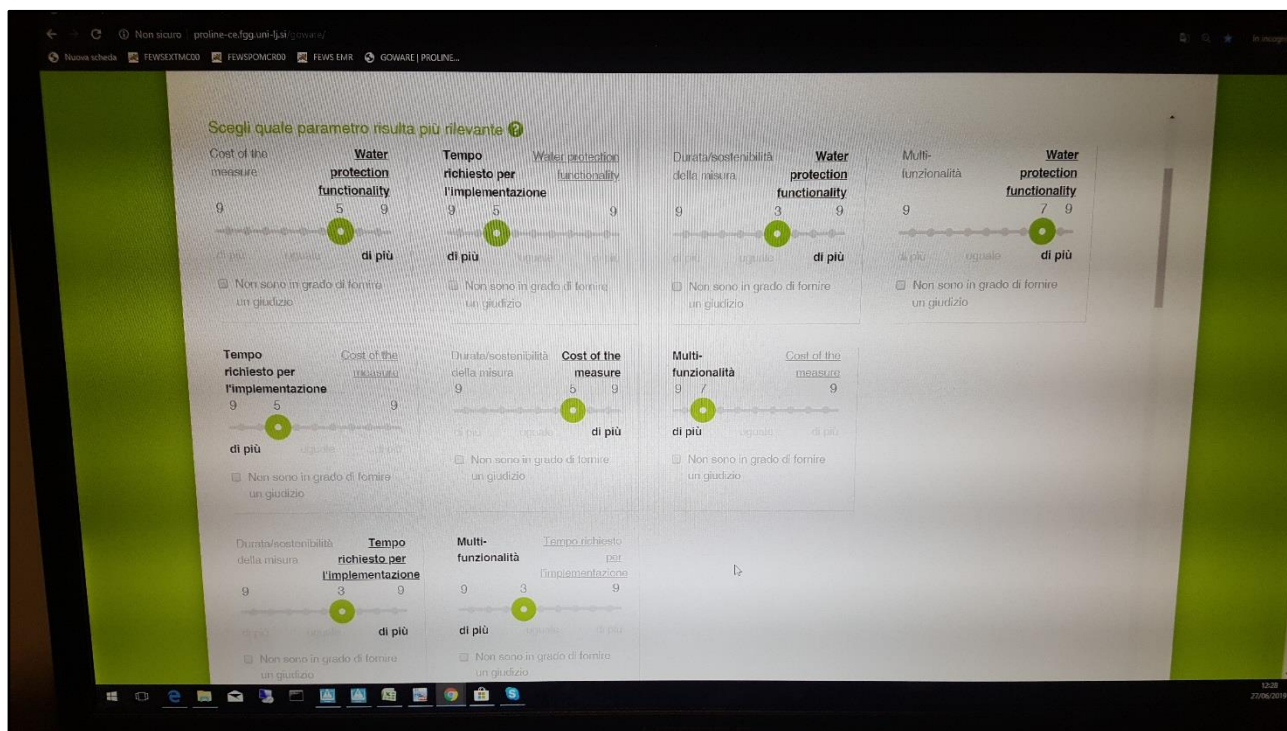


Figure 1 - Testing the web-tool (Parma - Italy, June 2019)

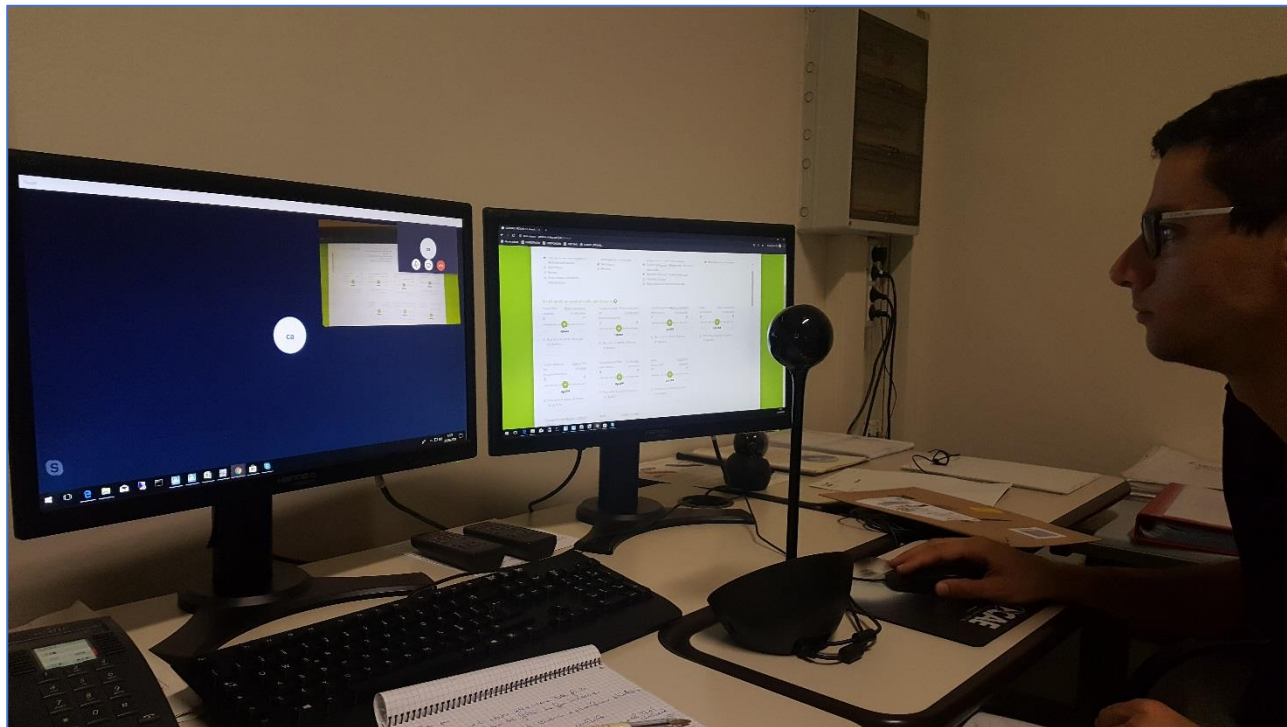


Figure 2 - Testing the web-tool (Parma - Italy, June 2019)

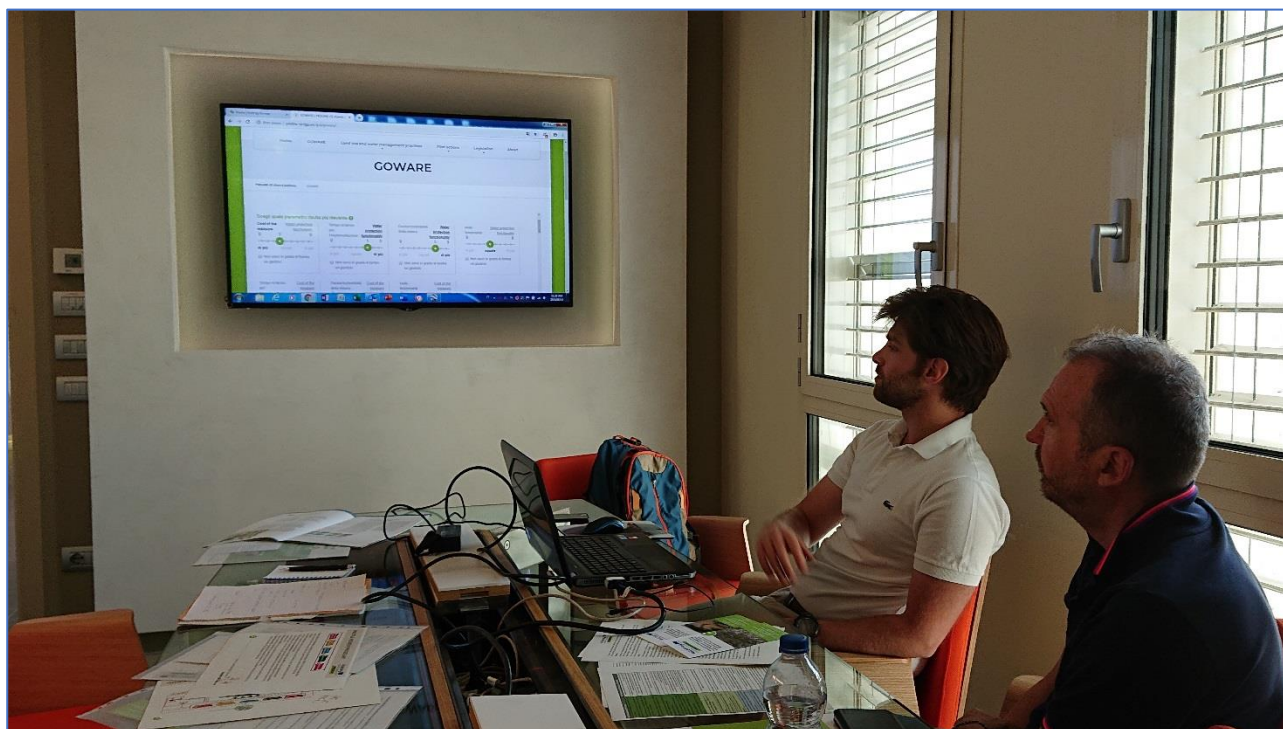


Figure 3 - Testing the web-tool (Parma - Italy, June 2019)

5. Testing GOWARE: the web-survey

During the testing phase, 32 web-questionnaires have been filled in at the end of the trial period by stakeholders, which provided their opinions and suggestions for improving the tool and its stages of analysis. Nonetheless, also in this case, the link is already maintained active to collect further feedbacks and suggestions for improvements.

Specifically, the web-survey has highlighted that the filters proposed for identifying the main context of interest in which the User result working (Land cover/use; Topographic setting; Adaptation target; Planning time horizon) resulted quite appropriate to the scope. In fact, 20 participants (62.5 % - Fig. 4) gave affirmative response to the first question of the questionnaire. Nevertheless, the participants who had difficulties in interpreting this stage of analysis have provided a number of comments/suggestions for improving its interpretation. In particular, two main aspects emerged from these comments: first, it has been suggested to consider some additional filtering categories (e.g. slope, aspect, groundwater), then, accounting for the filter related to the “Adaptation target”, it has been suggested to fix only a specific selectable option for each issue (Water quality/Water quantity/Flood mitigation) in order to avoid misunderstandings. In fact, in the present version of the tool, the Users can choose among six options, even selecting multiple choices. On the other hand, selecting specific “Adaptation target”, all the measures accounting for multiple goals including it, should be automatically opted. As recalled in §1, although if national testing have been focused on web version of GOWARE, an Excel-based version has been developed and made available after the testing. In this regard, it addresses such requirement facilitating the reliable adoption of the tool.

Are the filters appropriate to identify the main context of interest?

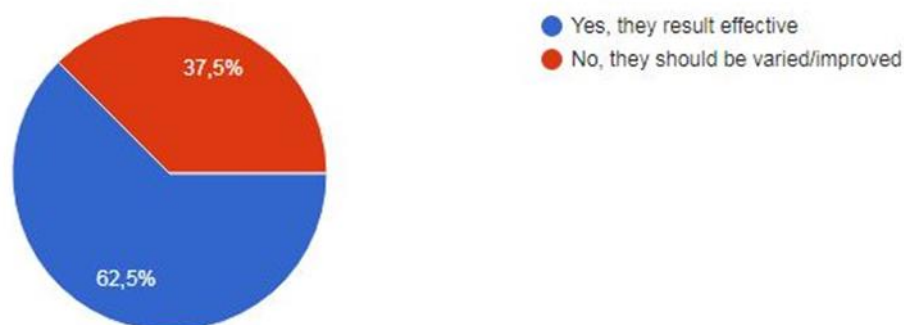


Figure 4 - Web-survey results: Stakeholders' responses to the first question of the questionnaire.

Accounting for the operative implementation of the pairwise comparisons, the web-survey has highlighted that most of the stakeholders considered the proposed procedure easily interpretable and applicable. In fact, as shown in Fig. 5, 21 participants have provided a score value to the second question of the questionnaire equal or higher than 6; among these, 8 people considered that the procedure is perfectly understandable (giving a score value of 10).

Is the procedure provided for pairwise comparison clearly understandable?

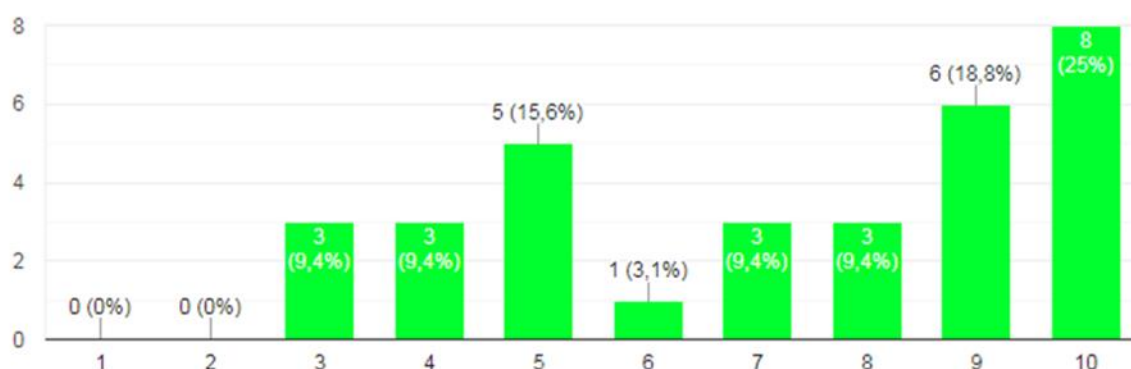


Figure 5 - Web-survey results: Stakeholders' responses to the second question of the questionnaire.

In this case, stakeholders suggested to provide a short description of the Stage 2 of analysis, in order to better define the meaning of each pairwise comparison. It is expected that such suggestion will be addressed by inserting, within the webpages, the full versions of Engineering and Users' Guides developed within D.T.3.2.2. Furthermore, a relevant aspect concerning the

judgements consistency evaluation has been pointed out: stakeholders suggested to adopt a less strict threshold for consistency evaluation. At the moment, according to literature indications it is set equal to 0.1; nevertheless, the Users consider that, usually, not exceeding such thresholds results quite complex. In any case, it worth noting that consistency evaluation should be considered as a sort of advice about potential deviations from fully rational assessments.

The third question of the questionnaire concerned the relative weighting system proposed for the criteria ranking. In this case, the answers were almost totally favourable since 96.8% of the participants (30) considered that the ranking system matched their expectations. Nevertheless, 43% of these responses expressed that, even if the results were consistent with their expectations, the relative weights were not fully compliant (Fig. 6).

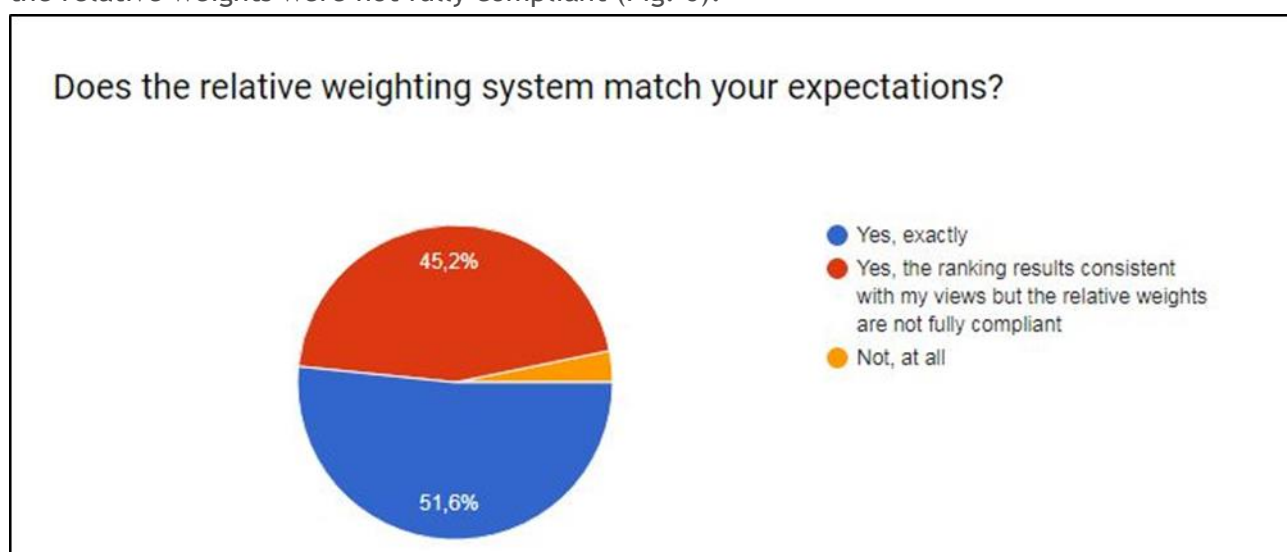


Figure 6 - Web-survey results: Stakeholders' responses to the third question of the questionnaire.

In Fig. 7 are shown the responses to the fourth question of the questionnaire in which, considering the results of their analysis, the Users were asked for providing their opinion about the ability of the ranked Best Management Practices to address the issue of their interest in order to evaluate if the results can be considered useful and appropriate.



Are the ranked Best Management Practices able to address the issue of your interest? Do you find the result useful and appropriate?



Figure 7 - Web-survey results: Stakeholders' responses to the fourth question of the questionnaire.

In this case, the majority of the interviewed (almost 50%) stated that the selected BMPs were appropriate for coping with their issues but the number of provided measures is limited. From the analysis resulted that in some cases the results were appropriate but the ranking assigned to the BMPs were not in compliance with the stakeholders' opinion.

Finally, Users have been asked to provide their opinion about the "Additional details" given to each BMP (Key Type of Measures - KTM, EU legislation, Measures included in the European Agricultural Fund for Rural Development (2007-2013), Relevant resources of reference including grey literature, peer-reviewed papers and EU Projects, a specific label regarding the nature of the practice (governance, structural, land use management), Additional Project Measures - APM). In this case, it emerged that 40% of the participants to the web-survey (12 people) considered this kind of additional information very useful for their purposes. On the other hand, 60% of the participants believed that other kind of key information should be added to properly support the choices of the most suitable BMPs. In this regard, it is worth stressing how the deeper the stakeholder involvement will be in further development stages the higher the number and the quality of additional information that could enhance the tool.



Do the Additional Details provide interesting information for your purposes?

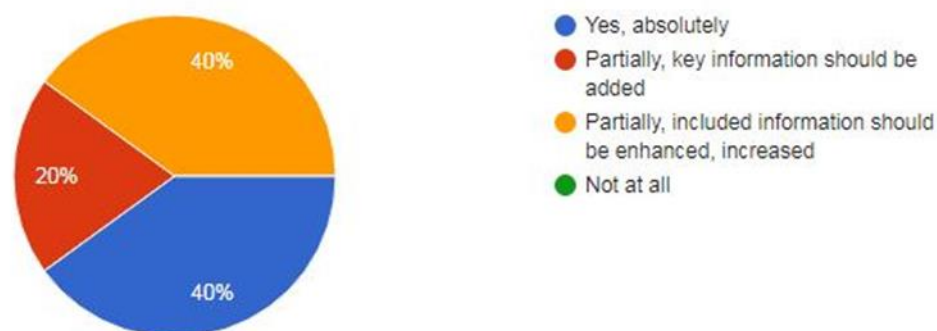


Figure 8 - Web-survey results: Stakeholders' responses to the fifth question of the questionnaire.

6. Stakeholders' feedbacks review

After the national stakeholder consultation process, a number of considerations, concerning advantages, limitations and possible future improvements of GOWARE, have emerged.

From a general overview, stakeholders expressed a strong interest and approval in GOWARE, which has been considered an effective tool for supporting decision making processes at different level of management; the tool has also resulted to be easily interpretable and usable. Stakeholders also declared that the translated version of the tool is very helpful for its dissemination and operative use at national/regional scale.

The most relevant criticality emerged from the web-survey and the direct discussions concerns the "Adaptation target filter" and, specifically, the selection of all the available options required for filtering a single water issue, for example, water quality. This approach has resulted to be not very intuitive and therefore stakeholders suggested that it would be better to select only a single choice for defining the water-related issue of interest (e.g. water quality), as has been addressed in the case of the Excel-based version of the tool. Another important aspect highlighted by the stakeholders' feedback is related to the meaning of the "Planning time horizon" filter, which has resulted to be not very clear. In this case, stakeholders asked for a better explanation about the definition of the operational and strategic planning time horizons. This point is very relevant since it may influence the potential categories of interested Users. In fact, operational practices can be considered of interest for short period activities and decisions while, on the other hand, strategical practices are mainly aimed at ensuring the long-time sustainable use of the different land covers. This means that local Users (e.g. farmers, water operators) are probably more interested in operational practices for the day-by-day planning activities while stakeholders at higher level of management (e.g. regional authorities, management bodies, and policy-makers) could be more



interested in strategical measures. Nevertheless, Users can leave this filter unselected in order to have access to all the BMPs available for the specific context.

Taking in consideration the pairwise comparison methodology proposed for the evaluation of the weights to be assigned to each criterion, stakeholders have considered this approach as a new and interesting concept, worth to be extended to other decision/assessment processes not strictly related to water management issues. In this regard, AHP approach, which is widely adopted in very different research fields, is recognized as one of the most effective ways to achieve tailored solutions and adequately take into account criteria and requirements of interest for single Users or specific categories.

As improvement, they pointed out that providing more detailed information about how to choose the numerical value between 1 and 9 could strongly facilitate the usability of the tool. Accounting for the consistency evaluation, it might be considered to extend the numeric interval for which the consistency is evaluated as “reliable” in order to reduce the number of inconsistent judgments. At the same time, stakeholders asked for specific suggestions concerning how to act when the judgments result inconsistent. In this case, in fact, the tool provides the inconsistency alert message but it does not provide indications on how to solve this issue. In this perspective, as reported above, inserting the final, full version of guides could drive the Users to make more aware decisions; on the other hand, at the moment, providing specific information about how to cope with “inconsistent” judgments could be complex and misrepresent the actual views of users.

The availability of “Additional information” has been well accepted and considered very useful for better contextualizing BMPs in the EU governance context and for facilitating the operative implementation. Nevertheless, stakeholders have proposed to add other information concerning specifically the water National legislations and Administrative requirements for each measure. Furthermore, a strong interest has been shown for the peer-reviewed papers as reference documents for more detailed information about previous experiences in the measures’ implementation. Moreover, links to examples of already implemented/tested practices are asked to be included in the output table, in order to facilitate their direct consultation.

Considering the web-tool graphical features, Users have provided several suggestions for improving the visualization of the results and simplifying their interpretation. In several cases, their requests for further explanations have been addressed in Users’ Guide (for example, about the meaning of the “Cost” criterion that should be intended as the relevance of the “Economic factor” in selecting BMPs and where, measures with the highest ratings, five stars, are characterized by higher cost-effectiveness ratios).

Finally, minor bugs have been identified by the Users and addressed by developers (e.g. compatibility with different browsers or visualization).

7. Conclusions and future developments

After National testing, it can be stated that GOWARE-DST has already reached an adequate level of maturity to be used confidently by different types of Users acting on water issues and flood protection. Nonetheless, an agile development approach is recognized as the most adequate for it. In this regard, the continuous collection of feedbacks will permit also beyond the Project’s



lifetime to implement the wished enhancements permitting the tool to be, properly updated, used and useful. Based on the suggestions collected during the testing, several enhancements have been implemented in web-tool and two improved tools are made available to all the stakeholders: Engineering and Users' Guides (D.T3.2.2) and GOWARE toolkit. The first one has highly benefited from the suggestions collected during this stage. Particular attention has been paid to the crucial stages that found to be complex or which had posed problems during the trial phase (e.g. consistency evaluation or AHP rating mechanisms). Concerning the second one, GOWARE toolkit aims at supplying potential Users with a version of the tool usable off-line or supporting decision-making process involving groups of people, as in the case of workshops and meetings. GOWARE toolkit is in fact composed by two Excel files: the first, "GOWARE_Single_decisions.xls", can be considered as the off-line version of the web-tool since it enables the analysis of the decision process based on judgments provided by a single User; the second, "GOWARE_Group_decisions.xls", allows analysing a set of priority vectors in order to obtain a synthetic solution based on the judgements provided by groups of Users. In these off-line versions of the tool, the issue related to the "Adaptation target filter" has been already fixed. In fact, in the Excel Interfaces the User/Users can define the issue of her/his/their interest among only few easily selectable options (Water quality/Water quantity/Flood mitigation).

On the other hand, it is worth recalling that national testing followed a first trial phase carried out during the second Project Round Table in Budapest (February, 2019) and devoted to detect the most efficient way to manage AHP procedure. The relevant insights collected during the testing were totally implemented in the actual release of GOWARE.

In this regard, the entire framework on which GOWARE-DST benefits from a deep stakeholders' involvement. The definition of GOWARE design as well as the organization of the activities for the stakeholders' engagement have also favored a strong cooperation and collaboration among Project Partners who, through dedicated meetings and remote conferences, have reached shared solutions and agreements concerning the operative decisions about the tool development and the planning activities. GOWARE has been developed for providing a plan for the implementation of sustainable land use and flood/drought management in the participating regions and, for this reason, further activities will be aimed at transferring the acquired knowledge and at maximizing the impact of the achieved results, at national level.

On the basis of the positive experience gained with all the stakeholders involved in PROLINE-CE Project, a good and productive network has been originated and therefore the foundations for further cooperation also beyond the Project's lifetime have been laid. In this perspective, the stakeholder's involvement will be fundamental also in further activities aimed at promoting a more comprehensive review of the already implemented practices for the water protection and climate change adaptation that will be potentially included in the catalogue. In this way, GOWARE will represent a basis for the improvement of the policy guidelines at different levels of operative management, supporting the definition of effective strategies and governance activities.