Chapter 12

Case studies in the quality-of-life assessment of cleaner energy interventions through 'narratives of impact'

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Abstract

In air quality programmes, interventions must be found to reduce air pollution from local sources of emissions in low-income contexts[1]. These sources include the burning of domestic fuels such as coal, wood, and paraffin, as well as the burning of domestic waste and vehicle-entrained road dust. Households use domestic fuels that cause harmful emissions: either as primary energy carriers or as stacking fuels for utilities such as cooking, space heating, and heating water for bathing and cleaning. When alternative cleaner energy options are introduced to households, it is crucial that these alternatives improve the quality of life of end users and do not introduce unforeseen negative side effects. Nova investigates the feasibility of interventions or intervention combinations before proceeding to larger-scale implementation.

1 Editors' note: Discussed in some of the preceding chapters, notably Chapters 3 and 4

This chapter scrutinises the process and results followed in feasibility assessments of interventions aimed at replacing or reducing wood use, the burning of domestic waste, and the use of paraffin. The feasibility assessments are done with a novel tool that Nova developed, the *Particular impact on quality-of-life assessment* (Piqola) tool. The chapter introduces the Piqola tool and provides case studies to show how it is used in practice. Specific focus is placed on the role of 'narratives of impact', that is, the information gained from verbatim feedback from participating end users describing how interventions impacted their quality of life. The Piqola tool results are contextualised and evaluated with reference to the broader field of quality-of-life studies.

Keywords: air quality in low-income settlements, energy poverty, narratives of impact, Particular impact on quality-of-life assessment (Piqola), quality-of-life assessment, quality-of-life studies, qualitative research

1. Introduction

As part of its mission to work towards improving the well-being of low-income communities in a responsible way, the Nova Institute, together with households and other stakeholders, is conducting community projects to improve air quality in line with national guidelines in provinces of South Africa that are home to mining operations and coal-fired power plants. The Nova Institute has initiated a novel approach to assessing how introducing interventions to improve everyday lives makes a difference in the quality of life of low-income households in South Africa. It is essential to test potential interventions before scaling these interventions up to the community level. Likewise, in air quality offset programmes, interventions are aimed at reducing harmful emissions caused by domestic energy use. Alternative energy usage patterns introduced to households will only be sustainable if the end users are satisfied with these interventions. Ultimately, end users must be placed in a better situation post-intervention than before the intervention. Therefore, much effort needs to go into planning community projects carefully and systematically to ensure

that the information needed to carry out interventions at scale is known in advance. No stone is left unturned to ensure that interventions fit with householders' needs and lifestyles, as well as their expectations of a better life in future.

Organisation of the Chapter

In this introduction, we first brief the readers on the Nova Institute's novel Piqola tool that is used to evaluate the feasibility of Nova's interventions by assessing the quality-of-life impact on end-using households. The next sections detail Piqola case studies to demonstrate step by step how the Piqola tool was applied in practice. We describe the Piqola indicators that measured how households went about and were satisfied with their daily routines before and after interventions to offset wood and waste burning and paraffin use. We then present findings from the Piqola case studies that showcase the value of narrative responses to inform decisions to implement interventions to scale in the communities under study. The final section discusses the contribution of Piqola to quality-of-life studies and the Social Indicators Movement. The context is the Anthropocene from a developing world perspective.

2. The Qola and Piqola Tools

Nova researchers have developed two original research tools to assess quality of life. The first tool, the Nova *Quality-of-Life Assessment (QOLA) tool, is used to gain a broad overview of an individual's quality of life within* the context of household life. The development and application of this tool are described in an article in the *International Journal of Sustainable Development* by Murray and Pauw (2022). The second tool, the *Nova Particular impact on quality-of-life assessment* (*Piqola*) tool, is used to assess the impact of a particular intervention on the quality of life of an individual in the context of household life. In this chapter, the authors will describe how the Piqola tool works and provide practical examples of how the tool was successfully used to assess the impact on quality of life of interventions to reduce air pollution.

Both the Qola and the Piqola tools build on the conceptual work of Manfred Max-Neef[2] (Max-Neef et al., 1991). For Max-Neef, quality of life depends on the possibilities that people have to adequately satisfy their fundamental human needs. Max-Neef differentiates between needs and satisfiers. For Max-Neef, needs are finite, few and classifiable and do not differ between cultures. Needs are values that include both the aspects of *deprivation* and *potential* (or *capabilities*). His typology of needs is based on nine values: *subsistence, protection, affection, understanding, participation, creation, idleness, identity,* and *freedom*, to which a tenth, *transcendence*, could be added. Thus, what differs between people is not their fundamental human needs but how these needs are satisfied or actualised (Murray & Pauw, 2022).

The development of Nova's quality-of-life assessment tools involved designing a conceptual framework and database for *need-satisfier-interface-analysis*. This was performed by extending Max-Neef's fundamental human needs typology to include aspects of needs and by identifying hundreds of aspects of the household as a complex system and reducing it through a process of semantic clustering to 25 constitutive elements. When the 10 fundamental human needs are placed on the x-axis of a matrix and the 25 household elements on the y-axis, there are 250 need-element interfaces, which Nova uses to analyse need satisfaction in the context of the household.

The difference between the Qola and Piqola tools. The Qola tool starts with a survey with 250 questions that probe need-element-interfaces to get an indication of the quality-of-life perception of an individual in the context of household life. In contrast, the Piqola tool does not start with an existing questionnaire - it is a hermeneutic tool that is used to generate questionnaires. The well-known strengths, weaknesses,

2 Editors' note: The thoughts of Max-Neef (1932-2019) underlies much of this book although it is explicitly mentioned only here and in Chapters 1 and 4. He was known as "The Barefoot Economist" because of his work amongst the poor and his interpretation of development.

opportunities and threats, or SWOT,[3] analysis could perhaps assist in explaining the approach: In a SWOT analysis, one would typically think or brainstorm about issues that confront your business. You will then consider per issue if it is a strength, weakness, opportunity, or threat. Thus, you creatively place an issue, your business, and one of the four SWOT categories together in a hermeneutic domain. SWOT's originator, Robert Franklin Stewart, emphasised the crucial role that creativity plays in the planning process (Puyt et al., 2023). The process aims to facilitate an enhanced understanding of the issues that confront your business to conduct better strategic planning. Whereas the SWOT analysis has four hermeneutic domains, the Nova Piqola framework has 250 hermeneutic domains, or one could also refer to these domains as *need-element-interfaces*.

When using the Piqola tool to generate a questionnaire to measure the impact of an intervention on quality of life, the researcher starts by considering whether the intended intervention could impact on quality of life in each of the 250 domains. Questions that could probe impact are written down in a matrix per domain. This leads to a comprehensive set of questions, which is later analysed and reduced to a practical number of questions for a pre- and post-intervention Piqola survey. Thus, the Piqola tool facilitates a process of *need-element-interface-brainstorming* to generate fitting questions to assess the particular impact of an intervention on the quality of life of end users.

The Piqola survey usually arranges these questions into three categories:

1. Broad semi-structured questions, which are open-ended questions that lead to narrative feedback from respondents. An example of such a question is: Could you please tell us how your household cooks?
2. Satisfaction questions that apply a numeric scale (0–10) that offer respondents the opportunity to rate their satisfaction with aspects of an intervention. An example of such a

3 Editors' note: This is also used as a method of analysis in Chapter 9.

question is: How satisfied are you that you can cook the way that you want to? (0–10)

3. Likert scale questions, which are statements with which respondents can *strongly disagree, disagree, agree, or strongly agree*. An example of such a statement is: Men and women should share cooking responsibilities.

Applying Piqola creatively. The Piqola tool requires experience and creativity from the researcher who applies the tool. Therefore, it is like a wood chisel in the hand of a sculptor rather than a lawnmower that does not require sophisticated skills from the user. The tool facilitates a comprehensive approach to quality-of-life impact assessment, maximising the chances of including relevant questions to explore the impact that the introduction of a new usage pattern can have in the context of a household as a complex system. The tool provides a way not only to gain insight into end user perceptions but also to compare pre- and post-intervention perceptions of participating respondents.

Community engagement. Perhaps the most discernible value of the tool is that it allows for the participation of community members as research partners to share narratives of their lived experiences. Therefore, if applied correctly, the tool does not enforce a preconceived model onto respondents. The comprehensive brainstorming exercise maximises the chance that relevant questions are included. In terms of the approach, the questionnaire starts with open-ended questions, which must allow the respondent to answer spontaneously without being influenced by the interviewer.

Table 11 lists the ten fundamental human needs as proposed by Max-Neef et al. (refer to the left columns of the table), and the 25 household elements identified by Murray and Pauw (2022) (refer to the right columns of the table). These household elements can further be arranged in six element categories (refer to the middle columns of the table).

Table 11: Fundamental needs and quality of life

	Fundamental Needs		**Element categories**		**Household elements**
1.	Subsistence	a.	Basic necessities:	1.	Water
2.	Protection			2.	Food
3.	Affection			3.	Waste
4.	Participation			4.	Clothes
5.	Understanding	b.	Localisation:	5.	Terrain
6.	Creation			6.	Air
7.	Idleness			7.	House
8.	Identity			8.	Climate
9.	Freedom			9.	Sound
10.	Transcendence	c.	Basic activities:	10.	Care
				11.	Work
				12.	Rest
		d.	Relationships:	13.	Self
				14.	Closest partner
				15.	Household members
				16.	Non-household member
		e.	Consciousness:	17.	Trust
				18.	Sensation
				19.	Motivation
				20.	Communication
				21.	Choice
				22.	Discovery
				23.	Meaning
		f.	Body structure:	24.	Gender
				25.	Development phase

3. Piqola in action: assessments of interventions

This chapter aims to introduce quality-of-life researchers and other readers to the Piqola tool in action. We describe how Nova conducted research in target communities to assess the impact of different types of interventions for beneficiaries. We systematically follow each step of three real-life community research projects to illustrate how Piqola generates the most appropriate social indicators to measure the impact of interventions. We present the set of questions that invited households to share their lived experience of daily routines before and after interventions. The open-ended Piqola questions invite respondents to produce 'narratives' that are key to a better understanding of the practical impact of interventions on different aspects of life as well as on overall quality of life. We hope to convince readers that Piqola may become the future research tool of choice for scholars involved in community quality-of-life studies, particularly in a developing country context, where the particular impact on the quality of life of interventions needs to be assessed.

3.1 Piqola case studies

We outline how Nova conducts its research to evaluate air-quality offset intervention options in selected target communities to reduce emissions from domestic wood and paraffin use, and waste-burning. For an intervention to be feasible, it should reduce emissions, have a positive (or at least neutral) impact on quality of life, and be practically implementable. The Piqola tool is used to assess feasibility from a quality-of-life perspective. The intervention should provide better utility to end users than the technology or practices that they are currently using without additional costs, negative side effects, or risks. The in-field feasibility testing using the Piqola tool informs Nova whether the interventions can be upscaled to the whole community.

Research methodology. Target research participants in each of the five different communities under study were assigned to experimental groups and control groups of 20

respondents each. The main person responsible for household tasks was interviewed. Interviews were conducted in the local language. Fieldworkers drawn from the target communities were trained to conduct the interviews. The same fieldworker interviewed the same person in the experimental groups before and after the intervention using Piqola to assess satisfaction with the intervention. Householders' responses were recorded with their permission and translated into English.

In the three **wood-burning communities**, the in-field feasibility study was conducted with six experimental and three control groups of 20 households each. The experimental groups were provided with different combinations of interventions, including the solar water heater, rocket stove, liquified petroleum gas (LPG) stove, as well as a *Wonderbag*[4], as shown here and in Table 12.

Solar water heater

The solar water heater (SWH) installation comprises two distinctive components: the SWH unit (Apollo Solar Technology, 100-litre, low-pressure system) with mounting frame, and a wooden pedestal on which the SWH is mounted. The design attempts to eliminate the safety risk, structural risk and maintenance risk associated with working on the roofs of low-income houses.

4 Editors' note: See Chapter 4.

Figure 27: Solar water heater

Rocket stove

A rocket stove is an efficient and hot-burning stove using small-diameter wood fuel burned in a simple combustion chamber with an insulated vertical chimney. This design ensures almost complete combustion before the flames reach the cooking surface. A *Burn Kuniokoa* stove was selected for the feasibility testing.

Figure 28: Rocket stove

Wonderbags

The *Wonderbag* is a non-electric slow cooker that uses heat-retention technology to continue cooking food once the pan has been removed from the heat source. Nova fieldwork teams distributed the *Wonderbags* with pots to participating households and trained them on usage.

Figure 29: Wonderbags

LPG stoves and cylinders

A 4-burner LPG stove and oven from Totai was selected for the feasibility testing.

Figure 30: LPG stove and cylinder

The fieldwork in the **paraffin-use community** was conducted with an experimental and a control group of 20 households each. The experimental group was provided with LPG stoves to replace their paraffin stoves as a potential offset intervention to reduce domestic paraffin use, as well as a *Wonderbag* (see Group 7 in Table 12).

Separation at source waste model

The intervention in the **waste-burning community** was a locally operated, full recycling with separation at source waste model. Three bins for the separation of recyclable, non-recyclable, and organic waste were provided for a stand, also known as a service centre, consisting of single and multiple households. The intervention further included a service provider (locally recruited waste-pickers[5]) and a central material-sorting facility. The experimental and the control group, of 20 households each, were randomly drawn from the first 50 stands included in Nova's in-field feasibility testing.

Table 12: Interventions provided to experimental households participating in the in-field feasibility studies

	Interventions				
Community Type	**Solar water heater**	**Rocket stove**	**LPG stove**	**Wonder bag**	**S@S waste model (bins)**
Wood-burning					
Community 1					
Group 1	X	X		X	
Group 2		X		X	
Group 3	X			X	
Community 2					
Group 4		X	X	X	
Community 3					
Group 5			X	X	

5 Editors' note: Also see Chapter 5.

	Interventions				
Community Type	**Solar water heater**	**Rocket stove**	**LPG stove**	**Wonder bag**	**S@S waste model (bins)**
Group 6		X		X	
Paraffin use					
Community 4					
Group 7			X	X	
Waste-burning					
Community 5					
Group 8					X
Total	**2**	**4**	**3**	**7**	**1**

The Piqola research in the five communities was conducted in two phases: The experimental and control groups were interviewed before intervention; the experimental groups were both interviewed pre- and post-intervention.

4. Piqola pre-intervention indicators

The Piqola tool lends itself to evaluating the feasibility of the different interventions from a quality-of-life perspective. The following sets of broad semi-structured questions, as outlined in the introduction, were posed to householders initially, before receiving interventions.

4.1 Overall Quality-of-life Indicators

Members of the experimental and control groups were posed three of the most frequently asked questions in quality-of-life studies conducted worldwide. Respondents were asked to rate their hedonic quality of life, that is, life satisfaction and happiness, and their eudaimonic quality of life, which refers to meaning and purpose in life. The following three questions were put to respondents:

> "All things considered, how satisfied are you with your life as a whole these days?"

"How happy did you feel yesterday?"

"To what extent do you feel that the things you do in your life are worthwhile?"

4.2 Descriptive Daily Routine Indicators

The initial broad-based questions put to respondents participating in the Piqola feasibility studies aimed to understand how their households went about their daily routines for cooking, heating, and waste removal. Respondents were encouraged to explain in greater detail when replying to the indicators.

4.2.1 Wood-burning and paraffin-use communities

Pre-intervention, all respondents, members of the experimental and control groups in the wood-burning and paraffin-use communities, were asked about their daily household routines that used energy. They were invited to describe how they went about cooking, heating water, bathing, washing and ironing clothes. They were asked about personal preferences and safety related to such household tasks ("Does the way that your household cooks suit you as a person?" "Is the way that your household uses warm water safe?"). Wood-burning households were also asked, "What do you like best, and what do you like least about cooking on an open fire?" The paraffin-use households were questioned about where they had bought their current stove and how they felt about the presence of the stove in their house.

4.2.2 Waste-burning communities

Similarly, the waste-burning experimental and control groups were asked to describe their waste disposal routines: Where and when they usually dumped or burned household waste ("Does your household sometimes burn waste inside your yard?"); what type of waste and how often they burned waste; as well as preferences and problems with the disposal of waste. Households with small children were asked how they disposed of diapers.

4.3 Satisfaction Indicators

Satisfaction questions are amongst the most frequently used social indicators to assess quality of life overall and across specific domains of life. They are sometimes used as 'dashboard' indicators that show how social policy and interventions impact community quality of life. The World Happiness Report (WHR, 2025) uses the Cantril (Cantril, 1965) ladder as its satisfaction measure. The extensive World Database of Happiness includes satisfaction measures from around the world (Veenhoven, 2023). The Diener et al. (1985) Satisfaction with Life Scale, and Multiple Discrepancy Index are based on satisfaction ratings.

Nova's Piqola tool measures satisfaction with the standard 11-point scale from zero to ten, where zero is not at all satisfied and ten is completely satisfied. Respondents were asked to rate their satisfaction with various aspects relevant to the understanding of the impact that the intervention could have on the quality of life of participating households. The satisfaction questions indicated below were put to the experimental and control groups.

4.3.1 Wood-burning communities

Piqola satisfaction items picked up on the descriptive indicators that enquired about how the household went about daily routines. The nine satisfaction items used in the wood-burning groups enquired: "How satisfied are you with the warm water that your household has for cooking / for bathing / for washing clothes / and for washing dishes?" "How satisfied are you that you can cook / your family can bathe / your household can wash clothes / dishes / iron clothes the way that they want to?"

4.3.2 Paraffin-use community

Similarly, the paraffin-use households were asked about their general satisfaction with the stove that they currently use, and how the stove "cooks / heats water / heats the house", and whether the stove "is right for you as a person" and "for your household?" Respondents were asked to share their views on how safe it is to cook with electricity, wood, and paraffin.

4.3.3 Waste-burning community

Households were asked to give a satisfaction rating for five items: "How satisfied are you with the way that your household currently manages your domestic waste / with how waste is managed in your community / with the cleanliness of your community / with the cleanliness of your yard outside your home / that the way that your household manages waste suits you as a person?"

As was the case with wood-burning and paraffin-using communities, the experimental group respondents were asked post-intervention to rate their satisfaction with the waste intervention and to respond to the same set of pre-intervention satisfaction items as described above.

4.4 Likert Scale Indicators

Likert scale questions are regularly used in social indicators research to sound opinions and viewpoints. The Piqola used Likert scale indicators on viewpoints held by community members to gain a better understanding of the impact that the Nova interventions could have on the quality of life of beneficiary households. Likert-style questions help to gain an indication of how many respondents share specific viewpoints. Consequently, it is one way to integrate quantitative and qualitative responses.

The Likert scale questions asked respondents whether they strongly agreed, agreed, disagreed, or strongly disagreed with statements related to energy use and to waste management. Questions eliciting the following responses were put to experimental and control groups:

4.4.1 Wood-burning communities

The experimental and control groups in the wood-use communities were asked Likert scale questions related to their possible concerns, preferences, and viewpoints.

Concerns: "I have enough energy for cooking food at times that I want to", "I can get burnt when I work with hot water", "My children can get burnt by hot water."

Preferences: Other statements enquired about energy use and wood-burning preferences: "I like the way that we heat water for bathing in our household", "I like it most to bath with water heated on an open fire", "I like the smell of smoke of a wood fire", "In winter times, we sometimes stand around the fire outside to stay warm."

Viewpoints: "Water that is boiled on a fire stays warmer longer than water boiled with electricity." "The smoke of a wood fire can heal your eyes." A statement also enquired about respondents' views on gender equality: "Men and women should share their cooking responsibilities."

4.4.2 *Paraffin-use community*

The experimental and control groups in the paraffin-use community were asked similar Likert scale questions related to their possible concerns and preferences. They were also asked about dependency on paraffin use and culture-related issues.

Concerns: I am satisfied that "I have enough energy to cook my food when I want to", and "Our household has enough energy to heat our house to a comfortable temperature when it is cold", and "I sometimes worry that my way of cooking / heating water is not safe."

Preferences: "I like my current way of cooking / the smell of a paraffin stove / wood fire." "Food cooked on a paraffin stove / wood fire tastes better than food cooked on a paraffin / electrical stove."

Dependence on paraffin: "I sometimes borrow paraffin from neighbours or family." "My neighbours or family sometimes borrow paraffin from me."

Culture: "Making an open fire connects us with our ancestors."

4.4.3 Waste-burning groups

Respondents were asked if they agreed or disagreed with the following twenty statements related to waste disposal practices in their community, as well as personal viewpoints.

Waste disposal routines:

Our household sometimes feeds animals with our organic waste.

Our household makes compost from our organic waste.

Our household currently has a vegetable garden.

A vegetable garden will not work for our household.

Most people in our community burn their waste at night.

Our household keeps glass bottles aside for recycling.

Our household keeps plastic aside for recycling.

Our household currently makes an income from waste recycling.

Problematic waste disposal issues:

I am often bothered by the smell of smoke from waste burning.

At our home, we often get bad smells from waste lying around in the community.

Animals digging in the waste of our household is a problem.

Viewpoints on waste disposal:

Burning non-recyclable waste is the best way to get rid of it.

It is acceptable to burn waste during the day.

Burning waste has a bad impact on the health of our community.

It is wrong to throw waste in the street.

Gender issues:

Waste burning is a woman's job.

Dumping waste in public is a woman's job.

Agency:

My household can help to keep our community clean.

I would like to learn more about how my household can recycle waste.

Waste picking is a job I would consider.

5. Piqola post-intervention indicators

5.1 Follow-up Overall Quality-of-life Indicators

The three frequently asked quality-of-life questions of the pre-intervention survey were again posed in the follow-up post-intervention Piqola survey.

5.2 Follow-up Descriptions of Daily Routines

The same questions asked of the experimental groups at the outset were again posed to them to learn how their interventions were utilised, about their safety, and how well they suited householders and impacted their daily lives and well-being.

As shown in Table 12, the experimental groups in the wood-use communities had received one or a combination of interventions (solar water heater, rocket stove, LPG stove) as well as a *Wonderbag*. The paraffin-use experimental group had been provided with the LPG stove and a *Wonderbag*. The waste-burning experimental group had received bins in which to deposit their separated waste, which was collected regularly.

5.3 Follow-up Satisfaction and Likert Scale Ratings

The respondents in the experimental groups were again asked to rate the same satisfaction and Likert scale items as in the pre-intervention phase. In addition, the waste-burning experimental group was asked to indicate their overall satisfaction with the waste project: "How satisfied are you in general with your participation in the waste project?"

5.4 Post-intervention Piqola 'Narrative' Questions

The selection of the most appropriate questions to evaluate the impact of the Nova interventions covered the fundamental human needs as set out in Table 13. The list of general and specific broad semi-structured questions put to the experimental groups post-intervention invited respondents to narrate the lived experience of using the intervention combinations. The fieldworkers were instructed to ask respondents to explain their answers in greater detail, especially in the case of questions that could be answered with a simple 'yes' or 'no' reply. In the lists below, such questions have one or two asterisks added. The narratives produced qualitative evidence that Nova would use to evaluate whether the interventions had indeed impacted positively on the quality of life of the target households participating in the case studies.

Table 13: Piqola: selection of the most appropriate post-intervention questions for households in the wood- and paraffin-use / waste-burning communities

1.	How do you feel about the intervention (different combinations of SWH / rocket stove /LPG or *Wonderbag*) / the waste project you are participating in?
2.	What is the best thing about your intervention / the waste project?
3.	What is the worst thing about your intervention / about the waste project?
4.	Has the intervention / waste project impacted on your household? *

5.	Would you recommend this intervention / the waste project to other households in your community? *
6.	Is there anything that you miss from your old way of doing things? *
7.	Has the intervention / the waste project made life easier or more difficult? *
8.	Will you continue to use the intervention when this project finishes? / Do you plan to continue to separate your waste? *
9.	Is the intervention equally acceptable in your culture as the way that you cooked and/or heated before? / Would you say that the burning of waste is more accepted in your culture than the separation of waste? *
10.	Do you pay more, less, or the same for energy since you started the intervention?" * (Not asked of waste project respondents)
11.	Has the intervention / the waste project changed the way you feel about yourself? **
12.	Has the intervention / the waste project changed the responsibilities of your household members? **
13.	Has the intervention / the waste project changed the way your closest partner appreciates you? **
14.	Has the intervention / waste project influenced your relationship with your neighbours? **
15.	Has the intervention / waste project changed the way you feel as a woman/man? **
16.	Has the intervention changed the amount of time that you spend inside your house?" ** (Not asked of waste project respondents)
17.	Has the intervention / waste project changed the way that you utilise your stand? **
18.	Did you have to do any repair work on the intervention since the project started / Are any of your (waste) bins broken or damaged? **
19.	Has the intervention / waste project impacted on the health of anyone in your household? **
20.	Has the intervention / waste project impacted on the amount of rest you get? **

** Respondents were asked: "Please explain your answer."*

*** Respondents who replied 'yes' to the question were asked "to please explain."*

5.5 Persistence of Pre-intervention Habits

Additional questions put to the experimental groups explored whether households still practised some of their pre-intervention wood-burning or waste-disposal habits.

5.5.1 Wood-burning and paraffin-use experimental groups

Respondents were asked if their household had made an open fire outside since they had started using their interventions. Respondents in the paraffin-user group were asked if they still sometimes use paraffin, and whether they had lent paraffin to anyone since the intervention started.

5.5.2 Waste-burning experimental group

Pre-intervention experimental and control groups in the waste-burning communities had been asked how and where they burnt or dumped their waste and disposed of diapers. Follow-up questions put to the waste project's experimental group repeated these questions. Post-intervention, respondents in the experimental groups were asked how the waste project had changed the way that they felt about the waste situation in their community. They were asked to give feedback on how they felt about the training and the waste bins that they had received, as well as about the waste collector who collected their waste. Had the project changed the way that they felt about waste collection as a possible job option for themselves? Lastly, respondents were asked if they had continued to burn or dump household waste in their yard or in a public place since the project started.

6. Data analysis

The results of all Piqola indicators collected before and after interventions for each of the control and experimental groups were compared to measure the impact on quality of life. The comparison of the values of the satisfaction and Likert scale indicators from pre- to post-intervention provided quantitative evidence of successful outcomes.

In the case of the qualitative selection of the most appropriate questions generated by the Piqola, narratives given by the experimental and the control groups in response to each question were content-analysed and collated into exhibits. The exhibits summarised the narratives along with 'quotable quotes.' Comparison of the pre- and post-intervention narratives showed how the interventions had impacted different aspects of the lives of beneficiaries of the Nova interventions and overall quality of life.

7. Reporting of Piqola indicators

The reports on the in-field feasibility studies for the three case studies covered the results of all the Piqola indicators collected from the participant experimental and control groups.

7.1 Satisfaction Indicators

Satisfaction ratings given pre- and post-intervention were compared to measure the impact on quality of life. For example, in the case of the **wood-burning** experimental group that had been issued a combination of three offset interventions (see Table 12), the solar water heater scored the highest mean satisfaction rating of 9.95 out of 10, followed by the rocket stove with 9.20, and the *Wonderbag* with 8.86.

In the **paraffin-use community**, participant households in the experimental and control groups were dissatisfied with the stove that they were using. The participants, who were provided with an LPG stove, experienced a significant increase in satisfaction from a median 3 out of 10 to a 10 out of 10 rating when switching from a paraffin to LPG, also considering the perceived safety considerations when using LPG.

In the **waste-burning community**, satisfaction increased in response to all questions from before to after the intervention. For example, on a scale of 0 to 10, satisfaction for "the way that your household currently manages your domestic waste" increased from a median of a 3 score before the intervention to 10 after the intervention. Post-intervention, respondents scored

a median of 10, indicating that they were completely satisfied with their participation in the waste programme.

7.2 Likert Scale Indicators

Results on the Likert scale indicators pre- and post-intervention were compared for each experimental group, as in the following examples:

In one of the **wood-burning** communities, the LPG / rocket stove / *Wonderbag* experimental group's agreement with the statement "I am satisfied that I have enough energy to cook my food when I want to" increased from 50% pre-intervention to 100% post-intervention. Conversely, the group's agreement with the statement "I like it most to bathe with water that was heated on an open fire" decreased from 81% pre-intervention to 75% post-intervention.

In the **paraffin-use** community, a large improvement in reported energy needs and uses was reported post-intervention. For example, 100% of the experimental households agreed that they could cook food when they wanted to, compared to 13% before the intervention.

In the **waste-burning** community, 100% of respondents agreed pre-intervention with the statements: "At our home, we often get bad smells from waste lying around in the community", and "I am bothered by the smell of smoke from waste burning". Post-intervention, only 21% and 29% agreed with each of these statements, respectively.

7.3 Piqola Narrative Responses Summarised in Textboxes

The narrative responses to the set of 20 Piqola questions in Table 13 and any additional questions were recorded for each experimental group. The narratives were content-analysed to assess changes in the daily routines of cooking, heating water, bathing, or disposing of household waste pre- and post-intervention.

Textboxes were prepared for the narrative responses to the descriptions of daily routines and to each of the Piqola

'best' questions in Table 13. Each textbox presents a summary of responses along with a selection of narratives, the most informative 'quotable quotes'.

The textbox assists Nova researchers in understanding better how an intervention impacts a particular aspect of life or overall quality of life. The following three textboxes illustrate how narrative responses to Piqola questions are summarised with quotable quotes.

7.3.1 Textbox 1

Paraffin-use community. The first textbox presents narratives in response to a descriptive daily-routine indicator on safety put to respondents pre- and post-intervention in the paraffin-use households. The textbox compares the results of the experimental group that received the intervention and the control group that did not.

"Is the way that your household cooks safe? Please explain."

Paraffin-use Experimental Group	
Pre-intervention result summary	**Post-intervention result summary**
Only three respondents say that it is safe to use the paraffin stove: the 1st respondent because he stays alone and there are no children; the 2nd because she has not had an accident, but she is aware of the risk; and the 3rd says it is a "little safe", because she knows how to use it, but paraffin is not safe. The danger that the paraffin stove can burst or explode, and that one must stay close to it to guard it, has been mentioned repeatedly before, and 13 respondents emphasise it again; of these, 2 say that it is dangerous to have children around. Another 4 mention the danger of smoke "getting into your chest", or giving you the flu.	All participants agree that the new stove is safer than their previous methods: Mentioning that the LPG stove is safer when there are children in the house, it cannot burst, and the safety allows them to also leave the house while food is cooking.

Pre-intervention quotable quotes	Post-intervention quotable quotes
HH7: "It is not right. Because of this smoke, you'd find us even being dark in complexion." HH14: "No, it is not safe. I have mentioned when I cook with this stove, it will burst and make a boom sound. It has never happened that it burned the house. But you must always observe it and make sure that the fire is heating okay. And that it is in the right position for cooking." HH19: "No, it is not safe. I can only say it is safe because we can eat. The smoke causes flu, and even if you are craving tea, you cannot light the stove and heat water because of the smoke that it causes." HH20: "No, it is not safe. I have mentioned it before that the paraffin has a problem of getting into your chest. And if I cook food late, I cannot leave the door closed. I must leave it opened so that the smoke goes out."	HH6: "The new method is safer because with the paraffin, when there is a child in the house and you make a mistake by spitting the paraffin on the floor and if the stove falls, the house could burn." HH10: "This one I am using now. Because the old way used to give me problems when I cooked using a flame stove. I had to not go out of the house; I had to stay in the house. Now I can go out of the house; there is not much problem."

Paraffin-use Control Group (pre-intervention only)
Pre-intervention result summary
The majority of participants said that the way that they are currently cooking is not safe; the main concern is the paraffin stove bursting. Other participants mentioned problems with smoke, burning risks for children, and that they need to keep an eye on the stove while they are cooking. However, a few participants mentioned that the stove is safer, specifically that it is safer than a wood fire. They make fire outside, which is safer than inside, and their specific stove does not burst.
Pre-intervention quotable quotes
HH8: "No, it is not safe. The stoves burst sometimes and the smoke from the paraffin is not okay when you sleep. At other times, when you breathe, you feel blocked in the nose." HH15: "Yes, it is safe because paraffin is better than the open fire." HH17: "No, I do not see it safe. Because the stove sometimes bursts, so when you cook with it, you must be careful."

7.3.2 *Textbox 2*

Wood-burning community. The second textbox summarises narratives in response to Piqola question 1 on the overall quality of life in Table 13 for an experimental group post-intervention. The quotable quotes illustrate how happiness peaked in this group of households.

Experimental group 1: Supplied with solar water heater, rocket stove, and *Wonderbag*

"How do you feel about the intervention?"

Post-intervention result summary
All participants reacted very positively to the intervention, especially mentioning the solar water heater. Respondents say that they can now save time and especially electricity. Several respondents mentioned that they enjoy bathing in hot water without using electricity or fire to heat it.
Post-intervention quotable quotes
HH9: "Do you know how happy I am?! I am happy, happy, happy, I wish I had everything that could make me use them every day, like the food; the wood I can burn with the water, I don't even want to say, we bathe very nicely, we even save electricity units even when we boil water." HH6: "I am so happy, especially with the geyser, because I don't have to use so many woods and I always have hot water. Even the stove is wonderful; I cook the way I like." HH17: "I feel very happy because they've reduced the hard work. We used to have to wake up early in the morning to make fire to heat water. Things are easy now."

7.3.3 *Textbox 3*

Waste project community. The third textbox showcases narratives in response to Piqola question 5 in Table 13 on whether the waste project should be recommended to other households in the community.

"Would you recommend the waste project to other households in your community? Please explain your answer."

Post-intervention result summary
All but one of the participants would recommend other households to take part in the waste project. Most participants said that others should take part because it works and keeps their area clean. The participant who would not recommend it said: "No, I don't know, it is your work. If I get R1,000.00 to send to my children?"
Post-intervention quotable quotes
HH5: "Yes, I can be able to tell people that I like this project because it has made this place clean. Since this project took place, there is a difference; we can see change from it."
HH14: "I would tell people, even now, I do tell them. I tell them about the goodness of it. I wish that if everyone could get these dustbins, it would be a very beautiful, good thing. As it is beautiful for us too."

8. Final assessment of the impact of interventions on quality of life

The final reports on the three case studies outline how the interventions impacted the quality of life of the target experimental groups post-intervention, drawing on the quantitative and qualitative responses to Piqola questions. The survey results are used to assess whether it would be advisable to upscale the distribution of the Nova interventions to all households in the communities under study. For the Nova interventions to be feasible for further testing and upscaling, three questions must be answered in the affirmative: Did the intervention reduce emissions from the target pollutant? Was the quality-of-life impact on end users positive or neutral? Was the potential offset intervention implementable? The Piqola assessment results are used to answer the second question, namely, what quality-of-life impact did the intervention have on the end users.

We provide an example of how the narrative responses to the Piqola selection of the most appropriate questions might be reported in a final assessment.

> Generally, the interventions to offset wood and paraffin use and waste dumping were well-received. Some respondents even enthused about how the interventions had impacted them personally and in daily life in their

households. The satisfaction and Likert scale ratings were generally higher post-intervention for end users. Only a few respondents missed the older ways of doing things. The majority stated that they would continue using the new cooking and water-heating interventions or practise the new waste management system and would recommend them to other households in their community. The interventions and the waste project had made life easier, saved time and money, and were also accepted in their culture. Members of the solar water heater / rocket stove / *Wonderbag* experimental group expressed gratitude that the interventions allowed them to save wood and to make progress in life, sentiments best captured in a quotable quote: "No, I miss nothing. Life has changed, life goes on. That's the old life, that's the poor life, it must stay behind, we're moving forward". Respondents indicated that the interventions had made them feel more positive about themselves. Their homes and yards were cleaner and more beautiful, and they felt more respected in their community. Some respondents in the wood-burning communities were grateful that their clothes no longer reeked of smoke or the smell of paraffin. Participants in the waste project no longer had to put up with the smell of rotting or burning garbage. Post-intervention respondents described in what ways they felt more appreciated by their closest partner, some of whom now more readily shared household responsibilities. For example, now that their households were equipped with interventions that were easier and safer to use, children were able to be more independent and could assist with household tasks. Post-intervention relationships with neighbours in the wood and paraffin-use communities tended to be mixed. Some neighbours were jealous and felt that they had been overlooked, while others hoped that they would become beneficiaries in future. Some neighbours were pleased for the beneficiaries next door and enjoyed being allowed to use their new stove or hot water occasionally, or during electricity blackouts. Respondents in the waste-burning communities

commented positively on their waste workers, and some said that they might even consider the job of waste worker as an employment option. Some householders in the wood-burning communities indicated that they did spend more time in the house post-intervention: they appreciated not having to collect wood or cook or heat water outdoors, particularly when it rained or in winter. There seemed to be few changes in utilising the households' stands, apart from a few mentions of planting a garden or having a tidier backyard, now that no waste was deposited or burnt there. In the few cases that the interventions had given problems, the need for repairs had been reported to Nova and were carried out promptly. In contrast, one experimental group noted that their community had received solar water heaters in the past that were faulty - they had not been repaired and were now in disuse. Householders reported that many of their pre-intervention health concerns had lessened or had been resolved now that their heating and cooking interventions were more efficient and safer to use. In particular, the paraffin stove had been tricky to operate and tended to 'explode'. The interventions allowed for more rest: Households in the wood-burning communities no longer needed to rise early to cook or heat water in the morning, and did not go to bed late after cooking supper at night. In some cases, the shorter cooking times and no longer having to watch water heat over the fire or mind the *Wonderbag* allowed for greater freedom to meet friends and pursue spare-time activities. Similarly, households participating in the waste management project did not need to dump or burn their waste at specific times of the day to be considerate of their neighbours.

9. Discussion

9.1 A homegrown instrument

Until recently, most instruments that measure quality of life have been developed by scholars in the Global North. The Piqola tool represents a pioneering effort to develop a homegrown instrument for use in developing countries.

Land and Michalos (2018), in their review of 50 years since the launch of the 1960s Social Indicators Movement, stressed the importance of documenting quality of life in a changing world. They invited suggestions for the way forward. In response to this call, three of their colleagues based in the Global South identified the need for a wider range of research approaches to widen the scope of quality-of-life and social indicators studies. For example, there was a need to enhance the policy relevance of the Social Indicators Movement (Rojas, 2018), to make more use of mixed-method data collection (Shek & Wu, 2018), and to enquire into human agency to improve quality of life, in particular on the part of women and mothers (Tsai, 2018).

The Piqola tool is a unique instrument that meets these recommendations. It represents a theoretically grounded approach to community quality-of-life research. Piqola's unit of analysis is the household[6] that provides for fundamental human needs, including relational well-being (Wissing et al., 2019), which reflects the African philosophy of *Ubuntu*. Piqola makes optimal use of narrative social indicators in line with Africa's oral culture that values storytelling. Included in Piqola's selection methodology for the most appropriate questions is one that enquires about the cultural acceptance of the interventions tested, lest they be rejected by local communities for this reason.

What is noteworthy is that Piqola follows in the footsteps of earlier quality-of-life pioneers, such as Hadley Cantril,

6 The household is also the unit of analysis for Statistics South Africa's household survey and for The National Income Dynamics Study (NIDS), South Africa's first national household panel study that tracks the welfare of household members over time.

who collected narratives of the real-life experiences of people living in 13 countries across the globe in the 1960s to document their hopes and fears in life. In his book, *The Pattern of Human Concerns*, Cantril devoted a whole chapter to comparing narratives on the meaning of a 'decent life' for survey respondents from rich and poor countries, the equivalents of Piqola's 'quotable quotes' (Cantril, 1965, pp. 203-207).

The Afrobarometer (Mattes, 2008) has the distinction of being the only barometer of quality of life around the world that does not use a life satisfaction measure (Veenhoven, 2023). Instead, the Afrobarometer's proxy experimental measure of 'lived poverty' asks households if they have made do without the basic necessities of life during the course of a year (see Mattes, 2008; Møller et al., 2008). Similarly, the Piqola post-intervention narratives on the use of alternatives to offset wood use and waste burning capture the 'real-life' experiences of low-income households in meeting their everyday needs.

9.2 Agency

Many of Piqola's narratives in response to the 20 broad-based specific questions lend voice to women's greater sense of self, their newfound freedoms, and greater appreciation and support from their partners and family. The narratives collected for the Nova case studies showed how women use their agency when taking measures to prevent harm to children and other members of the household when heating water or cooking. The narratives also revealed constraints on agency for respondents, who stated, pre-intervention, that they had 'no choice' but to burn or dump waste. "We are not satisfied, but we do not have a choice. The wood is a struggle; sometimes you are too lazy to go get wood, then you go and get impaled, now you are limping -- we only do it because we do not have an option". Similarly, 'no choice' households said that they were forced to use or revert to wood-burning during electricity outages, or when their budgets did not allow them to purchase cleaner, more efficient and safer energy for cooking or heating water.

9.3 Unintended intervention consequences

Piqola narratives alerted the Nova researchers to the harmful use of the rocket stove. The rocket stove is designed to be used outdoors. However, some target households reported using the stove to heat their homes in winter, which is a safety risk and causes harmful exposure to pollutants indoors that may result in negative health impacts. Based on this finding, future wider distribution of the wood burner to the target communities was not recommended, although the rocket stove received mostly high satisfaction and Likert scale ratings.

One of the Piqola questions enquired into the cultural acceptance of the tested intervention combinations, lest they be rejected for this reason. Generally, target households said that the interventions were acceptable in their culture. However, Piqola narratives revealed that some households did make use of and preferred different energy carriers for the slow-cooking of certain traditional dishes, and used wood fires for traditional ritual purposes.

9.4 Interventions that 'make good use of time'[7]

Time-use research for quality-of-life studies was first launched to record how the introduction of television into households affected family life in the last century. Time-use studies typically track the activities of household members every quarter of an hour throughout weekdays and weekends. Division of labour in households and likes and dislikes of activities have been of particular interest to time-use researchers. Piqola narratives revealed the importance that respondents placed on trying to avoid drudgery tasks, such as having to watch over cooking pots or rising before dawn to heat water for bathing before going to school or work. They welcomed the 'modern conveniences'[8] that

7 The International Association for Time Use Research (IATUR) held its 46th conference in 2024. Conference delegates traditionally give a toast 'to the good use of time' when gathered for the conference dinner.

8 The impact of 'modern conveniences' on quality of life in the 1960s was recorded by Cantril (1965). 'Modern conveniences' served as one of the survey categories that recorded respondents' hopes for a better life.

allowed for greater leisure, rest and participation in activities away from home, as well as the sharing of routine household tasks. In this respect, the *Wonderbag* intervention, which could be left to its own devices to slow cook, should be considered an ingenious invention. Thus, although it was found that the *Wonderbag* does not lead to significant emissions savings, it does contribute positively to the quality of life of the women who do occasionally use it.

'Always something new coming out of Africa' is the saying attributed to the 1st century Roman, Pliny the Elder. However, inventions must also be useful if they are to be adopted in Africa (see Bruton, 2015; Møller & Roberts, 2021). The Piqola questions that enquire about the practicality of the tested intervention combinations will ensure that this is the case: the Piqola narratives described whether interventions were correctly used and not faulty, as had been the case for earlier handouts of solar heaters received by some of the wood-burning households.

10. Conclusions

The innovative Piqola tool promises to inject new energy into social indicators research in the Anthropocene era, particularly in Africa and the Global South. Quality-of-life scholars believe that individuals themselves are the best judges of their own well-being[9], and Piqola studies give voice to survey respondents to do this. Piqola is versatile; it can be adapted to assessments of a wide range of applied and policy-relevant research projects. Piqola has pioneered a mixed-method research approach that makes use of quantitative and qualitative indicators to identify the capacities, and resources or constraints on agency in low-income households. Essentially, Piqola assists researchers in selecting the best indicators that will identify any unintended consequences of new policies and practices in advance of larger-scale implementation. Of importance, the method allows for

9 Editors' note: This stands in contrast (not contradiction) to the discussion of Chapter 10 where the issue was the use of scientific evidence as something objective to measure the validity of interventions, for example, air quality interventions necessitated by policy.

the participation of community members as research partners[10] to share their lived experiences and their narratives to inform policy and practice.

List of sources

Bruton, M.N. 2015. *What a great idea!: Awesome South African inventions.* Johannesburg: Jacana.

Cantril, H. 1965. *The pattern of human concerns.* New Bruncwick, NJ: Rutgers University Press.

Diener, E., Emmons, R.A., Larsen, R.J. & Griffin, S. 1985. The satisfaction with life scale. *Journal of Personality Assessment*, 49(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13

Land, K.C. & Michalos, A.C. 2018. Fifty years after the social indicators movement: Has the promise been fulfilled? An assessment and an agenda for the future. *Social Indicators Research,* 135(3), 835–868. https://doi.org/10.1007/s11205-017-1571-y

Mattes, R. 2008. The material and political bases of lived poverty in Africa: Insights from the Afrobarometer. In: *Barometers of quality of life around the globe: How are we doing?* Cham: Springer, 161–185.

Max-Neef, M.A. with contributions by Elizalde, A. and Hopenhayn, M. 1991. *Human scale development: conception, application and further reflections*. New York: The Apex Press.

Michalos, A, 1985. Multiple discrepancies theory (MDT). *Social Indicators Research,* 16(1985), 347–413. https://doi.org/10.1007/BF00333288

Møller, V., Huschka, D. & Michalos, A.C. (eds.) 2008. *Barometers of quality of life around the world: How are we doing?* Cham: Springer, Social Indicators Research Series 33.

Møller, V. & Roberts, B.J. 2021. Innovations for enriched quality of life. In: V. Møller & B.J. Roberts (eds.) *Quality of life and human well-being in sub-Saharan Africa: Prospects for future happiness.* Cham: Springer, 151–165.

10 Editors' note: As advocated by Chapter 9.

Murray, M. & Pauw, C.J, 2022. A novel tool for quality-of-life assessment in the household context. *International Journal of Sustainable Development*, 25(1/2), 95–113. https://doi.org/10.1504/IJSD.2022.10051426

Puyt, R., Lie, F.B. & Wilderom, C.P. 2023. The origins of SWOT analysis. *Long Range Planning*, 56(3), 1–24, art. 102304. https://doi.org/10.1016/j.lrp.2023.102304

Rojas, M. 2018. Indicators of people's well-being. *Social Indicators Research,* 135(3), 941–950. https://doi.org/10.1007/s11205-016-1507-y

Shek, D.T. & Wu, F.K. 2018. The social indicators movement: Progress, paradigms, puzzles, promise and potential research directions. *Social Indicators Research,* 135(3), 75–990. https://doi.org/10.1007/s11205-017-1552-1

Tsai, M.C. 2018. Social indicators movement and human agency: Comment on Land and Michalos. *Social Indicators Research,* 135(3), 991–999. https://doi.org/10.1007/s11205-017-1553-0

Veenhoven, R. 2023. *World Database of Happiness*. In: F. Maggino. (ed.) *Encyclopedia of quality of life and well-being research*. Cham: Springer International Publishing, 7861–7865. https://doi.org/10.1007/978-3-031-17299-1_3662

Wissing, M.P., Schutte, L. & Wilson Fadiji, A. 2019. Cultures of positivity: Interconnectedness as a way of being. In: I. Eloff (ed.) *Handbook of quality of life in African societies. Cham:* Springer, 3–22.

WHR (World Happiness Report). 2025. *About Us*. WHR. [Online]. Available at: https://www.worldhappiness.report/about/