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Technical Report · December 2014

DOI: 10.13140/RG.2.2.35847.70561

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Rainforest Flow's "Manu Expansion Project": Preliminary Evaluation of Social and Health Impacts of an Integrated Water Purification/Health Education Project in the Native Communities of Tayakome and Yomibato in Manu National Park, Peru

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December 2014

Prologue

When I first met Nancy Santullo in 2003 in the Native Community of Huacaria in the cultural zone of Manu National Park, Peru, and got to see the water project she had installed there with the organization then known as House of the Children, I had a dream of bringing a similar clean water and sanitation project to the far more remote communities of Tayakome and Yomibato, where I had been working for many years, deep in the interior of Manu National Park. Now, just over a decade later, that dream has come true.

Nancy Santullo and engineer Humphrey Blackburn at the collection source for Huacaria's tap water system.

A household sink installed by House of the Children in Huacaria

The school bathroom in Huacaria installed by House of the Children

Health and gastrointestinal illness in Tayakome and Yomibato, 1987-2007

As a medical anthropologist, I have worked for extended periods in these remote communities in Manu National Park carrying out research on traditional medicine and health status. During my interviews about infant mortality, as well as through my own experiences in the communities, diarrhea and other gastrointestinal illnesses were the second most common cause of illness and death in the overall population, and were the leading cause of death among children. High rates of gastrointestinal illness appear to owe mostly to high loads of intestinal parasites and the increasing contaminating of drinking water sources, associated with the growth, concentration and sedentization of a population which had previously been highly dispersed and semi-nomadic. I myself suffered from frequent bouts of stomach conditions until I began consistently treating my own drinking water with iodine or chlorine. Though such treatments work for an individual on fieldwork, they are not a practical solution for large numbers of community members.

Although the Matsigenka have a rich knowledge of medicinal plants for treating a wide range of illnesses and other culturally-defined health conditions, their traditional pharmacopeia is clearly insufficient for addressing many common health conditions that sometimes result in fatalities. During interviews I carried out in Yomibato in 1997 regarding perceived cause of death of family members, around 30% of adult deaths and 40% of deaths of children under 5 were attributed to gastrointestinal illnesses (Shepard 1999). Another 20% of child deaths were attributed to “spirit attack,” a culturally

important illness syndrome that often includes gastrointestinal manifestations such as diarrhea, vomiting and dehydration symptoms.

Matsigenka women use a many fragrant plant species to bathe newborn children to fend of "spirit attack"; the practice also keeps children clean

The community had only sporadic access to Western medicines and health professionals when I first started working in the community in 1987, but by 1995 there a government health clinic was established, staffed by trained nurses and visiting doctors and provided with basic medicines. Nonetheless, through the years of my work in the community from 1987 to 2007, the incidence of gastrointestinal illness appeared to be increasing as the population grew, water sources became more contaminated, and community members began to travel more outside their remote communities to participate in political activities and to seek education and employment. I remember in particular one particularly virulent epidemic of gastrointestinal illness that occurred in 2007, when a group of community leaders returned from a trip, apparently bringing some strain of highly contagious gastrointestinal disease that left much of the community prostrate for over a week and killed some 7 children in a single month.

First Visit of House of the Children / Rainforest Flow to Tayakome and Yomibato: 2007

After having seen the water and sanitation project in Huacaria community, and having helped document the major improvements in child health and village sanitation this project produced, I suggested to Nancy that we take a group of community representatives from Tayakome and Yomibato to visit Huacaria, get to see the project themselves. As a result of this visit in September 2007, the representatives of Tayakome

and Yomibato invited their fellow Matsigenka kinsmen from Huacaria to visit their communities in Manu National Park and explain to the other community members how the water system worked, and what benefits they might expect.

Access is especially difficult to the community of Yomibato, which is narrow, shallow and often blocked by fallen trees.

Author Glenn Shepard traveling with community members up Yomibato stream

A census carried out during this visit showed a population of 258 people in Yomibato and 162 in Tayakome. Sanitary installations were essentially non-existent. A few people had open-pit latrines, but most defecate in the forest or at designated spots in overgrown secondary forest at a short distance from their gardens or their houses. The Matsigenka maintain clean households, with women and girls sweeping the dirt floors inside the houses and men weeding and sweeping up the patio area around the house one or more times a day. Trash is gathered and either burned or tossed down a slope along the ravine. Most houses are located on ravines with nearby small stream which they use for washing and drinking. They prefer to use small streams or springs with limpid, sediment-free water over the often sediment-laden water from larger streams and rivers. The main liquid the Matsigenka drink is not water but rather masato, a beer made from fermented manioc. The fermentation process likely offers some natural anti-bacterial properties, but people (especially children) often drink "sweet" masato which has still not fermented.

The Health Ministry has made multiple campaigns to distribute chlorine drops and teach people the importance of treating water either with chlorine or by boiling, but in practice these suggestions are rarely followed because the drops run out, the containers the Ministry distributed were not robust and soon deteriorated, and because people are reluctant to do all the work of constantly boiling or treating water; besides, they do not like the flavor of chlorine or boiled water. The fermentation process likely offers some natural anti-bacterial properties, but people often drink.

Preparing masato

The Matsigenka bathe frequently and usually wash hands their hands immediately upon finishing a meal. Women made frequent trips to the stream or river to wash clothes and dishes and gather more water. Women were responsible for carrying water up the ravine in aluminum pots, buckets or traditional bottle gourds to store near the household for cooking, drinking and washing hands and dishes. In some places, people had developed simple water storage systems involving bamboo or plastic tubes that channeled water into a large aluminum pot or plastic drum to facilitate water gathering. In one case, a family had gathered left-over plastic tubes from a failed well construction project to bring water over 200 meters down a small incline to an improvised tap by the house. All of these observations reflect the importance of water gathering, storage and transportation to the Matsigenka in their current community setting, and help explain why most community members were eager to see a tap water system like that found in Huacaria established in their own community.

However not all community members were so enthusiastic. A government program had installed a tap water project in the community of Tayakome shortly before the House of the Children / Rainforest Flow team arrived in 2007. The project was carried out with utter incompetence and negligence. Of the dozen or so tap stands installed in the community, only two were technically feasible because the remainder were all at a higher elevation than the water source. The workers left the project unfinished since they knew water wouldn't arrive at the higher-elevation taps. They only installed the tap stands but did not connect it with the water supply. Hey left tubes for the people to dig their own trench, saying if they dug a deep enough trench for the tubes the water would come out of the taps, which was an obvious lie. Even the two tap stands that worked had minimal water pressure, such that when one was open, the other didn't work. Furthermore, the workers wasted some hundred bags of cement (all of which had to be transported days up river and then carried on people's backs up the bank) two huge columns that were supposed to form a suspension bridge to carry a tiny half-inch pipe across a small stream. Yet the suspension elements were never set into place, and the pipe hung loosely across the stream, with the pair of 4-meter tall cement columns standing as monoliths to the incompetence and negligence of this and other similar water government projects in remote communities in Peru, which deliver contaminated water or no water at all at a large cost to Peruvian taxpayers, for the profit of corrupt engineering companies, but with no benefit or even damage to local people. No wonder many people in Tayakome were initially suspicious and distrustful of the House of the Children / Rainforest Flow water project.

Government water systems installed throughout the region have consistently failed the communities due to incompetence, negligence and inadequate attention to social capacity building.

During our visit, which took place in November of 2007, House of the Children / Rainforest Flow team members used a portable microbiology lab to analyze samples of water taken from the places where people in the villages routinely gathered their water for drinking. The bacterial counts were moderate to high (see Table 1). Not that single-family water sources tended to be cleaner, since fewer people live nearby to contaminate them, while water sources near the central community areas, used by more people, showed 10 to 100 times as much contamination: this reinforces the observation that sedentization and concentration of the indigenous population around central communities has increased contamination and thus had a negative influence on health.

Small streams with limpid water are typically used for washing as well as drinking and cooking by Matsigenka families.

The Matsigenka term for 'clean/potable water', ***sanaari nia***, also refers to any water that is clear and limpid and sediment free. The assumption is that water that is limpid and free of sediment or odor is safe for drinking. And yet after running the microbiological samples of this supposedly "clean" water, the people could see the bacteria growing and even smell the fecal odor of the samples. "We're drinking our own feces!," one woman said in shock, "It looks clean, but it's not!"

Table 1: Microbiological analysis of water samples from Tayakome and Yomibato, Nov. 2007.

No.	Date	Lat.	Long.	Alt. (m)	Description	Fecal Coliform units / Total coliform units CFU/100 ml.	
1	21.Nov.07	-11.72375	-71.64592	369	Tayakome: Improvised piped water from stream source servicing one family	96	424
2	21.Nov.07	--	--	--	Tayakome: Stream water servicing the improvised water system (No. 1)	208	492
3	21.Nov.07	-	-	352	Tayakome: Stream	2000	5000

		11.73066	71.64378		water used as main water source for the community		
4	21.Nov.07	--	--	--	Tayakome: Stream used by one family	312	480
6	22.Nov.07	-11.78317	-71.79305	360	Yomibato: Stream used by the small residence group at Sarigemina ("Cacaotal")	80	580
7	22.Nov..07	--	--	--	Yomibato: River water near Sarigemina (middle Yomibato)	200	1880
8	23.Nov.07	-11.80107	-71.90772	364	Yomibato: Stream used as main water source by the central community	120	520
9	23.Nov.07	-11.80062	-71.90729	384	Yomibato: Stream used by one residence group	80	480
10	23.Nov.07	--	--	--	Yomybato: Stream used by a single residence group	24	249
11	23.Nov.07	--	--	--	Yomibato: Spring used by one residence group	50	472
12	23.Nov.07	-11.80541	-71.91057	387	Yomibato: Stream used by one residence group	103	684
13	23.Nov.07	--	--	--	Control: Mineral water	0	10

Water samples from various drinking water sources in Yomibato demonstrating moderate to high levels of fecal contamination.

"We're drinking our own feces!" Community members were shocked to see – and smell – the fecal contamination in their water.

Results 2007-2014:

Water system and sanitary installations, Tayakome and Yomibato

After the initial visits in 2007 to Tayakome and Yomibato which the communities ultimately welcomed the project, fund-raising, engineering and topography studies, design and construction moved quickly. By the time I returned to Tayakome in March of 2010 the water system was already fully functional, with most households receiving clean, pure water in practical household taps that had been adapted for maximum sturdiness, usefulness and efficiency in terms of minimizing the use of heavy materials. The school house had a single, larger stainless steel utility sink similar to the model use in the original Huacaria pilot project. This style of heavy-duty sink is appropriate for a place like the school house where lots of people use it, however individual household taps were simplified to save on materials and be more sturdy and practical for heavy household use. This capacity to adapt and modify the system design to maximize efficiency and to fit local needs is one of the hallmarks of Rainforest Flow's method, and one of many rasons for its success. The slow sand filtration system itself, rather than relying on heavy cement structures that need to be transported far up river and then carried by community members, takes advantage of modern materials similar to those used by the U.S. military and U.N. disaster relief programs: lightweight rubber and vinyl tanks with steel reinforcements are ready-made and need only be filled with rocks and sand in the proper proportions to set up durable clean water systems quickly and with minimal heavy materials in such remote communities.

Slow-sand filtration tanks in Tayakome

Peruvian project engineer Caleb Matos demonstrates maintenance of the slow sand filter.

Tayakome community member washing hands at household tap stand.

Utility sink at the Tayakome school house

A sturdy suspension bridge brings water from the filtration system across a ravine to the main community in Tayakome.

In 2011, once the water system was running, site selection was already underway for a school bathroom in Tayakome. In the meantime, topographic studies were already underway in the far more remote community of Yomibato. By the time I returned in December 2011, Tayakome already had a school bathroom with four flush toilets and an ecological composting system, and construction of the water system was underway in Yomibato, which presented many engineering challenges including the necessity of building a bridge to pipe water across the Yomibato river, and a much more dispersed population needing a wide network of pipes and tap stands.

When I returned in April of 2014 for a follow-up visit, Yomibato, too, had fully functional pure water tap stands in the majority of households throughout the community, and work was underway to install the school bathroom to replace an unhygienic, improvised bathroom built by the local school teacher.

Tap stand at a distant residence site in Yomibato

The water treatment plant in Yomibato.

Health and sanitation results, Tayakome 2009-2011:

I hadn't even arrived in the community of Yomibato in April of 2014, but even from the river bank, as our boat arrived, I could already see the transformation the clean tap water project had made in the community: all of the children were clean! As noted above, the Matsigenka bathe frequently, and mothers frequently clean and bathe their babies and young children. And yet living in the environment they live, it is impossible to

keep small children clean, especially in distant settlements who depend on precarious spring sources for water. For this reason, in prior years, it was commonplace to see many children with their faces, hands and chest covered in a crust of mud, food and mucus. Arriving in Yomibato in 2014, however, not a single child had a dirty face. As I had observed in other communities, when people have access to tap water, they use it, which means that basic hygienic activities like hand washing, bathing, clothes washing and dish-washing become much more frequent, almost constant in daily life. Rather than having to wait to go down to the river to bathe or wash, or constantly go down to fetch more water, women and children alike open a tap to wash their hands or faces, and other grab a sip of water to drink while they do so.

When people have water, they use it!

As part of Rainforest Flow's ongoing health monitoring project, a health team led by Dr. Miguel Cabieceses carried out a baseline health study prior to project initiation including laboratory analysis of parasite loads, anemia, and other health indicators. Follow-up studies documented the how these indicators changed after the water system and sanitation programs had been implemented. For the time being, follow-up studies are available only for Tayakome, since the Yomibato system was completed just this year.

Baseline health studies were carried out in Tayakome in 2009, before the tap water system and accompanying sanitation education programs were initiated. The studies were repeated in 2011, after the project had been fully running for over a year. After just a year, the health improvements are already visible especially among children under 5. The rural rainforest environment, after having been inhabited continually by native communities for several decades, has become fairly saturated with various

intestinal parasites. Severe parasite infestations can be especially damaging for child health, nutrition and growth and development. As Figure 1 shows, overall numbers of parasite infestations is down by 36%, from 86% of children positive for parasites in 2009 to 56% in 2009. By the same token, the number of children who are parasite-free increased by over three times, from 13% in 2009 to 44% in 2011.

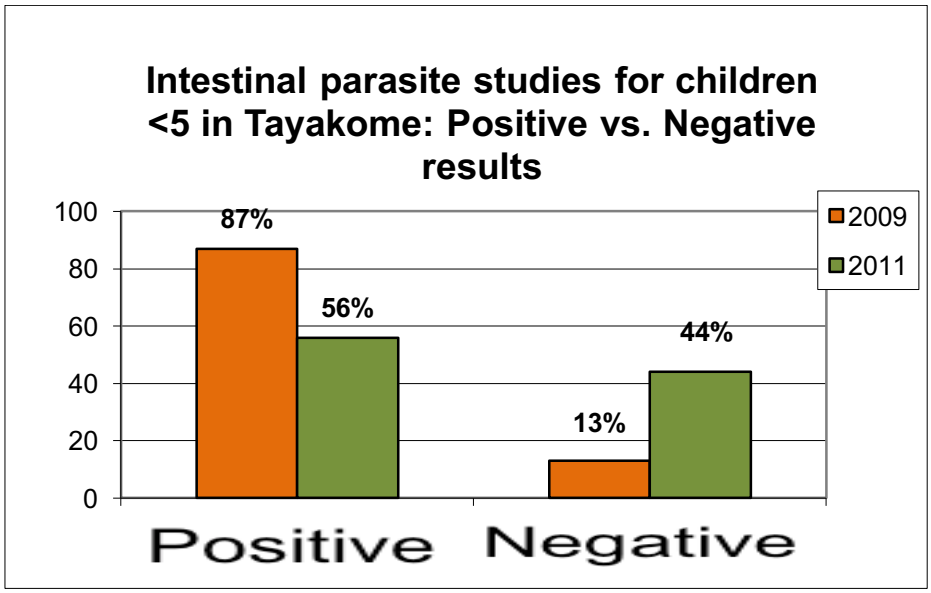

Figure 1: Reduction of intestinal parasites in children < 5, 2009-2011

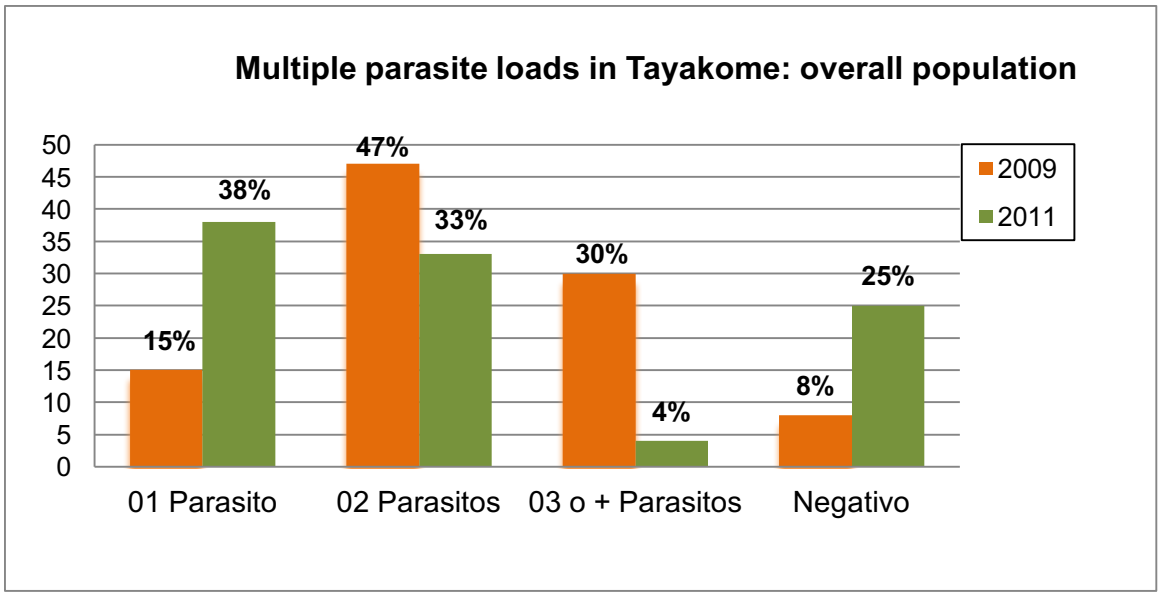

Figure 2: Reduction in multiple parasite loads in Tayakome, 2009-2011

What is even more important is how Rainforest Flow's installation of clean water and sanitation training helped to reduce *multiple* parasite loads. In the remote situation

and within the village environment, avoiding parasite infestation altogether is fairly difficult, and only can be achieved with sustained education, medication and other interventions. However multiple parasites take a high toll on the nutrition and health status of young children. Looking at Figure 2, we saw how infestation by three or more parasites simultaneously dropped by 87%, from 30% to only 4% of the 166 samples studied from the overall population. Infestation by two parasites simultaneously dropped 30%, from 47% to 33% of the population, and the overall number of people parasite-free tripled, from 8% in 2009 to 25% in 2011. Among the most common intestinal parasites, Ascaris (roundworm) infestations in children under 5 were reduced by 78% (from 77% to 17%), while the dangerous Strongyloides parasite was eliminated entirely, from an incidence rate of 17% to zero. However amoebic infestations, such as Giardia and Hymenolepsis nana, were hardly changed, which indicates that there are persistent problems of water contamination in other sources (probably stream water) besides the tap water system that children are still consuming.

Peruvian health care worker collaborating with Rainforest Flow in ongoing assessment of child and community health.

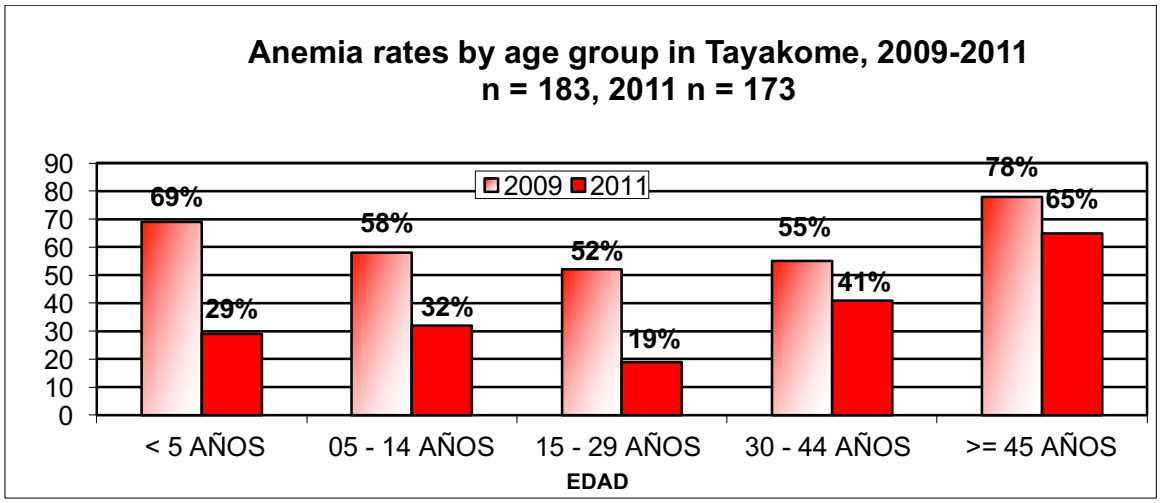

Figure 3: Reduction of anemia in Tayakome by age group, 2009-2011.

Anemia is influenced by a variety of factors, ranging from nutrition to intestinal parasites and other infections. A drastic 58% reduction in cases of anemia is found among the most vulnerable population, children under 5, with all other age groups showing significant reduction in anemia, with an overall reduction of 46% in the number of people suffering from anemia in Tayakome, from 61% in 2009 to 33% in 2011. These rates of anemia are still high, will likely require other interventions besides just clean water and hygiene, and yet it is clear that the reduction in heavy parasite loads associated with the availability of clean drinking water and the provisioning of hygiene interventions has contributed to a significant reduction in anemia throughout the population in general, with especially marked gains for children. Likewise, the status of infant nutrition also saw some improvement, with a 63% drop in the number of children considered to be "at risk" for malnutrition (from 38% in 2009 to 14% in 2011), and an increase in almost three-fold of "normal" weight children, from 12% to 30%. Still, 56% of children in Tayakome under 5 are considered to be underweight or under-size for their age, an indication of chronic poor nutritional status for many children that needs to be addressed with ongoing and multiple health, nutrition and educational interventions.

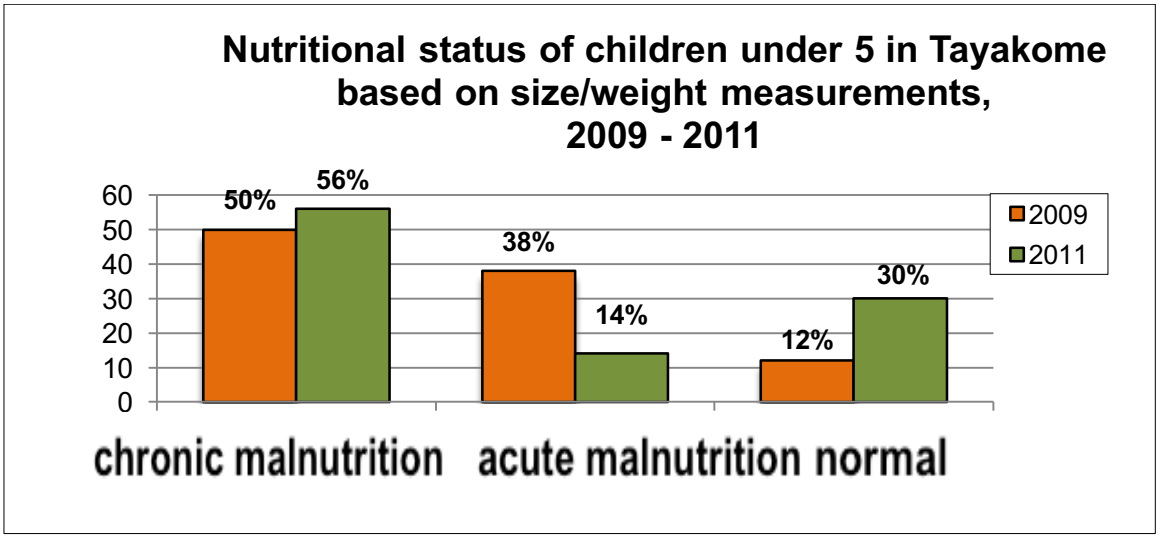

Figure 4: Reduction of acute infant malnutrition in Tayakome as determined through size/weight measurements, 2009-2011.

Ongoing challenges: Yomibato

The community of Yomibato, where Rainforest Flow is currently concluding construction of its full water system and school restroom, presents the greatest challenges of all communities where the project has worked so far. The community is extremely remote, with access especially difficult during the dry season when the small river leading to the community is ankle-deep in places and often blocked by fallen trees. The population there is far more dispersed and nomadic than that at Tayakome, and also almost twice as big. Because it is farther from the main rivers, the community has limited access to fish, mostly in the dry season, and hence the community has more difficulty acquiring adequate protein. Furthermore, a large proportion of the community members are newly arrived from isolated settlements in the headwaters of the Manu River who have only been in contact with Western culture (and Western diseases) for less than 20 years, which mean their immune systems are still highly vulnerable to introduced diseases, especially colds and gastrointestinal viruses. And yet because it is so remote, health care is also more precarious there. These factors mean that adults and newborn children of families recently arrived from the isolated headwater settlements suffer from additional chronic health and nutrition stresses.

Celso, one of several families who moved to Yomibato recently from isolated headwater communities seeking education, economic opportunities and better health.

The health baseline study carried out in Yomibato in 2011 revealed nearly half (49.2%) of the 31 children under 5 surveyed suffering from anemia and 88% suffering from some indication of chronic malnutrition (low size or weight for age). Some form of intestinal parasite was found in 80% of the children under 5, and over 50% had multiple parasite infections. With the recent completion of the full water and sanitation and the ongoing health training, it is hoped that this community also achieves the significant reduction in parasite loads, anemia and malnutrition witnessed in Tayakome and other communities where Rainforest Flow/House of the Children has been active.

Carrying out this project in these remote communities, in such distinctive and special cultural and ecological conditions, is a tremendous ongoing challenge. Respecting cultural particularities and the demands of the local economy and social customs, the project was carried out at a fairly gradual pace, such that the local people could assimilate and incorporate new habits and technologies into their lifestyle, without becoming overwhelmed. The project has also inspired the community to take better care of the village and surrounding environment, for example by using leftover project materials to build durable trash cans at the school house to reduce litter, and develop a routine for trash disposal, with special treatment for toxic items such as batteries. Attention to such details, and the flexibility to incorporate new elements and make

appropriate changes along the way, sets Rainforest Flow apart from most other development agencies and projects.

Rainforest Flow continues to monitor the health advances, and hopes to maintain and document these advances into the future. The people of the participating communities have made a clear and conscious change in their relationship with their community organization, community infrastructure and with their health. They have overcome numerous habits and a cultural attitude of dependency and apathy that had kept them and especially their children unhealthy for a long time. Now, the community's health is firmly back in their own hands, their own hearts, and their own rich cultural life.