Regen-D

REGENERATIVE DESIGN

REGEN-D **no.1**

Water management systems at Shikha Ecovillage

Sibaji Panda
Santanu Panda
Ulrike Zeshan

ISHARA PRESS

The Regen-D Series

The mission of the Regen-D games is to promote in new ways the voice of those working in the field of sustainability and regeneration. Regen-D stands for “regenerative design”, and publications in the series include fully implemented initiatives, work in progress, and design proposals. We understand regeneration as going a step further compared with sustainability - not only to make sure that future generations and the natural world can be sustained, but to actively repair the damage that has already been done while cultivating new relationships with nature and society. Moreover, we understand sustainability and regeneration in a broad sense. Therefore, this includes not only environmental issues but also social innovations, technological developments, arts and human creativity, tools and techniques for individual reflection, and systems-thinking.

Regen-D publications are bi- or multilingual in English and in at least one language of the local context. All games are printable/downloadable free of cost for self-assembling. Games in hardcopy can be ordered from Ishara Press CIC at https://ishara.uk. All Regen-D publications are peer reviewed by the editorial board.

Go to the Appendix for printing / downloading the game materials.

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1. Introduction

This book, together with the game that forms part of it, tells an important part of the story of Shikha Ecovillage in rural eastern India. The chosen focus of the story is water management. There are two reasons for this: firstly, in times of worsening climate change the use of freshwater is a major challenge, in India as well as in other parts of the world. Secondly, the story of water management is naturally interwoven with all the main activities at the ecovillage. Through this topic, the reader and player can get an overall idea of what life is like at Shikha. We hope that this will give valuable insights into our local area and generate further interest.

There is a particularly strong link between water, energy and food. This is sometimes called the "water-energy-food nexus". At Shikha Ecovillage, we see these relationships play out in a real-life example: we use electricity from solar panels to pump water and distribute it for both domestic and agricultural use. The food we grow for our community depends on good management of the available water, and on understanding the impact of the dry season and the monsoon season. This Regen-D game points out both the strengths and the vulnerabilities of our water management in this context.

Part of the content of this book is the result of research (see the reference to research and development projects in the acknowledgements). However, this book is not an academic research paper. Instead, through the game format we want to present the story of how we experimented with water management and developed it on our sites in a way that is not merely an abstract intellectual summary. We have integrated well-researched detail with multimodal content to give the players a tangible experience. Compiling and organising the multimedia materials has taken as much effort as writing the book, if not more. These materials are central to the documentation of our case study and not a supplementary add-on.

This book is an accompaniment to the Regen-D game and is intended to be used alongside playing the game. It is quite possible to play the game on its own, in hardcopy or by printing/downloading the materials in the appendix, without reading the book. However, some important perspectives are offered in the book that enrich the experience of the game. These are as follows:

- The context of Shikha Ecovillage and the details of its water management systems are set out coherently in Section 2 and Section 6. The game process introduces components of the water management systems in a random order, for players to discuss and make sense of actively. Reading everything again in a more systematic order is valuable to consolidate understanding.

- ➔ Facilitators who lead the game process with a group of players may want to read the book beforehand as preparation, but for everyone else it makes more sense to read these sections after playing the game.

- The concept and technical details of the game are set out in Sections 3, 4 and 5. Section 3 gives a summary of the game concept, explaining the background of Regen-D, how it is played, who the game is meant for and why people might want to play it. Sections 4 and 5 set out the game components and game rules in more detail. This is useful when self-assembling the game, and for additional clarity beyond the summary of game rules on the Rules Card.
    - ➔ Again, this is particularly useful for facilitators or teachers who want to use the game with groups. For people who have already played other Regen-D games published in this series, these sections may not be necessary.
- We provide some links for further information at the end of the book for those who want to go a little deeper into the topic. All links are openly accessible online free of cost. The sub-topics covered are: sustainability and regeneration, Serious Games, Living Labs, water management issues in India, the water-food-energy nexus, and Shikha Ecovillage. Links includes both scholarly materials and resources aimed at the general public.

The story of Shikha Ecovillage is a case study in regenerative design and practices. We understand sustainability broadly as involving practices that meet present needs while safeguarding resources and the natural environment for future generations, as, for instance, defined in the UN's Sustainable Development Goals. Literally, we aim to act so that what we are doing can be sustained in the long term. However, regeneration goes further than sustainability because we recognise that much damage has already been done to the natural world (as well as to society), and this has been accelerating over past decades. Therefore, regeneration seeks to repair past damage, add value to natural and built environments, and establish new relationships with nature and between people that are not exploitative. In fact, the shift from an extractive to a regenerative mindset is crucial here, and this book aims to contribute to such a shift.

In line with this aim of regeneration, Shikha Ecovillage was built from scratch on a piece of disused land with poor soil, where mostly shrubs and a few non-native eucalyptus trees were growing. Six years later, the site has transformed into a lush green space, and water from the nearby river has played a major role in this transformation. Figure 2 shows a view of part of the original site (top picture), and what the same place looks like now (bottom picture).

Figure 1. View of Shikha Ecovillage in 2017 (top) and in 2023 (bottom).

Shikha Ecovillage is located in an area where few people are fluent in English. It is important to us that its story can be understood through the local language. Therefore, the game materials in the appendix are listed twice, once in English and once in Sambalpuri/Odia. Use of both languages is as follows:

- Annotated pictures or diagrams have a separate version in both languages.
- In the English version, videos where Sambalpuri is spoken have subtitles in English.
- In the Sambalpuri/Odia version, non-speech videos with English subtitles have voice-over in Sambalpuri.
- In the Sambalpuri/Odia version, a few files are bilingual in English and Odia.

At the time of publication of this book, a full translation of the book into Odia is in progress.

2. Portrait of Shikha Ecovillage

Shikha Ecovillage is located in the western part of the Indian state of Odisha (previously spelled Orissa). The ecovillage consists of two 5-acre sites. The main site lies on the bank of the Mahanadi river, which is one of the largest rivers in India (Figure 2). On the other side of the river, a 15-minute drive away there is a secondary site called Bhoomi, which is used for experiments with agroecological practices.

The town nearest to the ecovillage is Binika in the district of Sonepur (officially renamed Subarnapur), just across the bridge. Shikha Ecovillage lies in the adjoining district of Ulunda. The closest larger city is Sambalpur, which can be reached by car in just under an hour (see the map in Figure 3).

Approximately 50km upstream from Shikha lies the Hirakud Dam. The Hirakud Resevoir is among the largest freshwater bodies in Odisha, and the dam is used for hydropower generation as well as large-scale irrigation. Release of water from the dam has a direct impact on the water level of the Mahanadi river at the Shikha main site. During the monsoon in particular, the water level can rise by several metres if excess water from heavy monsoon rains is released from the dam. At times the opposite riverbank floods but Shikha has not been affected by flooding because the riverbank is higher on its side of the river. Conversely, if most of the water is being held back at the dam in the dry season, this results in very low water levels downstream at Shikha.

Figure 2. The main site of Shikha Ecovillage (2023).

Figure 3. Map of Shikha Ecovillage (top) and map of the local area (bottom).

The main Shikha site has been planned as an eco-learning village. It includes a residential primary school for deaf children along with teaching and non-teaching school staff, and a group of farmers and farm workers. The unusual combination of a deaf school with farming is due to the ecovillage's founder Sibaji Panda (see author profile at the end of the book), who is a deaf academic with international experience but comes from a local farming family.

As of 2023, Shikha Ecovillage has about 60 residents on its main campus site, most of them connected with the Happy Hands School for the Deaf, which is a fully residential boarding school. Accommodation for visitors such as eco-volunteers and visiting experts is under construction, and a second hostel for the school is being built. With completion of both building projects, the ecovillage will grow, and within the next 3 years, we expect to house around 120 residents. In addition to the residential and school buildings, the Shikha campus is home to fruit orchards and vegetable plantations, with a complex irrigation and water management system.

The secondary site Bhoomi is used for horticulture and rice paddy. For managing the water supply there is a well, connected to irrigation and drainage trenches, and a canal flowing along the border of the site. The secondary site has a small house for farmworkers to occupy temporarily when work is going on at the site, but otherwise has no residents.

All agricultural activities are completely chemical-free on both sites. Likewise, both sites are off-grid and are powered entirely by solar energy. The main site uses ca. 25 solar panels with total capacity of 4600 kwp, while the secondary site only has a few solar panels.

Shikha Ecovillage is situated in a tropical climate, with monsoon rains between late June and early August (although with climate change, the monsoon rains are becoming less regular). The rest of the year, the weather is dry and there may be no rain for several months at a time. Nevertheless, the surrounding area supports substantial year-round vegetation, and the nearby hills have a lot of forest cover. Rice paddy fields are the dominant crop in the area. Where fields have irrigation, rice is harvested twice a year; otherwise, there is only one yearly harvest.

Both Ulunda and Sonepur are predominantly rural districts, and agriculture is the dominant economic activity. The local language is Sambalpuri, which is spoken by about 18 million people in a large area across western districts of Odisha. Sambalpuri is closely related to Odia, the state language of Odisha. The standard variety of Odia is predominant in the eastern parts of the state. Sambalpuri largely exists as a spoken

variety, although some literature is available, and its contexts of use are mostly informal. For written and formal contexts, it is more common to use Odia.[1]

Shikha Ecovillage is a multilingual and multicultural place. Indian Sign Language and English (in its written form) are used in the school. Otherwise, the dominant spoken languages on the ecovillage campus and in the local area are Sambalpuri and, to a lesser extent, Hindi (which is understood more commonly than spoken). Standard Odia is universally present in the area through formal education and mass media. The ecovillage often hosts visitors from other parts of India and also has regular visitors from abroad, in particular from Europe. International visitors mostly come for several weeks or months at a time, and short-term visits are not encouraged.

Shikha Ecovillage is a so-called "Living Lab", also known as "Real-world Lab". As the name suggests, a Living Lab is a place that functions as a living and/or working space in its own right, while also serving as a space for experimentation and research. In a Living Lab, the local users or residents of the space work closely with researchers, who may come from outside or also live at the site.

In a Living Lab, the integration of living, working and researching also means that there is potential for research itself to be defined differently. One such difference is in terms of who is regarded as a legitimate researcher. That is, research in a Living Lab relies not only on people with PhD degrees. Rather, local people who have a deep understanding of the context are very important for credible research. Accordingly, this Regen-D book and game is a collaboration between an external academic, a local innovator with both an academic and a farming background, and a local practitioner and farmer (see author profiles).

At Shikha Ecovillage, research, development and experimentation is done in these areas:

- alternative ways of teaching and learning
    - with language and literacy at the deaf school
    - with eco-learning
    - with gamification of learning
- regenerative agriculture
    - chemical-free farming
    - multi-cropping

As a Living Lab, Shikha Ecovillage is constantly under review and under development, with a welcoming attitude to new initiatives. With respect to the topic of this book and

[1] Therefore, spoken components of our multimedia materials are in Sambalpuri and written components are in Odia.

game, there are plans to do more rainwater harvesting, and to improve planting along the riverbank so that the high water level during the monsoon season does not erode the bank of the river. In addition, the site needs to diversify its energy sources, and the next step will be to build a small biogas plant next to the cowshed. At the moment, cooking relies on bottled gas. Finally, Shikha aims to introduce regular eco-learning opportunities in addition to the on-site school, moving from an ecovillage to an eco-learning village.

3. Regen-D games: The concept

3.1 What are Regen-D games?

The idea for the Regen-D games arose out of the motivation to make work in sustainability and regeneration more tangible for diverse audiences and bring initiatives to life in new ways. Over the past decades, the dissemination of such work has moved from text-only to digital multimedia. Instead of or in addition to written texts, people create blogs with embedded pictures and videos, make documentary films, use hyperlinks to enrich texts with digital multimedia files, or embed QR codes linking to multimedia content. There is also increasing collaboration with the arts to facilitate a personal connection with a topic, for example via physical and online exhibitions, or the performing arts.

While digital multimedia content is increasingly diverse and engaging, complex "book-length" works tend to be a one-way affair. That is, the audience will read or watch something, or view artefacts or performances. The presentation of the material is up to the creators or authors, and audiences have limited opportunity to take on an active role, other than specifically organised events with audiences, for example a public reading or a guided exhibition. Depending on the format, it may be possible to post comments and questions in a digital forum, for instance on social media or in a webinar, but such interactions tend to be short, and engagement is optional.

A Serious Game differs from other content in that it provides an immersive and interactive experience for the players. Regen-D is such a Serious Game, that is, a game that is played for purposes beyond mere entertainment. Serious Games have game features such as elements of chance (e.g. throwing a dice or picking up a card at random) and a game choreography (e.g. rules for turns to be played) as well as a game environment (e.g. in a boardgame). However, they are played not only for fun but for purposes such as education, awareness raising, collaboration and co-creation. There is an overlap with gamification of learning, but the field of Serious Games is broader than educational only.

This book is the first in a series of Regen-D publications. Regen-D games have the following design features:

- In a Regen-D game, the players actively reconstruct the initiative or project that is the topic of the game, instead of merely being told about it.
- Players do this via engaging with a variety of multimedia materials. These come up in random order, and players work together to create a visual content map of the materials.

- A Regen-D game is a group experience, where dialogue between the players is built into the game process, and all players participate actively.
- The Regen-D format is a hybrid between face-to-face and digital. It allows groups to enjoy playing face-to-face in a physical game environment, while the multimedia prompts are digital.

The game uses QR-codes printed on the front side of wooden disks, which link to the multimedia files. The basic game process is simple: When a QR-code field is selected, players open the QR link and discuss the content of the linked file in the group, after which they create a visual map from placeholder pictures that are printed on the reverse side of the disks. Each placeholder picture is a cut-out from its corresponding media file (Figure 4).

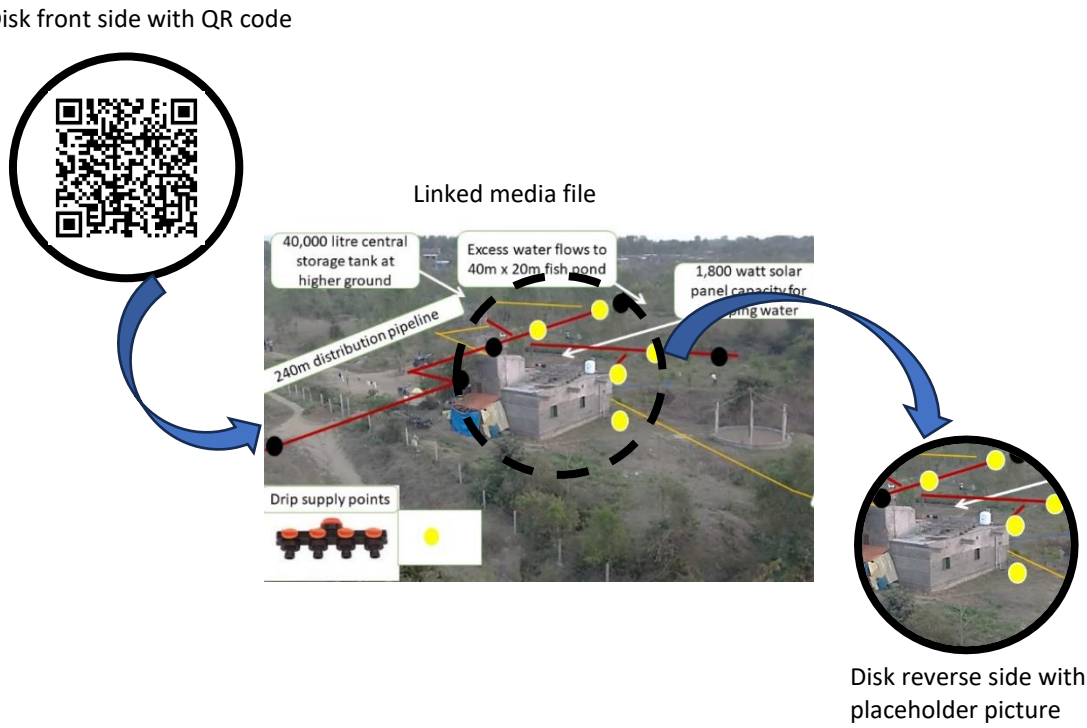


Figure 4. The basic game process.

This process leads the group to discover, step by step, the characteristics of the water management systems in use at Shikha Ecovillage. As placeholder pictures are added one by one, gradually a visual map is built up. The game process also generates other actions, including making connections between two components of the water management systems (the LINK action), commenting on the advantages and

disadvantages of a single component (the EVALUATE action), and a JOKER action.[2] These actions are also represented by wooden disks that are added to the map. The aim of the game is to develop a shared understanding of the water management systems while going through the game process (see Figure 5).

Figure 5. Visual map created in the game process.

Playing a Regen-D game is similar to accessing a curated online exhibition of multimedia resources. However, the virtual exhibition is not for viewing but for playing through as a game process. For our topic of water management at Shikha Ecovillage, these materials include the following:

- Video interviews (2)
- Other videos with titles/subtitles (2)
- Annotated diagrams and photos (5)
- Mixed media compiled from several source files and text (2)

Most of the materials are about the main Shikha Ecovillage site but there are three files relating to the secondary Bhoomi site, namely those labelled WM01, WM02 and WM07 (see Section 4.2 about this labelling).

[2] All additional game actions are explained in detail in Sections 4 and 5.

The next section describes how the players' experience and interactions are shaped by the game process.

3.2 How do Regen-D games work?

Playing a game based on multimedia content, instead of merely viewing the same content, has several consequences. The game allows the players to absorb the topic of more deeply by discussing the related multimedia prompts in a group. Instead of being presented with a completed publication, in whatever format, players have to actively reconstruct the content and to explore the limits of their understanding. For example, when a group of Europeans played the Shikha water management game there was discussion about the role of banana plants in grey water recycling, based on the prompt in Figure 6. The players wondered whether or not banana plants have the ability to filter and clean remnants from the household run-off such as soap. As nobody was familiar with banana plants, this question could not be resolved, but this is of secondary importance. The main point is that the game process prevents a passive attitude to the materials being presented, and as all players take turns, everyone is actively involved.

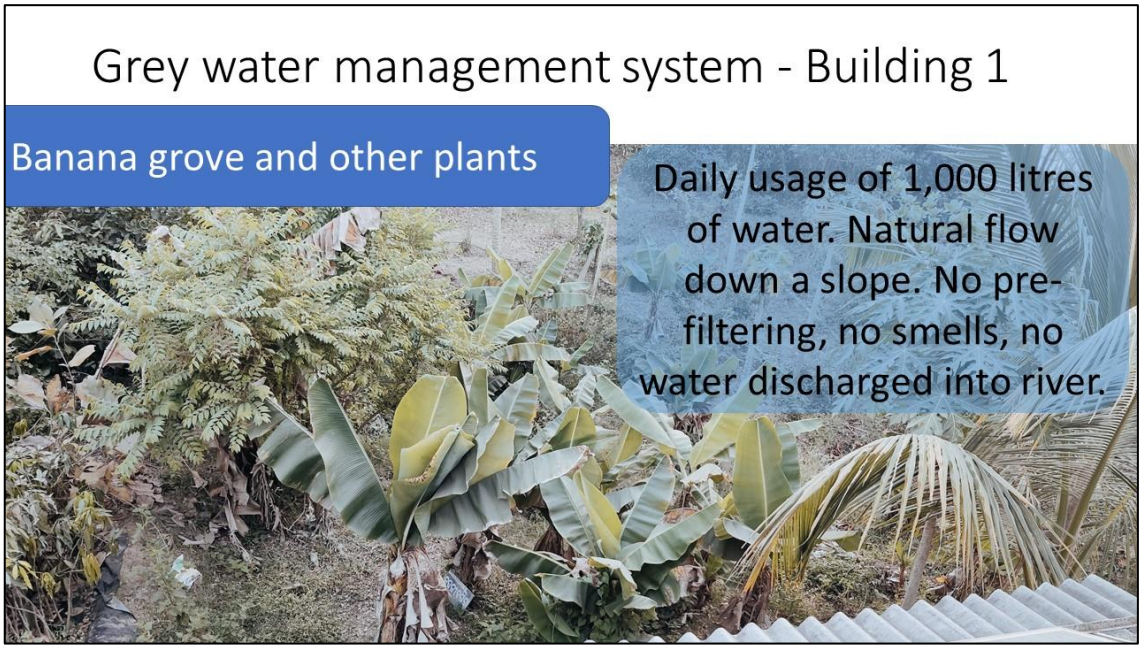


Figure 6. Annotated photo showing grey water recycling (one of the multimedia files from the game).

Another design feature of Regen-D games is that the same game can be played multiple times, and each time it will be a different experience for the players. The game process is unique each time in terms of:

- the order in which the multimedia files are accessed via the QR-codes;
- the order and number of times that additional actions (LINK, EVALUATE and JOKER) come up in the game;
- the resulting visual diagram that is created from the QR-code and the action disks;
- the group of players and their prior knowledge in relation to the topic of the game;
- whether or not there is a game facilitator;
- whether or not a time limit is set for the game.

Another factor that contributes to deeper engagement is the pace of a game as compared to another medium. The game proceeds at a much slower pace because each prompt is discussed in a group. This is a different experience compared to viewing a presentation or documentary film, where the tempo is fixed in case of live viewing, and control is limited to pausing or rewinding when in playback mode. In fact, if there is a game facilitator, one of the facilitator's main functions is to encourage the players to proceed to the next round in a timely manner and not spend too much time discussing a particular multimedia file. Some of the multimedia material in the Shikha water management game could easily lead to lengthy discussions, especially when the information is complex, such as in Figure 7.

In addition, the players have more control over engagement with the content in different ways. Each move can generate a variable amount of discussion, and players can choose what to focus on. For instance, a discussion of the file in Figure 7 might focus on the timeline of the development, the local cost of implementing the irrigation and drainage systems, or the technical details, depending on the interests of the group. Players may also deviate from the main topic, ignore part of the information, or relate the topic to their own experiences, and all such options are equally "allowed" and valid in the game. The game choreography ensures that the players always return to the main topic after each move.

Date	Activity	Photos	Details of activity	Resources	Costs in INR
31 January 2020	Well		Digging the well (size 4x5m). There is clear water at a depth of 6 foot.	Digger hired for 11 hours @ 900 per hour	9,900
02 February 2020	Irrigation; Well		Completing work on the well. From here an irrigation system will be built to serve the site.	3 workers came for 2 days @750 per day	4,500
08 March 2020	Digging trenches		Irrigation channels (trenches) are connected to the well. Excess water will run off into the natural reserve area next to the site.	Digger for 9 hours @900 per hours, and two workers for one day	9,600
15 March 2020	Drip system		The drip system with distribution points, pipes and other parts is for the horticulture part of the site.	The drip system for 1.5 acres of land cost @22,000 with subsidy	22,000

Figure 7. Multimedia file from the game with complex information.

Regen-D games are particularly useful if groups of players are very diverse. When coming together in a diverse group, there are always barriers to communication and mutual understanding, even when people speak the same language. Everyone has their own culture of communication, their own background, and potentially a different accent or a different professional jargon. If people come from different language backgrounds, it is even more important that the Regen-D Game provides a visual context for everyone to participate in.

For instance, “Water management systems at Shikha Ecovillage” might be played on-site with a mixed group of urban visitors speaking English and some Hindi and local farm workers speaking Sambalpuri and some Hindi. In addition to the linguistic challenge, both groups will have a very different understanding of the local context, as well as different communication styles. Because the game is based on dialogue supported by the visual context, it is much easier to understand complex information and to communicate clearly about the topic in such a group. It is then less likely that the interaction will be superficial.

Likewise, it is much easier in a game format to have an equitable discussion where individuals do not take up too much space, for example because they are perceived as having higher social status. Instead, the Regen-D game rules assign the role of discussion facilitator to everyone in turn. The person picking up one of the selected disks is responsible for hosting the discussion in that round. Importantly, how much

this player knows about the material at hand is irrelevant, and there is no expectation that anyone has to be an expert. Hosting the discussion may of course start from one's own understanding of the multimedia material, but it is equally possible and valid to make no comment at all and simply ask everyone else in the group to contribute to an understanding of the materials. For instance, a response to the picture in Figure 7 might be something like: "I see a picture with information in several columns. I am not too sure what to make of it. What do you all think?" - this invites others in the group to contribute.

In other words, we can say that the game format creates a non-threatening environment. Many people are worried about speaking up in a group for all sorts of reasons - being afraid of saying something wrong, not being used to speaking up in front of others, worrying about how they come across as a person. The fact that people come together to play a game rather than have a formal meeting diffuses some of this tension. Although using a game format is not a magic bullet to solve all communication issues, people are more likely to be creative and try out unusual things because it is, after all, "just a game". It is also helpful that the game involves simple physical moves to play, like spinning a dial and selecting a disk. Finally, a game potentially frees us to react with our whole person instead of using our intellect only, compared to how we feel in a formal meeting. In a game, we are allowed to activate our imagination, to have a laugh together, and to step in and out of different roles.

3.3 Who are Regen-D games for?

Regen-D games serve several audiences and can be played in various contexts and in different ways. The game on water management systems at Shikha Ecovillage is useful for educational contexts, for initiatives working on sustainability and regeneration, for corporate and professional training, and last but not least for the Shikha community itself.

a) Education

Regen-D games can be used in high schools and universities to support education for sustainable development (ESD). In this case, the teacher or lecturer will likely act as game facilitator, although Regen-D games do not need facilitators and can easily be played by students (and other groups) on their own.

Each Regen-D game is a case study that is situated in its particular context, in this case a local context with geographical, linguistic and cultural features that are characteristic of rural eastern India. The multimedia collection brings this context to life for ESD learners in a unique way.

As the example of grey water recycling with banana plants illustrates, many details of the topic may remain unclear if the players are unfamiliar with the subject matter and the local conditions. However, because the game process is built on dialogue in a group, it is more likely that uncertainties and open questions are brought up and discussed. The sequence of engagement that is proposed for learners goes from playing the game, to optionally reading the e-book, to accessing the links to additional information and resources compiled at the end of the book. In this process, active learning is more important than accuracy because these materials aim to prompt a change in attitude and to orient people towards a regenerative future.

Teachers and lecturers may want to frame a Regen-D game in a particular way to fit in with the curriculum, or they may want to plan the time spent with the game and any follow-on activities. To play through the entire water management game takes ca. 90 minutes, which suits a typical academic timetable. However, a shorter session (at least 30 minutes) is also possible, and playing the game partially can still provide a good experience for learners.

Depending on the size of the class, students may have to be divided into groups:

- Up to 8 players can comfortably form a circle to play the game. A laptop or computer screen is adequate to view the multimedia materials with a small group. The water management game ideally needs working audio because some of the multimedia files have sound, though there are subtitles as a backup option.
- For a single larger group of up to 16 players, it is best to use a “fishbowl” technique. This involves an arrangement with an inner and an outer circle of people, and a larger screen is needed. Those in the inner circle, a maximum of eight, play the game, and those in the outer circle are observers. Whenever someone in the inner circle has played a turn and led the discussion of the prompt, they move to the outer circle, and another player from the outer circle takes their place. This way everyone can remain involved in the game. If the group is larger than 16, there won’t be enough materials for everyone to play at least one turn.
- With groups larger than 16, the best option is to set up several parallel groups. However, if this is not possible, the outer fishbowl circle can be made larger to include everyone, and the multimedia prompts would be brought up on a large screen at the front of the class. Not everyone would be able to play actively but it may still be possible to involve the whole group in discussion to some extent; or else there will be a non-participating audience.

b) Dissemination and onboarding

Initiatives working on sustainability and regeneration can use Regen-D games to disseminate their work in an innovative and creative way. Having a playable game makes their work distinctive and is an alternative to tracking and reporting progress.

Regen-D is also ideal for onboarding new team members. Instead of explaining the project or concept, new members can play the game, once or several times, and learn about the interconnections and complexities, in this case in relation to managing local water resources. Shikha Ecovillage was founded quite recently in 2017, so its community has been growing every year. In future, when new staff join or when visitors stay on the campus temporarily, playing the game will introduce them to some of the ground realities at the ecovillage in an engaging and memorable way.

Many initiatives start with a small core group or innovators, beta testers or frontrunners, who then want to increase the number of people involved in their work. This is the case at Shikha Ecovillage as well. A Regen-D game is intended to enable such onboarding and create a positive vibe around the work. In addition, the game serves to disseminate the story of the ecovillage in general, because water management connects with many of the local activities.

c) Inboarding

While onboarding refers to new people joining up, inboarding is used with people who are already part of a location, initiative or project. The aim is for people to gain a deeper understanding of their context, to act and feel like an integrated team, and to cultivate shared values. At Shikha Ecovillage people have very different roles, from school teachers to project managers, farm workers to trustees. In each of these roles, people may only have a good grasp of part of the picture. Playing the water management game has a lot of potential for people in different roles to connect with each other around a topic that is important for everyone.

At the same time, initiatives can also use Regen-D games to keep track of their progress. One observation at Shikha Ecovillage over the past years has been that documenting activities and progress is quite challenging. It has been difficult to mobilise those who develop and manage the ecovillage to produce project reports, for instance to report back to funders. After failing with several different attempts at formal reporting, using the game format has been the first time that we have seen enthusiasm for documenting how the ecovillage has been developing.

The particular benefit of using the water management game to document aspects of work at Shikha lies not only in its format but also in the fact that the game can be updated multiple times. For instance, if the community decides to build underground storage for rainwater, this can be added to the game with a new QR-code disk. If parts of the fruit orchard no longer need drip irrigation because the trees are mature enough to cope without irrigation, this information can be updated in the game. In this

way, a Regen-D game can be a living and changing documentation of an initiative's progress, which can be used to keep track of progress and keep the local community involved.

d) Professional training and facilitation

Training of professionals or corporate training is another context for Regen-D games, though using Regen-D games in this context is as yet untested. Clearly, ESD (education for sustainable development) is not restricted to the education sector. As every societal sector must play its part in sustainability and regeneration, creating awareness through case studies can also be helpful for businesses and their corporate social responsibility progammes, for the third sector, public services, or grant-making organisations.

It may be particularly useful for professional facilitators working in the sustainability/regeneration space in any of the societal sectors to add Regen-D to their toolbox. Games can be "personalised" to suit a particular audience because it is easy to replace the curated multimedia materials, or indeed create an entirely new game for a particular training context. If there is enough time, facilitators can also lead groups to create their own Regen-D game, which may be particularly impactful but would need some preparation and sufficient time with the group. When playing the game with the group, the role of facilitators is similar to the role of teachers as described above.

e) Game variations

In summary, the game "Water management at Shikha Ecovillage" can be played with the following variations:

- Group sizes of 3-8 players, up to 16 players, and more than 16 players.
- Playing through the entire game or playing a shorter session / taster session.
- Playing with or without a facilitator.

Depending on the size of the group, it is important to have a sufficiently large screen for each group size, so that everyone can see the multimedia materials clearly. A minimum of three players is best to have good conversations.

Excluding time needed for self-assembling the game, playing through an entire Regen-D game takes ca. 90 minutes, though it may take longer depending on how long the ensuing discussions are at each new turn. Experience with the water management game so far suggests that this 90-minute timeframe suits different audiences because it is long enough to become fully comfortable with the game process and to dive quite deeply into the topic, but not so long as to make it impractical for participants to attend.

The game can also be played over several sessions with intervening time, or it can be played for a shorter predetermined time period. It is not necessary for the aim of the game to go through all multimedia materials, especially if the aim is educational. A learning effect will be achieved even in a shorter session, though a minimum of half an hour is recommended for taster sessions.

So far, the water management game has been prototyped and played either on-site at Shikha Ecovillage, where everyone is familiar with the local context, or with a knowledgeable facilitator. We are yet to gather more experience with the game when played without a facilitator or teacher. Although nothing in the game's choreography requires a facilitator, we need to know more about what the experience will be for groups playing the game independently.

While Regen-D games are hybrids with face-to-face and online components, at present a fully online version has not been implemented. Playing the water management game entirely online may be the next stage of development, and the advantages as well as limitations will need some additional research.

4. Game components

This section describes the materials that are needed to play the game. All materials are available for printing and/or download and can be assembled easily. The game consists of various disks that are arranged in a diagram during the game, a selector wheel, and a summary of game rules.

The game is best played on a horizontal surface with players sitting in a circle. However, it can also be used on a vertical surface with some simple modifications, with players sitting in a semicircle. If using the game vertically, the game disks need to be affixed to the vertical surface, such as a wall or blackboard/whiteboard, in a way so that they can be moved around, e.g. with sticky tack or thumb tacks.

The game space is the space where the game is played. Figure 8 shows a game space arrangement with the larger disks on one side and the smaller disk along with the selector wheel on the other side, but all game components are movable and can be arranged in any way preferred by the group of players. Whatever the initial arrangement of game materials, the middle of the game space must be empty at the beginning (shaded area). This is the diagram space where the disks are assembled turn-by-turn during the game.

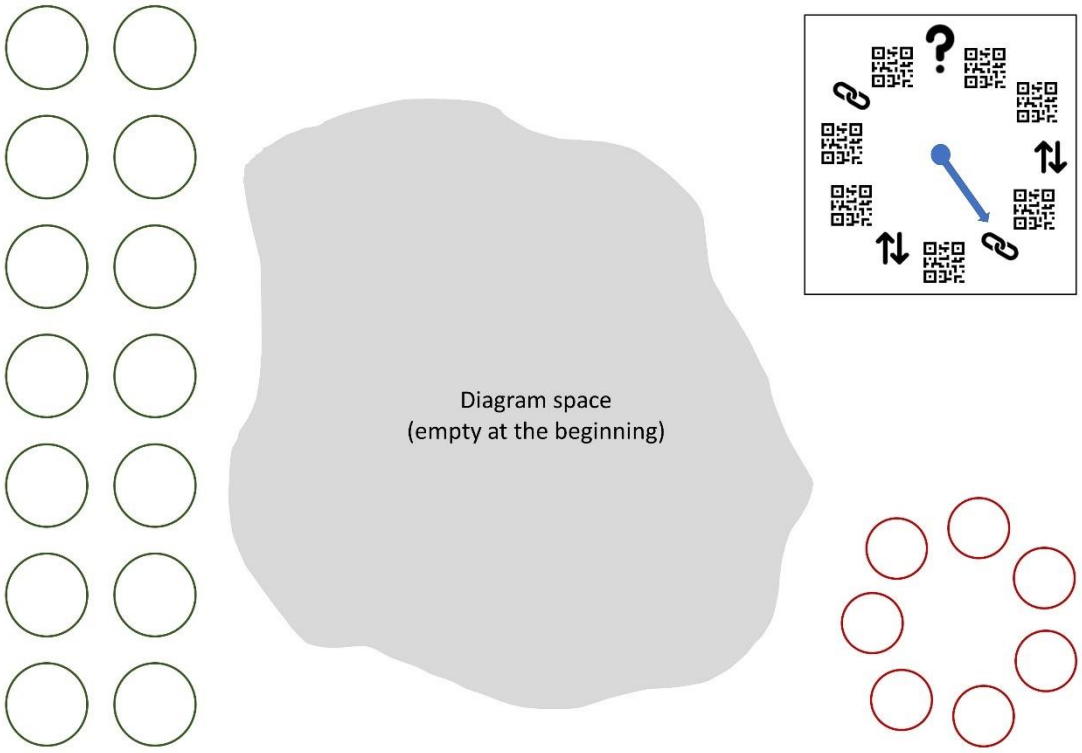


Figure 8. The game space.

4.1 Selector wheel

The selector wheel is used to randomly select which disk should be placed in the diagram space at each turn. It consists of symbols arranged in a circle (see the Appendix for a printable image in the actual size).

There are two options for using the selector wheel (see Figure 9). For the first option, a game spinner is added, so that the arrow spins and selects a symbol. Alternatively, an easier option is to use a pawn that is “walked” in a circle along the symbols of the selector wheel according to the throw of a dice. The start position for the token is at the top of the wheel (the question mark symbol).

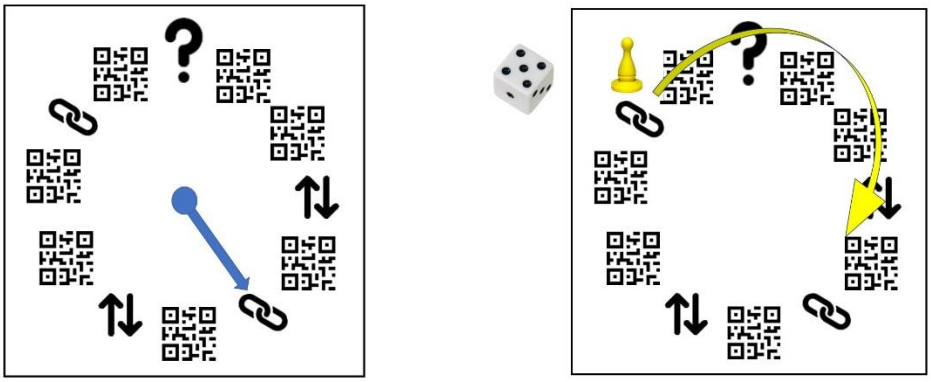


Figure 9. Options for using the selector wheel.

After printing out the selector wheel and sticking it on to a cardboard for better stability, game spinners can be made from simple materials, for example paperclips and thumb tacks (see Figure 10). Online instruction videos for assembling game spinners can be found by searching for “how to make a game spinner”.

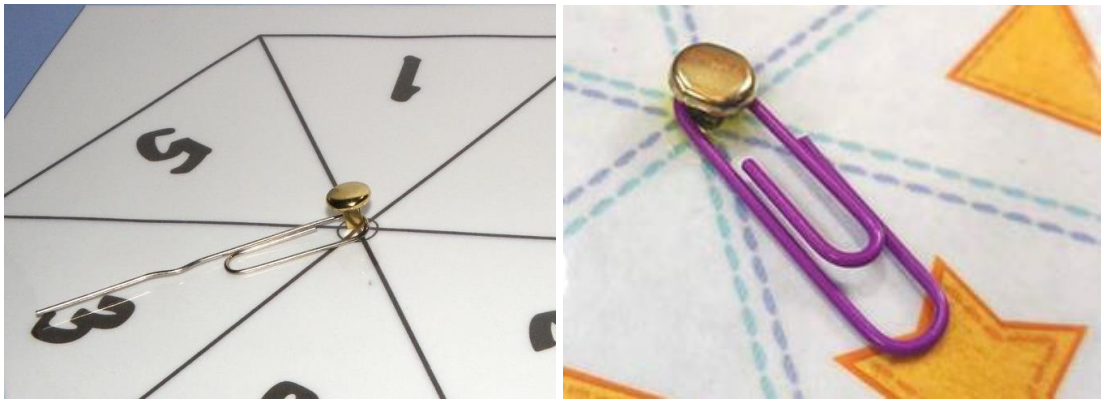


Figure 10. Examples of self-assembled game spinners.

4.2 QR-code disks

The game includes 11 QR-code disks. These disks are at the heart of the game, so they need to be produced with care. If the printout is blurred or damaged, the QR-code may fail to be read correctly and may not link to the intended multimedia file. QR-code disks are placed with the QR-code facing up.

Each QR-code disk has two sides: The QR-code and the placeholder picture. When printing out the QR-code disks, the right QR-code must be paired with the right placeholder picture. To make this easier, all pairs are numbered. For instance, QR-code number WM03 needs to be paired with placeholder picture number WM03 (Figure 11). The placeholder picture reflects what is shown in the multimedia material that the QR-code links to. For example, if the QR-code links to a graphic or photo, the placeholder picture is a cut-out from the larger picture. Colour printing is recommended for the placeholder pictures, so that they look just like the digital materials, but printing in greyscale will also work.

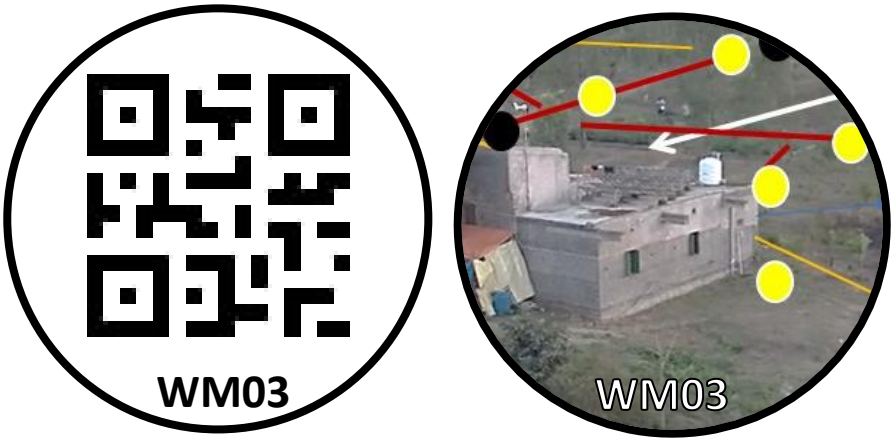


Figure 11. Paired front and back side of a QR-code disk from the game “Water management systems at Shikha Ecovillage”.

To produce these disks, print out the pairs of QR-codes and placeholder pictures and stick them together back-to-back. It is recommended to use heavier paper or cardboard for the disks, so that they are not too light. To create more durable disks that can be used many times rather than for a one-off game, a more solid material such as plywood is the best option. Cut out disks of the same size and stick the printed pairs onto both sides of the disk. Note that there are two additional disks of the same size that are used as jokers.

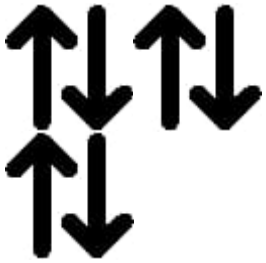
When scanning the QR-codes, the linked multimedia file needs to be visible to all players. The most straightforward option is to use a single smartphone to scan the QR-codes and link the phone to a larger screen, e.g. a laptop or a TV screen, so that whatever is shown on the smartphone's screen is mirrored on the larger screen. Scanning the QR-code directly with a laptop or desktop webcam is also possible with a QR-scanner either installed or accessed online. Alternatively, a group of players can have several smartphones between them and view the files on individual smartphone screens, but this is not recommended if there are more than six players because otherwise the communication flow will be negatively affected. This option is also not optimal because some of the video files have sound, which will play across each other if several smartphones are used. Finally, it is also possible to use a handheld QR-reader, also known as QR barcode scanner. QR-readers are available with USB-cables to plug into a screen, or as a wireless device.

4.3 Action disks

The action disks are created in the same way as the QR-code disks. Their role is to prompt further discussion of the QR-code disks that are laid out in the central diagram space at any given time.

There are three types of actions, each with a symbol:

The LINK action: This asks players to link two of the QR-code disks in the diagram space and explain their relationship to each other. The game has four LINK disks which are smaller than the QR-code disks.



The EVALUATE action: This action is applied to any single QR-code disk and asks players to evaluate the component represented by the QR-code disk. There are three EVALUATE disks in the game, of the same smaller size as the LINK disks.

The JOKER action: This action uses two additional empty disks that are the same size as the QR-code disks. The action asks players to think of an additional element to add to the diagram space and write a note or draw a picture on the disk to represent it.

When assembling the action disks in the same way as for the QR-code disks, the right symbol must be paired with the right description for LINK and EVALUATE. Disks are placed with the symbol facing up. The JOKER disks look the same on both sides.

4.4 Rules card, disk selection chart and teaser video

The game rules are explained in Section 5. For easy reference while playing the game, the rules card has a short summary of the rules. In addition, the disk selection chart further constrains which disks can be selected throughout the game. The allowable sequences on the chart ensure that there is a balance between the different types of disks and that task disks can always be actioned. The rules card and the disk selection chart are for printing out and keeping them close at hand while playing.

The rules card also has a QR-code that links to an introductory “teaser” video. Players watch the teaser video first and then start the game. The aim of the teaser video is to give a first impression of the topic of the game and to introduce the local context. The video shows a bird’s eye views of Shikha Ecovillage and the Mahanadi river, as well as scenes of daily life in the ecovillage. The subtitles draw attention to the issue of water management, but without giving any details.

5. Game rules

Aim of the game:

The aim of the game is for a group of players to develop a shared understanding of water management systems at Shikha Ecovillage by engaging with materials presented via the multimedia files. At the end of the game, the group of players will have created a visual diagram of the topic in the middle of the game space by the group of players.

Starting the game:

To start the game, watch the introductory “teaser” video that you can access via the QR-code on the rules card. The teaser video introduces you to the local context of Shikha Ecovillage, without giving any details of its water management systems. After watching it, you are ready for the rounds of the game.

Using the selector wheel:

The selector wheel is used in each round (except round 1 and round 2) to select the disk that will be placed next in the central diagram space. Spin the arrow of the wheel or “walk” the token on the wheel, and then pick up a disk of the selected type.

If the selector wheel has selected a disk that is no longer available because all disks of this type have been used up, simply move forward along the wheel until you reach the symbol for an available type of disk.

Playing rounds:

Round 1 and round 2:

In the first two rounds QR-code disks must be selected because the other actions cannot work unless there are some disks in the diagram space already. So play round 1 and round 2 without selector wheel and simply pick up QR-code disks at random to discuss.

Regular rounds:

From round 3 onwards, players start each round of the game by using the selector wheel. The person spinning the wheel or walking the token on it is responsible for the group discussion that follows from the selection. This player only has to hold the space and facilitate the discussion but does not need to talk more than others or know more about the topic than other players.

According to what comes up on the wheel, the players discuss either the multimedia file that is linked to the QR code, or an additional action, i.e. LINK, EVALUATE, or JOKER. Play each move as follows:

QR-code disks:

Pick up a QR-code disk of your choice and scan the QR code to reveal the multimedia file. Display the file on a screen that all players can see and discuss in the group what you understand from the content. Then place the disk in the middle of the game space (i.e. the diagram space) with the placeholder picture facing up.

LINK:

Pick up a LINK disk and place it in between two QR-code disks with the symbol facing upwards (you can move the QR-code disks around freely in the diagram space). Then discuss in the group how the two elements are linked.

EVALUATE:

Pick up an EVALUATE disk and place it next to a single QR-code disk with the symbol facing upwards. Then have a group discussion about the strengths and weaknesses ("positives and negatives") of this element of the water management system.

JOKER:

Pick up a joker disk (of the same size as the QR-code disks but empty) and think of an additional element that you would like to add to the game. For example, in the context of water management, the additional element might be local short-term flooding due to heavy rain, or a flock of ducks being kept in the ecovillage, or a sustained drought. Write a short note describing the new element or make a small drawing on the empty disk and place it in the diagram space, then discuss the new element with the group.

With each round, the diagram space in the middle is increasingly populated with disks that have been played. The picture in Figure 12 shows an example of what the game space will look like after a few rounds have been played.

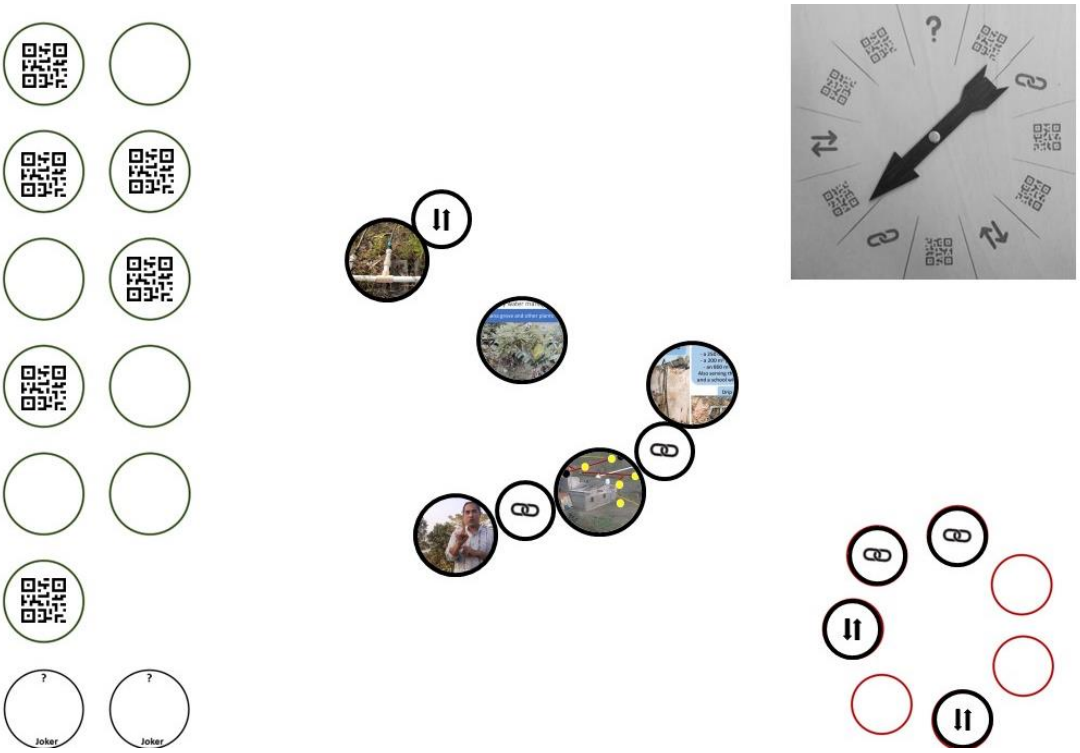


Figure 12: The game space mid-way through a game.

Additional game rules:

Disk selection rules:

For a good flow of the game, the selection of disks via the selector wheel follows some additional rules. The rules on the below disk selection chart ensure that there are not too many disks of the same type, and that a selected disk can always be actioned.

For example, if the selector wheel picks the LINK task in one round, and the EVALUATE task in the next round, a QR-code disk must be picked next (second row of the chart). Similarly, one of the task disks (LINK, EVALUATE or JOKER) must be selected if a QR-code disk has already been picked three times in a row.

If the selector wheel results in a choice that is not allowable according to the chart, move forward on the wheel to the next allowable symbol. For example, if a LINK disk cannot be played because all available QR-code disks have already been linked, move forward to the next field on the selector wheel.

Disk selection chart:

Allowable sequences	*Description*
	Select no more than three QR-code disks in a row. The fourth selection must be one of the task disks.
	Select no more than two task disks in a row. The third selection must be one of the QR-code disks.
	Select a joker disk only if a minimum of four QR-code disks have already been played.
	Select a LINK disk only if at least two QR-code disks are available to link together.
	Select an EVALUATE disk only if at least one QR-code disk is available that has not yet been evaluated.

Moves towards the end of the game:

Towards the end of the game, if only one type of disk is still available and all others have been used up, there is no need to use the selector wheel. Simply pick up an available disk to place in the diagram space.

Ending the game:

The game ends in one of two ways. If a time limit has been set, the game ends when the time runs out, regardless of whether all disks have been used up. For a good experience with the game, it is not necessary to use up all disks.

If no time limit had been set, the game ends when all QR-code disks have been used up. Any action disks that have not been played yet remain unused.

6. Summary of water management systems at Shikha Ecovillage

This summary is intended as supporting material for the game, which is the main activity. It is recommended that game facilitators read this summary *before* the game, but players can optionally read it *after* the game.

Between 2017 and 2022, the water management systems at Shikha Ecovillage have been built up successively in several stages. In this section, “Shikha” refers to the main site Ecovillage and “Bhoomi” refers to the secondary site, where redesign of the space began in 2021. Several components are described below, namely:

- Water sources
- Domestic water use
- Agricultural water use
- Wastewater and water conservation
- Water systems maintenance

In addition, we describe the resources in terms of finance, labour, and materials that have gone into building these components. There is a summary of these resources at the end of the section.

6.1 Water sources

The main water source at Shikha is the Mahanadi river. The river’s water level changes with the seasons, and depending on water release from the upstream Hirakud Dam. For most of the non-monsoon time, the water level is ca. 15-18m below the ecovillage, which lies on an elevated river bank section, directly bordering the river. During the monsoon rains the water level can rise almost up to two metres below the level of the site.

River water is pumped daily into a number of tanks for residential use and eventually to the main water tank, which lies at the highest elevation of the site. Considerable power is needed to lift the water. This is provided by 12 solar panels (1700 wp) which are linked to a pump with 3 hp capacity. Keeping costs relatively low, the solar panels were self-assembled and installed on the roof of the residential building that is closest to the river.

The main pipe transfers water over a distance of 133m up to the main water tank. The cowshed and all agricultural areas are supplied from the main tank, which has a capacity of 30,000-40,000 litres. There is a network of supply pipes across the site (see Figure 13).

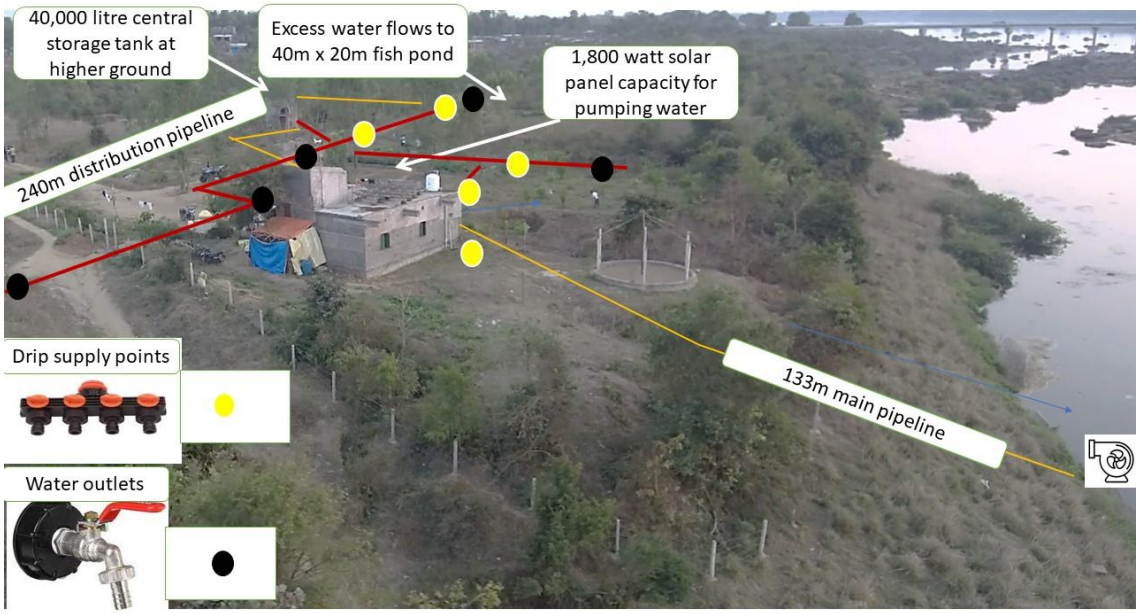


Figure 13. Network of supply pipes at the Shikha site.

Three smaller tanks on the roof of the residential building and three tanks for the school (two smaller ones at ground level and one large underground tank) are filled directly with solar pumped water. In addition, on the roof of the school building there are two smaller tanks, as well as the solar hot water system, which supply water to the hostel. Water is pumped into these rooftop tanks from the lower tanks by using a separate smaller pump that is connected to two solar panels providing 660hp (see Figure 14).

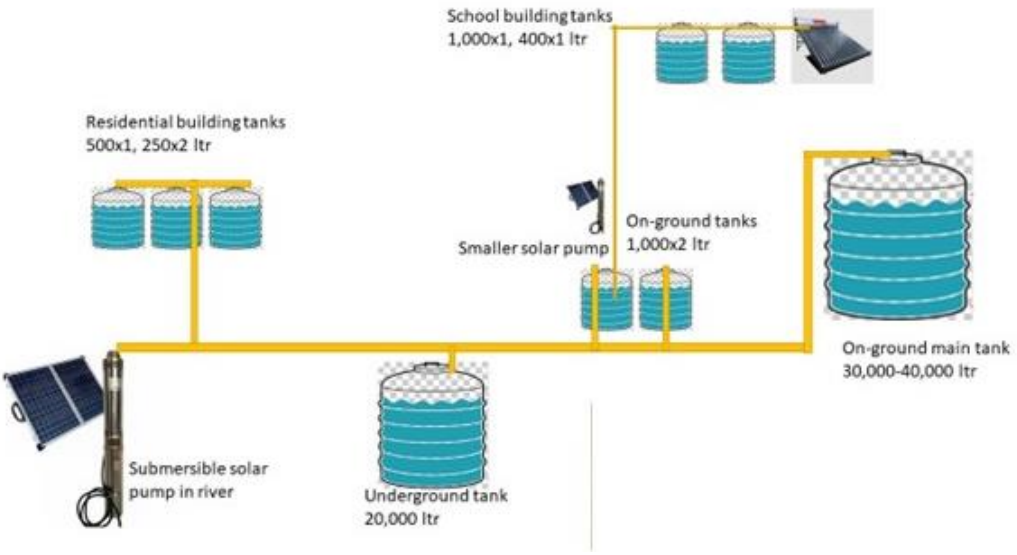


Figure 14. Water tanks for domestic use.

When the Shikha site was first established, overflow water from the main tank was directed to a fishpond at the far end of the site. The pond would receive water on most days except when cloudy weather limited the amount of solar power available. As the site has grown to accommodate 50 residents and two acres of agricultural production, there is now no excess water as of 2022. Therefore, the pond now dries out in the dry season and is only replenished during the monsoon. The fishpond does not hold water well; it is 40 feet above the riverbed and is above ground water level.

Shikha has no other water source, although we are experimenting with rainwater harvesting, which is done ad hoc in the monsoon season to store rainwater underground. There is no piped water from the local government as of 2022, and the site is completely off-grid with respect to both water and electricity. Therefore, the solar-powered pump is the weakest link in the water supply. If the pump has a technical failure, the entire water supply is endangered, as there is no backup system, and this has caused trouble several times. The main water tank can supply the campus for a few days at most. In addition to the pump itself, the pipe leading to Shikha from the river is also at risk. The pipe runs underground but at shallow depth, so it is vulnerable to wildfires which are a regular occurrence during the driest and hottest time of the year.

At the Bhoomi site, there are two sources of water: an on-site well and a canal provided by the government. The water table is very high, so that the well only needed to be dug to a depth of 3m to reach the groundwater. From the well, the water is

pumped with solar power to the small house that accommodates on-site farmworkers from time to time. The well also connects to a network of trenches and drip irrigation (see Figure 15).

Figure 15. Bhoomi site before planation, with well (light blue), trenches (dark blue) and canal (purple).

However, this single well is not enough to provide water for all the fields. In particular, the rice fields need additional water from time to time. The additional water is taken from the agricultural canal that runs along the border of the site. Access to this water is regulated, so that water can only be drawn at particular times.

6.2 Domestic water use

As the Bhoomi site does not have any regular residents, domestic water use is described for Shikha only. The residential house is supplied by three water tanks situated on the roof of the building, which supply ca. 2,000 and 3,000 litres of water daily. Two of the tanks directly supply the community kitchen, where daily meals are prepared for 50 people. The other tank supplies a smaller kitchen, a bathroom, and a solar powered washing machine which is also used by the school community.

The two-storey school building includes a girls' dormitory on the ground floor and a boys' dormitory on the first floor as well as classroom and office spaces. There are

several smaller water tanks that supply three indoor bathrooms with toilets and one outdoor shower area. In addition, there is a solar hot water system on the roof of the school building with a daily capacity of 200 litres. In the winter season, solar hot water is used for the bathrooms. However, for most of the year there is no need for hot water in the bathrooms, and the hot water is instead carried to the community kitchen, where it is used for cooking rice in large pots. The use of hot water for cooking reduces the need for wood, coal and gas and also reduces the time needed for cooking rice in large quantities.

The domestic water supply system is configured in such a way that the lowest-lying tanks fill up first; that is, the underground tank fills up first, then the ground-level tanks at the school building, and then the rooftop tanks at the residential building. Any excess water after filling all domestic tanks goes to the main tank of the site, which supplies the agricultural areas.

In addition, each building is configured so that water in the tanks neither runs out nor overflows. For the residential building where there is high water pressure, water is refilled continuously during the day as long as the solar pump is active. To stop the tanks from overflowing, they are fitted with stop valves that automatically close the inflow pipe when the tank has filled up.

For the school building, the rooftop tanks have a float sensor device to stop the pump from running when the tank is full. In addition, it is necessary to prevent the pump that lifts the water to the rooftop from “running dry” because the pump will overheat and break down. The pump in the ground-level tank is therefore configured so that it only starts working once the water has reached a certain level. If the water falls below the level where the pump is fitted, the pump automatically stops until enough water has re-filled, which again happens automatically as long as there is enough solar power. It can take 2-3 hours to fill the rooftop tanks on the school building.

Drinking water for both the residential house and the school building is supplied from the same rooftop tanks. The water goes through multiple filters including sediment filters and active coal filters. These systems work without electricity, and the water is pushed through the filters by gravity. In the absence of any substantial upstream pollution, e.g. from factories or urban effluent, the river water is relatively clean and is drinkable after filtering. However, during the monsoon season the river water quality becomes progressively worse until it is no longer safe to drink. Drinking water is then sourced from the nearby town in large canisters for this relatively short period.

With all buildings and residents together the ecovillage community uses an estimated 7,000 litres per day for residential purposes. Residential water is replenished daily as soon as the solar powered pump starts working. There are usually no water shortages,

except when the weather turns cloudy for several days in a row, so that there is not enough solar energy for pumping sufficient water. If the solar pump malfunctions, this also results in water shortage for a day or two until the pump is fixed. However, it becomes difficult to fix the pump when there is more water in the river because the pump is then some way below the water surface and harder to reach for repair.

6.3 Agricultural water use

Both sites use water for irrigation of agricultural plantations. The type of plantation and approximate size can be seen in Table 1 below:

Table 1: Plantations at the Bhoomi and Shikha sites.

Plantation	Bhoomi	Shikha
Rice paddy	3 acres	-
Fruit orchard	-	1 acre
Vegetable fields	1 acre	0.5 acre
Mixed use (nurseries, shading and flowering trees, mixed plantations)	0.2 acre	0.3 acre

At the Bhoomi site, the water supplied from the well and the canal is distributed across the site through irrigation trenches and pipes that end in drip irrigation. The trenches change with the seasons. In the monsoon season, they are full of water and function as drainage trenches, so that the horticultural fields do not become waterlogged. Along the trenches, water loving plants have been planted, such as bananas. These contribute to absorbing excess water. After the end of the monsoon, the trenches then contribute to irrigation along with the drip irrigation system.

For the horticultural fields and the fruit trees, irrigation systems are sufficient. However, for the part of the site where rice is planted, additional water from the agricultural canal is needed. Access to canal water is restricted by regulations and by custom; there is potential for conflict over the supply of water among the adjacent farmland. In order to grow rice, the fields need to be flooded several times, which requires substantial amounts of water at the right time. In the local area, there are two rice paddy seasons per year because irrigation is available. In other areas further away, where there is no canal water, the field can only sustain a single rice paddy season.

At the Shikha site, the water systems for irrigating plants are more complex. All water is supplied from the main pump that lifts water from the river. Water is then directed into several different systems. One type of connection ends in sprinklers. These supply a small nursery of ca. 24 m², as well as a pre-planting area of similar size where tree saplings are kept until they are planted out. A third sprinkler system is available for the vegetable garden, although this can be watered by hose as well. Sprinklers usually run for 1-2 hours daily on average, at the time when the solar power is at its peak and the water pressure is highest. From the main pipe that comes from the river, there are connections leading to the sprinklers. When there is enough pressure, water automatically flows to the sprinklers, and they stop in the afternoon when the solar power output becomes less, which causes the water pressure to drop.

To one side of Shikha, there is a half-acre area with vegetable fields. These are situated at the lowest end of the campus. Therefore, water simply flows through the fields by gravity. The rows of vegetables are separated by small channels through which water is channelled every couple of days to irrigate the fields.

The site also includes a half-acre fruit orchard as well as other fruit trees planted at various places throughout the campus. All fruit trees are watered by drip irrigation. From the main water tank, the water first flows through larger underground pipes to access points. From these points, smaller pipes run overground to supply the trees with drip irrigation (Figure 16).

Figure 16. Water distribution pipes for drip irrigation.

The drip irrigation system has to be turned on manually at its central access point, which is located at the base of the main water tank. There are two options for connecting and running the drip irrigation system. When the water pressure in the main pipe from the river is high enough, the drip irrigation can run directly off the main water pipe. Otherwise, the drip system can be connected to the main water tank, so that the water runs through the pipes driven by gravity. This second option is used in particular for running the drip irrigation system in the late afternoon or early evening.

6.4 Wastewater and water conservation

At both the Shikha and the Bhoomi site, the water management is intended to make good and conscientious use of water, avoiding excess run-off and re-using water where possible. At Bhoomi, the irrigation and drainage trenches also serve water conservation because they retain excess surface water, so that it percolates into the ground more slowly, recharging the groundwater. At Shikha, trenches have been built at one side of the campus rather than throughout the entire site. These trenches similarly aim at retaining water to recharge the water table, but they play no role in irrigation.

As Shikha has residents, the question of water recycling from the buildings arises. Black water, i.e. the water used to flush the toilets, is not recycled but goes into cesspits. This is typical of the local infrastructure, and external services are available to empty the pits when necessary. Other than this, there is no sewerage system.

The buildings have several points where grey water is released, namely the kitchen and the shower rooms. The residential house releases grey water from the kitchen and the bathroom into a large naturally sloping swale. This has been planted with bananas, which absorb the water, as they are water loving plants. The banana grove has a dozen banana plants that produce fruit for local consumption. A few other trees also grow in between the bananas, and the ground is covered with grasses all year round. At the hottest time of the year, this is the coolest place on the site. Although the swale ends at the river, no water is actually discharged into the river, as it is entirely absorbed by plants before it reaches the river. An estimated 6,500 litres of grey water per day are recycled in this way. The community kitchen that is located in the same building discharges its grey water into a smaller sloping area behind the house, where established trees and a few recent banana plants are growing.

From the school building, grey water from both the indoor bathrooms and the outdoor shower area is channelled into the adjacent vegetable garden, with the majority coming from the upstairs bathrooms. A filtering system to filter the water from upstairs has been designed but not yet implemented. The filter will direct water

through a tank filled with several layers of gravel and sand, and it will reach the vegetable garden below through gravity (see Figure 17).

Figure 17. Planned grey water system for the school building.

As the grey water feeds plants, harsh chemicals and detergents are not allowed to be used on site. The simple soap and mild detergents in use have not been observed to harm any of the plants. This grey water recycling does not include sending the water through any plants that are specifically chosen because they can absorb harmful chemicals and purify water. It seems, however, to work adequately for the time being.

6.5 Water systems maintenance

All systems have been designed in and for a low-resource setting. Both financial resources and availability of staff on site are limited, and the aim has been to set up simple systems that work with just as much technology as necessary but not more. Likewise, maintenance should be simple and not labour-intensive.

An important aspect of simplification is the fact that, at Shikha, the water system runs on solar energy. Therefore, pumping from the river starts automatically when the sun comes up high enough and stops automatically in the late afternoon. There is no need

to turn the pump on and off. Similarly, during the morning the rooftop tanks start filling up, and the sprinkler system starts running automatically. The tanks have a simple stop valve mechanism that prevents water from overflowing. When the tank is full, these valves automatically close the in-flow pipe.

The wires connected to the main water pump need regular maintenance and repairs. In the past, the pump has failed repeatedly mainly due to burnt wires. Repairing these is not easy, as the pump has to be lifted out of the river, making it especially difficult when the water level is high. The main water pump is a sensitive point for the water system and needs expert monitoring.

The other parts of the water system, in particular the irrigation for agricultural areas, are easier to maintain and replace. The underground pipes that distribute the bulk of the water across the sites need to be dug up if they fail, but they are quite robust, and this is not a major risk. The various access points above ground and the network of smaller drip irrigation pipes are more likely to need replacement. Overall, pipes and taps are not of high quality because of cost constraints, so they do break down from time to time.

Some overground water points send the water not through pipes but release the water directly into fields. Nearby fields receive water directly, while fields further away are watered using larger pipes that empty into the field. In addition, some areas are watered by hand with hoses, particularly the vegetable beds. At Bhoomi, the canal water is also operated manually, as are the sprinklers for the nursery at Bhoomi.

All watering for agricultural and horticultural purposes has to be operated by hand, laying pipes, turning taps on and off, maintaining drip irrigation pipes, and making repairs. This work is the responsibility of farm workers. Watering is needed at the right time and the right amount, and crops sometimes fail because there has been too much or too little water at the wrong time. There are not enough farm workers to manage both sites, so as of 2022, not all areas that could potentially be farmed are actually planted up with crops. This is another weak point in the system.

6.6 Resources for developing water management systems

It is useful to summarise the resources that have gone into developing the water management systems at both sites. Table 2 shows the materials, machinery, and labour needed for developing each of the water system components.

All costs are in Indian rupees (INR) at the time of development, using rounded figures for the sake of simplicity. “Labour days” show the number of days multiplied by the number of workers, e.g. 10x2 meaning two workers employed for 10 days.

Table 2: Resources for water systems development.

Site	Activity / component	Materials	Labour & machinery	Costs (in INR)
Shikha	Water system for veg and plantation	Main pumping, solar panels, supply pipes	10x6 labour days	Pump 60,000 Pipes 10,000 Solar panels 60,000
Shikha	Tanks and water storage	Large tanks and small tanks	10x4 labour days	120,000
Shikha	Drip system	Supply drip pipeline and literal drip pipes and nozzles	Continuous maintenance	60,000
Shikha	Water harvesting (7,000 ltr harvesting)	Pipes and fittings	1 labour day	30,000
Bhoomi	Open well	20x20 feet well	2 machinery digging days	22,000
Bhoomi	Pumping and piping	Pump, solar panels, supply pipes	Continuous work	Pump 20,000 Pipes 18,000 Solar panels 16,000
Bhoomi	Drip irrigation for vegetation and plantation (2 acre area)	Drip literal pipes, fittings	3x2 labour days	Drips 22,000 Supply system 8,000
Bhoomi	Site development with trenches and infrastructure	Building materials	Continuous work for 45 days, incl. some machinery work and labour	1 farmhouse of 450 sq feet 70,000 Site fencing and trenches 40,000

The authors

Sibaji Panda

Sibaji Panda was born and brought up in rural Odisha. He is the founder of the Shikha Ecovillage initiative and has introduced alternative farming practices locally there. He has worked on the ecovillage's two project sites to carry out various experiments with agroecological transformation and chemical-free farming. His passion is for designing off-grid living, innovation in water management, and sustainable habitation. In addition, he is one of the most prominent researchers and Deaf educators in India with experience of over two decades in research and development both in the UK and in India. His current focus is on Deaf Education reform and alternative educational approaches.

Santanu Panda

Santanu Panda is project manager at Shikha Ecovillage, specialising in infrastructure development and logistics. He supports both the agricultural work at Shikha and the school for deaf children. He also acts as the first point of contact for a range of purposes including suppliers, visitors and supporters of the ecovillage and the school. Santanu's family has been farming land near Shikha Ecovillage for generations, and he continues to oversee rice paddy farming on his land. He lives in Binika with his wife and two children.

Ulrike Zeshan

Prof Ulrike Zeshan is based at the University of Central Lancashire in the UK. She is a linguist and specialises in sign language research, transdisciplinary teaching and learning, and the development of Serious Games (i.e. games used for non-entertainment purposes such as education or collaboration). Ulrike is a polyglot who uses a dozen signed and spoken languages, including Hindi and Sambalpuri, which are two of the languages in common use in western Odisha. She has been supporting Shikha Ecovillage from the beginning, in particular with regard to the primary school for deaf children, as well as gamification in projects.

Links to further information and resources

Sustainability and regeneration	
Reed, Bill (2007) Shifting from 'sustainability' to regeneration, *Building Research & Information*, 35:6, 674-680 https://www.tandfonline.com/doi/full/10.1080/09613210701475753	Article describing the move from sustainability to regeneration.
Global Regeneration CoLab: https://www.grc.earth/	A global online network of people interested in and involved in regenerative initiatives.
Permaculture CoLab: https://www.perma.earth/	International online network supporting the global permaculture movement.
https://sdgs.un.org/goals	The UN's sustainable development goals.
Shikha Ecovillage	
https://shicol.in	The Shikha Ecovillage website.
GEN International: https://ecovillage.org/gen-international/	Global ecovillages network.
Happy Hands School for the Deaf: https://happyhandsschool.in/	The primary school for deaf children located at Shikha Ecovillage.
Glottolog catalogue of languages: https://glottolog.org/resource/languoid/id/samb1325 https://glottolog.org/resource/languoid/id/oriy1255	Information about the Sambalpuri and Odia languages.
Water management issues in India	
https://vikalpsangam.org/	Search for keyword "water" to find water-related initiatives and alternatives in India.

https://www.thebetterindia.com/	Search for keyword “water” to find water-related initiatives and alternatives in India.
https://nasagrace.unl.edu/Archive.aspx	NASA satellite data on groundwater and soil moisture. Select “Asia” in the area box to find map data that includes India; choose “date” and “type” of mapping.
Water-food-energy nexus	
https://www.water-energy-food.org/	A global knowledge hub with resources on water, energy and food.
https://sim4nexus.eu/	Case studies on the water-energy-land-food and climate nexus, mainly in Europe.
Serious Games	
https://seriousgamessociety.org/	Network of researchers on Serious Games; hosting a major journal (IJSG) and conference series (GALA)
Zeshan, Ulrike (2020). *Serious games in co-creative facilitation: Experiences from cross-sectoral work with deaf communities*. Ishara Research Series No. 4. Lancaster: Ishara Press. https://library.oapen.org/handle/20.500.12657/45769	R&D on collaboration games, with an appendix of playable games (non-digital).
Ouariachi, Tania, María Dolores Olvera-Lobo and José Gutiérrez-Pérez (2018). Serious Games and Sustainability. In W. Leal Filho (ed.) *Encyclopedia of Sustainability in Higher Education*. Springer, Cham. https://doi.org/10.1007/978-3-319-63951-2_326-1	A summary of serious games on sustainability issues, with examples.

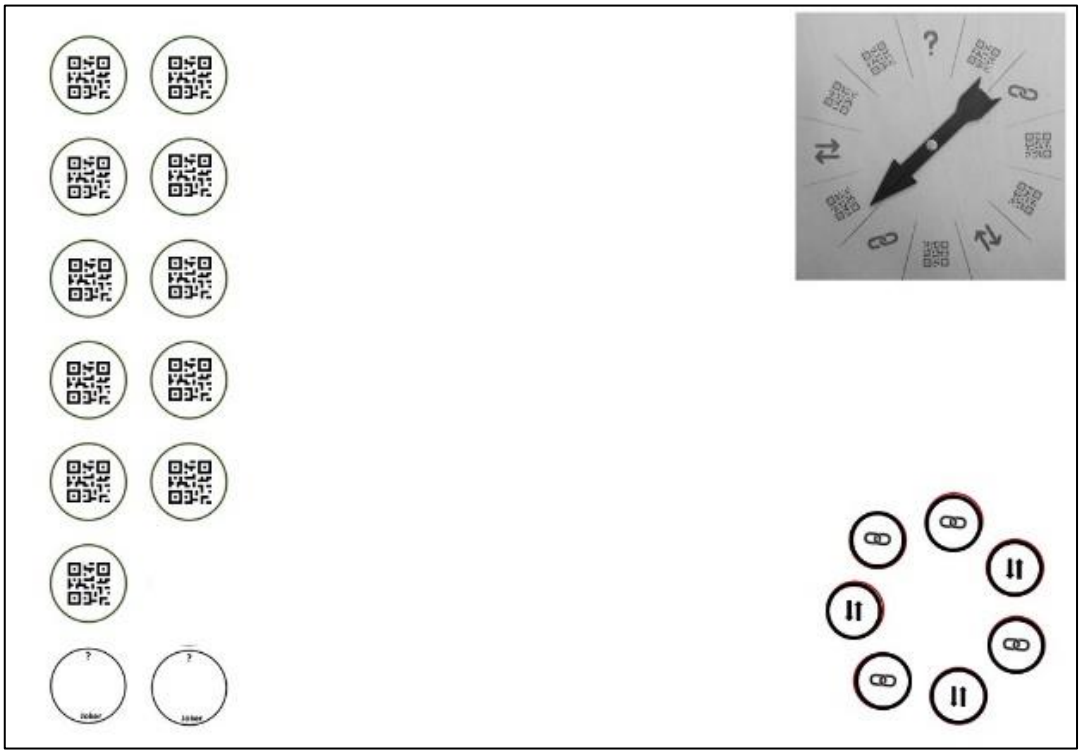
https://www.researchgate.net/profile/Tania-Ouariachi/publication/324475579_Serious_Games_and_Sustainability/links/5beaebae299bf1124fd059b6/Serious-Games-and-Sustainability.pdf	
www.gamesforchange.org	Projects and programmes on social impact games, mostly digital.
Living Labs (real-world labs)	
https://enoll.org/	The European Network of Living Labs, real-life test and experimentation environments for co-creation and innovation.
Labs in the Real World. GAIA - Ecological Perspectives for Science and Society Volume 27, Supplement 1, 2018. Oekom Verlag. https://www.ingentaconnect.com/content/oekom/gaia/2018/00000027/a00101s1	Collection of articles on Real-World Labs.

Appendix: Printing, downloading and assembling the game materials

In this appendix, all game materials are compiled for printing. The QR-code disks, the action discs, the rules card and the disk selection chart are available in English and in Odia.

The files that the QR-code disks link to can be downloaded (in English and in Sambalpuri/Odia) in case there is no live internet connection when playing the game. Otherwise, the files can be viewed online. The maximum file size is 42MB, and the total size of all files is approximately 153MB. Further information can be found at https://ishara.uk/regen-d/wm.

At the beginning of the game, all game materials should be assembled as shown in this picture, leaving the diagram space in the middle empty:

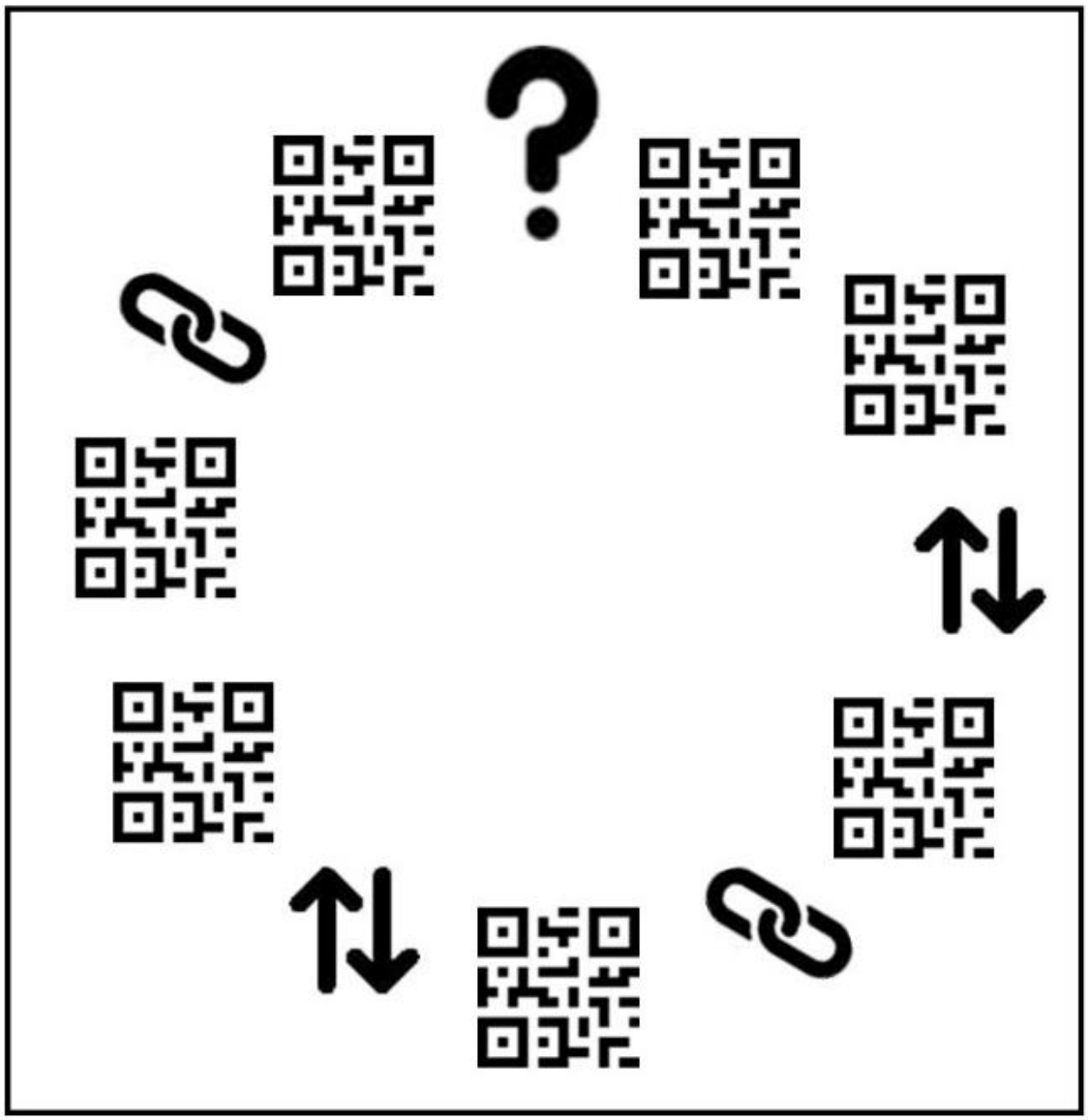


Game components

Regen-D games

Number of players	3-16
Duration	ca. 90 minutes (or a shorter predetermined time)
Materials needed	Selector wheel
	Game spinner or token and dice
	External screen (or sufficient number of smartphones)
	QR-code disks (11)
	Action disks (9)
	Pen / pencil for the joker
	Rules card (or access to the rules card file)
	Disk selection chart (or access to the chart file)

Selector wheel

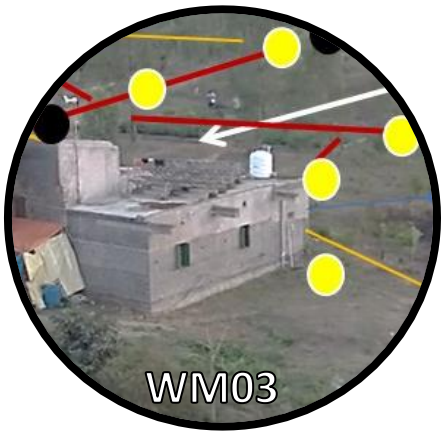


Materials in English

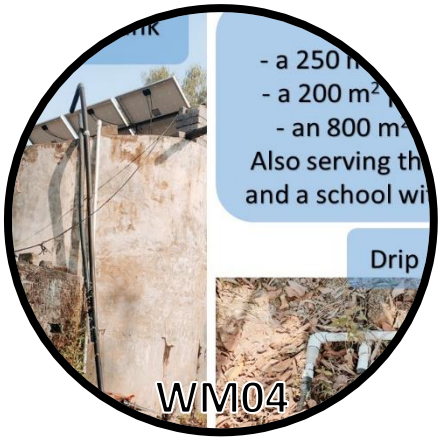
QR-code disks (English; back and front)

WM01 Bhoomi water system - English.pdf

WM02 trenches pdf - English.pdf



WM03 Shikha water pipelines - English.jpg



WM04 water distribution from central storage - English.jpg

WM05 grey water from building to banana - English.jpg

WM06 grey water school building - English.jpg

WM07

WM07 trenches video - English.mp4

WM08

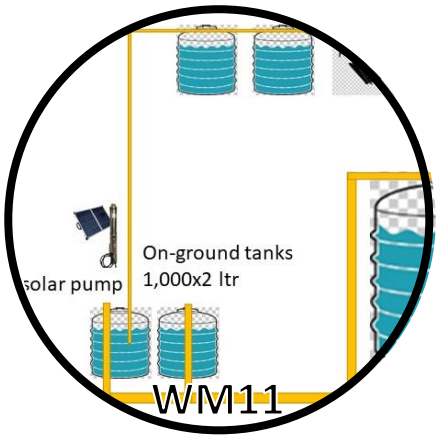
WM08 Water System Summary - English.mp4

WM09

WM09 solar hot water - English.mp4

WM10

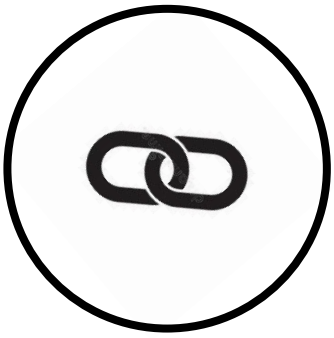
WM10 Drip Irrigation - English.m4v



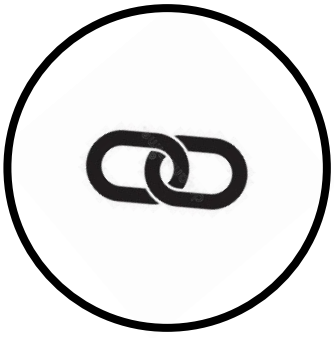
WM11

WM11 water tanks - English.jpg

Action disks (English; front and back)



1



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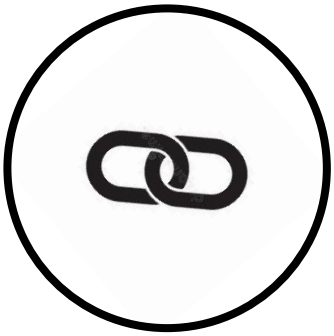

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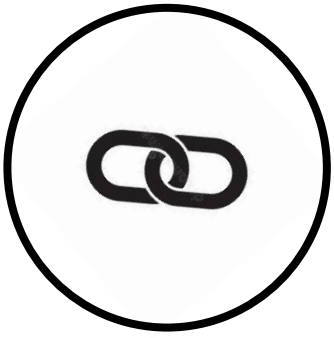

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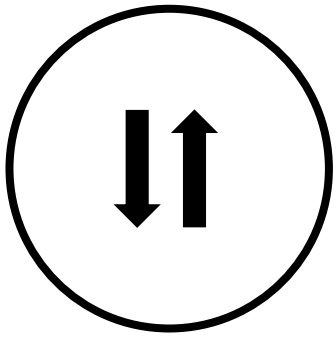
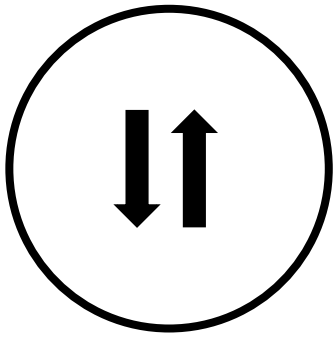


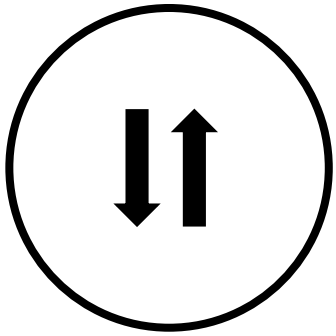

EVALUATE:
Discuss
positives &
negatives

5



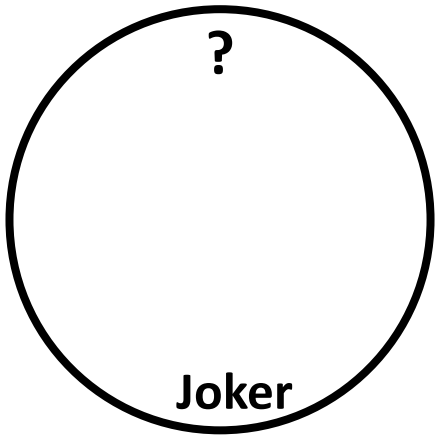

EVALUATE:
Discuss
positives &
negatives

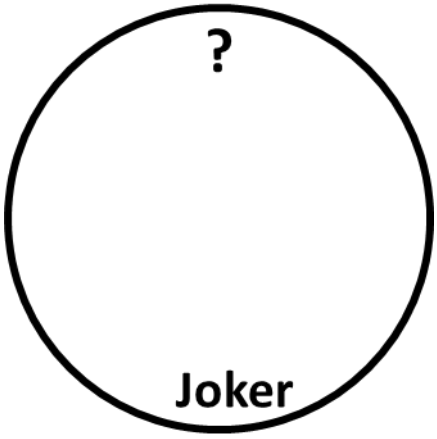
6



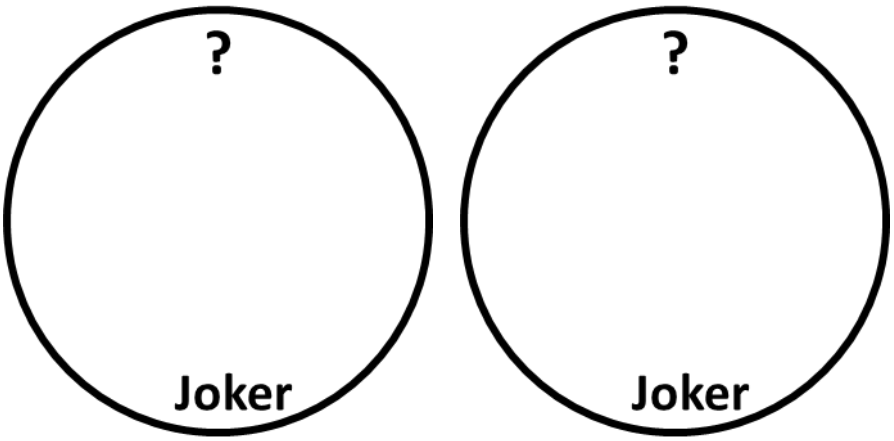

EVALUATE:
Discuss
positives &
negatives

7


?
Joker


?
Joker

8



9

Rules card (English; front and back)

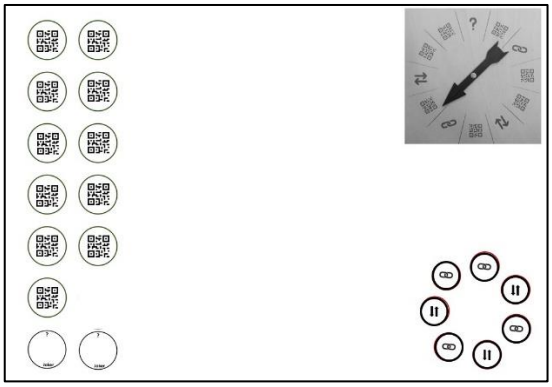
Regen-D Rules for "Water management systems at Shikha Ecovillage"

Aim of the game: For a group of players to develop a shared understanding of water management systems at Shikha Ecovillage by engaging with multimedia materials.

Number of players and time needed: 3-16 players / ca. 90 minutes

Starting the game: To start the game, watch the introductory video here (scan QR code):

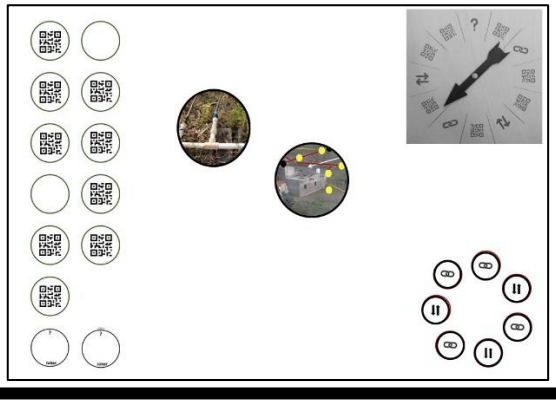
Preparation: Connect a QR-reading device to a screen that all players can see. Then arrange the game materials as in this picture, with an empty space in the middle (the diagram space):



Playing rounds:

A player starts a round by picking up a selected disk and placing it in the central diagram space. This is followed by a group discussion led by the same player. Over time, a visual diagram is built up from the disks.

First and second round: Choose a QR-code disk and scan the QR code to reveal the multimedia file on the screen, then discuss the content of the file. Place each disk in the central diagram space with the placeholder picture facing up:

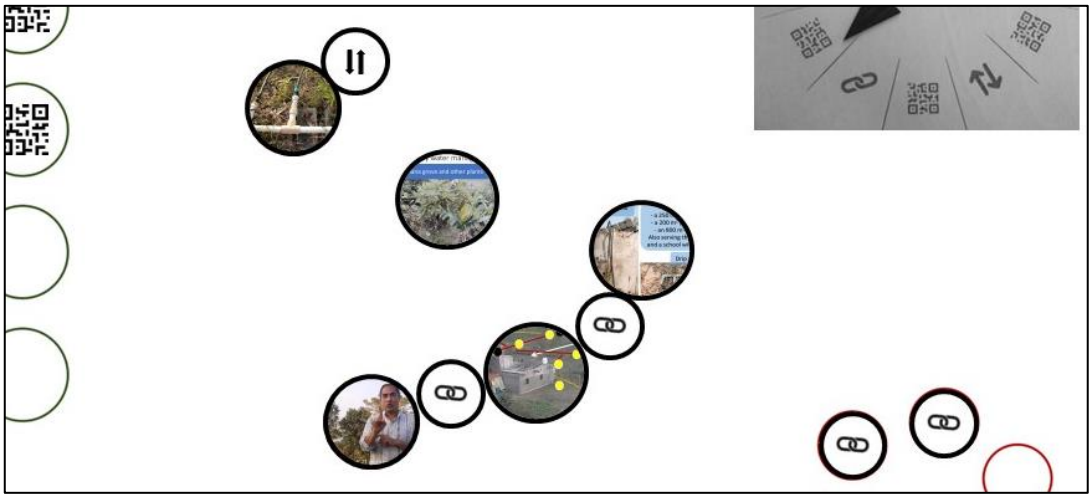


Further rounds:

Spin the selector wheel or walk the token on it to select the type of disk to be placed next in the diagram space, then carry out the action of the selected type of disk:

QR-code disks	Scan the QR code to reveal the multimedia file and discuss the content in the group.
LINK	Place the LINK disk in between two QR-code disks and discuss in the group how the two elements are linked.
EVALUATE	Place the EVALUATE disk next to a QR-code disk and discuss the element's advantages and disadvantages.
JOKER	Think of an additional element to add to the game, represent it with a written note and/or drawing on an empty disk, and discuss the newly added element in the group.

After playing a few rounds, the diagram space will look something like this (example):



Ending the game:

If a time limit has been set, the game ends when the time runs out, regardless of how many disks have been used. If no time limit had been set, the game ends when all QR-code disks are used up. Some action and joker disks may remain unused.

Note:

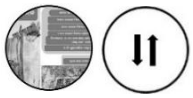
In each round, you can change the placement of the disks in the middle to modify the diagram. For example, move two QR-code disks close to each other if you want to link them with a LINK disk.

If the selector wheel selects a type of disk that has already been used up, move forward along the wheel to the next symbol for which a disk is still available. Towards the end of the game, if only one type of disk is still available and all others have been used up, there is no need to use the selector wheel.

Disk selection chart (English)

Disk selection chart

The rules on the disk selection chart ensure that there are not too many disks of the same type, and that a selected disk can always be actioned. For example, if the selector wheel picks the LINK task in one round, and the EVALUATE task in the next round, a QR-code disk must be picked next (second row of the chart).

Allowable sequences	*Description*
	Select no more than three QR-code disks in a row. The fourth selection must be one of the task disks.
	Select no more than two task disks in a row. The third selection must be one of the QR-code disks.
	Select a joker disk only if a minimum of four QR-code disks have already been played.
	Select a LINK disk only if at least two QR-code disks are available to link together.
	Select an EVALUATE disk only if at least one QR-code disk is available that has not yet been evaluated.

➔ **If the selector wheel results in a sequence that is not allowable according to the chart, move forward clockwise on the wheel to the next allowable symbol.**

Materials in Sambalpuri/Odia

QR-code disks (Odia; back and front)

WM01 Bhoomi water system - Odia.pdf

WM02 trenches pdf - Oda.pdf

WM03 Shikha water pipelines – Odia.odf

WM04or

WM04 water distribution from central storage – Odia.pdf

WM05or

WM05 grey water from building to banana - Odia.jpg

WM06or

WM06 grey water school building - Odia.jpg

WM07or

WM07 trenches video - Odia.mp4

WM08or

WM08 water system summary - Odiah.mp4

WM09or

WM09 solar hot water - Odia.mp4

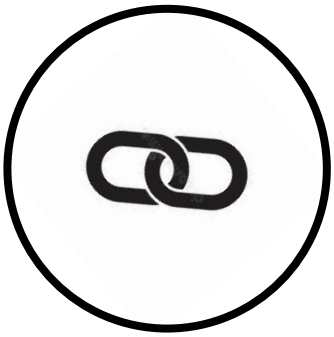
WM10or

WM10 Drip Irrigation - Odia.m4v

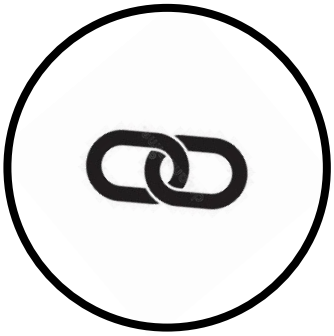
WM11or

WM11 water tanks – Odia.pdf

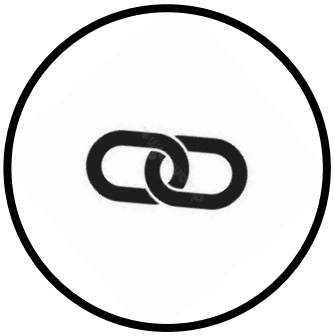
Action disks (Odia; front and back)



1



2



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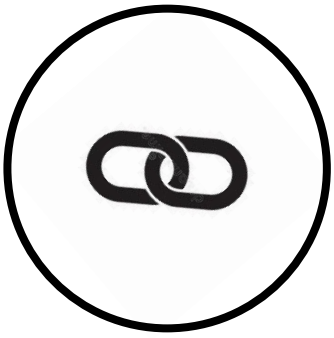
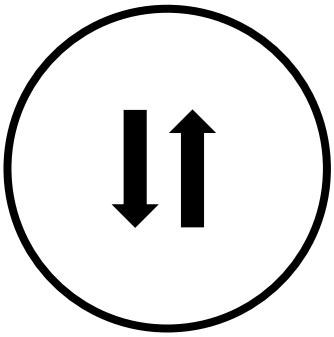
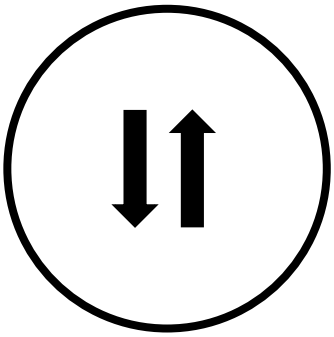


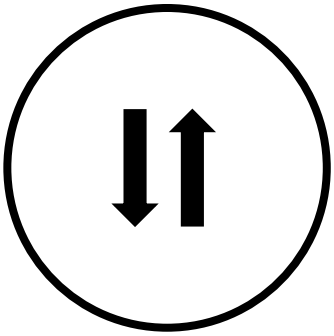
4



5

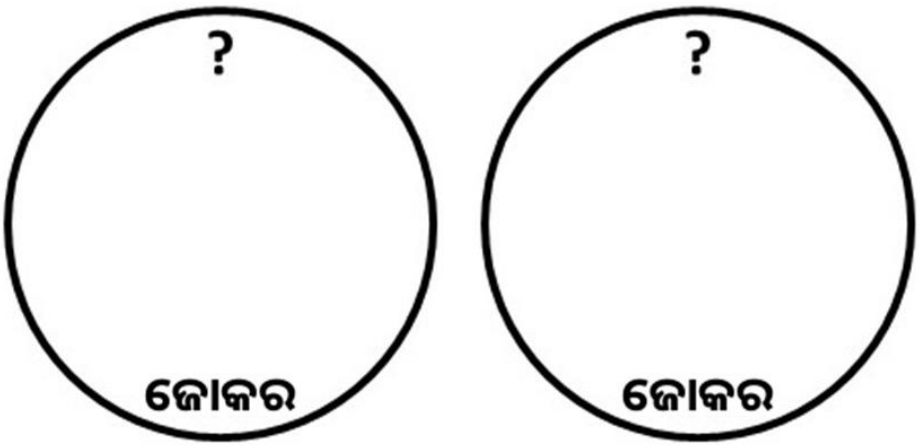


6



7

8



9

Rules card (Odia; front and back)

p. 67-68

Regen-D ନିୟମାବଳୀ: ଶିଖା ଇକୋଭିଲେଜ୍ ଠାରେ ଜଳ ପରିଚାଳନା ବ୍ୟବସ୍ଥା

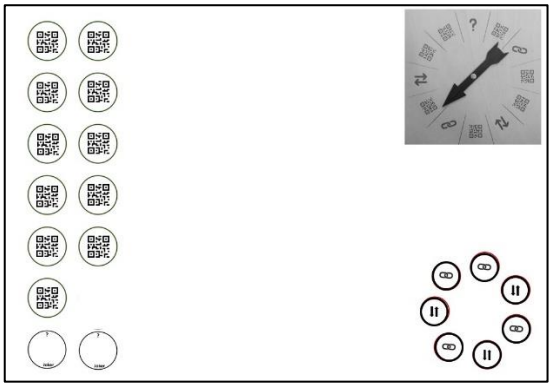
ଖେଳର ଲକ୍ଷ୍ୟ: ଏକ ଗୋଷ୍ଠୀ ପାଇଁ ମଲ୍ଟିମିଡ଼ିଆ ସାମଗ୍ରୀ ଦ୍ୱାରା ଶିଖା ଇକୋଭିଲେଜରେ ଜଳ ପରିଚାଳନା ବ୍ୟବସ୍ଥାର ଏକ ସହଭାଗୀ ବୁଝାମଣା ବିକଶିତ କରିବା.

ଖେଳାଳିଙ୍କ ସଙ୍ଖ୍ୟା ଏବଂ ଆବଶ୍ୟକ ସମୟ: 3-16 ଖେଳାଳି / ପାଖାପାଖି 90 ମିନିଟ୍

ଖେଳ ଆରମ୍ଭ...: ଖେଳ ଆରମ୍ଭ କରିବା ପାଇଁ,

ଦେଖନ୍ତୁ ପ୍ରାରମ୍ଭିକ ଭିଡିଓ ଏଠାରେ (କ୍ୟୁଆର କୋଡ୍ ସ୍କାନ୍ କରନ୍ତୁ):

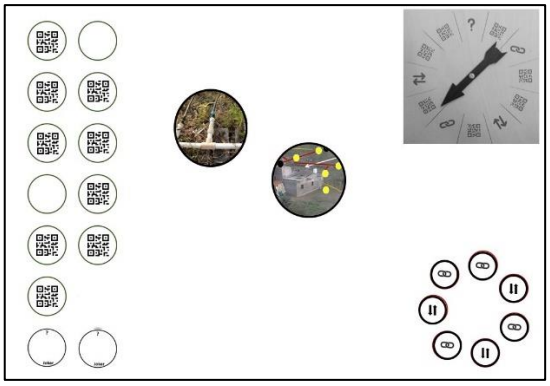
ପ୍ରସ୍ତୁତି: ସମସ୍ତ ଖେଳାଳିମାନେ ଦେଖିପାରୁଥିବା ଗୋଟିଏ ସ୍କ୍ରିନ ସହିତ ଏକ QR Reader ଉପକରଣକୁ ସଂଯୋଗ କରନ୍ତୁ। ତା'ପରେ ଏହି ଚିତ୍ରରେ ଥିବା ଭଳି ଖେଳ ସାମଗ୍ରୀକୁ ସଜାନ୍ତୁ, ମଝିରେ ଏକ ଖାଲି ସ୍ଥାନ ରଖିବେ.



ଖେଳ ରାଉଣ୍ଡ:

ଜଣେ ଖେଳାଳି ଏକ ଡିସ୍କକୁ ଉଠାଇ କେନ୍ଦ୍ରୀୟ ସ୍ଥାନରେ ରଖି ଏକ ରାଉଣ୍ଡ ଆରମ୍ଭ କରନ୍ତି। ଏହା ପରେ ସେହି ଖେଳାଳିଙ୍କ ନେତୃତ୍ୱରେ ଗ୍ରୁପ୍ ଆଲୋଚନା ହୋଇଥାଏ। ସମୟକ୍ରମେ ଡିସ୍କରୁ ଏକ ଭିଜୁଆଲ ଡାଏଗ୍ରାମ ତିଆରି ହୁଏ।

ପ୍ରଥମ ଓ ଦ୍ୱିତୀୟ ରାଉଣ୍ଡରେ...: କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କକୁ ବାଛନ୍ତୁ ଏବଂ ସ୍କ୍ରିନରେ ମଲ୍ଟିମିଡ଼ିଆ ଫାଇଲକୁ ପ୍ରକାଶ କରିବା ପାଇଁ କ୍ୟୁଆର କୋଡ୍କୁ ସ୍କାନ୍ କରନ୍ତୁ, ତାପରେ ଫାଇଲର ବିଷୟବସ୍ତୁ ବିଷୟରେ ଆଲୋଚନା କରନ୍ତୁ। ପ୍ରତ୍ୟେକ ଡିସ୍କକୁ କେନ୍ଦ୍ର ଚିତ୍ର ସ୍ଥାନରେ ରଖନ୍ତୁ ଯେଉଁଥିରେ ସ୍ଥାନଧାରକ ଚିତ୍ରଟି ଉପରକୁ ମୁହଁ କରି ରହିଛି:

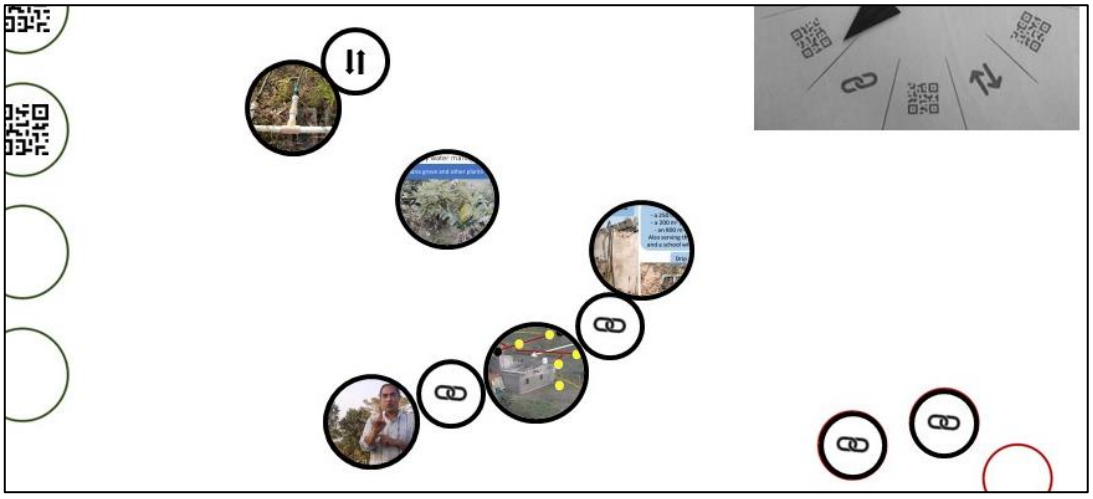


ଆହୁରି ରାଉଣ୍ଡ:

ଚୟନକ ଚକ୍ରକୁ ଘୁରାନ୍ତୁ କିମ୍ବା ଏହା ଉପରେ ଥିବା ଟୋକନକୁ ଚାଲନ୍ତୁ ଡାଏଗ୍ରାମ ସ୍ଥାନରେ ପରବର୍ତ୍ତୀ ଡିସ୍କର ପ୍ରକାରକୁ ବାଛନ୍ତୁ, ତା'ପରେ ବଚ୍ଛିତ ପ୍ରକାରର ଡିସ୍କର କାର୍ଯ୍ୟକୁ ସମ୍ପାଦନ କରନ୍ତୁ:

କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ	ମଲ୍ଟିମିଡିଆ ଫାଇଲକୁ ପ୍ରକାଶ କରିବା ପାଇଁ କ୍ୟୁଆର କୋଡକୁ ସ୍କାନ କରନ୍ତୁ ଏବଂ ଥିବା ବିଷୟବସ୍ତୁ ଉପରେ ଆଲୋଚନା କରନ୍ତୁ।
LINK ଲିଙ୍କ୍ (ସମ୍ପର୍କ)	LINK ଡିସ୍କକୁ ଦୁଇଟି କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ ମଧ୍ୟରେ ରଖନ୍ତୁ ଏବଂ ଦୁଇଟି ଉପାଦାନ କିପରି ସଂୟୋଗ ହୋଇଛି ତାହା ଗ୍ରୁପରେ ଆଲୋଚନା କରନ୍ତୁ।
ମୂଲ୍ୟ ନିର୍ଦ୍ଧାରଣ EVALUATE	EVALUATE ଡିସ୍କକୁ ଗୋଟିଏ କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ ପାଖରେ ରଖନ୍ତୁ ଏବଂ ଉପାଦାନର ଲାଭ ଏବଂ କ୍ଷତି ବିଷୟରେ ଆଲୋଚନା କରନ୍ତୁ।
ଜୋକର JOKER	ଖେଳରେ ଯୋଗ କରିବା ପାଇଁ ଏକ ଅତିରିକ୍ତ ଉପାଦାନ ବିଷୟରେ ଚିନ୍ତା କରନ୍ତୁ, ଏହାକୁ ଏକ ଲିଖିତ ନୋଟ୍ ଏବଂ / କିମ୍ବା ଏକ ଖାଲି ଡିସ୍କରେ ଅଙ୍କନ ସହିତ ଉପସ୍ଥାପନ କରନ୍ତୁ, ଏବଂ ସମୂହରେ ନୂତନ ଭାବେ ଯୋଡ଼ାୟାଇଥିବା ଉପାଦାନ ବିଷୟରେ ଆଲୋଚନା କରନ୍ତୁ।

କିଛି ରାଉଣ୍ଡ ଖେଳିବା ପରେ ଡାଏଗ୍ରାମ୍ କିଛି ଏମିତି ଦିଶିବ (ଉଦାହରଣ):



ଖେଳ ଶେଷ କରିବା :

ଯଦି ସମୟ ସୀମା ନିର୍ଦ୍ଧାରଣ କରାୟାଇଛି, ତେବେ କେତେ ଡିସ୍କ ବ୍ୟବହାର କରାୟାଇଛି ତାହାକୁ ଖାତିର ନକରି ସମୟ ସରିବା ପରେ ଖେଳ ଶେଷ ହୋଇଥାଏ। ଯଦି କୌଣସି ସମୟ ସୀମା ନିର୍ଦ୍ଧାରଣ କରାୟାଇନଥାନ୍ତା, ତେବେ ସମସ୍ତ କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ ବ୍ୟବହାର ହେବା ପରେ ଖେଳ ଶେଷ ହୋଇଥାଏ। କିଛି କାର୍ଯ୍ୟ ଏବଂ ଜୋକର ଡିସ୍କ ଅବ୍ୟବହୃତ ରହିଥାଇପାରେ।

ନୋଟ୍ (Note) :

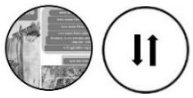
ପ୍ରତି ରାଉଣ୍ଡରେ, ଆପଣ ଚିତ୍ରକୁ ପରିବର୍ତ୍ତନ କରିବା ପାଇଁ ମଝିରେ ଥିବା ଡିସ୍କଗୁଡ଼ିକର ସ୍ଥାନ ପରିବର୍ତ୍ତନ କରିପାରିବେ। ଉଦାହରଣ ସ୍ୱରୂପ, ଯଦି ଆପଣ LINK ଡିସ୍କ ସହିତ ସଂୟୋଗ କରିବାକୁ ଚାହୁଁଛନ୍ତି, ତେବେ ଦୁଇଟି କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କକୁ ପରସ୍ପରର ନିକଟତର କରନ୍ତୁ।

ଯଦି ଚୟନକ ଚକ୍ର ଗୋଟିଏ ପ୍ରକାରର ଡିସ୍କକୁ ବାଛିଥାଏ ଯାହା ପୂର୍ବରୁ ବ୍ୟବହୃତ ହୋଇସାରିଛି, ତେବେ ପରବର୍ତ୍ତୀ ପ୍ରତୀକକୁ ଚକ ସହିତ ଆଗକୁ ଯାଆନ୍ତୁ ଯେଉଁଥିପାଇଁ ଗୋଟିଏ ଡିସ୍କ ଏବେ ବି ଉପଲବ୍ଧ ଅଛି। ଖେଳର ଶେଷ ଆଡକୁ, ଯଦି କେବଳ ଗୋଟିଏ ପ୍ରକାରର ଡିସ୍କ ଏବେ ବି ଉପଲବ୍ଧ ଅଛି ଏବଂ ଅନ୍ୟ ସମସ୍ତ ବ୍ୟବହାର ହୋଇସାରିଛି, ତେବେ ଚୟନକ ଚକ ବ୍ୟବହାର କରିବାର କୌଣସି ଆବଶ୍ୟକତା ନାହିଁ।

Disk selection chart (Odia)

ଡିସ୍କ ଚୟନ ତାଲିକା

ଡିସ୍କ ଚୟନ ତାଲିକାରେ ଥିବା ନିୟମଗୁଡ଼ିକ ନିଶ୍ଚିତ କରିଥାଏ ଯେ ଗୋଟିଏ ପ୍ରକାରର ଅଧିକ ଡିସ୍କ ନାହିଁ, ଏବଂ ଗୋଟିଏ ବଚ୍ଛିତ ଡିସ୍କକୁ ସର୍ବଦା କାର୍ଯ୍ୟକରାୟାଇପାରିବ। ଉଦାହରଣ ସ୍ୱରୂପ, ଯଦି ଚୟନକ ଚକ୍ର ଗୋଟିଏ ରାଉଣ୍ଡରେ LINK କାର୍ଯ୍ୟକୁ ଚୟନ କରେ, ଏବଂ ପରବର୍ତ୍ତୀ ରାଉଣ୍ଡରେ EVALUATE କାର୍ଯ୍ୟକୁ ଚୟନ କରେ, ତେବେ ପରବର୍ତ୍ତୀ ସମୟରେ (ଚାର୍ଟର ଦ୍ୱିତୀୟ ଧାଡ଼ି) ଏକ କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ ଚୟନ କରିବା ଆବଶ୍ୟକ।

ଅନୁମୋଦିତ ଅନୁକ୍ରମ	*ବର୍ଣ୍ଣନା*
	ଗୋଟିଏ ଧାଡ଼ିରେ ତିନୋଟିରୁ ଅଧିକ କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କକୁ ବାଛନ୍ତୁ ନାହିଁ। ଚତୁର୍ଥ ଚୟନଟି ଗୋଟିଏ କାର୍ଯ୍ୟ ଡିସ୍କ ମଧ୍ୟରୁ ଗୋଟିଏ ହେବା ଉଚିତ।
	ଗୋଟିଏ ଧାଡ଼ିରେ ଦୁଇଟିରୁ ଅଧିକ କାର୍ଯ୍ୟ ଡିସ୍କକୁ ବାଛନ୍ତୁ ନାହିଁ। ତୃତୀୟ ଚୟନଟି କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ ମଧ୍ୟରୁ ଗୋଟିଏ ହେବା ଆବଶ୍ୟକ।
	ଗୋଟିଏ ଜୋକର ଡିସ୍କକୁ କେବଳ ସେତେବେଳେ ବାଛନ୍ତୁ ଯଦି ଅତି କମରେ ଚାରୋଟି କ୍ୟୁଆର-କୋଡ଼ ଡିସ୍କ ପୂର୍ବରୁ ବାଜିସାରିଛି।
	ଗୋଟିଏ LINK ଡିସ୍କକୁ କେବଳ ସେହି ସମୟରେ ଚୟନ କରନ୍ତୁ ଯଦି ଅତି କମରେ ଦୁଇଟି କ୍ୟୁଆର-କୋଡ୍ ଡିସ୍କ ଏକତ୍ର ସଂୟୋଗ କରିବା ପାଇଁ ଉପଲବ୍ଧ ଅଛି।
	ଗୋଟିଏ EVALUATE ଡିସ୍କକୁ କେବଳ ସେତେବେଳେ ବାଛନ୍ତୁ ଯଦି ଅତିକମରେ ଗୋଟିଏ କ୍ୟୁଆର-କୋଡ ଡିସ୍କ ଉପଲବ୍ଧ ଅଛି ଯାହାକୁ ଏପର୍ଯ୍ୟନ୍ତ ମୂଲ୍ୟାଙ୍କନ କରାୟାଇନାହିଁ।

➔ **ଯଦି ଚୟନକ ଚକ୍ର ଗୋଟିଏ କ୍ରମରେ ଫଳିତ ହୁଏ ଯାହା ଚାର୍ଟ ଅନୁସାରେ ଅନୁମତିଯୋଗ୍ୟ ନୁହେଁ, ତେବେ ପରବର୍ତ୍ତୀ ଅନୁମତିଯୋଗ୍ୟ ପ୍ରତୀକକୁ ଚକ୍ରରେ ଘଡ଼ିଆଡେ ଆଗକୁ ଯାଆନ୍ତୁ।**