

The developed tool is incorporated into an Excel file, in which the collected data can be inserted in order to view the diagnostic results of the investigated site (Figure 2).

2.4 Tool validation

The following five key stakeholders from the society, government and NGO were identified that are active in Montes de Maria and relevant for the pro.eraa tool:

- Fondo Patrimonio Natural, as the holder of pro.eraa and the main implementer.
- Farmers of the region Montes de Maria as the main party concerned for the implementation and the direct implications of pro.eraa. Their involvement is crucial for the functionality of pro.eraa.
- Local interviewers that carry out interviews in households. They originate from the region and have a relation to the area and the inhabitants. As Patrimonio has worked at the area before our field study, they facilitated us two interviewers called promoters (in Spanish: Promotores). The promoters were already empowered to encourage sustainable practices and protect the environment by Patrimonio in previous projects.
- Local leaders as the mediator between the local interviewers and the farmers.
- Mayor or the local executive officer in municipalities

Two sites with different geographically and demographically characteristics are visited in order to prove the applicability of the tool regardless of the context of the area. These two sites are Chalan and Huamanga. The main method to collect the data for the indicators are household-centered surveys, which have been developed and pre-tested on two sites in Montes de Maria. This practical exercise enabled the optimization of the tool and adjusted it to the understanding of the regional specific context. Survey of the local authority could not be pre-tested due to inaccessibility and a workshop in this stage of the tool design was not feasible. It is recommended to have a second round of tool validation with a more consensus-based and the involvement of multi-actors stakeholders. Local surveyors are from the region and part of the project through Patrimonio. In order to be able to collect data from various sites, they are instructed by us during the tool validation process in Montes de Maria on how to apply the tool and any unclear technical terms were explained.

2.5 Tool analysis

The data collected in the second site, a remote village called Huamanga, was utilized to illustrate as an example on how to use the Excel Calculator and interpret the diagnostic results. For this purpose, a total of 20 households questionnaires, which is equivalent to 18% of the total households were collected and evaluated. The local authority survey could not be applied due to inavailability of the mayor in Carmen de Bolivar. Due to the distances and lack of time and means, the feasibility of conducting a workshop is considered low and would make it difficult to replicate later by users of the tool, which goes against the research objective of a simple and quick method.

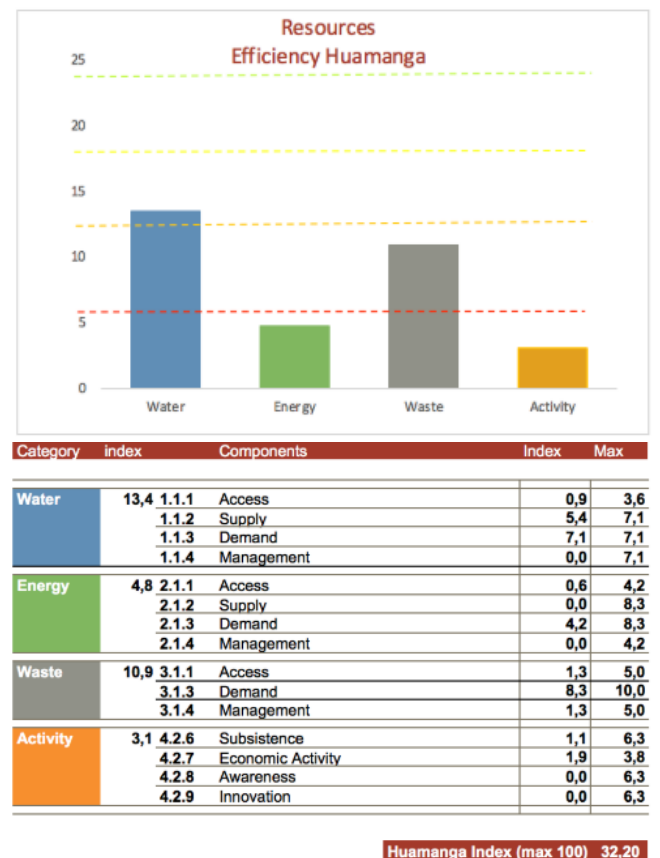


Figure 3. Index results of the tool application for the case study Huamanga

Table 2. Overview assessment sheet per criteria for Energy for the case study Huamanga

Component	Criteria	Max Results	Huamanga Results	%
Energy		25,0	6,7	27%
<i>Domestic</i>				
Access	Access to energy services	4,2	2,5	60%
Supply	Encourage renewable energy generation/increase substantially the share of renewable energy	4,2	0,0	0%
Demand	Minimisation of energy demand	4,2	4,2	100%
Management	Renewably powered water pumping (if applicable)	2,1	0	0%
	The use of resources efficiently to reduce use of fuelwood and deforestation	2,1	0	0%
<i>Non-Domestic</i>				
Supply	Cover of all non-domestic activities by renewable energy	4,2	0	0%
Demand	Minimisation of energy demand for economic activities	4,2	0	0%

After the data has been inserted into the Excel Calculator, the results could be read: The overall index of resource efficiency in Huamanga indicates a value of 32,20 out of 100 (Figure 3). The efficiency of all four resources is not high, however water efficiency and waste efficiency perform better than energy and activity. A closer look at the first three resources shows the highest value in the component “Demand”, which indicates a low consumption of water and energy and a low generation of waste. Regarding the component “Management” all the first three resources perform very poor. Less than half of the households have access to water and the situation for access to energy is only slightly better. The households that have access however, have no sustainable energy sources, which indicates the component “Supply” in energy. Resource ‘Activity’ reads that subsistence as well as economic activity are critical. There is no awareness regarding environmental protection and no innovation regarding sustainable practices.

The next Excel sheet illustrates the results per criteria for each resource. Table 2 exemplary presents the results for the resource “Energy”, which scores an overall value of 27%. Per component, the most critical criteria (index $\leq 25\%$) can be derived from this assessment sheet. For further information of each criteria, the next Excel sheet “Results per indicator” can provide revealing insight on request.

With the support of this show-case study a detailed application instruction of the tool is elaborated in the thesis

work.

2.6 Implementation guidelines

Based on the experiences gained during the pre-test, this part develops guide values for the estimation of minimum required time, costs and staff network in implementation of the tool. These guides show that a procedure with a minimum human capital of four person is required to apply a diagnosis analysis of the tool with a project manager (PM) in the head quarter, a field worker on site, an interviewer and a local community leader of the targeted site. Among this four, it is just the project manager, using the Excel Calculator for the diagnosis, while the others are involved in the data collection process. As the use of the Excel Calculator requires a basic understanding of resource efficiency, it is difficult to run on its own and on site. This means, the PM sends the diagnosis results to the local authority and local leader (Figure 4).

With this procedure, the PM successively collects data from sites in the region Montes de Maria. This enables the PM to have a good overview on macro and regional scale and shall support the decision-making process on the selection of intervention projects.

Further, in the thesis work this part also lays out a Monitoring & Evaluation guideline, an approach to select interventions as well as examples of interventions.

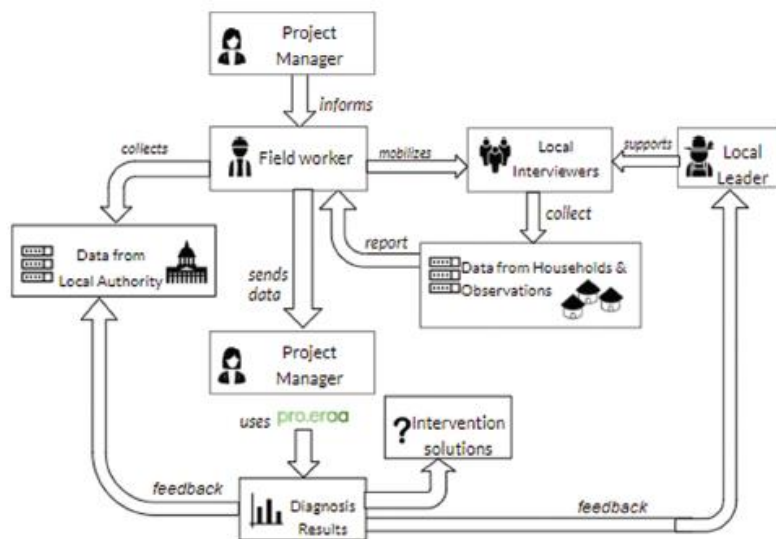


Figure 4. Required operational procedure to implement pro.eraa

3. RESULTS

Based on applied research the final product of this practical oriented study is an indicator based assessment tool for resource efficiency in agricultural households in Montes de Maria.

The tool analyses the state of the art of the access, supply, demand and management of the resources water, energy, waste and activity. It consists of 16 criteria with 21 indicators for water, 7 criteria with 8 indicators for energy, 10 criteria with 11 indicators for waste and 10 criteria with 11 indicators for activity. In retrospect, the research reviewed that designing and implementing an appropriate indicator-based assessment tool for resource efficiency can be challenging and requires the

consideration of the following aspects:

- Reference tools can provide a helpful guidance on the design of assessment tools. A research framework can help identify appropriate reference tools.
- Benchmarking indicators is the most challenging component of the design process. It requires an individual research for each indicator and some indicators are designed to establish a benchmarking with every new data input.
- Developing questionnaire requires a design process of its own. Sufficient time shall be dedicated for the design of the questionnaires with research for appropriate model questionnaires.
- The most important criterion for designing the

indicators is the accessibility and availability of data.

- Coming from a locally known institution like Patrimonio was massively helpful during the field trip in terms of orientation, existing contacts to the local community leaders and the provision of suitable interviewers. This granted us credibility towards the household owners and their willingness to participate in the survey.
- Planning a workshop is a complex matter that requires time, costs and experienced staff and an announcement sufficient time ahead.
- The quality of the data obtained depends on the proper design of the survey and a good knowledge transfer and training of the interviewers.
- The involvement of the local authority should not be taken for granted and need to be strategically planned. However, the tool has to be designed to function also in cases of inaccessibility of the local authority.
- To run a show case study is not only demonstrative for the future tool users but also helps to mirror your own work and results.
- A new tool comes with expectations and interests from different stakeholders. The first step is to establish a consensus of the purpose and objectives of the tool.
- The idea of a fully automatic tool is unrealistic. A certain amount of structure and means are necessary, and a basic understanding of resource efficiency for the interviewers is essential.
- The interdisciplinary nature of the tool caused for some indicators an unclear assignment to one resource.

4. FINAL DISCUSSION

The methodological approach determined the most inclusive method to measure and assess the resource efficiency performance of agricultural households in Montes de Maria in Colombia to be an indicator-based assessment tool. This tool was developed in a quantitative research based on a literature review from which guiding reference materials were derived. A negative finding in this phase was the research gap of sustainability assessment methods for rural areas.

The tool serves the main purpose to produce rapid findings at relatively low effort while enabling the monitoring of local-level projects. Apart from the operational limitation laid out in section 2.6, the tool can also only be applied in the agricultural context. However, it is geographically flexible and can be split by sector/resource.

Indicator-based assessment is in essence an approach to convert qualitative information into numerical data in order to evaluate the state-of-the-art and make it comparable. The quantification of information is in every case related to a loss of qualitative or local-specific information. The key issues in the process of the tool development were to find the balance between the amount of quantification of local-specific information and the requirement to have a faster and a more comparable diagnosis from which the approach of a community-based participation also suffers from. Ways on how to include the concerned local communities must be factored in during the selection of intervention phase. Another key issue is the process of weighting assignment that is vulnerable to ambiguity due to its subjective nature. Derived mainly from the intention to not prioritize neither environmental nor human indicators, our approach of

assigning equal weighting factors solved this issue partially. Lastly, the data obtained states and does not explain a static condition with some exceptions that requires a manual causation, such as no energy consumption due to no access to electricity. In most cases though, it does not explain i.e. the low consumption of energy. This leads to what we have seen in the case of Huamanga: The tool does not reflect political or social situation and assesses the low consumption for electricity as positively sustainable when the household cannot afford electrical appliances. This means, the tool does not serve as a proxy for social variables.

On a large scale, sustainability indicators are a proven method for driving sustainable urban development as a progress-measurement tool or static sustainability diagnostic. This research shows that indicator-based assessment tools can very well provide simple, measurable evidence needed to create and maintain rural areas that are environmentally sustainable, promote long-term biodiversity benefits, as well as provide prosperity in regard to the well-being of their residents.

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