CAMBODIA FLOATING VEGETABLE GARDENS PROJECT REPORT

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based on work undertaken at CoDesign Studio

September 2014

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EXECUTIVE SUMMARY

In 2012/13 CoDesign Studio (Australia), Agile Development Group (Australia/Cambodia) and Rural Friends for Community Development (Cambodia) partnered to run a participatory design project to develop low-cost floating vegetable gardens for villages on Lake Tonle Sap in Pursat Province, Cambodia.

These villages face a number of challenges, including food insecurity, financial insecurity, environmental degradation, over-fishing and water pollution. The majority of residents in these villages are classified by the Cambodian government as 'poor' or 'very poor'. Their diet consists heavily of fish, and as they do not own land, they cannot grow vegetables. Many families eat vegetables only once or twice per week, with health impacts. Some families have been given funding to establish floating gardens, however there are significant difficulties with the current design including cost of construction, susceptibility to damage/destruction during storms, and pest control.

Our participatory design method determined needs and appropriate design responses through an intensive workshop. This is in contrast to a common model of infrastructure development, in which professionals approach a community with solutions to offer.

During the ten day prototyping workshop four teams - each consisting of a local family, visitors from a neighbouring village, two volunteer professionals and one Cambodian volunteer facilitator - worked together to develop and construct a test garden. These prototypes were managed and monitored by the local family for nine months prior to an evaluation process.

The Cambodia Floating Gardens Project has been a successful pilot. The participatory design process was effective in producing an innovative design outcome that solved problems associated with the previous floating garden program. Nutrition and food sovereignty has been improved, villagers have greater knowledge of design and agriculture, and the gardens are producing economic benefits.

We have produced a Participatory Design Handbook to allow other organizations to reproduce the project process. It is a practical guide, written in plain English, intended for NGO's, professionals, and students. This floating gardens project is used as a case study throughout the Handbook, however it is hoped many of the activities will have relevance for all community based projects.

1. PROJECT CONTEXT

Village Background

Floating villages on Lake Tonle Sap face a number of challenges, including food insecurity, financial insecurity, environmental degradation, over-fishing and water pollution. Landlessness and poverty are closely linked. Because floating village residents do not own land, they cannot grow vegetables. Many families eat vegetables only once or twice per week, with obvious health impacts.

The floating villages were established followed the political upheaval in the late 1970s, primarily to take advantage of the abundant fishing opportunities by people who had no access to land for agriculture. Fishing remains the main source of income for most inhabitants, although this is at risk due to declining fish stocks from overfishing and poor eco-system management.

RFCD works in three villages in Pursat Province. The villages involved in this project are Au Akol, which is located a one hour motor boat ride north of the land-based town Kampong Luong, and Kampong Khneas, which is located approximately half an hour south of Kampong Luong. Kampong Luong is 3-4 hours drive from the Cambodian capital Phnom Penh.

The majority of residents in these villages are classified by the Cambodian government as 'poor' or 'very poor'. Living conditions are basic, with each house-boat having no more than two rooms made of wood or thatch and kept afloat with bamboo poles and petrol drums. Cooking is done on a wood stove and sanitation is poor. Fluctuating seasonal water levels on the lake mean that the villagers need to move their floating houses up to eight times per year. To ensure a good fishing catch, it is necessary to remain some distance from the edge of the lake, making it difficult to access markets and fresh fruit and vegetables.

Village	**Kampong Khneas**	**Au Akol**
Number of families	46	33
Total population	182	196
Number of women	89	82
Average family size	4	6
Percentage of 'poor' families	24%	41%
Percentage of 'very poor' families	42%	26%

Project Timeline

April 2012	Partnership Development (CoDesign Studio and Agile Development)
July 2012	Project Identification, Partnership Development (RFCD and Small World), Brief Development
August-October 2012	Recruitment of multi-disciplinary CoDesign Studio volunteer team, Research, Activities Preparation
November 2012	Prototyping Field Trip
December 2012 – July 2013	Prototype Monitoring
August 2013	Evaluation

Project Team

A variety of organizations were involved in the three phases of the Capacity Building Project:

1. Research and Field Trip Preparation (CoDesign Studio research volunteers, Agile Development, RFCD)
2. Prototyping Field Trip (CoDesign Studio field trip volunteers, Agile Development, RFCD, Small World, local village families)
3. Monitoring and Evaluation (CoDesign Studio, Agile Development, RFCD, local village families)

CoDesign Studio

CoDesign Studio is a multi-disciplinary non-profit organisation based in Melbourne, Australia. We work to empower socially excluded communities to become involved in visioning, shaping, owning and implementing projects that improve their living environment. CoDesign's vision is for a world where all communities are safe, healthy, inclusive and sustainable.

CoDesign is a social enterprise made up of qualified professionals from a variety of disciplinary backgrounds. Our core staff are experienced in urban design, architecture and community development. We have a large network of volunteers with expertise in planning, landscape architecture, industrial design, interior design, environmental management, engineering, economics, social sciences and more, who contribute to our projects.

CoDesign Studio's Role

CoDesign's role was to manage the project, provide design expertise and facilitate a participatory design process. A group of CoDesign Studio volunteers were recruited for the research and field trip phases, led by CoDesign staff member Kate Ferguson.

The following volunteers were part of the research team:

- Madeline Gorham – Landscape Architect
- Dai Le – Landscape Architect
- Matt McCallum – Industrial Designer
- Tim Denshire-Key– Industrial Designer
- Jackson Bellchambers – Industrial Designer
- Mani Williams – Engineer
- Matthew Dent – Engineer
- Marc Rouqueirol – Engineer
- Jane Wong – Urban Planning and Design

The following volunteers were part of the research team, and also took part in the Prototyping Field Trip in November 2012. Biographies are included in *Appendix 2 Floating Gardens:*

- David Heymann (Volunteer Coordinator) – Landscape Architect
- Rhian Thomas – Landscape Architect
- Fiona Hurse – Landscape Architect
- Jessica Parke – Industrial Designer
- Kristen Wood – Engineer
- Seona Candy – Engineer
- Glenda Yiu – Architect
- Peter Eckersley – International Urban and Environmental Management

Agile Development Group

Agile Development Group is a Melbourne and Phnom Penh based international development consultancy. They develop community focused enterprise solutions based on locally identified social and economic needs. Agile adhere to principles of social/cultural, environmental and economic sustainable development, with an additional focus on human rights, women and children.

Agile's staff have diverse work and educational backgrounds, they have project development and implementation experience in Australia, Cambodia, China, Colombia, Costa Rica, Guatemala, India, Nepal, Thailand, Timor Leste and Vietnam, with consultation and mentoring provided to organisations in additional countries. They have expertise in grassroots community development, women's programs and social enterprise development services. A current focus is on the development and adaptation of organic sustainable gardens to increase rural food security, income generation, and climate change adaptability.

Agile Development Group's Role

Agile's role in the project is to facilitate the project in Cambodia through their networks with a variety of local organisations, and their expertise in community development. The following staff are involved:

- Ms Vannary San, Program Director
- Mr Joseph Dixon, Country Coordinator
- Mr Ian Jones, Managing Director

Rural Friends for Community Development (RFCD)

Rural Friends for Community Development (RFCD) are a grass roots non-government organization based in Kampong Luong, Pursat Province, Cambodia.

In 1993 French organization Partarne commenced work in Pursat Province, with the selection four influential members of the community around Kampong Luong. Mr Phall and Mr Saum Ty are still working for RFCD nineteen years later. Four initial members underwent a year of training before beginning community development projects such as building a village road, savings groups, rice banks, a community study centre, and an illiteracy program. In 2000 Partarne withdrew from the province, having handed over full management of the organization to local staff, registered RFCD up as a government-approved development organization, and provided them with an office and equipment. Since this time RFCD have partnered with a number of aid organizations to deliver projects in the region. From 2005 until present they have had a long term partnership with UK based aid organization ActionAid. They currently run four programs in thirteen villages in Pursat Province: a food security program, a women's health program, an education program and a good governance program.

RFCD's role

RFCD have a strong connection to the village of Au Akol, having run programs there since 2005. Their role in the project is to select and provide support to the village families involved. The following people were involved in the field trip.

- Mr Keo Phall, Executive Director
- Ms Sagu Sela, Volunteer to food rights program
- Ms Srey Mom, Community facilitator in Au Akol

Food Security Network

The Food Security Network have experience in organic farming techniques. Mr Long participated in the design process and provided training to the village.

Small World

A team of four Cambodian volunteers from a youth-led organisation called Small World were recruited to take part in the field trip. Their role was to facilitate the engagement with each family, including translation between Khmer and English. Biographies are included in *Appendix 2 Floating Gardens.*

- Eng Songhout
- Seat Lykheang
- Theang Sithat
- Phem Menghak

Au Akol families

The following families were selected to take part in the program because RFCD have found them to be motivated in the past, they have some experience with gardening, and they would be likely to look after their gardens through the test period.

- Srey Mom's family
- Chan-ny's Family
- Sobhoeun's Family
- Pah's family

Four design teams were assembled around these four families. The family's role was to inform the design brief for their garden, participate in the design process, keep a logbook to record the inputs, outputs and maintenance activities for their garden, and participate in evaluation after a nine month test period.

Kampong Khneas families

Representatives from the nearby floating village of Kampong Khneas were invited to join the field trip program:

- Om Ny
- Om Leng
- Cheb
- Thuk
- Mao
- Dar

Their role was to participate in the design process, and take ideas back to their own village.

2. PROJECT BRIEF

RFCD's Floating Garden Program

As part of RFCD's food security program, a floating gardens group has been operating in the villages of Kampong Kheannas since 2010, and Au Akol since 2009.

In 2009 an international non-government organization donated 100 bamboo poles each to some families to build floating platforms for gardens. Bamboo is an effective material for both structure and floatation, but it is also very expensive and only lasts for a few years before becoming water-logged. Although villagers were enthusiastic about growing their own vegetables, they couldn't afford to replace the bamboo once it began to break down. Bamboo was also a useful material for house construction, and in some cases the poles from the floating gardens were re-purposed when houses were damaged during storms.

RFCD identify two major problems with the floating garden program:

- There is a limit to the number of families who have access to a garden because of the cost of setup, and families cannot afford to repair gardens when needed;
- People don't understand how to grow vegetables on water, including the use of natural pesticides and fertilisers, because they haven't had any training.

During community workshops in both villages, local people provided the following information about the floating gardens program:

Diet and health

- Health is better when their family has a garden: they have less headaches, are less tired, they don't need coining at the moment (a local massage healing technique). They are more confident about making food from vegetables they have grown because they know that chemical fertilisers haven't been used.
- There are 3-4 families (in Kampong Prak village) who are very poor and don't have enough food to eat.
- With no garden, they eat vegetables 2-3 times per week. With a garden they eat vegetables 6 times per week.
- Without a garden, a family will spend approximately $2/day on vegetables. Each village has a house that operates as a shop and sells vegetables (brought from Kampong Luong) but they don't always have vegetables available.

Construction methods

- Gardens are currently constructed with bamboo and three petrol containers. Because the bamboo and drums are in water all the time, they break down and get rusty.
- In the 2011 storm, fourteen out of twenty vegetable gardens were destroyed. Ten of the gardens were destroyed because those families used the bamboo from the gardens to reinforce their house. The other four gardens sank. The bamboo was about three years old at the time, so it was starting to break down and the storm made it worse.
- Travelling to the land to get soil is labour intensive and time consuming.
- Soil is heavy, so unless there is a lot of buoyancy, the grow-able area is small.

Cost

- A garden costs $250 to set up. Petrol containers last 1-2 years, and get rusty, and cost $10 each. Bamboo is better, but more expensive as $100 buys 80 lengths of bamboo.
- No families have chosen to build a garden without financial assistance. This is because the cost of a garden is the same as a new large non-motorised boat, and the boat has the potential to produce significantly more income.
- When they have a garden, they spend their savings on rice, garlic, sugar, repairing their fishing nets and houses.
- They need to be able to grow enough vegetables to sell them so they can pay for repairs

Agriculture

- The following pests are a problem:
    - rats eat the roots and stems of the plants, and destroy the soil;
    - ants attack the small leaves,
    - aphids
- The following vegetables are currently grown: taro, spinach, cabbage, Thai basil, lemongrass, spring onions, Vietnamese mint, tumeric, kaffir lime, galangal.
- Seeds, which are currently bought from the market, are sometimes not good quality

Labour and time

- The families with successful gardens spend 2-3 hours each day caring for it, and the family organised to help with this.

Gender

- Women currently have many responsibilities including fishing, fish processing (ie smoking and drying), cooking, housework, caring for children and the elderly and educating children. Many women say that gardening will need the cooperation of their husbands and children to be successful.

New Garden Design Criteria

Based on discussion with RFCD, community consultation in the floating villages, and professional opinion, the following design principles were developed during project scoping:

GARDEN DESIGN BRIEF	IN ORDER TO…
Low cost	Reduce donor reliance
Recycled materials where possible	Increase environmental sustainability, and reduce water pollution
Locally available materials	Increase the number of families who can build a garden without donor assistance.
Avoid materials that are used for house construction	Reduce the likelihood that gardens are destroyed during bad weather
Explore hydroponic solutions	Reduce need for buoyant materials and labour intensive soil collection
Explore aquaponic solutions	Create a mutually beneficial and productive system involving fish farming, vegetable production and reduction in water pollution
Simple construction techniques	Allow families to construct gardens without external assistance, and within the free time they have available.
Safe materials	Ensure food safety and quality is not affected: - PET plastic needs to be covered from the sun (otherwise it leaches antimony) - BPA leaches out of some plastics - HDPE is a good high density plastic that can be made with a UV filter. It should last 15-20 years but is expensive

3. PROJECT METHODOLOGY

Participatory Design

Participatory Design, also known as co-design, is an approach that centres around the idea that people who are affected by a decision, event or product should have an opportunity to influence it. Working with users in their own environment is not always easy and the participatory design process can be complex, messy and slow moving. Ultimately though, including users in all stages of the design process increases their ownership of the end product and the probability of a usable design in the long term. Along with the development of an appropriate design, an equally important outcome in participatory design is the empowerment of the users to express their needs and ideas, and gain skills which enable them to address future design challenges without the need for external design professionals.

When differences in culture and/or life experiences exist between professional designers and the users of a product, user involvement becomes a key success factor. Communities are experts in their own local environment and needs, and no matter how experienced the designers are, what they perceive as being the best solution will inevitably be based on their own world view. High levels of user participation mean designers do not interpret collected data from their own cultural vantage point in isolation from the users. This helps to avoid misinterpretation. Recognition of the users as experts is also empowering, leading to better development effectiveness.

The main guiding principles for participatory design include:

- Allowing designers to work directly with users in their own environment to understand actions and technologies in actual settings;
- Enabling users, professional designers, and other stakeholders to participate equally so design ideas arise in collaboration with participants from different backgrounds, and decision-making is democratic;
- Valuing all kinds of knowledge, regardless of whether it has been gained through professional training or lived experience.

The traditional model for participatory design is described in Figure 1. Designers team up with users and maybe some other selected stakeholders to do co-creation, i.e., participatory design. Together, often in workshops, user needs and problems with existing technology or products are identified and new solutions are developed. This model is most easily implemented in places where: there is an effective education system which places value on skills such as problem solving, critical thinking, and creativity; there is an egalitarian culture with relatively equal power relations between professionals and non-professionals, and; participants have a common language and cultural understanding of how to communicate respectfully and effectively with each other.

These conditions are often not present when working in a community development context. It may not be possible to work together equally from the beginning because users may be less likely or less able to express their ideas due to cultural norms, class differences, language barriers and/or education background. For this reason, a slightly different methodology may be necessary, as shown in Figure 2. Initially the co-designing process is led by the designers, with the aim that the users will take the lead at a later stage. This can occur once the users have sufficient design knowledge and confidence to express their ideas and once the designers have sufficient cultural understanding to facilitate effectively.

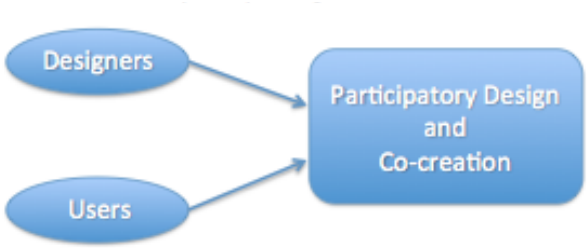

Figure 1: Traditional participatory design process

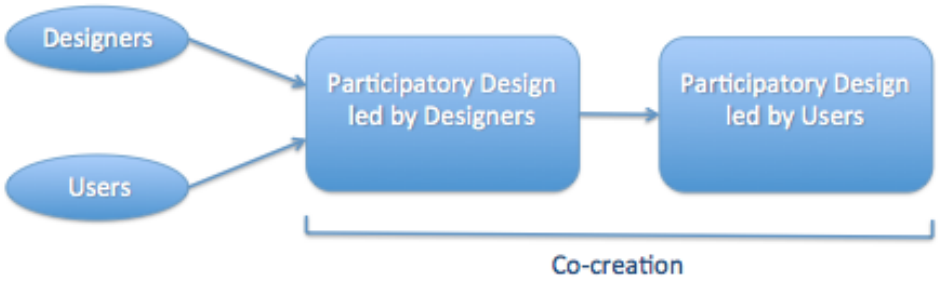

Figure 2: Participatory design process in a community development context

Role of the designer – facilitator and contributor
In the participatory design process, the role of the designer is often as a facilitator of the process in addition to a contributor of ideas. These roles can be separated where resources are available.

To empower participants, facilitators must put great effort into seeking and understanding participants' opinions, and ensure all participants are given real opportunities for influencing the product or services being designed. A common challenge occurs when professional designers and participants disagree. In this case it is important for all participants to discuss why they hold their opinion: delving deeper into the issue allows participants to learn from each other, and this understanding can inform the best solution. It is a mistake for a designer to think that their technical knowledge means they know the best solution. Sometimes designers believe their role is to guide participants toward this 'best' outcome (from their own point of view), however this mindset is damaging because it does not value the knowledge that other participants bring. It is true that designers will have knowledge that the participants have not been exposed to, but the reverse is also true: participants have knowledge that the designers do not. There may be many underlying reasons for participants to express certain preferences, and the job of a facilitator is to bring these reasons to light. The facilitator also needs to be flexible to alter their approach to suit the dynamics of the group. This requires knowledge of a suite of approaches and activities to foster participation and also regular monitoring and evaluation throughout the design process. It is also important for facilitators to reflect on their own identity, expectations and assumptions, and how these things influence the process.

In the role of contributor, a designer must be able to communicate their suggestions and the reasons behind them in ways that are appropriate for other participants to understand. They must also be a listener and team member, treating other participants with respect and working toward a collaborative solution.

Importance of Tools / Activities
Putting participation into practice often relies on activities (also called 'tools') to help non-designers to articulate their needs and ideas. The different types of activities are defined as:

- Making tools - tools and techniques for making tangible things (collages, maps, models and mock-ups made by non-designer participants)

- Telling tools – tools and techniques that support verbally oriented activities such as talking and explaining (diaries, logs and the use of cards for organizing ideas).
- Enacting tools – tools and techniques to facilitate acting and playing (role playing, improvisation, use of props and puppets)

Each participatory design process will generally require a different combination of activities depending on the context, and the specific capabilities and cultural norms of participants. It must be stressed that the activities themselves do not guarantee success, and facilitation is very important.

Research, Ideas Generation and Activities Preparation

The following activities were carried out before the participatory design workshop.

Scoping

CoDesign Studio and Agile Development discussed Agile's ideas for projects based on their current experiences in Cambodia. A Scoping Field Trip was undertaken for CoDesign Studio to get a better understanding of the context of floating villages and work with local people to identify issues. The result was the information and design brief described above in Section 4 RFCD's Floating Gardens Program.

Research

A multi-disciplinary team of volunteers were recruited, and initial research focused on:

- Possible construction systems
- Locally available materials
- Local industry and skills
- Cultural context
- Ecology and climate

Ideas generation

Following this research, the CoDesign Studio team began responding to the design brief developed during the scoping trip, and developing ideas. Materials tests were undertaken.

Activities preparation

A series of activities were developed in preparation for the field trip. These are described in the next section.

Material testing in Melbourne

Prototyping Field Trip

A team of nine CoDesign Studio representatives undertook a 10-day field trip to Cambodia in November 2012. The purpose of the field trip was to run a participatory design workshop with village families, and build four test designs that could be monitored by the families over the subsequent year. This section outlines the field trip program and outcomes.

Day 1 – Phnom Penh

The morning consisted of a team meeting including introductions from organizations and individual volunteers, and discussion around project goals, activities and planning for the field trip. In the afternoon the team broke into small groups to: collect waste materials from markets, shops and recycling depots, refine the field trip program; and visit local organization Live and Learn Environmental's floating garden test site.

Visiting waste depots

Day 2 – Phnom Penh, travel to Kampong Luong

Day 2 began with a discussion with Taber Hand from Conservation International. The team then split, with some people collecting more materials, and a group working on a detailed Monitoring and Evaluation plan for the field trip (refer to *Section 5 Field Trip Outcomes*)

In the afternoon we travelled by bus to Kampong Luong, and later team meetings carried on late into the night.

Day 3 Kampong Luong, travel to Au Akol

We spent the morning investigating the markets in Kampong Luong and Krakor, to determine availability and price of materials, and then travelled by boat to Au Akol. In the afternoon a village meeting was convened. We undertook the following activities with the villagers.

What is design?

A charade game where CoDesign volunteers acted out an everyday design process (creating a fan when it is hot) with the aim of inspiring people to want to get involved and demonstrate that language differences do not have to be a big barrier. Reflection with the villagers centred around the ideas that design is:

- about problem solving
- iterative (testing, learning from mistakes)
- collaborative (different knowledge and perspectives are important)
- creative (imagining a different future)
- something that everyone can do.

Expectations of the project

In discussing expectations with village families, it seemed that people hoped that were there to provide bamboo to fix their existing gardens. They had observed us arriving with our recycled materials, and thought that the plastic bottles would just blow away. They also thought that it wouldn't be possible to build a garden for $25, which was what they thought they afford without donor assistance.

Day 4

The team split into four groups with each group containing:

- 2 CoDesign volunteers
- 1 Small World volunteer
- 1 Au Akol family
- 1-2 representatives from Kampong Khneas village

For the next 5 days we worked in these teams, based at the Au Akol family's house. Activities in the first two days are outlined below, and the remainder of time was spent sourcing materials and building the floating gardens. Please refer to *Appendix 2 Floating Gardens* for detailed information about each team and the garden they designed and built.

Activity 1: Introductions

An informal conversation with each family was useful in order to get to know each other, learn about life in the village gather information.

Activity 2: Design exercise to establish baseline skills

We asked each family to draw their 'perfect' garden, in order to find out what elements are important, and also establish and understanding of baseline skills in design. This exercise demonstrated that people think carefully about how a garden is laid out, for example the width of rows and space for walking, however the construction systems drawn were the same as what already exists, people have not considered the use of other materials, and there is therefore a need to develop new ideas and build the confidence of families to experiment.

Activity 3: Materials

Flashcards showing a variety of locally available materials were sorted into 'useful' and 'not useful', and the reasons for the categorisation was discussed. Useful information from this activity centred around durability of materials, especially when exposed to sunlight or submerged in water.

Activity 4: Climate and weather characteristics
A chart showing months and weather characteristics was used to discuss and record the characteristics of each month.

Activity 4: Floating Garden Examples
Examples of floating gardens and structures in other parts of the world were discussed, and their relevance to the Cambodia context analysed.

Day 5 - 8

Design, sourcing of materials, and construction took place in the four teams (refer *Appendix 2 Floating Gardens*)

Day 9

All interested villagers were invited to a village meeting in which each family presented their design for the floating garden, including an explanation of:

- The materials needed
- The cost of materials
- The steps involved in the construction process
- Their perception of the advantages and disadvantages of their design.

The representatives from Kampong Khneas village also gave a presentation about what they had learnt through the program, and their plans to implement a floating garden program in their own village.

The school teacher, who had arrived in the village part way through the field trip, had taken the initiative to developed a gardening program to tie into the school curriculum. Hanging gardens made of plastic drink bottles and bamboo segments were built, and each child tends to one of these modules. The teacher has developed some teaching about gardening, and there are prizes for the best tended plant.

Monitoring

The four families with gardens were given logbooks at the end of the Prototyping Field Trip. With the help of the community facilitator, they recorded inputs (labour, maintenance materials, seeds, fertiliser etc) and outputs (quantity and whether the produce was eaten, sold or gifted).

After nine months, the project team returned to evaluate the project. The methods and results are documented in Section 6 Evaluation.

4. FLOATING GARDEN PROTOTYPES

This section provides information about each of the designs that was developed during the Prototyping Field Trip.

Srey Mom's Garden – Raft with 'bottle-bricks'

Au Akol Family
Srey Mom is 20 years old and lives with her father Mr Sok, her sister Srey Touch, her grandmother and grandfather. Srey Mom works as the Community Facilitator and earns $5/month. She is the only literate person in her family. Srey Touch, who is eight years old, attends school. Srey Mom's grandparents fish for their own personal use. They have not attempted to make a profit from their small catch. To help feed the family, the household keep a small garden and spend around ten to fifteen minutes per day tending to its upkeep.

Kampong Khneas family representatives
Cheb is Kampong Khneas' village facilitator/representative, middle aged man who can read and write Khmer. For the duration of the project he was taking notes and actively contributing to discussions. On the final day when the group was preparing for their community presentation, Cheb drafted his own action plan based on what was achieved in the past week to initiate in his own village.

Thuk a young female also accompanied Cheb from Kampong Khneas. Thuk is unable to read or write Khmer and initially was quite timid and hesitant to participate in group activities such as "the perfect garden" exercise. Following the experience was really inspired to start collecting bottles to build her own garden.

CoDesign Studio
Seona Candy is an engineer and recently completed a PhD investigating the use of low-cost appropriate technologies to address food security and nutrition in remote, impoverished mountain communities in Nepal. Glenda Yiu is a photographer and poet at heart and an architect by profession with experience working in the UK, Indonesia and Australia.

Small World
Seat Lykheang

Design brief

In addition to the basic brief, the family had the following requirements:

1. The family required a sizable garden (not tokenistic) to provide extra income as well as to increase nutrition in diet.
2. They initially wanted something solid enough to walk on but we were able to introduce the idea of working the garden from the edges in a boat. This then influenced the sizing of the garden.
3. Family had little resources themselves to contribute, financially. This guided the project design whereby many of the materials can be gathered over time at no cost. Eg. Timber can be gathered in the dry season, plastic bottles can slowly be accumulated, old fishing nets can be re-used.
4. As the family had two males with very strong construction skills, this lead the design to be as it is.

Materials

Item	Quantity	Price per unit	Total price
plastic bottles of same size and shape with lids. 500ml	768	50R	38 400R* ($12.10*)
string to tie bottles into “blocks”			
6m bamboo	2	6 000R	12 000R
6m timber	9	4 000R	36 000R* ($9.60*)
40kg rice bags	4		
25kg rice bags	2		
rice bags (sewn together)	Area: 3m x 1.5m		
old fishing net		-	
water hyacinth roots		-	
coconut husks			
long nails	500g	8 000R/kg	4 000R
short nails	500g	8 000R/kg	4 000R
rope			
TOTAL			**120 400R* (US$31.10*)**

* Market price however can be collected over time at no cost.

Tools

- large sewing needle
- hammer
- axe
- hand drill
- saw

Chan-ny's Garden – Raft with tins

Au Akol Family
The Chea household has seven people: Ros Phally, the father, Ren Chan-ny, the mother and their five sons, Chea Sokthea, 11 years old, Chea Seth, 9 years old, Chea Chamrouen, 7 years old, Ros Rina, 3 years old, and Ros Tary, 4 months old.

Sokthea, Seth and Chamrouen all attend school, and do not pay tuition fees. To support their family, Phally, a former monk, works as a fisherman and Chan-ny, when she is not doing household chores, sells fish. Phally works from 8am to 3pm and earns an average of $10 per day in the wet season.

Chan-ny attempted to work on a garden for the household. She used soil, and planted water hyacinth. Later, all the soil fell through and she lost the garden. Chan-ny had been reliant on outside help for the materials for her garden, and has not been able to mend and improve on the failed resource.

Kampong Khneas family representatives
Mao was an integral part of the design and construction team. She is a mother, a fisherperson and was eager to learn how to build a garden so that she could build one at her home in Kampong Khneas.

CoDesign
Kristen Wood is an engineer/scientist with experience in community-led development projects in India, Mexico and Nicaragua. In Australia, she works in the renewable energy and energy efficiency industries and gets inspired by projects that take us closer to a sustainable and equitable world. Peter Eckersley has a background in European languages and political science. He is passionate about social justice and sustainable urban development and is currently doing a Masters of International Urban and Environmental Development at RMIT University in Melbourne.

Small World
Theang Sithat is a twenty-two year old law student. This project is the first time Sithat has volunteered and her first time working with an ethnic minority.

Design brief

In addition to the basic brief, the Chea family had the following requirements:

5. Ability to stand on the garden to tend to it
6. Maximum growing area for the budget
7. Sides of the garden to provide a barrier from rats, and also prevent soil from leaking out of beds when it rains
8. Square-shaped bamboo frame
9. Use of a smaller number of larger plastic containers rather than many smaller plastic bottles (they thought that small bottles would not stay together well enough in a storm)
10. Covering the plastic containers from UV light

Materials

Item	Quantity	Price per unit	Total price
Metal oil tins (rectangle 17L)	16	2500 riel	40,000
Bamboo lengths (6-8m)	3	10,000 riel	30,000
Plastic containers (25L)	10	5,000 riel	50,000
Old fishing net (end-of-life)	1 kg	1,300 riel	1,300
Small nails	50g (120)	5,000 riel	5,000
Unfinished timber lengths (1.5m)	10	free	
Electrical tape (roll)	1		
Old clothes/fabrics		free	
TOTAL			**126,300 Riel = US$31.57**

Tools

- Pliers
- Wire cutters
- Small axe
- Scissors
- Rubber mallet

Sobhoeun's Garden - Baskets

Au Akol Family
The Sabeourn Family are Phoual (husband) 28, and Chhum Soboeun (wife) 26, with 3 young children, Chea (son) aged 9, Ooen (daughter) aged 4 and a baby boy approximately 1 year old.

The family is dependent on a fishing livelihood and in the dry season, Phoual can catch 20kg/day of fish around 3-4 days per week. They take the fish to Kampong Luong but in the wet season a fish buyer comes to the village. Phoual was born in this village but moved to Phnom Penh when he was young. He would like to return but is restricted by income.

Chhum Soboeun, normally fishes during early hours 5am-9am and then again from approximately 3pm-7pm on a normal day. Between fishing she looks after the children, cooks meals, cleans the house and tends the existing floating garden. When she goes fishing, she takes her youngest son and daughter in the boat.

Chea (the son) is able to go to school around 1 week out of 4. He wants to become a teacher. They say that Ooen will go to school when she is about 7 years old. Normally children start going to help with fishing they are 11 years old, and therefore Chea doesn't work yet.

Kampong Khneas family representatives
Ny and Leng also participated in the team and were older ladies from Kampong Khneas.

CoDesign
Kate is an architect specializing in participatory design. She has led volunteer projects in a community based setting in Australia, Papua New Guinea, Turkey and Canada. She is COO at CoDesign Studio. David Heymann is a landscape architect with experience in volunteer architecture projects from the very rural north of Thailand, to the 'slums' of India. Fiona Hurse is a landscape architect with a keen interest in natural systems, ecological processes and the integration of these within the design process to create site responsive solutions.

Small World
Eng Songhout

Design brief

In addition to the basic brief, the Sabeourn family had the following requirements:

1. The family required a garden that they could easily maintain and move if required during the wet season.
2. They wanted something sturdy, but also flexible. This influenced the idea of a more modular design that could be added to as more money became available to build more units.
3. The family had an existing garden attached to the house, but it was not very stable and needed repair. A more accessible design was required that did not need to be walked on, but easily reached. This influenced the idea of using fishing baskets as the growing area. The existing garden was cared for by Sobuen who was keen to expand/ have a more productive garden.
4. 2 days of discussions lead to the development of the floating fishermans basket idea that would be based around a more traditional frame.
5. Phual was apt at construction and dominant in putting the frame for the prototypes together, however his wife would be the one who would look after the garden when complete, including caring for the plants.
6. The family also wanted to show the difficulty of accessing soil (**see *collecting soil**)

Materials

Item	Quantity	Price per unit	Total price
Prototype 1 – Bamboo Float			
Bamboo	4 x 1m	2,000	8,000r
Square Timber	4m	2,000	8,000r
Basket	1	15,000	15,000r
Small Bottles	40	50	2,000r
Rice Bags	2	500	1,000r
Rope			750r
Nails	8		75r
Total			**34,825r**
			= US$8.70
Prototype 2 – Oil / Dishwashing Liquid Bottle Float			
Square Timber	4m	2,000	8,000r
Small Bottles	50	50	2,500r
4L Oil/Dishwashing Liquid Bottles	4	1,500	6,000r
Basket	1	15,000	15,000r
Rice Bags	2	500	1,000r
Nails	8		75r
Rope			750r
Total			**33,325r**
			=US$8.30
Prototype 3 – Bottle bag floats			
Square Timber	6m	2,000	12,000r
Small Bottles	72	50	3,600r
Rice Bags	3	500	1,500r
Basket	1	15,000	15,000r
Nails	16		150r
Rope			1,000r
Fishing net			500r
4L Oil/Dishwashing Liquid Bottles	2	1,500	3,000r
Total			**36,750r**
			= US$9.18
TOTAL (3 Prototypes)			**104,900r = US$26.225**

* Market price however can be collected over time at no cost.

Tools

- large sewing needle
- hammer
- hand drill
- saw
- chisel
- machete

Pah's Garden – Inner tubes

Au Akol Family
There are nine members of the Pah and Dah household. Pah, is a 51 year-old divorcee. Her husband left her fifteen years ago, but Pah had remarried since. Pah and Dah have had three children together: Borung, who is10 years old, Meng-heur, who is 13, and their sister, Menga.

Pah and Dah live with Pah's younger sister. Her sister is a widow, but continues to care for her three children. To earn a living, she buys, smokes and then sells on fish. All the children attended school for two years, but are no longer in education, due to the distance from their village to the school, which adds travel expenses on top of their other outgoings.

When the adults struggle to support their families, the two eldest children work in rice fields away from the village. They are at home from October to December

CoDesign Studio
Jess Parke is an Industrial Designer and has worked in furniture and joinery design for 6 years. With an interest in sustainability and design for social change, she has since returned to university to study a Masters of International and Community Development. She has been training in circus arts for 5 years, but has no plans to run away with the circus just yet.

Rhian Thomas is a Welsh Australian working as a Landscape Architect on projects up in the NW of Western Australia aiming to engage cultural values, and design interactive, engaging, liveable spaces. Through design, Rhian wishes to encourage others to embrace, appreciate and respect our 'country'. A passion in community development, permaculture and sustainable design led Rhian to CoDesign in 2012 where she soon became involved in the Cambodia Floating Garden Project, an invaluable, incredible, educational experience filled with great people and great ideas.

Small World
Phem Menghak is from a remote village in Kampong Chhnang Province, Cambodia. His parents are farmers, and on completion of high school in 2010 and got scholarship from the Ministry of Education, Youth and Sport to study at Royal University of Agriculture in Animal Science faculty. Alongside his studies, Menghak is involved in a variety of volunteer activities in Phnom Penh city and the provinces. In the future, he would like to study a Masters in Animal Production internationally, and work as a farm manager in his home country, in order to produce a lot of work for his nation and other countries.

Materials

ITEM	QUANTITY	PRICE (riel)
Prototype 1		
Inner tubes, inflatable	6	30000
Inner tube, unrepairable	2	1600
small plastic bottles	30	1500
old fishing net	3	nil
twine		300
rice bag, damaged	3	nil
coconut husk/hyacinth root		nil
Tape (for bottle tops)		
Soil		
		33400 =US$8.35
Prototype 2		
Small bottles	150	**7500**
rice sack (40kg)	6	**4200**
twine	20m	**1000**

electrical tape	60m	**7200**
old clothes	3	**nil**
coconut husk/hyacinth root		**nil**
inner tube, damaged	2	**1600**
bamboo	3m	**5000**
		27,500R **= US$6.85**
Prototype 3		
1.25L plastic bottle	9	**4500**
3L plastic bottle	10	**5000**
25kg rice sacks	5	**3500**
old clothes		**nil**
thread or twine	20m	**500**
bamboo strips	9m	**4500 (overestimate)**
wire	3m	**500**
coconut hush/hyacinth root		**nil**
		18,500R **= US$4.62**

Tools

Prototype 1:

- Scissors
- Pump
- Machete

Prototype 2:

- scissors
- saw

Prototype 3:

- scissors
- large needle
- Machete (to strip bamboo)

5. EVALUATION

Project Goals

The following outcomes were developed in collaboration between partner organisations and village people:

1. Improved Nutrition and Food Sovereignty
2. Effective participatory design method
3. Increased knowledge of design and agriculture
4. Innovative design outcome
5. Gender
6. Economic benefits of gardens

Evaluation Methods

The following methods were used to collect data:

- **Nutritional survey:** a baseline and post-project survey to gather data on nutritional intake.
- **Design skills activity:** Each family was asked to draw their ideal garden. This was used to establish whether participants were aware of other ways of constructing, and capacity for creative thinking.
- **Volunteer diaries:** each team kept a diary for daily reflection, and this included documenting changes in behaviour amongst the villagers and the amount of participation from men, women, boys, girls and youth. They also reflected on the quality of participation, such as amount of talking, sharing ideas, critical analysis, and identifying problems and developing solutions to them.
- **Informal discussion** between the participant families and Agile Development and Small World.
- **Village presentation:** at the conclusion of the field trip each family presented the design developed by their team, including their perception of the advantages and disadvantages of the design.
- **Family Logbooks:** Each family with a garden has a logbook to document any repairs or improvements they make to their garden, what they plant, harvest, eat and sell.
- **Family Interviews:** Each participating family was interviewed nine months after the Prototyping Field Trip.
- **Critical reflection**: the CoDesign Studio volunteer team reflected on their own learnings, successes, and criticisms, and we will be seeking critique from other experts as part of the evaluation phase.
- **Cost Benefit Analysis**: Using data from the Family Logbooks, Agile Development Group produced a detailed cost benefit analysis

Results Overview

Of the four participating families in Au Akol village, three were still gardening nine months after the Prototyping Field Trip. One family had given up gardening, and one new family had built a floating garden with help from a participating family. In Kampong Khneas village, all five participating families had built a floating garden using their own money and design skills. An additional eight families had observed these participants and adapted the idea to design and build floating duck pens, which is a new industry for that village.

The family who gave up gardening did not participate much during the field trip, but were very enthusiastic about their team's design at the end-of-project presentation. When asked about this nine months later, Pah responded that she never liked the design and she felt pressured to do what we wanted. She was positive in the village presentation because she believed it would be successful if it did last a long time like the designers said it would. The fact that all other participants responded well to the project process suggests that there were misaligned expectations with this family. It was felt by the partner organisations that the reasons for lack of success with this family were:

- that they didn't understand the concept of a trial/experimentation and they thought that anything a donor gives them should be successful;
- they were not very open or willing to try things;
- they were in fear because they felt under pressure to make it successful in order to please the donor;
- that the family intend to move to land so are not very interested in investing their time in gardening; and
- that they stopped gardening because of some sickness in the family.

Outcomes Summary

This section documents the project results against the goals, including a summary of all goals, followed by a detailed description of the evaluation of each goal including reason for the goal, indicators, methods and measurements.

1. Improved Nutrition and Food Sovereignty

Three out of four Au Akol participant families have significantly increased their vegetable intake. They value vegetables for nutrition and the increased variety in diet they offer. They feel more confident about eating vegetables due to their control over the pesticides and fertilizers used. In Kampong Khneas, five families have built floating gardens which is likely to lead to increased vegetable intake.

2. Effectiveness of participatory design method

Three out of four families showed strong participation throughout the process, and took the lead at various stages of design and construction. One family displayed limited engagement, did not see value in the idea of testing, and expected to be provided with a successful solution. They have not continued gardening, preferring to buy their vegetables.

The design activities were challenging for the families yet mostly effective. There was some frustration at the amount of talking and drawing (before acting), however some participants said they realized the importance of this, even though they found it a challenging and unfamiliar experience. The volunteer team felt that three-dimensional activities such as model-making may have been easier to engage with than drawing.

3. Increased knowledge of design and agriculture

At the beginning of the project the families' ideas were very similar to what already existed and they were hesitant to experiment with new materials. Throughout the Prototyping Field Trip three teams became more creative: contributing valuable ideas, solving problems and eventually leading the design and construction process. Through their presentations to the rest of the village they displayed understanding of the benefits of testing new materials and construction techniques.

During the monitoring period some families solved problems associated with the design, and taught other villagers the skills they had learnt. The agricultural training was seen as very useful, and these new skills have resulted in increased vegetable production and labour-saving.

In Kampong Khneas, the participants built gardens that reflected their preference for the raft design, and have made some improvements. The design ideas have also been adapted and applied in order to increase the floatation on houses and create floating duck pens. Duck raising is a new activity in this village, and this initiative demonstrates creative thinking and application of design ideas. It is also a potential new income stream.

4. Innovative design outcome

The designs are all low cost, with the favourite raft design only a sixth of the cost of the previous floating garden design. In the nine months following the field trip, fourteen families in two villages used their own money to establish new floating structures, demonstrating that the cost is affordable. The designs incorporate materials that are locally available and mostly recycled. They can be constructed using local tools and construction knowledge. Two gardens were durable and withstood a storm season. One garden was abandoned prior to the storm season. One garden faced a number of problems due to the materials chosen, and has been heavily modified. The knowledge gained from this failed design is useful.

5. Gender

The quality of women's participation in the design and construction was generally good, with some challenges associated with their other duties. Women felt that their ideas were incorporated in the design, and they feel proud of themselves and the project.

6. Economic benefit of gardens

The most successful of the gardens was constructed with a cost of 120,400 riel, which is approximately US$30. The financial return to Srey Mom's family and community during the first 9 months was 131,000 riel, which after the inclusion of early maintenance and modifications returned $0.98 per every dollar spent.

Projections indicate that for each $1 invested into a version of Srey Mom's garden returning $2.26 over 12 months, and $4.69 over a 36 month period. In short, taking into account the overall gross community benefit, future gardens built by the community will be able to recoup the investment made after only 5.5 months, at 1/16th the cost of the previous donor model.

Outcome 1 – Improved nutrition and food sovereignty

Reason
Residents of floating villages do not own land, and therefore cannot grow vegetables conventionally. It was assumed that this affected their health.

Indicators
1. Families eat vegetables 2-3 times more often than they did without gardens / previously
2. Families value vegetables for nutrition, not just for sale.
3. Families have more food choices than previously

Methods
1. Initial interviews verified the assumption that people believe a diet low in vegetables negatively affects their health.
2. A baseline survey was undertaken by the Food Security Network at the time of the field trip to establish:
    a. how often people eat vegetables
    b. what quantity of vegetables are eaten
    c. how it is cooked (to inform assumptions about nutritional value)
    d. seasonal difference in nutritional intake.
3. Family Interviews nine months the garden construction measured the change in vegetable intake, along with other nutrition-related issues.

Results by indicator

1. Families eat vegetables 2-3 times more often than they did without gardens / previously
Chan-ny stated that her family ate vegetables 1-2 times per week previously, and now they eat vegetables 3-4 times per week. Sobhoeun's family intake increased from 3 times per week to 5 times per week. Srey Mom's family intake increased from 2 times per week to 4 times per week.

2. Families value vegetables for nutrition, not just for sale.
The Au Akol families are eating the produce from their garden in addition to selling it. Chan-ny believes her family's nutrition has improved because "in this village you need to buy food from the market, but with a garden you can eat vegetables every day". Sobhoeun's garden is most suited to lemongrass, so she grows this to sell, and spends the income on food and medicine.

3. Families have more food choices than previously
Chan-ny stated she now has many choices when preparing meals. Sobhoeun feels very confident eating vegetables she has grown herself because she knows they haven't been treated with chemicals. Srey Mom explained that now she can choose a variety of types of food to cook, when before they would just have fried fish or fish soup. The family feels healthier than before, and believe it has reduced anaemia.

Outcome 2 – Effectiveness of participatory design method

Reason
Participatory design leads not only to a better design outcome through the integration of expert and local knowledge; it also builds participants' capacity to design and problem solve.

Indicators:
1. All design groups made transition from designer-led to user-led design
2. Participants believe the activities and process was useful.

Methods:
1. The volunteer diaries reflect on the level of success of the activities undertaken.
2. Agile Development and the Small World volunteers also engaged the village participants in informal conversation about their perceptions of the process.

Results by indicator

1. All design groups made transition from designer-led to user-led design

Initially most village participants spoke only when asked direct questions. When discussing expectations, it became clear that they wanted bamboo to fix their existing gardens, and did not believe a participatory design process would be beneficial. We learnt later that the participating families had agreed amongst themselves that they would all press for bamboo to be given to them, in the hope we would change our minds.

People were willing to spend time participating and took time away from income-earning activities in order to do so. At first participation focused on criticism of the materials we had brought. Some participants were receptive to thinking differently, others were dismissive of anything other than what they already knew. As time went on the quality of participation improved, with people beginning to discuss and compare materials and debate ideas.

Sobhoeun's husband initially did not intend to be participate, however on the first day he decided to go fishing less so that he could take part, demonstrating that he saw value in the project. A key moment when a sense of ownership was clearly demonstrated occurred for this team on the third day with the family: the village participants were asked to draw an idea for a garden, and while they discussed this, the CoDesign Studio volunteers developed their own design based on what they had learnt from the villagers. Each group explained their design to the other, and the day ended quite late, with noisy children and obvious tiredness within the team. The drawings were left at the family's house, and when the team met again in the morning, the family had spent time overnight producing a cost comparison of both designs, and developing a combined design idea that took the best elements of each, and stayed within the allocated budget. This demonstrated a growing commitment to the process and development of design skills.

In Srey Mom's team, the family took the lead in the construction phase, with the volunteers observing and doing other activities with children. In Chan-ny's team and Sobhouen's team there was continued collaboration with the volunteers throughout the construction phase. Pah's family did not take the lead in design, but did participate in parts of the construction.

At the village presentation all families showed a strong sense of ownership over the process, presenting their work clearly and with pride.

2. Participants believe the activities and process was useful

Srey Mom believed the activities were good, and that although only four families were involved in the program, it is an inspiration to a lot of other families. She said the process was challenging and she had a sore head from lots of thinking, but she also recognized that this was necessary in order to come up with new solutions.

The CoDesign Studio team reflected that the *Materials Flashcards Activity* was useful in sharing knowledge about cost, durability and availability of materials. The *Floating Garden Examples Activity* was useful as it provided inspiration and proof that there are alternatives to bamboo and metal drums. Participants began to point out elements of the designs that they thought were useful or otherwise. The *Drawing Activity* was useful, but may have been more effective as a 3D model-making activity as some people were not comfortable drawing.

Outcome 3 – Increased knowledge of design and agriculture

Reason
Increasing people's capacity will help them to solve other problems in the future.

Indicators
1. When asked to explain their 'perfect garden' there is evidence of increased creative thinking in comparison to the baseline activity conducted at the beginning of the Prototyping Field Trip
2. Agricultural production is higher than before the project
3. Participants display increased understanding of design principles throughout the Prototyping Field Trip
4. Participants solve problems related to their garden design, and plan or make improvements to their garden
5. Participants believe they learned skills through the project
6. Participants see benefit in experimentation
7. There is a transfer of design and agriculture knowledge to other villagers

Methods
1. At the beginning of the Prototyping Field Trip each family was asked to draw their ideal garden. This was used to establish whether participants were aware of other ways of constructing, and capacity for creative thinking.
2. Volunteer diaries documented informal conversations with participants and changes in behaviour amongst the villagers during the prototyping field trip
3. Each family was given a logbook to record any repairs or improvements they make to their garden in order to show the amount and type of problem solving that is undertaken without external assistance. Record-keeping was assisted by the literate community facilitator.
4. Family interviews were conducted nine months after the Prototyping Field Trip

Results by indicator

1. When asked to explain their 'perfect garden' there is evidence of increased creative thinking in comparison to the baseline activity conducted at the beginning of the Prototyping Field Trip
The 'perfect garden' exercise at the beginning of the project demonstrated that people think carefully about how a garden is laid out, for example the width of rows and space for walking, however the construction systems drawn were the same as what already exists, and people were not considering the use of other materials.

During the Evaluation Field Trip, each family repeated the exercise. Three out of four families had changed their idea of the perfect garden. All were based on the bottle-brick raft prototype, with improvements to the framing system and either an increased size or multiple units. They were thinking about longevity with improvements that would increase the cost of the garden. It was unclear whether they had analysed the cost-benefit relationship of these proposed improvements.

2. Agricultural production is higher than before the project
Three out of four families had increased their agricultural production.

3. Participants display increased understanding of design principles throughout the Prototyping Field Trip
There were definite changes in the perception of the value of waste materials: when the team arrived with boatloads of plastic bottles, people were extremely skeptical, believing the bottles would blow away in the wind and not provide enough stability for a garden. Initially the villagers pressed us to purchase bamboo for them instead of undertaking a design process. The volunteers working with Pah's family struggled to involve them in the design due to this skepticism, so decided to develop a test using inner tubes, bottles and rice sacks. That night there was heavy rain, and the villagers were very surprised to see the garden still floating in the morning. This incident helped to build confidence that testing new ideas was worthwhile.

In Sobhoeun's team, three versions of a basket were designed, with differences in the type and location of bottles used for floatation. At the final village presentation her husband Phuoal could be observed looking at the left-over bottles of different sizes and shapes, weighing them, measuring the length, and obviously thinking about how they could best be incorporated into a garden.

4. Participants solve problems related to their garden design and plan or make improvements to their garden

Some families have made repairs and improvements to their garden.

Sobhoeun's garden has not needed any improvements. She is happy that the frame is strong and she plans to replace the baskets when they break down. Her biggest concern is that there is a relatively small growing area. When she can afford to extend the garden she would build a raft structure garden and tie the baskets to the outside. The raft would be used for growing shallow-rooted vegetables and the baskets for deep-rooted vegetables.

Srey Mom and her family have added some old bamboo to the sides of the garden. The challenge with the garden is that rats chew the rice sack and fishing nets. Her idea to solve this is to make a frame and fill it with bottles, and seal the frame. She thinks this will cost about an extra $20-25, but will be worth the investment.

Chan-ny's garden faced a number of problems which she solved in the following manner:

- The tins rusted, and have been replaced with a wooden frame covered in old fabric.
- The tins got hot and made the soil dry out so they needed a lot of watering. She covered the tins with old clothes
- The large white plastic bottles became brittle when exposed to the sun, and split. They have been replaced with bamboo, but she plans to cut the bottles in half along their length and use them as planting pots. It was her idea to use bamboo, and her neighbour helped her do it and she gave them some corn (that she had bought) as payment.

Chan-ny also plans to improve her garden in the better fishing season when she can save some money to buy small bottles. She plans to make a wooden frame to protect the bottles from the sun.

In Kampong Khneas village, Chep explained that Pe Ny created two small basket models, but found a drawback with the small models in that when they move the houses they are easily bumped and are harder to manoeuvre. With a bigger garden it can be tied behind the house and is more stable. Pe Ny has a number of small sections of bamboo saved up, and plans to plant lettuce in them and line them up in a row on the edge of the garden structure. She has adapted this idea from the hanging garden developed at the Au Akol school.

5. Participants believe they learned skills through the project

Attendees at the Food Security Network training believe they gained valuable knowledge. Chan-ny explained the training has made a big difference to her garden, because now everything is healthy and green. Previously, if a plant was attacked by insects, she didn't know what to do, so she just stopped growing that plant. Now she knows what to do, and she is also experimenting with new ideas. For example, she is growing lemongrass at the corners of the garden to keep pests away, and scrunching up lemongrass leaves and scattering them on the soil of the rows. She also learnt how to make a fertiliser using fish scraps, sugar, salt, snail shells, and diluting it.

Sobhoeun found the agricultural training valuable, but has forgotten some of the lessons because she can't write to take any notes.

6. Participants see benefit in experimentation

Chan-ny is thinking of experimenting with other varieties of mint. She feels confident to extend her new garden. She plans to build a trellis so she can grow squash. She believes it is worth the cost because squash sell for a good price. She thought it was helpful to get ideas from the other gardens. She likes Srey Mom's best but if she were to make a garden she would use more fishing net. She thought the tests were good because it gave people more choice. Chan-ny continued to

say that though her own garden was not very successful, her participation gave her a garden, and also gave her the idea that other materials are possible: before that she had only ever thought that bamboo was possible.

Sobhoeun feels very confident that she can extend her garden, or build a different type of garden in the future. She has experimented with gathering a big type of ant (leaf ants?) from the trees to put in the garden so they can eat the small pests.

Srey Mom plans to experiment with leaving seeds in water one-two nights before planting them, to help with germination. She plans to experiment growing onions in pots. She has already experimented growing okra, but the family doesn't like it, so she will try to sell it on land. She trusts that she can make her perfect garden, even though she doesn't know for sure.

7. There is a transfer of design and agriculture knowledge to other villagers

Chan-ny inspired four other families to start gardens, her husband's relatives. She gave them seeds, her knowledge, and physical help to set the garden up. Her sister-in-law demonstrated strong understanding of a variety of design principles. These families have now set up a crop exchange, with each growing different things. Channy has done other capacity building projects in which she learnt it is best to share knowledge rather than keep it to oneself. She believes that if each family shares their knowledge, it can make the whole village better. When she sees other families gardening successfully after her help, she feels very happy. She noted that these other families have not received money or support from a donor, but they have changed their behaviour anyway.

Srey Mom believes the project has inspired the whole village through the use of waste materials. She notes that nobody had that idea before.

In Kampong Khneas, Chep has made a garden using 720 small bottles (including 100 given to him at the end of the prototyping workshop). When he returned from the prototyping workshop he spent around 6 weeks gathering materials before building his garden. People asked him how to do it and how much the materials cost, and when they found out they decided to do it too. The idea has inspired two other families to use the bottle brick technology to float a pig pen, and six families have taken up duck raising. They were not doing animal husbandry beforehand, and it is not part of a program; it was a personal choice taken by these families. Chep believes the village has been inspired by the project.

Chanthuk believes the project was very successful as a demonstration project. Other people in Kampong Khneas have watched how it is done, and the whole village is very proud. She says people think it is a very creative and modern technique, and lots of people want to do it.

Outcome 4 – Innovative design outcome

Reason
A need for a different design was identified because the existing design was unaffordable without donor assistance, and materials were sometimes re-appropriated for house repairs, particularly during storms.

Indicators
1. Design is low cost / affordable for typical family
2. Design incorporates mostly waste materials / recycling
3. Design uses primarily locally available materials.
4. Design can be constructed with local expertise.
5. Design can withstand local conditions in all seasons.

Methods
- A critical assessment of how well the designs met the Design Criteria developed during project scoping;
- Presentations at a village meeting by each participating family in order to capture the family's perception of the advantages and disadvantages of the design;
- Each participating family was interviewed
- A cost-benefit analysis

Results by indicator

The following table documents the outcomes in relation to each of the Design Criteria developed during project scoping:

GARDEN DESIGN CRITERIA	IN ORDER TO…	OUTCOME
Low cost	Reduce donor reliance	The villagers' favourite design – Team 1 raft structure – was only 1/6th of the cost of the previous type of floating garden, per square meter of growing area.
Recycled materials where possible	Increase environmental sustainability, and reduce water pollution	Approximately 70% of materials were recycled. A variety of recycled materials were tested in the different designs, such as plastic bottles of varying sizes, tin cans, old fishing nets, rice sacks, old clothes and inner tubes. Non-recycled materials included nails, timber, bamboo, woven baskets and tape. Bamboo was primarily used for its structural value, rather than as floatation.
Locally available materials	Increase the number of families who can build a garden without donor assistance.	All materials can be sourced in the nearby villages of Kampong Luong and Krakor.
Avoid materials that are used for house construction	Reduce the likelihood that gardens are destroyed during bad weather	The only materials used that would have value in house construction are bamboo and timber. In some designs these materials are in short lengths, making them unsuitable for house construction.

Explore hydroponic solutions	Reduce need for buoyant materials and labour intensive soil collection	A survey of villagers dietary preferences showed that they wanted vegetables that grow best in soil.
Explore aquaponic solutions	Create a mutually beneficial and productive system involving fish farming, vegetable production and reduction in water pollution	Aquaponic systems were researched, but it was decided to rule this out due to the complexity of the system, the fact that fish breeding would need to be done in closed vessels rather than the existing open cages and a lack of experience in this could lead to early failure. There would be a need for specialized skills and a strong maintenance routine, and it was unclear whether capacity for this existed in the villages.
Simple construction techniques	Allow families to construct gardens without external assistance, and within the free time they have available.	All gardens were constructed using local tools and construction techniques, with the villagers taking a strong role in the construction phase in three out of four teams.
Safe materials	Ensure food safety and quality is not affected	Plastics were researched, and design measures taken to prevent chemical leaching. The main issue is exposure of certain plastics to sunlight. In the designs, plastic is shaded/enclosed by the structure in most places. In external conditions it is covered with water hyacinth plants. Success relies on villagers' understanding of this risk, and it was difficult to explain the importance of this.
Explore suitable cash crops	Alternative income stream that will increase economic security and reduce reliance on fishing (contributing to more sustainable fishing practices)	A survey of food preferences showed that people would like to sell similar vegetables to those which they eat.

Outcome 5 – Gender

Reason

Given that women do the majority of work related to a garden, it is important that their wellbeing is increased by it.

Indicators

1. Women participate equally in the design process
2. Women's contributions to the design process are incorporated in the designs
3. Women feel proud of their involvement in the project
4. Women's wellbeing is increased by having a garden

Methods

1. Volunteer diaries document the amount and quality of women's and men's participation.
2. Participant interviews

Results by indicator

1. Women participate equally in the design process

In general women participated strongly in most teams, contributing ideas and helping with construction. Most of the participants who came from the village of Kampong Khneas were women, and their participation was strong because they came alone and therefore did not have domestic duties to attend to. It was more difficult for the women from Au Akol to participate because they also needed to care for children and guests. The morning meal was eaten in the team groups at the host family's house, and while this provided a good opportunity for building relationships through cooking and eating together, it also increased the workload for the woman of the household.

2. Women's contributions to the design process are incorporated in the designs

Chan-ny believes both sides (volunteers and families) contributed to the design. The ideas of splitting the bamboo for the top, and using old clothes, were hers. She had other ideas about using timber that were not incorporated because the design team said they wanted to test new ideas.

Sobhoeun explained that she provided lots of good ideas about the frame for the garden and how to support it. She saw our idea to put the bottles inside the basket, and she helped by contributing the ideas to use the strips of bamboo to hold the bottles in place (when others had been thinking about tying or sewing them in place).

Srey Mom was quite busy in her role as community facilitator during the Prototyping Field Trip and says that CoDesign contributed the idea to use water bottles, but all the other ideas came from her grandfather.

3. Women feel proud of their involvement in the project

Chan-ny is glad and feels proud of our project because she has a new garden and other villagers can see that she is knowledgeable about gardening and can learn from her success. She felt very proud and happy when they did a victory lap of the village on their garden. Chan-ny believes the village is proud of her for keeping her garden going while her husband is in jail, even though she is alone with the kids.

Sobhoeun is very happy with the project even though her garden has had a low yield compared to the raft garden. She believes her garden is strong and she can replace the baskets when they break down. She says she is happy because she has more vegetables for her family to eat and as well a small amount to sell. She feels she could make a garden like this, or like Srey Mom's, without help from others.

Srey Mom feels so proud of herself and the program because it has inspired the whole village.

4. Women's wellbeing is increased by having a garden

Across all families women play the largest role in maintaining and using the garden. It was unclear whether their overall workload increases because of this, or whether they do a reduced amount of fishing. They seemed genuinely happy and proud to have a garden, indicating that they do not resent any increased workload that may exist.

Chan-ny was thankful that she had a garden during the time that her husband was in jail for illegal fishing.

In Kampong Khneas village, 53 year old widow Sun Leng said she felt so happy when she came back from the workshop. Making this garden was easy. She stated: "I am alone but I feel good that I have some vegetables to eat." Although she was not able to build her garden herself, she paid someone $10 for the labour to build the frame, and she designed it herself and told them how to build it.

Outcome 6 – Economic benefits of gardens

Reason
Increase in income, or savings that result from eating vegetables from the garden, will provide more choices for families and decrease poverty.

Indicators
1. The return on investment is positive (the gardens generate more economic value than they cost to build and maintain)

Methods
1. Logbooks were kept by each family to record garden inputs (such as labour and cost of materials or seeds) and outputs (quanitities of vegetables eaten/sold/gifted)
2. Cost Benefit Analysis
3. Participant interviews

Refer to the following pages for a detailed Cost Benefit Analysis produced by Agile Development Group.

Capacity building

Through the collaborative process, the project partners learnt from each other. This section explains what each partner felt they learned.

Agile Development Group
Agile Development Group (ADG) have previously utilised an informal co-design approach to their land based food security projects, which built upon naturally occurring knowledge and cultural systems within a community and the scaffolding of new ideas. Through the facilitation of this project, it allowed them to witness and actively learn from CoDesign's experience and approach to the methodology, and incorporate new techniques or adapt existing ones.

Additionally, it allowed Agile to build upon their tiered or 'step down' refinement approach to project development. In contrast to traditional project design where the framework may be designed by a single person with limited knowledge of the target area, Agile were able to continually refine and adapt the project by engaging the relevant partner or stakeholder at each stage. For example, CoDesign's initial engagement strategy and working plan were presented to Agile, who together with CoDesign refined and evolved it to be more suitable to broader Cambodian context. Both organisations then met with local partner Rural Friends for Cambodian Development, who provided input and further refined for the local, cultural and literacy context and levels. The final stage was working with the local community facilitator, Srey Mom, who through her experience living within the target village understood the local relationships and the subtleties required to overcome barriers such as the initial refusal to move away from bamboo. This approach allows for a ‘softer’ engagement with target communities as many of the design and engagement kinks have already been ironed out.

RFCD
CoDesign Studio and Agile Development Group led a reflection session with RFCD staff to evaluate the impact of the program on them. RFCD staff believed the biggest success factors in the project were the creative thinking and adaptive design, and the method of testing a variety of designs to find out what works best.

Small World volunteers
During the prototyping field trip, four Cambodian volunteers in their early 20s worked with CoDesign volunteers as team facilitators and translators. Two of these volunteers returned for the evaluation field trip.

Sithat feels the project helped her to organise a team, achieve new designs and learn a great deal from the both the local people and the CoDesign volunteers. This was her first time working with an ethnic minority and she felt proud to be part of a group sharing knowledge and ideas, and working with villagers. At the start, she found the translation very challenging; what to translate, what was most important and understanding the local dialects. In the end however, she believes the project has helped her a lot in communication and potential future work. Studying law, Sithat is continually faced with explaining scenarios to people who may not understand the complexities of law. As such, she feels this project has assisted her greatly in her ability to communicate today and in the future.

Menghak is studying agricultural science at a university in Phnom Penh. He feels the project enhanced his skills in humanitarian volunteering, knowledge sharing and learning from foreigners. It assisted his communication and facilitation skills: listening to the local people and understanding their specific needs. During the Prototyping Field Trip he felt very challenged. During the Evaluation Field Trip he felt more confident and also 'happy and warm' to be able to be an ongoing part of the project. Meng believes his participation in the project will help him in future. He would like to work (and study) overseas and thinks that his involvement with projects such as this one will be a great asset in his applications. In the meantime, Meng feels he has a lot to give back to his own country and will continue to work in humanitarian aid within Cambodia.

CoDesign Studio

At an evaluation meeting following the prototyping field trip, the CoDesign volunteers shared their responses to a set of evaluation questions, as well as their general reactions and lessons learned from the project.

Although they were aware that participatory design was a different approach, most still had the traditional expectation that they would need to develop designs to take there to be tested. There was some anxiety prior to leaving about not having developed these sufficiently. Following the trip however, we realized that facilitation skills were just as important as technical preparation for the eventual success of the project. In hindsight, the volunteers stated that they would have spent more time improving facilitation skills and preparing resources and activities to enable more participation for the villagers. They also became more aware of the fact that typical methods used in design workshops, such as drawing, would not necessarily be effective in a context with such different levels of education, in particular literacy.

Due to the success outcomes achieved in this project compared to others they may have been involved with, there was a general feeling amongst the CoDesign volunteers that a participatory approach is an effective way to achieve better design outcomes, build capacity and empower a community. They also believed that they could apply the facilitation skills they acquired in other aspects of their professional lives.

6. PARTICIPATORY DESIGN HANDBOOK

We have produced a Participatory Design Handbook to allow other organizations to reproduce the project process. It is a practical guide, written in plain English, intended for NGO's, professionals, and students. This floating gardens project is used as a case study throughout the Handbook, however it is hoped many of the activities will have relevance for all community based projects.

The Handbook is split into three sections containing practical activities:

- Initiation: activities to develop relationships and plan for the project;
- Design: facilitation activities for participatory design;
- Monitoring and Evaluation: activities to set goals and measure outcomes.

The Handbook is available free of charge. It can be downloaded from codesignstudio.com.au or kateferguson.org

7. CONCLUSION

The Cambodia Floating Gardens Project has been a successful pilot. The participatory design process was effective in producing an innovative design outcome that solved problems associated with the previous floating garden program. Nutrition and food sovereignty have been improved, villagers have greater knowledge of design and agriculture, and the gardens are producing economic benefits.

It is hoped the Participatory Design Handbook will allow the process of participatory design to be more easily understood and used.

8. FURTHER INFORMATION

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