



## Case Study

# Permaculture MESMIS - a methodology to evaluate ecological well-being on permaculture farms

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## Abstract

*This article presents a specific methodology to evaluate ecological well-being on farms managed through permaculture design and practice. First tested on a case-study in Brazil, our aim is to propose an adaptation for testing and potential application in different sites and conditions. A brief review of the literature around ecological well-being, the permaculture ethics and design principles and the consecrated MESMIS methodology is presented in order to clarify the Permaculture MESMIS methodology and its applicability. In order to build upon the Permaculture MESMIS methodology, six steps were executed. The applicability of this methodology is explored at different stages, aiming to understand people's ecological well-being before and after the adoption of permaculture as a way of life. Different ways of applying such a methodology, as well as how to present its results, are also suggested.*

**Keywords:** Ecological well-being, MESMIS framework, methodology, permaculture.

## Introduction

Adopted in many countries around the world as a design concept for rural, peri-urban and urban places, permaculture strives for energy efficiency and sustainability. Over the last few decades, permaculture and its ethics and design principles are empowering and encouraging people to modify personal aspirations and develop more holistic views about sustainable living, inspiring some people to pursue self-reliance and develop design skills to support a reverse migration from cities to rural areas<sup>1</sup>. This article presents a methodology to evaluate the adoption of permaculture approaches and how this can be linked to the ecological well-being (EWB) of land managed by permaculture graduates. The study sought to measure the adoption of permaculture ethics and design principles, which aim to create designs mimicking the diversity, resilience and stability of the natural ecosystems, providing energy, shelter and human food in a harmonious way with the environment<sup>2</sup>. The article's structure starts with a theoretical review of well-being and ecological well-being. It then provides a brief introduction to permaculture ethics and design principles and is followed by a discussion of the MESMIS methodology and the Permaculture MESMIS methodology. The article then covers the application of this methodology, followed by some analysis and conclusions.

**Well-being and ecological well-being:** Well-being can be understood in many ways and it is generally considered as a synonym of quality of life. Depending on the point of view used to evaluate well-being, it can be measured by different dimensions<sup>3</sup> and the dominant measurement of national

economic well-being in many countries is Gross Domestic Product (GDP). It is usually inferred that the bigger a country's GDP, the better is the *per capita* quality of life of its inhabitants<sup>4,5</sup>. However, this view is underwritten by an assumption that well-being can be measured through people's consumption capacity. This is a reductionist view, focused on mercantile aspect, disregarding social and ecological factors, considering that "better lives" comprises more than just higher GDP<sup>3</sup>. Thus, the use of GDP to measure well-being is inappropriate as it was not designed for this application<sup>6</sup>, and further, "GDP is dangerously inadequate as a measure of quality of life"<sup>7</sup>. Another well-known index commonly used to evaluate well-being is the Genuine Progress Indicator (GPI), but it "does not claim to be a perfect, or even an adequate, indicator of changes in national well-being; it claims only to be a better – and possibly a much better – indicator than GDP"<sup>8</sup>. The United Nations (UN) claims the Human Development Index (HDI) is "the ultimate criteria for assessing the development of a country, not just the economic growth alone"<sup>9</sup>. In many cases, the HDI is also understood as a measure of well-being<sup>10,11</sup>. The problem with using the HDI is that this is a limited way to evaluate sustainability, as it does not take into account measures such as a healthy environment, nature/human integration and happiness.

More recently the United Nations Development Programme has developed the Sustainable Development Goals (SDGs), a set of directives made to understand and provide actions for "environmental, political and economic challenges facing our world"<sup>9</sup>. The SDGs includes "Good health and well-being" as the 3<sup>rd</sup> goal and considers many environmental initiatives embedded in the other goals.

The Network of Wellbeing<sup>12</sup> believes that “permaculture and well-being can be used as frameworks to engage people on a personal level and connect them with wider positive changes in society and the natural world”. In the same way, The Well-being Economy Alliance<sup>13</sup> intends to “change the economic system” through a decentralised empowerment, focused on clusters and hubs seeking to create a well-being economy, that “delivers human and ecological well-being”.

The overall aim of permaculture principles is to develop sustainable human habitats "that do not result in ecological degradation or social injustice"<sup>14</sup>. Thus, “an ecological *habitus* can be the key for the advance to an ecological well-being where the inertial behaviour of people now, take in consideration a low impact way to live based in the logic to live well in the place enjoying it socially and ecologically integrated manner” and be the key to advancing ecological well-being<sup>14</sup>. “Permaculture is both local and global articulating global matters of concern such as food production, renewable energy sources, and ecological well-being in deeply localised variants”<sup>15</sup>.

Permaculture design aims at the appreciation of “socio-ecological organisation of human communities”<sup>16</sup> where “the purpose is that of creating the condition both for human well-being and for the health of the biotic community”<sup>16</sup>.

In the psychology field, a therapy method that aims to improve general well-being<sup>17</sup>. They sought to understand “the integration between the psychotherapeutic and gardening aspects of the nature-based therapy”, with focus on the “integration between the psychotherapeutic and permacultural aspects”. Some environmental psychology researchers are concluding that living in a more ecological way can produce more happiness than a life based on consumption, because ecological “individuals hold intrinsically oriented values and are more mindful of their inner experience and behaviour”<sup>18</sup>.

In this scenario, it is important to measure permaculturists’ ecological well-being, in order to explore whether permaculture could be an important way to provide well-being, sustainability and, as consequence, stimulate other people to adopt it, or create public policies in the same direction.

**Mesmis Framework:** MESMIS is a research method that enables the evaluation and monitoring of natural resources and managed systems sustainability<sup>19</sup>. Its aim is to provide an embracing and interdisciplinary vision for understanding the fragilities and potentialities of a managed system, considering environmental, economic and social processes. Beyond that, the MESMIS framework has been attracting considerable attention, since it has been extensively tested in case studies<sup>19</sup>.

MESMIS proposes a comparison between existing management systems and alternative systems (transverse evaluation) and/or modifications and observation over the time line (longitudinal

evaluation). Both aims to evaluate how sustainable a determined agro ecosystem is and what are the critical points that can influence sustainability in a negative or positive way. One of the major characteristics assigned to this methodology is its participatory character, where its discussion and feedback are facilitated between evaluators and the evaluated people.

The evaluation cycle proposed by MESMIS initially provides a focus on determining the management systems to be evaluated, followed by identification of critical points that may compromise sustainability, choice of indicators to be measured, monitoring and evaluating results to determine the major obstacles and favourable points to attain sustainability and, at last, writing conclusions and recommendations.

In the MESMIS application, several techniques are used. One of them is an “open-ended and semi-structured interview with farmers, key community members and project staff”<sup>19</sup>. The choice of MESMIS as a research framework was made because of its convergent aspects in evaluating sustainability and EWB as well.

The framework for assessing the sustainability of natural resources' management systems (MESMIS, the acronym in Spanish) was used to evaluate 5 farms in Italy<sup>1</sup>, one of them having a permaculture profile. Thus, the sustainability of farms managed using permaculture logic is a new theme and remains well less researched.

In the original MESMIS methodology, the selected attributes mainly concern food production<sup>20</sup>. The author applied attributes from researchers from other disciplines to broaden the analysis further to include ethical, cultural and social indicators in order to achieve a holistic view of the relationship between the landholder and the land. Hence, it is possible that the MESMIS methodology can be modified and applied to evaluate different environments, such as permaculture farms.

**Permaculture MESMIS:** The Permaculture MESMIS methodology intends to answer the question "How can we evaluate the understanding and adoption of permaculture in rural environments?" This question is multifaceted because permaculture, unlike other paradigms, such as organic agriculture, agroecology, and biodynamics with its focus on food production, seeks to provide a holistic and sustainable approach to the living on the land. Thus, Permaculture MESMIS is a quali-quantitative evaluation instrument based on MESMIS framework. Some customisations were included to consider issues beyond food production. Thus, a specific questionnaire contemplating permaculture ethics and design principles (briefly described below), was designed to be applied with permaculture-trained landholders.

**Permaculture ethics and design principles:** In the early 70's many people across the world realised they were living in a developing environmental crisis, linked to the “booming of

mass-market economy<sup>21</sup> and growth of an industrial consumer society. Individuals and grass-roots counterculture movements began to explore solutions to the crisis<sup>22</sup>. Bill Mollison and David Holmgren systematised principles and techniques for a 'permanent agriculture', inspired by natural patterns, aiming the reduction of the dependency on agrochemicals or labour exploitation<sup>23</sup>. This 'permaculture', that was mainly documented around food, water and shelter was steadily articulated as a philosophy and design system for all domains of human endeavour, a 'permanent culture' with "function as a framework for integrating knowledge and practice across disciplines to support collaboration with mixed groups"<sup>24</sup> "to help shed new light on grassroots networks and transition processes"<sup>25</sup>.

Thus, permaculture is much more than a holistic science, it can be understood as a life philosophy in which humans integrate with nature rather than destroying and dominating it<sup>26</sup>. In this context, humans can promote natural processes and interactions with nature with the aim of improving food production, energy capture and storing, water quality and other items necessary for human life<sup>27</sup>.

The permaculture concept has been developed on the basis of three ethics, supported by twelve design principles that give practical directions for sustainable design<sup>28</sup> (Figure-1). The ethics of permaculture involves three great areas of necessity for our coexistence with Earth: environmental, social and economic. The first ethic "Earth care" takes into consideration environmental questions and tells us of our obligation to care for the planet in the knowledge that it is the home of all humanity. "People care" is the second and it sets an action line for social systems and behaviours and alerts us about individual and community needs for physical and mental health, well-being, political autonomy, shelter, food security, human rights, and education. The third, "Future care"<sup>29-32</sup> assumes that abundance is the way to do it, where each one shares their surplus and ensures policies aiming a fair opportunity for everyone to a sustainable future. Thus, "the environmental, social, and economic, triangle that forms the basis of understanding for many sustainable development models is directly correlated to the permaculture core ethics of earth care, people care, and fair share"<sup>33</sup>.

Under these ethics are the twelve design principles that guide the human-nature interaction, establishing an effective permaculture design. A briefing of the dozen design principles<sup>28</sup> is shown as follows: i. Observe and interact - searches knowledge from nature through observation and the interaction with it. ii. Capture and store energy - it shows that there are, in a local scale, a diversity energy kind that can be captured and stored to supply human necessities. iii. Obtain a yield - in the short term harvesting is needed to supply immediate necessities and provisions for a long term design. iv. Apply self-regulation and accept feedback - to recognise the dynamic equilibrium and to be watchful on how nature matches to our actions. v. Use and value renewable resources and services - adjustments are

needed to improve the use of more natural renewable services and elements, including sunlight, rainwater, winds, biomass, etc. vi. Produce no waste - by avoiding waste we can save time, efforts, nature services and its richness. vii. Design from patterns to details - we can find a lot of patterns, its dimensions and its repetition on nature. They are patterns that contain the harmony in its operation. It suggests following these pattern directions in the day by day work providing efficient systems way more equilibrated and integrated with nature. viii. Integrate rather than segregate - attempt to replace competition by cooperation, both in relationship and production. ix. Use small and slow solutions - it searches to avoid the immediateness stimulated by a consumption society. It is important to think in simple solutions with longer and effective results. x. Use and value diversity - Earth is very much diverse in cultures, landscapes, vegetation and biomes. Its diversity should be respected and seeded, because the imposition of one way to live over others causes suffering and degradation, while its values can guarantee and make our survival easier. xi. Use edges and value the marginal - the edges in the nature are places with a lot of energy concentration. When two or more environments meet, the diversity and resistance to adversities are larger, making the system more productive. xii. Creatively use and respond to change - building a more equilibrated society is a process of [re]adaptation that demands creativity, because adversities will be present all the time and also should be viewed as a learning opportunity instead of a problem.

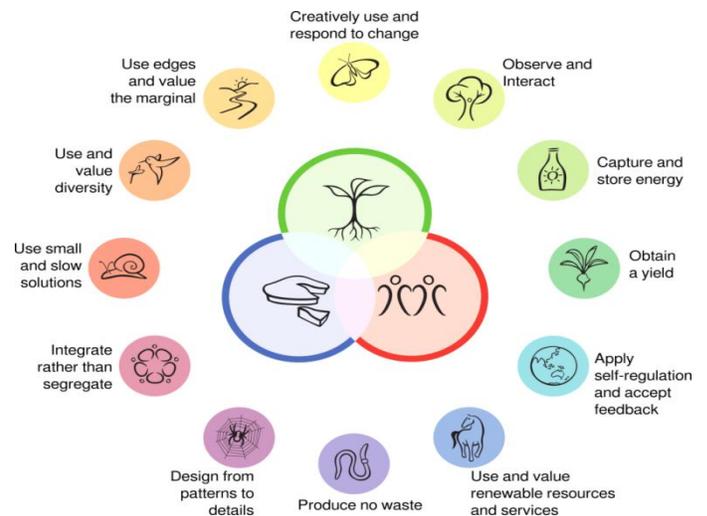


Figure-1: Permaculture ethics and design principles (peripheral) proposed by Holmgren<sup>34</sup>.

## Methodology

The applicability of MESMIS for rural spaces designed in the permaculture concept, required a construction of a specific methodology, taking into account permacultural particularities. Thus, the "Permaculture MESMIS" methodology was created, structured in six steps tested by case studies<sup>26</sup>. According to these authors, the first step involves the selection of non-permacultural farmers to be evaluated. The second demands the

participation of the Permaculture Design Certificate (PDC) course. The third involves adjustments between MESMIS variables and permaculture principles. The fourth, comprises the integration of 12 permaculture design principles instead of the 7 general attributes proposed by the original MESMIS. The fifth considers a Participatory Rural Diagnosis and the sixth, the most important step, is the development of a questionnaire to evaluate EWB, consisting of 36 questions being 12 for each of the ethics areas of Earth care, People care and Future care.

One a specific questionnaire designed for a particular cultural region in southern Brazil was proposed<sup>26</sup>. The questions were applied in three stages with the sample farmers over a period of two years: once before the PDC and the other right after the PDC and third one, one year after the PDC. The authors suggest that the adoption of Permaculture MESMIS needs to consider having the flexibility in the questions to ensure the applicability of the relevant regional physical, economic and social realities.

Trying to adapt the Permaculture MESMIS from a local reality to a generic working framework able to measure the intensity of EWB, the Measurement Attitudes methodology<sup>35</sup> scope were used to build the semi-structured questionnaire involving the permaculture ethics and design principles. This questionnaire (Table-1), considers generic statements to evaluate how much the sample farmers incorporated the permaculture ethics and the design principles to the management of their farms. As a general rule, it is suggested that a customisation of the statements for specific cases must incorporate local cultures and habits.

Furthermore, there are numerous considerations in the literature about the risk of using statements in questionnaires and many guides on writing survey questions recommend avoiding agree-disagree statements, because most people have a general tendency to provide affirmative answers to the questionnaire items, regardless of the content of the items (the acquiescence response bias) causing assessments distortions<sup>36</sup>. Therefore, it is suggested that researchers use strategies to avoid this effect, like the adoption of answer inversion for different statements and "it is probably best that all items be positively or directly worded and not mixed with negatively worded items<sup>37</sup>. For this reason, in this article only the simple positive statements will be presented.

In order to assign final values to each statement, scores between 1 and 5 are indicated: where "1" is related to "strongly disagree" and "5" is "strongly agree". So, the intensity of EWB is considered here as proportional to the scores and sums obtained from the whole questionnaire. To facilitate understanding and to be accessible for illiterate people, cartoon facial expressions could be used, each one having correspondence with mentioned values (Table-1). At the time of the interview to conduct the questionnaire, these numbers should not be shown to the interviewee. Instead, five cards containing only the facial expressions should be used.

To register any additional feedback from permaculturists, it is better to record the interviews and encourage the interviewee to give more in-depth answers to each statement using prompts like: Why did you chose that answer? Can you give an example?

In some cases, when possible, it is interesting to try to make comparisons between different stages of the incorporation of ethics and design principles<sup>26</sup>, when measuring EWB using Permaculture MESMIS on before, right after, one year after the PDC and beyond, aiming to establish if a more resilient well-being it was incorporated. Where it is not possible to apply MESMIS before participants have completed their PDC, it is suggested researchers undertake a "second round" for all statements, considering the following question at the end of interview: How do you think you would have answered these questions differently before you did your PDC? This "second round" is usually faster than the first part of the interview.

It is important to consider that this second round results show only the interviewee's perception about his/her lifestyle before the PDC or incorporation of permaculture ethics and principles. As applied after the first statements round, there is an enormous possibility of response inductance, once the interviewee does a self-reporting, but now considering its sustainability and ecological well-being incorporated by the adoption of permaculture ethics and principles. Thus, this "second round" results have limitations that can affect both the interpretation and the final analysis.

## Results and discussion

The integration of data resulting from interviews can be done using a simple spreadsheet. This spreadsheet can enable further analysis involving the ethics and design principles. As an example, data collected from one monitored permaculture farm in Brazil<sup>26</sup> is presented on Table-2, along with the 36 statements and their obtained scores, being 1-12 (Earth care), 13-24 (People care) and 25-36 (Future care).

There are different ways to present the data collected from the interviews. One of the most used by traditional MESMIS framework one is the AMOEBA diagram<sup>38,39</sup>. The AMOEBA diagram is an effective way of showing different researched stages, using simple and coloured lines shaping polygons. As an example, the case study presented<sup>26</sup> employed the AMOEBA diagram, exploring coloured lines in three different stages: before the PDC, right after PDC and one year after the PDC. It makes the distinction between the three permaculture ethics and generates three pie pieces for the AMOEBA diagram, when questions 1 to 12 are related to Earth care, 13 to 24 to People care and 25 to 36 to Future care (Figure-2). The analysis of the graph shows a huge incorporation of each design principle, since the stage "before PDC" clearly displays a closer polygon than the stage "one year after PDC" showing a clearer and more significant improvement on the EWB.

**Table-1:** Permaculture MESMIS interview questionnaire for evaluating ecological well-being.

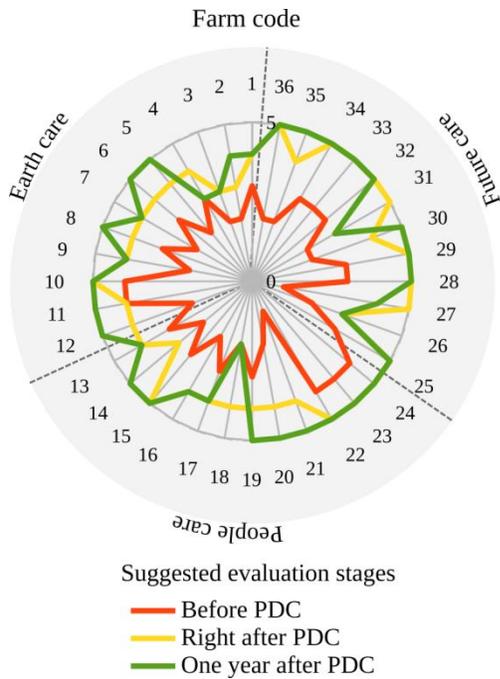
Earth care (environmental)					
Design principles	Facial expression and scores				
	 1	 2	 3	 4	 5
1 - Observe and interact	The design and management of my farm is based on observation and interaction with nature				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
2 - Catch and store energy	The farm's energy needs are provided by capture and storage on site				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
3 - Obtain a yield	Our food needs are met by what is grown and produced on site				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
4 - Apply self-regulation and accept feedback	I change my behaviour in response to nature's feedback				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
5 - Use and value renewable resources and services	When I use renewable resources and services I consider their long term impact				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
6 - Produce no waste	Waste produced on site is reused				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
7 - Design from pattern to details	I consider natural patterns in the design and management of my farm				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
8 - Integrate rather than segregate	Elements and functions are well integrated on my farm				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
9 - Use small and slow solutions	I use small and slow solutions when implementing a new landscape design				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
10 - Use and value diversity	The farm is designed to increase and value a diversity of species				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
11 - Use edges and value the marginal	The landscape design of my property maximises edges and use of margins areas where land of different types join				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
12 - Creatively use and respond to change	The landscape design of my property allows for flexibility and adaptability				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree

People care (social)					
Design principles	Facial expression and scores				
	 1	 2	 3	 4	 5
13 - Observe and interact	I interact with and have a good relationship with my neighbours				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
14 - Catch and store energy	The inputs for my property are produced locally				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
15 - Obtain a yield	The food produced on my farm is not grown with chemical inputs				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
16 - Apply self-regulation and accept feedback	I change my behaviour in response to social/community feedback				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
17 - Use and value renewable resources and services	I use renewable community resources and services considering their long term impact				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
18 - Produce no waste	I avoid sending waste to landfill				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
19 - Design from patterns to details	I seek broader community input in making design decisions				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
20 - Integrate rather than segregate	I open my farm to the public and seek to establish partnerships with others				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
21 - Use small and slow solutions	I work collectively with my community to resolve local issues				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
22 - Use and value diversity	I respect other people's choices: ethnicities, sexual orientation, gender, ages, religion, culture and seek to relate to people in a consistent manner				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
23 - Use edges and value the marginal	I believe socially progressive marginalised movements add value to society				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
24 – Creatively use and respond to change	I take action to respond to social crisis and solve problems in my community				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree

Future care (economics)					
Design principles	Facial expression and scores				
	 1	 2	 3	 4	 5
25 - Observe and interact	I recognise and respond to limits on production and consumption on my farm				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
26 - Catch and store energy	Farm inputs are generated on site				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
27 - Obtain a yield	My income is generated by activities on site				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
28 - Apply self-regulation and accept feedback	I consider fair share in consumption and distribution of resources				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
29 - Use and value renewable resources and services	I don't spend money on non-renewable resources				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
30 - Produce no waste	I consider waste as a resource				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
31 - Design from patterns to details	I use integrated systems to design for efficiency and optimise productivity				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
32 - Integrate rather than segregate	I seek to integrate my production with other local farms				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
33 - Use small and slow solutions	When facing a production problem, I resolve the problem with ecological management and avoid the use of chemicals				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
34 - Use and value diversity	My farm generates a diversity of income streams				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
35 - Use edges and value the marginal	I consider gaps in the market when deciding which product streams to invest on my farm				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree
36 - Creatively use and respond to change	I creatively respond to and solve production flow issues				
	Strongly disagree	Disagree	Undecided	Agree	Strongly agree

**Table-2:** Example data including scores and sums for one monitored permaculture farm in Brazil<sup>26</sup>.

Statement	Scores			Statement	Scores		
	Before PDC	Soon after PDC	One year after PDC		Before PDC	Soon after PDC	One year after PDC
1	3	4	4	25	3	5	5
2	2	3	4	26	2	3	3
3	2	3	3	27	1	5	4
4	3	4	3	28	3	5	5
5	2	4	5	29	3	5	5
6	3	4	5	30	2	4	5
7	2	4	4	31	2	5	3
8	3	4	5	32	3	5	5
9	2	4	4	33	3	5	5
10	4	5	5	34	3	5	5
11	4	4	5	35	2	4	5
12	2	4	5	36	2	5	5
13	3	4	4	Sum of scores for each ethic			
14	2	3	5				
15	3	5	5				
16	2	4	4				
17	3	4	4				
18	2	4	2	Ethics	Before PDC	Soon after PDC	One year after PDC
19	3	4	5	Earth Care	32	47	52
20	2	4	5				
21	1	4	5	People Care	33	51	54
22	4	5	5				
23	4	5	5	Future Care	29	56	55
24	4	5	5				

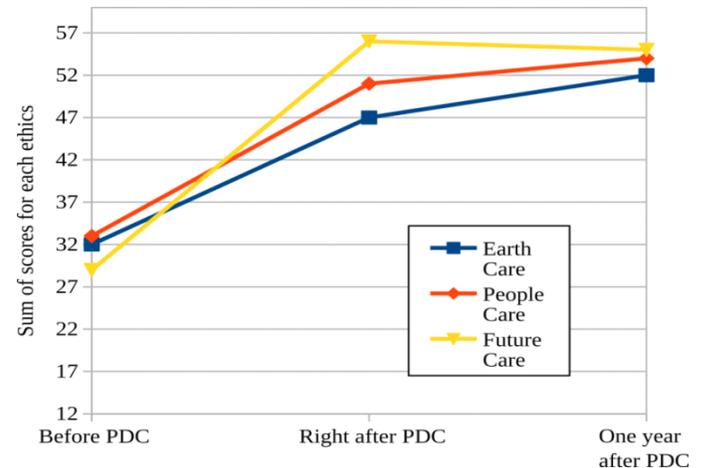


**Figure-2:** Example containing results representation of the design principles scores for the three evaluated stages from one monitored<sup>26</sup>.

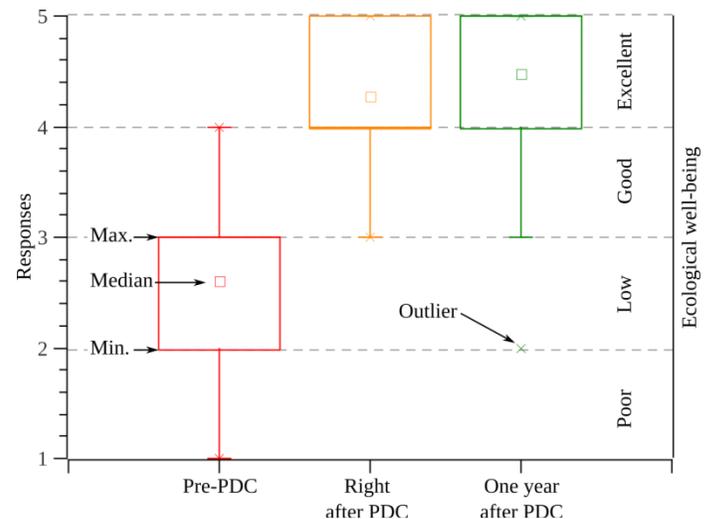
The AMOEBA diagram provides a visual way to recognise the incorporation of each design principle for different stages of the research, but it cannot reveal the intensity of its whole incorporation, the EWB. To achieve this information an analysis involving the sum of each separately ethic is necessary. Thus, using the “Sum of the scores for each ethic” (Table-2) it is possible to plot the data on a simple line graph (Figure-3) to reveal which ethics was increased or decreased, considering the three stages suggested and evaluated<sup>26</sup>. The final summed scores for all ethics on graph indicates that the PDC was an important “tool” to increase the incorporation of design principles and improved the EWB on farm, signed by the difference of polygon sizes between the stage “before PDC” and “right after PDC”. Furthermore, the “Future care” was the most changed ethic at the same stage. It is yet possible to affirm, that the “after the PDC” stage scores are in a stable condition, keeping its intensity on “one year after PDC” stage. Thus, the results suggest that the PDC worked as a turning point for landholders.

Another well-used way to represent and analyse the data is the use of the box-plot graphic to show the statistical distribution (quartiles, outliers and medians), especially if there is a large amount of data. The Figure-4 shows a box-plot graph for the same results presented on Table-2. The representation of the results using this way provides a complete view about the evolution between each of three analysed stages. Using the median as the indicator of EWB makes it easier to verify if there were improvement or not. One limitation of this way of presenting the results is the impossibility of revealing the differences for each of the permaculture ethics as is possible in

the AMOEBA diagram, because it considers the sum of whole scores evaluated. In the other hand, it is possible to express a summary of results by plotting the median into a “scale”, considering 4 intervals (corresponding 1 to 5 scores), for EWB: poor, low, good and excellent (Figure-4).



**Figure-3:** Example containing results representation for the summed scores of each ethic over the three evaluated stages from one monitored<sup>26</sup>.



**Figure-4:** Example containing results representation for each analysed farm for three suggested evaluation stages.

### Conclusion

The adoption of a customised tool like “Permaculture MESMIS” to evaluate the EWB on permaculture farms is suggested, because the sustainability evaluation needs to take into account all variables linked to social, environmental and economic aspects. The permaculture ethics and design principles provide a holistic framework for doing this. The EWB framework enables quantification of each process inside the managed landscape providing the ability to rank the sustainability of permaculture farms if compared to other methods where food production is the most important indicator.

It is important to highlight that the Permaculture MESMIS need to be refined, generalised in some cases, and adapted to suburban and urban environments, respecting different contexts. Future applications of the Permaculture MESMIS would help to refine the tool and to provide more detailed results and approaches, with the ultimate aim of designing better methods for the evaluation of ecological well-being.

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## References

1. Krebs, J., & Bach, S. (2018). Permaculture—Scientific evidence of principles for the agroecological design of farming systems. *Sustainability*, 10(9), 3218.
2. Mollison, B. (1988). *Permaculture: A Designers' Manual*. Tagari Publication, Tyalgum, Australia. ISBN: 978-0-908228-01-0
3. OECD (2017). *How's Life? 2017: Measuring Well-being*. OECD Publishing, Paris. ISBN: 978-92-64-28390-9
4. England, R. W. (1998). Measurement of social well-being: alternatives to gross domestic product. *Ecological Economics*, 25, 89–103. [https://doi.org/10.1016/S0921-8009\(97\)00098-0](https://doi.org/10.1016/S0921-8009(97)00098-0)
5. Decanq, K., and Schokkaert, E. (2016). Beyond GDP: Using Equivalent Incomes to Measure Well-Being in Europe. *Soc Indic Res.* 126, 21–55. <https://doi.org/10.1007/s11205-015-0885-x>
6. Costanza Robert; Hart Maureen; Posner Stephen; Talberth J. (2009). *Beyond GDP: The Need for New Measures of Progress*. <http://www.bu.edu/pardee/files/documents/PP-004-GDP.pdf> (Accessed April 28, 2019).
7. Costanza, R., Kubiszewski, I., Giovannini, E., Lovins, H., McGlade, J., Pickett, K. E., Ragnarsdóttir, K. V., Roberts, D., De Vogli, R., and Wilkinson, R. (2014). Development: Time to leave GDP behind. *Nature News*, 505, 283. <https://doi.org/10.1038/505283a>
8. Hamilton C. Saddler H. (1997). *The Genuine Progress Indicator, A new index of changes in well-being in Australia*. The Australia institute. No 14.
9. United Nations Development Programme (2019). *Human Development Index (HDI) | Human Development Reports*. Human Development Reports. <http://hdr.undp.org/en/content/human-development-index-hdi>. Accessed February 17, 2019.
10. McGillivray, M. (2006). *Human Well-Being: Concept and Measurement, Studies in Development Economics and Policy*, Palgrave Macmillan UK. ISBN: 978-0-230-62560-0.
11. United Nations Development Programme (2001). *Energy and Human Well-Being | Human Development Reports*. <http://hdr.undp.org/en/content/energy-and-human-well-being>. Accessed April 28, 2019.
12. Network of Well-being (2017). *Exploring the Links between Wellbeing and Permaculture*. <http://www.networkofwellbeing.org/index.php/blog/post/exploring-the-links-between-wellbeing-and-permaculture>. Accessed December 10, 2017.
13. WE All Home (2019). *Wellbeing Economy Alliance*. <https://wellbeingeconomy.org/> Accessed November 7, 2019.
14. Lockyer, J. and Veteto, J.R. (2013). *Environmental Anthropology Engaging Ecotopia*. Berghahn Books, New York, London. ISBN: 978-0-85745-879-7
15. Crosby, A., Lorber-Kasunic, J., and Accarigi, I. V. (2014). Value the Edge: Permaculture as Counterculture in Australia. *M/C Journal*. <http://journal.media-culture.org.au/index.php/mcjournal/article/view/915> Accessed February 19, 2019.
16. Centemeri, L. (2019). *Health and the Environment in Ecological Transition: The Case of the Permaculture Movement in Making Sense of Health, Disease, and the Environment in Cross-Cultural History: The Arabic-Islamic World, China, Europe, and North America*. Bretelle-Estabet, F., Gaille, M., and Katouzian-Safadi, M. eds, pp. 309–331, *Boston Studies in the Philosophy and History of Science*, Springer International Publishing, Cham, [https://doi.org/10.1007/978-3-030-19082-8\\_13](https://doi.org/10.1007/978-3-030-19082-8_13)
17. Corazon, S. S., Stigsdotter, U. K., Moeller, M. S., and Rasmussen, S. M. (2012). Nature as therapist: Integrating permaculture with mindfulness- and acceptance-based therapy in the Danish Healing Forest Garden Nacadia. *European Journal of Psychotherapy & Counselling*, 14, 335–347. <https://doi.org/10.1080/13642537.2012.734471>
18. Brown, K. W., and Kasser, T. (2005). Are Psychological and Ecological Well-being Compatible? The Role of Values, Mindfulness, and Lifestyle. *Soc Indic Res.* 74, 349–368. <https://doi.org/10.1007/s11205-004-8207-8>

19. Speelman, E. N., López-Ridaura, S., Colomer, N. A., Astier, M., and Masera, O. R. (2007). Ten years of sustainability evaluation using the MESMIS framework: Lessons learned from its application in 28 Latin American case studies. *International Journal of Sustainable Development & World Ecology*, 14, 345–361. <https://doi.org/10.1080/13504500709469735>
20. Silva, J. C. B. V. (2014). Ecologização do agricultor familiar: avançando desde uma transição ecoformadora. <https://acervodigital.ufpr.br/handle/1884/37259> (Accessed November 4, 2020)
21. Morgan, E. P. (1991). *The 60s Experience: Hard Lessons about Modern America*. Temple University Press. ISBN: 978-0-87722-805-9
22. Pereira, C. A. M. (1986). *O que é contracultura*. Brasiliense. ISBN: 978-851101-100-5
23. Mollison B. C. and Holmgren David (1990). *Permaculture one: a perennial agriculture for human settlements*. Tagari, Australia. ISBN: 978-0-908228-03-4
24. Ferguson R. S. and Lovell S. T. (2014). Permaculture for agroecology: design, movement, practice and worldview. A review. *Agron. Sustain. Dev.* 34, 251–274. <https://doi.org/10.1007/s13593-013-0181-6>
25. Ferguson R. S. and Lovell S. T. (2015). Grassroots engagement with transition to sustainability: diversity and modes of participation in the international permaculture movement. *Ecology and Society*. <https://www.jstor.org/stable/26270300>. Accessed November 3, 2019.
26. Paiter, L. L., Santos, L. dos, Venturi, M., and Nanni, A. S. (2018). A qualidade de vida em unidades rurais planejadas pela permacultura avaliada com base no MESMIS. *RHE*. 18, 141–159. <https://doi.org/10.14295/holos.v18i2.12268>
27. Santos, L (2018). A permacultura como dispositivo de resignificação do espaço geográfico., Trabalho de Conclusão de Curso de Graduação em Geografia. Universidade Federal de Santa Catarina, Centro de Filosofia e Ciências Humanas, Florianópolis, SC, <https://repositorio.ufsc.br/xmlui/handle/123456789/182866> (Accessed October 12, 2017).
28. Holmgren D. (2002). *Permaculture: principles & pathways beyond sustainability*. Holmgren Design Services, Hepburn, Victoria. Australia. ISBN: 978-0-646-41844-5
29. Harland, M. (2018). Future Care – redefining the third permaculture ethic. *Permaculture magazine*. <https://www.permaculture.co.uk/articld-permaculture-ethic-future-care>. Accessed March 12, 2018.
30. Powers, M. (2018). *The Advanced Permaculture Student Teacher’s Guide*. The Permaculture Research Institute. <https://www.permaculturenews.org/permaculture-shop/educational-resources/the-advanced-permaculture-student-teachers-guide/> Accessed April 13, 2020.
31. Mckenzie, L., and Lemos, E. (2017). *The Tropical Permaculture Guidebook: A Gift from Timor-Leste*. International Edition. ISBN: 978-0-648-16699-3
32. Dixon, M., and Spotten, S. (2017). *Future Care*. <https://permacultureproductions.com/2014/01/future-care/> Accessed October 26, 2017.
33. Gundersen D. T. and O’Day T. (2009). Permaculture, A Natural Systems Design Approach For Teaching Sustainability In Higher Education: Pacific University’S B-Street Permaculture Project. *Addressing Global Environmental Security Through Innovative Educational Curricula*, pp. 165–177, NATO Science for Peace and Security Series C: Environmental Security, Springer, Dordrecht, 10.1007/978-1-4020-9314-2\_16
34. Holmgren, D. (2002). *The Essence of Permaculture. Permaculture Principles*. <https://permacultureprinciples.com/resources/free-downloads/principles-poster> Accessed March 12, 2021.
35. Likert, R. (1932). *A technique for the measurement of attitudes*. Doctorate Thesis, The Science Press, New York.
36. Hinz, A., Michalski, D., Schwarz, R., and Herzberg, P. Y. (2007). The acquiescence effect in responding to a questionnaire. *Psychosoc Med*. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2736523/> Accessed October 28, 2017.
37. Barnette, J. J. (2000). Effects of Stem and Likert Response Option Reversals on Survey Internal Consistency: If You Feel the Need, There is a Better Alternative to Using those Negatively Worded Stems. *Educational and Psychological Measurement*. 60, 361–370. <https://doi.org/10.1177/00131640021970592>
38. López-Ridaura, S., Masera, O., and Astier, M. (2002). Evaluating the sustainability of complex socio-environmental systems. The MESMIS framework. *Ecological Indicators*. 2, 135–148. [https://doi.org/10.1016/S1470-160X\(02\)00043-2](https://doi.org/10.1016/S1470-160X(02)00043-2)
39. Ten Brink, B. J. E., Hosper S. H. and Colijn, F. (1991). A quantitative method for description & assessment of ecosystems: The AMOEBA-approach. *Marine Pollution Bulletin*. 23, 265–270. [https://doi.org/10.1016/0025-326X\(91\)90685-L](https://doi.org/10.1016/0025-326X(91)90685-L)