Application of ecological sanitation and permaculture techniques: food and water security for indigenous tribes and rural areas in Brazil

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This paper describes a demonstration project carried out in an indigenous tribe in Brazil. The project works with around 20 families and carries a demonstration site at the local school, including rainwater harvesting, greywater treatment and reuse, and application of urine as fertilizer. Around the area, 13 arborloo-type toilets and 2 banana tree circles receiving greywater were implemented. The project is followed by a capacity building and environmental education training and it is running for 14 months. So far we could observe the following aspects: i) good acceptance on the chosen techniques, ii) difficulties for the community to work as a group, iii) difficulties with the maintenance of the toilets, which greatly improved after new visits to the houses and training, and iv) the poor hygienic conditions could be confirmed through parasitological tests performed with samples taken from the arborloo pits that showed the presence of at least 4 parasites.

Introduction

The demonstration project is carried out in a Kaiowa indigenous tribe (LimãoVerde). This tribe does not count on river springs. Their source of water is pumped groundwater distributed in communal taps and laundry areas. This facility is provided for free by the National Foundation for Health (FUNASA), which is encharged of providing water and sanitation for the Brazilian indigenous tribes. In the region, due to the deforestation, the sandy soil does not produce most of the rich variety of plants typical from Cerrado (tropical savanna ecoregion), consequently, the fauna is also affected, affecting their hunting activities. Besides, they hardly have source for wood, fibers and liana anymore, which were used in the past for fire, handcraft and house construction. The situation is similar among many of the tribes in Brazil, since their lands were partially taken by farmers and the remaining natural resouces are under depletion due to a lack of sustainable management. The nutritional condition of these people is poor since hunting used to be their main source of food. Due to the present conditions, thir habits are being changed and they start working with agriculture, but still, they face the poor soil conditions, little water availability and lack of fertilizers. For this reason, about 90% of the population depends on the delivery of staple food done once a month by the Federal Government, which does not suffice their needs.

The objectives of this work are to promote and transfer the use of simple technologies based on ecological sanitation (Winblad and Simpson-Hébert, 2004) and permaculture concepts providing sanitation, supporting the rational use of water and enabling the food production in indigenous and/or rural communities. The main activities within the project are the reuse of greywater (Steinfeld, C. and Del Porto, D., 2004) and rainwater and the use of human excreta (Morgan, 2004) for food and water security. The project aims the capacity building of the population so that, when necessary, they can build, operate and manage the decentralised systems, strengthening their communities by promoting health and self-sufficiency on food production. The main objetive of this project is in the frame of finding sustainable and accepted sanitation

options, where FUNASA may financially help with implementation and the community itself can manage and improve their quality of life.

Methodology

The project works with around 20 families. The implementation of the project was divided in 6 different phases, where most of them are already implemented and being monitored. The activities are the following: course on construction techniques using bamboo (Cardoso, 2002), construction of 2 rainwater harvesting systems (Figure 1A), construction of 20 arborloo-type toilets (13 implemmented so far), 1 constructed wetland for treating the greywater produced in the kitchen of the school followed by a vegetable garden, 2 banana tree circles (Figure 1B) treating the greywater produced in 2 communal laundry areas and 1 low tech urinal (Figure 3B) in the school (connected to a flower garden). The research team visits the tribe 1 week/month and together with volunteers from the own tribe apply the surveys, prepare workshops, promote educational training, implement the facilities and work on systems sampling, monitoring and maintenance. When the team is not present the community is supposed to carry on several activities. To improve the latter, meetings with the presence of research team, community leader and volunteers take place once a month for instructions, since these member are going to act as the project multipliers. The meetings also serve to evaluate the acceptance of the implemented facilities as well as the difficulties faced, aiming at project adaptation and improvement. The ongoing phase is the implementation of urinals at school and special environmental education training on the complete system. Physico-chemical and bacteriological analyses of treated greywater and rainwater (school) are carried out monthly to assess their quality and possible applications. The sampling is limited since the project site is situated 400 km away from the capital. Samples from 2 arborloo toilets (after planting the tree) are collected every month and parasitological analyses are carried out.

Figure 1 A: rain water harvesting system (bamboo structure) for one household. B: banana tree circle (permaculture) at a communal laundry area.

Results and discussion

Project implementation

During the course of the work, we found a certain difficulty on the comunitity to work as a group, while more results were achieved on the activities developed with individual households. However, a smaller group, composed mainly by women, is helping to construct the toilets in other households even when the research team is not present. The pace of the work turned out to be slower than expected. For this reason, more ludic methods are being applied in order to captivate the participants and convince the group to proceed with the activities when the research team is

not present. It was also difficult to convince the participants to note down informations of importance to the project (for instance: when moved the arborloo to a new pit, when planted the tree, health conditions of the family, etc).
Due to these difficulties and also due to a conflict between 2 political groups at the tribe, most of the project activities were moved to the school, where workshops on environmental education are being offered for teachers and students, concerning the topics linked to the project, bringing together the school community to work on the implementation and maintenance of the ecological sanitation facilities, hoping that the trainned group will act as multiplier.

There is a growing interest of the teachers concerning the awareness of the students and community in respect to water and soil protection. They are coming up with some suggestions on themes to be worked, such as prevention of vegetation burnt and valorisation of indigenous culture aiming at the reconnection with nature. This interest and full participation on the workshops are resulting on a better participation of students and community on the project activities due to a more clear understanding of the objectives of ecosan and its importance for their well being, guaranteeing the continuation of the activities after the conclusion of the project.

Technical issues
The bamboo construction techniques course was very successful. The participants demonstrated high interest on learning and are using the acquired knowledge to construct the arborloo "houses" and other structures. The rainwater harvesting systems were constructed in 2 different points: the first one in a household, using bamboo structure and a tank (Figure A). Due to the dry season we still could not collect a sample for analysis. As a system to release the first rain or any treatment was installed, the destination of this water will be probably for bathing, laundry and cleaning. The cistern at the school is under construction using ferro cement technique. For this case the water will be used mainly to water the garden (vegetable and flowers) and for cleaning the school.

The constructed wetland treating the greywater of kitchen at the school, is often clogging and

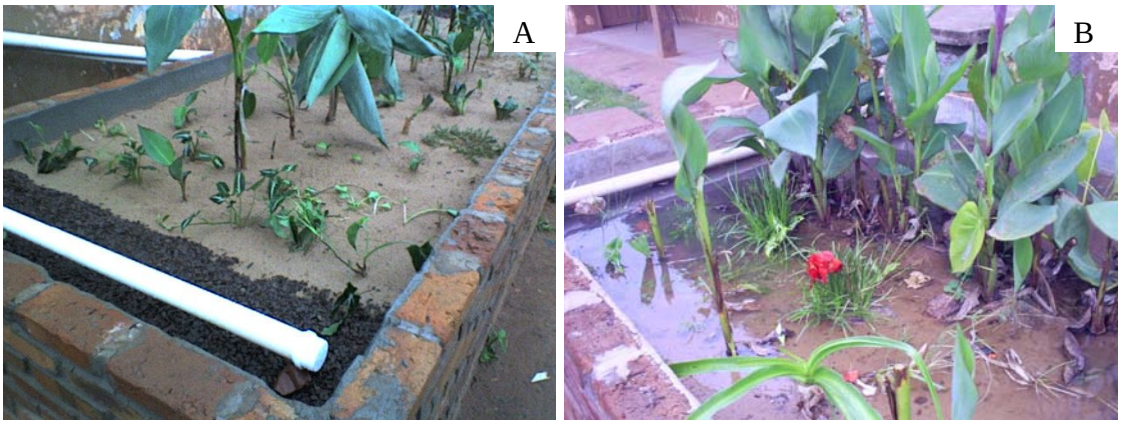

Figure 2 Constructed wetland (school). A: before start up. B: after 5 months of operation, problems with clogging and overflow.

overflowing (Figure 2). The main reason is the lack of awareness of the cooking lady, who uses large amount of water and discharge fat and left overs into the sink. Besides, we found out that the children were playing on the top of the sand bed, when the plants were not covering it completely, packing tightly together the sand, not allowing the water to flow.

Involving everyone on the educational training is helping to solve the problem. When there is effluent, this is released in the middle of a vegetable garden (Figure 3A), which was prepared with the help of the children. Physico-chemical analyses of 3 samples taken so far indicate a good COD (chemical oxygen demand) and suspended solids removal. As the only source of greywater

is the kitchen sink, there is no major concern with pathogens; however, this parameter is being considered during the system monitoring.

Samples from 2 arborloo toilets (Figure 4) are collected every month and parasitological analyses are carried out. So far only 2 families were chosen for being more commited with the project, representing only 10% of the number of the participant families. Table 1 shows the results of the

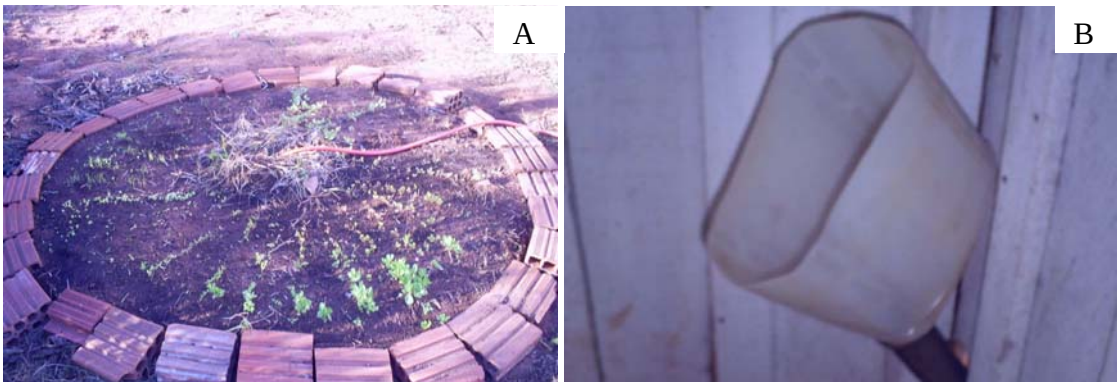

Figure 3 School. A: Vegetable garden receiving greywater from the wetland. B: Low tech urinol for boys at school (urine will be used to a siminar garden planted with flowers).

first sample taken to illustrate the start point of these 2 latrines. The arborloo 1 and 2 were sampled 3 and 8 months, respectively, after closing the pit and planting the tree.

Table 1 Parasites found in samples colleted in arborloo pits.

[1]**Arborloo 1**	[2]**Arborloo 2**
Ascaris lumbricoides eggs	*Iodamoeba* cysts
Hymenolepis nana eggs	*Escherichia coli* cysts
Ancylostoma duodenale eggs	*Ancylostoma duodenale* eggs
Strongyloides stercoralis larvae	*Strongyloides stercoralis* larvae

[1] sampled 3 months after pit was closed, [2] sampled 8 months after pit was closed.

Six different intestinal parasites were found. That was somehow expected considering that the atmosphere of these tribes is highly favorable to spread of the parasitoses due to the bad hygiene habits, infrastructure lack, basic sanitation and cultural habits, amongst others (Gilio et al, 2006). Samples are also being taken from family members using the arborloos, as well as questionnaires are being answered. These data will be crossed with information collected at the nearest health care centre for indigenous people. All this information will give support to a study considering the health related risks due to poor nutrition and the lack of water and sanitation, comparing whether the education programme together with ecosan and permaculture techniques improved their health conditions, by the end of the project.

Figure 4 A: Arborloo structure made with bamboo. B: Mango tree planted after moving the arborloo to a new pit.

Conclusions

- Good acceptance on the chosen techniques, specially the arborloo toilet.
- Difficulties for the community to work as a group (household level activities presents better results).
- Difficulties with the maintenance of the toilets, causing the appearance of flies and bad odour due to the non addition of ashes or saw dust as taught. However, after new visits to the houses and new training, the hygienic condition of the toilets has greatly improved.

From the findings of this paper it is expected to get more insight in respect to the safe use of ecological sanitation and permaculture for indigenous tribes and rural areas, contributing for the direct use or adaptation of these techniques in other similar communities, always respecting the cultural aspects of each population. For the success of project implementation it is of paramount importance the educational work and population participation, which goes beyond the transfer of technology.

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