Hungarian University of Agriculture and Life Sciences

The role of Intentional Communities in achieving the Sustainable Development Goals

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DOCTORAL DISSERTATION

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LIST OF ABBREVIATIONS

AV: Auroville
BDI: Biological Diversity Index
CSA: Community Supported Agriculture
DEWATS: Decentralized Wastewater Treatment Systems
EM: Effective Microorganism
EMS: Environmental Monitoring Service
FSSD: Framework for sustainable strategic development
GEN: Global Ecovillage Network
GWP: Global World Partnership
HLPF: High-Level Political Forum
ICs: Intentional Communities
IWRM: Integrated Water Resource Management
JMP: Joint Monitoring Program
KRV: Krishna Valley
MDGs: Millennium Development Goals
NGO: Non-governmental Organization
Nrg4SD: Energy for Sustainable Development (organization focuses on Regional Governments)
ODF: Open Defecation
OECD: The Organization for Economic Cooperation and Development
RegGovs: Regional Governments
SD: Sustainable Development
SDGs: Sustainable Development Goals
TDEF: Tropical Dry Evergreen Forest
UN: United Nations
VLR: Voluntary Local Review
VNR: Voluntary National Review
WHO: World Health Organization
WW: wastewater
WWT: wastewater treatment

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1. INTRODUCTION

Risks to human health were the early recognition of what is now seen as a global environmental crisis. As early as 1898, Lucy Dean warned about the health risks of asbestos (Deane 1898), a popular construction material in the 20th century. The UK government and the EU banned white asbestos only one hundred years later. Despite the ban, houses in the UK still contain asbestos, causing about 3000 asbestos-caused deaths per year (EEA 2001). The next warning was Rachel Carson's 1962 book "The Silent Spring", which detailed the agrochemical industry's widespread damage to humans and nature (Carson 2002) and is credited as beginning the global green movement. Agro-modernization did not solve the problem of famine but has created multiple new problems, including the dissemination of toxic food chemicals, pharmaceutical content, preservation, storage chemicals, GMOs, and nanotechnology (Beardsworth, Keil 1998). Today, eco-nutrition movements link health concerns with security, sustainability, equal rights, and moral concerns such as animal rights and farmers' livelihood (Coff et al. 2008; Klein et al. 2014).

The 1972 book, Limits to Growth, looked at the environmental problem holistically and warned about the destruction of the entire planet (Meadows et al. 1972). The dynamical behavior of the planet's natural systems is now changing more rapidly than at any time during the previous 10000 years of the Holocene. Evidence of the changes' scale, magnitude, and significance has been sufficient for geologists to conclude that an epoch-scale boundary has been crossed, and we are now in a new epoch, the 'Anthropocene' (Steffen et al. 2011; Zalasiewicz et al. 2011). Living in the Anthropocene age comes with a new set of challenges. It will require us to deal with ongoing and rapid or sudden onset threats such as oil spills, chemical and nuclear accidents, landslides, tsunamis, severe weather, storms and cyclones, floods, wildfires and epidemics, and slow-onset threats such as poor air quality, droughts and desertification, food security, epidemics, and climate change (Dunkel et al. 2018; Rockström et al. 2009; UNEP 2012). In addition to this environmental crisis, we also deal with complex social struggles (Åhman 2013; Gardner, Stern 1996).

Despite repeated warnings and organized efforts toward sustainability, experts' assessment asserts that we are overusing vital resources and currently require 1.5 Earths to sustain ourselves. Our future is at risk, and drastic actions are required to avoid the catastrophe. Since more than hundred years we were warned about the crises, and for the past 60 years, it has become mainstream discourse, yet we have not done enough to avoid catastrophe. A response to the current crisis has been triggered from the top down and bottom up. The UN guides a top-down crisis response, while grassroots organizations formulate bottom-up crisis responses.

The United Nations (UN) report "Our Common Future" addresses the concerns of the Anthropocene and defines sustainable development as a potential solution. Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN 1987). The Brundtland Report popularized the term sustainable development (SD). SD is a new way of economic development: "doing development differently" by integrating environmental, economic, and social aspects into systems thinking (Berke, Conroy 2000). 2015, the UN compiled 17 goals and 169 sub-goals, which point to the most urgent issues where change is needed to ensure the future of humanity (Figure 1). The Sustainable Development Goals (SDGs) were signed by 193 countries and aimed to be achieved by 2030. It is a utopian vision of a world where humanity can live sustainably (UN 2017). The SDG framework aims to encompass and target all societal actors, and grassroots organizations were already involved in its formulation (Corella, et al

2020). It aims to holistically address poverty, climate change, and inequality in developed and developing countries (Uphoff 2014).

The SDG framework is designed to be inherently participatory; it can highlight good practices, influence decisions, and accelerate the sustainability transition, while its targets and indicators can be adapted to the local context. The framework allows the grassroots organizations to become prominent actors in the SD transition. In each region, they could actively engage and ensure that their decades of practice and experience in sustainability are integrated into the localization of the SDGs.

Figure 1. The 17 SDGs (UN 2019)

Such grassroots organizations are the Intentional Communities (ICs), whose number, as shown by history, increases in times of turmoil. ICs seem to be the forerunners of change whenever humanity is in a crisis. Historical reference from the 3rd century B.C. onwards shows that small groups frequently separated from the rest of the population, breaking away from the mainstream whenever crises occurred (Dawson 2006; FIC n.d.; GEN n.d.; Metcalf 2012). ICs worked to bring about the changes needed for human evolution and survival, first within their community and then as a model for their regions. "*At a time when people are desperate for more social connection and answers to complex problems, intentional communities are offering hope in an increasingly broken world"* (FIC n.d.). Modern ICs, which have sprung from the present crisis and the responding green movements, focus on environmental issues and sustainability. ICs act against the hegemonic status quo and non-sustainable lifestyle by creating new norms within their communities and affecting society. They cause paradigm shifts by acting as agents of change and advocates for human evolution. ICs often espouse holistic worldviews but are typically initiated by concerned citizens who gather in their locality, organizing themselves around one or more sustainability issues from the bottom up. Their voluntary mission is to create a utopian world similar to the one described by the UN SDGs today.

However, the attitude of ICs differs from the top-down approaches of the UN and the governments. While top-down organizations put more energy into planning sustainability, ICs prefer prototyping as living laboratories. Often without making this formal and explicit, ICs already contribute to the SDGs in their locality. People of these communities combine ancient wisdom with modern technology to develop sustainable practices. Practices developed and adapted in the ICs can be easily replicated in their closer vicinity due to the local environment's shared place-specific cultural-social systems and geographic and climatic conditions. Scaling up their good practices further to the territorial or regional level would benefit Regional Governments in tackling the global crisis locally.

Halfway through the SDGs' 15 years agenda, in 2023, we hardly see the ICs' engagement in SDGs, despite their natural affinity for the global goals' overall ethos, guidelines and often even specific details. One could argue that the UN SDG principle, "transforming our world and leaving no one behind," is already practiced in the ICs, and the SDGs guidelines are the very ones the ICs are advocating for. Why are ICs not prominent advocates of SDGs at local or higher levels? The aim of this research is to answer these questions and to identify roles ICs can take to achieve the SDGs.

2. RESEARCH OBJECTIVES

We are experiencing a crisis, and the UN has directed global leaders toward sustainability to avoid a catastrophe (Keeble 1988). The involvement of all sectors is vital in the sustainability transition, and I wanted to explore the potential role ICs can play in it. Sustainability is a broad and complex field, and my research aimed to provide a general overview as well as concrete and detailed data.

In order to accomplish this, the research followed an hourglass shape, structured by five objectives, hypotheses and their corresponding one to four research questions (Figure 2). I started with broader lenses, first looking at the four dimensions of sustainability in communities (O1), then narrowing down to the 17 SDGs in forty-two ICs (O2). The research then focused on one goal in four ecovillages (O3); the SDG6, and its eight targets, fifty-one sub targets and 270 indicators. Once I gained detailed data, I broadened the research scope to draw general conclusions on the ICs' constraints and potential role in achieving the SDGs (O4, O5).

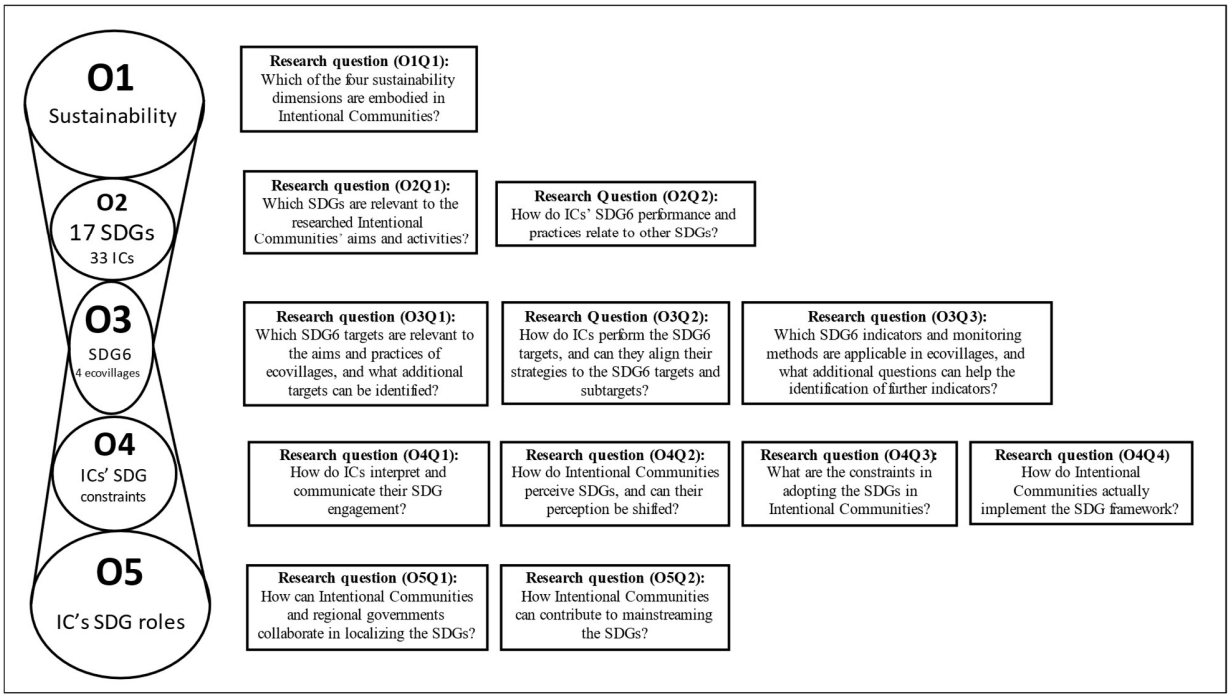

Figure 2. The structure of research objectives and questions

First Objective (O1): To gain an overview on Intentional Communities' relation to sustainability.

Hypothesis (O1H): Intentional Communities embody the four sustainability dimensions by their inherent purpose and design.

Research question (O1Q1): Which of the four sustainability dimensions are embodied in Intentional Communities?

Sustainability is described by four interlinked dimensions: ecology, society, economy, and governance/culture/partnership. The four dimensions of sustainability are interlinked and interdependent in a complex way. Numerous sustainability theories and concepts were developed; some, addressing the community sector, were reviewed in detail. I studied the literature and kept the four-dimension of sustainability as a reference point throughout the research, particularly applying it in the case studies.

Second Objective (O2): To evaluate the Intentional Communities' relevance with the SDGs.

Hypothesis (O2H): Intentional Communities' have practices, aims, and activities relevant to the SDGs

Research question (O2Q1): Which SDGs are relevant to the researched Intentional Communities' aims and activities?

In 2015, 193 countries adopted the SDG framework to accelerate the SD transition. The 17 Goals of the UN agenda translate the four dimensions of sustainability to the most pressing issues of our time. The research explored which of the 17 goals are already addressed by the ICs' aims and activities. Data was collected through comprehensive and case study research.

Research Question (O2Q2): How do ICs' SDG6 performance and practices relate to other SDGs?

The UN SDG framework comprises 17 goals and 169 targets subdivided by normative interpretations (UN 2016). Reaching each of these targets is essential for reaching the goals. The research scope was reduced to one goal and four ICs to fit into the period of the Ph.D. research. SDG 6 was selected for detailed research. Among the 17 goals, SDG6 is fundamental to all other SDGs (Figure 3). This goal addresses diverse aspects of water through eight targets to create a life where water is equitable and sustainable for present and future generations. Detailed data were collected on SDG6 with case studies, and a study examined interlinkages to other goals, highlighting some synergistic SDG6 practices.

Figure 3. The water-centric 17 Sustainable Development Goals for each sector (Makarigakis, Jimenez-Cisneros 2019)

Third Objective (O3): To critically analyze if the SDG 6 framework can accommodate ICs' aims and activities.

Hypothesis (O3H): The SDG 6 framework can accommodate the ICs' contribution to the sustainability transition.

Research question (O3Q1): Which SDG6 targets are relevant to the aims and practices of ecovillages, and what additional targets can be identified?

The SDG framework is designed to accelerate humanity's transformation to sustainability and has two critical elements: targets and monitoring. According to the UN, the targets are designed to accommodate the participation of grassroots organizations (Corella, et al 2020). The research examined whether existing targets and sub targets are relevant to the ICs' aims and activities. The SDG6 Monitoring Inventory was developed in a pilot study containing the SDG6 targets, sub targets and indicators. The targets applicability was examined during the pilot study and when using the inventory for data collection in the case studies.

Research Question (O3Q2): How do ICs perform the SDG6 targets, and can they align their strategies to the SDG6 targets and sub targets?

Four ecovillages were selected from the researched 42 ICs, to investigate their SDG6 relevant practices. Ecovillages deal with complex sustainable lifestyle alternatives and can be representative to residential and non-residential ICs focusing on sustainability issues. The developed SDG6 Monitoring Inventory was used in the case studies to investigate the ICs' SDG6-related aims and activities. Data was collected through site visits, interviews, community engagement, laboratory analysis, and the analysis of theme-specific documents of the researched ecovillages. Two of the four ecovillages were recently founded with fewer practical results but high commitments to sustainability. Action research method was used to identify and align the SDG6-related aims as strategies in these recent ecovillages.

Research question (O3Q3): Which SDG6 indicators and monitoring methods are applicable in ecovillages, and what additional questions can help the identification of further indicators?

The second element of the SDG framework is monitoring. According to the UN, monitoring aims to highlight the good practices of ICs. The question examined whether the existing methods and indicators are suitable to highlight the ICs' aims and activities, or additional questions are needed. The indicators' applicability was examined during the pilot study and when using the inventory for data collection in the case studies.

Fourth Objective (O4): To identify potential constraints of ICs SDG interpretation and engagement

Hypothesis (O4H): ICs SDG engagement is challenged.

Research question (O4Q1): How do ICs interpret and communicate their SDG engagement?

Although we are already halfway through the 2015-2030 SDG agenda, there is little public visibility of ICs engaging in achieving the SDGs. Therefore, exploring whether ICs understand and utilize the SDG framework to communicate their aims and activities is crucial. Answers were collected with comprehensive research, but I also gained impressions through the case studies.

Research question (O4Q2): How do Intentional Communities perceive the SDGs, and can their perception be shifted?

Adapting the intricate SDG framework requires commitment and resources. ICs are created by concerned citizens spontaneously gathering and organizing from the bottom up while challenging the existing hegemonic regimes. This organizational structure questions whether ICs willingly devote time and energy to adapting the top-down defined SDGs. Initially, I had no intention to address this question, but it emerged as a research problem for both the comprehensive and the case study research. I pooled the spontaneously accumulated data and then studied perception shifts using the tools I developed.

Research question (O4Q3), What are the constraints in adopting the SDGs in Intentional Communities?

Halfway to the SDG agenda, the lack of ICs' active engagement suggests that the SDG framework may be difficult to use. The literature review and the synthesized comprehensive and case study research were instrumental in exploring the research question.

Research question (O4Q4) How do Intentional Communities actually implement the SDG framework?

The SDG framework is an instrument designed to accelerate the sustainability transition. If it is implemented, it could empower the ICs to participate in formulating SDG-related policies and benefit from its assistance. Knowing how well the ICs are prepared to implement the framework is essential. Data was collected through the self-assessment part of the comprehensive research.

Fifth Objective (O5): To identify roles Intentional Communities can play in achieving the SDGs

Hypothesis (O5H): Intentional Communities can have an active role in achieving the SDGs.

Research question (O5Q2): How can Intentional Communities and Regional Governments collaborate in localizing the SDGs?

The SDG framework aims to engage all actors in the Sustainability transition. The framework's global approach can be adjusted to territorial issues. This process is called localization, where the Regional Governments are entitled to guide the local implementation of the SDGs, but ICs could also take an active role.

I explored this question by synthesizing the results of the literature review, the comprehensive and the case study research.

Research question (O5Q3): How can Intentional Communities contribute to mainstreaming the SDGs?

The SDG framework aims to engage all actors in the Sustainability transition. The framework's global approach can be translated to sectoral issues, and ICs could take an active role in adopting the SDGs to the community sector. I explored this question by synthesizing the results of the literature review, the comprehensive and the case study research.

3. LITERATURE REVIEW

The literature review is composed of five subchapters. It begins with typology, introducing the terms "intentional community" and "ecovillage" which are frequently used interchangeably in academic discourse but have distinct meanings in the dissertation. The second subchapter introduces the four dimensions of sustainability and describes the operation of communities concerning the four sustainability dimensions. The third subchapter investigates the SDG framework, whereas the final subchapter examines the relationship between ICs and SDGs and highlights the potential challenges and opportunities for ICs to participate in the global SDGs.

3.1. Typology

3.1.1. Intentional Communities

The term Intentional Communities (ICs) originates from the Foundation for Intentional Community (FIC n.d.), a network founded in the USA in 1937 (Gurvis 2006)

The FIC defines an intentional community as "*a group of people who share land or housing or are otherwise geographically close enough to be in continuous active fellowship in order to carry out the purposes to which it is dedicated. Members of the intentional community are committed to the shared concern with intent and purpose"* (FIC n.d.).

Shenker states, *"An intentional community is a relatively small group of people who have created a whole way of life for the attainment of a certain set of goals"* (Shenker 1986).

Metcalf describes an Intentional Community as *"five or more people, drawn from more than one family or kinship group, who have voluntarily come together for the purpose of ameliorating perceived social problems and inadequacies. They seek to live beyond the bounds of mainstream society by adopting a consciously devised and usually well thought-out social and cultural alternative. In the pursuit of their goals, they share significant aspects of their lives together. Participants are characterized by a "we-consciousness," seeing themselves as a continuing group, separate from and in many ways better than the society from which they emerged"* (Metcalf 2004).

Takács Sánta defines Intentional Community as *"a group of people who: (1) interact with each other on a regular and frequent personal basis, and communicate with each other in the same space at regular intervals; (2) they are linked by a similar set of values and worldview (i.e., the mindset of community members is fundamentally similar); and (3) have common practical goals and work together to achieve them. It is also important that (4) they consist of at least three (sometimes hundreds) adult members who represent at least two separate lines of kinship"* (Takács-Sánta 2016).

Intentional communities differ from traditional communities (Tönnies 2004), as members are typically not born into the community but have consciously chosen it. They cannot be considered an inclusive community; only people with particular values or worldviews can be members. These communities consciously seek to implement some form of lifestyle alternative outside the mainstream society, seeking to address some social issues or shortcomings (Meijering et al. 2007; Metcalf 2004). Most Intentional Communities concentrate on one or few particular challenges rather than striving for complex lifestyle alternatives (Takács-Sánta 2016). ICs can be community gardens (Rosta 2013) local

community markets or eco-shopping cooperatives, community farms (Nemes et al. 2020), cohousings, alternative or green schools, spiritual or religious centers, and alternative healing centers to name a few. The FIC network listed 1814 Intentional Communities at the end of 2022, divided into nine categories, including ecovillages as the most prominent but still only one category.

3.1.2. Ecovillages

George Ramsey used the phrase "eco-village" for the first time in 1978, referring to compact, car-free, small-scale projects, including suburban areas, and arguing that "*the great energy waste in the United States is not in its technology; it is in its lifestyle and concept of living*" (Ramsey 1979).

Robert and Diane Gilman popularized the term "ecovillage" in 1991 when they wrote a report titled Ecovillages and Sustainable Communities at the request of the Danish charity Gaia Trust. According to Gilmans, *"an ecovillage is a human-scale, full-featured settlement in which human activities are harmlessly integrated into the natural world in a way that is supportive of healthy human development, and can be successfully continued into the indefinite future"* (Gilman 1991).

According to 1994 founded Global Ecovillage Network (GEN), "*An ecovillage is an intentional, traditional or urban community that is consciously designing its pathway through locally owned, participatory processes, and aiming to address the Ecovillage Principles in the 4 Areas of Regeneration (social, culture, ecology, economy into a whole systems design)"* (GEN n.d.).

Contrary to other Intentional Communities, ecovillages implement a complex ecological lifestyle alternative and are located as separate settlements or in a district of settlements that serve as a community's residence (Christian 2007; Takács-Sánta 2012). Ecovillages in urban and rural settlements are long-term organizations, as opposed to other Intentional Communities, which can be created to address one or more specific short-term challenges (Takács-Sánta 2012).

Intentional Communities and ecovillages are often hard to distinguish both in theory and practice. Many communities are listed on both FIC and GEN networks' websites. The 1814 Intentional Communities on the FIC network are divided into nine categories one of which is ecovillages. On the other hand, GEN lists 7100 ecovillages from 131 countries under 20 categories, some of which FIC lists as Intentional Communities (FIC n.d.; GEN n.d.).

The term "Intentional Communities" is used throughout this dissertation to refer to a broader category, including ecovillages as one type of Intentional Community. The researched ICs meet all criteria of Takács-Sánta's community definition, *"a group of people who: (1) interact with each (2) linked by a similar set of values and worldview (3) have common goals, and (4) consist of at least three adult members from at least two separate kinship*" (Takács-Sánta 2016). However, the additional characteristics of the examined ICs are their shared intention of sustainability, and their geographically well-defined location (Barton 2000; Roseland 2012), where their sustainability achievements are assessable. Forty-two ICs from five continents were studied with comprehensive research during the Ph.D. research (Annex 1).

In the research, those residential-type Intentional Communities, which are grouped not only around one or a few sustainability intentions but strive to create a complex new sustainability lifestyle (Uphoff 2014) in harmony with nature, with members existing in an interdependent relationship with one another and choosing voluntary simplicity to minimize the human interventions on their environment are called ecovillages. I chose four ecovillages as case studies for the SDG6 research (Objective 3).

Given their complexity I suggest that ecovillages can help to draw general conclusions about ICs' roles in achieving the SDGs.

3.2. Intentional Communities and the four dimensions of sustainability

3.2.1. The four dimensions of sustainability

Scholars define sustainability in four dimensions. Some call these pillars, and others call them domains, realms or spheres. The first three dimensions are identified as the bases, which everyone refers to as ecology, economy and society. The fourth dimension is defined and referred to distinctively as the Cultural Pillar (Nurse 2007), the Human Pillar (RMIT n.d.), the Worldview Dimension (Gaia Education n.d.), the Political Sphere (O'Connor 2006), Governance (GEN n.d.) to name a few. This fourth dimension is represented in the SDGs as Partnership.

The following pages will introduce theories and concepts of sustainable community development through the four dimensions of sustainability.

3.2.2. Ecology

Since the industrial revolution, man increasingly pollutes the environment. The main goal of today's ICs is to stop environmental destruction and restore ecosystems. Intentional communities have existed since ancient times (Metcalf 2012), emerging in days of crisis (Meijering et al. 2007). Historical exploration points out that today's Intentional Communities are rooted in green movements (Farkas 2014) and sustainability concerns (Dawson 2006). Today's ICs were developed with the green movement to respond to the environmental crisis. ICs today emphasize environmental regeneration and protection, even those with religious or spiritual background (Esteves 2017; Koduvayur Venkitaraman, Joshi 2022; Kun 2012). Rural and residential ICs have outstanding results on landscape rehabilitation and increasing biodiversity. They use organic techniques and products, live a simple lifestyle, and adjust their water and food consumption to the locally available resources (Farkas 2017b; Takács-Sánta 2017b). ICs evenly participate in environmental protection through urban greening projects (Sanguinetti 2012), environmental education programs (Kensler 2012) and lowering their ecological footprints through conscious consumer choices (Daly 2017). Urban and rural ICs can meaningfully contribute to establishing green lifestyle alternatives for urban areas (Gaia Education 2018).

Today, cities occupy 3–4 percent of the world's land surface, use 80 percent of resources, discharge most global waste (Girardet 2014) increasingly vulnerable to climate change and health challenges, and are linked to increased destruction of the environment (UN 2014). The UN Global Agenda for 2030 includes one specific goal (SDG 11) for "inclusive, safe, resilient, and sustainable" cities (UNSDG n.d.). The significance of developing urban assets, as opposed to growing sprawls, is crucial. Urban space planned according to sustainability principles can simultaneously increase human well-being and regenerate ecological functions (Girardet 2014). Ecourban developments are a set of planning, design, and social and technological arrangements for living better within resource limits

(Sturgeon et al. n.d.). Ecourbanism is "*the development of multi-dimensional sustainable human communities within harmonious and balanced built environments"* (Ruano 1999). Sustainable neighborhoods are said to be the central concern of ecourbanism, as neighborhoods still matter in many people's daily lives, especially in the lives of families (Smith 2018). At the beginning of the 19th century, 98% of humanity lived in villages or nomadic communities (Ponting 2007), while today more than 3.5 billion people live in cities (Smith 2018), and in 2050 10 billion people are expected to live in cities (Gaia Education 2018). Developing sustainable neighborhoods is crucial but must happen with the involvement of the community, the people, and the environment in a coevolutionary process, engaging all related systems, sub-systems, and stakeholders (Neuman 2005).

Urban Intentional Communities can actively advocate to transform their neighborhoods into sustainable eco-districts. Ecovillages can be exemplary sites, as they perceive their environment as a biological habitat and intend to regenerate and protect it (Nagy 2018; Nagy, Sallay 2019). The mission of ecovillages is to replace societal dependence and urban consumerism with a dependence on and adaptation to their natural environment. Ecovillage residents choose dependence on nature, awareness of water scarcity, recycling, and using homemade and organic products and adapt their lives to the weather and the rhythms of nature as means of voluntary simplicity (Osikominu, Bocken 2020). Ecovillage-type Intentional Communities emphasize locality and localization, value ecology, natural preservation, and biodiversity, and perceive their environment as biological habitats that need to be protected from human interference. They conserve water as a valuable resource, seek farming methods and building materials that harmonize with the landscape (Kilonzo, George 2017).

3.2.3. Economy

For a century or more, the overwhelming majority of countries have placed the highest priority upon economic growth. Political thought has become locked into the 'growth fetish' The result has been a significant increase in industrial production and the consumption of non-renewable resources (Smith 2018). Traditional economic growth advises cities to maintain or increase their economic output by improving technology, accumulating capital, and enhancing labor productivity (Girardet 2014). A sustainable future requires twinning improvements in quality of life with decreased consumption of materials and non-renewable resources.

Despite historical and theoretical debates, a sustainable community should not be understood as a series of trade-offs between social, environmental, and economic priorities. Protecting ecosystems and promoting social inclusion at the local level need not mean job loss or economic downturn; rather, it represents a new way of thinking about economic and other development over the long term: it is about "doing development differently" (Roseland, 2012). It requires fundamental changes to the status quo to stop "sustaining" an ill-functioning and unsustainable system. Achieving meaningful improvements to community well-being and the natural environment requires reducing the business-as-usual operations driven by quantitative increases (Roseland, Spiliotopoulou 2016). A productive community can be simultaneously livable, resilient, healthy, smart, regenerative, safe, creative, and happy. These positive results can raise this dynamic paradigm to be the new normal for communities to sustain and achieve locally relevant long-term sustainability goals while also contributing to the 2030 Sustainable Development Goals (Spiliotopoulou, Roseland 2020).

Today's Intentional Communities are ecolocal communities (Takács-Sánta 2017). Based on the works of Power (1996), Douthwaite (1996) and Gibson-Graham (2002), Curtis developed the eco-local economic theory, also called ecolocalism, which argues that sustainability is best achieved by local or

regional self-reliant community economies (Curtis 2003). Curtis's ecolocalism is place-specific and assumes that local people recognize the importance of the local ecosystem services and have the place-specific cultural-social systems and means to steward and maintain the sustainability of the local environment. Ecolocalist businesses may produce smaller monetary gains, as was observed in ecovillages, where communities chose organic farming or ecotourism to protect their environment as a biological habitat. They aim to increase the well-being of current and future generations by lowering their material expectations while regenerating their natural environment and increasing community values such as social capital (Bartecchi 2015).

Entrepreneurship characterizes Intentional Communities that strive to make the local goods, the local services, and the activities of the local government and companies environmentally friendly, even to the point where the community starts exemplary businesses (Takács-Sánta 2012). Many IC members, particularly those living in ecovillages, chose dependence on nature and practice voluntary simplicity instead of the modern/urban comfort where one can consume water almost without limits and eat non-seasonally. (Farkas 2017). They chose dependence not only on nature but also on one another. Economic relationships in ecovillages, such as the exchange of goods, carpools, joint ownership, joint sowing and harvesting increase members' interdependence as their prosperity and livelihood depend on each other (Vágvölgyi, Szép 2014).

3.2.4. Society

The loss and rediscovery of the community have been critical academic topics since the 18th and 19th centuries. From the 19th century, there was an increased tendency to idealize the community and describe the pain of losing traditions, stability, and collective memory. The problem of disintegrating communities grew with the emergence of an industrialized and highly mobilized society. (Farkas 2017a). The generalization of "one-person groups" (Csányi 2002) is a product of mass urbanization starting in the 19th century.

The term social capital was used as early as 1920 in Lyda Judson Hanifan's work, The Community Center, referring to "*goodwill, fellowship, sympathy, and social intercourse among the individuals and families who make up a social unit*" (Hanifan 2022). Putnam popularized the term social capital and defined it as "*features of social organization, such as networks, norms and trust that facilitate coordination and cooperation for mutual benefit*." Putnam treated social capital as a public good—the amount of participatory potential, civic orientation, and trust in others available to cities, states, or nations (Putnam 1993). Initially, social capital was used to explain micro-level cooperation between individuals, households, and communities (Bartecchi 2015). Putnam argued that social capital is essentially the 'amount' of 'trust' available and is the leading stock characterizing the political culture of modern societies (Putnam 1993). In general, trust is the glue that holds groups together. Trust ensures that collaborative behaviors are reciprocated by the members and not exploited. The level of trust determines the level of collaboration within communities. Trust is fundamental to ICs.

James Kelly developed the ecological theory to provide a framework for communities' social structure and function. Kelly's theory outlines four principles within social systems: 1.) interdependence, 2.) adaptation, 3.) cycling of resources, and 4.) the principle of succession (Kelly 1968).

Interdependence helps individuals to recognize that everything is interconnected, humans and the environment. In human relations, this interdependence corresponds to the psychological sense of community described by community psychologist Sarason as: *"the perception of similarity to others,*

an acknowledged interdependence with others, a willingness to maintain this interdependence by giving to or doing for others what one expects from them, the feeling one is part of a larger dependable and stable structure" (Sarason 1974). McMillan and Chavis defined a sense of community as a feeling that members belong and matter to one another and the group. There is a shared faith that members' needs will be met through their commitment to being together (McMillan, Chavis 1986). In particular, the sense of community theory claims that if people feel they exist within an interdependent network, they are more willing to commit to and even make personal sacrifices for that group. The sense of community is feelings-based rather than based on a rational evaluation of the fulfillment of a person's needs or aspirations. A sense of community is more than the market-based "cohesion" that does not need an emotional connection to accomplish tasks. Sense of community is more than positive group feelings, such as "morale" (Jason 2016). In all the ICs researched there is a sense of community, and interdependence exists in all residential ICs, as observed in each of the case studied ecovillages.

Adaptation: Kelly's adaptation principle focuses on the interactions between humans and the environment. This principle is critical for the longevity and functioning of ICs. Many IC initiatives are short-lived, but those that persist longer strongly emphasize adaptation (Baumber et al. 2022; Kapitány, Kapitány 2007).

The cycling of resources simultaneously impacts the communities' social structure, economy, and ecology. It is the systematic process of using and developing materials and resources that impact community growth and development. This principle refers to how communities identify, incorporate, and use different types of resources within their communities. Resources can be skills and expertise, information, networks of social support, socialization processes for social and cultural cohesion access to supplies or equipment exchange of goods, joint ownership, joint sowing, harvesting, and the use of carpools (Jimenez et al. 2019; Vágvölgyi, Szép 2014). Hoffman interpreted the principle of cycling resources in community gardening. The resources of soil, compost, and seeds are used to grow foods, and the garden area is used to teach the principles of horticulture and healthy food production. The programs provide unique psychological and physical benefits of green space sustainable activities (Hoffman 2017). In ecovillages, unused and degraded lands were converted to farmlands producing healthy foods for local consumers at a reduced cost (Nagy 2018).

Succession refers to the constant presence of change in communities. In a changing environment, the community itself is changing (McGlade 1999; McGlade, van den Hove 2013).

3.2.5. Governance/Culture/Partnerships

Sustainable development is about the achievement of three principles: economic development, social justice and ecological responsibility. Sustainable development in practice is a conflict between these three principles and in some cases, only one or two of these are achieved. The fourth dimension identifies the values, norms and the decision-making processes to reduce friction between the three principles and achieve genuine sustainability (Low 1999). However, the 4th dimension is not clearly defined and different names are used in different disciplines. I will refer to it as governance/culture/partnership in my dissertation and will address these three elements of the fourth dimension in the case studies.

Governance:

Historical records show IC members to be system-critical intellectuals whose concept and practice is influenced by their need for autonomy in infrastructure and nutrition, and their resilience to global

economic and social processes. These organizations practice participatory governance (Fischer 2012, 2017). GEN promotes sociocracy and holacracy organizational models among its members (Czekaj et al.2020). GEN also propagates the use of alternative methods in decision making such as the Framework for Strategic Sustainable Development (FSSD) (Broman, Robèrt 2017) and ABCD backcasting (Antonopoulos et al. 2019; GEN n.d.; The Natural Step, 2015). These two methods were used in the action research SDG6 Localizing Workshops (Annex 6, Annex 7). The success of these methods requires people who can easily participate in group work and participatory decision-making processes. In the two recent ecovillages, the SDG6 Localizing Workshop was successful, demonstrating that ecovillage members are already skilled in participatory governance.

Culture:

Culture is defined as "the way of life, especially the general customs and beliefs, and the attitudes, behavior, opinions of a particular group of people within society at a particular time (Cambridge Dictionary 2023). Agenda 21 acknowledges culture as the fourth pilar of sustainability (Agenda 21 n.d.). Hawkes emphasizes the importance of culture as the most important pilar of sustainability and argues that culture should be viewed as the key element to sustainable development (Hawkes 2001). The importance of cultural values in ecolocal practices is well explained in a case study from North-East Thailand by Parnwell (Parnwell 2006). Parnwell describes how the local abbot, disturbed by his region's spiritual, social, and environmental degradation, initiated the movement of "neo-localism" in 1983 in six villages. Using Buddhist practices, the abbot could activate the local villagers and with the support of NGOs and Universities, successfully reforested the landscape, initiated environmental and social programs, created a community mill, and propagated organic agriculture practices. The abbot's initiatives soon gained countrywide acknowledgment and financial support from the government and international civil and business organizations. Nevertheless, we cannot overlook the element of spirituality in this practical example of eco-localism. Parnwell explains that *"the local abbot played a catalytic role in redirecting the sustainability pendulum through his attempts to rekindle sammakee, the Buddhist notion of communal harmony."* Spirituality is the guiding principle behind the Auroville community development. Auroville is one of the case studied ecovillages.

Partnership:

The fourth dimension is represented in the SDGs as partnership. It has one goal, SDG17, and is embedded in each goal as separate targets. Rockström and Sukhdev pushed for a new way of viewing the Sustainable Development Goals' economic, social and ecological aspects, and they created the wedding cake illustration and concept (Figure 4). The illustration describes how economies and societies should be seen as embedded parts of the biosphere. This vision moves away from the current sectoral approach where social, economic, and ecological development are seen as separate parts (Rockström 2017). Intentional communities are keen to act as a knowledge hub to transfer sustainability practices and maintain active interactions with interested parties and educational institutions. Some ICs and GEN collaborate with governments.

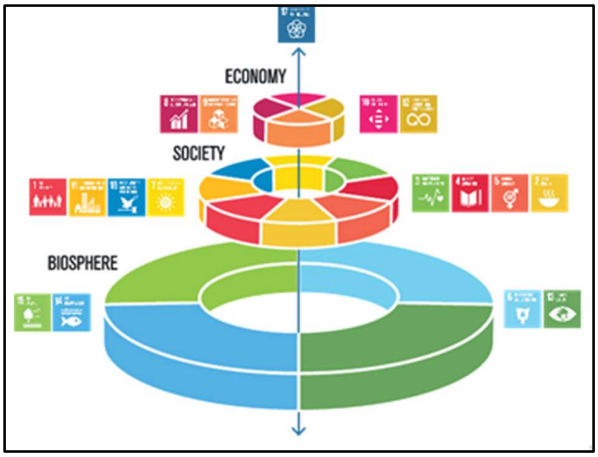

Figure 4. The SDGs wedding cake,

Source: (Stockholm Resilience Centre n.d.)

3.3. Sustainable Development Goals (SDGs)

3.3.1. History

The United Nations (UN) is an international organization. It was founded in 1945 after the Second World War to maintain international peace and security, develop friendly relations among nations and promote social progress, better living standards, and human rights. The organization has been working since the seventies to advocate for sustainable development. It held its first conference on the environment in Stockholm in 1972. The Brundtland Commission published "Our Common Future," calling for sustainable development in 1987. At the 1992 UN Earth Summit in Rio de Janeiro, Agenda 21 was created. The UN launched a new global partnership for sustainable development in New York five years later. In 2002 the UN World Summit on Sustainable Development in Johannesburg committed to the Millennium Development Goals. In 2012, at the RIO+ 20 conference, it was decided to learn from the Millennium Development Goals and create a new program that applies to all nations and encompasses the whole concept of sustainability, with its environmental, economic, social, and human aspects. The UN developed the new Sustainable Development Goals or SDGs over three years, with countless meetings and consultations involving hundreds of thousands of people and all sectors of society, including 5,000 grassroots organizations. The new 2030 framework was adopted in September 2015 by 193 countries. SDG has 17 goals and 169 targets, and its primary mission is to transform our world by leaving no one behind (Corella, et al 2020).

3.3.2. Synergies and Tradeoffs

Agenda 2030's 17 SDGs provide the framework all UN member states have committed to achieving. In contrast to previous policy initiatives emphasizing economic growth, the SDGs are a multi-dimensional framework with many conflicting targets in the economic, social, and environmental sectors, although some goals are mutually reinforcing. Since 1989, the World Bank has closely monitored 331 indicators in 263 countries. These indicators became linked to 71 Sustainable Development Goal targets. David Lusseau and Francesca Mancini created the "sustainome" (Figure 5) using data from the World Bank and offered a global overview of SDG target interactions. In their diagram, the nodes represent the targets or SDGs and the lines represent the interactions (positive in blue and negative in red) (Lusseau, Mancini 2018). Their findings revealed that SDG interaction conflicts are a significant barrier to SDG implementation. They cautioned that efforts to achieve SDGs in isolation might significantly affect other SDGs (Lusseau, Mancini 2019). Interactions are labeled as synergies when one target's improvement facilitates another's progress. Interactions are named trade-offs when progress in one target endangers the achievement of another. Humanity's ability to enhance synergies and diminish existing trade-offs between the SDGs will be vital (Kroll et al. 2019).

3.3.3. Monitoring

Collecting data is crucial to understanding the SDGs' interactions, maximizing the synergies, and minimizing the tradeoffs. Monitoring is essential to highlight the good practices, assess the progress, the extent of change, and the results of interventions. The complex UN monitoring system has 231 global indicators designed to provide a statistically measurable picture of the achievements. The

collected data can alter decisions, set new priorities, and recognize synergies, conflicts, and good practices. The data gives information on the current progress and challenges and the further adaptations and resources needed to achieve the SDGs (UN 2017). The UN monitors global progress while encouraging everyone to voluntarily review sectoral or local progress and report it online and offline to the High-Level Political Forum (UN n.d.-b). Monitoring SDGs is an essential but challenging task, and not all currently used global indicators are suitable for detecting changes on a territorial level.

The existing UN global indicators are often unsuitable for measuring local progress and assisting local action. In 2016, David Satterthwaite suggested collecting some data even at the street level so that action can happen accordingly, exactly where it is most needed. According to his paper, it is essential to define local indicators and develop local data collection methods, which today lack professional direction from the UN (Satterthwaite 2016). In order to maintain the participatory aspect of the SDG framework, the UNDP emphasizes that local initiatives are responsible for developing their local indicators and data collecting and reporting methods (GTF 2016). To help the development of country monitoring systems, the concept of "progressive monitoring steps" has been introduced. Data collection starts with simple methods and, year by year, progressively adopts more advanced and accurate monitoring methodologies. Later, data from new technologies, such as Earth Observations and geospatial data, will also be available (UN-WATER 2016).

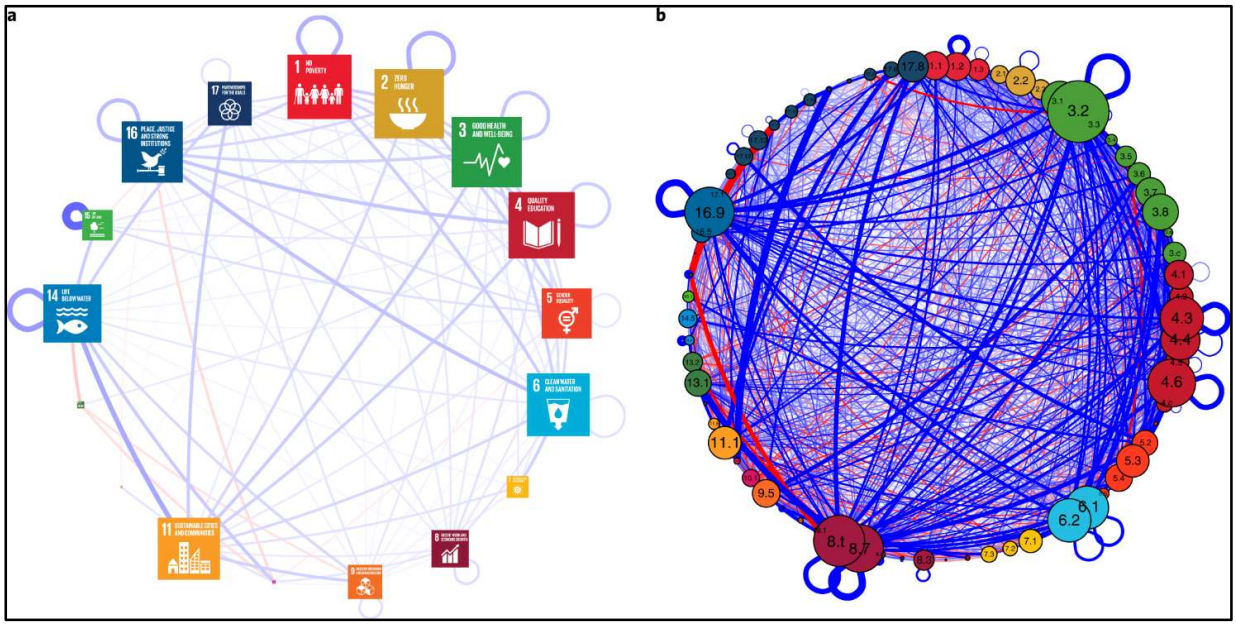

Figure 5. Sustainome by Lusseu and Mancini, Source: (Lusseau, Mancini 2018)

3.3.4. Localization

Targets and means for their implementation need to be established at the local level. Localization is the process where local governments operationalize the implementation of SDGs. “It is a process that is sensitive to local opportunities, priorities, and ideas. It goes beyond adjusting global goals to the local level and calls for co-creating solutions through the generation of genuine partnerships, resulting in more inclusive, needs-driven, local-level responses to global challenges and objectives. Ultimately, localizing means enabling local governments and communities to be the catalysts of change to support the achievement of the global goals.” (UNESCAP n.d.)

Global goals cannot be achieved without local efforts at national, regional, municipal, or even more minor territorial scales. Local monitoring would be needed to promote local results. On a country level, each country is entitled to translate the more general global targets into specific, local targets tailored to the national circumstances and to define new indicators to their local targets. The countries' voluntary monitoring activity and results are reported as Voluntary National Reviews (VNR). Some Regional Governments and municipalities are also engaged in SDG implementation. While the UN has not provided adequate assistance for developing local monitoring systems, there are good examples of local SDG adaptation and monitoring initiatives, like the Voluntary Local Review (VLR) series, where cities worldwide report their SDG performances. Their work can be a good example and influence local communities to develop their monitoring system. While each available VLR were studied, twelve of these practically contributed to the research with SDG6-specific information on targets, indicators, and monitoring methods for local objectives, problems, and opportunities (UN-VLR n.d.).

The nrg4SD report “*Localizing the SDGs: Regional Governments Paving the Way”* was prepared for the 2018 HLPF. It investigated 47 Regional Governments (RegGovs) from across the globe with self-assessment questionnaires. The report described the efforts that Regional Governments carried out in their operations to implement the SDG agenda (nrg4SD 2018).

The SDG6 research was conducted in four ecovillages, and the available local SDG reviews in the ecovillages’ respective environments were studied. The four ecovillages are located in India and Hungary, and at the time of the research, only country-level local reviews were available in Hungary and India. The study of the countries' volunteer reviews and monitoring procedures revealed significant differences.

Hungary has already developed its national sustainability strategy before the SDG framework. Since 2015 Hungary has worked on harmonizing the already existing strategy and the new SDG framework, and in 2018 it presented its first VNR. For monitoring and reporting SDG6, Hungary used only the global UN-Water indicators and did not present any country-specific local indicators (MFAT 2018).

India has reshaped its national targets in line with the SDGs. It created the NITI AAyog program, which formulated the country’s 3-, 7- and 15-year strategic national plans aligned with the SDGs. The developed indicators and collected data guide the policymakers and the implementers of various schemes and programs. In developing the National Indicator Framework, 306 statistical indicators were used, preceded by a national consultation program, many of which differ from the global indicators. India’s VNR and its annual reports communicate the results measured by the national indicators; therefore, UN-Water presents different indicators on India than the country’s VNR (Government of India 2021; MoSPI 2016; NITI Aayog 2018, 2020).

SDGs are implemented in India otherwise than in Hungary, and the studied VLR documents further confirm that each location uses and interprets the SDG framework differently. The wide variety of

monitoring approaches can be beneficial and progressive but could also be confusing to ICs. Ideally, an IC could engage with the SDG localization of its region, but only a few Regional Governments uptake the implementation task. Without a local framework, ICs could only use the country-level or global framework as an available model. A sectoral SDG framework could support ICs SDG implementation and enhance their cross-border SDG collaboration.

3.3.5. Sectorization

Another approach to making the SDG framework more accessible is sectoral. Human activity can be grouped into several sectors, and of these, to my knowledge, only the business sector has made a significant attempt to adapt the SDG framework to its operations. The business sector has developed a voluntary monitoring system using quantitative indicators to measure and communicate SDG achievements and progress (SDG Compass n.d.) Business actors can support sustainable development by reducing harmful effects and increasing the positive impacts of their activities (James, Bakker n.d.). With the adaptation of SDGs, business actors can actively participate in achieving SDGs and, through their efforts, become effective partners of governments, NGOs, and similar companies (WBCSD n.d.). An inventory was compiled with 1553 SDG indicators from widely recognized sources to properly monitor and communicate their results. The large quantity of indicators supports companies using selected indicators to fit their monitoring capabilities. However, it is essential to highlight that using a selective choice of indicators can reinforce trade-offs. An additional booklet gives adequate guidance on how to choose among the indicators. In addition, companies can develop and use their indicators and data collection methods. "*If the required data is not available through existing systems, other general methods of collecting and aggregating data include implementing reporting systems (for company operations and suppliers), performing field visits, questionnaires, focus groups, interviews"* are also recommended (GRI et al. 2017). When developing the ICs' monitoring concept, the 133 SDG6 indicators from the business inventory were studied, and the relevant ones were extracted into the developed SDG6 Monitoring Inventory.

In my research I was curious about the applicability of SDGs in the community sector. *"Community Sector means all the joint activity undertaken by people on the basis of shared concerns or interests. It includes informal and invisible activities that connect people together in common effort and the variety of other ways in which people participate in communities other than through voluntary organizations* (Law Insider n.d.)." The community sector has many subsectors, and ICs are one of them with a long-standing commitment to sustainability. Research on ICs can meaningfully contribute to the broader community sector.

Intentional Communities have been working for sustainability for decades, even before the UN SDG framework. In 2017, GEN investigated how 30 ecovillages from 5 continents contributed to the UN SDGs. Their findings were presented at the 2018 HLPF. Figure 6 shows how the researched ecovillages` practices contribute to highlighted SDGs (GEN 2019). However, if we study the research, we see that the GEN research team interpreted the ecovillages answers in SDGs, and GEN's research questions did not use the SDG terminology and the known SDG indicators. The report raises the question of whether ICs could interpret SDGs and engage in local and global SDG implementation without the involvement of SDG experts.

A sectoral guide for Intentional Communities is required to review the SDG results of ICs in a standardized way. Developing indicators compatible with the UN SDG monitoring framework and translating the good practices and achievements of ICs into measurable outcomes aligned with policy

regulations and support systems is essential. As no IC-specific SDG monitoring was available, a specific monitoring inventory was developed for the third research objective, the SDG6 research.

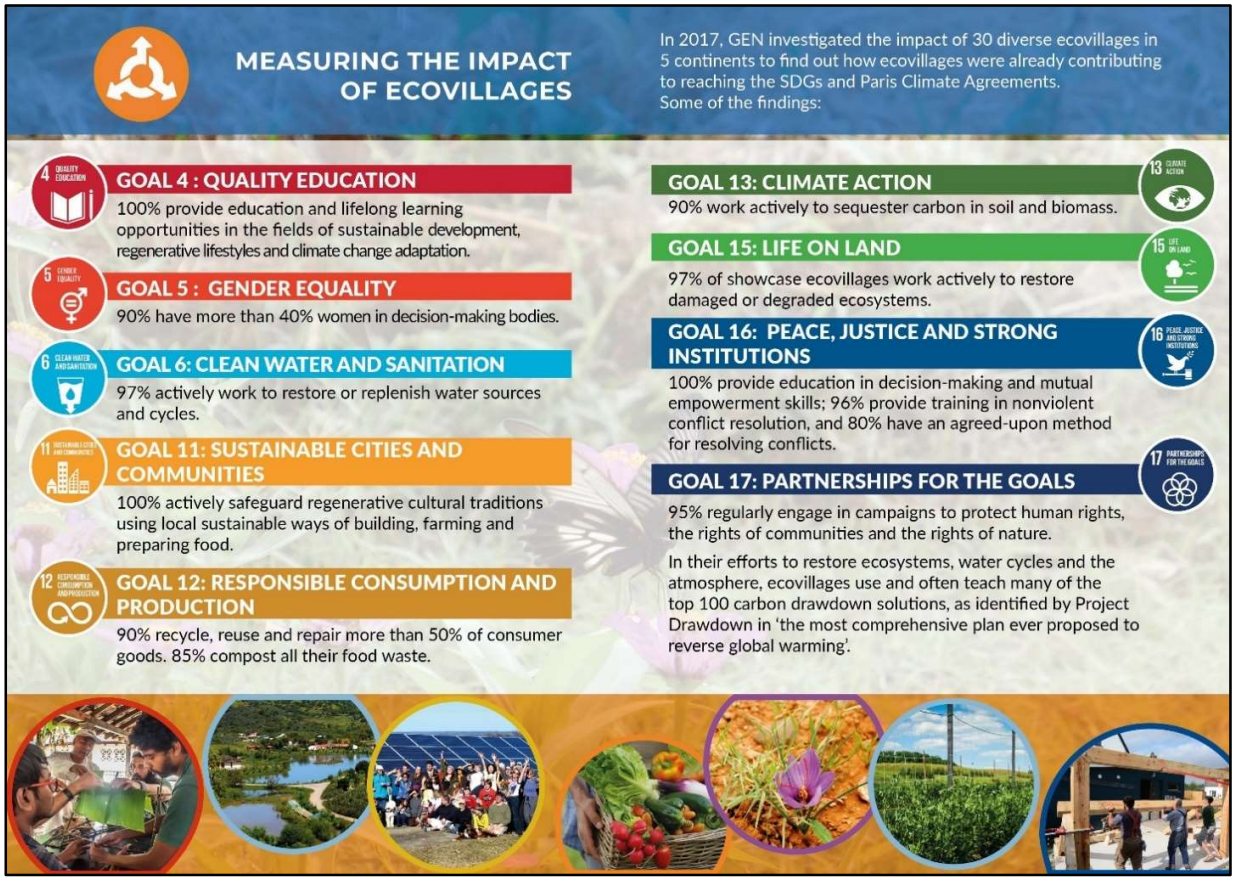

Figure 6. GEN research measuring the SDGs impact of ecovillages , Source:(GEN 2019)

3.4. Intentional Communities' potential roles and difficulties with SDGs

Thomas More's Utopia (1552) is the first thing that comes to mind when discussing Intentional Communities. More envisioned an island where people without societal divisions live harmoniously with nature. Building a new social model on an island to escape existing social issues was not a unique concept. Intentional communities have existed since ancient times (Metcalf 2012). Most Intentional communities were religious communities that emerged against the secularization of society. Later communities emerged where the main goal was to live a communal way of life, as opposed to the atomization and individualization of our societies (Meijering et al. 2007). Since the sixties, the number of ecovillage-type ICs has increased significantly; people of different religious, cultural, and ethnic origins live and work together in such communities (Litfin 2013). One frequent motivation for the ecovillages is the vision of a total economic, ecological, moral, and social catastrophe due to the unsustainable self-destructive current processes in the world. Ecovillages envision the crisis as inevitable and are preparing consciously for a catastrophe. In their capability of resilience or adaptivity

to the crisis, they attach great importance to local cooperation (Farkas 2015; Takács-Sánta 2017). One of the case-studied ecovillages shows a lesson on the importance of adaptivity. The extreme weather events of recent years in South India caused less material and no human casualties in Auroville, which was built with a conscious ecological approach to landscape use than its neighborhoods. Due to their sustainable land use and close collaborations, even in disaster situations, ecovillages adapt and recover more quickly than their neighborhood, as in Auroville, after a devastating cyclone of 2011 (Nagy 2018).

3.4.1. SDGs and ICs coherence interpreted through Takács-Sánta's crisis response framework

In his 1968 work Tragedy of Commons, Hardin outlined a null model of the ecological crisis (Hardin 1968). Takács-Sánta in his book: Comedy of Commons) wrote four possible response models to Hardin's sustainability dilemma (Takács-Sánta 2017).

1. Through laws, regulations, and support mechanisms created by governments in top-down systems.

This response can be identified as the UN's work and the creation of the SDG framework. While it's a top-down framework, it was designed to be participatory, including grassroots organizations. It can highlight good practices and alter regulations and support systems. The framework allows the ICs to become prominent actors in the SD transition. It even offers one goal specifically focused on communities; Goal 11: Sustainable Cities and Communities (Corella, et al 2020; Gaia Education 2018).

2. By initiating community-led, non-governmental social processes.

According to Takács-Sánta, Intentional Communities pursue their ecolocalist goals on three levels. a.) At the individual or household level, community members can assist each other in living more sustainably and making their homes more eco-friendly. For instance, they can exchange information and experiences about environmentally friendly solutions or adhere to environmentally friendly standards of behavior. b.) On a community level, members have many lifestyle alternatives, such as sharing utility items (e.g., cars, tools, books) or farming together. c.) At the settlement level, the community can engage in political debate and decision-making on the public affairs of the settlement (possibly part of a settlement or district). They utilize a variety of approaches to achieve their aims in their neighborhoods and settlements. Some try to make the activities of the local government or local companies more environmentally friendly, while others put more energy into the engagement of residents of the settlement (Takács-Sánta 2012). Intentional Communities could play a key role in making ecological thinking more visible today in politics, especially at the local level (Takács-Sánta 2017). Local communities can be vital to regaining people's power over their lives, making democracy more participatory. Changing the top-down system with the self-determination of local communities is essential for sustainability (Lányi 2012).

3. By disseminating knowledge and causing attitude shifts.

Education and the formation of new value systems are one path to a sustainable transition. The ICs could be leaders and role models, and ecovillages offer the transfer of experience on sustainable lifestyle (Farkas 2014, Litfin 2013). Intentional communities are eager to take part in knowledge sharing (Dawson 2006; FIC n.d.; GEN n.d.; Litfin 2013). On the settlement level, the community can try to shape the mindset and behavior of local people through environmental education (Takács-Sánta

2012). Many ICs provide environmental education, such as the increasingly popular community gardens (Hoffman 2017; Rosta 2013).

4. By changing values, norms, and worldviews.

Intentional communities go against the hegemonic systems and explore new values. Their members are system criticals who, contrary to their environment, recognize the present as a crisis and have a different vision from the rest of society. They have long-term goals for the survival of the earth for nature and humanity. Vision strengthens these communities to defer needs and present renunciations for future ascension (Bergmann 1990). Along with their vision, they develop sustainable lifestyle alternatives where community interdependence and voluntary simplicity become values. However, seeing the links between individual needs and global politics, economics, and cultural development is vital to achieving constructive change in a community (Sutton 2020). Social capital theory suggests that low levels of social capital at the micro-level would lead to less accountability at the macro-level, and macro-level structures, when corrupt, unaccountable, and oppressive, can have a corrosive effect on micro-level social capital. On the other hand, the higher levels of social capital (trust, communication, shared norms) generally shared within and between communities will positively influence the performance of macro-level structures (local, state, and national governance) through the informed, engaged, and organized citizens (Bartecchi 2015).

ICs can play an instrumental role in all four levels of the crisis response. They can contribute to the top-down SDG framework, participate in community-led societal processes, share sustainability knowledge and practices, and promote norms, values and worldviews facilitating the transition to macro level sustainability.

3.4.2. ICs' challenges to adapting the SDG framework

Defining ICs' role in promoting and achieving the SDGs raises two questions: whether the top-down UN framework applies to ICs, and whether ICs are open to participating in implementing the SDG framework. After the Brundtland Report, the UN adopted the term sustainable development in its political discourse, which has been criticized as ambiguous and open to contradictory interpretations and operating inside the capitalist system without trying to change the system's rules (Roseland, Spiliotopoulou 2016). Initially, the demanding environmental initiatives questioned the hegemonic foundations of economic growth and employment and opened up a space for contestation and counter-hegemonic articulations (Bengtson, Östman 2014). The notion of 'environment' initially represented something particular, controversial, and not mainstreamed in society, and when merged into the term "Sustainable Development," it turned a particular idea into a generality. The new term was supposed to bring about the solution to not particular issues but global crises. The concept was fuzzy enough to articulate differing interests and groups into a form of totality that seemed consensual on the one hand but at the same time neglected any contingency. The term turned into an empty signifier. Empty signifiers appear when social creative helplessness in crises increases uncertainty, and to defend their interests, hegemonic groups and political forces desperately try to address all issues simultaneously. Such empty signifiers promise to fulfill the demands of antagonistic initiatives while keeping a hegemonic status quo, although this promise is unrealizable in a contingent society (Laclau 1996). Oxford reference identifies an empty signifier: "*as a signifier with a vague, highly variable, unspecifiable, or non-existent signified. Such signifiers mean different things to different people: they may stand for many or even any signified; they may mean whatever their interpreters want them to mean* "(Oxford Reference n.d.) .Tschapka assumes that the universality of the empty signifier of

Sustainable Development gave certain interest groups and government actors the illusion of a consensual foundation, where the original demand to integrate controversial environmental initiatives from the periphery into the hegemonic center vanished (Tschapka 2018).

As the SDGs notion encompasses the empty signified SDs, the SDGs themselves may be perceived as empty signifiers by many, which assumption was confirmed by my research experience with the ICs. In addition to the empty signifier perception, the perception of the SDGs is affected negatively by the reality that not all UN plans and programs support a holistic approach or follow implementation strategies, leading to lost opportunities, lack of credibility and increased public skepticism (Spiliotopoulou, Roseland 2020). If the SDGs are interpreted as empty signifiers, it is necessary to explore the potential of grassroots social movements to alternate the dominant discourses on sustainability (Grange 2017).

The UN framework also raises questions about whether the top-down regulatory system of the SDGs is ready to engage different societal actors in the implementation of it. The open structure of the UN monitoring system gives local and sectoral actors the freedom to develop and modify targets and indicators, but not all actors are ready to take on this task. The diversity of voluntarily developed monitoring systems makes it difficult to find indicators that are suitable for all. However, monitoring is key to redesigning the path toward the SDGs with consideration of the synergies and trade-offs revealed by monitoring. The SDG framework, with its 169 sometimes synergistic and other times compromised targets, is complex and poses uncertainties in its implementation, even for Regional Governments, who are part of the top-down system and are committed to the SDGs (nrg4SD 2018).

This research did not dive deep into the challenges embedded in the SDGs but aimed to recognize them, as well as the constraints embedded in the ICs preventing them from actively engaging in SDG implementation.

Intentional communities have existed since ancient times (Metcalf 2012), emerging in days of crisis and opposing the hegemonic systems (Meijering et al. 2007). Experience shows that today ICs are reluctant to cooperate with any political concepts from above as such work contradicts their core values of questioning and opposing hegemonic political systems (Sargisson 2009). Because of their strong opposition to the status quo, ICs can have a hostile relationship with the authorities even within their settlement. Unfortunately, a significant proportion (90%) of IC initiatives fail due to bureaucratic hurdles and competition with unsustainable organizations. Their relationship with their social environment is often cold, distant, and sometimes even hostile (Dawson 2006). Bureaucratic challenges often compromise them, as examples from around the world show. The lost legal opportunity of community land ownership in Hungary, a planned highway through the restored forests of Auroville in India (Nagy, Szabó 2019), more money spent in gaining permission for wind turbines than in their purchase, transport, and installation together in Findhorn, Scotland (Dawson 2006) are examples of ICs challenges.

With all these challenges, ICs struggle to operate and cannot devote time and energy to the complex SDG framework, even if SDGs would entitle governments to assist the ICs. Many ICs see the SDGs as part of the capitalistic system, while IC members question the global economic model and the interests of technocracy and power and join the community as a critique of global capitalism (Litfin 2013).

3.4.3. Good example of ICs activity in SDGs

The SDG framework emphasizes the importance of partnership and seeks to enable broad societal participation, and there are promising examples of ICs' participation in SDGs implementation.

ICs are increasingly open to collaborating with global and local decision-makers to be a greater force in the sustainability transitions. Even if individual ICs are often disadvantaged in their contexts, one of their networks, GEN, has successfully engaged with decision-makers and obtained consultative status at the United Nations Economic and Social Council in 2001. In 2018 GEN published its research report on SDGs on the HLPF. GEN works to increase the number and visibility of grassroots actions and ecovillage projects linked to it. GEN shares best practices, showcases the solutions implemented by ecovillage projects on the ground, offers pathways to sustainability that are easy to implement, and further develops educational meetings and conferences to promote sustainable lifestyles and resilience. GEN also builds and strengthens strategic alliances with like-minded governmental and civil society organizations and socially responsible corporations (GEN n.d.).

3.4.4. ICs as Living Laboratories of sustainability

Community researchers often refer to ecovillages as "living laboratories of sustainability" (Dawson 2006; GEN n.d.; Litfin 2013). Google Scholar delivers 1,730,000 results for the search term "Living Laboratories sustainability," but only a fraction of these findings refers to the term "ecovillage" or "Intentional Community".

William J. Mitchell developed the Living Laboratory or Living Lab (LL) concept at the School of Architecture and City Planning, MIT, Boston. The concept incorporates innovation and research methods into a user-friendly environment. The Living Lab is a research setting that allows sensing, prototyping, testing, and refining complicated solutions in various complex real-world scenarios (Schumacher, Feurstein 2007). The European Network of Living Labs (ENOLL) describes Living Labs as „*open innovation ecosystems that employ iterative feedback procedures throughout an idea's lifecycle to produce lasting effect. In order to provide (various sorts of) joint-value to the associated stakeholders, they put a strong emphasis on co-creation, quick prototyping & testing, and scaling-up inventions & enterprises. Living labs serve as brokers or orchestrators between citizens, research institutions, businesses, and governmental bodies in this setting. They all have similar traits across a wide range of living labs, yet they all have different implementations"* (ENOLL n.d.).

ICs' members oppose the mainstream world and create a new pattern of human life, a model for sustainability. They are experiencing all problems of the current crisis but develop new solutions through prototyping, experimenting, and exploring sustainability. They create sustainable patterns that can facilitate change throughout the region turning the crisis into a learning opportunity instead of a catastrophe. They adapt to their local circumstances and explore complex sustainable lifestyle alternatives based on ancient methods, modern sustainable technologies, and practical experiences. Prototyped successful methods rapidly multiply and become local good practices within the ICs.

ICs are created in many places, building communities and positively impacting their region. They are not only aiming for sustainability but also taking on the role of the knowledge transfer model. ICs' recognition as Living Labs for localizing and sectorizing SDGs, and training venues and collaborating partners of governments would accelerate the sustainability transition. Therefore, it is important to investigate whether they could serve as local Living Laboratories for SDGs.

4. METHODS AND MATERIALS

The research started with reviewing the relevant literature. Three pilot studies were used to alter a questionnaire, highlight difficulties, and assess the applicability of targets, sub targets and indicators. Comprehensive research examined the 17 SDGs in ICs, using web content analysis and self-assessment questionnaire methods. Forty-two ICs' web content was analyzed, identifying relevant aims and activities for each SDG. The interaction with the ICs started with the sending of questionnaires. Thirty-three ICs responded, revealing how they see themselves in SDG engagement beyond what they communicate about themselves online. The research scope was reduced to one goal, SDG6. An inventory was developed, including eight targets, fifty-one sub targets and two-hundred-seventy-three indicators. This inventory, the SDG6 Monitoring Inventory, was further developed during a pilot study of the case studies. Four web content analyzed and questionnaire-responded ICs were researched as case studies on SDG 6 targets, practices and monitoring. The SDG6 Monitoring Inventory was used as a base for the data collection. Data was collected through fieldwork with community engagements, laboratory analysis and action research. The ICs' SDG perception emerged during the research, and a perception shift survey was conducted to help collect data related to the topic. Qualitative and quantitative methods were linked to the research objectives, and specific qualitative data were quantified and analyzed with an Excel program.

4.1. Methods of literature review and document analysis

A thorough review studied the literature. The concepts and theories reviewed were used as references in the research.

The SDGs were defined in 2015 by the UN, but the global framework allows and encourages all member states and stakeholders to customize it. Hence overwhelming quantities of documents and studies were written on this theme, and significant research was devoted to locating and studying relevant documents to gain a comprehensive knowledge of the topic.

4.2. Pilot studies

Several pilot studies were conducted, and these were fundamental to the research.

The comprehensive research used questionnaires developed through a pilot study, adapting the nrg4SD questionnaire to ICs through interviews and discussions with IC members.

Two pilot studies were carried out in Auroville. The first mapped Auroville activities and identified 37 groups and 11 individuals who jointly worked with each of the 169 SDG targets. Selected SDG targets and indicators were sent to the groups and individuals with a request to reflect on them. Although the pilot study did not yield results for the questions asked, it highlighted the ICs' SDG perception.

The last pilot study in Auroville was instrumental in developing the SDG6 Monitoring Inventory used for case studies. It examined the applicability of the 270 indicators collected by the SDG6 documents analysis in 11 Auroville communities, whose data was not included but has influenced the overall research. (Akashwa, Auroorchard, Auroville Papers, Budha Garden, Coin de Terre, Gaia's Garden, Village Action Group, Fertile Forest, Auroville Future, Palmyra, Solitude Farm). The pilot study identified new sub-targets and additional questions to highlight practices relevant to the SDG6 targets.

4.3. Comprehensive research

4.3.1. Communities Studied

Forty-two ICs from Hungary and abroad were chosen (Figure 7, 8 and Annex1) for the data collection between 2019 and 2021. Some were members of the GEN network (GEN n.d.), some were members of the Kisközösségi Új Komaháló network (Kisközösségi Program 2020), and others were collected through personal and professional contacts. The intentional communities were twenty-seven ecovillages, six community gardens, five eco-shopping communities, one community farm and three eco-local NGOs with various activities.

Figure 7. Researched International ICs

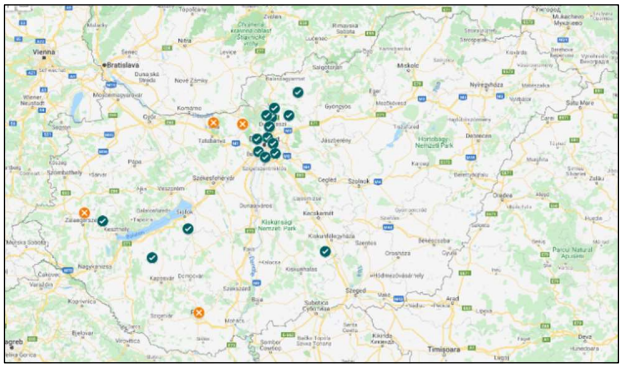

Figure 8. Researched Hungarian ICs

Each community was selected after a quick overview of their web content identified them as eco-local communities striving for sustainability. Forty-two community's web content was thoroughly analyzed regarding each of the seventeen SDGs. Thirty-three web content analyzed communities filled out the self-evaluation questionnaire, five responded but refused the questionnaire, and four did not respond. Forty-two ICs shaped the research, but only the data of the thirty-three ICs were used in the results. In Figures 7 and 8, ICs missing the questionnaire are marked with an orange x, and those completing the questionnaire are marked with a green tick.

4.3.2. Web content analysis

The research was conducted with the students of the Ecovillages Around the World subject from MATE University. Preparing for the web content analysis, the students became acquainted with the

SDGs' targets and their implications in different Intentional Communities. Their training included lectures on the relevant academic literature and policy documents, and representatives of six Intentional Communities gave lectures on the appliance of SDGs in their communities. The training prepared the researchers to translate the ICs activities, achievements and aims into the 17 Sustainable Development Goals. The researched ICs' online communication materials were reviewed, on their websites, online publications, and social platforms. The ICs' achievements, activities, good practices, and aims were mapped to each SD goal to understand how each researched IC relates to the SDG framework. The harvested information was compiled into Word documents, and qualitative data were quantified into Excel sheets.

4.3.3. ICs' self-assessment questionnaires

The web content analyzed communities were invited to a questionnaire-based self-assessment. Questionnaires were administered either through interviews or sent to the forty-two web content analyzed ICs via email.

The core of the questionnaire was built on the nrg4SD research questionnaire. Based on pilot research, the original nrg4SD questions and answers were slightly altered to suit the ICs, yet to retain the essence of the original nrg4SD for comparison of RegGovs and ICs (Annex 2).

In the pilot study, IC representatives hesitated to identify the SDGs relevant to the ICs` aims, activities, and achievements. For instance, it was questioned whether a vegan community situated far from the sea, whose members do not consume fish, can state to contribute to the achievement of SDG14 (protection of marine life). Consequently, the questionnaire offered the choice of direct or indirect relevance to individual goals to reduce uncertainty. These answers were subtracted to identify the goals perceived as relevant to the community's aims and activities.

4.4. Developing the SDG6 Monitoring Inventory

In this section, I present the SDG6 Monitoring Inventory, the basis for the case studies. The literature on SDGs, particularly SDG6 targets and their monitoring, was studied. SDG6 targets and indicators were gathered from UN and JMP monitoring and reporting systems (UN 2021, n.d.-a; UN Water 2017; UN-WATER 2016), Voluntary National Reviews (a series in which countries report their SDG performance) (OHCHR n.d.), Voluntary Local Reviews (a series in which cities report their SDG performance) (UNHABITAT n.d.), and the business sector (GRI et al. 2017). The collected indicators were organized into the SDG 6 Monitoring Inventory, categorized by the UN normative interpretations of SDG6 targets (UN 2016).

The compiled inventory's applicability was assessed in a pilot survey and supplemented with new questions and sub targets. The compiled inventory was used to collect SDG 6 data from the researched ecovillages and evaluate the collected indicators' IC applicability. The prepared SDG6 Monitoring Inventory is in the Annex 4.

4.5. Case Studies

Four ecovillages were selected from the researched ICs for further investigation on SDG6, two recently established ecovillages and two mature ecovillages, three Hungarian and one Indian. The chosen ecovillages implement a complex ecological lifestyle alternative and serve as community residences, versatile in their aims and activities and can be representative case studies to ICs.

4.5.1. Auroville

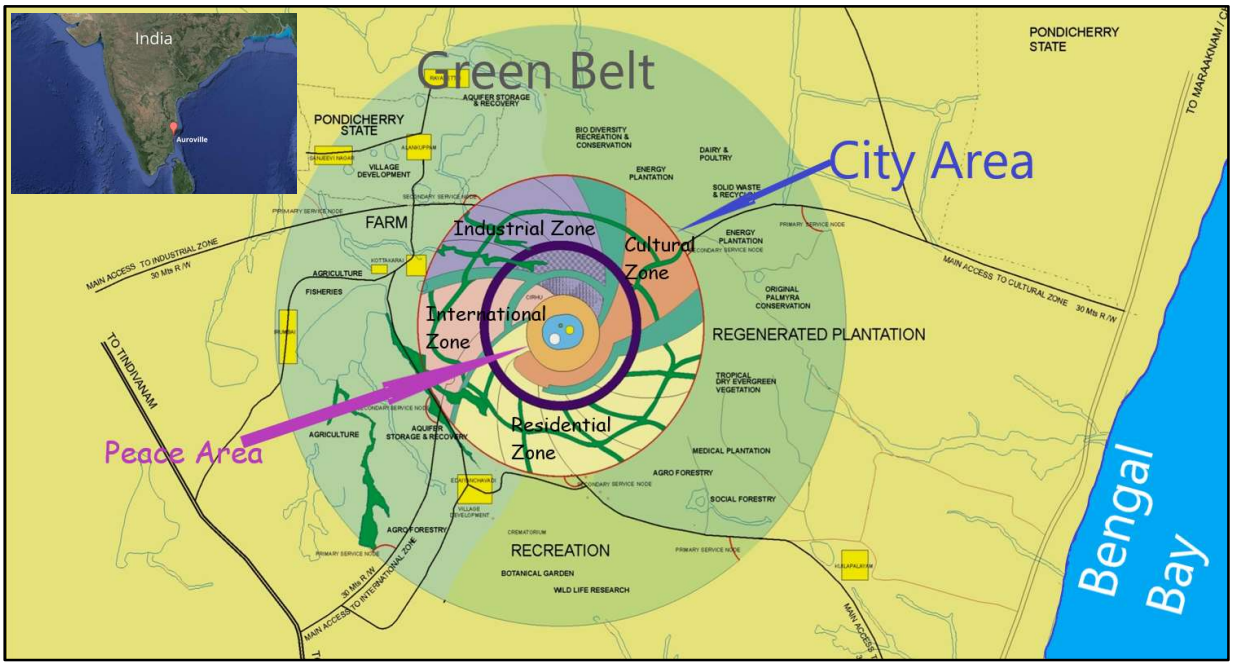

Figure 9. Auroville Map, Source: (CSR 2016)

Ecology:

Auroville was founded in 1968 on a 20 km^2 area of the Coromandel Coast on Bengal Bay in South India. The area is characterized by a tropical monsoon climate, where sudden heavy rainfalls follow long dry periods. Over the last 200 years, the native vegetation of the area, Tropical Dry Evergreen Forest (TDEF), has been largely eradicated. The rain has quickly removed the soil in the absence of groundcover, leaving behind a heavily eroded landscape. The rainwater ran toward the sea from the slightly sloping area shaping canyons. The land of once rich forests had become a barren plateau, and 1960 UNESCO research declared the land unfit for human habitation (Gilles et al 2013). The pioneering years of Auroville focused on landscape rehabilitation through reforestation and water management. As the number of inhabitants increased, a sustainable city evolved with integrated urban development, organic agriculture and alternative energy plants. Today, Auroville is considered an ecological wonder with its luscious, green environment (Nagy 2018).

Economy:

Numerous experiments and research were performed to develop the land, the infrastructure and the self-sustaining economy. The Auroville Master Plan comprises two areas: The Green Belt (1200 ha) and the City area (Figure 9). The City area compromises five zones: Peace Area, Residential Zone (189 ha), Cultural Zone (93 ha), Industrial Zone (109 ha), International Zone (74 ha). It consists of income-generating units and non-income-generating services maintained from the surplus of the units. Regardless of where one community member works, each individual receives the same income designated as a maintenance allowance. Thomas' book on Auroville's economy model investigated 40 years of accounting and financial reports. His description of Auroville's economy includes ecolocalist principles, but furthermore, it emphasizes the role of spirituality, community ownership, and the entrepreneurial spirit of the residents as instrumental to the developed ecolocalist system (Thomas, Thomas 2013). Many residents practice voluntary simplicity.

Society:

It was founded in 1968, in the presence of more than 5000 people, representatives from UNESCO and 149 countries. Auroville aspires to become "the city the Earth needs," with a maximum number of 50.000 inhabitants. The success of Auroville depends on the perseverance and financial capacity of the spirited individuals behind the project, who live in interdependence and trust each other. In April 2023, 2638 people from 60 countries lived there (Auroville Census n.d.).

Governance/Culture/Partnership:

Auroville's governance was defined as "divine anarchy" by its founder (The Mother n.d.) or "creative anarchy" by visiting political scientists. As professor Norman Myers, described it: "*I'm struck by the way you discuss and discuss issues until a decision bubbles to the surface - you don't so much take a decision as see what emerges*."(InternalAuroville n.d.). Due to its lack of centralized government and organic development, Auroville is not simply one community but a settlement of many communities. Each community is autonomic in many senses of governance. Solutions are spread not by a central power but by the collaboration of individuals. This characteristic posed a challenge in data collection but provided a unique opportunity to develop the SDG6 Monitoring Inventory, which was later applied for data collection.

Auroville's culture is based on the spiritual teachings of Sri Aurobindo. His system is called integral yoga, which acknowledges all life as divine, all work and activities as experiments, and the purpose of life as evolution. It was founded by Mira Alfassa, who was named "The Mother" by Sri Aurobindo. It meant not to be a monastery but a laboratory of human evolution, relying on the inherent good of man and not on religious practices. It aimed to create a land suitable for human life where new norms and values could be explored and experimented.

Auroville has a vibrant partnership as a knowledge-sharing hub with governments, UNESCO, the UN and the EU, and with universities and organizations striving for sustainability.

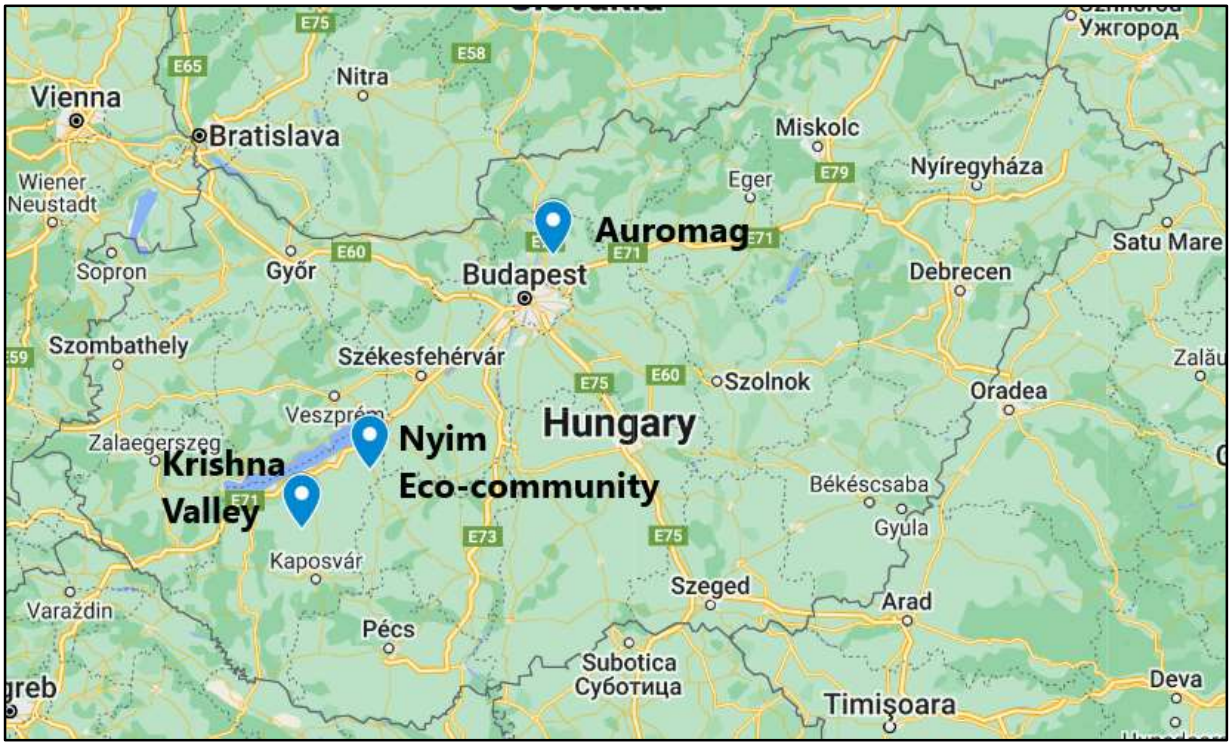

Figure 10. Auromag, Krishna Valley and Nyim Eco Community location

4.5.2. Krishna Valley

Ecology:

Krishna Valley (KRV) was founded in 1993 in Hungary, close to Lake Balaton, next to Somogyvámos village. The land is 285 hectares. The initial state of nature showed a bleak picture in the 90ies. The biodiversity of the abandoned lands was low; the population of Somogyvámos was declining. The groundwater was heavily nitrated due to decades of conventional agriculture and the non-sustainable use of agrochemicals. Over the past 30 years, the landscape has transformed. The once eroded monocultural land became a natural habitat where biodiversity has increased significantly. Today, 125 bird species live in the area.

Economy:

The goal of Krishna Valley was to create a self-sufficient farm community. Since 1994, controlled organic farming has been practiced in the area. They grow cereals, vegetables, and fruits and have cattle. The food produced above the community's needs is preserved in their small factory and sold. Tourism also generates income; the ecovillage has 25,000 visitors a year. In addition to pilgrimages, various workshops, retreats, and courses are regularly held. They have a vegetarian restaurant and accommodations with green certification. They have resident and non-resident employees, whose number varies from 20-40 depending on the season. Krishna Valley is a church community, the land and properties are owned by the church, and the residents do not receive a salary but perform service

in exchange for maintenance from the church. Residents practice voluntary simplicity as part of their religious beliefs.

Society: It currently has 130 residents, while 200 "civil" believers live in the neighboring village, Somogyvámos, who, according to their own decision, have a closer or looser relationship with Krishna Valley. The plan is to expand Krishna Valley into an ecovillage that can sustain 300 people. They have a kindergarten, an elementary, and a high school with children of the residents and other Krishna devotees. These are all accredited church educational institutions.

Governance/Culture/Partnership:

It has a hierarchic governance structure, with many departments united in directorates. The board of directors has a chairman.

The ecovillage is the largest Krishna Community Farm in Europe; Krishna believers founded it. The lives of the residents here are built around church. They worship nature and practice voluntary simplicity based on religious beliefs.

It fosters lively cooperation with its partners. It is a member of GEN and has cooperation agreements with higher education institutions (Nagy, Sallay 2019). It has good relations with the neighboring village of Somogyvámos. Of Somogyvámos' 850 inhabitants, 330 are Krishna believers participating in the municipality's activities (local government, council and local businesses).

4.5.3. Auromag

Ecology:

The community was started in 2017 in Pest County in Hungary on abandoned agricultural land that had been unused for 20 years. The site has been gradually occupied by vegetation, primarily saline, dry meadow image due to poor soil quality and deep groundwater. The quality of the land is inferior, with 3-6 gold crowns per hectare. The community aims to regenerate the land with permaculture practices.

Economy:

The community has no income generation yet; it focuses on buying the land. The community-held eight hectare plots (four leased, four owned) are fragmented within the 80-hectare land and are surrounded by abandoned fields. The entire 80 hectares area was allocated in government compensation 20 years ago and fragmented into 400 plots. Since then, no development or land use has taken place. The landowners do not use the land and consider it unfit for agricultural production but hope to sell it for industrial developments if interest arises. As the area is agricultural land, there are challenging regulations for buying, leasing and developing the land due to the Hungarian land protection law. Auromag requires self-sufficiency out of compulsion and sustainability, as all infrastructure is located far away from the land and local resources are poor, without any water bodies,

and only one well with poor water quality and quantity. The land is still underdeveloped, and members settling down gradually.

Society:

The community comprises 40 members (adults and children); only two live on the community land permanently, while others live in neighboring towns. As buildings are built, members gradually move in permanently, but some do not plan to live on the community land.

Governance/Culture/ Partnership:

The community has a consensual decision-making process; its board consists of five working groups covering the various field of their activities.

It considers Auroville as its model, cooperates with the Auroville Hungary association and several members of the Auromag community have been to Auroville. Its spiritual development follows the Auroville guidelines and has sustainability as its primary objective.

It has been focusing on the inner works since its recent foundation. It is a member of Auroville International Network, Új Komaháló, and aims to partner with GEN, national and international organizations, and institutions. Its members have personal collaborations with their neighboring municipalities, educational institutions and NGOs.

4.5.4. Nyim Eco Community

Ecology:

The 26 hectares of contiguous land of Nyim Eco Community (Nyim EC) was bought in 2012 in Somogy County, Hungary, next to the village of Nyim on overused agricultural land next to a protected forest. The community had a hydrological water research survey of the area and a holistic plan right from the start. The landscape wounds were the first to be taken care of, where water flowed down the hills and swept the soil. By today these wounds have disappeared, green manure was sowed, trees have been planted, and 400 meters long downpour dams have been created. Biodiversity studies showed a significant increase in BDI.

Economy:

The community has a social cooperative and an agricultural cooperative, which manages the community's land by renting it from the members. Furthermore, it is planned to purchase more land in the future. The community members are encouraged to buy land, which they lease to the community. The community has a system of compensating for economical differences. There is municipal electricity, water pipes, and other infrastructure a few meters from the land border, which can be easily connected to. The land has a master plan, and a 28 meters deep well was recently dug. Buildings are gradually developing.

Society:

The community was started in 2010 before its lands were bought. The community has 14 core members and a circle of collaborators, some of whom moved to Nyim village to live near the community land. One family currently lives on the community land, and another is in the homebuilding process. The community land is next to the built-in area of Nyim village, where some members live in private and public village houses. The aim is to have 20 core members in the near future and approximately 80 members eventually. It is estimated that the community land can accommodate 150 people.

Governance/Culture/Partnership:

Their governance structure has sociocracy elements; decisions are made by consensus of the core members who attend weekly meetings and dedicate one weekend day to work on the common property. The community has one operational meeting and one working day together per week, and quarterly one full-day meeting focuses on community well-being, strategizing or celebration.

The community has cultural elements originating from its members but not imposed on the community. Related to the question of ethicality, taking ecological and human values seriously and sincerely, they often reach more profound levels of a state close to spiritual experiences. Several cultural habits that originated from its members are practiced but not imposed, still recognized as the culture of the community.

The community is an aspiring member of GEN Europe and the only active member in Hungary accredited to host ESC volunteers. The community also collaborates with Nyim municipality.

4.5.5. Fieldwork with community engagements

Eleven months were spent in Auroville, India, and the three Hungarian communities were regularly visited during the Ph.D. research period.

Interviews were held with local members, stakeholders, and experts were interviewed. Fifty-six experts and stakeholders were interviewed in Auroville, listed under seven topic categories, as demonstrated in the Annex 5. Multiple interviews were conducted in Krishna Valley, Auromag and Nyim Eco Community. The interviews were semi-structured, based on the developed SDG6 Monitoring Inventory Draft, but leaving space for new targets and indicators to emerge.

Water-related documents of the researched ecovillages were collected from interviewees. Data was compiled from the collected documents.

During site visits, I had the opportunity to use toilets, drink drinking water, eat local food, visit green industries, observe the hygiene of community kitchens, canteens and schools, and visit wastewater

treatment plants, waterbodies and agricultural lands. My observations complemented the data collected in the interviews.

My participation in community activities helped me to understand the communities' commitment to SDG6 objectives. I participated in a sustainability conference in Krishna Valley and a deep-ecology workshop in Nyim Eco Community. I participated in numerous water-related community activities, presentations, seminars, focus group discussions, gatherings in Auroville, and sustainability-related community activities and discussions in Auromag.

In organized and announced plenary sessions, the local SDG6 findings were discussed with local community members. The research results were presented in a plenary session with a discussion in Auroville and a focus group discussion in KRV. The local findings were discussed during the SDG6 Localizing Workshops in Nyim and Auromag. Each discussion was filmed, and the reflections were later incorporated into the results.

4.5.6. Laboratory analysis

The literature on chemical analysis of water bodies, namely SDG indicator 6.3.2, was reviewed (UN, GEMI 2020; UN Water 2017). Laboratory tests were conducted in Auroville and Krishna Valley. The water collection points were chosen after consulting the communities' experts. Water samples were collected and tested by local government-approved laboratories, the Environmental Monitoring Service in Auroville, and the Synlab Kaposvár in KRV (EMS n.d.; SYNLAB n.d.).

4.5.7. Action Research: SDG6 Localizing Workshops

The constructed SDG6 Monitoring Inventory can assist in evaluating existing practices, but the recently established ecovillages have more aspirations than accomplishments. A new method was required to reveal the SDG6-related ambitions of Auromag and Nyim Eco Community. The one-day-long SDG6 Localizing Workshop was built on the collected SDG6-specific local data and included local people in developing an SDG6 strategy. It combined intellectual knowledge (SWOT analysis, FSSD framework, Presentations, study groups, plenary discussions, ABCD backcasting) with awakened community wisdom (meditation, music and creative artwork in nature). Detailed description of the workshop is in Annex 6.

As preparation, the relevant literature was studied on SDG6, participatory planning, local, sustainable strategic planning, SWOT analysis, ABCD back-casting, FSSD framework (Broman, Robèrt 2017), community planning processes, water meditations, and creative community art processes. The SDG6 Localizing Workshop was assembled utilizing the knowledge and tools gathered.

Full-day workshops were held at the two recent ecovillages encompassing a projector, laptop, camera, various-sized papers, writing and painting tools, and a swinging chime for meditation. The workshops were recorded, and mini-interviews collected participants' feedback on the workshop experience.

Workshop sheets and recordings were documented. Auromag agreed to share the workshop outcome, which is in Annex 7.

4.6. Perception shift survey

Information on SDG perception was spontaneously accumulated from the pilot studies, personal and written interaction with ICs and IC members' observations. This information slowly uncovered the ICs' empty signifier perception of SDGs. A short survey was done directly before and after the SDG6 Localizing Workshops to assess how IC members' SDG perception changed when the intricately worded SDG6 targets were translated into local and sectoral aims and actions.

5. RESULTS AND DISCUSSION

The research was conducted on two scales. Chapter 5.1 presents the results of the broader comprehensive research, which examined the 17 SDGs in forty-two ICs across five continents. Chapter 5.2 presents the results of the case studies, which were narrowed in-depth research, focusing on the SDG6 targets, sub targets indicators and associated practices of four ecovillages.

5.1. Sustainable Development Goals in Intentional Communities

The chapter presents results of the comprehensive and the perception research. It is divided into three sections that examine data providing information and insights to answer research questions related to the second, fourth and fifth objectives. In addition to the research data, this chapter also includes extracted data from the GEN and nrg4SD research reports. This sub-chapter explores the broader research scope of the 17 SDGs in ICs. Forty-two web content analyzed ICs received a self-assessment questionnaire, and thirty-three completed it. For clarity, only data from those who completed the questionnaire are used in this review. Information on the aims and activities of the ecovillages was collected for each SDG.

5.1.1. Practical experiences with the seventeen SDGs

This subchapter explores the SDGs' relevance to the researched Intentional Communities' aims and activities (O2Q1 research question). Data were collected both via web content analysis and ICs self-assessment questionnaires.

Before presenting my findings, I would like to discuss briefly some results of the GEN and nrg4SD research introduced in the literature review (GEN 2019; nrg4SD 2018). The two research reports have been inspirational for my research. Both reports were prepared for the 2018 HLPF. The nrg4SD report approached the SDG achievement from the localization side by examining RegGovs. The GEN report explored the contribution of ecovillages to SDGs, i.e., it can be seen as a community sectoral approach. The research was studied, and relevant data were extracted from these publications to Excel sheets.

Not all SDGs were examined in these surveys. The graph shows that the two findings are significantly different for the SDGs both organizations measured (Figure 11). The difference may suggest that ecovillages have more SDG-related practices than RegGovs. However, carefully examining the research methods, we can find a difference, researchers asked different questions in their questionnaires. Nrg4SD listed the SDGs to choose from. GEN asked practice-oriented questions without mentioning SDGs, and the information collected was translated into SDGs. For example, findings on soil and biomass were translated into SDG 13 Climate action. In the report "90% of the researched ecovillages work actively to sequester carbon in soil and biomass" is written (Figure 6).

I suspect that the difference in nrg4sd and GEN research results could be due to their sustainability practices but could also be caused by the difference in research methods and the difficulty of interpreting SDGs. Anyone unfamiliar with the 17 goals and 169 targets has difficulty identifying their actions and aims in SDG terms.

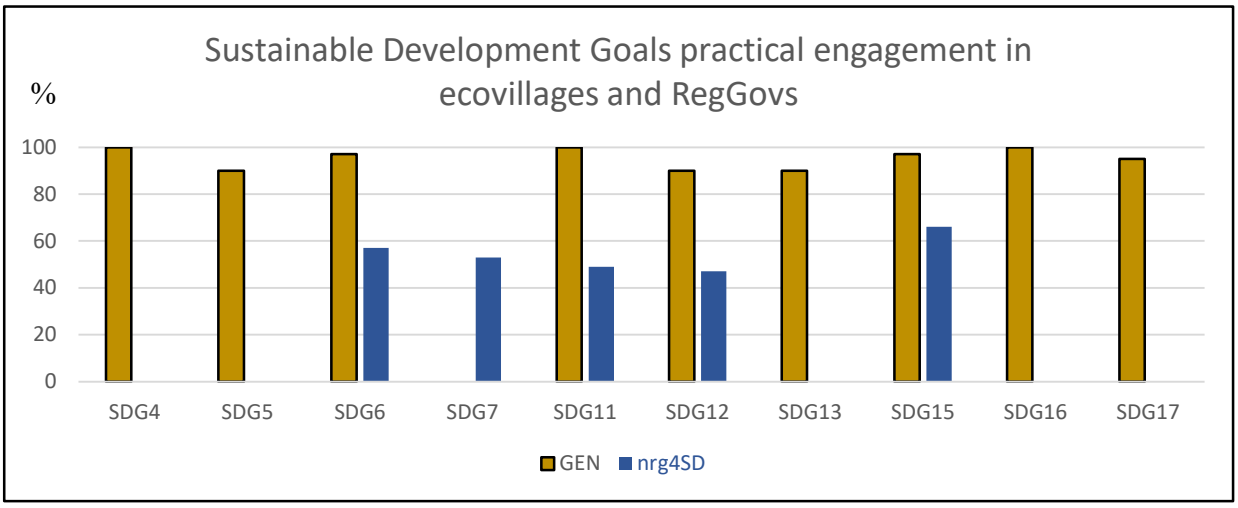

Figure 11. Practical experiences on SDGs in ecovillages and RegGovs. Extracted data from GEN and nrg4SD research reports (GEN 2019; nrg4SD 2018)

The differences between the nrg4SD and GEN research methods motivated me to investigate the SDGs in ICs in two ways. I used a self-assessment questionnaire (Annex 2) and web content analysis to examine the same questions, namely, which SDGs are relevant or irrelevant to the researched ICs' aims and activities (Figure 12).

Figure 12 shows the ICs practical experiences on SDGs measured by self-assessment questionnaires and web content analysis.

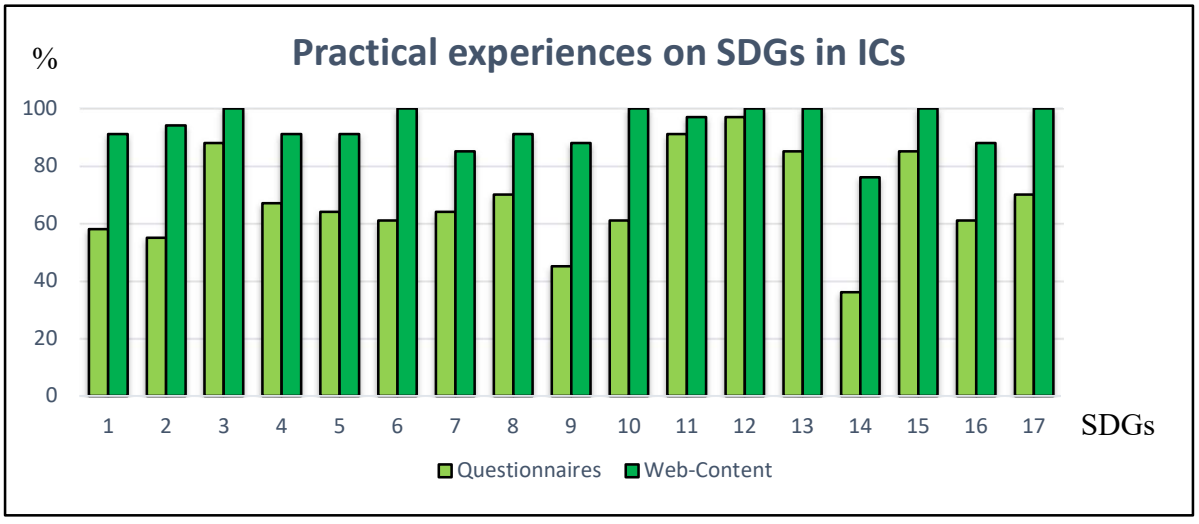

Figure 12. Practical experiences on SDGs in the researched ICs assessed by questionnaire and web content analysis

Comparing Figure 12 with Figure 11, we can see that both web content analysis and self-assessment results of ICs show higher values than nrg4SD results on the five SDGs measured. The difference suggest that ICS may be ahead of RegGovs in practical sustainability experiences. Figure 12 shows

that the researched ICs claim to have aims and activities corresponding to each SDG on their websites and in the questionnaires. The researched ICs' aims and works were set without knowing the SDGs; still, their activities correspond and contribute to each SDG's local and global achievements even if their contribution is not uniform across all goals. The research confirmed the O2H hypothesis that each SDG are relevant to the ICs.

However, the research shows significant differences in the results collected using web content analysis and self-assessment questionnaires. IC's self-assessment showed significantly less SDG experience than their web content analysis. The two studies differed in that trained researchers translated the practices into SDGs during web content analysis. While during the self-assessment, the ICs attempted to identify the goals relevant and irrelevant to their aims and activities. The results suggest that ICs have difficulty interpreting the SDGs to their aims and activities. The results confirm the O4H hypothesis and raise further questions, which I will discuss in the following subchapter.

5.1.2. ICs' awareness, interpretation, communication, and perception of SDGs

This sub-chapter addresses the O4Q1 and O4Q2 research questions and compares results from web content analysis and self-assessment questionnaires, and presents the results of the perception shift survey.

The difference in Figure 12 is striking, comparing the data of IC's self-assessment and web content analysis. The ICs` self-assessment measured significantly lower SDG engagement levels than their web content analysis. The reason behind this phenomenon can be the lack of expertise in interpreting the UN SDGs. Most ICs were unaware of the detailed meaning of the SDGs and tended to underestimate their experience level. The researched ICs were offered only the 17 SDG icons to choose from to keep the self-assessment questionnaire short and similar to the nrg4SD research (Annex 2). On the other hand, the web content analysis was done by trained researchers, who received 12 hours of training on SDGs and their implications in ICs. The trained researchers mapped the communities' aims and activities' relevance to the SDGs, not only by the SDG terminology but also by identifying activities relevant to each SDG goal and target. Matching activities, good practices, and ambitions related to each SDG were identified at almost every IC.

Both the web content analysis and the questionnaires showed that 80% of ICs are not using the SDGs in their communication. In their self-assessment, only four out of the thirty-three communities stated that they regularly refer to the SDGs when presenting their achievements, goals and activities. While the web content analysis confirmed that three of these four communities share information on the SDGs, they do not refer to the work of the communities but present the SDGs in general. The web content analysis found only one IC that used the SDGs to actually communicate its aims and activities.

We categorized the communities with the research students based on the web content and questionnaire findings. The results are shown in Figure 13. We got the impression that at least 67% of the ICs are not interested in the SDGs, do not plan to use them and even refuse to use them. We found only one IC that uses SDGs to refer to its aims and activities.

The researchers' overall impression of the ICs was that while each IC significantly contributes to the SDGs, only a few are aware of it, and even fewer find it valuable to communicate their engagement with the SDGs. Their answers suggest that SDGs are not known, used, and valued as a framework for communicating the ICs` aims, achievements, activities and good practices.

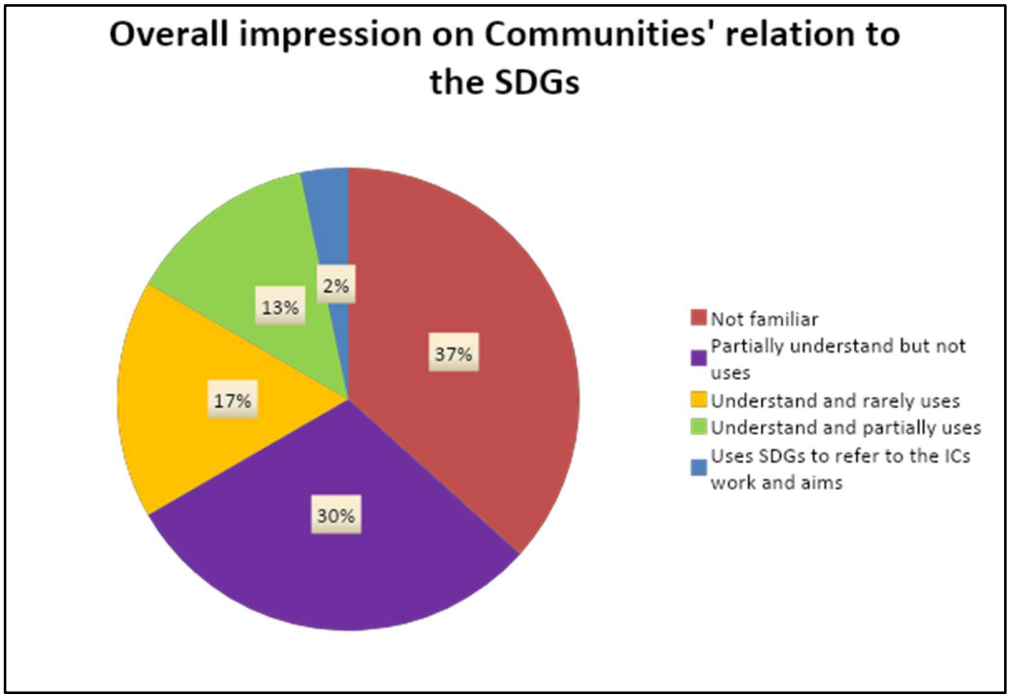

Figure 13. ICs relation to the SDGs

The assumption of underestimation was reinforced by the SDGs marked as irrelevant to the ICs` aims, activities and achievements in the questionnaire responses (Figure 14).

Figure 14 shows a significant difference between the SDGs evaluated by the ICs themselves and evaluated by the trained researchers based on their web content. It showed that most ICs unaware of the detailed meaning of the SDGs and tended to underestimate their engagement level. For instance, several communities working with organic agriculture indicated SDG 2 (Zero Hunger) as irrelevant. This goal has eight targets, five relevant to organic agriculture practices. We can conclude that ICs are often not aware of the extent to which their activities are related to the SDGs and tend to underestimate their SDG performances. The reason can be the complicated form of SDG documents and the challenge of addressing the potential conflicts between SDGs. This experience highlights the need for expertise in using the SDG framework. The result supports the O4H hypothesis.

Information spontaneously accumulated in the other sections of the questionnaire and communicating with IC members in writing and verbally showed that most communities do not see SDGs as a potential tool to collaborate for common goals; they see them merely as a reflection of the mainstream regime, as empty signifiers.

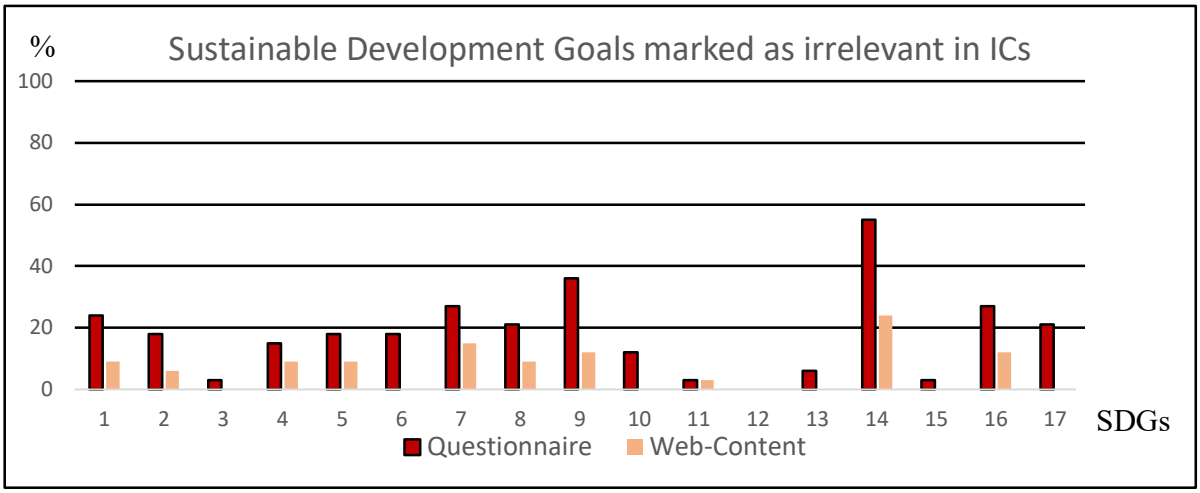

Figure 14. SDGs marked as irrelevant to the ICs by their self-assessment questionaire and based on the web content analysis

This outcome resonated with a 2018 pilot research experience in Auroville. I mapped Auroville activities and identified 37 groups and 11 individuals who jointly worked on each of the 169 SDG targets. I contacted the groups and individuals and requested them to reflect on the selected SDG targets I identified as relevant to their work.

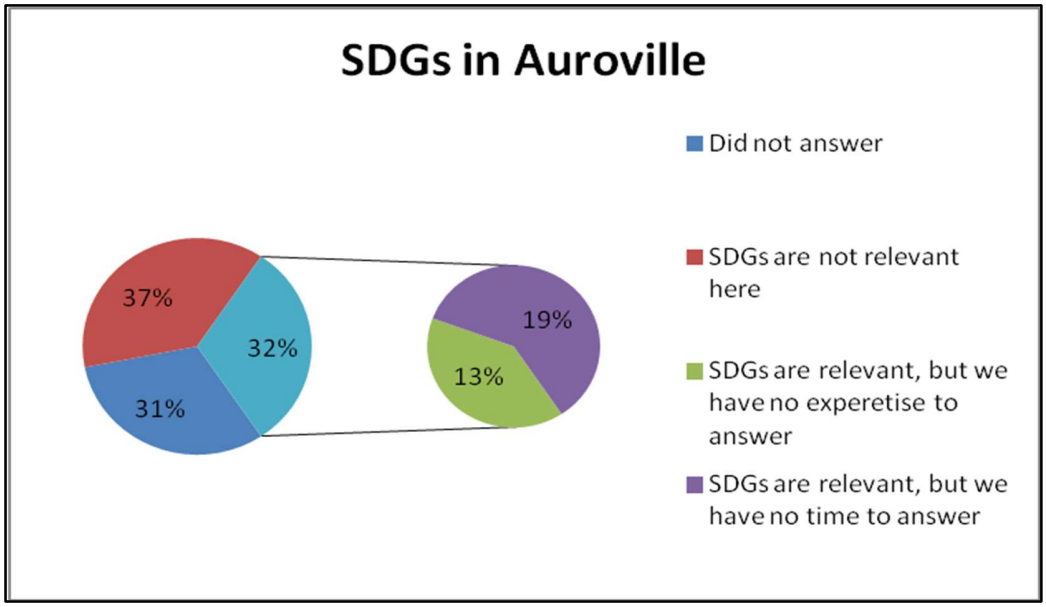

Figure 15. Aurovilian stakeholders responses to SDG research

Responses (Figure 15.) shattered my enthusiasm, fundamentally shaped the research and inspired the perception research.

One-third of the questioned did not respond. Another third responded that SDGs are not relevant to Auroville. The last third of respondents lacked the time or the expertise to answer. When discussed in person, most respondents agreed with what one said: “The SDGs are not relevant in Auroville; here we walk the talk!”

A similar attitude was perceived during the ICs’ research. Of the 42 addressed communities, nine have not filled out the questionnaire, and five explained their refusal, finding SDGs irrelevant to their work or lacking the time or expertise. Among the 33 ICs who responded, many expressed mistrust of the SDG framework via personal conversation or in the “other” options of the questionnaire.

The accumulated negative comments showed SDGs to be perceived as empty signifiers among most ICs.

An experiment tested if ICs’ SDG perception can be shifted when SDG 6 is interpreted in local and sectoral contexts. Two SDG6 Localizing Workshops were held with 20 members of two researched ICs. These workshops translated the intricately worded UN documents into tangible and practical local actions. A survey identified the SD Goals irrelevant to the aims and activities of the communities before and after the workshops.

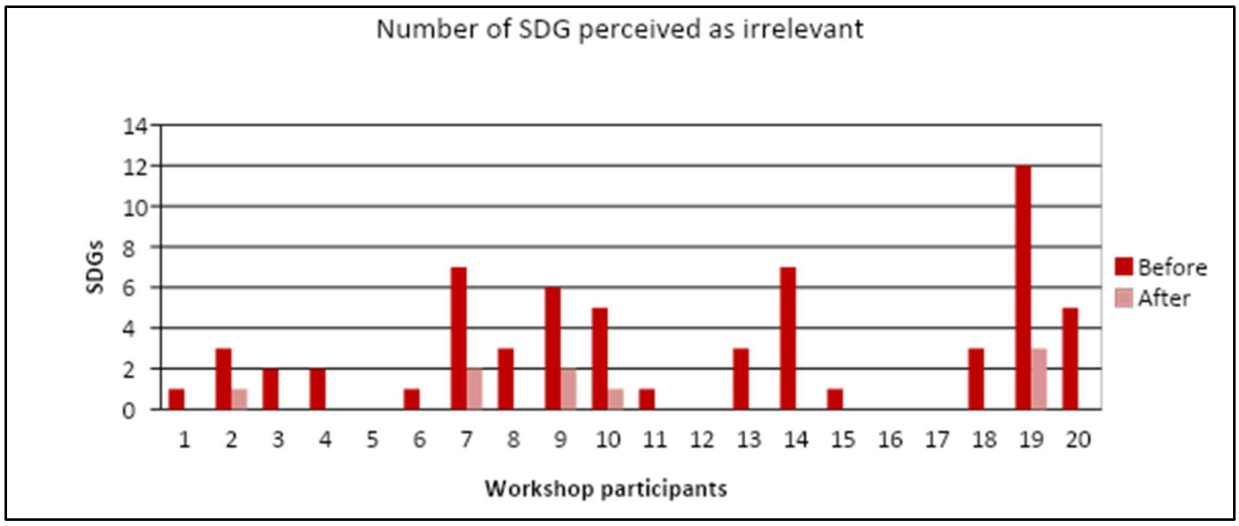

Figure 16. Change in owning the SDGs attitude before and after the SDG6 localizing workshop

The difference was striking; the number of SDGs marked as irrelevant significantly dropped after the workshop. Although the one-day workshop focused only on localizing SDG6, fifteen out of the twenty participants marked all SDGs as relevant to their community’s aims and activities after the workshops (Figure 16.).

The subchapter addressed the O4Q1 and O4Q2 research questions. The results show that many ICs do not use the SDGs framework adequately to communicate their aims and activities. The reason behind this phenomenon can be the lack of expertise and commitment due to the empty signifier perception of SDGs. The perception shift research suggests that ICs' perception changes once the intricate framework is translated to local and sectoral issues.

5.1.3. Perspectives on SDG implementation by Intentional Communities and Regional Governments

The previous chapter addressed the perceptual constraints that may prevent ICs' SDG engagement. It highlighted that only a few ICs are familiar with the SDGs, and even fewer use them when communicating their aims and activities. The question arises whether their SDG6 related good practices and experiences will reach local decision-makers without publicizing them.

This sub-chapter addresses the O4Q3, O4Q4 and O5Q1 research questions. It compares results extracted from the nrg4SD report and results from the ICs questionnaires. The literature review discussed SDGs localization, in which the Regional Governments, as local representatives of the top-down SDG system, are entitled to guide and accelerate the implementation process.

To explore the possibility of cooperation between ICs and RegGovs in SDG localization, I asked ICs implementation questions similar to the ones found in the nrg4SD questionnaire. By doing this, two research questions were addressed simultaneously (O4Q4 and O5Q1). For the ICs questionnaire, the nrg4SD questionnaire was used as a basis, but questions and answers were slightly altered following initial interviews as described in the Methods chapter. The subchapter compares the implementation of the SDGs in ICs and RegGovs and seeks insights into future collaborations between Intentional Communities and Regional Governments on localizing the SDGs.

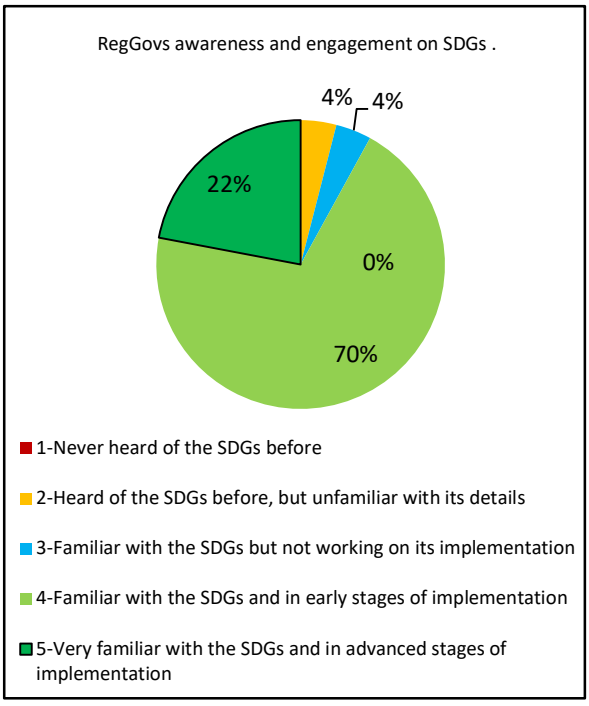

Figure 17. RegGovs awareness and engagement on SDGs, Source: (nrg4SD 2018)

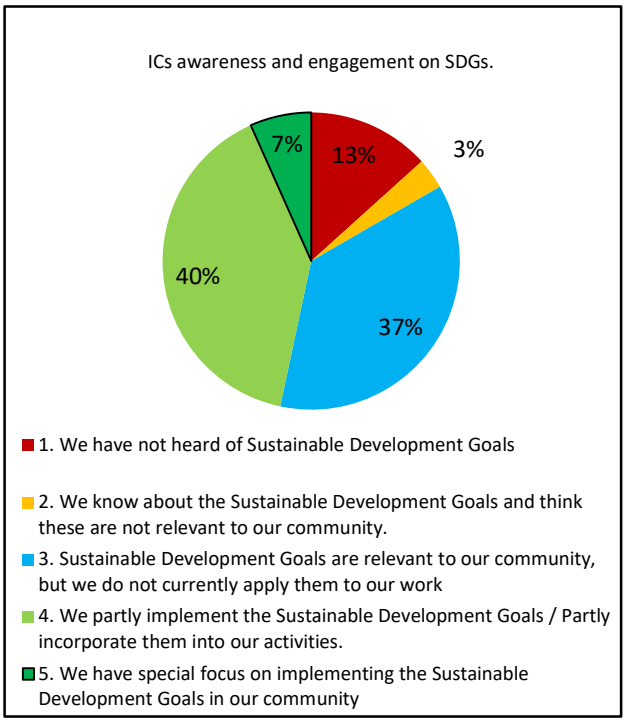

Figure 18. ICs' awareness and engagement on SDGs

Figure 17. and Figure 18. compares the awareness and engagement level on SDGs implementation in RegGovs and ICs. According to the nrg4SD report, 92% of Regional Governments claim to be aware of the SDGs and are at an early or advanced stage of implementation, while only 47% of ICs claimed to be aware of and implementing the SDGs, and 13% of ICs admitted to never heard of the SDGs.

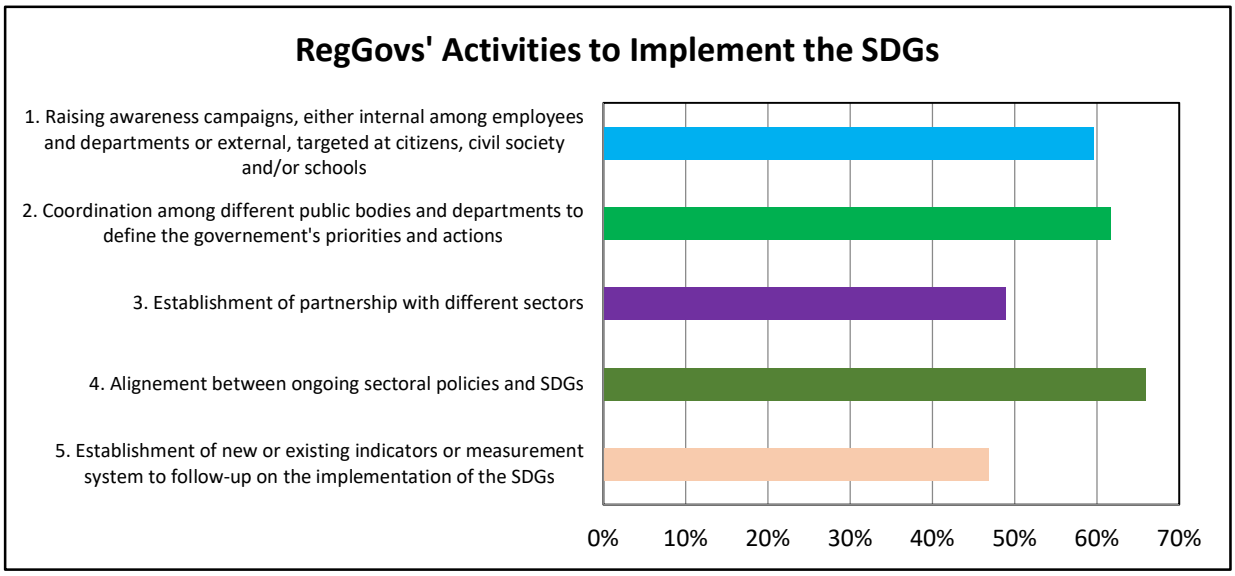

Figure 19. RegGovs adopted actions to implement the SDGs (nrg4SD, 2018)

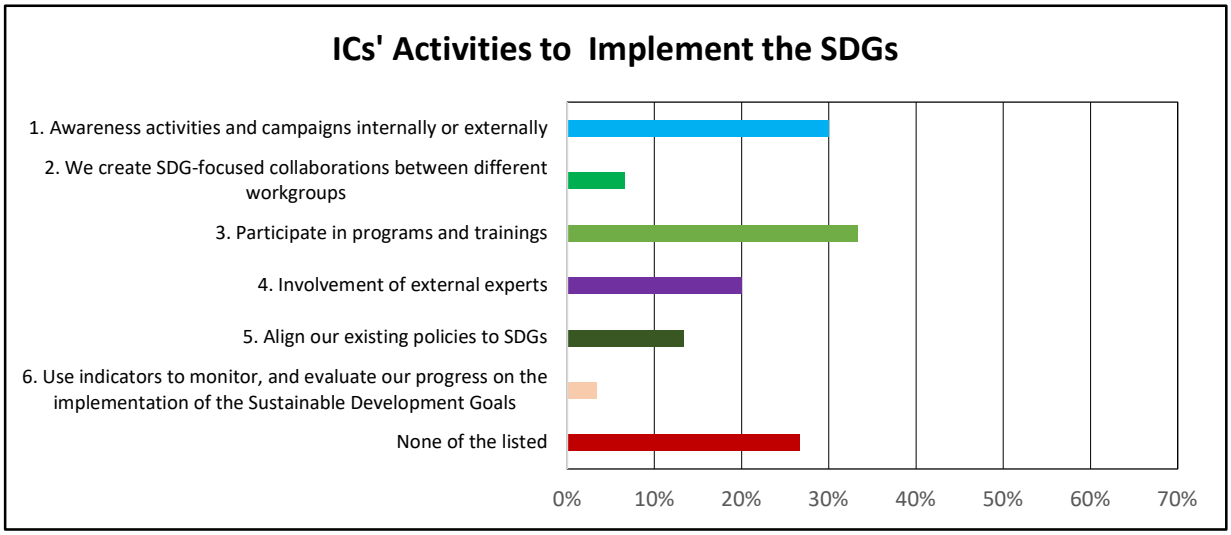

Figure 20. ICs' actions to implement the SDGs

Figure 19 and Figure 20 compare the selected local actions to achieve the SDGs. The actions help to adapt the SDG agenda and are necessary preparatory work for SDG localization.

Comparing the datasets reveals that more Regional Governments have identified actions toward implementing the SDGs than Intentional Communities. The most common actions chosen by RegGovs were to align policies with the SDGs, but over 60% of RegGovs indicated that they also wanted to coordinate public bodies to identify priorities and actions. Figure 19 shows that more RegGovs claim taking on the task of developing local monitoring systems to track the implementation of the SDGs.

Figure 20 shows that ICs are not so interested in actions related to policy implementation but are open to awareness raising and participation in programs and trainings. Awareness raising is key to gaining knowledge and partnership on the SDGs. Participation in programs or awareness-raising activities can be an excellent preparatory step towards alignment with the SDGs if ICs find this effort constructive.

Furthermore, 87% of the Regional Governments declared having specific instruments or policies to implement the SDGs, while only 27% of the ICs reported having taken formal measures to implement the SDGs. When asked what formal measures and instruments are in place to implement the SDGs, nearly 62% of RegGovs claimed to have a specific strategy or action plan, 55% claimed to have an internal committee or working group, 40% claimed to have a government decree or law, and 21% claimed to have an SD council with authority to implement the SDGs (nrg4SD 2017). Meanwhile, only 20% of ICs reported having a vision, and 13% said they had the expertise to implement the SDGs, but none of them chose the formal instruments listed in the questionnaire (Annex 2).

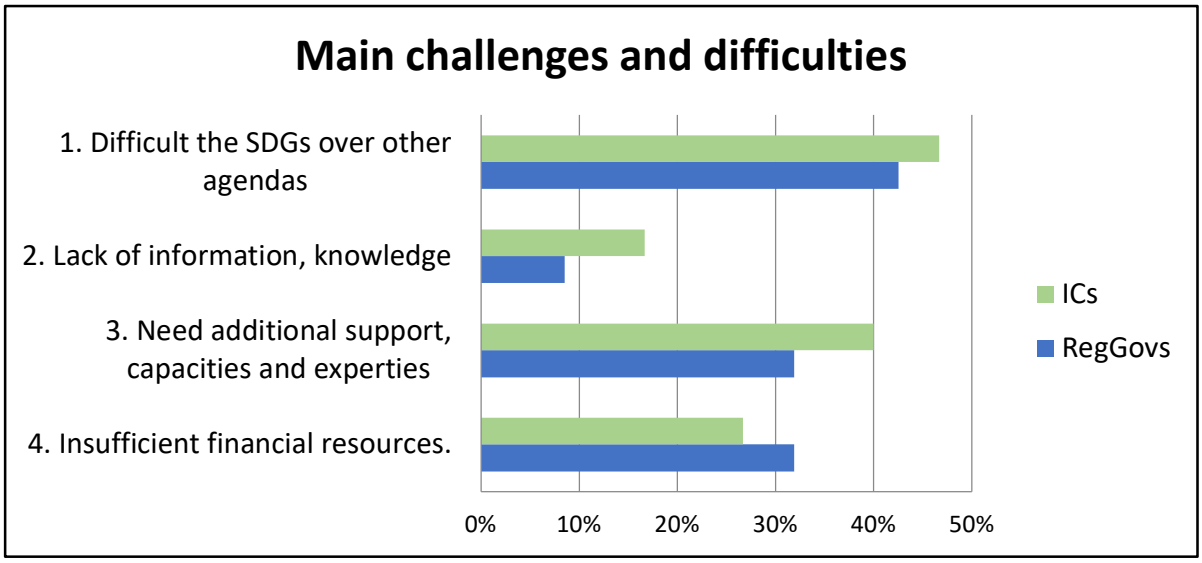

Figure 21. The Challenges in adopting the SDG framework ICs and RegGovs (nrg4SD 2018)

Figure 21 shows that ICs and Regional Governments face similar difficulties implementing the SDGs. Both find it challenging to address the SDGs in addition to their existing priorities. This challenge can be due to the complicated form of SDG documents and the challenge of addressing the potential conflicts between SDGs. As we can see, ICs already have experience in the practical manifestation of SDGs, and RegGovs are better equipped to implement the SDG framework. In principle, the SDG framework can be a tool to promote collaborations between local ICs and RegGovs. Local ICs can

offer experimented good SDG practices that are worth upscaling in the region. RegGovs alter regulations and support systems and to spread the ICs' good practices in the territory and accelerate the SDG achievements within their region.

The task of the RegGovs is urgent as the deadline for the SDGs approaches. They need to identify and accelerate local good practices, while the ICs need to refer to the SDGs to make the RegGovs aware of their good practices.

The research confirmed in O5H and answered the O5Q1 research question; ICs can play an active role in localizing SDGs. RegGovs and ICs can collaborate in localizing the SDGs. Together they can reduce the lack of time, resources and funds and accelerate the sustainability transition in their regions.

5.2. Sustainable Development Goal six in four ecovillages

The chapter presents case studies, data collected during fieldwork, laboratory analyses and action research. It consists of ten subchapters exploring how the SDG 6 targets are linked to ecovillage practices (O3Q1) and how appropriate the SDG6 framework is to highlight the good practices of ecovillages (O3Q2, O3Q3).

The first subsection presents the information related to the SDG6 framework. It introduces the developed SDG6 Monitoring Inventory, which was used for data collection. The inventory was developed based on document analysis and a pilot study and consists of targets, sub targets, indicators and added questions.

The following eight subchapters discuss ecovillages practices related to the eight SDG6 targets and analyze the relevant sub targets and monitoring methods. The SDG6 practices are referred to the four dimensions of sustainability.

In the last chapter, I address the O2Q2 research question by exploring the links between SDG6 ecovillage practices and the other SDGs.

5.2.1. SDG6 Monitoring Inventory

The development of the SDGs was long and built on the practices and experiences of the MDGs. The MDGs had no individual goal on water; its two water targets and four indicators focused on homes. Monitoring is about exploring the problem and determining where and by what means decision-makers, governments and stakeholders should take action. It was necessary to bring in new targets and indicators to monitor the entire water cycle. The new indicators and new elements to existing indicators altered the perspective on the water situation. In 2015 the MDG indicator measured 90% of humanity having adequate drinking water, while the SDG indicator, which included water quality and the distance of the water source from home, measured less than 50% of humanity having adequate water in 2016. The currently used indicators are complexes; some consist of 7 components. Progressive data monitoring is recommended and may include country-specific complementary targets and indicators; the data can be quantitative, qualitative and remote sensing.

UN-Water provides global monitoring of SDG 6 through custodian agencies. JMP (Joint Monitoring Program for Water Supply, Sanitation and Hygiene), GEMI (Global Environmental Management Initiative) and GLAAS (Global Analysis and Assessment of Sanitation and Drinking Water) are responsible for developing the SDG6 global indicators and collecting the data globally (Figure 22). The JMP is a monitoring program implemented in collaboration with WHO and UNICEF. The JMP-managed SDG targets 6.1 and 6.2 were already present in the MDGs. Their monitoring and interpretation are elaborate and supported by detailed online publications but are still progressing.

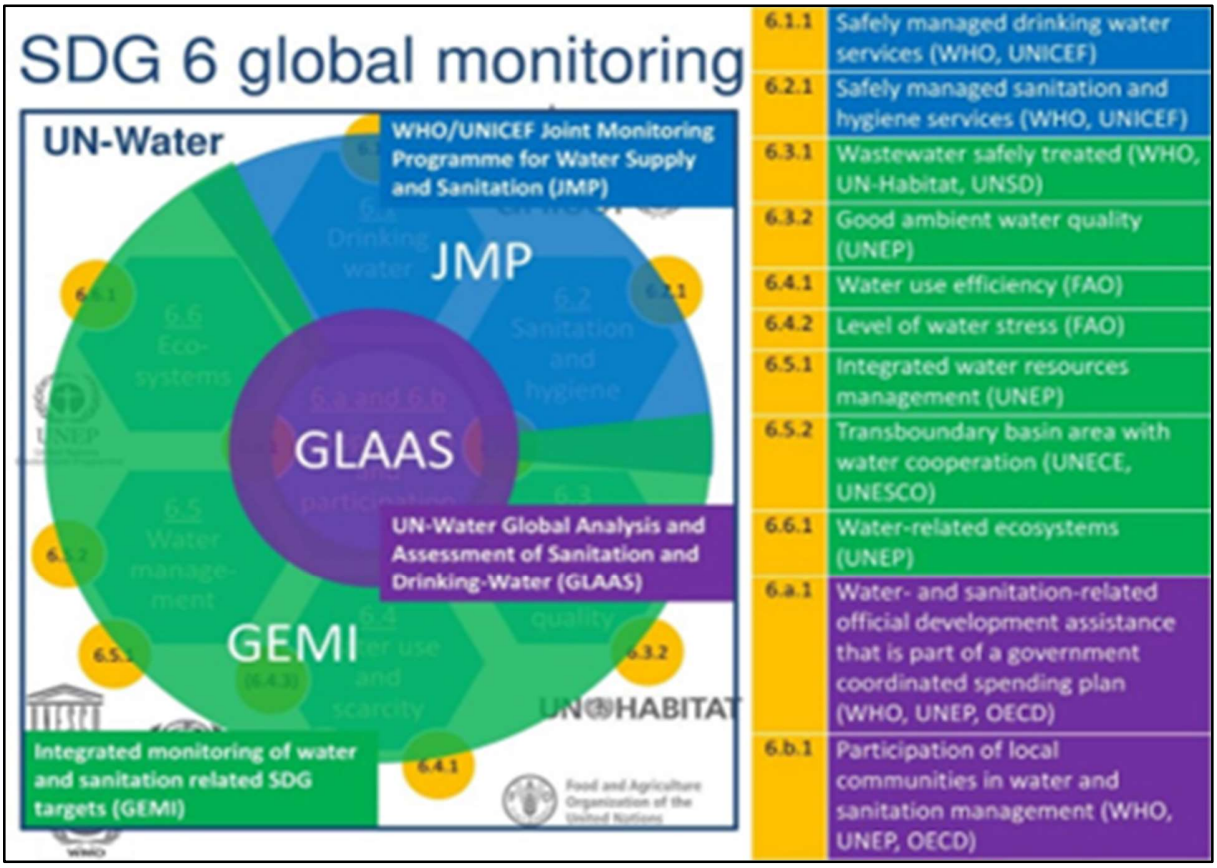

Figure 22. SDG6 monitoring, Source: (OECD Governance n.d.)

JMP has been collecting data on drinking water and sanitation since 1990. It has a well-established monitoring system and adequate data to show trends. The GEMI, in collaboration with WHO, FAO, UNECE, UNSD, UN-Habitat, and UN Environment, monitors water quality, wastewater, water use, water stress, integrated water management, and protection of water-related natural habitats. GEMI was established in 2014 and currently has less global data collection and monitoring experience than JMP. The GLAAS agency, with the WHO, UN-Water and OECD organizations, handles the horizontal targets on collaborations and participatory water governance. This agency presently has few indicators and global data (GWP 2019). SDG6.3-SDG6.B targets lack long-term data collection, which makes identifying the related trends and required interventions challenging.

The global indicators developed so far may need to be reviewed and corrected for future monitoring processes. Vanham and 13 international experts published a paper that discussed the SDG6.4.2: “level of water stress” global indicator. The paper acknowledged the benefits of the SDG indicator compared

to the prior MDG indicator, highlighted its shortcomings and listed seven recommendations (Vanham et al. 2018). This example shows the constant progress and work needed to improve the UN SDGs.

THE DEVELOPED SDG6 MONITORING INVENTORY

The MDGs had two water targets, and the SDG framework has eight water targets, but it is still elaborated. The SDG 6 UN framework contains 8 targets and 10 indicators (UN 2017), and allows the development of additional local and sectoral targets and indicators. Many SDG-specific documents have been produced, but during the literature research and document analysis I did not find any IC-specific SDG implementation documents. GEN's report on SDGs in ecovillages did not contain the information I needed. I developed new tools to measure SDG6 practices in ICs. Targets and indicators were gathered for the SDG 6 Monitoring Inventory, which was pilot studied and used as a base for data collection in the four researched communities through interviews, site visits, laboratory tests, community engagements and document analyses.

TARGETS:

The UN determined eight SDG6 targets are further divided into 51 sub targets through normative interpretation (UN 2016). Each target and sub target were included in the SDG6 Monitoring Inventory. The UN encourages everyone to develop additional local and sectoral targets and sub targets. I added six sub targets that emerged in the studied ecovillages based on their SDG6 prectices. The targets and sub targets frame the inventory, and the indicators are structured under the corresponding targets.

INDICATORS:

The UN determined ten SDG6 indicators (UN 2017) and encouraged territories and sectors to determine additional indicators. Two-hundred-seventy SDG6 indicators were gathered from the studied documents. The indicators are to measure the achievements on targets and highlight good practices. However, the indicators did not adequately reflect the researched ecovillages achievements and good practices. Therefore, the Monitoring Inventory was supplemented with a hundred sixty-one questions focusing on these.

I compiled the found indicators into an inventory, evaluated them during a pilot study and data collection, and assigned them to three categories (Table 1). I labeled as “not measurable” those that could not be accurately measured in the case studies. Although many indicators were not measurable in the researched ecovillages, these were kept in the SDG 6 Monitoring Inventory, with their label (Annex 4).

I labeled as “challenged” the indicators that require specific expertise, commitment and resources. Also included in the challenged category are indicators that, by the UN definition, present ecovillages practices negatively. For an example, the UN indicator SDG6.1.1. "Proportion of population using

safely managed drinking water services" is included in the challenged category because "drinking water," according to the UN, includes "water used for drinking, cooking, food preparation and personal hygiene." The ecovillages separate directly consumed drinking water from domestic water and manage them differently.

I have included in the measurable category those indicators that can be measured without particular expertise and effort. I put some national-level indicators in this category and transcribed them to the area level. SDG 6.6 UNSTAT indicator: "Nationally derived extent of wetlands (square kilometres)" is measurable locally as my fieldwork showed each researched ecovillages are skilled in remote sensing using Google Earth and other programs.

Table 1. Content of the SDG6 Monitoring Inventory

	Sub targets determined by the UN normative interpretations	Suggested additional sub targets	Indicators	Added questions
SDG 6.1	8 sub targets	1	38 indicators	35 questions
SDG 6.2	8 sub targets	1	26 indicators	29 questions
SDG 6.3	8 sub targets	none	49 indicators	28 questions
SDG 6.4	6 sub targets	none	51 indicators	17 questions
SDG 6.5	5 sub targets	none	12 indicators	12 questions
SDG 6.6	10 sub targets	3	59 indicators	21 questions
SDG 6.A	3 sub targets	none	4 indicators	6 questions
SDG 6.B	3 sub targets	1	31 indicators	13 questions
SUM	51	6	270	161

5.2.2. SDG 6.1 Drinking water

The SDG 6.1 target is: *"By 2030, achieve universal and equitable access to safe and affordable drinking water for all"* (UN 2016).

The normative interpretation divides the SDG 6.1 target into seven sub targets, shown in Table 2. Practices related to these sub targets are presented in three topics: water supply, water quality and social justice.

Table 2. SDG 6.1 UN subdivision by normative interpretation (UN 2016)

By 2030, achieve universal and	Implies all exposures and settings including households, schools, health facilities, workplaces, and public spaces.
equitable	Implies progressive reduction and elimination of inequalities between population subgroups.
access to	Implies sufficient water to meet domestic needs is reliably available close to home.
safe and	Safe drinking water is free from pathogens and elevated levels of toxic chemicals at all times.
affordable	Payment for services does not present a barrier to access or prevent people meeting other basic human needs.
drinking water	Water used for drinking, cooking, food preparation and personal hygiene.
for all.	Suitable for use by men, women, girls, and boys of all ages, including people living with disabilities.

WATER SUPPLY

The SDG 6.1 target's two sub targets ("universal" and "access") address water supply issues. These sub targets aim to ensure that sufficient water is reliably available close to all households, schools, health facilities, workplaces and public spaces.

In **Auroville,** all households, schools, healthcare facilities, and workplaces in the City area are supplied with piped water. The piped water is pumped from covered, protected borewells using solar, wind, or electric pump. Water is stored in elevated or underground tanks and flows by gravity or electric booster pumps. In the early days, water was provided from various sources, including open borewells and handpumps. Some of these are still in use in the Green Belt area as supplement alternatives to the piped water systems. Water is reliably provided seven days a week, 24 hours per day in the two mature ecovillages, with occasional limitations due to maintenance or repair works. Most Auroville communities have experimented with alternative water supply solutions to meet domestic needs reliably. There was a noticeable evolution from the simple individual wells towards the multisourcing and semi-central water systems. Site-level water systems were developed in the

early days when sites were far apart. Later, neighborhood water systems and, recently, semi-centralized water systems were developed. Most communities today have multiple water sources and underground or overhead water tanks. While each site has its site-level system, the sites share water through pipes when necessary. Some communities connect to multiple water supply systems as a backup for water shortage situations. Providers and committed locals maintain the water systems. The water systems are linked to Kelly's principle of interdependence and adaptation, ensuring water security during extreme weather events (Nagy 2018).

Krishna Valley is served by a single central water system that provides piped water to all buildings, including homes, a school, workplaces, and the temple. It uses a wind turbine to draw water from a 120-meter-deep well. The water flows through the pipe system by gravity from an elevated tank. Individual households have dug wells in addition to the central water system. While in Auroville, the system gradually evolved from less sophisticated site-level water systems to semi-centralized services; we can see the opposite movement in Krishna Valley. From the beginning, the ecovillage had a centralized piped water system. Somogyvámos village's municipal water initially supplied it, later its 200-meter-deep central well and underground water tank. Today, additional borewells are used as a backup water source. Aside from centrally piped water systems, households have dug wells from which residents draw water manually. These became the primary source of domestic water. Krishna Valley's multi-sourced water system provides constant water even in emergency or breakdown situations. Besides, the site's streams and lakes are used for ritual bathing.

The two older ecovillages are equipped with piped water in all facilities. The two recently established ecovillages lack piped water systems and aspire to develop their water systems, but they have not yet reached the critical number of residents needed for such developments.

Auromag has a scarcity of water resources. The only well is 42 meters deep with a low yield, pumped by a generator. The community decided to collect and use rainwater for washing and personal hygiene. The water for bathing and washing is limited but can be collected from the well and roof-rain water. Access to hot water is also limited due to power supply constraints. The land is not connected to electricity, municipal power lines are distant and solar panels have not been installed, given the risk of theft due to the lack of constant presence on the land. The community can use the nearby public thermal pool and washing machines in the neighboring city for washing and personal hygiene. These services are reasonably priced.

Nyim Eco Community has a twenty-six meters deep dug well. It is deeper and yields less than expected. However, in the nearby village, a few hundred meters from the Nyim community site, community members have private houses and a public house equipped with municipal infrastructure such as piped water and electricity. Future residents of the community site may use these facilities for a limited or extended time. The municipal drinking water pipe is approximately 50 meters from the community plot boundary of the ecovillage. Connecting to the municipal water supply was considered as an alternative option for safe and sufficient water on site. The same applies to the power supply. The plan is to start on municipal supplies and gradually develop the community's self-sufficiency as the number of members increases, as it happened in Krishna Valley. Nevertheless, the municipal system will remain a backup for water-scarce situations.

All researched ecovillages strive for multi-sourced water systems linked to interdependence, ecolocalism, adaptation and cycling of resources.

WATER QUALITY

The SDG 6.1 target's two sub targets ("Safe" and "drinking water") address domestic water quality. These sub targets intend to ensure that water used for drinking, cooking, food preparation and personal hygiene is always free from pathogens and elevated levels of toxic chemicals. As per the UN definition, drinking water is used for drinking, cooking, and personal hygiene. This definition disregards the fact that in many parts of the world, water for direct drinking differs from water used for cooking and personal hygiene. Treatment methods are often too costly to treat all water used. Water drank directly presents higher health risks and is treated for higher costs. All four researched ecovillages separately treat and store the water consumed for direct drinking.

All four ecovillages attempt to eliminate chemical contamination of their water sources. Organic farming is used exclusively, and no harmful chemicals are used in homes or industrial units. These practices significantly impact groundwater quality. These practices are in synergies with SDG 6.3 (water quality) and SDG 6.6 (ecosystems), as we will see in later chapters, but also synergies with additional SDGs. The groundwater quality of **Krishna Valley** has measurably improved due to decades of organic farming the nitrate level decreased. Tests showed groundwater sources in **Auroville** had less than the permissible concentration of chemical substances. In contrast, tests showed significant chemical and pesticide contamination of the groundwaters of Auroville's bioregion, where many water sources were found unsuitable for human consumption. **Auromag** and **Nyim** community members agreed to live a chemical-free lifestyle to avoid groundwater pollution. Agrochemicals used in neighboring agricultural lands may contaminate groundwater, and future land purchases are intended to prevent pollution. Increasing the number of community members willing to invest in neighboring lands is critical for the two recent ecovillages.

Water pipes themselves can challenge water safety if their material is hazardous to health. This issue was not mentioned in the specific UN documents, but Los Angeles, Pittsburgh and Toyoma emphasized the importance of it. It also came up as a concern and practice in the researched ecovillages. In recent years the **Auroville** Water Service (AWS) changed most pipelines (AWS n.d.) within the city area, as the old pipes were claimed to leak and pose a health risk by polluting the drinking water with microplastics. The newly used HDPE pipes are claimed to be safer for humans than the previously used PVC pipes. In addition, AWS measured 30% water loss in 2000, but it has reduced to almost 0% after the pipes change; the practice simultaneously contributes to SDG 6.1 and SDG 6.4 (water use efficiency) targets. The water pipes of **Krishna Valley** have been consciously chosen as the healthiest available HDPE pipes since their installation, despite their high costs.

Each researched ecovillage adequately addresses the threat of microbiological contamination in drinking water. Three of the researched ecovillages are in Hungary, while one is in India, where the threat of microbiological contamination is high.

The threat of microbiological contamination in India is high; therefore, **Auroville** developed rigorous exemplary practices to provide microbiologically safe drinking water. Treated drinking water is available on all sites. Piped water in Auroville is free from chemical threats but may contain microbiological contamination and is not safe for direct consumption; therefore, water treatment is recommended before drinking directly, and all visited sites had treated water available for direct drinking in small refillable containers. Water purifiers were installed in all public spaces and many

homes (Figure 23). Among the various water treatment methods, several are used in Auroville, and the most popular are the purifiers of the local company (AquaDyn n.d.).

In contrast to Auroville, all piped water in **Krishna Valley** is treated and safe to drink. Iron/manganese remover, hydrogen peroxide dispenser, and potassium permanganate dispenser are utilized. The majority of residents use the house dug wells for domestic consumption. Well water is home-treated via boiling or the use of small-scale purifiers for drinking purposes to reduce chemical and microbiological threats. Besides, a public water purifier fountain with a 12m3/day capacity is also available. It is located in the heart of the community, and everyone can recharge their drinking water storage container there. It is frequently used by residents and visitors and is claimed to enhance the taste of drinking water.

Auromag and **Nyim Eco Community** (Nyim EC) have no safe drinking water source on site, as the well water is unsuitable for human consumption. Today drinking water is transported and stored in refillable tanks, but the communities aim to have a drinking water source on site. Safety is considered to avoid contaminating the drinking water. **Auromag** is not yet prepared to source its purified drinking water, which would necessitate electricity for filtering. Community members transport and maintain drinking water tanks for drinking and cooking but use untreated water for personal hygiene. **Nyim EC** intends to separately treat and store the drinking water used for direct consumption.

Various water purifying systems are used in the ecovillages, each has advantages and disadvantages, but laboratory tests remain necessary to control drinking water's purity. Each ecovillage has taken steps to prepare for regular laboratory tests on water quality. The two recent ecovillages have contacted laboratories and run water tests.

In **Krishna Valley,** water tests are made every two months by a service provider located 30 kilometers from the settlement. The test results showed no contamination in Total coliform or E. coli. The results are ready two weeks after sample collection. The report contains rather detailed data on the drinking water quality, including two field tests (on active chlorine), seven microbiological data, 34 chemical data and 11 microscopic biology data.

The microbiological threat is high in India, while the available laboratory services are limited. **Auroville** created its laboratory with an entrepreneurial spirit. Since 1993, the Environmental Monitoring Service Laboratory (EMS) has been monitoring water quality and providing Total coliform and E coli results within 24 hours (EMS n.d.). Their rapid monitoring is critical for identifying pathogens and acting quickly to reduce the occurrence and spread of waterborne diseases. According to EMS results, water in pipes is contaminated in most communities, so additional water purifiers are recommended for drinking direct water. These purifiers can become contaminated at times. When a community suspects drinking water contamination, the EMS laboratory tests water samples, and immediate steps are taken to provide safe drinking water from an alternative Auroville source. Several maintenance works follow on the site, like cleaning and sealing the water tank and water purifier, followed by repeated laboratory tests. The procedure is repeated until laboratory tests detect no pathogens in the drinking water. This example highlights the critical importance of the available, accessible, and prompt laboratory service and how the local hygiene safety procedures of water tanks are developed with the inclusion of the EMS laboratory. Most communities perform regular cleaning and maintenance work on the water purifying machines and water storage tanks (Nagy 2021).

SOCIAL JUSTICE

The SDG 6.1 target's three sub targets ("equitable," "affordable," and “for all”) address drinking water social issues. These sub targets intend to reduce and eliminate inequalities between population subgroups and provide water to men, women, girls, and boys of all ages, including people with disabilities, at a price that does not present a barrier to people meeting their basic human needs.

Due to strong community values, no discrimination can occur in the researched ecovillages. In fact, many communities see water rights as so fundamental that water is purposely not metered because it is believed that all should get water for free. The drinking water sources were accessible in all ecovillages for men, women, girls, and boys of all ages. Some places have additional access for people in wheelchairs. As previously described, drinking water used for direct consumption in the studied ecovillages is treated and stored separately from tap water. Water tanks and containers with purified drinking water are placed where locals and visitors can access them free of charge.

Auroville is located in India, where water rights can be a matter of social standing. There are no inequities in water rights within Auroville, but there has been a progressive evolution of the water supply systems, which causes a difference in comfort level. Auroville has grown gradually over the last 50 years. New needs arose as the population grew, and technologies were developed to meet those needs. Some pioneer communities in the Green Belt continue to use technologies that were cutting-edge 30 years ago but are now outdated. Communities in the Green Belt promote a simple way of life, and their residents must adjust their water usage to account for the needs of others during dry periods. Daily consumption is limited by water tank size, or human power is used for water extraction due to the chosen voluntary simplicity. The practice fosters interdependence and a strong sense of community which was mentioned earlier in the literature review. The newly constructed buildings in the city area are equipped with more recent technology, including a centrally managed inflow water system. As a result, City residents have greater independence and a higher level of comfort.

Auroville has four high-capacity public drinking water purifier fountains (HCPWP). These fountains are serviced and tested regularly. The four fountains are in different corners of Auroville, providing all with easy access to filtered water. Two 6.000-liter mobile water tanks containing laboratory-tested safe drinking water and one mobile HCPWP are on standby in Auroville. These can be moved to the location of a water shortage emergency or mass gatherings.

There is an ongoing debate in **Auroville** on water billing. Some argue that monthly payments based on water meter data raise awareness and reduce water consumption. Others question the accuracy of the water meters and suggest that water should be freely available as a basic human need. Each community covers water costs differently; most have developed an assistance system. Water costs are entirely covered by an institution or a site unit (income generator) in many communities. In other communities, costs are shared between the main unit (income generator) and the residents. This type of assistance offers an option on the household level to provide drinking water for a relatively low cost.

Water rights are not a matter of social status in Hungary.

In **Krishna Valley** we can see voluntarily chosen simplicity for sustainability. While every household is linked to the centrally managed inflow water system, most favor using human-powered dug wells.

Krishna Valley's human-powered domestic dug wells represent a commitment to voluntary simplicity. Although using the outdoor man-powered wells is less convenient than using the indoor piped water, people often prefer it to gain direct awareness of groundwater availability while living a simple and sustainable lifestyle. An HCPWP is located in the church, and water containers are placed throughout the community. Everyone pays for water services, but the church offers financial assistance and covers most of the costs. The church pays for the digging and annual cleaning of each household's dug well, but the households are responsible for all other maintenance costs.

Both mature ecovillages have assistance to their residents in order to ensure water affordability. Both **Auroville** and **Krishna Valley** occasionally hold mass gatherings, providing all visitors with drinking water.

Both simplicity and sustainability are valued in the two recent ecovillages. They want to develop water systems that offer the option of comfort and voluntary commitment to simplicity for those who want to live a life with a constant awareness of water limitations. The two recent ecovillages are struggling with the costs of water systems development. Drilling new wells is expensive, and obtaining permits for new wells is becoming increasingly difficult. They intend to raise funds to cover their expenses. The drinking water in **Auromag** is transported from the closest municipal public drinking water tap, 1,5 km away. As not everyone has a vehicle, the community members collaborate in transporting the drinking water.

People in the researched ecovillages can have varying levels of comfort based on their needs. Some people need more comfort, while others prefer less comfort but more sustainable systems, ones that are directly connected to the actual daily water situation. Such differences may be viewed as inequity, whereas in ecovillages, differences in comfort and simplicity are viewed as freedom of choice rather than inequity. Farkas observed that ecovillages often choose a more simple and sustainable water system that is limited and directly provides awareness on the actual water situation (Farkas 2017a), like using human-powered dug wells in Krishna Valley. The UN drinking water indicator could measure voluntarily chosen simplicity, dependence, and interdependence for sustainability as inequity, leading to monitoring issues in ecovillages.

ADDITIONAL SUB TARGETS OF SDG 6.1 NOT ADDRESSED BY THE UN

Auroville and Krishna Valley significantly reduce plastic bottled drinking water use by setting up public drinking water fountains and banning plastic bottled water. Several drinking water containers are placed throughout the ecovillages, and local vendors only sell long-lasting refillable water bottles. This practice further contributes to SDG 6.3 target and SD Goal 12; Responsible Consumption and Production.

SDG 6.1 UN FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

The normative interpretation divides the target into eight parts, and each is well-suited to the functioning and goals of ecovillages.

The UN SDG 6.1 framework does not address plastic bottled drinking water pollution. Efforts to reduce plastic bottled drinking water are practiced in the ecovillages. They tackle the problem by locating central drinking fountains and restricting the distribution of plastic bottled water. One indicator and three questions were added to the monitoring inventory regarding measures to reduce plastic bottled water use (Table 3, Annex 4).

INDICATORS

The UN definition of drinking water, which includes water used for cooking and personal hygiene, is disadvantageous to ICs. Water for direct drinking, cooking and personal hygiene is treated and stored separately in the studied ecovillages. Meanwhile, the UN JMP monitoring emphasizes piped water supply but does not adequately address the piped water quality. In India, piped water's microbiological contamination is problematic, while Pittsburgh VLR mentioned lead contamination from old pipes.

seven sub targets. Nine indicators were labeled "not measurable"; some "not measurable" indicators contain a water consumption volume element, which is not measurable in all ecovillages, due to the principle that water is a fundamental human right and therefore the amount consumed is not to be measured directly. Thirty-five questions were added to the monitoring list (Table 3, Annex 4).

DISCUSSION

The SDG6.1 target addresses the provision of drinking water. The UN definition on drinking water includes water used for drinking, cooking and personal hygiene, basically the domestic piped water. I'm not convinced that it's sustainably feasible for all the world's population to have drinking water quality piped domestic water. What seems more sustainable is the practice seen in the ecovillages where drinking water for direct consumption undergoes different treatment and storage than the rest of the domestic piped water.

Many practices on SDG6.1 are aligned with the four sustainability dimensions. The ecosystem is the foundational dimension, practices eliminate pollution of both groundwater and its catchment area. Ecovillages primarily rely on groundwater as their drinking water source, and believe that a clean environment is prerequisite to clean drinking water. The used water pipes are made of sustainable material. In terms of the economy dimension, the separation of drinking water used for direct consumption is significantly reducing the costs associated with water purification. The entrepreneur spirit appeared in their developed a products and services (AquaDyn, EMS) which were created out of necessity but have become income generating by selling the products and services outside of the ecovillages. In addition, the spirit of experimentation is noticeable in all four ecovillages, exploring different methods to provide water security, through multisourcing. Many residents choose

dependence on dug well, and adapting their water needs, in the principle of voluntary simplicity. In terms of the social dimension, all four ecovillages consider water as a basic human right and often do not measure water consumption. They trust each other as they share the same cultural norms and values, and drinking water is protected by all. This practice is linked to the fourth dimension, the participatory governance, whereby information about drinking water is available to everyone.

Table 3. Analysis of the SDG 6.1 Inventory developed for ICs

SDG 6.1 sub targets	Indicators found in the studied documents				Added questions	
	pc.	applicability in ICs			pc.	Short description
		challenged	not measurable	measurable		
universal	8	3	3	2	2	Simple questions regarding water source location
equitable	4	1	1	2	2	To measure chosen simplicity due to sustainability
access	2	1	0	1	5	Measures reliability and collects info on used practices to reduce the impact of water scarcity or water shortage situations
safe	13	9	0	4	14	Practical questions on water testing habits, hygienic procedures and water quality
affordable	5	2	3	0	3	Direct questions on affordability and the locally established subsidy practices related to the interdependence community principle.
drinking water	1	0	1	0	1	Questions whether water used for direct drinking is separate from the water used for cooking and personal hygiene. No separation of water for direct drinking! A disadvantage!
for all	5	1	1	3	5	Practical questions on water accessibility for all
Discovered additional sub targets						
Limiting plastic bottled water use	0	0	0	0	3	Practical questions on measures taken to reduce plastic-bottled drinking water
SUM	38	17	9	12	35	

Practices and aspirations related to each sub targets are already present in the ecovillages. Their practices uncovered a new sub target, the aspiration to reduce plastic-bottled water. Out of the 38 indicators found, only 12 are measurable and 35 additional questions have been formulated. A significant proportion of the indicators have element of metered water consumption, which is not always measured in the ecovillages, because metering water consumption contradicts with their principle of water being a fundamental human right.

The literature analysis identified thirty-eight indicators, and twelve of these can measure five of the

5.2.3. SDG 6.2 Sanitation and hygiene

UN definition: *"By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations"* (UN 2016). The target is divided into nine sub targets by its' normative interpretation (Table 4). The related practices are presented in three topics: sanitation practices, hygiene practices and social justice.

Table 4. SDG 6.2 UN subdivision by normative interpretations (UN 2016)

By 2030, achieve access to	Implies facilities close to home that can be easily reached and used when needed.
adequate and	Implies a system which hygienically separates excreta from human contact as well as safe reuse/treatment of excreta in situ, or safe transport and treatment off-site.
equitable	Implies progressive reduction and elimination of inequalities between population sub-groups.
sanitation and	Sanitation is the provision of facilities and services for the safe management and disposal of human urine and faeces.
hygiene	Hygiene is the conditions and practices that help maintain health and prevent the spread of disease, including handwashing, menstrual hygiene management, and food hygiene.
for all and	Suitable for use by men, women, girls, and boys of all ages, including people living with disabilities.
end open defecation	Excreta of adults or children are: deposited (directly or after being covered by a layer of earth) in the bush, a field, a beach, or other open area; discharged directly into a drainage channel, river, sea, or other water body; or are wrapped in temporary material and discarded.
paying special attention to the needs of women and girls	Implies reducing the burden of water collection and enabling women and girls to manage sanitation and hygiene needs with dignity. Special attention should be given to the needs of women and girls in 'high use' settings such as schools and workplaces, and 'high risk' settings such as health care facilities and detention centres.
and those in vulnerable situations.	Implies attention to specific WASH needs found in 'special cases' including refugee camps, detention centres, mass gatherings and pilgrimages.

SANITATION PRACTICES

The SDG6.2 target's three sub targets *("access," "sanitation" and "end open defecation"*) address sanitation issues. These sub targets aim to ensure that sanitation facilities safely manage human urine and feces, can be easily reached when needed, and helps to end open defecation practices.

According to the **Auroville** Town Development Council, all homes, schools, healthcare facilities, and workplaces have sanitation and hygiene facilities that are accessible when needed. Toilet facilities were located outside the homes in the early days of Auroville and shared by several homes. Nowadays, the trend is to construct private toilet facilities within the building, but shared and outside toilet facilities are still in use in the Green Belt communities.

The problem of excreta disposal is complex. When feces, urine, and wastewater are released into surface water bodies, they can harm the local ecosystem and threaten human health. In the ecovillages wastewater sludge, urine, and feces are considered potential fertilizers. The goal is to avoid human health risks while reusing beneficial fertilizers, when released into the soil.

In **Auroville**, three types of toilet and manure storage systems are in use, which hygienically store, treat, and separate excreta from human contact.

Dry compost toilets have an excreta collector. In this method, solid and liquid waste is collected separately (Figure 24). Water cannot be mixed with feces, but a separate container is used for urine and washing. The feces are mixed with sawdust; once the collector is full, it is exchanged for an empty collector. The entire collector is then left to sit for decomposition in a safe storage location. The decomposed manure is exposed to the sun and sterilized by UV before reuse. This fertilizer is only used under trees and ornamental plants, and not used under edible plants, to avoid risks to human health.

Flush/Pour-flush toilets have inground soak pits with a permeable wall, allowing liquid to soak directly into the ground while the sludge is emptied as needed. This method permits water usage in the toilet but is a primitive excreta processing method.

In **wastewater treatment systems** (WWTS), the toilet effluent is mixed with other effluents from the kitchen or bathroom. The mixed wastewater is collected primarily in septic tanks and flows through multiple chambers and processing phases. Sludge and water are separated in the septic tank by grating and sedimentation. The wastewater overflows into a chamber system for further treatment while the sludge remains in the septic tank. The septic tanks are regularly desluiced by site management or an authorized Auroville service, and the sludge is placed on an Auroville forest site to decompose naturally, far from human contact.

All homes in **Krishna Valley** have private bathrooms with toilets located within the buildings, and there are public toilets for residents, visitors, and staff to use. Some enthusiastic resident experiments with composting toilets in their backyards. Krishna Valley, like Auroville, would prefer to dispose of and recycle its sewage sludge as compost on its land, but Hungarian regulations prohibit this. Krishna Valley has a large sewage treatment plant connected to all flush toilets. According to Hungarian regulations, the plant is located further away from the inhabited area. Once a year, Effective Microorganism (EM) is added directly into the wastewater treatment plant to enhance the bacterial

life. Krishna Valley is not allowed to empty and reuse its sludge from the wastewater treatment system, but an authorized external contractor regularly transports it to a regional storage site. The liquid remains in Krishna Valley and is irrigated on an energy forest, effectively reusing its nutrition content.

Nyim EC and **Auromag** intend to build sanitation facilities near and within future homes and to pay close attention to the safe handling of wastewater and sludge from compost toilets to avoid contaminating the waters. They are also looking for ways to recycle the manure locally.

Auromag Community already has a water shortage, and flushing toilets would exacerbate the problem. Members prefer the eco-friendlier compost toilets. These do not require water; the product can be decomposed and recycled locally. The method enables greywater separation, making wastewater treatment and reuse easier and less expensive. On the site, there are already four hygienic, visibly safe, and discreet composting toilets. The composting toilet contents are emptied, covered with sawdust, and stored in a designated spot to decompose. Future developments will necessitate professional design and sanitary maintenance procedures.

As the planned community site in **Nyim EC** is currently uninhabited, no toilets or washing facilities have been installed. The community house (located in the nearby village) has two flush toilets with septic tanks and two compost toilets. These are visibly safe, lockable, hygienic, and sufficient in number for gatherings and public programs. The homes in the village have additional private toilets. There are flush toilets in homes with septic tanks and compost toilets in the gardens. The community plans to create more composting toilets, as there is water limitation and flush toilets are difficult to maintain. Some members find compost toilets challenging.

Open defecation (ODF) is widely practiced in India but not in Hungary. There were no ODF traces in the visited ecovillages of Hungary or on the visited Auroville sites, whereas they were noticeable in the vicinity of the Auroville communities, such as the public beach on the seashore of Quiet community. Some Auroville forest and farm community members and workers prefer to defecate in nature rather than in a toilet. This practice, however, is performed far from water sources, and feces are always buried deep in the ground, causing no inconvenience to site members.

HYGIENE PRACTICES

The SDG6.2 target's two sub targets *("adequate", and "hygiene"*) address hygiene issues. These sub targets aim to ensure that hygienic practices, including sanitation, handwashing and food hygiene, prevent disease spread.

In the ecovillages wastewater sludge, urine, and feces are considered potential fertilizers, but pose human health risks, so specific hygienic procedures were developed to store and handle them safely.

In **Auroville**, all sludge and wastewater are released into the soil, not into water bodies. The minor occurrences of waterborne disease and microbial contamination suggest that Auroville sanitation practices are safe for human health. The dry compost toilets' decomposed manure is exposed to the sun for a few months to be UV sterilized before being reused as fertilizer. This fertilizer is not used

on edible plants, only on trees and ornamental plants to avoid risks to human health. The Auroville Wastewater Service or the community maintenance person manages the septic tank sludge. In several Auroville communities where there is enough space and appropriate conditions the sludge is composting on-site. The sludges are UV purified by 3-9 months sun drying before the final product is mixed into the garden compost. However, it is only used under trees and not on vegetables because it is considered to pose a human health risk when used on edible plants. Communities without adequate space for composting request the professional services of the Auroville Wastewater Service, which handles the transportation and desludging professionally, and places the sludge in a forest site identified by the Auroville Forest Group members.

In terms of treatment, EM is poured into the toilet or added to the septic tanks to eliminate odors and improve the natural decomposing process in **Auroville** and **Krishna Valley.**

In the two recently established ecovillages, sanitation practices have not yet posed a risk to human health; **Nyim EC** and **Auromag** acknowledged that adequately using a compost toilet requires a particular commitment and sound design. The appropriate hygienic protocol is required to avoid any threats to drinking water contamination.

The Covid pandemic highlighted the crucial importance of handwashing facilities. **Auroville**, **Krishna Valley** and **Nyim EC** community houses are equipped with handwashing facilities and soaps. These facilities were found in the toilets, bathrooms, and dining halls. Each classroom was equipped with additional handwashing facilities in the visited schools of Auroville and Krishna Valley. **Auromag** has no public hand washing and bathing rooms with soap and water on the site. A short-term goal is to establish a secure and hygienic laundry facility. The SDG6 Localizing Workshop initiated a bathroom experiment. Due to the lack of permanent stay or regular cooking on the site, hygiene was mentioned concerning toilets and wastewater but not food hygiene.

Food hygiene is a critical aspect of **Auroville** and **Krishna Valley** since both do food processing and serving. Both ecovillages' kitchens and food processing workshops were found clean during the site visits. This achievement is partly due to regular health inspections and training. This service is provided in Auroville by the local Auroville Health Service (AVHS) or Tamil Nadu authorities. ÁNTSZ (National Public Health and Medical Officer Service) regularly visits Krishna Valley's food processing units. The residents teach and uphold hygienic standards. Working with food is subject to stringent regulations related to religious and yogic beliefs.

SOCIAL JUSTICE

The SDG6.2 target's four sub targets *("equitable," "for all," "paying special attention to the needs of women and girls, and those in vulnerable situations")* address social justice. These sub targets aim to eliminate inequalities between population sub-groups, and ensure sanitation and hygiene for men, women, girls, and boys of all ages, including people with disabilities. It focuses on the needs of women, girls, and in 'special cases' includes refugee camps, detention centers, mass gatherings and pilgrimages.

Some toilets and bathroom facilities in Auroville and Krishna Valley are wheelchair accessible, while Auroville's public restrooms were equipped with both Indian and Western-style seats.

An important aspect of sanitation is menstrual hygiene and safety. In the researched ecovillages, private and public toilets are appropriate for women's safe and hygienic menstrual practices. Although there are no separate men's and women's toilets everywhere, all toilets are designed to be safe and convenient for girls and women to manage their sanitation needs hygienically and with dignity. The visited public toilet facilities had buckets where disposable pads could be dumped. Some public toilets in the researched ecovillages had additional shower bathrooms and soaps, offering bathing and washing opportunities for menstruating women.

The work in menstrual hygiene is prominent in **Auroville** compared to the researched Hungarian ecovillages. Aurovillian women were looking for sustainable solutions to menstrual hygiene, but since they could not find any, they created an enterprise and craft factory that grew into a worldwide distribution network today. Ecofemme social enterprise grew from social research on menstruation in 2010. It produces hygienic menstrual tools that are safe for women and the environment. Eco Femme has sold and distributed 680.000 pads, saving 51 million disposable pads from landfills until January 2020. The company provided free training to 44.000 adolescent Indian girls on menstrual hygiene and waste management. Eco-femme also offers training on menstrual hygiene for the female staff and residents of Auroville (Ecofemme 2020; Nagy 2021).

None of the ecovillages deal with refugees, but Krishna Valley and Auroville often hold mass gatherings. The annual international Marathon and other sporting and cultural events attract thousands of visitors to **Auroville,** while **Krishna Valley** hosts religious pilgrimage programs with thousands of visitors yearly. At these mass gatherings, toilet and hygiene needs are professionally addressed. **Nyim EC** and **Auromag** do not intend to host such events yet.

ADDITIONAL SUB TARGETS OF SDG 6.2 NOT ADDRESSED BY THE UN

While the global targets primarily focus on treating human feces and urine, non-decomposable wastes also contribute to the challenge of handling toilet wastes. In **Krishna Valley** and **Auroville**, visitors disturb the local wastewater treatment system by flushing plastic waste down the drain, clogging the wastewater treatment plants, and using artificial beauty products that harm the biological wastewater treatment plants. The ecovillages have investigated various solutions, including placing awareness posters in the restrooms, launching awareness campaigns, and technological solutions like inserting grids in pipes and placing waste bins in toilets, but the problem persists. This issue is further discussed in the following subchapter.

SDG 6.2 UN FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

The normative interpretation divides the target into nine parts that can be well interpreted to the ICs aims and activities.

The sub target “equitable” raises the dilemma of chosen simplicity. Most households in Auroville and Krishna Valley have private toilets, but some homes are equipped with shared toilets and bathrooms, like in the KRIYA community of Auroville or the dormitory-type rooms in Krishna Valley. However, community members do not experience the shared bathroom as a limitation but as their voluntary free choice of a simple and sustainable lifestyle.

INDICATORS

Eighteen of the twenty-six indicators are suitable for monitoring eight of the nine SDG6.2 sub targets in ICs; twenty-nine further questions and one sub target were added to the monitoring collection (Table 5, Annex 4).

The UN indicator 6.2.1 defines sanitation services as limited if several households use shared toilets or bathrooms. The co-housing-type homes in the examined ecovillages share the toilet-bathrooms among two households. Residents experience this not as a limitation but as a voluntary simplicity for sustainability. Therefore 6.2.1 indicator was labeled as challenged; in the future, this indicator needs enlargement to include the co-housing type shared toilet-bathrooms as non-limited.

DISCUSSION

SDG6.2 addresses sanitation and hygiene. The practices described contribute to several targets and even goals simultaneously, i.e., they are synergistic. In terms of the four sustainability dimensions, the following practices were found. Ecovillages do not pollute water. Their compost toilet practice can be interpreted in the economy dimension as voluntary simplicity and cycling of resources, as these reduce water use and return nutrients into the soil. A particular sub target of this goal is menstrual hygiene activities, and in this context, the Auroville entrepreneur spirit came to the fore when a small business was created that approached the local problem in an environmentally friendly way; this local business has now grown to a global scale. It offers free menstrual tools and training to the poorest, thus linking this practice to the social dimension. In order to live without hygiene risks, it is vital to have trust in each other and to have commonly agreed hygiene protocols that are learned and practiced by all community members. These are the social and cultural dimensions of sustainability. Norms require discipline and simplicity, and visitors harm the otherwise well-functioning biological wastewater treatment plants with their brought-in wipes and chemicals. The situation is used to raise awareness and explicitly inform visitors on sustainability issues bringing forward the knowledge-sharing aspect of the ecovillages.

Table 5. Analysis on the SDG 6.2 Inventory developed for ICs

SDG 6.2 sub targets	**Indicators found in the studied documents**				**Questions added to the SDG6 Inventory after research in the ecovillages**	
	pc.	**Applicability in ICs**			**pc.**	**Short description**
		challenged	**not measurable**	**measurable**		
By 2030 achieve access	4	2	0	2	2	Simple questions regarding location and shared sanitation facilities.
adequate	4	0	1	3	3	Measures the types of sanitation facilities and the methods used to manage the excreta hygienically.
equitable	5	2	0	3	2	Measures availability and cleanliness of the sanitation facilities
sanitation	4	2	0	2	4	Practical questions on excreta disposal
hygiene	3	0	0	3	3	Practical questions on hygiene procedures
for all	2	0	0	2	6	Practical questions on access for all.
end open defecation	2	1	0	1	2	Practical questions on ODF
needs of women and girls	2	0	0	2	4	Practical questions reflecting on women's and girls' needs.
and those in vulnerable situations	0	0	0	0	2	Practical questions on mass gatherings and their sanitation practices.
Additional sub targets						
Handle non-compostable toilet waste	0	0	0	0	1	Practical question on non-composting toilet waste
SUM	26	7	1	18	29	

All sub targets related practices and efforts already exist in the ecovillages, and there is one new sub target-related practice, non-decomposable toilet waste management. Of the 26 indicators, 18 are measurable, and 29 additional questions were formulated. The UN indicator DG 6.2.1.a. measure shared toilet facilities as a disadvantage, while the ecovillages do not consider it a disadvantage but as voluntary simplicity for sustainability.

5.2.4. SDG 6.3 Water quality and wastewater

"By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally." The target is divided into nine sub targets by the normative interpretation. The found practices are described under three topics: reducing pollution, treating wastewater and recycling/reusing wastewater.

Table 6. SDG 6.3 UN subdivision by normative interpretations (UN 2016)

By 2030, Improve water quality by	Implies achieving adequate quality of receiving water bodies so that they do not present risks to the environment or human health.
reducing pollution	Implies minimising the generation of pollutants at source and reducing the discharge of polluting substances from point sources (for example, wastewater outlets from economic activities and households) and non-point sources (for example, urban and agricultural runoff).
eliminating dumping and	Implies ending all inadequate disposal of waste (solid and liquid, for example, leachates from poorly managed solid waste)
minimising release of hazardous chemicals and materials	Implies reducing the generation, use and discharge of hazardous substances, as defined and listed in the conventions of Basel, Rotterdam and Stockholm.
halving the proportion of untreated wastewater and	Implies halving the proportion of wastewater that is untreated, generated by households and all economic activities (based on International Standard Industrial Classification (ISIC) Rev. 4); some economic activities are of special relevance due to high wastewater generation, including agriculture, mining and quarrying, manufacturing, electricity and sewerage. Treatment implies any process for rendering wastewater fit to meet applicable environmental standards or other quality norms; treatment can be categorized into primary, secondary and tertiary treatments (and further by mechanical, biological, and advanced technology treatments). Discarded water that is no longer required by the owner or user, including discharges to drains or sewers for treatment or direct discharges into the environment, as well as water reused by another user without further treatment.
substantially increasing recycling and	Implies increasing the on-site reuse of water within the same establishment or industry.
safe	Implies water has undergone sufficient treatment, combined with non-treatment barriers to protect human health, for the intended use (as described in the 2006 WHO Guidelines for safe use of wastewater, excreta and greywater
reuse	Implies wastewater supplied to a user for further use, with or without prior treatment (for example, use of household wastewater in agriculture), excluding the recycling of water within the same establishment.
globally.	Implies increased recycling and safe reuse at the global scale, allowing for differentiated efforts at the national and regional scales, focusing efforts on water-scarce regions

REDUCING POLLUTION

The SDG 6.3 target's three sub targets *("Reducing pollution, Eliminating dumping, Minimising release of hazardous chemicals and materials")* address pollution entering into the water. These sub targets aim to minimize, reduce and end pollution entering water bodies.

Five types of water pollution were listed in the studied literature (Walker et al. 2019); a) domestic wastewater, b) urban runoff, c) agricultural runoff, d) contaminants from improperly treated/stored garbage, and e) industrial pollutants.

a) Domestic Wastewater

Cleaning and beauty products are the primary sources of domestic wastewater pollution. It is therefore important to emphasize that biodegradable cleaning and beauty products are favorable in all the researched ecovillages. Institutions, services and community buildings use only biodegradable soaps and cleaning products, but in private households, this is an option rather than an obligation. Biodegradable products are purchased in bulk in **Krishna Valley** and **Nyim EC** and produced by local manufacturers in Auroville. By producing biodegradable cleaning agents and beauty products, Auroville is protecting the environment, and in entrepreneurial spirit developed a product with a niche market, which is now sold worldwide, bringing economic benefits to Auroville.

Nine **Auroville** units manufacture biodegradable cleaning products. The cleaning agents' raw materials are soap tree seeds, bamboo ash, and EM. These chemicals clean well but have a short shelf life, and liquid cleaners should be used within one month. Biodegradable cleaning products are sold in bulk at local stores. Customers can purchase liquid soap in quantities as small as 100ml. It can be recharged into reusable personal bottles, reducing the accumulation of plastic waste, thus contributing to SDG 8; Decent Work and Economic Growth. While these are popular products, not everyone uses biodegradable products only. Some question the disinfection properties of the products and thus use additional chemicals. Some find biodegradable products far more expensive than commercial cleaning products and use additional conventional products for economic reasons.

Due to religious commitment, **Krishna Valley** uses environmentally friendly cleaning and disinfecting agents which do not pollute or harm nature.

Nyim EC and **Auromag** impose strict rules and principles on their limiting chemical use. The chemical-free lifestyle is demanding, so dedication and perseverance are required. They agree to separate black and grey water, and because grey water only contains biodegradable chemicals, it can be irrigated or soaked into the garden directly. Only biodegradable products will be used in the public community house, and such products will be provided to guests. The goal is to return used water to nature as pure as possible. Members join forces for bulk shopping with interdependence, reducing the pollution and costs associated with packaging.

b) Urban runoff

Vehicle pollutants constitute a significant source of urban runoff pollution.

Cars and motorbikes are parked under roofs in **Auroville**, reducing the risk of contaminants being washed away by the rain. The vehicles of Aireville Transportation Service are checked daily for leakages and washed weekly in a service park, where the wash water is collected and treated to avoid pollution of the environment.

Repair workshops and manure plants in **Krishna Valley** are separated from the soil or surface water to prevent contamination. The workshops have grease and oil traps. Oily rags and used oils are collected and delivered to disposal sites.

The **Nyim EC** and **Auromag** communities have yet to encounter and plan for this aspect of pollution.

c) Agricultural runoff

Only organic farming happens in the researched ecovillages. On **Auroville's** 22 farms, laying hens, dairy cows, and work bullocks are kept, and various plants are grown. **Krishna Valley** is known for its cattle breeding and crop production. Agriculture in Nyim EC and Auromag is still primitive, with some kitchen gardens and larger forest gardens planted and maintained.

Auroville uses only natural and organic products for agriculture and gardening, such as Neem oil or EM products. To avoid using agrochemicals and protect the water, farms and gardens make their own natural sprays to enhance the flowers or weaken and repel pests. These products are sold on the outside market as well.

Krishna Valley is a certified organic farm, and the urine collected from dairy farming is used to treat and compost the pastures. The manure plant is built on a concrete foundation; all leachates are collected.

d) Contaminants from improperly treated/stored garbage (plastic, microplastic)

All organic waste is composted in the communities, while non-decomposable garbage is collected selectively.

The EcoService of **Auroville** locally collects, further separates, recycles and sells 72% of its non-decomposable garbage (Eco-Service 2019).

Due to national laws, **Krishna Valley**, **Nyim Eco Community**, and **Auromag** cannot recycle all of their trash. Waste Paper is recycled locally, and selectively collected garbage is handed to regional garbage collectors.

Nondegradable plastics and microplastics are a significant pollution to water bodies. The most effective way to reduce such pollution is to limit the use and purchase of non-degradable plastic packaging. Products in Krishna Valley and Auroville are sold without packaging to reduce plastic waste. Items for the local store are purchased in bulk, and customers can pick up their goods in their containers. Handicraft companies collaborated and purchased biodegradable plastic for packaging in an Auroville project from 2006 to 2009, while Krishna Valley recycles its packaging materials. Nyim EC and Auromag also intend to organize bulk, package-free community purchases of some products.

While visiting the sites, no plastic rubbish was observed in the Hungarian sites or within Auroville, but Auroville's neighboring lands are frequently littered. That is why **Auroville** organizes regular garbage collection campaigns and activities to collect garbage from the neighborhood, particularly from rainwater catchment sites. Residents of the Hungarian ecovillages often organize and participate in garbage collecting programs in their neighborhoods.

Various educational and awareness-raising programs happen in the ecovillages to develop healthy consumption habits and achieve zero-waste lifestyles. WasteLess, an Auroville-based non-profit research center, has developed innovative education tools and programs for Sustainable Waste Management, including Garbology 101, kNOW Plastics, and 'Pick it Up.' It is a collaborator in the International Start Upcycling project. Their educational programs, shared throughout India, focus on developing healthy consumption habits from an early age (WasteLess 2019). They share their knowledge with others and act as a knowledge center in environmental education, shaping attitudes and influencing the norms of society.

e) Industrial Pollutants: improperly treated hazardous chemicals

Efforts are made to minimize harmful chemicals in the researched ecovillages. Varnishing materials, wood treaters, and concrete construction are considered environmentally hazardous.

A small canning plant in **Krishna Valley** produces flour, oils, jams, syrups, juices, semi-finished products (pasta dressings, mustards, chutneys, pâtés), honey, and medicinal products. This industry does not pollute the environment with hazardous chemicals. To avoid hazardous chemicals entering the water, used frying oil, dry battery, thinners, and other chemicals are collected separately.

Two of the 17 categories of highly polluting industries, listed by the Central Pollution Control Board of India (CITE) as potentially hazardous to water safety, can be found in **Auroville**: the Auroville Paper Factory and the Colours of Nature fabric dyeing unit. Both companies have a highly sophisticated wastewater treatment system and work exclusively from organic raw materials. Their technology and products are more expensive than other companies using harmful substances. The wastewater generated is free of chemical pollution and directly reused for irrigation, while the sewage sludge is reused as compost to replenish plant nutrients (Nagy 2021).

When environmentally friendly methods are used in green industries, the wastewater generated can be fully recycled, and the cycling of resources principle is addressed.

Nyim EC and **Auromag** have no industries at present.

TREATING WASTEWATER

The SDG 6.3 target's two sub targets *("Improve water quality. Halving the proportion of untreated wastewater")* address wastewater treatment. These sub targets aim to maximize the quantity of adequately treated wastewater.

The **Auroville** community has experimented with small-scale wastewater treatment systems since the mid-eighties. Various treatment systems were built, experiences were gathered, and the plants improved. The first experiments were learning possibilities with many errors due to a lack of expertise. After consulting with experts worldwide, the early wastewater systems switched to planted filters. These were popular in the 1990s and served well but required much space. Auroville participated in an EU-funded project on Decentralized Wastewater Systems from 1995 to 1998 (CSR 2016). As a result of these prototyping experiments, several types of wastewater treatments are in use today in Auroville.

Most of Auroville's wastewater is treated using multilevel biological wastewater treatment systems. Gravity determines water flow, so the systems are non-mechanical, except for some cases where pumps are used for aeration and irrigation.

Many treatment systems include a vortex ventilator (Figure 25) a root zone cleaning and buffer tank sedimentation (CSR 2016). The resulting wastewater is clean and odorless and can be stored as an ornamental pond near buildings or used to irrigate parks. Some systems include a polish pond for storing treated wastewater. Fish inhabits these polish ponds and serve as wetlands and homes for water birds.

The capacity of the wastewater treatment systems varies. Some are appropriate for a single household, while others are suitable for multiple families, institutions, or larger units. The largest is a semi-central system that has been operational since 2019. Currently, this system treats wastewater for eight residential communities. It has a capacity of 450 people, which is yet to be reached. Several individuals and communities effectively reuse returning treated water for irrigating trees and ornamental plants, which positively contributes to other goals, such as SDG15, Land on the Earth.

Contrary to Auroville, there is only one centralized wastewater treatment system in **Krishna Valley**. In 2004, Krishna Valley prepared several drafts to develop a natural wastewater treatment method in harmony with its sustainability approach. The most critical consideration in selecting the technology was to design a system that contributes to nature and operates in an environmentally conscious manner. The Kickuth reed bed wastewater treatment system was chosen, which has the advantage of inexpensive design and maintenance. It does not require qualified personnel or chemicals to operate. A relatively large area has been converted into one hectare of wastewater treatment area. When planning, the wastewater treatment system was designed for a maximum capacity corresponding to the planned population of 300 people. The location allows the increase of this capacity if necessary. EM is occasionally added to the central wastewater treatment plant. The wastewater treatment plant is located at one of the lowest points in the landscape, so without additional energy investment, gravity delivers wastewater. The plant's capacity is 32 m3/day but treats on average 12 m3 /day (in winter, 8 m3 / day, in summer, 16 m3 / day). The wastewater enters a two-level settling basin where it undergoes lattice mechanical cleaning. From here, 96-97% of the wastewater continues to flow, while 3-4% remains as sewage sludge discharged by sniffing. Wastewater treated by the reeds with 94-95%

efficiency goes to a 2000m3 reservoir pond. The winter period's exciting experience is that microorganisms clean efficiently despite the cold (Table 7). The reeds are not cut but left to fall in the winter, and as a heat blanket, they protect the soil and the microorganisms that function correctly despite the cold weather. The measured values show that the wastewater could be discharged into living water. Still, a regulation in the Balaton catchment area stipulates that sewage must not be discharged into a watercourse. A post-reservoir stores the treated wastewater for at least two months. This reservoir has been transformed into a beautiful biotope (Figure 31). The last element of the wastewater treatment system is the 2320 m2 energy plantation, where the treated wastewater enters by opening sluices. The plantation is 80% poplar tree and 20% evergreen bamboo, which can absorb water even in winter. One of the criteria for selecting species was compliance with the official permit, and the other was to choose varieties that can withstand much water. The trees planted here grew from 1.2-meter seedlings to 8-9 meters in seven years. Trees are regularly cut and replaced and used for heating. Thus, trees are involved in the water and energy cycles (Kun 2012; Partha 2008). Energy management is vital as Krishna Valley seeks self-sufficiency regarding energy supply. Much of the water used in the area comes from a 330-meter-deep drilled well. The pump is powered by a solar cell and aggregator. The energy invested in pumping is returned to the energy cycle by burning trees irrigated by the wastewater.

Table 7. Treated wastewater data in Krishna Valley (Source: Krishna Valley)

	2009- 08-25	**2010- 01-11**	**2010- 12-01**	**2015- 09-17**	**2017- 09-14**	**2018- 09-13**
COD mg/l	126	40	95	48	73	118
BOD mg/l	48	7	39	12	12	3
Total suspended solids mg/l	30	10	25	23.3	9	22

Auromag and **Nyim EC** communities aspire to develop biological wastewater treatment systems. Natural and inexpensive wastewater treatment methods are adequate if compost toilets and biodegradable cleaning products are used.

It was acknowledged that specific care is needed to maintain such wastewater treatment systems. The chemical-free lifestyle is complex, and commitment and perseverance are required for proper use. Obtaining the permits required for commissioning and maintenance is complicated, expensive and lengthy. Keeping a sewage treatment plant in operation requires a large amount of sewage flow, which is challenging, considering the small number of residents. Maintenance is also required to make the system work properly. Some wastewater treatment systems require electricity, yet another limitation in **Auromag**.

The design of the root zone biological wastewater treatment system came up during the SDG6 localizing workshop in **Auromag**, and it was questioned whether the existing sandy soil allows for local implementation of this system. The community decided to identify a wastewater treatment site, survey alternative wastewater systems, and invite professional assistance through Auromag's networks.

Members' houses in the neighboring village of **Nyim** EC are equipped with a biological sewage treatment system. There is no sewage canalization, but a licensed service treats and empties separate septic tanks regularly. The aerated sewage treatment system discharges excess water into the ground, while the septic tank rarely empties. A microcomputer controls the system, which requires extensive monthly maintenance from the municipality. It should not dry out throughout the summer or freeze during winter. The bacterial colony may become overloaded if it receives much input. The community wants to develop a different wastewater treatment system because the current system is expensive, noisy, and requires constant power and maintenance. It is unclear whether wastewater treatment will be centralized or undertaken per household. Several families are required for centralized systems. Grants and private funds will be used to cover the costs.

RECYCLING AND REUSING WASTEWATER

The SDG 6.3 target's four sub targets *("substantially increasing recycling, safe, reuse, globally")* address wastewater recycling. These sub targets aim to achieve surface and groundwater quality that does not pose a risk to the environment by recycling the wastewater.

The term "receiving water" used in the SDG 6.3 normative interpretation refers to any ocean, stream, river, pond, lake, or other surface water bodies into which treated or untreated wastewater or effluent is discharged. There are various natural water bodies in the ecovillages, but none are "receiving water" as no wastewater is discharged into them. When wastewater is discharged into water bodies, it can harm the local ecosystem, but when released into the soil, it becomes a source of nutrients. As a result, all wastewater is reused for irrigation. The goal of the ecovillages is to return used water to nature as purely as possible, ensuring that wastewater pollution does not affect the quality of surface waters or land. They have environmental and economic reasons, as stated in **Krishna Valley**: "So much energy was spent to bring up the water, we will not pollute it and waste it with one bath." During the research, laboratory tests measured the water quality of surface and groundwater bodies in **Auroville** and **Krishna Valley**; these findings were reflected in the SDG 6.6 target chapter, as the indicators linked to that target too.

The location determines the difference in wastewater recycling; if irrigated within the place of manifesting, it is titled recycled; if irrigated outside, it is titled reused. Parks and farmlands are considered commons, and even if wastewater travels long distances in pipelines, it remains within the ecovillage, and can be considered recycling. Auroville's semi-centralized wastewater treatment system's pressurized return line allows the connected habitats to use the treated wastewater for irrigation purposes distant from the wastewater treatment plant. Some treated wastewater or separated greywater is partially recycled on-site, while some are partially recycled in neighboring parks or fields but still within the ecovillage.

Wastewater recycling is prevalent in all researched ecovillages, as it is acknowledged as a valuable water source and fertilizer. Treated wastewater is recycled for irrigation purposes, not for edible plants, but only for trees, orchards, or grasses to avoid health risks. Separate tanks and pipe systems ensure wastewater recycling for irrigation without compromising drinking water safety. Greywater is fully or partially separated in the researched ecovillages. It is completely separated in communities and homes that use only compost toilets. Kitchen greywater is used directly for irrigation when only

biodegradable cleaning agents are used. Kitchen gardens are placed near the kitchens, and greywater directly flows on them in **Auroville**. The implementation of such gardens is planned in **Auromag** and **Nyim EC**. Greywater generated in some homes of **Krishna Valley** is exclusively used to refill toilet flush tanks.

The total amount of treated wastewater in **Krishna Valley** is recycled for irrigation on an energy plantation. The wastewater treatment plant is located far from the inhabited zone but still part of the ecovillage. The treated wastewater is irrigated in an energy forest without affecting drinking water safety. The treated wastewater is recycled in **Auroville** for irrigation, and the unused cleaned wastewater from the semi-central wastewater treatment system is captured in four tanks of 50 cubic meters and used for irrigation in the parks of Auroville (CSR 2020; Nagy 2021). The treated wastewater will be recycled in **Auromag** and **Nyim EC** for irrigating forest trees.

Table 8. Untreated wastewater data during and outside of the visiting period
(Source: Krishna Valley)

Date	COD value mg/l
2009-08-25	1390,00
2010-01-11	770,00

Auroville and **Krishna Valley** host many visitors. Such visits provide an excellent opportunity for environmental education and on-site training. **Auromag** and **Nyim EC** also intend to offer training and host programs and visitors. The researched ecovillages also participate in global and regional collaborations, as explained under SDG6.A. chapter. However, hosting visitors poses particular challenges to eco-friendly wastewater treatment systems. Only biodegradable chemicals are recommended and only such cleaning and beauty products are available at the local store of **Krishna Valley** and most stores of **Auroville;** still, many visitors bring their own cleaning and beauty products, which harm essential microorganisms in the biological wastewater treatment systems. During the summer, the number of visitors to **Krishna Valley** increases, as does the amount of wastewater. Summer wastewater contains higher proportions of non-biodegradable chemicals brought in by visitors, according to experience and data. Table 8 compares raw wastewater data from two measurement days, one in the summer and one in the autumn in the absence of visitors. The difference is striking, and Krishna Valley assumes that it is caused by the harmful chemicals the visitors use.

SDG 6.3 FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

The normative interpretation divides the target into nine parts, all well reflected in the ICs. There is no emphasis on 100% wastewater retention's contribution to local water security. In the future, it may be worth considering emphasizing this aspect of wastewater as additional sub target.

INDICATORS

Sixteen of the forty-nine indicators found are suitable for monitoring four out of the nine SDG6.3 sub targets in ICs, and twenty-eight further questions were added to the monitoring collection (Table 9). A significant number of indicators are not measurable because they require accurate water consumption data. No indicators were addressing biodegradable cleaning products, greywater separation and consumer habits. In the literature studied, six indicators were found that did not fit under the nine sub targets; these are monitoring the financial parameters of drinking and wastewater.

Table 9. Analysis of the SDG 6.3 Inventory developed for ICs

SDG 6.3 sub targets	Indicators found in the studied documents				Questions added to the SDG6 Inventory after research in the ecovillages	
	Pc.	Applicability in ICs			Pc.	Short description
		challenged	not measurable	measurable		
"By 2030, Improve water quality by	9	9	0	0	3	Practical questions to monitor if ICs discharge wastewater in water bodies.
reducing pollution	6	2	4	0	4	Practical questions on reducing pollution.
eliminating dumping and	5	1	4	0	8	Practical questions on the methods used to eliminate dumping.
minimising release of hazardous chemicals and materials	6	1	0	5	3	Practical questions on treating and handling hazardous waste.
halving the proportion of untreated wastewater and	8	1	0	7	4	Practical questions on wastewater treatment procedures.
substantially Increasing recycling and	5	0	4	1	3	Practical questions on recycling and grey water.
safe	0	0	0	0	1	Practical question
reuse	4	1	2	1	2	Practical questions on reuse.
globally	0	0	0	0	0	Not relevant in ICs.
Found non sub target specific indicators	6	1	3	2	1	Question on non-decomposable toilet waste
SUM	49	16	17	16	28	

DISCUSSION

SDG6.3 is related to wastewater and waste management. Ecovillages are at the forefront of good practice, as they value wastewater as a resource, not a problem. Considering the ecosystem dimension of sustainability, as described in 6.1 and 6.2, ecovillages committed not to pollute water and watersheds. They use organic agriculture, green industries and compost toilets to separate greywater. In addition, they use environmentally friendly cleaning and beauty products in their households. Small entrepreneurial companies have been set up to produce these cleaning products, which are also sold outside, linking to the economic dimension of sustainability. Products are purchased in bulk shopping, thus reducing the environmental damages and the costs associated with packaging materials. Bulk shopping is also tied to the social dimension through the interdependence principle since the primary condition for bulk shopping is to have enough people willing to buy together. A sufficient number of people willing to collaborate is also essential for wastewater treatment plants. Cycling resources is an important aspect of wastewater. Their choices are linked to their cultural norms. They share their knowledge with others by acting as a knowledge center and thus shaping attitudes through environmental education, influencing the norms of society through wastewater treatment systems.

Each sub target has already been linked to the existing practices and aspirations of the ecovillages, and 100% wastewater retention takes place, with no wastewater being discharged into water bodies.

Of the 49 indicators found, 16 are measurable while 28 additional questions were formulated.

5.2.5. SDG 6.4 Water use and scarcity

UN definition: *"By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity"* (UN 2016). The normative interpretation defines six sub targets, as shown in Table 10. These were examined in three topics: water use efficiency, sustainable water withdrawals, and water scarcity.

WATER USE EFFICIENCY

Today it is estimated that 70% of water is used in agriculture, 20% in industry and 10% in domestic use (Flörke et al. 2013). In the researched ecovillages, many methods are used to reduce the amount of water used and thus achieve greater water use efficiency.

Table 10. SDG 6.4 UN subdivision by normative interpretations (UN 2016)

By 2030, substantially increase water-use efficiency	Implies maximizing the productivity of economic activities while minimizing their water use (generating more output per input of water, including by reducing water losses); closely related to the concept of sustainable production and consumption.
across all sectors	All economic activities (based on ISIC Rev. 4 categories); some industries are of special relevance due to high water use, including agriculture, mining and quarrying, manufacturing, electricity, and water collection, treatment and supply.
and ensure sustainable withdrawals:	Implies that water withdrawals do not lead to permanent depletion of water bodies, taking environmental water requirements into account.
and supply of freshwater:	Naturally occurring water with a low concentration of salts, or generally accepted as suitable for abstraction and treatment to produce potable water (to compare with brackish and marine water – defining salinity concentrations varies among countries); the definition of inland water resources includes both freshwater and brackish water, categorized as surface water, groundwater and soil water.
to address water scarcity	The point at which the aggregate impact of all users impinges on the supply or quality of water, to the extent that, under prevailing institutional arrangements, the demand by all sectors, including the environment, cannot be fully satisfied; physical water scarcity prevails when more than 75% of available water resources is withdrawn; economic water scarcity prevails when malnutrition exists, although less than 25% of available water resources is withdrawn.
and substantially reduce the number of people suffering from water scarcity.	Implies targeting physical and economic water scarcity to reduce its impact on people, for example, by helping those suffering from malnutrition.

Agricultural water use efficiency practices:

Various alternative agricultural methods and proper water management allow the ecovillages to produce food even under challenging weather conditions. Laying hens, dairy cows, and work bullocks are kept, and various plant cultivation occurs on **Auroville**'s 22 farms. **Krishna Valley** has cattle breeding and crop production. In **Nyim EC** and **Auromag** agriculture is still rudimentary. Some kitchen gardens and more extensive forest gardens are planted and maintained. Each farm is organic and utilizes only environmentally friendly pest and disease control products to avoid polluting the land and water.

The combination of several methods reduces the water consumption for irrigation in **Auroville** farms and parks. Different irrigation methods are used on various crops. Only rainwater is used for flood irrigation to grow rice in Auroville during and after the monsoon season, and rainwater is collected in 50000 m^3 rainwater reservoirs to extend the rice plantation period of the largest rice producer farm, Annapurna Farm. Mulch-covered drip irrigation or micro sprinkler systems reduce water consumption and preserve soil moisture in vegetable gardens and orchards. All four researched ecovillages use this method, but the Buddha Garden Auroville farm experiment even incorporates smart technologies into the mulch-covered micro-irrigation system. The amount of daily water used in this system is determined by plant species and daily data on soil moisture and weather forecast. When combined with mulching, this method maximizes the farm's water efficiency (Budha Garden n.d.). To avoid soil

desertification, the ground in the researched ecovillages is not plowed and covered with green manure, grass, or mulch. Permaculture, multi-layered farming, plant associations, and combinations of these methods are used in the ecovillages, allowing groundcover plants to protect the soil from evaporation. The taller species provide adequate shade. This way, the plant species support each other and grow well while allowing optimal use of the available water. Rainwater retaining ditches, as explained in subchapter 5.2.6, assist in infiltrating fast-running rainwater into the soil.

Using drought-tolerant and rain-fed species further reduces the water needs in the researched ecovillages. **Auroville** and **Krishna Valley** farms grow crops according to the seasons. In Auroville, the crops that require much water, like rice, are generally produced during the rainy season, while in the drier seasons, the local drought-resistant crops are grown, such as samai, kombhu, varagu and ragi. These crops produce lower yields than rice but require less water, grow well during dry seasons and drought, and have excellent nutritional content.

While in Auroville the change of seasons constitutes the exchange of dry and wet weather, in Hungary with the seasons cold-hot periods are exchanged. There is seasonal planting in the fields and continuous planting in the horticultural greenhouses of **Krishna Valley**. Greenhouses and foils are not heated, so the winter cultivation focuses mainly on leafy vegetables (spinach, lettuce, arugula, coriander, mizuna, pakchoi, radish, and cabbages).

Experiments are ongoing in several **Auroville** forests to plant and propagate tree varieties suitable for food and biofuel production. Ayurvedic medicinal herbs are successfully grown in the woods and are used as nutritional supplements and medicines. Herbs also produce soaps, detergents, and environmentally friendly sprays for agricultural pest and disease control. Trees and forests are incorporated into agriculture. In the vertical horticulture concept, only the morning sunlight reaches the heat-sensitive vegetable gardens of the forest ground, while during the afternoon, they are protected by natural shade. The shade provided by trees allowed Auroville to extend the production period and grow vegetables and fruits for a more extended portion of the year.

Forest gardens were developed in **Nyim EC** and **Auromag**, and in **Krishna Valley**, the orchard plays a vital role in water retention, while water from the sewage plant irrigates the energy forest. Tree lines planted around **Auroville** and **Krishna Valley** ponds reduce evaporation.

Alternative water-saving farming methods, such as hydroponics and spirulina farming (Figure 27) are explored in **Auroville**. These methods successfully produce green leafy vegetables with limited water use.

The cowshed barns in **Krishna Valley** and **Auroville** are not cleaned with water, but straw is used to reduce water consumption in the husbandry. In **Auroville** water used for bathing animals is reduced by using a sponge and bucket instead of hosepipes and running water.

Beyond production, it is equally crucial that rainfed crops are valued and consumed. The local restaurants and shops prioritize healthy rainfed local crops in the concept of ecolocalism.

A significant deficiency of SDG 6.4 monitoring, as criticized by Vanham and his colleagues (Vanham et al. 2018), is the lack of green water integration into the developed existing indicators. Ecovillages combine several technologies to increase green water in the area, such as ground-cover plants, vertical

planting, and permaculture principles. The meadow in **Nyim EC** was moved for years, and the hay was sold. In recent years the community decided not to mow the area because the grassland began to decay, and the soil dried out during summer droughts, as no biomass was left on the lain. Today a cleaning mower is used with a chopper which leaves the cut plants on the ground as mulching. Income is lost while humidity and nutrition remain on the land.

Auromag`s SDG6 strategic planning workshop discussed rainfed agriculture. Their goal is to have a flawless operation of cultivated areas regarding water retention. Despite the lack of water, the land can be turned into a productive area through mulching and plant selection (Figure 26). Measurements will be taken to improve soil quality and water retention. As a first step, temporary mulching is applied, eventually replaced with a permanent green cover and transformed into a permaculture multi-layered garden. Drip irrigation is explored to reduce agricultural water needs.

Industrial water use efficiency practices:

Small-scale handicrafts are present in Auroville, and a canning unit in Krishna Valley, while Nyim EC and Auromag have no plan for industrial activities yet.

The two mature ecovillages have industrial activities which consume water, but the resulting sewage is not contaminated with toxic substances, only with environmentally friendly organic waste. This water is recycled locally and remains in the local water circulation.

The Paper Factory and Colors of Nature dying unit in **Auroville** uses only organic materials, and their wastewater is reused on agricultural lands. Colours of Nature has plans to modify its system and further reduce its water consumption. AquaDyn produces water purifiers, and the byproduct of their Reverse Osmosis system, the mineral-rich "grey" (industrial) water, is directly reused in toilet flushing and plant irrigation.

The canning unit in **Krishna Valley** is a relatively big water consumer compared to their other activities, as the cleaning method used is water-intensive. The workers are trained for the best procedure to limit water use.

Domestic water use efficiency practices:

Roof rainwater is collected in non-permeable tanks for domestic use to reduce groundwater consumption in all four researched ecovillages. They primarily use the collected rainwater for irrigation, but experiments are ongoing to use it for personal hygiene. **Nyim EC** and **Auromag** intend to install rainwater catchment tanks in all future buildings to collect all rainwater runoff from the buildings. Greywater recycling as toilet flush in **Krishna Valley** reduces domestic water consumption.

Most institutions, public kitchens, and public bathrooms in **Auroville** and **Krishna Valley** have water-saving taps; faucet aerators reduce water pressure by mixing water with air and water-saving flush toilets are used. **Auromag** intends to investigate dishwashing and cleaning with sawdust to reduce

domestic water use, as the community has an abundance of sawdust. All four communities experimented with compost toilets and bucket showers to significantly reduce water needs.

Some **Auroville** sites have small pools for kids during summer, and these pools are situated in a higher plane, and all of their water is reused for irrigation.

Every ecovillage dedicates extra effort to control dripping taps and leaking pipes. The **Auroville** Water Service, a semi-centralized water supplier, has changed its pipelines. It measured 30% of water loss in 2000, which has reduced to almost 0% since installing their new HDPE pipes (AWS n.d.). In **Krishna Valley** everyone pays attention to the dripping faucets in their homes, and one person is responsible for detecting leaking pipes for the institutions. Water conservation is a recurring theme in meetings, discussions, and internal communication materials.

SUSTAINABLE WATER WITHDRAWALS

The SDG 6.4 target's two sub targets *("ensure sustainable withdrawals and supply of freshwater")* focuses on sustainable water withdrawals without permanently depleting water bodies.

All four ecovillages are dependent on groundwater. The groundwater level has fluctuated significantly and has dropped noticeably over the past decades in each ecovillage.

Agricultural activities in the bioregion of **Auroville** over-extract the groundwater. A 2005 survey counted 6137 wells near Auroville and measured a 54-meter drop in groundwater level over 30 years due to over-extraction. According to experts, the number of wells has tripled since 2005 (Gilles et al 2013). Drilling wells are not regulated in India, but Auroville regulates the drilling on its lands. Farmers within Auroville must apply to the Farm Group and the Town Development Council for a well drilling permit. Farmers are encouraged and assisted to construct rainwater reservoirs rather than drill into deeper layers of aquifers to increase irrigation capacity.

Domestic piped water consumption in **Krishna Valley** is 8-10 m^3/day in winter and 12-20 m^3/day in summer. Each house has a small yield dug well, providing residents with constant and firsthand awareness of groundwater. In Krishna Valley, the domestic dug well is a constraint. The capacity of the dug wells is modest, and the physical labor required to collect the water has the potential to raise awareness. Its yield drops significantly during droughts. Each dug well in Krishna Valley holds 1.5-2 m^3 of water daily. When it wears out, it recharges in one day in principle. During intermittent droughts, the recharge can take 3-4 days, which is noticed without measurements. At dug wells, water yields fall sharply during droughts. These dug wells had to be cleaned and deepened by 0.2-2 meters in recent years.

Due to descending groundwater, the water became hard in the Hungarian ecovillages and salinated in **Auroville**, where the seawater has infiltrated the aquifer near the coastline. The Coromandel plateau`s groundwater layers are over-extracted for agricultural cultivation, and their levels have dropped drastically. The salinization of near-shore water resources is becoming more significant as the groundwater level falls in contrast to the rising sea level (Figure 28), and these so-called brackish waters are unsuitable for human consumption or agricultural irrigation. The rate of salinization in

Auroville is lower than in other areas of the Coromandel Plateau (Figure 29), most probably due to groundwater recharge achieved through conscious landscaping work (Vincent, Violette 2017).

WATER SCARCITY

The SDG 6.4 target's two sub targets ("to address water scarcity and substantially reduce the number of people suffering from water scarcity") address water scarcity issues.

The water level fluctuates seasonally, but both **Auroville** and **Krishna Valley** have noticed a significant drop in the water level over the past decades. **Auromag** and **Nyim EC** recently built wells, but the water was deeper and yielded less than expected.

The ecovillages multi-source water in several forms, such as groundwater, harvested rainwater, recycled treated wastewater and even seawater desalination experiments are ongoing in Auroville. Water stress occurred in Auroville and Krishna Valley, primarily due to technical issues such as pump failure or power cuts. To address these problems, they were looking for alternative solutions. Water systems have been transformed into multi-sourced systems with backup solutions and equipment for water-scarce situations. In **Auroville,** portable water tanks and mobile water purification equipment are delivered to the needed sites during the repair. Water shortages were common when Krishna Valley was only connected to the municipal water network. Sometimes the network was unable to provide adequate water pressure and volume. There has been no water shortage since changing the operating system in 2010. The community can rely on dug wells and reservoirs if a water pipe breaks or requires maintenance. If there is no water, irrigation and programs are halted, but Krishna Valley still has a backup system to the village network.

SDG 6.4 UN FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

Normative interpretation breaks the target into six parts that apply well to ICs.

INDICATORS

Out of the fifty-one indicators, only six can measure three of the six sub targets. Seventeen additional questions were listed in the monitoring collection. A precondition for several indicators is the quantity of consumed water, which is challenging to measure in ecovillages due to the water-related moral reasons on water pricing and technical reasons for multisourcing. New indicators are needed that assess practices reducing water use, diversifying water supply systems, addressing water scarcity and building community resilience.

Water use efficiency is measured by UN 6.4.1. indicator (GDP/water m^3). However, this indicator does not consider the cost of environmental damage that may occur in conjunction with the industrial activities that generate the most financial gain from water use. Monitoring this indicator in the researched ecovillages is difficult as there is no reliable data on total water consumption due to the researched ecovillages no water metering policy. The ecovillages are more concerned with nature restoration, environment protection, and clean water than generating financial gains. Collecting data for some income-generating projects with metrics required for such calculation was possible, as shown in Table 11. The water use efficiency data was calculated from the Gross Revenue (GR) and water consumption data of 2019 in two **Auroville** and one **Krishna Valley** income-generating units.

Table 11. Water use efficiency in three industrial units of two ecovillages Gross Revenue/yearly Water Use	
Svaram, Auroville:	11,413 RS/ m^3
Colours of Nature, Auroville:	2,403 RS/ m^3
Canning Plant, Krishna Valley	12000 Huf/m^3 = 3000 RS/m^3

As shown in Table 11, Svaram's 2019 water use efficiency is approximately five times higher than Colors of Nature's, even though both companies are in Auroville and employ roughly the same number of people. While this indicator suggests that Svaram is more water-use efficient, it cannot express Colors of Nature's efforts for sustainable water use and conscious recycling of all used water. The 1993-established Colours of Nature research unit employs ancient dye-making techniques, primarily the fermentation of indigo tree leaves. It also explores the cultivation, harvesting and processing of its colorants and has used the same water in its vats since 1993. It uses only organic materials, and the byproduct is a valuable fertilizer. The company is doing upfront research on reducing industry water pollution and reusing it efficiently. All generated wastewater is completely recycled for irrigation purposes, which is not considered by the 6.4.1 indicator.

DISCUSSION

SDG6.4 addresses water use efficiency and water scarcity. The practices found in the ecovillages relate to all four sustainability dimensions. In the ecology dimension, their pursuit is reflected in their choice of agricultural and industrial practices that are environmentally friendly. While this may bring smaller economic benefits, the economy dimension is characterized by ecolocalism. For example, residents and local shops and restaurants support local farmers by selling seasonal crops. In addition, cycling of resources occurs when factory wastewater is not polluted due to environmentally friendly technology and can be reused for irrigation. Water conservation is a community interest, and all community members are involved in it. They trust each other and rely on each other with interdependence. Water saving is achieved through internal discussions, interdependence, and shared norms, which practice is related to the social and governance/culture/partnership sustainability dimensions.

Table 12. Analysis of the SDG 6.4 Inventory developed for ICs

SDG 6.4 sub targets	Indicators found in the studied documents				Added questions	
	Pc.	Applicability in ICs			Pc.	Short description
		challenged	not measurable	measurable		
By 2030, substantially increase water-use efficiency	7	0	7	0	1	water accounting
across all sectors	5	1	3	1	4	Practical questions on metering and reducing water consumption
and ensure sustainable withdrawals	20	0	19	1	4	Practical questions on water data, water withdrawal reduction
and supply of freshwater"	2	0	0	2	3	Practical questions on water storage
to address water scarcity	4	2	2	0	2	Practical questions on water scarcity
and substantially reduce the number of people suffering from water scarcity"	3	1	0	2	2	Experiences local practical solutions to water stress
Non sub target specific indicators	10	6	4	0	1	The energy needed to provide water
SUM	51	10	35	6	17	

Practices and aspirations related to each sub target were found in the ecovillages. However, of the 51 indicators found, only six were measurable, while seventeen additional questions have been formulated for this target. One explanation for the small number of IC-applicable indicators could be that most indicators are focused on economic benefits without considering the economic costs of the damage caused to the environment.

5.2.6. SDG 6.5 Water management

UN definition: *"By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate"* (UN 2016). The target is further divided by normative interpretations into five sub targets (Table 13). Ecovillage practices are described under three topics: Integrated Water Resources Management (IWRM) regulatory systems, IWRM practices and transboundary conflicts and cooperations.

Table 13. SDG 6.5 UN subdivision by normative interpretations (UN 2016)

By 2030, implement	Refers to the Johannesburg Plan of Implementation (2002) objective to develop IWRM and water efficiency plans.
integrated water resources management	Process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems, taking into account hydrological and technical aspects, as well as socioeconomic, political and environmental dimensions.
at all levels	Refers primarily to vertical levels of governance, from national government to local government, basin authorities and stakeholder participation.
including through transboundary	Surface water or groundwater basins (aquifers) that cross or are located on boundaries among two or more countries; refers to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki 1992) and the Convention on the Law of the Non navigational Uses of International Watercourses (New York 1997).
cooperation as appropriate.	Customary international water law requires countries to cooperate in managing transboundary waters, with the main principles contained in the above-mentioned United Nations conventions; apart from island countries without a terrestrial border or countries not having transboundary waters, transboundary water cooperation is appropriate.

IWRM REGULATORY SYSTEMS

The SDG 6.5 target's two sub targets *("By 2030, implement", and "at all level")* focuses on already existing IWRM papers and governance.

In the two mature ecovillages, individuals and groups have worked on frameworks for water management in recent decades. Several documents, presentations, and plans were created on this topic. Sixty-two papers were listed on water topics on the **Auroville** Research Platform webpage in 2022 (Auroville n.d.), and many could contribute to IWRM concept document. Several professional individuals and working groups focus on water issues, and one group exclusively focuses on water issues in Auroville, the Water Group. Two ecovillage development concepts were prepared for **Krishna Valley**. These address aspects of IWRM. In Krishna Valley, there is no working group exclusively for water, but the community's professional organization group discusses the relevant issues. The person in charge of public utility infrastructure brings the water issues to the meetings.

Nyim EC and **Auromag** Community lacked the design and joint development of integrated water management guidelines, but many members were already elaborating on developing such concepts and documents. Both ecovillages discussed formulating an IWRM document, but additional financial and professional support is needed. During the localizing workshops, both communities developed a preliminary SDG6 strategic document.

IWRM PRACTICES

The SDG 6.5 target's "*integrated water resources management*" sub target focuses on IWRM practices.

The studied ecovillages have many practices that fit into the scope of IWRM. The recycling of wastewater and groundwater management practices were mentioned in previous subchapters. Rainwater management is vital, and each ecovillage has developed various good practices. Therefore, I decided to dedicate a few pages in this subchapter specifically to practices for rainwater harvesting.

The efforts made on rainwater management are outstanding in all four researched ecovillages. Auroville`s tropical monsoon climate is characterized by long dry periods followed by short rainy seasons with heavy rains. In recent years extreme weather events with monsoon-like rains occurred in the Hungarian ecovillages, often followed by prolonged droughts. Proper rainwater management aims to achieve zero rainwater loss, replenish groundwater resources, create water reserves, prevent flooding stop erosion and desertification. Various landscaping guidelines and structures are used for rainwater management in all four ecovillages.

Auroville had to adapt to the monsoonal climate. In the pioneering years, without vegetation, the water ran off from the slightly sloppy plateau into the Bengal Bay, washing away the earth and painting the sea red during the monsoon season. The stormwater dug deep canyons to find its way to the sea. The rain quickly washed away the soil layer, leaving the eroded red ground. The pioneers began to work on improving the water situation as early as the first years. Due to the unpredictability of rainwater, its abundance and scarcity caused equally challenging problems. At the same time when the first trees were planted, to stop losing the water and the soil, bunds were created following the contour lines and guiding the stormwater into various size soak pits and soak ponds from where it was slowly percolating into the ground. The system's development took a lot of time and energy. When improperly constructed dams failed, the accumulated water caused damage to young trees and homes. The dams were later reformed into stages of check dams in the canyons. The system's purpose is to divert and retain sudden rain. It hinders water away from buildings and land, slows down the water flow in the canyons, and encourages water accumulating on the ground to seep slowly into the soil, thus replenishing groundwater resources. Whereas at first, the landscaping work was done only by hand, today, machines are used for faster and more efficient landscaping. Almost every researched site uses landscaping tools to retain water, while many Aurovilians participate in bunds and forest maintenance, especially the farm and forest residents. Therefore, we can state that rainwater management happens in a participatory manner, and the residents rely on each other.

Krishna Valley has done exemplary landscaping for rainwater retention. On hillsides, the cultivation direction is perpendicular to the slope. Groups of trees on certain parts of the hillsides bind the storm water's strength, and the pastures infiltrate the showers into the soil. Still, it has not yet achieved the desired level of rainwater retention. Contoured infiltration trenches are planned, and additional bunds and ditches perpendicular to the slope are still to be created. Grassed wooded slopes catch rainwater, but many water drains. Excess rainwater is channeled to the deepest point into a stream. Stream dams slow down the rainwater rush. There are no soak ponds, but the showers accumulate in the lake. The lakes have a buffer area for flood protection, raising the water level by half a meter.

In **Auromag,** a series of lakes and wetlands is envisioned to collect and store rainwater on the bottom of the sloppy area. The **Nyim EC** community used ditches to keep the rainwater from running away with the soil. The method already showed success. The place became visibly greener. The cultivation techniques further enlarge the "green water catchment"; no plowing lower erosion risk. The community plans to create more terracing connected to downpour dams. By terracing, small gardens are designed.

In addition to the built structures, the indigenous flora also supports the rainwater retention efforts. In **Auroville,** the trees and forests act as a sponge, retaining water in the soil, and an **Auroville** expert states zero runoff is achieved by today. **Krishna Valley** and **Auroville** have less than 5 % built-up surfaces, and there is enough land to catch the surplus water from the roofs (Annex 5). In addition, designed tree lines and parks among the buildings further enhance rainwater retention in Auroville.

Among the four researched ecovillages, **Auroville** intended to grow towards a larger population, and new challenges arose with the development of the city, which today has a population of nearly 3000 people. The rainwater running off from roads and buildings must be managed. Green corridors are a vital part of rainwater management (Figure 30) Vegetation of the parks and green corridors around the buildings absorb rainwater. Auroville structures were developed to percolate the roof rainwater into the ground; these are used for community gatherings during dry periods. All the roads and paths of Auroville are made of percolating materials, and some are equipped with bunds and rainwater catchment channels, soak pits and tree lines.

All roads are permeable in **Krishna Valley**. Some are paved with paving stones, and there is a road network with scattered stones.

Several experiments are ongoing in **Auroville** for long-term rainwater storage in underground and clay or plastic-insulated surface water tanks. Roof rainwater is collected and stored in some households' cisterns in **Krishna Valley**. **Auromag** agreed that all roof rainwater should be collected and stored. This water can be used for bathing, washing, and irrigation but not for drinking or cooking. **Nyim EC** community has an agreed concept for water use. Collecting rainwater is crucial, as there are limited groundwater sources. The community already collects rainwater, and the rain-collecting surface will increase when more houses are built.

TRANSBOUNDARY CONFLICTS AND COOPERATION

The SDG 6.5 target's two sub targets (*"including through transboundary" and "cooperation as appropriate")* address cooperation on transboundary waterbodies.

It was interesting to explore transboundary cooperation. The research showed that emerging conflicts are the basis of cooperation, and it is critical to map transboundary waterbodies and existing conflicts as a basis for future cooperation.

Auroville has some seasonal lakes and ponds on its borders, while Krishna Valley has streams flowing through the community land into neighbors' lands year-round. All four ecovillages are characterized by the fact that the groundwater basins (aquifers) cross boundaries with their neighbors. There were conflicts about groundwater quantity and quality in each ecovillage due to transboundary groundwater use.

Auroville's development did not follow the original master plan. Some lands outside the master plan are the property of Auroville, while non-AV parties own about 70% of the land within the master plan. This situation poses various challenges, and water-related conflicts are one. Waste management culture is poor, and open defecation is still widely practiced in India causing recurring conflicts in Auroville's neighborhood. Garbage and sewage are dumped in the village sections of common catchment canyons, and Aurovilians regularly clean them. Some non-Auroville neighbors transformed the common (parambouke) water catchment land into farming. Auroville and local government officials were collaborating in restoring such rainwater catchment sites. The biggest concern is water use. The number of groundwater wells near Auroville has increased exponentially and caused a groundwater level drop. The groundwater quality is endangered by the pesticides and agrochemicals used on neighboring farms. Industrial sites in the neighborhood are rumored to inject toxic substances into groundwater. With its neighbors, Auroville cooperates on rainwater catchment and various water management projects of the bioregion, described in more detail in chapter SDG 6.A. and the Auroville published report on SDG6 (Nagy 2021). To reduce the use of agrochemicals, Auroville advocates for organic agriculture. Neighboring cashew farms using harmful chemicals are given environmentally friendly chemicals free of charge, and organic cashews are bought for a significant price from farmers who decide to start pesticide-free cultivation.

Two streams stem from the **Krishna Valley** area and flow into Lake Balaton, touching the village and multiple fishing ponds. These are listed as intermittent watercourses. One stream with more constant water flow was dammed, and lakes were created along its path. There were no conflicts from the water flow of the stream. There are neighborhood fishponds in a row down the stream that flows from Krishna Valley, and the community consults with the owners about flood control during intense rainfalls. The ecovillage is in a valley, in a watershed, so even though agrochemicals are used in the surrounding fields, the groundwater is free of agrochemicals. Water quality studies of dug wells show that adjacent fields do not pollute groundwater. There is no industrial factory in the area that could contaminate the groundwater. At the same time, the amount of groundwater has decreased significantly in the past decades. A mineral water filler in a nearby village uses the groundwater, but no conflict or cooperation has existed.

The **Auromag** community lands are dispersed among neighboring unused lands, and it is essential to incorporate this situation's possible threats and benefits. It can cause danger in the future if new neighbors with different water and environment management practices occupy the unused plots. The future use of agrochemicals may endanger groundwater quality. Therefore, it is suggested to establish clear guidelines on chemical use and develop collaborations with present and future neighbors. It is ideal to purchase or lease more lands and eliminate fragmentation in the future. There are extensive municipal lands in the area that are not cultivated. The community has suggested cooperating with the local government to develop programs that contribute to protection and sustainable development. Possible collaborations are a social farm or an educational sensitization and awareness camp that Auromag members would happily organize. The extensive forests in the land's immediate vicinity are likely to affect the groundwater level. The groundwater is very deep at about 40 meters, and it is feared that if the nearby forests are cut down, the water level will drop more profoundly, and it will become more costly and difficult to access the groundwater. Therefore, it is essential to keep a forest buffer zone at the area's boundary.

In **Nyim Eco Community** cooperation with the village is essential. Conventional agriculture is practiced, and agrochemicals are used on neighboring lands. If finances allow, it would be better to purchase the neighboring lands. The community has established good connections with the municipality. The IC helped to create a new municipal master plan and gained particular building and land use permission for the community-owned lands. The authorities recognize the plot as an ecovillage district of Nyim EC, and the community has permission to build. A new collaboration can focus on recent extreme rains that caused mud avalanches in the village. The community would like to collaborate with the village by inviting an expert (Sepp Holtzer) to suggest landscaping techniques to avoid future catastrophes.

All four ecovillages make efforts to achieve zero rainwater runoff. As their neighbors do not put effort into rainwater catchment, the ecovillages put extra energy into catching all additional rainwater flowing through their fields. Auroville maintains the rainwater catchment canyons of the neighboring lands, Krishna Valley built extra storage capacity in its lakes to slow down the downpour in the streams, Nyim EC has a threat of mudslides from neighbors situated in higher planes, and Auromag maintains the roads that are shared with neighbors but regularly destroyed by the heavy rains.

SDG 6.5 FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

The normative interpretation divides the SDG 6.5 target into five parts; each is well-suited to the functioning and goals of the researched ecovillages.

INDICATORS

The twelve indicators found refer primarily to documents or regulatory systems. None applies to ICs, as their collaborations are based on personal relationships and are not always documented. In any case, ICs could benefit if IWRM documents reinforce the existing practices and cooperations. Among

the indicators, measurements to monitor practical solutions are missing. Twelve additional questions were listed in the monitoring collection. Additional indicators are needed that measure current conflicts, the amount of water retention, the achievement of zero runoff, the dependence on groundwater resources and the use of alternative water resources.

Table 14. Analysis of the SDG 6.5 Inventory developed for ICs

SDG 6.5 sub targets	Indicators found in the studied documents				Added questions	
	Pc.	Applicability in ICs			Pc.	Short description
		challenged	not measurable	measurable		
"By 2030, implement	0	0	0	0	0	
integrated water resources management	4	0	4	0	3	Practical questions IWRM practices, groundwater dependence and rainwater availability
at all levels	0	0	0	0	5	Practical questions on rainwater management
including through transboundary	4	0	4	0	2	Practical questions on transboundary water bodies
cooperation as appropriate."	4	0	4	0	2	Practical questions on transboundary water conflicts and cooperations
SUM	12	0	12	0	12	

DISCUSSION

SDG6.5 focuses on integrated water resource management. This target seeks to ensure that all aspects of life have adequate water. The different interests conflict over the quantity and quality of water, and unfortunately, economic interests often come first. While I found good practices and efforts related to each sub target, I was disappointed to find no indicator to measure ecovillages IWRM practices. I think it is precisely in this target that ecovillage developed sustainable practices worth sharing. These practices are not always written on paper but are embedded in the local norms and values.

The ecosystem is the foundation, and all water management practices seek environmentally friendly solutions that protect and regenerate the environment. SDG6.5 relates to several practices, such as wastewater recycling, agriculture and drinking water supply, described in chapters 5.2.2-5.2.5. In this chapter, I have addressed rainwater management which is central to all four ecovillages. Good rainwater management protects and regenerates the ecosystems, while it also plays an essential role in the economy, as it reduces the economic damage caused by extreme weather events (heavy rains and droughts) while protects and recycles resources (soil, water). In the ecovillages, the developed

rainwater management systems require continuous improvement and maintenance, involving the whole community in an interdependent and participatory manner. Many water collaborations are not on paper but habitual and part of established cultural values and norms.

5.2.7. SDG 6.6 Ecosystems

UN definition: "*By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes"* (UN 2016). The target is set to be achieved by 2020, unlike most SDG targets with a timeline of 2030. The target is further divided by normative interpretations into ten sub targets (Table 15). The practices are listed under two topics: green- and bluewater protection and restoration.

Table 15. SDG 6.6 UN subdivision by normative interpretations (UN 2016)

By 2020	Refers to the Aichi Biodiversity Targets to be reached by 2020.
protect and	Implies a reduction in or eradication of the loss or degradation of ecosystems.
restore	Implies a reversal of loss or degradation; assisting the recovery of degraded, damaged or destroyed ecosystems by re-establishing structural characteristics, species composition and ecological processes.
water-related ecosystems	Whereas all ecosystems depend on water, some ecosystems – as specified below – play a more prominent role in the provision of water-related services to society.
including mountains	Most of the world's rivers are fed from mountain sources, with snow acting as a storage mechanism for downstream users; more than half of humanity depends on mountains for water.
forests	Large areas of land covered with trees or other woody vegetation, covering about 30% of the world's land area and accounting for 75% of gross primary production; forests are central for safeguarding water quantity and quality.
wetlands	Swamp, pond, peat or water, natural or artificial, permanent or temporary, stagnant or flowing water, including estuaries and marine waters down to 6 m below the low-tide mark (definition by the Ramsar Convention).
rivers	Channels where water flows continuously or periodically.
lakes and	Depressions in the Earth's surface occupied by bodies of standing water; they also include small and shallow water bodies, such as ponds and lagoons.
aquifers.	Underground zones that contain sufficient saturated permeable material to yield significant quantities of water to wells and springs.

GREENWATER PROTECTION AND RESTORATION

The SDG 6.6 target's four sub targets (*"protect and restore… including mountains and forests")* focus on landscape protection and restoration of green water. Each ecovillage was started on heavily degraded and abandoned land, which they restored through decades of work.

Archaeological research shows that the **Auroville** area has been densely populated since ancient times, but wildlife and forests were relatively undisturbed. During colonial times, forests were seen merely as opportunities for harvesting, and only the Sacred Groves were spared, where people for generations protected the trees through religious restrictions. Over the last 200 years, the native vegetation of the area, the Tropical Dry Evergreen Forest (TDEF), has been largely eradicated. The rain quickly removed the soil without ground cover, leaving behind a heavily eroded landscape. Once rich forests had become barren plateaus that turned into a swamp when it rained and into a reddish desert during the dry seasons. Once the indigenous forest was cut, the land became so devastated that a UNESCO survey from the 1960s identified it unfit for human habitation (Gilles et al 2013). Auroville was founded in 1968 on a barren plateau in South India. The pioneering years of Auroville primarily focused on landscape rehabilitation through reforestation and water management. Initially, fast-growing trees were planted, mainly Acacia varieties imported from Australia (AvBotanical n.d.). Later, the focus moved to indigenous trees, and plant propagating materials were collected from temple gardens and sacred groves where strict religious restrictions have preserved the trees for centuries. The young trees required thorny fenced protection and water for the first 3-4 years (Nagy 2018). With the return of the indigenous animal species, the forest became self-sustaining because the animals dispersed the seeds. Auroville's reforestation work accounts for 4% of the total area of TDEF in India (Land and Nature 2020). The reforestation success in past decades has contributed substantially to developing a pleasant microclimate and refilling groundwater aquifers. It has been estimated that there are approximately 5 million trees in Auroville today (Nagy, Szabó 2019). Protecting the restored ecosystems is essential and is considered in all activities and developments.

Krishna Valley has done landscape rehabilitation in a highly degraded area. From the initial low-diversity, degraded areas, a mosaic, natural landscape structure was formed in 30 years. Diversity has changed significantly due to habitat expansion. The number of bird species grew from 40 to 125 species. Species of arthropods, amphibians, and reptiles have appeared. The flora has been enriched vastly; protected species have appeared spontaneously and through artificial restocking. The ecovillage has 75 hectares of forests. It consists of natural forests: floodplain softwood grove, alder, hornbeam oak, deciduous forest, wooded pasture and cultivated forests: Acacia and poplar. Forests in Krishna Valley act as a vital element of water retention, slowing down the downpour on the hillside, absorbing the wastewater, and offering shade at the lakes, thus minimizing evaporation. Protecting the restored ecosystems is essential. Ecosystem protection is considered for all activities and developments (KRV n.d.).

In **Auromag**, the soil quality and its water retention capacity are inferior. Ground cover plants and mulching can help to retain water, improve soil quality, and increase biodiversity. Soil improvement experiments were carried out with good results. Soil quality has improved under thickly mulched surfaces, soil moisture and nutrient content have increased significantly. Grazing animals could further improve the quality of the soil and its water retention capacity. Tree planting is planned to

increase humidity and water retention capacities. Protecting the neighboring forests, which belong to three municipalities, is also essential. Planting trees along the forest borders can reduce the impact of future tree logging. As preparation for forestation, a nursery is started that needs water and mulching. A tree planting strategy will be developed, with a landscape design, project design, and monitoring. External experts will be contacted. A National Ecological Research Institute biologist identified numerous protected plant species on the land.

Since its beginning, **Nyim EC** has had an impact on biodiversity. The community land was used as conventional agricultural land with agrochemicals. Since the community bought the land, no agrochemicals have been used, and measurements were done to keep the soil and its moisture in place. Since the beginning, biodiversity surveys have been done regularly, and the area's ecosystem biodiversity rate is increasing. Many birds, small mammals, reptiles, and insects live on the site today. There was an initial BDI survey, but unfortunately, it was not followed up due to other priorities and limitations of human resources. It would be valuable to repeat the assessment yearly and monitor the changes. It is planned to add terracing, connected to the downpour dam and make small gardens on the terraces. The future residential area will be concentrated, leaving a larger space for nature.

No mountains are located in either of the researched ecovillages, but all have slopes where the rushing of downpours can wash away the soil on its way. Therefore, each ecovillage has incorporated measurements to slow the downpour, support its retention, and avoid soil erosion.

BLUEWATER PROTECTION AND RESTORATION

The SDG 6.6 target's five sub targets (*"water-related ecosystems, wetlands, rivers, lakes and aquifers")* focus on protecting and restoring water bodies.

Auroville does not have permanent natural surface water bodies. Many artificial water bodies were created, like Annapurna farm reservoirs of 50000 m^3 in three tanks or wastewater polish ponds at the Future School, Solar Kitchen or Library. Ant channels are located around the buildings. These water tanks are full of fish and offer a superb opportunity for endangered water birds to use Auroville and its artificial ponds as their habitat. Soak pits, soak ponds, channels, and reservoirs were created to catch, guide, and reserve the monsoon's rainwater. The polish ponds and connected wetlands are part of the wastewater treatment systems and are located in the community gardens creating a park-like environment. Water samples were collected from 11 artificial surface water bodies and 10 wells from four aquifers. The Auroville Water Group (AVGIS n.d.) provided information on aquifers. Good ambient water quality has been measured for both surface and groundwater (Table 16, 17).

Krishna Valley has two streams with an average of 7 l/s fluctuating yield. A system of artificial lakes was created along the stream. No wastewater or other pollution gets into these water bodies. Seven lakes were created by swelling one of the streams. Three reservoirs with 3300, 3200 and 160 m^2 water surface and four small ornamental ponds (20-50 m^2). Due to limited financial resources, the quality of only one stream with a more permanent water yield (Table 18) one lake (Table 16) and four wells were examined (Table 17). Good ambient water quality has been measured for both surface and groundwater. A relatively large area, one hectare of KRV, has been converted into a wastewater treatment area, including a 1200m^2 reedbed, a 2000m^3 lake and a 2400m^2 woody-bamboo energy

plantation. The undisturbed area has become an authentic biotope where waterfowl nest and many fish, frog species, and marsh turtles live (Figure 31). The reeds are not cut in the winter either, so it has become an excellent bird habitat. The cleaned wastewater reservoir can store water for up to 120 days; from there, it can be transferred to the energy plantation by opening sluices. The reservoir lake was insulated from below, was odorless during the field visit, and served as a biotope habitat. Carp and crucian fry were introduced to reduce mosquitoes, making many waterbirds constant visitors and residents, such as the grey heron, waterfowl, warbler and mallard. Table 17 shows the groundwater parameters collected in Krishna Valley. The change in agricultural methods from the conventional monoculture system to organic agriculture caused a measurable shift in groundwater's nitrate level, turning it drinkable.

Table 16. The water quality of lakes and ponds in Auroville and Krishna Valley

	Water-body location	pH (at 25° C)	EC µS/cm	Total Nitrogen (as N mg/l)	Total Phosphorus (as P mg/l)	BOD3 mg/l
Limit values/suggested standard (UN, GEMI 2020)s		7-8.5	20-500	35	10	11
Auroville Reservoirs						
1	Aurodam kolam	6.8	101	3.9	2.0	4.8
2	**Sidharta forest kolam**	6.5	79	3.3	3.0	3.9
3	**Nine palms Kolam**	5.9	46	1.7	1.1	1.9
4	**Pitchandikulam lake**	6.2	45	3.2	2.9	2.4
5	**Annapoorna farm lake 1**	6.8	185	4.9	3.6	3.1
6	**Annapoorna farm lake 2**	7.1	326	5.3	4.1	1.9
Auroville DEWATT system polish ponds						
7	**Solar kitchen**	6.6	440	12.9	6.6	9.9
8	**Last school**	6.7	90	2.9	4.9	3.1
Village reservoirs of the Auroville bioregion						
9	**Alankuppam lake**	6.4	77	4.7	3.8	6.6
10	**Irumbai lake**	6.2	85	3.7	2.3	4.1
11	**Kuilapalayam lake**	6.3	191	7.3	5.6	6.4
	Krishna Valley					
	Lake	7,86	68	1	0,43	<3

Table 17. Water quality of groundwater in Auroville and Krishna Valley

	Groundwater-well location	pH (at 25° C)	EC (at 25° C) µS/cm	Nitrate (as NO3) mg/l
Limit values/suggested standards (SYNLAB)		6,5 - 9,5	30-2500	50
CUDDALORE Aquifer				
1	**Revelation,**	6.1	122	2.3
2	**Fertile East,**	6.7	492	4.7
3	**Visitors center**	6.5	592	3.1
CUDDALORE-MANAVELI Aquifer				
4	**Mantra**	5,5	274	2,1
5	**Gaia,**	6,2	324	1,4
6	**Center Field**	5,6	157	1,7
MANAVELI Aquifer				
7	**Mango Garden**	7	629	9,1
8	**Solitude**	6,4	323	6,4
9	**KK Farm**	6,7	647	10,7
KADAPERI KUPPAM Aquifer				
10	**Afsaneh Guest House**	6,1	342	3,2
Groundwater parameters in Krishna Valley				
1	**Deep Well**	7,29	554	3,2
2	**Dug well 1**	7,39	924	6,3
3	**Dug Well 2**	7,33	754	14,4
4	**Dug Well 3**	7,09	938	8,9

Table 18. Water quality of a stream in Krishna Valley

	pH	COD mg/L O2	EC µS/cm	Total P mg/L	BOD mg/L	Total N mg/L
Limit-value (UN, GEMI 2020)	6.5-8.0	15	125-2200	5	11	25
Stream	7,9	3,1	697	0,11	<3	1

There are no surface water bodies on the land of **Auromag** and **Nyim EC**, but both communities plan to create artificial water bodies for rainwater catchment and wastewater treatment.

The **Auromag** water catchment reservoirs are planned to be in the valley or depression. Rainwater catchment is planned in small artificial ponds and wetlands. These must be appropriately designed and sealed as the sandy soil does not hold the water. A pond experiment is planned in the short term, learning from this experiment, a bigger lake is designed, and later a system of ponds and wetlands is envisioned. A complete landscape design is needed to identify the perfect location of future ponds and wetlands.

The **Nyim** community land has no surface water body on-site, but a lake is envisioned. The lake water can be fed from wastewater and roof-rainwater. Therefore, living on the site is a preliminary condition of the lake.

ADDITIONAL SUB TARGETS OF SDG 6.6 NOT ADDRESSED BY THE UN

The target SDG6.6 does not explicitly mention the meadows and the soil life, but the researched ecovillages show that these are essential for water retention.

Table 19. Built-up percentage in Auroville's researched communities

All area	2915774.3 m^2
Built-up area	71053.4 m^2
Built-up %	2.4 %

In the researched ecovillages land use is considered important, precisely the size and location of built-up surfaces. The built-up percentage is low, 3-5%, in all four ecovillages; even the buildings incorporate green surfaces. In addition to the low density the buildings are grouped closely, leaving lands where undisturbed natural ecosystems can develop. The Green Belt of Auroville was initially designed to provide animals and plants with a living space that is relatively undisturbed by humans. Due to landscape rehabilitation, the former desert-like landscape of Auroville has changed to a green ecosystem. Auroville's built-up percentage is still relatively low, as shown in Table 19. The data refer to the 54 research sites I examined.

Auroville's built-up% is lowest on Farms and Forests located in the Greenbelt. The gardens, parks, and creeper-covered buildings in the city area host ecosystems. Besides, water is placed out for birds and butterflies to drink and bathe. **Krishna Valley's** 285 ha total area has only 30 ha zone where human activities are located, allowing ecosystems to exist undisturbed by humans. The building zone is more of a suburban residential area. The size of households is about 60m2 per unit, and the most prominent building is 1000m2.

SDG 6.6 FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

This target differs from the other SDG6 targets as it was to be achieved by 2020. It focuses on ecosystems and acknowledges the importance of water for all living beings. It underlines the common belief: “Where there is water, there is life!”

The eleven sub targets fit well in the concept of the researched ICs.

Several vital aspects are missing from the UN target, and three new sub targets were suggested.

Considering soil life and meadows as essential parts of water-related ecosystems is missing from SDG6.6. Another shortcoming of the target is that it does not consider lands in human use to be protected. This approach does not acknowledge human habitats as home to ecosystems. Efforts are required to turn human settlements, agricultural lands and wastewater treatment plants into diverse ecosystems. The goal is well laid out, but it needs to include humanity as part of nature.

INDICATORS

The UN indicator 6.3.2. (Proportion of bodies of water with good ambient water quality) can simultaneously monitor targets 6.6 and 6.3. It is a simple and affordable chemical test. The monitoring method is described in the UN booklet: “Step by step monitoring methodology for indicator 6.3.2” (UN Water 2017). The indicator SDG6.3.2 provides results for both SDG6.3 and SDG6.6 targets. The measurement is not too expensive and relatively easy to obtain, although expert knowledge is required. I asked Synlab and EMS laboratories to do the testing. The measurement is meaningful if performed regularly and if as many surface and groundwater samples are taken as possible. The great advantage of the indicator is that it provides well-measured and scientifically validated quantitative data but given the ICs SDG perception and limited resources I doubt this indicator will be systematically used for measurements in ICs.

Most of the Fifty-nine indicators found can be used in ICs. Twenty-one questions were added to the monitoring collection.

DISCUSSION

The SDG 6.6 target is most comprehensible in the ecovillages, as outstanding work is already done in ecosystem protection and restoration. At the same time, ecolocalistic practices are applied, i.e., when keeping meadow grasses on the land instead of selling it thus maintaining biodiversity, keeping water in place and providing long-term economic benefits. Established cultural values and norms play a prominent role in protecting the ecosystem, and the residents trust each other to live by these norms.

Each sub target has been addressed in the ecovillages, and three additional sub targets were discovered, the soil and meadows protection and the human settlements as significant parts of the ecosystems. Of the 59 indicators, 36 are measurable, and 21 additional questions were formulated.

However, it is important to stress that while appropriate guidelines on water quality tests are available, it is unlikely that SDG6.3.2 indicator for ICs will become a systematic measurement.

Table 20. Analysis of the SDG 6.6 Inventory developed for ICs

SDG 6.6 sub targets	Indicators found in the studied documents				Added questions	
	pc.	Applicability in ICs			pc.	Short description
		challenged	not measurable	measurable		
By 2020, (Aichi BDI)	0	0	0	0	1	Achievements by 2020
protect and	18	9	0	9	4	Practical questions on BDI, Site use, Protection
restore	3	0	0	3	2	Practical questions on restoration
water-related ecosystems	19	3	2	14	1	Practical questions on land use in order to identify unused lands left for nature
including mountains	1	0	1	0	0	
forests	0	0	0	0	3	Data on forest
wetlands	3	0	0	3	3	Information on wetlands
rivers	5	0	1	4	1	Information on rivers
aquifers	4	3	1	0	2	Questions on the quality of groundwater and info on overexploitation
lakes	0	0	0	0	1	Information on ponds and lakes
Found non sub target specific indicators	6	0	3	3	0	
Discovered additional sub targets						
protect and restore soil life	0	0	0	0	1	Question on soil life
protect and restore meadows.	0	0	0	0	1	Question on pastures
regenerative human-used lands	0	0	0	0	1	Organic agriculture and human habitats as a home for nature
SUM	59	15	8	36	21	

HORIZONTAL TARGETS

In addition to the introduced six targets, the two horizontal targets go beyond the technical solutions and aim to create equity through partnerships and inclusion of all in the benefits and maintenance of water security.

5.2.8. SDG 6.A Cooperation

UN definition: *"By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies"* (2016). The target is further divided by normative interpretations into three sub targets, and related practices will be described in the following subchapter.

Table 21. SDG 6.A UN subdivision by normative interpretations (UN 2016)

By 2030, expand international cooperation	Implies aid in the form of grants or loans from external support agencies.
and capacity building support	Implies strengthening the skills, competencies and abilities of people and communities, so that they can overcome the causes of their exclusion and suffering.
in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.	Practices, processes and technologies that support progress towards water- and sanitation-related targets; the monitoring of water and sanitation, including observation networks and databases for surface and groundwater, is also important.

Each researched ecovillage offers on-site learning opportunities and can be seen as a knowledge-sharing center, a practical university or a Living Lab.

Approximately 1 million people visit **Auroville** annually, including student groups from universities, NGOs, village representatives and curious individuals who come to Auroville to learn the described practical solutions on site. The community developed solutions for its local challenges and shared its practical knowledge with the world. In past decades, Auroville participated in projects to solve water-related challenges close to Auroville, all over India and the world (Auroville Green Practices n.d.; SLI n.d.). They are participating in UN and UNESCO grants to construct drinking water stations and build toilets in schools and villages (Aqua Dyn n.d.; AVAG n.d.; EMS n.d.). Auroville also collects donations through local and international fundraisers in 45 countries (AVI n.d.).

Below are a few funded projects where **Auroville** units were the projects' driving force (Nagy 2021).

6.1: Drinking water

Sunlit Future Auroville: participation in the Grundfos Foundation 100 pumps, 100 villages project for 50,000 people (Sunlit Future 2020).

6.2: Sanitation and hygiene,

Ecofemme enterprise Pad For Sisters program provides free menstrual hygiene products from its income on international sales. Ecofemme gave free training on menstrual health education to over 44,000 girls and has sold and freely distributed 7,31,264 cloth pads, saving 54.8 million disposable pads from landfills (Ecofemme 2020).

6.3 Water quality and wastewater

From 2015 on EcoPro have been engaged with Ramco Textiles mills in Rajapalayam for the improvement of municipal and solid waste management in schools and colleges (EcoPro n.d.).

6.4 Water use and Scarcity

Auroville Consulting, in collaboration with Innovative UK, German International Cooperation, Heriot-Watt University and NABARD implemented Smart Agricultural Irrigation Control systems in 20 farms in Karnataka, Maharashtra, and Tamil Nadu (Auroville Consulting 2019).

6.5: Water management

In collaboration with the Ministry of Rural Development of India and the Indian Canadian Environmental Facility, Palmyra restored 29 water tanks and 12,06 km of water channels, planted 83.000 trees, and built check dams to stop soil erosion and water loss (Pütz 2006).

6.6: Ecosystems

Pitchandikulam Forest Consultants collaborated to restore more than 700 acres of land with lakes and forests (PFC 2020).

Krishna Valley provides knowledge on water management, wastewater treatment and permaculture practices. It regularly offers online and in-person lectures, courses, training and conferences on sustainability and has published books on their sustainable experiences. It has long-term collaborations with universities. On-site learning experiences are offered for curious individuals and volunteers to explore community sustainability practices. They provided several on-site and distant consultations to municipalities on their unique sewage system experience. It also experiments with drought-tolerant plants and shares the seeds with those who ask for them. The Hungarian Krishna Church, also the maintainer of Krishna Valley, organizes daily free food distributions for the poor, including food prepared in Krishna Valley.

Krishna Valley and **Nyim EC** have grants-based sustainability collaborations with their neighboring municipalities. The communities provided support in writing tenders and providing project management as they had the necessary expertise, which was lacking in their neighboring village.

Nyim EC members have specific experiment-based knowledge of project and landscape management, water retention, and excess rainwater management. The accumulated knowledge and expertise will be shared with other ICs and neighboring villages. The aim is to become a model of sustainable

innovations and a center for knowledge sharing. The community already organizes and hosts knowledge-sharing events and educational programs on sustainability (Figure 32).

Auromag primarily sees itself as a place for knowledge sharing and on-site education. It is open to collaborating with neighboring municipal and civil societies and educational institutes. The suggestion of a social farm or a sustainability education center came up. The community will look for possibilities to engage in cross-country cooperations and projects to share good practices on sustainability.

SDG6.A FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

The normative interpretation is relatively short and divides the target into three parts that fit well with the goals and activities of the ICs.

Table 22. Analysis of the SD G6.A. inventory developed for ICs

SDG 6.A sub targets	Indicators				Questions added	
	pc.	Applicability in ICs			pc.	Short description
		challenged	not measurable	measurable		
"By 2030, expand international cooperation	3	0	3	0	1	Practical questions on financial assistance
and capacity building support to developing countries	1	1	0	0	3	Practical questions on knowledge transfer
in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies"	0	0	0	0	2	Practical questions on the sub target listed aspects
SUM	4	1	3	0	6	

MONITORING AND INDICATORS:

Only four indicators were found; these provide data on water-related development assistance programs and knowledge-sharing collaboration programs. Seven questions were added to the monitoring collection regarding online shared practical information, the capacity or experience for on-site learning and the involvement in assistance or knowledge transfer programs.

DISCUSSION:

The SDG6.A target on water-related cooperation is relatively new and has only three sub targets and four indicators. Each ecovillage has practices and ambitions related to this target. The ecovillages are enthusiastic about sharing their sustainability practices related to each sustainability dimension.

5.2.9. SDG6.B Participation

UN definition: Support and strengthen the participation of local communities in improving water and sanitation management.

The normative interpretation divides the target into three sub targets (Table 23); associated practices are presented in the subchapter.

Table 23. SDG 6.B. UN subdivision by normative interpretations (UN 2016)

Support and strengthen the participation	Participation implies a mechanism by which individuals and communities can meaningfully contribute to decisions and directions on water and sanitation planning that affect or can be affected by them.
local communities	Groups of interacting people living in a common location.
in improving water and sanitation management.	Implies improving the management of all aspects of water and sanitation.

No matter how sophisticated the available technological solutions are, the SDG6 targets cannot be achieved without local people's involvement and participation. Each researched ecovillage is outstanding in this regard. During the interviews, I asked what provided water security within the community, and shared values and responsibility were mentioned as the primary cause in each researched ecovillage. In some sites, water-related responsibilities are also entitled to one person, but there is a general trust in the members' awareness and practices.

Aurovilians are actively engaged in achieving water security and water autonomy. There are regular discussions, meetings and presentations on water topics. Water is a recurring theme in the local radio, newspapers, and social media platforms. Water is integrated into the decision-making processes of

planning, development, and management of Auroville. Regarding the water costs, on most of the researched sites, an institute or income generator unit covers most of the costs of the water supply systems.

The available sustainable practices are offered choices rather than enforced regulations like using biodegradable cleaning products or composting toilets. Entrepreneurship spirit has developed local solutions that contribute to SDG6. Biodegradable cleaning products are available in the local shops, rain-fed crops are served at the local restaurants, and indigenous water-resistant plants are available in the local seed banks. Community activities like collecting plastic garbage from nearby villages' water channels, reconstructing the Auroville bunds, and planting trees in the monsoon season empower people to co-create a water-secure community.

In **Krishna Valley,** one person is responsible for water-related administration, but the whole community participates in SDG6-related practices. Regular discussions and small publications inform members on the water situation and help them adjust their sustainability practices. Krishna Valley measures water consumption in its central system and accounts for the cost of producing water based on the measured value. It is charged to the extent of consumption in the institutions. Households contribute a flat rate to the water system's operation, even those using only groundwater wells.

Auromag community comprises people with different lifestyles and water footprints, making it challenging to shape community-agreed water use principles. Community members rely on each other in all water aspects and acknowledge that only communal participation can solve problems. There is a community willingness to cooperate and develop policies, but there is no experience yet. Based on experience, community discussions and participatory processes, guidelines will be gradually built up. There are trust and love in the community; that is the basis. There will be a graduality in water supply development. Some members who will be the pioneers on the land are willing to live with less comfort. They will prototype, experiment and set up the infrastructure for the members with higher comfort expectations (like running hot water). All present members agreed to use the composting toilet. All present members agreed to use only biodegradable detergents and organic agriculture. The members own private plots but will collaborate to achieve the land's full water retention potential. They agreed to develop landscape-based water catchment systems, including ponds, wetlands, hedges, ditches, bunds, soak pits, and rain gardens. The members are willing to exchange their lands for the best landscape rehabilitation solutions. Collaboration is necessary with the members, neighbors and the municipality to develop the best water-retentive landscape. For this reason, community members engage with the neighbors and the local municipality.

Nyim Eco Community: Concerning water, the community wants consensual decision-making. Some members are ready to use the less comfortable compost toilets, and others are not. The same goes for other water aspects. There is a directive on the community house's sustainable and environmentally friendly operation, but not for private households. Guidelines and basic agreements is to be reached on chemical use. The intention is to solve waste management locally. The land has a designated residential area, where future homes are near each other, allowing for everyday interactions and common infrastructure development. Kalaka, a traditional Hungarian community work procedure, will be a form of community work. The ecovillage already has experience in community design and maintenance through a small-scale food garden experiment. The community members' collaboration, shared knowledge, and experience is available to all.

ADDITIONAL SUB TARGETS

According to the literature, developing new values is essential for the crisis response and the sustainability transition. Each ecovillage has practices that strengthen the cultural value of the water.

Auroville researches and integrates the ancient local rainwater management methods while developing new technologies. The deep gratitude and honor that Auroville treats water is the creative inspiration behind past decades of pioneering experiments and practical solutions.

Auroville hosts the Aquatic Bodywork Centre of India. In its warm water pool, training and sessions (Figure 33) are offered to visitors from around the world, sharing the healing powers of water. On the 50th Birthday of Auroville, a special ceremony was held to celebrate and honor the water. Water from over 400 sources of the world was mixed into a golden bowl, representing unity and oneness and expressing Auroville's wish to co-create a water-secure future (Auroville 2018).

In the Krishna religion, water is respected as the energy of God. The stream that flows in **Krishna Valley** is considered a manifestation of a sacred river. Bathing in it can be regarded as a spiritual cleansing, and residents sometimes take a holy bath. Visitors have no opportunity to do so, and the sanctity of water cannot be damaged by having fun in the water. Along the lakes, the established places of pilgrimage, shrines and sacred gardens commemorate the episodes of Krishna's life (Figure 34). Krishna Valley's culture is based on water and follows a high-purity way of life. The dressing is changed daily, and clothes require much washing. People bathe several times daily, basically water-bound culture from the cradle to the grave when the ashes are scattered into the waters. From this starting point, everyone bears water security in their hearts. The design of the operating system helps to maintain these cultural water-aware practices. The combination of technical and sociocultural design is the basis of their sustainable water management practices.

In **Nyim Eco Community**, mini sanctuaries are planned along the rainwater catchment terraces. A dimension of metaphysics has emerged to place sanctuaries, some small symbols in the area. One suggestion is to plant individual trees with a particular symbolic mission to explicitly distinguish a more vibrant tree that can be cultivated and become stable. These shelters would diversify the landscape and allow people to connect better to specific sites.

In **Auromag,** water rituals are practiced.

SDG6.B. FRAMEWORK APPLICABILITY FOR REPORTING AND MONITORING

SUB TARGETS

The normative interpretation is relatively short and divides the target into three parts that fit well with the goals and activities of the ICs.

An additional sub target was identified by the ecovillage's practices, which aim to acknowledge the cultural and spiritual value of the water.

INDICATORS

Thirty-one indicators were found, including 20 from New York VLR, which examine customer satisfaction and service reliability. Interestingly, out of New York's 29 SDG 6 indicators, 20 are aligned to the SDG6.B. target, which could be an example of the importance of SDG6.B. for all municipalities. The remaining non-New York SDG6.B. indicators refer to documents, laws, policies and planning processes in which local communities can participate.

Eleven indicators can be suitable for measuring one of the three sub targets in ICs. Eighteen questions were added to the monitoring list. A simple hand could measure the water management topics' appearance in the local media, the community's engagement in the communication, and the available online or printed publications that provide information to the residents.

Table 24. Analysis of the SD G6.B Inventory developed for ICs

SDG 6.A sub targets	Indicators found in the studied documents				Questions added	
	pc.	Applicability in ICs			pc.	Short description
		challenged	not measurable	measurable		
By 2030, support and strengthen the participation of"	6	6	0	0	5	Questions on administration and participation in water costs
local communities	4	0	4	0	3	methods to activate people
in improving water and sanitation management.	21	9	1	11	4	practical questions on water responsibilities
Discovered additional sub targets						
Culture/spirituality	0	0	0	0	1	question on local water culture/spiritual practices
SUM	31	15	5	11	13	

DISCUSSION

SDG6.B focuses on participation in water-related activities. The relatively recent target can be divided into 3 sub targets, all already reflected in ecovillages practices and ambitions. The cultural dimension has emerged as a complementary sub target, sometimes as spiritual practices, adding local norms and value to water. Most of the 31 indicators found are New York local indicators, which is unsurprising since SDG6.B is a community-specific target. Eleven indicators were found measurable, and 13 additional questions were suggested.

Concerning the four sustainability dimensions, this target is mainly significant in the social and governance/culture/partnership dimensions. Practices involve all residents in water-related issues along the principles of interdependence and participation, and water issues also link to ecosystems and the economy. A community, aka a critical number of committed people who trust each other, is needed to establish an ecological wastewater treatment plant, bulk shopping, and sustainable land use.

5.2.10. SDG6 and its synergies to other SDGs

SDG6 and its eight targets represent an urgent problem, covering all four dimensions of sustainability. As water is essential to life, the work to achieve SDG 6 directly impacts all SDGs. The "SDG wedding cake" concept helps us visualize how the SDGs are interlinked and connected to the four dimensions of sustainability (Figure 4).

This chapter demonstrates how the researched ecovillages' SDG 6 practices contribute to the other SDGs. The explanation themed by the four sustainability dimensions as presented in Figure 4. The study shows that the practices identified by SDG6 research also contribute to achieving other goals. For brevity, only a few examples are presented.

BIOSPHERE

The biosphere dimension consists of four targets.

SDG6. Water and Sanitation

All four ecovillage sites are characterized by water resource limitations and were started on heavily degraded and unused land. The researched ecovillages prioritize landscape rehabilitation and protection over economic growth. They believe that when nature is restored, it provides adequate quality and quantity of water and impacts all SDG targets.

SDG13. Climate Action

Due to climate change, the precipitation significantly altered in all researched ecovillages. Extreme weather events, such as monsoon-type showers in Hungary and extreme rains in India, follow periods of drought. Achieving green and blue water retention is emphasized at each site. Retaining rainwater and percolation into the soil is a goal in all researched ecovillages and directly reduces climate-related disasters. Tillage systems were changed, trees were planted, and bunds and ditches following the contour lines were built. Rainwater is soaked into the soil by different landscaping methods. Dams, soak pits, and soak ponds slowly percolate the rainwater. These methods are found at each researched ecovillage, and all strive to achieve complete water retention and zero runoff. The technologies keep the water and soil in place and reduce erosion and desertification. The restored forests, pastures and permaculture practices bind the Co2, further contributing to SDG13.

SDG14. Life Below Water

The studied ecovillages do not allow wastewater to enter into natural water bodies. They aim to return the used water to nature as unpolluted as possible. Auroville is located on the seaside, so by recycling its wastewater Auroville directly reduces its negative impact on marine life.

SDG15. Life on Land

All four ecovillages were launched on eroded and degraded land, and landscape restoration has been the primary goal. The task is energy-consuming and requires perseverance, especially in the pioneering years. The regenerated land holds and provides pure water, which is essential for all lives. First, all four ecovillages focused on landscape restoration and then the blue and green water retention capacity changed. The used biological wastewater treatment plants contain polish ponds, which act as biotopes. The fishes that live in these artificial water bodies are food for waterbirds. Soil restoration is a fundamental goal in all four ecovillages and is strongly related to water retention and biodiversity. Pastures and farms are rich in biodiversity and contribute to water retention, and even rainwater catchment systems function as natural habitats. Their agricultural lands became diverse ecosystems. They save local indigenous seeds and impact biodiversity.

SOCIETY

The society dimension consists of eight goals.

SDG1. No Poverty

Both Auroville and Krishna Valley support people experiencing poverty. Krishna Valley offers food donations, while Auroville partners with water-related assistance programs listed under SDG6.A.

SDG2. Zero Hunger

Each researched ecovillage grows food. In the four researched ecovillages agriculture is organic, follows the permaculture principles, and prioritizes local indigenous varieties. The largest consumer of water is agriculture, and many permaculture tools are used to reduce water consumption. The grass is not cut for sale, and multi-layered crop production and ground cover plantation are used to achieve green water retention. No plowing, mulching, and micro-irrigation are applied against water loss through evaporation. Local drought-resistant plants are planted in seasonal planting. Community cuisines serve seasonal crops on their menu.

SDG3. Good Health and Well-Being

The COVID pandemic drew attention to the importance of handwashing. Sanitation and hygiene are promptly addressed in the researched ecovillages. The ecovillages' public bathrooms, toilets, classrooms, workplaces and dining rooms are equipped with handwashing facilities with soaps. Primarily biodegradable soap is used. Hygiene standards are taken good care of, not by external regulations but by internal interests. Hygiene protocols are closely monitored in the visited ecovillages. The hygienic monitoring system is essential due to the communal canteens, catering and

food production. Regular training and well-developed hygiene monitoring systems have evolved in the communities. Each community primarily relies on groundwater as a source of drinking water, and efforts are made to preserve its quality. Hazardous contaminants are prevented from entering the soil or water. Special attention is paid to the quality of the pipes to avoid microplastic or lead contamination of the drinking water. The practice of organic agriculture reduces the threat of chemical contamination. Strictly followed hygienic practices reduce the risk of microbiological contamination. Directly consumed drinking water undergoes different treatment and storage than piped water. The treatments are sophisticated; purifiers with reversed osmosis are the most popular. Besides, the ecovillages rely on modern science, with regular and occasional laboratory water analysis. If a suspicion arises of microbiologic contamination, laboratory tests are requested to identify the source of contamination. The tests are repeated and followed by cleaning and maintenance work until there is no contamination in the water. Based on these tests, the hygiene and maintenance procedures are continuously re-shaped. In these resilient communities, laboratory tests lead the adaptation and development of hygienic protocols.

SDG4. Quality Education

A shared characteristic of all four ecovillages is the eagerness to participate in knowledge sharing. Knowledge and expertise are accumulating in the ecovillages, and the ecovillage members have specific experiment-based knowledge on landscape management, water retention, and excess rainwater management. They collaborate with educational institutions, local governments and individual stakeholders and offer practical on-site learning. Even the two younger ecovillages thrive to become educational centers and regularly organize and host educational programs.

SDG5. Gender Equality

Women and men can safely use the toilets; there are separate women/men public restrooms. Some public toilets are unisex. These are lockable from the inside and visible proof, thus safe for ladies. Some workplaces are equipped with bathrooms, showers and attached laundry facilities. The menstrual hygiene needs of women are strongly reflected in Auroville. EcoFemme social enterprise provides training and menstrual cloth pads. It also campaigns for the use of eco-friendly menstrual products.

SDG7. Affordable and Clean Energy

Reforestation is a significant activity in the researched ecovillages, but trees also contribute to the energy circle. Water storage and production require energy, and a partial renewal is achieved when the wastewater is irrigated on energy plants, which are later used in the community for cooking and heating. The energy used in Krishna Valley to extract the groundwater returns to the village when the wastewater irrigated energy forest is dedicated to heating; still, the forest hosts a diverse ecosystem. The ecovillages take advantage of the natural elevation of the landscape to maximize the use of gravity, both in the wastewater and piped water systems. In addition, solar, wind and manpower are also used for groundwater extraction.

SDG11. Sustainable Cities and Communities

All four studied communities were to develop a human habitat. Auroville was a desert before its first inhabitants began planting trees. They rehabilitated the landscape near their homes for comfort, benefiting wildlife. The development concept of each ecovillage includes the concentration of built-up areas, leaving room for wildlife undisturbed by human presence. The built-up zones are located in such a manner to create relatively larger continuous areas for ecosystems.

Urban green infrastructure like parks around the buildings, apartments, terraces with bird feeders, and green walls can function as a habitat for ecosystems. The human habitat can become a complex ecosystem and contribute to rainwater catchment while offering a livable space. Ecovillages pay attention to the percolation of excess water from the built-up areas. The rainwater draining from the buildings is led into the soil with unique structures, and the roads are permeable and lined with ditches, soak pits, and forest lanes.

ICs can actively contribute to developing sustainable neighborhoods, the building blocks of urban sustainability.

SDG16. Peace, Justice, and Strong Institutions

Members of the studied ecovillages are actively involved in water-related decisions. The community organization helps individuals with water-conscious choices that are readily available. Community engagement is accompanied by technological solutions and support systems adapted to the residents. The combination of technical and sociocultural design is the basis to the sustainable water management practices in the researched ecovillages.

ECONOMY

Economy dimension consists of four goals.

SDG8. Decent Work and Economic Growth

Auroville and Krishna Valley already established economic activities with their green industries, agriculture and tourism. These activities offer decent work to members of the ecovillages and people living in the neighborhood. Their rainwater management practices reduce economic losses due to climate vulnerability.

SDG9. Industry, Innovation, and Infrastructure

As we can see, innovation is one of the main characteristics of each researched ecovillage. They aim to change their environment and develop required and inaccessible local services and products. Committed individuals fund and execute new experiments. The successful tools and methods then spread throughout the community, not under coercion from above but based on individual certitude and responsibility. The ecovillages strive to reduce water consumption in industrial activities. On the one hand, they recycle water with sustainable technologies. On the other hand, they do not release toxic substances into the wastewater reuse for watering, thus keeping it within the site as green water.

SDG10. Reduced Inequalities

The researched ecovillages act as a model and are keen to be the catalyst of SDG-related change in their neighbors and regions. Water rights are equal, and the members can rely on each other.

SDG12. Responsible Consumption and Production

Wastewater is considered a valuable resource, partially because all researched ecovillages have limited water sources. When appropriately managed, it is a reusable water source and can impact the water balance. The ecovillages are making outstanding efforts to reduce plastic waste with their drinking water, sanitation, and packaging practices.

PARTNERSHIP

17. Partnership for the Goals

The researched communities represent an outstanding alternative and sustainable knowledge hub in their region and collaborate with their neighborhood to share their knowledge and collaborate in grants and activities. The research revealed that ecovillages cooperate with stakeholders, decision-makers, educational institutions and other ICs for sustainability.

6. Conclusions

The research aimed to identify the role of Intentional Communities in achieving the Sustainable Development Goals. The research followed an hourglass structure, started with broader objectives, then narrowed to one Sustainable Development Goal in four ecovillages, and eventually drew broader conclusions (Figure 2). Five research objectives and hypotheses were defined, and research questions were formulated for each objective. The chapter presents the theses and related explanations based on the research findings. Table 27, at the end of Chapter 6, presents the contextual framework of the research.

Thesis 1: I confirmed that Intentional Communities embody all four dimensions of sustainability (ecology, economy, society, governance/culture/partnership), and ecovillages practices on water management impact each dimension. Modern ICs originate from the green movement and engage the ecology dimension through their environmental protection and nature restoration activities. They believe a well-functioning ecosystem provides water for all human needs. ICs approach the economic dimension through eco-local activities, shared ownership, and voluntary simplicity in an entrepreneurial spirit. Regarding the social dimension, interdependence and trust in each other are fundamental to the ICs and their water practices. Regarding the fourth dimension, ICs practice participatory governance, their cultural practices, norms and values are linked to sustainability, and they strive to partner with local and global stakeholders and participate in formal and non-formal educational programs on sustainability.

The first objective (O1) was to gain an overview of International Communities' relationship to sustainability. Sustainability is described in terms of four dimensions: ecology, society, economy and the fourth dimension, which I called governance/culture/participation in this research. The four dimensions of sustainability are interrelated and interdependent in complex ways.

Research question O1Q1 examined which of the four sustainability dimensions is embodied in Intentional Communities. The literature review examined theories and concepts linking communities to the four dimensions of sustainability. The four dimensions of sustainability were used as reference points in the case studies. On the ecology dimension, landscape regeneration was fundamental to each ecovillage. The economic dimension includes ecolocal principles, voluntary simplicity and shared ownership. At the same time, the entrepreneurial spirit appeared in their developed products and services created out of necessity but have become income generating by selling the products and services outside of the ecovillages. Regarding the social dimension, their water practices build on interdependence and trust in each other. In the fourth dimension, they practice participatory decision-making processes and collaborate with neighbors and stakeholders while offering practical education on sustainability. There is an additional cultural-spiritual aspect to water in each researched ecovillage. In Krishna Valley, the religion revered water as sacred; spiritual baths and sanctuaries characterize this ecovillage. In Auroville, water is seen as a healing medium in the aquatic bodywork center. Water-related spiritual attitudes also appeared in the two recent communities. The combination of technical and sociocultural design is the basis for sustainable water management practices in the researched ecovillages.

The research proved the O1H hypothesis; ICs, by their very nature, already engaged in and embody all four dimensions of sustainability.

<u>Thesis 2:</u> I identified each Sustainable Development Goal relevant to the Intentional Communities' aims and activities. ICs' aims and activities are often set without knowing the SDGs, yet, correspond and contribute to SDGs' local and global achievement.

The second objective (O2) was to gain insights into the ICs' SDG relevance. In 2015, 193 countries adopted the SDGs. The 17 Goals of the UN agenda translate the four dimensions of sustainability to the most pressing issues of our time.

Research Question O1Q1 examined which SDGs are relevant to the researched Intentional Communities' aims and activities. The comprehensive research mapped the 17 goals in ICs' aims and activities. Forty-two ICs` web content was studied with trained student researchers, and thirty-three communities carried out a self-assessment with a questionnaire. The web content analysis found matching activities, good practices, or ambitions related to each SD Goal. In summarizing the ICs' self-assessment questionnaires, each SDG was found relevant to the ICs' objectives and activities. The researched ICs' aims and works were set without knowing the SDGs, yet, their goals and activities correspond and contribute to the SDGs' local and global achievement.

Research question O2Q2 examined how ICs' SDG6 performance and practices relate to other SDGs. As detailed data was collected on SDG 6 only, it was essential to explore how the gained research findings can be translated into general conclusions and help to identify the potential roles of ICs in achieving the SDGs. A study (5.2.10 subchapter) described the synergies of some ecovillage SDG6 practices to the seventeen SDGs, one goal at a time. The study showed that ecovillage water practices contribute to all SDGs.

The research confirmed the O2H hypothesis; ICs have aims and activities relevant to and contributing to each SDG.

<u>Thesis 3:</u> I demonstrated that ecovillage practices and aspirations contribute to each SDG6 target. With the action research, I demonstrated that Intentional Communities could align their aims as strategies to the SDG6 framework. Each SDG6 target and sub target described by the UN normative interpretations could accommodate ICs' aims and activities. I defined additional subtargets related to existing ecovillage SDG6 practices.

The third objective (O3) focused on one goal and aimed to critically analyze whether the SDG 6 framework can accommodate ICs' aims and activities. The UN SDG framework comprises 17 goals and 169 targets subdivided by normative interpretations. As it was impractical to examine all targets in detail during the research period, the research scope was narrowed, and four ecovillages were selected from the researched ICs to investigate the practical implementation of one goal: SDG6 and its eight targets. Normative interpretations subdivided the UN SDG6 targets into fifty-one sub targets (UN 2016).

The SDG framework builds on targets and their monitoring. According to the UN, the targets are designed to accommodate the participation of grassroots organizations.

SDG6-specific documents were studied. Targets, sub targets, indicators and monitoring methods were collected from the UN, national, regional and business documents. The found indicators were arranged into the SDG6 Monitoring Inventory framed by the SDG6 targets and sub targets (Annex 4). The inventory was supplemented with additional questions revealed by pilot research.

Research questions investigated which SDG6 targets and sub targets are relevant to the aims and practices of ecovillages, what additional sub targets can be identified (O3Q1), how ICs perform the SDG6 and if they can align their strategies to it (O3Q2).

The developed SDG6 Monitoring Inventory was used in the fieldwork to collect data through site visits, interviews, community engagement, laboratory analysis, and theme-specific documents of the researched ecovillages. Two of the four ecovillages were recently founded with fewer practical results but high commitments to sustainability. The action research method was used to identify and align the SDG6-related aims as strategies in these recent ecovillages.

The data collection revealed practices and objectives related to each SDG6 target. The research showed each SDG6 target and sub target applicable in ICs. Six additional sub targets were discovered in the researched ecovillages, and these could be added to describe the diverse work of ICs in a sector-specific target document (Table 25). Further research is suggested to explore additional sub targets describing the ICs' SDG-related practices.

The research confirmed part of the O3H hypothesis; the SDG6 targets and sub targets can accommodate the ICs' SDG6 contribution. However, as new subtargets emerged, additional research for IC sectoral targets is suggested.

Table 25. Comparative analysis on SDG6 sub targets

SDGs	SDG 6.1	SDG 6.2	SDG 6.3	SDG 6.4	SDG 6.5	SDG 6.6	SDG 6.A	SDG 6.B	SUM
Sub targets	8	8	8	6	5	10	3	3	51
Applicability	8	8	8	6	5	10	3	3	51
Discovered additional sub targets	1	1	0	0	0	3	0	1	6

<u>Thesis 4:</u> I classified the available SDG6 indicators and determined that not all are suitable for monitoring the ICs. are suitable for monitoring the ICs. Available indicators cannot monitor each target and sub target in ICs, and the overall monitoring may become biased and lead to tradeoffs. Therefore, a sector-specific monitoring system is needed to highlight the ICs' achievements, good practices and aspirations on SDG6.

The third objective (O3) focused on one goal and aimed to critically analyze if the SDG 6 framework can accommodate ICs' aims and activities.

The first element of the SDG framework are the targets, and Thesis 3 has stated that each SDG6 target is relevant to ICs.

The second element of the SDG framework is monitoring. SDGs are interlinked in complex interactions, creating synergies and tradeoffs. Monitoring is essential to identify and avoid the tradeoffs and accelerate the synergies and sustainability transition. According to the UN policies, monitoring aims to highlight the good practices of ICs. In reviewing the SDG documents, I comprehended the crucial importance of monitoring. The goals, targets and sub targets define the destination, but the path is not yet paved. As we walk the path, the bricks are being laid down step by step. However, the conflicting targets can lead us off the track. Avoiding tradeoffs requires constant adjustment and feedback. Monitoring determines where to put the next brick on the road to reallocate resources and develop new policies. It is essential to have monitoring methods to highlight ICs' good practices and involve them in the sustainability transition.

Research question O3Q2 investigated which SDG6 indicators and monitoring methods are applicable in ecovillages and what additional indicators can be identified. Table 26 shows the found data on SDG6 indicators' applicability. The indicators were divided into three categories, Measurable, not measurable and challenged. I categorized as "challenged" indicators that required expertise and resources lacking in the ecovillages studied. While 100 indicators were found measurable, these did not measure all targets and sub targets; therefore, using only the found indicators could create tradeoffs. To avoid this problem and to highlight the good practices, 161 additional questions supplement the inventory. These questions translate the targets into already existing practices. It is important to note that even if there are measurable indicators, their distribution is not even, e.g., there are sub targets and even targets that cannot be monitored, and the overall monitoring may become biased and lead to tradeoffs. Monitoring SDGs is a complex task. Currently, available SDG6 monitoring systems are unsuitable for highlighting the good practices of ICs. However, monitoring the SDGs in each sector and on the smallest possible scale would be essential to allow individual approaches to flourish.

The research did not confirm the O3H hypothesis, but it did point to a weakness in the SDG6 framework. Existing indicators and monitoring methods, although many in number, are limited in their capacity to highlight good practices of ICs. The development of an IC sectoral monitoring system is suggested.

Table 26. Comparative analysis on SDG6 indicators

SDGs	SDG 6.1	SDG 6.2	SDG 6.3	SDG 6.4	SDG 6.5	SDG 6.6	SDG 6.A	SDG 6.B	SUM
Indicators	39	28	49	51	12	59	4	31	270
Measurable	13	20	16	6	0	36	0	11	100
Challenged	17	7	16	10	0	15	1	15	81
Not measurable	9	1	17	35	12	8	3	5	90
Added questions	34	29	26	17	12	26	6	13	161

<u>Thesis 5:</u> I recognized that many ICs do not interpret and communicate their aims and activities in terms of SDGs. One reason behind this phenomenon could be the empty signifier perception. I proved that ICs' perception changes when SDGs are identified and filled with local contexts.

The fourth objective (O4) aimed to identify potential constraints of ICs' SDGs engagement. Thesis 1 and Thesis 2 concluded that ICs have aims and activities corresponding to and contributing to the SDGs. Nevertheless, and although we are already halfway through the 2015-2030 SDGs agenda, ICs' SDG commitments are poorly publicized. This observation has raised the hypothesis that there are constraints preventing ICs from implementing the SDGs.

To investigate the O4 objective, research question O4Q1 explored how ICs interpret and communicate their SDG engagement. The research compared web content analysis and self-assessment results and revealed that most ICs are unfamiliar with the SDGs, and even those familiar with them do not use them to communicate their aims and achievements.

Research question O4Q2 explored how ICs perceive the SDGs and whether their perception can be altered. ICs are created by concerned citizens spontaneously gathering and organizing from the bottom up while challenging the existing hegemonic regimes. This organizational structure questions whether ICs can willingly devote time and energy to adopting the top-down defined SDGs. The literature review explored the challenges inherent in the SDG framework itself, and the possibility of an empty signifier emerged. Interactions with IC members further supported the literature findings. During the SDG6 Localizing Workshops, all eight targets of SDG6 were discussed in their local context. The detailed learning on SD Goal 6 has significantly changed the IC's members' SDG perception, not only on the 6th but on each SD Goal. A perception shift survey before and after the SDG6 Localizing Workshop demonstrated that ICs' SDG perception changes when SDG targets are interpreted in their local context.

The research confirmed the O4H hypothesis. There are inherent constraints in ICs to implement the SDGs. Awareness-raising programs translating local concerns to SDGs are needed to amplify ICs' engagement.

<u>Thesis 6:</u> I demonstrated that ICs lack the expertise, resources, and commitment to implement the SDG framework. They need assistance interpreting and applying the intricate and complex framework and allocating time among their pre-existing priorities. Tools need to be developed which enable ICs to adopt the SDGs.

The fourth objective (O4) aimed to identify potential constraints of ICS SDGs engagement. Thesis 5 indicated that the ICs have perceptual constraints on SDGs, while Thesis 6 suggests that the SDGs framework's complexity constraints ICs' engagement. The SDG agenda allows ICs to become actors in the sustainability transition. However, examining whether the current framework is suitable for ICs is essential. The SDG framework is complex and complex, and its implementation requires expertise, resources and commitment. Sector-specific assistance tools, such as the monitoring system highlighted in Thesis 4, are yet to be formulated.

Research question O4Q3 sought to identify constraints that exist within the SDG framework. The literature and the case study confirmed that the SDG framework is complex and requires commitment, and the current SDG6 monitoring system is not applicable in ICs.

The research question (O4Q4) examined how prepared ICs are to implement the SDG framework. Information gathered through the self-assessment questionnaire revealed that although they already have good SDG practices, ICs are not ready to implement the SDG framework. They do not have the required tools, expertise, resources and commitment.

The research confirmed the O4H hypothesis. There are inherent constraints in SDGs, and tools, expertise, resources, and commitment are needed to amplify ICs' engagement.

<u>Thesis 7</u>: I revealed that Intentional Communities' good practices contribute to the SDGs and are worth promoting in their local geographic and socio-cultural context to accelerate the territorial transition to sustainability. I demonstrated that Intentional Communities and Regional Governments could collaborate in localizing the SDGs. Intentional Communities are keen to act as local sustainability catalysts, providing practical experience to regional stakeholders. Regional Governments are entitled to guide the SDG localization and have tools and expertise to develop a regulatory and support system to disseminate the ICs' good practices at the regional level.

The final objective (O5) aimed to identify potential roles ICs can play in achieving the SDGs. The literature review, interpreting ICs' potential roles in a four-level crisis response framework, identified the SDGs as top-down crisis management. The SDG framework aims to engage all actors in the sustainability transition and can promote ICs' good practices in their territorial regions. The SDGs' global approach can be adjusted to territorial issues. This process is called localization, and the Regional Governments (RegGovs) are entitled to guide and promote the process in their regions.

Research question O5Q1 explored how ICs and RegGovs can collaborate in localizing the SDGs. The literature review explored the nrg4SD's 2018 High-Level Political Forum research report: "SDG Localization, Regional Governments Paving the Way." Following pilot research, the nrg4SD questionnaire was adapted to Intentional Communities. A comparison of the questionnaire results

suggests that ICs have more practical experience with the SDGs, but Regional Governments are ahead in the SDG framework policy implementation. However, neither ICs nor RegGovs have sufficient capacity to implement SDGs at the local level. Due to their other priorities, they cannot devote sufficient time and energy to this task, and it would be equally beneficial if ICs and RegGovs could work together to localize the SDGs. The literature and the research revealed good examples and opportunities for ICs to collaborate in the top-down SDGs framework.

The research confirmed the O5H hypothesis; ICs can have an active role in SDGs' localization.

<u>Thesis 8:</u> I demonstrated that ICs could be Living Laboratories for complex SDG research and instrument development. The SDG6 tools developed in Auroville were applicable beyond regional, national, and even continental borders, illustrating that ICs can play an active role beyond their localities. ICs can assist in adapting the SDG framework to the community sector and the wider society. ICs could also accelerate the sustainability transition of the social sector by initiating community-led, non-governmental social processes, disseminating their knowledge and good practices, and changing values, norms, and worldviews on sustainability.

The final objective (O5) aimed to identify potential roles ICs can play in achieving the SDGs. The SDG framework aims to engage all actors in the sustainability transition. The framework's global approach can be translated to sectoral issues. The community sector can contribute to the SDGs' achievement by engaging the whole society. Scholars refer to ICs as Living Laboratories of sustainability. The Living Laboratory concept incorporates innovation and research methods into a user-friendly environment, where the research setting allows sensing, prototyping, testing, and refining complicated solutions in various complex real-world scenarios.

Research question O5Q2 explored how ICs can contribute to mainstreaming the SDGs. The literature review, the comprehensible research and the case study research indicated that ICs could accelerate the sustainability transition by initiating community-led, non-governmental social processes, disseminating their knowledge and good practices, and changing values, norms, and worldviews on sustainability. They can actively contribute to developing sustainable neighborhoods, the building blocks of urban sustainability. The spirit of experimentation and prototyping was the base of the developed water systems in the researched ecovillages, proving that ecovillages already act as Living Laboratories.

The literature review found no IC-specific tools for SDG engagement, while the business sector has developed several tools to engage the business actors. New tools are required to translate the complex SDGs into community-specific actions. I developed IC-specific tools for the case studies. The developed SDG6 tools: the awareness-raising video, the SDG6 Monitoring Inventory, and the SDG6 Localizing Workshop, are suitable to amplify ICs' role in achieving the SDGs. The tools were developed in India but were successfully used in Hungarian ecovillages and small settlements of Hungary and Serbia after the research period, and the documentary won first prize in an international film festival. ICs developed tools could be cross-regional, adapting the SDGs to the community sector.

The research confirmed the O5H hypothesis; ICs could have an active role in mainstreaming the SDGs as key members of the social sector and as Living Laboratories.

Table 27. Context of research objectives, research questions, research processes and theses

Objectives and Hypotheses	Research Questions	Research Methods	Conclusions
First Objective (O1): To gain an overview on Intentional Communities' relation to sustainability. Hypothesis (O1H): Intentional Communities embody the four sustainability dimensions by their inherent purpose and design.	Research question (O1Q1): Which of the four sustainability dimensions are embodied in Intentional Communities?	Literature review, case studies.	Thesis 1: I confirmed that Intentional Communities embody all four dimensions of sustainability (ecology, economy, society, governance/culture/partnership), and ecovillages practices on water management impact each dimension. Modern ICs originate from the green movement and engage the ecology dimension through their environmental protection and nature restoration activities. They believe a well-functioning ecosystem provides water for all human needs. ICs approach the economic dimension through eco-local activities, shared ownership, and voluntary simplicity in an entrepreneurial spirit. Regarding the social dimension, interdependence and trust in each other are fundamental to the ICs and their water practices. Regarding the fourth dimension, ICs practice participatory governance, their cultural practices, norms and values are linked to sustainability, and they strive to partner with local and global stakeholders and participate in formal and non-formal educational programs on sustainability.
Second Objective (O2): To evaluate the Intentional Communities' relevance with the SDGs. Hypothesis (O2H): ICs' have practices, aims, and activities relevant to the SDGs.	Research question (O2Q1): Which SDGs are relevant to the researched Intentional Communities' aims and activities?	Comprehensive research.	Thesis 2: I identified each Sustainable Development Goal relevant to the Intentional Communities' aims and activities. ICs' aims and activities are often set without knowing the SDGs, yet, correspond and contribute to SDGs' local and global achievement.
	Research Question (O2Q2): How do ICs' SDG6 performance and practices relate to other SDGs?	A study (5.2.10 subchapter) based on case studies	
Third Objective (O3): To critically analyze if the SDG 6 framework can accommodate ICs' aims and activities. Hypothesis (O3H): The SDG 6 framework can accommodate the ICs' contribution to the sustainability transition.	Research question (O3Q1): Which SDG6 targets are relevant to the aims and practices of ecovillages, and what additional targets can be identified?	Case studies, analysis of SDG6 targets and sub targets.	Thesis 3: I demonstrated that ecovillage practices and aspirations contribute to each SDG6 target. With the action research, I demonstrated that Intentional Communities could align their aims as strategies to the SDG6 framework. Each SDG6 target and sub target described by the UN normative interpretations could accommodate ICs' aims and activities. I defined additional subtargets related to existing ecovillage SDG6 practices.
	Research Question (O3Q2): How do ICs perform the SDG6 targets, and can they align their strategies to the SDG6 targets and sub targets?		
	Research question (O3Q3): Which SDG6 indicators and monitoring methods are applicable in ecovillages, and what additional questions can help the identification of further indicators?	Case studies, analysis of SDG6 indicators.	Thesis 4: I classified the available SDG6 indicators and determined that not all are suitable for monitoring the ICs. are suitable for monitoring the ICs. Available indicators cannot monitor each target and sub target in ICs, and the overall monitoring may become biased and lead to tradeoffs. Therefore, a sector-specific monitoring system is needed to highlight the ICs' achievements, good practices and aspirations on SDG6.
Fourth Objective (O4): To identify potential constraints of ICs SDG interpretation and engagement. Hypothesis (O4H): ICs SDG engagement is challenged.	Research question (O4Q1): How do ICs interpret and communicate their SDG engagement?	Comprehensive research.	Thesis 5: I recognized that many ICs do not interpret and communicate their aims and activities in terms of SDGs. One reason behind this phenomenon could be the empty signifier perception. I proved that ICs' perception changes when SDGs are identified and filled with local contexts.
	Research question (O4Q2): How do Intentional Communities perceive SDGs, and can their perception be shifted?	Data spontaneously accumulated through the interactions with ICs. Perception shift survey before and after the SDG6 Localizing Workshop.	
	Research question (O4Q3): What are the constraints in adopting the SDGs in Intentional Communities?	Literature review and the case studies	Thesis 6: I demonstrated that ICs lack the expertise, resources, and commitment to implement the SDG framework. They need assistance interpreting and applying the intricate and complex framework and allocating time among their pre-existing priorities. Tools need to be developed which enable ICs to adopt the SDGs.
	Research question (O4Q4) How do Intentional Communities actually implement the SDG framework?	Self-assessment questionnaire.	
Fifth Objective (O5): To identify roles Intentional Communities can play in achieving the SDGs. Hypothesis (O5H): Intentional Communities can have an active role in achieving the SDGs.	Research question (O5Q1): How can Intentional Communities and Regional Governments collaborate in localizing the SDGs?	Extracted data from nrg4SD research, ICs' self-assessment questionnaire, synthesis of research results.	Thesis 7: I revealed that Intentional Communities' good practices contribute to the SDGs and are worth promoting in their local geographic and socio-cultural context to accelerate the territorial transition to sustainability. I demonstrated that Intentional Communities and Regional Governments could collaborate in localizing the SDGs. Intentional Communities are keen to act as local sustainability catalysts, providing practical experience to regional stakeholders. Regional Governments are entitled to guide the SDG localization and have tools and expertise to develop a regulatory and support system to disseminate the ICs' good practices at the regional level.
	Research question (O5Q2): How Intentional Communities can contribute to mainstreaming the SDGs?	Synthesis of the research results.	Thesis 8: I demonstrated that ICs could be Living Laboratories for complex SDG research and instrument development. The SDG6 tools developed in Auroville were applicable beyond regional, national, and even continental borders, illustrating that ICs can play an active role beyond their localities. ICs can assist in adapting the SDG framework to the community sector and the wider society. ICs could also accelerate the sustainability transition of the social sector by initiating community-led, non-governmental social processes, disseminating their knowledge and good practices, and changing values, norms, and worldviews on sustainability.

7. New scientific results-Contribution to science

Throughout the research, my primary quest was to identify the potential challenges preventing the ICS' participation in achieving the SDGs.

The research early on revealed that ICs have good practices contributing to the SDGs, however, there is a lack of visibility of ICs' commitment to the SDGs. I identified the empty signifier status of the SDGs as the underlying cause of ICs' disengagement with the top-down 2030 Agenda. I was looking for tools to support ICs in adopting the SDGs and to reframe the SDGs in a way that is attractive and understandable for ICs. Since I could not identify such instruments, I developed tools based on my findings and applied them in the research.

Throughout the research, I developed three tools introduced below. These tools can build on each other and be used in any locality to identify the SDG6-related local problems and good practices and define strategy. After the dissertation research finished, I had the opportunity to use these tools in ICs and small municipalities in India, Hungary and Serbia.

7.1. Educational Video

Many Intentional Communities perceive Sustainable Development Goals as empty signifiers. The video attempts to explain the political agenda of the UN's Sustainable Development Goals (SDGs) in a meaningful and engaging way to the ICs and the general public.

A Stichting de Zaaier grant sponsored the shooting, and the manuscript and voice-over were written in collaboration with professional filmmakers and language tutors. It interprets the intricately worded SDG6 targets into tangible results and good practices, highlighting some of the good practices of Auroville. It has an English and a Tamil voice-over version and a Hungarian subtitled version; further translations are in the process. The documentary won the Handle Climate Change International Film Festival in 2022. It is available on YouTube: https://www.youtube.com/watch?v=dteNLfkc0kA

It is openly accessible and aims to inspire Intentional Communities, grassroots organizations and citizens to engage in the global and local discourse on SDGs. After the research phase of this dissertation, it was used for awareness raising in various localities. A two-hour discussion with the viewers followed the 30 minutes of documentary, identifying the local problems and local opportunities for achieving SDG6.

7.2. SDG6 Monitoring Inventory for ICs and small settlements

The SDG6 Monitoring Inventory for Intentional Communities is a work in progress.

The developed inventory is an excellent resource of indicators for SDG6 monitoring. It contains 270 indicators obtained from the UN, voluntary national reviews, voluntary local reviews, and the business sector. It also includes 161 additional questions developed for the SDG6 assessments in Intentional Communities and small settlements, as the indicators found were insufficient to be used in the researched ecovillages to highlight the SDG6 related good practices. Annex 4 contains the inventory.

During the research the inventory was used in India and Hungary, while after the research phase of this dissertation, the tool was used in ICs and small municipalities of Serbia under an Erasmus Program. It is planned to be further developed into an inspiring, easy-to-use digital self-assessment tool for non-expert citizens, communities, stakeholders, organizations and municipalities. People without specialized knowledge of SDGs could evaluate their SDG6 performance. The online tool would automatically generate a detailed report, highlighting the good practices and areas for improvement. Such reports will encourage territorial cooperation and accelerate regional sustainability transitions.

7.3. SDG6 localizing workshop for ICs and small settlements

The SDG6 localizing workshop is a complex participatory planning workshop with additional research and organizing work before and documentation work after the program. It aims to empower and include local people in developing an SDG6 strategy. It combines intellectual knowledge (SWOT analysis, FSSD framework, presentations, study groups, plenary discussions) with awakened community wisdom (meditation, music and creative artwork situated in nature). By applying this structured planning system, participants learn to strategically approach local water challenges in our unsustainable world. The workshop highlights good local practices and fosters cross-sector collaborations. It provides information on the current progress and challenges and the necessary adaptations and resources to achieve SDG6 locally.

The SDG6 Localizing Workshop was developed in two ecovillages to assess their SDG6-related achievements, aims and to develop local SDG6 strategies.

As it turned out with the perception shift research the workshop is an excellent tool to bring more understanding and awareness on the importance and potential of SDGs to the participants.

I intend to develop further the workshop that evolved during this doctoral research into a training program accompanied by a toolkit.

See detailed descriptions and examples in Annex 6 and Annex 7.

Summary

The Sustainable Development Goals (SDGs) were developed to accelerate the sustainability transition by including all. Intentional Communities (ICs) have been concerned about sustainability for decades and are already advanced in developing and implementing sustainable practices. Nevertheless, there remains a lack of visibility on ICs' SDGs engagement. The research intended to investigate this contradiction and identify ICs' role in achieving the SDGs. The research had five objectives and hypotheses and eleven research questions. The research structure followed an hourglass-shaped format, starting from the broad perspective of the four sustainability dimensions and the 17 SDGs, then narrowing the research scope to one goal, and eventually drawing broader concepts by investigating constraints and opportunities on ICs' SDGs engagement.

The UN, as the developer of SDGs, works with custodian agencies and encourages all to develop individual SDG targets and indicators; thus, countless studies, research reports and documents have been produced on SDGs. Document analysis and literature review are fundamental to the research. The literature review defined the concepts of the ecovillage and Intentional Community, introduced the Sustainable Development Goals, addressed the applicability of the four sustainability dimensions in ICs, and concluded by looking at the role ICs can play in the sustainability transition and the constraints preventing them from implementing the SDGs. The comprehensive research analyzed forty-two Intentional communities' SDG engagement with web content analysis and self-assessment questionnaires for the broader objectives. The research scope was narrowed to SDG6 and four ecovillage-type communities from India and Hungary using the case study research method. The fieldwork included interviews, site visits, community engagement, laboratory analysis, and action research.

The research showed that ICs have aims and practices that contribute to achieving the SDGs but do not communicate them, partly because they do not interpret them. The research indicated that SDG targets could accommodate, but SDG indicators cannot highlight the ICs' good practices. The research revealed that tools, expertise and commitment are needed to implement the SDGs' complex framework. ICs do not have sector-specific tools, lack the expertise and resources required for implementation, and are not committed to the SDGs rather perceive them as empty signifiers. The research showed that ICs' perception changes once the broad ideas of SDGs are interpreted to local problems and tasks. ICs can play an essential role in achieving the SDGs. Locally, by collaborating with Regional Governments to develop regulatory and support systems disseminating ICs' best practices in the region. In addition, ICs can mainstream the SDGs by initiating community-led processes, disseminating knowledge and changing worldviews on sustainability. ICs can also serve as living laboratories for developing tools that translate the complex SDGs into doable action for the community sector.

During the research, three tools were developed to support data collection on SDG6, which supports communities' SDG6 engagement. The SDG6 Monitoring Inventory uses the UN targets and normative interpretation framework. It includes SDG6-related indicators with their applicability assessment in ICs. It also includes additional questions and sub targets that emerged during fieldwork. An SDG6 localizing workshop method was used as action research collecting data on existing good practices and objectives related to SDG6. This tool uses planning and creative tools to help ICs embrace the SDG6 framework and develop local strategies. A documentary was developed to raise awareness and be used as a perception shifter when working with ICs on SDGs. The film received international recognition; it won the 2022 Handle Climate Change International Film Festival.

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ANNEX

Annex 1. List of the 42 researched ICs for the 17 SDGs

Researched ICs by web content analysis and their questionnaire responses

Residential ICs		questionnaire		Non-Residential ICs (only from Hungary)	
1	Switzerland: Schloss Glarisegg	Y	-	Local sustainable market, CSA Farm,	
2	Germany: LandGut Girtenmühle	y	Y	28	Sziget Kosara
3	Tenerife: Asociación Manantial de Tara	Y	Y	29	Kelenföldi Zöldségkör
4	Denmark: Ecovillage Dyssekilde	y	Y	30	Dunakeszi Kispiac
5	Germany:ZEGG	y	Y	31	Nyitott Porták
6	Australia: Firestone Sanctuary	Y	Y	32	Magos Völgy
7	Jordan: Alia Eco-village	y	Y	33	Zöld Almárium
8	Senegal: Adunam ecovillage	Y		Community Gardens	
9	Poland: Aranya	Y	Y	34	Felsőgödi telekkert
10	Ireland: Cloughrojdan ecovillage	Y	Y	35	Békási Közösségi Kert
11	USA: Our ecovillage	Y	Y	36	Budapesti Zugkert
12	China: Southern Life Community	Y	Y	37	Budapesti Grundkert
13	Canada: Ideal Society	Y	N	38	Pécsi Zöld Folt
14	India:Auroville	Y	N	39	Sándor János kertjei
15	Nyim Eco Community, Hungary	y	-	Local multifunctional ICs	
16	Hu: Auromag	y	Y	40	Szentendrei Öko Party
17	Hu: Krisnavölgy	y	Y	41	Kör Tér
18	France, Ecotopia	N	-	Network organization of ICs	
19	Norway: Hurdal	N	Y	42	KÉK
20	France: Saint Camelle Ecovillage	N			
21	Hungary: Máriahalom	N			
22	Hungary: Agostyán	N			
23	Hungary: Nagypáli	N			
24	France: Vabres ecovillage	N			
25	Latvia: Smiltenei	N			
26	France: Pourgues	N			
27	Australia: Jagera Ecocomm	N			

Annex 2. Questionnaire to the community representatives (17 SDGs)

Dear Community,
In September 2015, the UN general meeting in New York adopted the "Transforming our World: A Sustainable Development 2030 Agenda" document, which was ratified by 193 countries. The document consists of 17 development goals, and governments undertook the responsibility to achieve these goals globally and locally. Many of the 17 objectives fit into the activities of communities. The research at the Faculty of Landscape Architecture and Landscape Ecology of St István University, Hungary, aspires to explore how Intentional Communities use the Sustainable Development Goals toolkit to plan and communicate their activities. The following picture shows the 17goals.

Please help our work, by responding to the following 9 questions.

QUESTION I: Please mark in the number line below the numbers of the Sustainable Development Goals that your community directly works with. Please use the above picture for reference.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

QUESTION II. : Please mark in the number line below the numbers of the Sustainable Development Goals that your community indirectly works with. Please use the above picture for reference.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

QUESTION III. : Please mark in the number line below the numbers of the Sustainable Development Goals that are not relevant to the aims and work of your community. Please use the above picture for reference.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

QUESTION IV: From a list of 1 to 5, how much do you know about the UN Sustainable Development Goals and how do you apply them? Only one answer is possible.
1. We have not heard of Sustainable Development Goals

2. We know about the Sustainable Development Goals and think these are not relevant to our community.
3. Sustainable Development Goals are relevant to our community, but we do not currently apply them to our work.
4. We partly implement the Sustainable Development Goals / Partly incorporate them into our activities.
5. We have special focus on implementing the Sustainable Development Goals in our community.

QUESTION V: Do you have specific policies and / or activities to discuss and implement the Sustainable Development Goals?
1. Yes
2. No
3. Other:

QUESTION VI: What tools do you use to implement or incorporate the Sustainable Development Goals.

1. Sustainable Development Council, Working group, committee, expert or something similar
2. Action plan, strategy, or vision, provision, policy or something similar
3. None of the above
4. Other:

QUESTION VII. What activities support your work to achieve the Sustainable Development Goals?
1. Awareness activities and campaigns internally or externally
2. Participate in programs and trainings
3. We create SDG-focused collaborations between different workgroups
4. Involvement of external experts
5. Align our existing policies to SDGs
6. Use indicators to monitor, and evaluate our progress on the implementation of the Sustainable Development Goals
7. None of the above
8. Other:

QUESTION VIII: How do you communicate your work in relation to the Sustainable Development Goals?
1. We regularly refer to Sustainable Development Goals when present our results and activities in our inner or outer communication
2. Currently, we are not yet using Sustainable Development Goals in our communication.
3. Other:

QUESTION IX: What are your challenges in planning, implementing and/or communicating the Sustainable Development Goals in your community?
1. Lack of information, lack of knowledge
2. We have too many other current tasks and it is difficult to prioritize them over SDGs
3. We would need support, either expert or capacity, to focus on SDGs
4. We do not have sufficient financial resources.
5. Other:

Annex 3. Pictures from the case studies

SDG6.1

Figure 23. Small scale water purifier, Source: AquaDyn

SDG6.2

Figure 24. Compost Toilets in Fertile Forest and International House,
Source: Personal and International House (International House 2011)

SDG 6.3

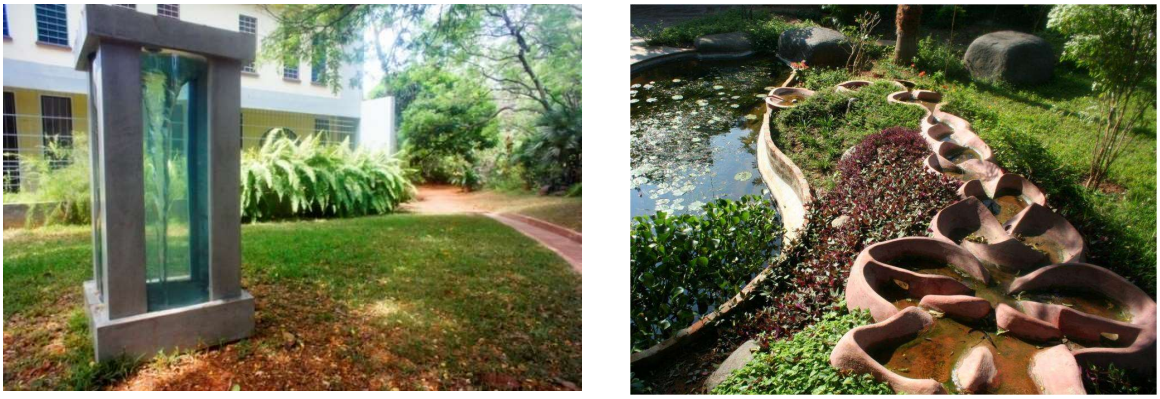


Figure 25. Vortex and WW Ariating Flow, Source: Auroville Archives

SDG6.4

Figure 26. Mulched beds in Auromag

Figure 27. Spirulina Farm, in Av

Source: (Aurospirul 2017)

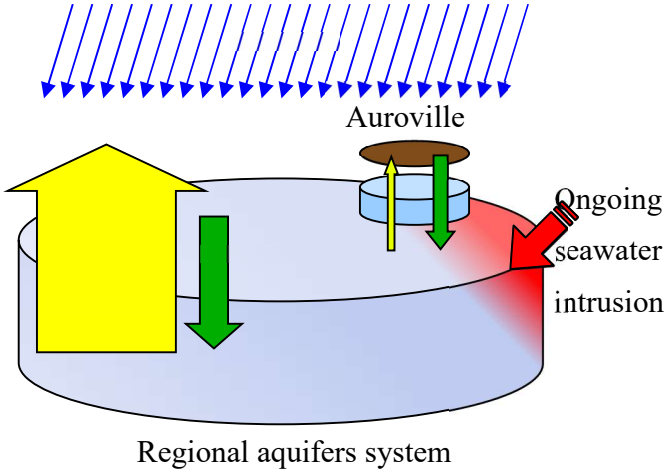


Figure 28. Seawater intrusion (Gilles et al 2013)

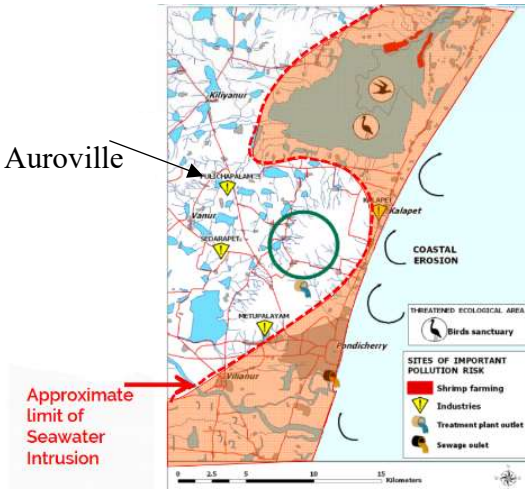


Figure 29. Salinizated groundwater (Vincent, Violette 2017)

SDG6.5

Figure 30. Town planning: integrating greenbelt and green corridors for zero run off,

Source: Auroville Town Development Council

SDG6.6

Figure 31. The Krishna Valley wastewater treatment post-reservoir pond is home to protected birds

SDG6.A

Figure 32. Training in Nyim Eco Community, Source: Facebook/nyimi.oko.kozosseg/photos

SDG6.B

Figure 33. Watsu treatment for a pregnant lady in Auroville

Figure 34. Krishna Valley lakeside, pilgrimage station, Source: Krishna Valley.

Annex 4. SDG 6 Monitoring Inventory

SDG 6.1 target: “By 2030, achieve universal and equitable access to safe and affordable drinking water for all”. (UN 2016)

UNIVERSAL		
Normative Interpretation: Implies all exposures and settings including households, schools, health-care facilities and workplaces		
Indicators		Application in ICs
1. NIF2018,) Niti Aayog2018	Percentage of population having safe and adequate drinking water within their premises.	challenged by UN definition of drinking water
2. UN	Proportion of population using safely managed drinking water services	challenged by UN definition of drinking water
3. UNSTAT)	Proportion of population using safely managed drinking water services, by urban/rural	challenged by UN definition of drinking water
4. Basque)	Total water supply	not measurable if water is not metered
5. Toyama)	Water service coverage	measurable
6. Shimokawa)	Percentage of water coverage by population	measurable
7. Shimokawa	Water supplied per residents	not measurable if water is not metered
8. New York)	Average daily in-City water consumption (millions of gallons) Description: The mean number of gallons delivered each day for in-City consumption.	not measurable if water is not metered
Additional Questions		Comments
1. What is the source of water for drinking, cooking and personal hygiene in the community?		If water is carried in a private refillable container, then it’s not packaged water and please mark here the source of the carried water.
2. Where is the drinking water source located? On premises?		
EQUITABLE		
Normative interpretation: Implies progressive reduction and elimination of inequalities among population subgroups		
Indicators		Application in ICs
1. Business)	Percentage of rights holders report that they have not experienced threats/assaults	measurable, but these two indicators measure rather the achievement of the "for all" sub target, than “equitable”,
2. Business	Percentage of rights holders with access to information about water related issues	measurable, but these two indicators measure rather the achievement of the "for all" sub target, than “equitable”,
3. New York	Overall enforcement activity	not measurable
4. Business	Undertaken human-rights impact assessments and/or social and environmental impact assessments that explicitly consider water, to understand its actual and potential impacts particularly in water-stressed areas	Challenging in ICs expertise is needed to measure
Additional Questions		Comments
1. What type of piped water supply does your household use? Why?		Choose from list of types (JMP), reason chosen simplicity
2. What voluntary simplicity you choose for/-in connection to water supply		

ACCESS		
Normative interpretation: Implies sufficient water to meet domestic needs is reliably available close to home		
Indicators		Application in ICs
1. NIF 2.0)	Percentage of Population getting safe and adequate drinking water within premises through Pipe Water Supply	challenged by UN definition of drinking water
2. New York	Water supply – Critical equipment out of service (%)	measurable
Additional Questions		Comments
1. How many hours per day is water supplied on average?		
2. Have you experienced limitations in water for drinking, cooking or personal hygiene? What was the (main) reason you were unable to access sufficient quantities of water when needed?		
3. Does your site/community have large storage tank(s)?		How many liters does the storage tank hold?
4. If you collect drinking water in your own container outside of the community how long does it take?		Including time taken for a single roundtrip, queuing and refilling time. Can be skipped if there is a drinking water source within the dwelling or yard.
5. What do you do when you have no water?		Do you bring the drinking water here? How, from how far? How big quantities?
SAFE		
Normative interpretation: Safe drinking water is free from pathogens and elevated levels of toxic chemicals at all times		
Indicators		Application in ICs
1. NIF2018, Niti Aayog2018	Percentage of population having safe and adequate drinking water within their premises.	challenged by UN definition of drinking water
2. UN	Proportion of population using safely managed drinking water services	challenged by UN definition of drinking water
3. UNSTAT	Proportion of population using safely managed drinking water services, by urban/rural	challenged by UN definition of drinking water
4. Business	Quality level of drinking water	challenged, needs expertise and costly
5. Business	Exposure to unsafe water quality and workers lacking access to drinking water.	measurable
6. New York	Samples testing positive for coliform bacteria (%)	challenged, needs expertise and costly
7. New York	In-City samples meeting water quality standards for coliform bacteria	challenged, needs expertise and costly
8. Shimokawa	Achievement rate of drinking water quality standards	challenged, needs expertise and costly
9. Toyama	Ratio of concrete pipes with measures against dilapidation	challenged, needs precise engineering not prototyping experiments of ecovillages
10. Pittsburgh 2020)	Extent of replacement of pipes due to health risks (lead)	measurable
11. Pittsburgh	Chemical (lead) data of water	challenged, needs expertise and costly
12. Pittsburgh	Money spent on pipes replacement due to health risk	measurable
13. Los Angeles)	customer service for onsite old drinking water pipe maintenances	measurable
Additional Questions		Comments
1. Do you have treated water available for drinking?		

2.	What method do you use for treatment?	
3.	Are there any indications that drinking water is unsafe?	
4.	Do you know people who drink tap water directly, without any treatment?	
5.	How often do you check your water microbiological/chemical contamination	
6.	Do you contain drinking water in small containers?	
7.	Is your drinking water container sealed, regularly cleaned and maintained?	
8.	If you have a water filter or purifier, do you maintain/clean it?	How?
9.	If you have a big water tank, do you maintain/clean/disinfect it?	This question is about the big storage capacities that stores water for drinking, cooking and personal hygiene and other purposes, not the small drinking water containers for direct consumption
10.	Who provide maintenance	to your small containers, big storage tanks, water purifiers and filters?
11.	Is the water supplied from your main source usually acceptable?	Rate 1-5
12.	Have you noticed any change in the water quality?	If yes please specify:
13.	What type of water pipes do you use?	Did you or do you plan to change the water pipes due to health reasons?
14.	Hygienic procedures to ensure water safety of containers, pipes, wells	Specific info, can choose from list

AFFORDABLE		
Normative Interpretation: Payment for services does not present a barrier to access to or prevent people from meeting basic human needs		
Indicators		Application in ICs
1. Business	Estimated number of individuals who have improved access to an improved water source as a result of the initiative. As an example, this may include employees who have improved access to water at the work site or consumers who purchase access to these services at a more affordable rate.	measurable
2. Business	Company water accounting - percentage of water being measured and monitored in company operations (global) - Current access to fully-functioning WASH services for all employees	not measurable if water is not meter
3. Business	Investment in water and sanitation with private participation	Measurable
4. Basque	Unit cost of water	not measurable if water is not meter
5. Pittsburgh	Financial assistance program (?USD) for those in need	measurable
Additional Questions		Comments
1. Do you pay for the water?		Is your water contribution meter based? Is it maintenance based?
2. Who covers the water costs?		How do you share the water costs? Everyone pays equally? There is a type of support system? Etc.
3. Do you find the cost of your water affordable?		

DRINKING WATER
Normative Interpretation: Water used for drinking, cooking, food preparation and personal hygiene

Indicators		Application in ICs
1. Niti Aayog 2020	Percentage of households having improved source of drinking water	not measurable if water is not meter
Additional Questions		Comments
1. Do you treat and store water for direct drinking differently than water for cooking and personal hygiene?		If yes more under "safe"
FOR ALL		
Normative interpretation: Suitable for use by men, women, girls and boys of all ages, including people with disabilities		
Indicators		Application in ICs
1. Business	Percentage of rights holders report who have not experienced threats/assaults	measurable
2. Business	Percentage of rights holders with access to information about water related issues	measurable
3. Business	Percent of facilities with fully functioning WASH services for all workers	measurable
4. Business	Undertaken human-rights impact assessments and/or social and environmental impact assessments that explicitly consider water, to understand its actual and potential impacts particularly in water-stressed areas	Challenging in ICs expertise is needed to measure
5. New York	Overall enforcement activity	Not measurable
Additional Questions		Comments
1. Is the drinking water publicly available within the site? (check all options)		Multiple answer options. Private access means that drinking water is only available within households, open access means that a jar or fountain etc. is placed with glass for public access.
2. Is drinking water accessible to those with limited mobility or vision?		
3. Is drinking water accessible to women, men, girls and boys equally?		
4. Is drinking water accessible to the smallest children at the site (of a school)?		
5. How big is the capacity of the drinking water facilities/day (fountains)		
ADDITIONAL SUB TARGETS: TO LIMIT BOTTLED WATER USE		
Additional Questions		Comments
1. Do you restrict the use of plastic bottles?		
2. Do you have measures to reduce plastic waste of drinking water?		Choose from list
3 Nr of freely accessible drinking water fountains		

SDG 6.2: "By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations."

ACHIEVE ACCESS			
Normative Interpretation: Implies facilities close to home that can be easily reached and used when needed			
	Indicators		Application in ICs
1	Business	Distance between workplace premises and facilities	measurable

2	Niti Aayog 2018	Percentage of rural households with individual household toilets	Challenged, shared toilet counts as disadvantage
3	Niti Aayog 2020	Percentage of urban households with individual household toilets	Challenged, shared toilet counts as disadvantage
4	NIF2018	Proportion of households having access to toilet facility (Urban & Rural)	measurable
	Additional Questions		Comments
1	Where is the toilet facility located?		Within a household or close proximity?
2	Do you share this facility with others who are not members of your household?		Why? Voluntary simplicity
ADEQUATE			
Normative interpretation: Implies a system that hygienically separates excreta from human contact as well as safe reuse/treatment of excreta in situ, or safe transport and treatment off site			
	Indicators		Application in ICs
1	Toyama	Ratio of concrete pipes with measures against dilapidation	Not measurable
2	Toyama	Proportion of population with sewage treatment	measurable
3	Shimokawa	Usage rate of flush toilet (%)	measurable
4	Shimokawa	Percentage with sewered population (%)	measurable
	Additional Questions		Comments
1	What type of toilets/latrines are in the community?		Nr of composting toilets
2	How is the excreta stored?		Where? When is it emptied?
3	Do you add EM to the toilet?		
EQUITABLE			
Normative Interpretation: Implies progressive reduction and elimination of inequalities among population subgroups			
	Indicators		Application in ICs
1	EUSTAT)	Population having neither a bath, nor a shower, nor indoor flushing toilet in their household, (by annual growth rate, by country	measurable
2	Business	Investment in water and sanitation with private participation	measurable
3	Business	Undertaken human-rights impact assessments and/or social and environmental impact assessments that explicitly consider water, to understand its actual and potential impacts particularly in water-stressed areas	challenged needs expertise
4	Business	Number of toilets/urinals provided (on the basis of a rate of 2 toilet seats and 2 urinal facilities per 45 male-workers and 3 toilet seats per 50 females)	measurable
5	Business	Estimated number of individuals who have improved access to an improved sanitation as a result of the initiative. As an example, this may include installing sanitation facilities at home or public areas.	Challenged, if shared toilet counts as disadvantage
	Additional Questions		Comments
1	How many toilets are available for the nr of users? Bathrooms, public/individual		all public toilets and hand wash basins
2	In general, how clean are the public toilets?		How many times per week are the public toilets cleaned?

SANITATION			
Normative interpretation: The provision of facilities and services for safe management and disposal of human urine and faeces			
	Indicators		Application in ICs
1	UNSTAT	Proportion of population using safely managed sanitation services, by urban/rural	measurable
2	UN	Proportion of population using safely managed sanitation service	measurable
3	Business	Company-wide water targets (quantitative) or goals (qualitative)- Increased access to Water, Sanitation and Hygiene Including: Motivation; Description of target; Quantitative unit of measurement; Baseline year; Target year; Proportion of target achieved;	challenged needs expertise
4	Business	Description of company-wide water targets (quantitative) or goals (qualitative) and progress to date- Providing access to WASH in workplace- Providing access to WASH in local communities- Strengthen links w/local community Including: Motivation; Description; Progress	challenged needs expertise
	Additional Questions		Comments
1	Has your (pit latrine or septic tank) ever been emptied?		What is the procedure? The last time it was emptied, where were the contents emptied to? Was it removed by a service provider?----WHO??? How many years ago was your pit latrine/septic tank last emptied?
2	Does your sanitation facility leak or overflow wastes at any time of year?		
3	Where does your septic tank wastewater overflow discharge to?		
4	How do you dispose of household grey water used for cooking, laundry and bathing?		
HYGIENE			
Normative interpretation: The conditions and practices that help maintain health and prevent spread of disease including hand-washing, menstrual hygiene management and food hygiene			
	Indicators		Application in ICs
1	Business	Number of employees receiving hygiene training and awareness raising	measurable
2	UN	Proportion of population using a hand-washing facility with soap and water	measurable
3	UNSTAT	Proportion of population with basic hand-washing facilities on premises, by urban/rural	measurable
	Additional Questions		Comments
1	Are both soap and water currently available at the hand-washing facilities?		
2	Where are your hand-washing facilities located? -----DO YOU HAVE? HOW MANY?		
3	Do you receive regular hygiene inspections and trainings on the site?		Pls explain
FOR ALL			
Normative interpretation: Suitable for use by men, women, girls and boys of all ages, including people with disabilities			
	Indicators		Application in ICs
1	Business	Worksite has separate toilet facility for women	measurable

2	Business	Current access to fully-functioning WASH services for all employees	measurable
	Additional Questions		Comments
1	Does the design of your toilet prevent other people seeing and hearing what you are doing when you use it?		Is the toilet lockable from the inside?
2	Percentage of woman/man toilet public safe space for women hygenie.		Are there women/men on site? How many women/men toilets are on the site?
3	Is there at least one usable toilet that is accessible to the smallest children (of the school)?		
4	Is there at least one usable toilet that is accessible to those with limited mobility or vision?		
5	Are there hand-washing facilities accessible to those with limited mobility or vision?		
6	Are there hand-washing facilities accessible to the smallest children (of the school)?		
END OPEN DEFECATION			
Normative interpretation: Excreta of adults or children are: deposited (directly or after being covered by a layer of earth) in the bush, a field, a beach or any other open area; discharged directly into a drainage channel, river, sea or any other water body; or are wrapped in temporary material and discarded			
	Indicators		Application in ICs
1	UNSTAT	Proportion of population practicing open defecation, by urban/rural	challenged
2	NIF2018	Percentage of Districts achieving Open Defecation Free (ODF) target.	measurable
	Additional Questions		Comments
1	Is there any trace of open defecation on the site?		(compost toilet is NOT ODF!)
2	Is it known/suspected that some people do open defecation on the site?		Open Defecation on construction sites and seasonal workers farms
NEEDS OF WOMEN AND GIRLS			
Normative Interpretation: Implies reducing the burden of water collection and enabling women and girls to manage sanitation and hygiene needs with dignity. Special attention should be given to the needs of women and girls in high-use settings such as schools and workplaces, and high-risk settings such as health-care facilities and detention centres			
	Indicators		Application in ICs
1	Business	Worksite has separate toilet facility for women	measurable
2	NIF2018	Proportion of schools with separate toilet facility for girls	measurable
	Additional Questions		Comments
1	During your last menstrual period were you able to wash and change in privacy while at home?		Are water and soap available in a private space for women and girls to manage menstrual hygiene?
2	During your last menstrual period, what hygiene materials did you use?		Were these materials reusable?
3	Which of the following provisions for menstrual hygiene management (MHM) are available at site/community?		Bathing areas, MHM materials (e.g. pads), MHM education
4	Are there covered bins for disposal of menstrual hygiene materials in girls' toilets?		Are there disposal mechanisms for menstrual hygiene waste at the school? How does your household usually dispose of menstrual garbage? Is it done by a service provider?
DISCOVERED ADDITIONAL SUB TARGETS			

TOILET WASTE HANDLE		
1	How do you treat non decomposable toilet wastes?	Do you have a procedure to avoid this to get into the waste water?

SDG6.3. Water quality and Wastewater: "By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally."

IMPROVE WATER QUALITY			
Normative interpretation: Implies achieving adequate quality of receiving water bodies so that they do not present risks to the environment or human health.			
	Indicators		Application in ICs
1	UN	Proportion of bodies of water with good ambient water quality	challenged needs expertise and costly
2	UNSTAT	Proportion of groundwater bodies with good ambient water quality	challenged needs expertise and costly
3	UNSTAT	Proportion of open water bodies with good ambient water quality	challenged needs expertise and costly
4	UNSTAT	Proportion of river water bodies with good ambient water quality	challenged needs expertise and costly
5	EUSTAT	Biochemical oxygen demand in rivers, (mg O2 per litre), Compound annual growth rate (CAGR) of the biochemical oxygen demand in rivers,	challenged needs expertise and costly
6	EUSTAT	Nitrate in groundwater, (mg NO3 per litre)	challenged needs expertise and costly
7	EUSTAT	Phosphate in rivers, EU, (mg PO4 per litre), Compound annual growth rate (CAGR) of the phosphate in rivers,	challenged needs expertise and costly
8	New York	Harbor survey stations meeting the fishable standard of 5mg/L for dissolved oxygen (%) Description: The City collects and tests water samples from 35 harbor survey stations in the water bodies surrounding New York City. This indicator represents the percent of these stations that were in compliance with the 5mg/L fishable standard for the amount of dissolved oxygen. The New York State Department of Environmental Conservation classifies water bodies and establishes water quality standards depending on the classification of the water body. The 5mg/L for dissolved oxygen threshold is the State's "fishable" standard for dissolved oxygen.	challenged needs expertise and costly
9	Business	Percent of facilities adhering to relevant water quality standard(s)	challenged needs expertise and costly
	Additional Questions		Comments
1	Are there receiving water bodies such as an ocean, stream, river, pond, lake, or another such body of water into which treated or untreated wastewater or effluent is discharged?		If not what happens to the wastewater? Pollution of water on premises
2	What is the quality of the site's permanent surface water bodies?		Chemical parameters:
3	Data on water qualities of borewell, ponds		any data collection ever happened?
REDUCING POLLUTION			

Normative interpretation: Implies minimizing the generation of pollutants at source and reducing the discharge of polluting substances from point sources (for example, wastewater outlets from economic activities and households) and non-point sources (for example, urban and agricultural runoff)			
	Indicators		Application in ICs
1	Business	Quality of storm water by applicable regulatory standards	challanged needs expertise and costly
2	Business	Number of process safety events, by business activity	Not measurable
3	Business	Total amounts of overburden, rock, tailings, and sludges and their associated risks	Not measurable
4	Business	Total water discharge by quality and destination	Not measurable if water is not metered
5	Business	Company water accounting - % of water being measured and monitored in company operations (global)- Water discharge quality data - quality by standard effluent parameter	Not measurable
6	Business	Company-wide water targets (quantitative) or goals (qualitative)- Reduction in wastewater- Water pollution prevention Including: Motivation; Description of target; Quantitative unit of measurement; Baseline year; Target year; Proportion of target achieved; % value	challenged needs expertise and costly
	Additional Questions		Comments
1	Chemical use guide lines on reducing pollution via domestic use?		cleaning agents and beauty products
2	How do you treat urban run of/vehicle pollution?		
3	Do you practice organic agriculture and gardening, or do you use non organic chemicals?		
4	How do you lower pollution from Agriculture, Urban runoff, Wastewater outlets?		
ELIMINATING DUMPING			
Normative interpretation: Implies ending all inadequate disposal of waste (solid and liquid, for example, leachates from poorly managed solid waste)			
	Indicators		Application in ICs
1	Business	Amount of drilling waste (drill mud and cuttings) and strategies for treatment and disposal	Not measurable
2	Business	Total weight of waste by type and disposal method	challanged needs expertise and costly
3	Business	Volume and disposal of formation or produced water	Not measurable if water is not metered
4	Business	Company water discharges - total water discharge data by destination, across operations, including: Destination; Quantity (megaliters/year); YOY comparison of total water discharged to this destination	Not measurable
5	Business	Total weight of non-hazardous waste, with a breakdown by the following disposal methods where applicable: i. Reuse ii. Recycling iii. Composting iv. Recovery, including energy recovery v. Incineration (mass burn) vi. Deep well injection vii. Landfill viii. On-site storage ix. Other (to be specified by the organization)	Not Measurable
	Additional Questions		Comments
1	What happens to the wwt sludge, waste water?		Where it goes?
2	What happens to compost toilet compost?		

3	Are you aware of any leachets?		
4	How do you collect garbage/solid waste?		How do you recycle, decrease solid waste?
5	Do you compost organic waste?		In what %?
6	How do you achieve zero waste?		What awareness rising you do for zero waste?
7	How do you reduce plastic waste?		How do you change consumption habits, Do you offer non packaged items in local stores
8	What % do you recycle or landfill your waste?		
MINIMIZING RELEASE OF HAZARDOUS CHEMICALS AND MATERIALS			
Normative interpretation: Implies reducing the generation, use and discharge of hazardous substances, as defined and listed in the conventions of Basel, Rotterdam and Stockholm			
	Indicators		Application in ICs
1	NIF2018	Percentage of industries (17 category of highly polluting industries/grossly polluting industry/red category of industries) complying with wastewater treatment as per CPCB norms.	challenged needs expertise and costly
2	Business	Impacts of significant spills. Number of spills/tons	measurable
3	Business	Total number and total volume of recorded significant spills.	measurable
4	Business	The following additional information for each spill that was reported in the organization's financial statements: i. Location of spill; i. Volume of spill; ii. Material of spill, categorized by: oil spills (soil or water surfaces), fuel spills (soil or water surfaces), spills of wastes (soil or water surfaces), spills of chemicals (mostly soil or water surfaces), and other (to be specified by the organization).	measurable
5	Business	Total weight of hazardous waste, with a breakdown by the following disposal methods where applicable: i. Reuse ii. Recycling iii. Composting iv. Recovery, including energy recovery v. Incineration (mass burn)vi. Deep well injection vii. Landfill viii. On-site storage ix. Other (to be specified by the organization)	measurable
6	Business	Number (and percentage) of company operating sites where artisanal and small-scale mining (ASM) takes place on, or adjacent to, the site; the associated risks and the actions taken to manage and mitigate these risks	measurable
	Additional Questions		Comments
1	Hazardous Chemicals?		How do you treat them? No hazardous chemicals are released into the water.
2	Do you have any industrial unit from the 17 highly polluting types?		What are their technologies? Do they work with hazardous materials? If yes how do they treat them?
3	Do you have hazardous waste?		How do you treat/process them?
HALVING THE PROPORTION OF UNTREATED WASTEWATER			
Normative interpretation: Implies halving the proportion of wastewater that is untreated, generated by households and all economic activities (based on International Standard Industrial Classification (ISIC) Rev. 4); some economic activities are of special relevance due to high wastewater generation, including agriculture, mining and quarrying, manufacturing, electricity and sewerage. Treatment implies any process for rendering wastewater fit to meet applicable environmental standards or other			

quality norms; treatment can be categorized into primary, secondary and tertiary treatments (and further by mechanical, biological, and advanced technology treatments). Discarded water that is no longer required by the owner or user, including discharges to drains or sewers for treatment or direct discharges into the environment, as well as water reused by another user without further treatment			
	Indicators		Application in ICs
1	Business	Wastewater treatment level weighted by connection to wastewater treatment rate	measurable
2	NIF2018	Percentage of sewage treated before discharge into surface water bodies	measurable
3	NIF2018	Proportion of waste water treatment capacity created vis-à-vis total generation	measurable
4	Niti Aayog 2018	Installed sewage treatment capacity as a proportion of sewage generated in urban areas	measurable
5	UN	Proportion of wastewater safely treated	measurable
6	UNSTAT	Proportion of safely treated domestic wastewater flows	measurable
7	EUSTAT	Population connected to at least secondary wastewater treatment, (% of population)	measurable
8	New York	Wastewater treatment plant (WWTP) effluent meeting federal standards (%) Description: The percent of treated wastewater leaving in-City treatment plants that meets federal standards for suspended solids and biochemical oxygen demand	challenged needs expertise and costly
	Additional Questions		Comments
1	Do you have data on the quantity and quality of wastewater?		monitored waste water quality treated, untreated any data?
2	How do you treat waste water?		Wastewater treatment facility, NR of installed sewage treatment systems
3	Capacity of waste water?		Type of sewage treatment methods, capacity of sewage treatment
4	Nr of settlements without sewage treatment?		
INCREASING RECYCLING			
Normative interpretation: Implies increasing the on-site reuse of water within the same establishment or industry			
	Indicators		Application in ICs
1	Business	Wastewater Produced, collected, treated municipal wastewater Number of municipal wastewater treatment facilities Capacity of the municipal wastewater treatment facilities Not treated municipal wastewater Treated and not treated municipal wastewater discharged (secondary water) Direct use of treated municipal wastewater Direct use of treated, and not treated municipal wastewater for irrigation purposes Area equipped for irrigation by direct use of treated and not treated municipal wastewater	Not measurable
2	Business	Water withdrawal by source: Fresh surface water withdrawal (primary and secondary) Fresh groundwater withdrawal (primary and secondary) Total freshwater withdrawal (primary and secondary) Desalinated water produced Direct use of treated municipal wastewater Direct use of agricultural drainage water	Not measurable if water is not metered
3	Business	Total volume of water recycled by the organization.	Not measurable if water is not metered

4	Business	Total volume of water recycled as a percentage of the total water withdrawal	Not measurable if water is not metered
5	Business	Percentage and total volume of water recycled	measurable
	Additional Questions		Comments
1	Is wastewater recycled?		For what purpose?
2	Grey-black water separation?		For what purpose?
3	Sludge decomposed?		For what purpose?
SAFE			
Normative interpretation: Implies water has undergone sufficient treatment, combined with non-treatment barriers to protect human health, for the intended use (as described in the 2006 WHO Guidelines for safe use of wastewater, excreta and greywater			
	Indicators		Application in ICs
	No indicator was found		
	Additional Questions		Comments
1	What procedures, technologies ensure the safe recycle or reuse of waste water?		Without threatening drinking or other water quality?
REUSE			
Normative interpretation: Implies wastewater supplied to a user for further use, with or without prior treatment (for example, use of household wastewater in agriculture), excluding the recycling of water within the same establishment			
	Indicators		Application in ICs
1	Business	Total volume of planned and unplanned water discharges by: i. Destination; ii. Quality of the water, including treatment method; iii. Whether the water was reused by another organization.	challenged needs expertise and costly
2	Business	Total volume of water reused by the organization.	Not measurable
3	Business	Total volume of water reused as a percentage of the total water withdrawal	Not measurable
4	Business	Percentage and total volume of water reused	measurable
	Additional Questions		Comments
1	Do you reuse of grey water?		
2	Modes of treated waste water reuse or recycle?		
GLOBALLY			
Normative interpretation: Implies increased recycling and safe reuse at the global scale, allowing for differentiated efforts at the national and regional scales, focusing efforts on water-scarce regions			
	Indicators		Application in ICs
	No indicators were found		
ADDITIONAL INDICATORS ON SDG6.3			
	Indicators		Application in ICs[b8]
1	Business	Water performance in the value chain	Not measurable, requires watermeter data
2	Business	Total renewable water resources Total renewable surface water Total renewable groundwater Overlap: between surface water and groundwater Total renewable water resources Dependency ratio	Not measurable, requires watermeter data

3	Business	Pressure on water resources˜ Freshwater withdrawal as % of total renewable water resources Agricultural water withdrawal as % of total renewable water resources	Not measurable, requires watermeter data
4	Business	Amount of land (owned or leased, and managed for production activities or extractive use) disturbed or rehabilitated	measurable
5	Business	Land remediated and in need of remediation for the existing or intended land use, according to applicable legal designations	measurable
6	New York	WWTPs – Critical equipment out-of-service (% below minimum) Description: There are certain types of equipment at wastewater treatment plants, such as main sewage pumps, that are critical to the treatment of sewage. For each of these equipment types, each of the City's 14 wastewater treatment plants establishes the minimum number which must be in service in order to treat the industry standard of two times dry weather flow. This indicator reports the total number of unit types that were below the required number at any time during the month as a percent of total critical equipment units (the aggregate of number and type).	challenged needs expertise and costly

SDG 6.4 Water use and Scarcity: "By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity."

WATER-USE EFFICIENCY			
Normative interpretation: Implies maximizing the productivity of economic activities while minimizing their water use (generating more output per input of water, including by reducing water losses); closely related to the concept of sustainable production and consumption			
	Indicators		Application in ICs
1	UN	Change in water-use efficiency over time	Not measurable
2	UNSTAT	Water Use Efficiency (United States dollars per cubic meter)	Not measurable
3	Business	Water productivity	Not measurable
4	Business	Water consumption per net value added	Not measurable
5	Business	Location-specific data: Water intensity	Not measurable
6	Business	Water performance in the value chain	Not measurable
7	Business	Determination of the proportion of water consumption in operations vs. water consumption in supply chain	Not measurable
	Additional Questions		Comments
1	Do you have information on the income generated and the used water / year? Accountable! Kind of Water use efficiency		Do you pay for the water? Is it metered?
ACROSS ALL SECTORS			
Normative interpretation: All economic activities (based on ISIC Rev. 4 categories); some industries are of special relevance due to high water use, including agriculture, mining and quarrying, manufacturing, electricity, and water collection, treatment and supply			
	Indicators		Application in ICs
1	Business	Building water intensity	Not measurable

2	Business	Company water governance - companies with water policy- Commitment to customer education	Not measurable
3	Business	Set a specific target to reduce water use in direct operations	Not measurable
4	Business	Description of company-wide water targets (quantitative) or goals (qualitative) and progress to date- Educate customers to help them minimize product impacts- Engagement with public policy makers to advance sustainable water policies and management Including: Motivation; Description; Progress	challenged needs expertise
5	Business	Does the Company system have procedures or systems in place to help reduce its footprint on water? (for instance, seeking alternative water sources, such as grey water or rainwater capture systems)?	measurable
	Additional Questions		Comments
1	Water use communal		Metered?
2	Water use in the industrial purposes		
3	Water use agricultural		
4	How do you lower water use in Agriculture, Industry, Domestic?		farming technologies for water efficiency please select, grey water reuse, etc…
AND ENSURE SUSTAINABLE WITHDRAWALS"			
Normative interpretation: Implies that water withdrawals do not lead to permanent depletion of water bodies, taking environmental water requirements into account			
	Indicators		Application in ICs
1	NIF2018	Percentage ground water withdrawal against net annual availability	Not measurable
2	EUSTAT	Water exploitation index plus (WEI+), (% of renewable water resources)	Not measurable
3	Business	Location-specific data: Water withdrawals by source type	Not measurable
4	Business	Total and percentage of withdrawals in water-stressed or water-scarce areas	Not measurable
5	Business	Total water withdrawal by source	Not measurable
6	Business	Water sources significantly affected by withdrawal of water	measurable
7	Business	Water withdrawals: for the reporting year, with water accounting data for all facilities	not measurable if water is not metered
8	Business	Water withdrawals: for the reporting year, please provide total water withdrawal data by source, across your operations	Not measurable
9	Business	Water withdrawals: for the reporting year, please provide withdrawal data, in megaliters per year, for the water sources used for all facilities reported	Not measurable
10	Business	Water consumption: for the reporting year, please provide total water consumption data, across your operations	Not measurable
11	Business	Water consumption: for the reporting year, please provide water consumption data for all facilities reported	Not measurable

12	Business	Company water accounting - total water withdrawal data by source, across company operations- Fresh surface water Including: Quantity (megaliters/year); comparison w/last reporting year;	Not measurable
13	Business	Company water consumption - total water consumption data- Consumption (megaliters/year); comparison to previous year	Not measurable
14	Business	Company water withdrawals (facility level) - water accounting data for all facilities- Facility reference number; Country; River basin; Facility name; Total water withdrawals (megaliters / year) at this facility; comparison with previous year	Not measurable
15	Business	Company water withdrawals (facility level) - withdrawal data (megaliters per year) for the water sources used for all facilities- Facility reference number; Fresh surface water	Not measurable
16	Business	Total volume of water withdrawn, with a breakdown by the following sources: i. Surface water, including water from wetlands, rivers, lakes, and oceans; ii. Ground water; iii. Rainwater collected directly and stored by the organization; iv. Waste water from another organization; v. Municipal water supplies or other public or private water utilities.	Not measurable
17	Business	Company water consumption (facility level) - water consumption data for all facilities	Not measurable
18	Business	Total number of water sources significantly affected by withdrawal by type:i. Size of the water source;ii. Whether the source is designated as a nationally or internationally protected area; iii. Biodiversity value (such as species diversity and endemism, and total number of protected species);iv. Value or importance of the water source to local communities and indigenous peoples.	Not measurable
19	Business	Company-wide water targets (quantitative) or goals (qualitative)- Absolute reduction of water withdrawals- Reduction in consumptive volumes- Reduction in wastewater Including: Motivation; Description of target; Quantitative unit of measurement; Baseline year; Target year; Proportion of target achieved; % value	Not measurable
20	Business	Location-specific data: Water consumption	Not measurable
	Additional Questions		Comments
1	All water use and purpose?		measurement (water tank size, how often refilled etc)
2	Fresh water withdrawal?		history data, observations
3	Nr of borewells on site, their history?		
4	How do you control water withdrawal?		
AND SUPPLY OF FRESHWATER			
Normative interpretation: Naturally occurring water with a low concentration of salts, or generally accepted as suitable for abstraction and treatment to produce potable water (to compare with brackish and marine water – defining salinity concentrations varies among countries); the definition of inland water resources includes both freshwater and brackish water, categorized as surface water, groundwater and soil water			
	Indicators		Application in ICs
1	NIF2018	Per capita storage of water(m3/person)	measurable

2	NIF2018	Per capita availability of water (m3/person)	measurable
	Additional Questions		Comments
1	How do you store water?		
2	How big water tanks, and how many people using them, Per capita storage of water		
3	Rainwater catchment tanks?		
TO ADDRESS WATER SCARCITY			
Normative interpretation: The point at which the aggregate impact of all users impinges on the supply or quality of water, to the extent that, under prevailing institutional arrangements, the demand by all sectors, including the environment, cannot be fully satisfied; physical water scarcity prevails when more than 75% of available water resources is withdrawn; economic water scarcity prevails when malnutrition exists, although less than 25% of available water resources is withdraw			
	Indicators		Application in ICs
1	UN	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	Not measurable, if water is not metered
2	UNSTAT	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (%)	challenged estimation only
3	Business	Average water intensity in water-stressed or water-scarce areas	Not measurable
4	Business	Number of premises under direct control where water saving technologies and water saving awareness campaign are employed in areas facing water scarcity or water stress	challenged needs expertise
	Additional Questions		Comments
1	Salt water intrusion in coastline, or Changes in water quality due to water scarcity…		(ph, hardness, salinity, sodium)
2	Drop in water level? Borewell depth data, observations		
WATER SCARCITY			
Normative interpretation: Implies targeting physical and economic water scarcity to reduce its impact on people, for example, by helping those suffering from malnutrition			
	Indicators		Application in ICs
1	Business	Conduct community consultation on water-stress assessments or sustainability assessments of shared water sources	measurable
2	Business	Require fair compensation and grievance mechanisms in case water rights have been violated and/or relinquished	measurable
3	Business	Undertaken human-rights impact assessments and/or social and environmental impact assessments that explicitly consider water, to understand its actual and potential impacts particularly in water-stressed areas	challenged needs expertise
	Additional Questions		Comments
1	Have you experienced water stress in the past years?		Have you overcome them? How? How do you prioritize needs during water stress period within the premises
2	What solutions have you explored/developed against water scarcity?		
ADDITIONAL INDICATORS ON SDG6.4			
	Indicators		Application in ICs

1	Business	Percentage and total volume of water recycled and reused	challenged, % measurable, total volume not measurable
2	Business	Total volume of water recycled and reused by the organization.	challenged
3	Business	Total volume of water recycled and reused as a percentage of the total water withdrawal as specified in Disclosure 303-1.	challenged
4	Business	Total volume of planned and unplanned water discharges by: i. Destination; ii. Quality of the water, including treatment method; iii. Whether the water was reused by another organization.	not measurable
5	Business	Company water discharge (facility level) - water accounting data for all facilities	not measurable
6	Business	Company water discharge (facility level) - water discharge data (in megaliters / year) by destination for all facilities	not measurable
7	Business	Volume and disposal of formation or produced water	not measurable
8	Business	Type and number of sustainability certification, rating and labeling schemes for new construction, management, occupation and redevelopment	challenged
9	Business	Extent of impact mitigation of environmental impacts of products and services	challenged
10	Business	Company water accounting - % of water being measured and monitored in company operations (global)- Water aspect; % of sites/ facilities/ operations	not measurable
Additional Questions on SDG6.4			
1	Energy that is needed to access to water (electric, solar, wind, human powered, etc)		How is it provided?

SDG 6.5 Water management: "By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate."

IMPLEMENT			
Normative interpretation: Refers to the Johannesburg Plan of Implementation (2002) objective to develop IWRM and water efficiency plans			
	Indicators		
	None		
	Questions		
	None		
INTEGRATED WATER RESOURCES MANAGEMENT			
Normative interpretation: Process that promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems, taking into account hydrological and technical aspects, as well as socioeconomic, political and environmental dimensions			
	Indicators		Application in ICs
1	NIF2018	Percentage area of river basins brought under integrated water resources management	Not measurable

2	UN	Degree of integrated water resources management implementation (0–100)	Not measurable
3	UNSTAT	Degree of integrated water resources management implementation (%)	Not measurable
4	UNSTAT	Proportion of countries by IWRM implementation category (%)	Not measurable
	Additional Questions		Comments
1	How do you lower groundwater dependence		
2	Rainwater per year (mm)		size of the community (ha), potential quantity of rainwater on site?
3	Any practice of IWRM?		Integrated water management IWRM is implemented, documented.
			Committee person in charge of IWRM
AT ALL LEVELS			
Normative interpretation: Refers primarily to vertical levels of governance, from national government to local government, basin authorities and stakeholder participation			
	Indicators		
	None		
	Additional questions		Comments
1	size of built up/ covered areas (no prelocation)		
2	How do you manage the water in your basin?		
3	How do you recharge ground water?		
4	What water catchment water retentive practices do you use?		Ground water refilling, nr/size/percentage of prelocative ponds
5	Technologies for zero run off		Achievement of zero run off
INCLUDING THROUGH TRANSBOUNDARY			
Normative interpretation: Surface water or groundwater basins (aquifers) that cross or are located on boundaries among two or more countries; refers to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992) and the Convention on the Law of the Non navigational Uses of International Watercourses (New York, 1997)			
	Indicators		Applicability
1	UN	Proportion of transboundary basin area (with an operational arrangement for water cooperation)	Not measurable
2	UNSTAT	Proportion of transboundary aquifers (with an operational arrangement for water cooperation (%))	Not measurable
3	UNSTAT	Proportion of transboundary basins (river and lake basins and aquifers) (*with an operational arrangement for water cooperation*)	Not measurable
4	UNSTAT	Proportion of transboundary river and lake basins (with an operational arrangement for water cooperation (%))	Not measurable
	Questions		Comments
1	What transboundary water basin/catchment area do you have?		Transboundary ponds, transboundary canyons, other transboundary elements (kolam?)

2	Any neighbors information?		
COOPERATION AS APPROPRIATE			
Normative interpretation: Customary international water law requires countries to cooperate in managing transboundary waters, with the main principles contained in the above-mentioned United Nations conventions; apart from island countries without a terrestrial border or countries not having transboundary waters, transboundary water cooperation is appropriate			
	Indicators		Applicability
1	UN	Proportion of transboundary basin area with an operational arrangement for water cooperation	Not measurable
2	UNSTAT	Proportion of transboundary aquifers with an operational arrangement for water cooperation (%)	Not measurable
3	UNSTAT	Proportion of transboundary basins (river and lake basins and aquifers) with an operational arrangement for water cooperation (%)	Not measurable
4	UNSTAT	Proportion of transboundary river and lake basins with an operational arrangement for water cooperation (%)	Not measurable
	Questions		Comments
1	Transboundary water related conflicts?		transboundary water basin/catchment area – conflict/cooperation?
			Transboundary ponds – conflict/cooperation?
			Canyons conflict/cooperation?
			Waste water from neighbors conflict/cooperation?
			Monsoon extra water flow, conflict/cooperation?
2	Transboundary water related cooperations?		Water stress issues with neighbors borewells conflict/cooperation?

SDG 6.6 Ecosystems: "By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes."

BY 2020"	
Normative interpretation: Refers to the Aichi Biodiversity Targets to be reached by 2020	
	Indicators
	None
	Questions
1	What restoration and protection you have achieved by 2020
PROTECT	
Normative interpretation: Implies a reduction in or eradication of the loss or degradation of ecosystems	

	Indicators		Applicability
1	Business	Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the organization's discharges of water and runoff	challenged needs expertise
2	Business	The number and percentage of total sites identified as requiring biodiversity management plans according to stated criteria, and the number (percentage) of those sites with plans in place	challenged needs expertise
3	Business	For each operational site owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas, the following information: i. Geographic location; ii. Subsurface and underground land that may be owned, leased, or managed by the organization; iii. Position in relation to the protected area (in the area, adjacent to, or containing portions of the protected area) or the high biodiversity value area outside protected areas; iv. Type of operation (office, manufacturing or production, or extractive);v. Size of operational site in km2 (or another unit, if appropriate);vi. Biodiversity value characterized by the attribute of the protected area or area of high biodiversity value outside the protected area (terrestrial, freshwater, or maritime ecosystem);vii. Biodiversity value characterized by listing of protected status (such as IUCN Protected Area Management Categories, Ramsar Convention, national legislation).	challenged needs expertise
4	Business	Amount of land (owned or leased, and managed for production activities or extractive use) disturbed or rehabilitated	measurable
5	Business	Total number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk	measurable
6	Business	Biodiversity of offset habitats compared to the biodiversity of the affected areas	measurable
7	Business	Trends in population and extinction risk of utilized species, including species in trade	challenged needs expertise
8	Business	Threatened bird, fish, mammal and plant species	challenged
9	Business	Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas	challenged needs expertise
10	Business	Number and percentage of significant operating sites in which biodiversity risk has been assessed and monitored	measurable
11	Business	Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas	measurable
12	Business	Terrestrial and marine protected areas	measurable
13	Business	Company water risk assessment - contextual issues factored in- current status of ecosystems and habitats at local level- Estimates of future potential changes in the status of ecosystems and habitats at a local level- Scenario analysis of potential changes in the status of ecosystems and habitats at a local level	challenged needs expertise
14	Business	Total number of IUCN Red List species and national conservation list species with habitats in areas affected by the operations of the organization, by level of extinction risk: i. Critically endangered ii.	challenged needs expertise

		Endangered iii. Vulnerable iv. Near threatened v. Least concern	
15	Business	Nature of significant direct and indirect impacts on biodiversity with reference to one or more of the following: i. Construction or use of manufacturing plants, mines, and transport infrastructure; ii. Pollution (introduction of substances that do not naturally occur in the habitat from point and non-point sources);iii. Introduction of invasive species, pests, and pathogens; iv. Reduction of species; v. Habitat conversion; vi. Changes in ecological processes outside the natural range of variation (such as salinity or changes in groundwater level).	challenged needs expertise
16	Business	Significant direct and indirect positive and negative impacts with reference to the following: i. Species affected; ii. Extent of areas impacted; iii. Duration of impacts; iv. Reversibility or irreversibility of the impacts.	measurable
17	Business	Habitats protected	measurable
18	Business	Size and location of all habitat areas protected	measurable
	Questions		Comments
1	How do you protect? What principles, policies are to protect nature?		
2	Land use data?		Building allocations within sites, disperse or concentrated Size of continuous park, garden, habitat with little human presence, undisturbed by humans
3	Do you do environment impact assessment before building/development?		
4	Biodiversity indexes, Wildlife, biodiversity		
RESTORE			
Normative interpretation: Implies a reversal of loss or degradation; assisting the recovery of degraded, damaged or destroyed ecosystems by re-establishing structural characteristics, species composition and ecological processes			
	Indicators		Applicability
1	Business	Habitats restored	measurable
2	Business	Land remediated and in need of remediation for the existing or intended land use, according to applicable legal designations	measurable
3	Business	Size and location of all habitat areas restored, and whether the success of the restoration measure was or is approved by independent external professionals.	measurable
	Questions		Comments
1	How the nature/landscape/flora and fauna changed since you moved in? How have you impacted BDI?		
2	Do you have any restoration project in progress now? What NRS, values? (size, species, etc)		
WATER-RELATED ECOSYSTEMS			
Normative interpretation: Whereas all ecosystems depend on water, some ecosystems – as specified below – play a more prominent role in the provision of water-related services to society			
	Indicators		Applicability

1	UN	Change in the extent of water-related ecosystems over time	measurable
2	UNSTAT	Nationally derived extent of open water bodies (square kilometres)	measurable
3	UNSTAT	Nationally derived proportion of water bodies with good quality (%)	challenged needs expertise
4	UNSTAT	Nationally derived quality of open water bodies(%)	challenged needs expertise
5	UNSTAT	Nationally derived quantity of open water bodies (million of cubic metres per annum)	measurable
6	UNSTAT	Nationally derived total extent (square kilometres)	measurable
7	UNSTAT	Nationally derived total quantity (millions of cubic metres per annum)	measurable
8	UNSTAT	Water body extent (permanent and maybe permanent) (% of total land area)	measurable
9	UNSTAT	Water body extent (permanent and maybe permanent) (square kilometres)	measurable
10	UNSTAT	Water body extent (permanent) (% of total land area)	measurable
11	UNSTAT	Water body extent (permanent) (square kilometres)	measurable
12	NIF2018	Biological assessment information of surface water bodies.	challenged needs expertise
13	Business	Total number and total volume of recorded significant spills.	measurable
14	Business	Total amounts of overburden, rock, tailings, and sludges and their associated risks	measurable
15	Business	Total water discharge by quality and destination	Not measurable
16	Business	Water bodies affected by water discharges and/or runoff	measurable
17	Business	Total volume of planned and unplanned water discharges by: i. Destination; ii. Quality of the water, including treatment method; iii. Whether the water was reused by another organization.	Not measurable
18	Business	a. Water bodies and related habitats that are significantly affected by water discharges and/or runoff, including information on: i. The size of the water body and related habitat; ii. Whether the water body and related habitat is designated as a nationally or internationally protected area; iii. The biodiversity value, such as total number of protected species.	measurable
19	Business	Environment Area salinized by irrigation % of area equipped for irrigation salinized Area waterlogged by irrigation Flood occurrence (WRI)	measurable
	Questions		Applicability
1	Built up %?		Parks, lawns, size of organic farms, map with the different type of lands, type of ecosystems and size
INCLUDING MOUNTAINS			
Normative interpretation: Most of the world's rivers are fed from mountain sources, with snow acting as a storage mechanism for downstream users; more than half of humanity depends on mountains for water			
	Indicators		Applicability
1	Business	Number (and percentage) of company operating sites where artisanal and small-scale mining (ASM) takes place on, or adjacent to, the site; the associated risks and the actions taken to manage and mitigate these risks	Not measurable

FORESTS			
Normative interpretation: Large areas of land covered with trees or other woody vegetation, covering about 30% of the world's land area and accounting for 75% of gross primary production; forests are central for safeguarding water quantity and quality			
	Indicators		
	Included in ecosystems		
	Questions		
1	Size of forests?		
2	Type of forest on site?		
3	Any info on BDI?		
WETLANDS			
Normative interpretation: Swamp, pond, peat or water, natural or artificial, permanent or temporary, stagnant or flowing water, including estuaries and marine waters down to 6 m below the low-tide mark (definition by the Ramsar Convention)			
	Indicators		Applicability
1	UNSTAT	Extent of human made wetlands (square kilometres)	measurable
2	UNSTAT	Extent of inland wetlands (square kilometres)	measurable
3	UNSTAT	Nationally derived extent of wetlands (square kilometres)	measurable
	Questions		Comments
1	Artificial ponds ecosystems?		Ant channels?
2	Size of permanent or temporary wetlands?		
3	Reed beds? Wetlands?		Size, BDI? Water quality?
RIVERS			
Normative interpretation: Channels where water flows continuously or periodically			
	Indicators		Applicability
1	NIF2018	Percentage sewage load treated in major rivers	measurable
2	UNSTAT	Nationally derived extend of rivers (square kilometres)	measurable
3	UNSTAT	Nationally derived quality of river(%)	measurable
4	UNSTAT	Nationally derived quantity of rivers (million of cubic metres per annum)	measurable
5	Business	Company water risk assessment - Number of company facilities per river basin exposed to water risks that could generate a substantive change in business, operations, revenue or expenditure and the proportion this represents of total operations company-wide- Country; River basin; Number of facilities exposed to water risk; Proportion of total operations company-wide (%)	Not measurable
	Questions		Comments
1	Rivers, size, water quality, BDI?		
AQUIFERS			
Normative interpretation: Underground zones that contain sufficient saturated permeable material to yield significant quantities of water to wells and springs			
	Indicators		Applicability
1	UNSTAT	Nationally derived quality of groundwater (%)	challenged needs expertise

2	UNSTAT	Nationally derived quantity of groundwater (millions of cubic metres per annum)	Not measurable
3	NIF2.0	Percentage of blocks/mandals/taluka over-exploited, (in percentage)	challenged needs expertise
4	NIF2018	Area under over-exploited blocks	challenged needs expertise
	Questions		Comments
1	Quality of groundwater?		
2	Overexploitation		
LAKES			
Normative interpretation: Depressions in the Earth's surface occupied by bodies of standing water; they also include small and shallow water bodies, such as ponds and lagoons			
	Indicators		
	Included in ecosystems		
	Questions		
1	Ponds eco systems, quality, size, BDI?		
ADDITIONAL INDICATORS ON SDG6.6			
	Indicators		
1	Business	Company water risk assessment - Companies w/exposure to water risks, either current and/or future, that could generate a substantive change in business, operations, revenue or expenditure	Not measurable
2	Business	Company water targets - Description of company-wide water targets (quantitative) or goals (qualitative) and progress to date- Watershed remediation and habitat restoration, ecosystem preservation Including: Motivation; Description; Progress	Not measurable
3	Business	Whether partnerships exist with third parties to protect or restore habitat areas distinct from where the organization has overseen and implemented restoration or protection measures.	measurable
4	Business	Total number and volume of significant spills	measurable
5	Business	Impacts of significant spills.	measurable
6	Business	The following additional information for each spill that was reported in the organization's financial statements: i. Location of spill; ii. Volume of spill; iii. Material of spill, categorized by: oil spills (soil or water surfaces), fuel spills (soil or water surfaces), spills of wastes (soil or water surfaces), spills of chemicals (mostly soil or water surfaces), and other (to be specified by the organization).	Not measurable
ADDITIONAL SUB TARGETS: PROTECT AND RESTORE SOIL LIFE, PROTECT AND RESTORE MEADOWS, REGENERATIVE HUMAN-USED LANDS			
	Questions		Comments
1	Do you practice organic agriculture?		Pastures size? BDI?
2	Examples of human habitats as nature habitats?		
3	How alive is the soil? What do you do to restore and protect it?		

SDG 6.A Cooperation: By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies.

EXPAND INTERNATIONAL COOPERATION			
Normative interpretation: Implies aid in the form of grants or loans from external support agencies			
	Indicators		Applicability
1	UN	Amount of water- and sanitation-related official development assistance that is part of a government coordinated spending plan	Not measurable
2	UNSTAT	Total official development assistance (gross disbursement) for water supply and sanitation, by recipient countries (millions of constant 2018 United States dollars)	Not measurable
3	NIF2018	Amount of water- and sanitation-related official development assistance that is part of a government-coordinated spending plan	Not measurable
	Additional Questions		
1	Financial assistance, participation in grants, collaborations in projects?		
CAPACITY BUILDING SUPPORT TO DEVELOPING COUNTRIES			
Normative interpretation: Implies strengthening the skills, competencies and abilities of people and communities, so that they can overcome the causes of their exclusion and suffering			
	Indicators		Applicabality
1	NIF2018	Number of MoU/Co operation agreements for capacity building and technology transfer	challenged needs expertise
	Questions		Comments
1	Knowledge sharing with organizations, institutes, individuals, governments?		Trainings on site?
			Knowledge sharing web based?
			Cooperation with universities, training institutes, Training for workers, volunteers
2	Technologies developed and shared on SDG6.1-6?		As knowledge transfer
3	How do you share your accumulated knowledge and experience on SDG6.1-6?		
IN WATER- AND SANITATION-RELATED ACTIVITIES AND PROGRAMMES, INCLUDING WATER HARVESTING, DESALINATION, WATER EFFICIENCY, WASTEWATER TREATMENT, RECYCLING AND REUSE TECHNOLOGIES"			
Normative interpretation: Practices, processes and technologies that support progress towards water- and sanitation-related targets; the monitoring of water and sanitation, including observation networks and databases for surface and groundwater, is also important			
	Indicators		
	None		
	Questions		Comments
1	Please list the financial assistances on the sub target		Trainings on site?
			Knowledge sharing web based?
			Cooperation with universities, training institutes, Training for workers, volunteers
2	Please list the knowledge transfer on the sub target		

SDG6.B Participation: Support and strengthen the participation of local communities in improving water and sanitation management.

SUPPORT AND STRENGTHEN THE PARTICIPATION OF			
Normative interpretation: Participation implies a mechanism by which individuals and communities can meaningfully contribute to decisions and directions on water and sanitation planning that affect or can be affected by them			
	Indicators		Applicability
1	NIF2018	Proportion of villages with Village Water & Sanitation Committee	challenged
2	UN	Proportion of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management	challenged
3	UNSTAT	Proportion of countries with clearly defined procedures in law or policy for participation by service users/communities in planning program in rural drinking-water supply	challenged
4	UNSTAT	Proportion of countries with clearly defined procedures in law or policy for participation by service users/communities in planning program in water resources planning and management	challenged
5	UNSTAT	Countries with procedures in law or policy for participation by service users/communities in planning program in rural drinking-water supply, by level of definition in procedures (10 = Clearly defined; 5 = Not clearly defined; 0 = NA)	challenged
6	UNSTAT	Countries with procedures in law or policy for participation by service users/communities in planning program in water resources planning and management, by level of definition in procedures (10 = Clearly defined; 5 = Not clearly defined; 0 = NA)	challenged
	Questions		Comments
1	Do you have administrative group on water?		
2	What documents do you have on water?		data collection and data sharing on water
3	Do you meter water?		how
4	How are water supply maintenance costs administered?		
5	Who covers cost?		: users, income generator, mixed
LOCAL COMMUNITIES			
Normative interpretation: Groups of interacting people living in a common location			
	Indicators		Applicability
1	UNSTAT	Proportion of countries with high level of users/communities participating in planning programs in rural drinking-water supply	Not measurable
2	UNSTAT	Proportion of countries with high level of users/communities participating in planning programs in water resources planning and management	Not measurable
3	UNSTAT	Countries with users/communities participating in planning programs in rural drinking-water supply, by level of participation (3 = High; 2 = Moderate; 1 = Low; 0 = NA)	Not measurable

4	UNSTAT	Countries with users/communities participating in planning programs in water resources planning and management, by level of participation (3 = High; 2 = Moderate; 1 = Low; 0 = NA)	Not measurable
	Questions		Comments
1	efforts for community participation?		Community programs
			How do you include and activate people for water governance?
			Nr of meetings, discussions on topic
2	Topic represented in local media?		
3	Topic in schools, etc?		awareness raising non-ending education?
IN IMPROVING WATER AND SANITATION MANAGEMENT			
Normative interpretation: Implies improving the management of all aspects of water and sanitation			
	Indicators		Applicability
1	NIF2018	Percentage of developed Irrigated Command Area brought under Water Users Association(WUAs)	Not measurable
2	New York	Sewer backup complaints received	measurable
3	New York	Sewer backup complaints resolved – Confirmed (on City infrastructure)	challenged
4	New York	Sewer backup complaints resolved – Unconfirmed (not on City infrastructure or unfounded)	challenged
5	New York	Sewer backup resolution time (hours)	challenged
6	New York	Street segments with confirmed sewer backup in the last 12 months (% of total segments)	challenged
7	New York	Street segments with recurring confirmed sewer backup in the last 12 months (% of total segments)	challenged
8	New York	The number of water main breaks	measurable
9	New York	The number of water main breaks per 100 miles of main during the last 12 months.	challenged
10	New York	Average time to restore water to customers after confirming breaks (hours)	measurable
11	New York	Broken and inoperative hydrants (%)	measurable
12	New York	Average time to repair or replace high-priority broken or inoperative hydrants (days)	measurable
13	New York	The total number of clogged catch basin complaints received during the reporting period.	measurable
14	New York	Catch basin backup resolution time (days)	measurable
15	New York	Catch basins surveyed/inspected (%) (cumulative) to identify those in need of cleaning, hooding and/or repair.	challenged
16	New York	Catch basins cleaned.	measurable
17	New York	The total number of catch basins cleaned as part of the Department's regularly scheduled cleaning and maintenance program.	measurable
18	New York	The total number of catch basins cleaned as a result of complaints from the public.	measurable
19	New York	Backlog of catch basin repairs (% of system)	challenged
20	New York	The total number of leak complaints received during the reporting period and the number received for each reporting category.	measurable

21	New York	Leak resolution time (days)	challenged
	Questions		Comments
1	What local practices empower the community members water aware practices?		
2	Labor tests? self reliance on water source? maintains bunds and channels? Shops that sell water positive products?		
3	What are the shared and what are the entitled responsibilities on water management?		
4	How do you co-create/share water responsibilities		conscious water use based on community values, caretaker responsibility/shared responsibility
ADDITIONAL SUB TARGET CULTURE/SPIRITUALITY			
	Questions		Comments
1	Water related cultural/spiritual practices?		

Annex 5. Interviewed experts/stakeholders, and surveyed communities in Auroville

Central/overall management and administration	Waste-wastewater management	Food and Farming	Forest/landscape restoration	Hygiene-Laboratory drinking water safety	Alternative architecture	Public engagement: Auroville, bioregion and beyond
Luca	Hervé	Priya,	Paul	Satyavidi	Manu	Mita
Gilles	Jesus	Krishna	Josh	Alok	Dharmesh	Guido
Toby	Jan	Angelika	Patrick	Igor	Eugen	Juergen P
Slava	Jean Francis	Thomas	Bern	Lucas	Michael	Kavit
Ole	Jhonny	Hendrik	Kireet	Jessaminj	Rene	AVAG
Sauro	Palani	Akash		Paula	David	Ram
Andrea	Lucas	Martina				Ing-Marie
Harini	Hari	Jasmin				Martin
Vinnay		Christian				Michael S
Palani A		Charlie				Giulio

HABITATS	Minimum people	Maximum people	Site size m^2	Built-up area m^2	Built-up %	Location on Masterplan
Citadines	56	56	10845.58	1225.69	11.3	Administrative
Courage	110	110	12504.79	2235.5	17.9	Residential
Djaima	35	35	72681.54	2917.39	4	outer
Human Scapes	34	34	9550.581	1978.28	20.7	Residential
Kriya	50	50	11290.73	1400	12.4	Residential
Mahalakshmi Assisted Living	20	25	205863.6	1372.23	0.7	Cultural
New Creation	80	180	30877.51	4499.28	14.6	outer
Sacred Groves	30	125	23148.02	816.2	35.3	Residential
Samasti	50	50	28408.93	2367.96	8.3	Green Belt
Sunship	70	70	3035.142	1388	45.7	Administrative
Swayam	50	75	8296.056	1218	14.7	Residential
avarage	53.2	73.6	37863.9	1947.1	16.9	
minimum	20	25	3035.142	816.2	0.7	
maximum	110	180	205863.6	4499.3	45.7	

FORESTS	Minimum people	Maximum people	Site size m2	Built-up area m2	Built-up %	Zone
Botanical Garden	30	70	202909.4	1366	0.7	Green Belt
Hermitage	9	9	253859.3	504	0.2	outer
Nilattangam	2	14	35005.31	476	1.4	Green Belt
Pitchandikulam Forest	25	45	262155.4	2113.39	0.8	Green Belt
Revelation	12	20	274336.4	934	0.3	Green Belt
Sidharta Forest	10	20	37878.58	414	1.1	Green Belt
Average	14.7	29.7	177690.7	967.9	0.8	

Minimum	2	9	35005.3	414	0.2	
Maximum	30	70	274336	2113.4	1.4	

FARMS	Minimum people	Maximum people	Site size m^2	Built-up area m^2	Built-up %	Master-Plan Zone
Annapurna Farm	20	50	662268.1	1218	0.2	outer
AuroGreen	12	12	122822.1	1536	1.3	Green Belt
Ayyarpadi	15	15	94575.03	445	4.7	International
Red Earth Riding School	14	40	47793.37	722	1.5	Outer
Windarra-TerraSoul	13	23	79561.2	1232	1.5	Green-Belt
Average	14.8	28.0	201404	1030.6	1.8	
Minimum	12	12	47793.4	445	0.2	
maximum	20	50	662268	1536	4.7	

Industrial complexes	Minimum people	Maximum people	Site size m^2	Built-up area m^2	Built-up %	Zone
AquaDyn	21	21	7405.7	1922	26	outer
Aureka	45	45	6879.7	1096	15.9	outer
Colors of Nature	80	80	15216	922	6.1	industrial
Eco-Femme-Sara-con	80	100	1821.1	458	25.1	industrial
Naturelmant	55	90	10239	1190	11.6	industrial
Svaram	45	120	4208.7	812	19.3	industrial
Sunlit Future	40	40	8336.5	786	9.4	industrial
Average	52.3	70.9	7729.5	1026.6	16.2	
Minimum	21	21	1821.1	458	6.1	
maximum	80	120	15216	1922	26	

Institutes/ Cultural centers	Minimum people	Maximum people	Site size m^2	Built-up area m^2	Built-up %	Zone
Aikiyam School	100	270	6839.187	1632	23.9	outer
Deepam School	45	45	15297.12	1625.6	10.6	outer
Language Lab	10	80	2711.394	1249	46	international
Last School	50	50	6223	1307	21	cultural
Library	30	80	4249.199	804	18.9	residential
Nandanam School	80	100	9671.987	1209	12.5	residential
Pitanga	25	300	8862.616	668	7.5	residential
Unity Pavilion	15	200	7284.342	1035	14.2	international
Youth Center/Manolo	6	500	53378.04	177	0.3	Green Belt
Average	40.1	180.6	12724.1	1078.5	17.2	
Minimum	6	45	2711.394	177	0.3	
Maximum	100	500	53378.04	1632	46	

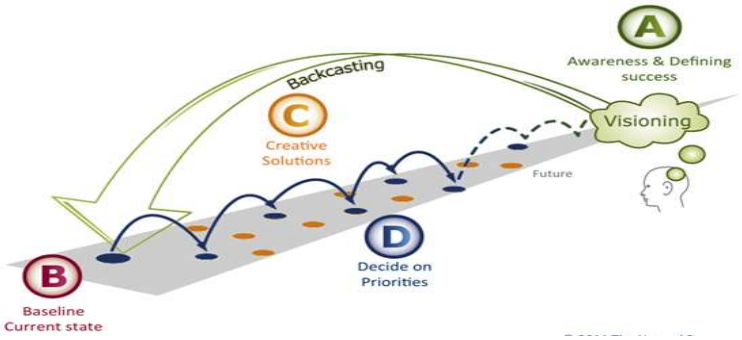
Service Complex	Minimum people	Maximum people	Site size m^2	Built-up area m^2	Built-up %	Zone
Aurolec	100	100	21044	825	3.9	outer

Auroville Health Center	50	100	3925.5	815	20.8	outer
Pour Tous	250	350	4249.2	1036.7	24.4	outer
SAIIER building	30	150	2266.2	672	29.7	administrative
Santé	25	100	2428.1	498	20.5	residential
SLI	30	100	4120	300	7.3	outer
Solar Kitchen	500	600	24362	3115.5	12.8	residential
Town Hall	200	450	3116.1	520	16.7	administrative
Transport Service	13	13	6570	712		Green Belt
Average	133.1	218.1	8009.0	943.8	17.0	
Minimum	13	13	2266.2	300	3.9	
maximum	500	600	24362	3115.5	29.7	

Guest facilities	Minimum people	Maximum people	Site size m^2	Built-up area m^2	Built-up %	Zone
Arka	30	60	12707.13	1707	13.4	Residential
International house	15	50	11398	950.25	8.3	International
Mitra	47	47	1618.743	535	33.1	Administrative
Quiet Healing Center	21	120	26326	2907	11.0	Outer
Tibetan Pavilion	6	30	7415.46	1283.5	17.3	International
Verite	30	100	37676.23	2431	6.4	Industrial
Visitors center	1000	8000	88261.94	3474	3.9	International
Average	164.1	1201.0	26486.2	1898.2	13.4	
Minimum	6	30	1618.743	535	3.9	
maximum	1000	8000	88261.94	3474	33.1	

Annex 6. Action Research, Localizing SDG6 workshops in Communities

The workshop had plenary and micro study groups sessions. As the number of participants was small, I formed 3 study groups in Nyim EC with 9 participants and 4 study groups in Auromag with 11 participants. I merged the eight SDG6 targets into combined study groups. This merging worked very well as the targets are interconnected and can be easily combined. I gave the study groups enough time to work. During the group-works, I was available to answer questions and to facilitate group dynamics.



III.2.5. A = Awareness: The aim is to settle for a common understanding, that is, to lay the groundwork before we begin to work together.

This part consisted of a presentation with the following main components.

1. Short introduction to the program of the day, tools and rhythm of the day.

2. Introduction to the Sustainable Development Goals

3. Introduction to the SDG6 in general, present world UN-Water reports, SDG6 in Auroville with the developed educational video presentation.

4. Short report on SDG6 in the researched ecovillage (based on the interviews and reports).

After the presentation, the participants reflected on the presentations, emerging questioned were discussed, additions and clarifications were made on the ecovillages SDG6 performance.

III.2.5. B = **Baseline:** An assessment of "today."

The participants broke into SDG6 target-specific study groups and made the SWOT analysis to their targets. The SWOT analysis was prepared on the upper part of the given large papers of the groups.

The groups presented their SWOT analysis on a plenary discussion. It was further discussed, and the others added comments, questions or debated the results. This way, the SWOT analyses were slightly reshaped and reformulated in the papers. I recorded the plenary session and later used the recording in the documentation.

III.2.5. C = Creative Solutions: Visioning and defining success level.

Situating: Section C took part in nature. Participants were invited to connect with nature, tune in to the water to sense how it wants to be present on the land and in the community. Participants quietly connected with the surrounding nature, drew inspiration from it, and were attuned to the presence of water. The participants remained silent, leaving room for quiet creation and the emergence of creative visions for the main part of this section.

Meditation*:* Water-tuned ayurvedic swinging chime meditation tools were used, and guided meditation emphasized water's significance. This meditation is similar to the Auroville developed meditation: (Auroville Water Vision 2021).

Artwork: A large table was set up with one A0 size paper sheet and many art tools: brushes, colored pencils, felt-tip pens, crayons and paints. The participants started to create their visions into separate

parts of the paper. Eventually, their creative visions artwork molded and blended into each other, and they enjoyed the co-creative space in silence. Once the creative artwork was finished, the participants shared their experiences and introduced their art in a few words. Their sharings were recorded and later noted down. See in Annex 5.

III.2.5. D= Decide on Priorities: Designing the steps to achieve the success level, setting and managing priorities, defining strategy, action, and tools level.

We returned into the room, reformulated the study groups and continued with the next steps of strategic planning. The study groups followed the Framework for Strategic Sustainable Development's remaining steps on the SWOT analysis paper. The groups defined the success level, priorities, strategies, and actions inspired by the artwork. I went around and helped with the group work.

The groups presented the filled-out tables on a plenary session. After the presentations, the participants further developed and polished the ideas arriving at a group consensus. All suggested and accepted changes were documented, and the final FSSD tables and strategies were created.

Framework for SDG6 Strategic Sustainable Development	
A	Awareness-The setting of common grounds.
System Level B	Baseline- How are the SDG6 targets currently implemented in the IC? SWOT
Success Level C	What is the acquired success level set by the community?
Strategy level D	What are the new or existing strategic guidelines that need to be developed to reach the success level?
Action level D	What steps, decisions, and actions need to be taken to achieve and maintain the specified success level? What will be the priorities, order and schedule?
Tools level D	What material, legal, knowledge-based, political, etc., tools are needed. How will the concepts be shaped and tracked? By what means can we prove (or not) that we are on the right track?

Annex 7. SDG6 Localizing workshop of Auromag Community

<table>
<tr><td colspan="5">AUROMAG, UN SDGs 6.1, 6.2 and aspects of 6.4 in relation to 6.1and 6.2
Group 1with 3 members: Domestic water consumption (drinking water, washing and sanitation) and related water efficiency, ie relevant elements of</td></tr>
<tr><td colspan="5">Goal 6.1: There are 3 drinking water springs near our place, 1.5 km away is a public well, 2.5 km away is a public drinking well with medicinal water at a spa and 8 km away is an Ártesi drinking well spring. In addition, we have members who live in the settlement 3-4 km away and have a public water supply in their home, ie they have available drinking water. Goal 6.2: We already use compost toilets in the area for sanitation, and the interviewed members of the community have a willingness to use compost toilets in the future, although there are those who are worried about winter use as they have unheated toilets outside. Those who currently live outside or who plan to move out in the next 3 years are willing to solve the washing method with a bucket-tubing method on a temporary basis and discharge the resulting water, which contains little and no harmful chemicals, directly into the environment. We have members who would like to move out but want warm running water within the household. In order to design and maintain these systems, however, it is necessary for those who manage and maintain the structures to live on site, even in winter. Currently, we can use the water from the Camomile's well. There is a thermal public bath 2.5 km from the area, which is open in winter and summer and offers discounted admission after 5 p.m. The proximity of this was a consideration when choosing the area, because we know from experience that it is a good option for bathing. Washing is currently carried out at an external location, there would be a need for on-site washing, but as there is no power source in the area, this is temporarily not possible, because the power source must have a permanent presence on site so that solar panels are not stolen. Goal 6.4: Plan to reuse domestic water for irrigation, with only gray wastewater generated using compost water. Sawdust can be used for washing dishes, which is available to us in infinite quantities for transport costs through one of our members.</td></tr>
<tr><td>I, Zs, Zs</td><td>Strength</td><td>Weakness</td><td>Opportunities</td><td>Threaths</td></tr>
<tr><td>Basis, System Level</td><td>➢ community, ie we can agree together to either carry the water or, if we develop something, to do it in agreement and cooperation</td><td>➢ financial constraints, ie what we can afford, such as a well drilling, and if there will already be a drilled well, how much can we take advantage of because either there will be a suitable power source or not,
➢ and the question of what kind of power source we will be able to provide and thus we have returned to the financial resources</td><td>➢ Chamomile's well. It would be good to know how the well and its water are used by current users, how efficiently and how the bathing-water is used for irrigation
➢ Rainwater can also be collected and used
➢ and that the water we use for washing, bathing and washing dishes should be chemically free.
➢ and the cultivated areas are further cultivated without chemicals</td><td>➢ chemicalization of the lands around us in the form of fertilizers or spraying,
➢ Obtaining permits can be an external difficulty eg if you want to drill a well, or if you want to introduce electricity or if you want to set up a larger water tank, it is all subject to a permit.¬</td></tr>
<tr><td>Purpose-Success level (GOAL-TARGET)</td><td colspan="4">➢ have sufficient drinking water available locally</td></tr>
<tr><td>What is needed to achieve the GOAL? Strategy Level,</td><td colspan="4">➢ storage, cleaning equipment and source
➢ collection tools / catchment surface from which we collect
➢ Water transport equipment: water supply</td></tr>
<tr><td>Steps, Tools, Decisions Action Level,</td><td colspan="4">➢ Design
➢ study of how much drinking water and bathing-cleaning water a household uses,
➢ alternatives should be examined throughout, what are the possibilities, quantitatively what are the advantages, disadvantages and costs associated with it, needs assessment
➢ decisions, implementation
➢ Funds, work, water resources
➢ prioritization, what comes after what results</td></tr>
<tr><td>Priorities Order schedule Tools Level</td><td colspan="4">➢ Where does the water come from, how do we collect it, how do we store it, how do we take it here
➢ needs assessment,
➢ with our current resources we can collect bathing or sink water,
➢ but we will not be able to produce water suitable for drinking water without danger for a long time, and we may not be in need of it, we actually want to produce drinking water ourselves, a very large energy investment, we can supply it relatively easily from a public well one and a half kilometres away.
➢ At the community building to be built, we should solve the problem of collecting the rainwater generated there
➢ Bucket bathing place shower between the trees, to the construction camp, which we want in the summer, close to a water source an outdoor washing place should be found in front of the construction camp… e.g. create a team to create space,
➢ We already have a compost toilet outside</td></tr>
<tr><td colspan="5">INDICATORS? MONITORING? FOLLOW-UP? I’ve heard it many times to have studies, so let’s somehow keep track of what we envisioned coming true. At the end of construction seasons, we can evaluate and then adapt our plans and then we can learn from that for the next season</td></tr>
</table>

AUROMAG: UN SDG **6.3** and **6.4** aspects in relation to 6.3
Group 2, 3 members: Wastewater treatment and related water efficiency, ie relevant elements of UN SDG 6.3 and 6.4

There is an openness and curiosity in the community to restrict chemicals or use only biodegradable chemicals to keep groundwater resources as clean as possible and to use wastewater for irrigation after as little treatment as possible. By using a compost toilet, we have the opportunity to use less expensive wastewater treatment methods. The design of the root zone wastewater treatment system came up as an idea from others.

V, I, K	Strength	Weakness	Opportunities	Threats
Basis, System Level	➢ There is a willingness in the community to lead a chemical-free lifestyle ➢ We already have a large area, which gives us the opportunity for a lot of things	➢ Commitment and perseverance are needed for proper use, as the chemical-free lifestyle is not easy, there are challenges in this, and compost toilet is a challenging method compared to flush toilets ➢ Sandy soil may not be suitable for root zone treatment method cleaning	➢ compost toilet end product can be used for soil improvement ➢ Gray water can be used for direct watering ➢ or design of a root zone cleaning system ➢ we can get straw from the farmers in the area, J can get sawdust ➢ We know experts from whom we can ask for help	➢ the root zone cleaning system is subject to a permit, it is not easy to design it on the basis of private DIY unauthorized way, but officially it is even more difficult to meet all expectations and regulations ➢ Improperly designed and used system ➢ There is a risk of infection or disease
Purpose-Success level (GOAL-TARGET)	➢ recycling, returning wastewater to nature ➢ water "polluted" with environmentally friendly cleaning agents, ie the water should be so polluted that it can be used without harm, eg for watering, so polluted that it is not suitable for drinking or human consumption, but can still be used for watering in the garden ➢ isolation gray sewage but the faeces are emptied into a separate compost toilet, there will be no black sewage (compost toilet)			
What is needed to achieve the GOAL? Strategy Level,	➢ professional design of a compost toilet, our members and guests will use the compost toilet, the contents of the compost toilet were emptied and covered with straw in the forest at the Gyüttment festival, in the agricultural field if we want to use it for food crops, we need a thick straw bed, then the placement after that we do not apply new doses continuously, but let it decompose for 3 years, after which it can be used for fertilization into soil. It would also be good to work out what tools we use to clean the litter because there was a rolling bin at the collection festival and a raised litter. Our composttoilet has not been cleaned yet because we have not yet reached a level of use that should have been cleaned, but it may happen during the construction camp. So we also need to look for some place and method so that we can empty the compost material. ➢ Gray wastewater treatment system that requires electricity ➢ Site selection for wastewater treatment ➢ Study of alternatives from wastewater systems, can be individual or community wastewater treatment systems			
Steps, Tools, Decisions Action Level,	➢ needs assessment ➢ Space for further decomposition time ➢ There will be only 3 new households in 3 years, in which the tub washing may remain and there will be no need to treat wastewater, while we know that in 3 years the next development will be able to meet the needs of 10-20 households.			
Priorities Order schedule Tools Level	➢ Designation of location - for Compost toilets emptying ➢ Coordinators and time interval, and it is his job to describe if the task has been done and also if not so that we know that the task still needs help ➢ Deadlines ➢ Reports, feedback regularly			
Monitoring?				

AUROMAG: UN SDG **6.6**, and related aspects of **6.4** and **6.5**
Group 3: (3 members) water-related ecosystems, the maintenance of our freshwater resources and the achievement of associated water efficiency, ie the relevant elements of UN SDG 6.5, 6.6 and 6.4, Groundwater resources and protection of ecosystems

Short and long-term goals, pairing S-O
With the rainwater catchment, we will be able to produce domestic water, which can be used for irrigation.
In agriculture, we use other methods instead of watering due to lack of water. There are many arable lands in our area, the soil quality of which is very poor, so also its water retention capacity. Soil improvement experiments carried out in the past year (short-term goal) show good results, soil quality on thickly mulched surfaces has improved, soil moisture and nutrient content have increased significantly. Some plants grow well while others do not, and this is not appropriate for a varied diet. Therefore, the plants grown here have a hobby value for the time being, we cannot solve our meal from the food grown here, but in case of a disaster we will be able to survive, for example, from the plant grown here. By mulching and plant selection, we can achieve that we turn the place into a production area and, despite the lack of water, we can produce with minimal or no

watering. In order to improve the quality of the soil and its good water retention capacity, it would be useful to think about grazing, our area may be suitable for this.
Long-term goal: With Landscaping, we will try to achieve an increased humidity, for which it is possible to plant trees. The large forests in the immediate vicinity of the area and the groups of trees and strips in the area are likely to have a positive effect on the landscape and water supply, although the groundwater is very deep at about 40 meters, it is feared that if these forests are cut down, the groundwater will be even deeper, and will cost more to access it.
Long-term goal: A pond could be created in a recess in the landscape, these areas are for sale, but we don't currently have the money to buy them. There is a specialist in Austria who deals with landscaping that can be used to create lakes, such as Tamera.

J, A, E,	Strength	Weakness	Opportunities	Threats
Basis, System Level	➢ there is annual rainfall therefore it is worth thinking about freshwater resources and aquatic ecosystem, which is not obvious at first sight of the area ➢ we have a non-flat area, so we can create a reservoir in the valley or depression, or we can find on historical maps where there was a swamp or wetland ➢ strength of community	➢ soil is sandy therefore not easy to implement even a pond ➢ available financial and manpower resources are limited	➢ tree planting, soil protection ➢ ground covers and mulching in some parts, which we hope will keep more water in the area ➢ lake design ➢ Writing applications maybe there are grants that help to create an aquatic ecosystem ➢ It is possible that from the road section washed away by rain, where for some reason water used to stand for weeks after the rain, we can drain the water to our area with a drainage ditch from one of the dirt roads near our area after	➢ Deforestation of adjacent forests will worsen our current water situation. If we can do anything about it, it would be good, because unfortunately full logging is widespread in the area, ie we will not see a forest on our border for 20 years, but in a good case they will want to use seedlings or something else, eg Samsung development in our area. 30 ha of forest have already been cut and 24 more will be cut down, which is unfortunately not only a hypothetical threat ➢ water retention from our neighbors, somewhere not far from us there is a stream along which someone who bought a plot started to use the stream water, so its water flow decreased, if we use and retain water from this stream we can get into conflict with those below us, ➢ limited resources: time, money, examples in other communities we see that they come up with something that hoped to be an ideal solution to a problem, and if it doesn't work the way it should, the community may not have the energy, resources, commitment to fix it and operate it as it really should ➢ In the case of lake construction, there is a danger that the ideal area for the lake is not yet fully in our possession and that we cannot simply obtain a lake construction permit, but is officially subject to a permit which can only be applied for 5 years after ownership of the land. ➢ The weather is changing and there are heavy and intense rains that can wash away the soil, there is a dirt road 200 m from our area that has been washed away by the rain
Purpose-Success level (GOAL-TARGET)	➢ prevention of deforestation, the forest area belongs to three municipalities ➢ planting trees in our own area mainly along the forests, because if the forests are cut down, the shock effect should not be so great, by then the trees we have planted ourselves should also grow, ➢ Establishment of a pond system and associated wetlands (bogs, swamps), mosquitoes and bats and swallows ➢ soil protection			
What is needed to achieve the GOAL? Strategy Level,	➢ Information: forest plan, contact: manager, owner, negotiate with local forest holdings to find out when they are planned and in what form their management eg full cutting or thread cutting or thinning, it is worth checking what is in the areas, forest plans are laid down in rules and approved by the authority , but you may be asked to keep the trees in at least one lane at the border of our area. It would be good to know how many years according to the forest plan the trees in our area will be cut down. ➢ nursery (water, soil fertilizer), seedling, good quality soil ➢ STRATEGY ➢ location, size ?? ➢ soil cover, cover plant: In autumn, a minimum of 2600m2 of contiguous area need to be planted with one type of groundcover, due to the support, it can be at the forest garden and the apple tree, alfalfa would be the most suitable because it remains for several years			
Steps, Tools, Decisions Action Level,	➢ water, soil manure ➢ designation of suitable periods for tree planting + tree planting STRATEGY how much tree we want to transplant in how much time, what kind of tree, why and where, and what tools, work and money it requires ➢ pond experiment in a small area to be thrown now, clay that is not in the area, or with large stones, should be unloaded, its location should be formed, possibly around the garden shower, so that the water used for washing immediately flows into the pond to replenish the water			

	➢ additional land purchase for the construction of the lake, here is the 5-year wait before the exception, and the location of the lake will have to be taken out,
Priorities Order schedule Tools Level	➢ we have 50 large straw bales in our area, 2 bales have been used to cover 100 m2, and in 2 months we could put it on again, ➢ the bales that are there will be used up and we will settle accounts with Zsuzsi ➢ Can we bring more raw material for mulching next to the bath and from the Nest ➢ or are we afraid of spreading snails to our area? ➢ Groundcover financing who pays and works with it, individual or community?
Monitoring?	
Additional workshop material to SDG6.6:	

GOALS related to SDG 6.6	Protection of the existing forests next to our lands	Reforestation on our lands:	Pond and wetland system creation	Water retention with soil protection
Success:	Preservation of forest areas - continuous forest cover	Creating well functioning forest gardens on our lands.	Well functioning ponds and wetlands on our area	Ideal operation of cultivated areas in terms of water retention
Strategy:	1.Getting to know forest management plans (1 year plan) a. Who are the forest owners? b. Who are the forest managers? c. When are the forests planned to be used? d. In what form are the forest planned to be used? 2.Impact on forest management, fort owners: (5 years plan) use as gently as possible there should be no cut keep at least a buffer zone at the boundary of the area b. reinforce social activities and usage hiking sports forest school, forest kindergarten forest garden 3. Contribute to the survival and utilization of the surrounding forest. (10 years plan)	1.Operation of a tree nursery *(1 year plan)* 2.Planning and creation of Forest Gardens, planting trees from nursery or elsewhere *(5 years plan)* 3.Operation of the Forest Graden *(10 years plan)*	1. Pond experiment on small scale in the designated land *(1 year plan)* 2. Pond creation *(5 years plan)* 3.Pond and wetlands system *(10 years plan)*	1. Covering hemp land (1 year plan) 2. Ensuring permanent vegetation cover in all cultivated areas (5 years plan)
Action:	1. establishing a relationship with the forest manager and owner, describing our goals, using forest land 2. precise formulation of our goals and possibilities: messages and offers to the forest owner, forest manager	1. Clarification and designation of the size and location of the nursery 2. Care of nursery seedlings, 3. Identification of tree species intended for planting 4. Purchase new seedlings 5. Planting seedlings in the nursery 6. Designing forest gardens, 7. Designation of suitable periods for tree planting + tree planting STRATEGY how much tree we want to transplant in how much time, what kind of tree, why and where, and what tools, work and money it requires 8. Planting trees from the nursery	1. Mark the location of the pond experiment 2. Determination of lake test bed material (lake foil, clay) 3. Establishment and filling of an experimental pond with water 4. Locating ponds 5. Purchase of necessary land 6. Study of regulations related to the design of lakes 7. Planning the location and design of the lakes with the involvement of landscape architects 8. Design of lakes 9. Monitoring the condition of lakes 10. Necessary maintenance and monitoring of lakes	1. Spreading straw bales on hemp soil 2. Mulching all cultivated areas 3. Planting of alfalfa or other groundcover on at least 2600 square meters,

		9. Caring for the trees planted in their place, monitoring their condition		
Tools:	1. community knowledge, connection skills, 2. Establishment of forest group with monthly meetings	1. Work equipment on site 2. Contact with forestry, horticulture, nurseries 3. Forest garden topic inclusion regularly in the programs of monthly meetings	1. Carrying out a lake experiment in the framework of the construction camp 2. Include the location of lakes on the agenda of the Earth group 3. Preparation of a lake design project plan 4. Tender monitoring	1. Straw bales in the area 2.Mulch base material at the Bath and Nest 3. Agricultural group

AUROMAG: UN SDG **6.5, 6.a, 6.b**

Group 4: cross-border co-operation, water governance, and opportunities for grant applications, ie relevant elements of UN SDG 6.5, 6a and 6bWater governance-Development of water cooperation across territorial boundaries, tenders, grants, underdeveloped

There are large municipal lands in our area that are not cared for. It would be worthwhile, in cooperation with local governments, to develop programs that contribute to the protection and sustainable development of the area. For example, by setting up a social farm or a sensitizing and awareness camp that our members would be happy to deal with.

In the future, it would be useful to pass on the ideas we have developed to others in the form of a collection of good practices, and to do so by applying for and supporting less developed places, and seeking application and expertise grants based on our own underdevelopment.

There is willingness in the community to cooperate and develop policies, but there is no experience yet. The Kamillóék well in our area, which is the only local water source and its communal use has not yet been settled, we do not currently pay any contribution for the use of the well, although well drilling was very expensive and water flow was limited. Households strive for efficient water use and have a willingness to formulate basic guidelines, e.g., that the chemicals and soaps used in the area be environmentally friendly or that we use compost toilet, but no guidelines have been described yet. The community is made up of very different people with different lifestyles and water footprints, which can make it difficult to shape community water use. The community building is under development, where there will be a rainwater catchment and possibly a common well.

N,B	Strength	Weakness	Opportunities	Threats
Basis, System Level	➢ good team ➢ Chamomile are collaborators and they have a well that can be used temporarily while we need little water ➢ There is a possibility for individual solutions even for water systems that are independent of each household, because not everyone lives the same way of life, they need the same amount of water consumption ➢ The own plots located mosaically in the larger unused area allow us to build a well, a rainwater catchment lake, relying on the larger catchment area.	➢ within the larger area the owned plot is small and mosaic like situated among other unused lands, if we develop eg a well or a lake then can we go through it if the land between it is not ours? or if we expect a larger catchment area that is not ours then the neighbours can pollute the water ➢ missing guidelines eg for the use of chamomile well, how much we can use, when, we do not have rules eg for the use of chemicals, etc. ➢ We have no legal power and are unlikely to enforce the rules ➢ tension can arise from the joint use of water by following the rules, eg to decide who can wash how many times the difference is quite large for children and non-children family needs	➢ the missing area is not in use and for sale ➢ there are grants for eg watering development for farmers	➢ Well drilling is regulated and subject to a permit ➢ legal systems authorities ➢ Due to fragmentation, it is difficult to comply with the invented rules, eg with regard to the use of chemicals with potential new landowners in the areas between our territories. ➢ new members
Purpose-Success level (GOAL-TARGET)	➢ Establish clear guidelines that we can tell new entrants before joining, eg that we have agreed to use a composting toilet for water protection, and if you are unable to use a composting toilet for some health reasons, we will first talk about what new lifestyles we can accommodate in our community and what alternative technology solutions we can adopt. ➢ detergents, chemicals, water consumption discussion ➢ developing collaborations with our neighbours			

What is needed to achieve the GOAL? Strategy Level,	➢ working group who develops the guidelines we mentioned ➢ Involvement of external experts and collection of info and experience ➢ Gathering experience so far, eg how to use the Camomile's well according to last year's example, how much water can be used without drying the well, how much the pump costs, or based on the water contribution fee per cubic meter, which includes the equipment depreciation. ➢ If a device that is owned by Chamomile, but also serves us, breaks down, how do we agree on the cost of repairing it. It depends on the rain how much water is in the well and now we don't know what the water level is. We don't know how much water there is and how much of it we can use.
Steps, Tools, Decisions Action Level,	➢ in the well water level measurement (water level meter) should be done or a device for this to do while the pump is running then we could monitor how much the water level drops and then we could continuously monitor the water and regulate the water abstraction accordingly. ➢ experience has shown that the water flow of the well is 0.5 m^3 per day, so far it has not been that the well has been pumped too much, but it is so that the water was cloudy, which indicated that it was very upset because the water level was very low. ➢ We discuss that the outsourced water tanks will be filled from the well by the Chamomile as much as possible, and everyone uses the water from it by paying attention to the amount consumed as we experience it. ➢ the solar water pump is not suitable because the well is too deep, now the pumping is only with a gasoline engine generator ➢ there should be a water storage device for the winter where water can be stored even in the winter, in which the water does not freeze. ➢ The well is 42 meters deep ➢ if a new well is drilled, they should not be close to each other, but at a distance of at least 150 meters, so that the two wells do not draw water from each other ➢ Kamiék has a well drilling rig that could be used to drill another well, he was stuck at a depth of 15 meters due to gravel, we might have to ask permission before drilling the well ➢ develop guidelines on how to contribute to the operation and repair of machinery that is privately owned but also in public and private use
Priorities Order schedule Tools Level	➢ How much is the contribution of chamomile to water? ➢ Try the water drill: • learn to use it so that we know when the water has been reached, it can be about 40-60 meters deep, the device can be drilled to 25 m, but it can be longer. • water is needed for drilling and it would need at least storage equipment (25m3 if not recycled in principle 3m3 if there is a recirculation system but it needs a bronze vane pump which is not owned or rented by members of our community?) • determination of the location for the drilling experiment, which is at a sufficient distance from the existing well and close to the new construction sites • acquisition of an underground water map • radiesynthesis together
Monitoring?	

Auromag Creative Visioning reflections

„What is most important to me overall is that we use water in harmony with and in conjunction with the plants and the environment. Eg the bathing place is among the trees, a natural lake where you can also bathe. And let it be one unity with the plants we eat, let our actions be united, and the wholebe in a cooperating unity. And when I imagined how good it would be to paint clouds here, someone started painting waves here and then I was so happy about how good it will be here with a little sky addition. ”

„I was greatly influenced by the meditation and I couldn't really separate what water meant to me and what memories I had attached to it. I experienced very strong emotions during meditation and I have more of a picture about it. How far back they are, from the dinosaurs, how much water there is in us and around us. So we are also part of it and our sending part and how this reality will relate to our village. So in the picture, what I depicted are the past, present, future, and my feelings that were during the meditation..”

„I was trying to draw a cloud here that became a lake, this is the strength of the community. But I think I'm drawing a cloud here now. Here I draw as the water falls from the cloud and goes into the lake. It would be good if we could attract clouds and rain here with a common meditation."

„I also drew a lake with an island and thank the others for working on the lake. Along the lake, I have already painted such crops in which the spirals are vertical windmills that may also generate electricity, but I imagine them to bring beauty to the space. We have a friend who makes these, beautiful shapes, tulips and lotus flowers rotating on a standing shaft. And these will not only be able to cause pleasure visually, but with this rotation, and even now I have quickly drawn a spiral in the opposite direction, that there are two directions, the female and the male, and that they dynamize and energize this space."

„I connected to the lake and tried to gather this on the one hand, so that even then there would be a small swamp next to it. I have tried to populate that this water will not only be good for us, but we will have many many and large strong trees from it. We attract all kinds of animals, which should be a very important wetland from a nature conservation point of view. I tried to draw a turtle, water bugs, chick beetles, ducks, fish and even a frog here, oh and a water snake that I couldn't miss of course. And it will all live with us there."

„I saw a picture of a fetus, and I saw that circulation in that picture, and I felt like I would rather put a big patch of red in the middle of the whole picture, but then I tried to reinterpret that. Well, a lot can be deduced from this circulation, because there you can control the system with man and mind. And it's all in a circle. And next to that, I even drew flowers."

„My plan was to connect the separate lakes, because I looked at this here as a lake, and this one, I connected it. I even had plans to make further improvements here to connect this third with the big lake to the small lake and the medium lake. But to make it possible to travel anyway without an obstacle I drew a bridge here. It was one of my activities, and the other was that this waterman, I tried to emphasize that at the heart of all this wateris this waterjuggler who makes it all happen."

"I drew a life-giving sun and sunbeam. I really like to see the water drops on the leaves after the rain and I just highlighted it. And so I bathed in the lake, a natural lake, and looked around me at what you had already drawn. So that's all we're in. "

„I was distracted by the flowers in the silence and I couldn't break away from it. Because here I noticed that there is a small stream and I put flowers on its bank and I can't rationalize that."

„I didn't draw, but if I could imagine something I would imagine a waterfall. Not too big, but a little water movement. There is a water well here. I saw the lake as a slippery animal, and this cloud for me from a Japanese cartoon called Chihiro is the dragon for me. It's a celestial laurel and it's a slipper, and it's a minotaur."

„It was here that I started to remove the cat footprints on the paper, but as I started to draw around I felt like I didn't have to remove them, so that's part of it all, too. You only need a little water and they are already transformed. It's almost like a turtle to me."