SEATEC INTERNATIONAL

EVALUATION
OF
RURAL WATER SUPPLY PROJECT
USING THE
COCONUT FIBER/BURNT RICE HUSKS FILTER ("FRANKEL FILTER")
IN THE BICOL RIVER BASIN, PHILIPPINES

REPORT

TO

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RURAL WATER SUPPLY PROJECT USING THE COCONUT FIBER/BURNT RICE HUSKS FILTER ("FRANKEL FILTER")

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RURAL WATER SUPPLY PROJECT USING THE COCONUT FIBER/BURNT RICE HUSKS FILTER ("FRANKEL FILTER") IN THE BICOL RIVER BASIN, PHILIPPINES

I. INTRODUCTION

This report describes the results of a six month monitoring program by the Bicol River Basin Development Program (BRBDP) covering the operation of three pilot coconut fiber/burnt rice husks filters (known as the Frankel Filter Project) in the barrios of Balagbag, Milaor; San Francisco (Bawa), Canaman; and San Juan, Magarao. This period began in May 1976. The period was extended to permit gathering of more water samples and additional analyses of water quality data.

The monitoring program included water quality testing of the raw and filtered waters, evaluation of the quality of alternative water sources, review of villager (or baranguy resident) participation, and a preliminary evaluation of the socio-health impact of the filters on villager water use and related habits. The report also contains the results of two sets of socio-economic surveys conducted in the three baranguys both before the units were installed and after completion of the six-months trial operating period.

A. Background

The development of the coconut fiber/burnt rice husks filter was a result of some two years of laboratory research at the Asian Institute of Technology, Bangkok by Dr. Richard Frankel, in a search to find a simple, inexpensive, and efficient method of water treatment for rural communities in Southeast Asia. The emphasis of the research was to utilize local materials as filter media, in a gravity fed system without the need for backwashing, and to eliminate wherever possible the use of any chemicals.

The methodology developed was a two-stage filtering process using coconut fiber and burnt rice husks as filter media. The raw water from a surface stream, pond or shallow well, is first passed through shredded coconut fiber, which achieves an initial reduction in turbidity and suspended solids

removal, then passes through burnt rice husks, which achieves the second or polishing stage in removing residual turbidity and bacteria. Generally no chemicals are needed, but in certain cases some coagulants might be needed to enhance removals of colloidal materials. The first stage filter with coconut fiber is found to act essentially as a substitute for the coagulation and sedimentation phases of conventional water treatment plants. The second stage, using burnt rice husks, is similar to slow sand filtration. However, in addition to achieving removals by the process of filtration, the burnt rice husks achieves some additional removals of taste, color, and odor through the process of absorption, similar to the use of activated carbon.

Pilot plant testing of the two-stage filtration system began in 1973 in the lower Mekong basin countries. The scope included field testing of the units to determine filter efficiencies, effluent quality, lengths of filter run, and operational problems, and to test the acceptance of the treated water by the villagers.

Pilot plant testing began in the Philippines in early 1976 after an initial training program with BRBDP in the design, construction and operation of the units. Based on the experiences in the lower Mekong basin countries, improvements were incorporated in the units built in the Philippines to enhance operational simplicity of the filters.

Construction of the units took place in late 1975 and early 1976. The first few months of 1976 were then utilized to gain experience, including training operators, methods of water sampling, repair of pumps, purchase and transport of gasoline to the barrios, and discussion with baranguy leaders. Once water quality testing equipment was procured and a monitoring program worked out, BRBDP undertook to oversee the entire operation for a 6 month period starting May 1976. Following the 6 months period, the units were to be turned over to the baranguys to operate themselves (starting January 1977).

B. Pilot Plant Objectives

The primary objective of the Frankel Filter Project was to test its applicability to the Philippine situation at Bicol. Special questions to be answered included (1) could the units be built cheaply using local materials?

(2) could the units be operated by the baranguy residents? (3) could the filters produce a better quality water than that previously available to the residents? (4) would the project be accepted by the baranguy residents? and (5) could they afford to operate the filters using their own financial resources? During the six months test period, the BRBDP personnel provided operational assistance to the baranguys, coordinated the collection of water samples, carried out most of the water quality testing including physical, chemical and bacteriological tests, conducted the socio-health surveys in the selected barrios, and helped write up preliminary results of the findings.

The scope of the consulting services was essentially to oversee the BRBDP operation, assist in development and analysis of the water quality testing program, in development of the survey questionnaire, and in the interpretation and analysis of the findings.

C. Project Impact Analysis

A pre-project survey was conducted in all three baranguys prior to the construction and operation of the Frankel filter projects. The survey, conducted by the Department of Health, Regional Health Office V in Lagaspi, was carried out during the months of November-December 1975. All households in the three baranguys were included in the survey. A summary of the questionnaire responses on the personal background of the household heads or perceived heads interviewed, on individual health habits, water use, and some data on income and expenditures in the three baranguys is attached as Appendix A. The summary tabulates statistically the responses of the households by baranguy and shows the distribution of responses by percent of households.

In December 1976, one year later and after the pilot Frankel filter projects were put into operation, supervised, and tested by BRBDP over a 6 month period, a similar survey was conducted by the Planning Research Division, BRBDP, in the three baranguys. The second survey covered some 166 household heads or perceived heads. The responses are tabulated and presented statistically in Appendix B as reported by the Planning Research Division, BRBDP.

II. OPERATION OF PILOT FILTER UNITS

A. Pilot Unit at Balagbag, Milaor

The Frankel filter project located at Balagbag was constructed on land adjacent to the home of the baranguy captain who operated the unit throughout the six month period of testing and observation. The unit draws its water from the surface stream that passes alongside the property. The water level in this stream is quite high throughout the year and averages a depth of approximately one meter.

Prior to the construction of the project, most residents pumped locally available groundwater while others purchased drinking water in Naga City and brought it back into the baranguy in 18 liter cans by local bus transport. Water from Naga City was purchased at a price of ₱ 0.25 per can (equivalent to over US$ 6.30 per 1,000 gallons). Families purchasing water spent an average of 40 hours per week fetching such drinking water.

The groundwater obtained from shallow wells was highly turbid, with a slight smell and color problem due to the high organic activity of the soil and the dissolved iron. In addition it was suspected that water at the site might be contaminated with high levels of pesticides accumulated from surface runoff from the neighboring agricultural areas.

Construction of the filter project permitted testing of the absorption capacity of the burnt rice husks to remove pesticides. The efficiency of pesticide removal was unknown as this problem had not been encountered previously in other pilot studies. Hence, it was recommended to sample the raw surface water, the filter effluent, and the shallow well water and send samples monthly to the National Pollution Control Commission in Manila for long chromatograph analysis for selected organo-chemical materials.

A photograph of the unit is shown in Figure 1. The large concrete storage tank, which holds about 6 m^3, was filled every other day. Chlorine was added (when available) into this tank. The baranguy residents themselves constructed a concrete pathway using materials donated by the Philippine government to insure year-round access to the filter project.

Over the six month study period, the baranguy captain spent about four hours per day in activities related to operation of the unit. The filter was operated approximately 2-3 hours per day and supplied sufficient water for drinking and cooking needs of some 85 resident families. At the end of the six months period, the project was turned over to the baranguy. The residents elected to contribute one Peso (₱ 1.0) per family per month towards the upkeep of the unit. These funds collected by the baranguy captain, were used to pay for gasoline to run the pump (which amounted to almost ₱ 60 per month). The captain received no salary or stipend and no funds were collected for either repayment of capital or for future expansion of the distribution system. However, the residents had requested cement and pipes from the government in order to connect the storage tank to both the barrio school and health center on opposite sides of the road which runs through the barrio.

B. Pilot Unit at San Francisco (Bawa), Canaman

The unit located in San Francisco (also referred to as Bawa) was built on a donated piece of land near the main shallow well of the barrio. Drinking water is a big problem in San Francisco even during the wet season. The shallow wells have a high iron content and rice cooked in this water becomes dark. Clothes washed in the water were often stained and residents complained of the water having a disagreeable taste. As an alternative supply, water was purchased from Naga City by the more affluent barrio residents at a cost of ₱ 0.25 to ₱ 0.45 per can of 18 liters hauled in by boat (a 1 hour trip up the Bicol River). Unfortunately, the barrio could not utilize the Bicol river water along its banks for drinking water since during the dry season the water was saline due to salt water intrusion up the estuary.

The inaccessability of the barrio by road made assistance by BRBDP personnel more difficult and limited communication between the barrio and BRBDP. Rapid solution of problems of design and operation encountered was not possible. Operational problems remained and were not completely solved during the six month study period.

The unit was originally designed to handle the expected high iron content in the ground water by building the upper tank with two layers of gravel in a two-tray aerator above the coconut fiber. The tray aerator was designed to enhance oxidation of the dissolved iron in the well water to form a red precipitate which would settle and be removed by the coconut fiber, and for this reason the coconut fiber was not maintained under water as is the practice in other units. The raw water simply filtered through the medium to the lower tank containing burnt rice husks. This latter medium was maintained immersed at all times by the configuration of the effluent piping. A photograph of the unit is shown in Figure 2.

The depth of burnt rice husks was only about 40 cm and should have been raised to 80 cm while at the same time raising the level of the effluent pipe above the bottom of the filter tank to control the depth of water in the tank at the same height. This correction was pointed out during the construction and operation phases, but was not completed by BRBDP. The well supplying the unit was also far too small for the filter project. A series of interconnecting wells was proposed but never built, because of problems in coordinating barrio labor assistance and in getting additional construction funds approved. Hence the heavy pumping of the well from the gasoline operated pump exhausted the water supply in some 15-30 minutes and eventually caused the walls of the well to collapse. Temporary bamboo poles were put in to shore up the walls but rotting of the poles caused a major deterioration in the raw water quality adding color and odor problems to the raw water. Although the filter effluent was unaffected, the appearance of the raw water discouraged many residents from participating in the project.

The filtered water storage tank, which holds almost 10 m^3 of water, is far too large (an overdesign problem) for the present usage and connections should be considered to the barrio school site and to another section of the barrio to improve distribution of the water to more potential users. No funds were as yet being collected by the baranguy captain from the residents to operate the unit. They were still expecting BRBDP assistance because the unit had not been officially turned over to them. This was expected to take place in early April.

C. Pilot Unit at San Juan, Magarao

The Frankel filter project at San Juan was located at the proposed market site of the baranguy about 100 m from the municipal offices and health clinic and across the stream from the baranguy proper. The filter obtained its water supply originally from a shallow well located near the unit. However, the project pump exhausted the well within 30 minutes so to insure a sufficient supply of water, the intake was extended to the stream by means of an underground connecting pipe from the shallow well. Rip-rap was also put along the banks of the stream to strengthen the retaining walls. The photograph of the site is shown in Figure 3 with the completed market place in the background. The Mayor had requisitioned pipe needed to connect the filter unit with his offices and with the market place, and was planning to concrete the road and a walkway to the unit this year (1977). It is believed that once these additions are made that the unit will be extensively used. The selection of the site tied use of the project to the completion of the proposed market rather than to use by the baranguy residents for household consumption. This was a political decision which had immediate affects on the project. After completion of the filter unit, the project did not catch the interest of the residents. Drinking water was already plentiful in the area, in that baranguy residents typically use the ground water under their homes. Most families had installed a shallow well with a hand operated pump for their domestic needs. The stream was not used as a water supply except for washing clothes. Fear of pesticides in the water associated with the dead fish found in the stream was also a factor contributing to the reluctance of the resident to use the water. The non-acceptance of the filtered water in the future might hinge on the extent of this fear of pesticide pollution. Hence, samples of the raw water, filtered water, and alternative ground water were sent to Manila for analysis.

III. EFFICIENCY OF FILTRATION PROCESS

A. Operation of the Unit at Balagbag, Milaor

1. Efficiency of Filter

The efficiency of the filter to remove contaminants from the raw water was measured in terms of removals of (a) turbidity, using a HACH turbidity meter, (b) iron, using a LaMotte chemical test kit, and (c) coliform bacteria, using Millipore field monitors. Data were collected over the six month period for both turbidity and iron removals. Figure 4 shows that the filtered water turbidity was generally reduced to about 5 TU (Hach Turbidity Units) where as both the raw and alternative well water sources showed turbidities between 20-50 TU. The well water turbidity was consistently higher than that in the surface stream. Figure 5 shows a similar trend for iron. The well water iron content varied from 0.5 to 4.0 mg/l, the raw water from 0.3 to 2.0 mg/l, while the filtered water contained an iron level of between zero and 0.6 mg/l.

Bacteriological test results were unfortunately few in number. Millipore bacteriological field monitors, measuring total coliforms were purchased from the United States for the monitoring program, only after several months of delay waiting for equipment to be repaired at the Bicol Regional Health Office. Total samples analyzed amounted to less than 30 water samples. No tests were made of final water supplied to the residents following chlorination. Some 200 additional field monitors arrived after the monitoring study period and data should be made available by BRBDP in the near future. It is believed that simple chlorination of the filtered water in the storage tank will produce a potable supply as judged by WHO International Drinking Water Standards.

Bacteriological removals by the filter media prior to chlorination are shown in Table 1. Based on six samples only, the results show an average removal of 87 percent with a residual bacteria count prior to chlorination similar to that of the alternative shallow well water.

Removal of pesticides by the filter as shown in Table 2 was inconclusive due to an even more limited number of samples. Two out of three samples showed removals of 60 to 90 percent whereas the third sample showed an apparent slight increase in the concentration of one pesticide through the filter. In almost all samples the alternative water supply showed higher pesticide levels than the filtered water (one exception only).

2. Baranguy Participation

The baranguy residents enthusiastically utilized the filtered water for drinking and cooking and also for some washing and cleaning purposes. The filtered water contained no taste or odor problems, produced a white rice when cooked, and was available in sufficient quantity for most families without necessitating the purchase of additional water from Naga City. Time and money savings in using the filtered water were obvious. Purchase of water from Naga dropped off significantly. Comparison of the pre- and post-surveys shows that water consumption significantly increased over the period by 10 lpcpd, particularly for washing and bathing. There was only minor use of the filtered water for washing and bathing, but the filter freed alternative sources for such consumption. More households showed washing of hands before meals, a significant increase in the number of persons using soap when washing, and in the number of water sealed toilets constructed. A full 83 percent of the resident families used the filtered water exclusively for their drinking and cooking needs whereas prior to the project some 60 percent of all families purchased drinking water from Naga City. Only 8 percent of the families continued to do so after the project was put into operation. Residents of Balagbag, when interviewed by BRBDP Planning Research Division, placed their first priority of change on wanting to have connected pipelines from the project to their houses. All of the residents thought that the system helped the community because the water was clean and safe, more accessible, and less expensive to secure for drinking and other purposes.

B. Operation of the Unit at San Francisco (Bawa), Canaman

1. Efficiency of Filter

Figure 6 shows that turbidity removal was consistently substantial producing a final water quality of about 5 TU. Both alternative and raw water sources had turbidities ranging from 10 to over 100 TU. Iron removals were most pronounced as the iron content of the shallow well waters is a major problem in San Francisco. Figure 7 shows that the iron content of the filtered water was generally less than 0.2 mg/l versus the shallow well water of up to almost 5.0 mg/l. No bacteriological data were available. Pesticide removals as shown in Table 2 were negligible. It is believed that the 40 cm depth of burnt rice husks was too shallow to permit sufficient contact time between the pesticide and the medium.

2. Baranguy Participation

The filtered product was enthusiastically accepted by the residents when available. Numerous delays in operation breakdowns reduced the number of families who participated in the project. Some 66 percent of the families did utilize the filtered water for drinking and cooking. Considerably fewer families bought water from Naga City or used their shallow wells. Water consumption did not show any increase, except for washing and bathing. These activities are however carried out for the most past in the Bicol River and hence the overall lower water consumption in San Francisco is believed due to the lower reporting of water used for these purposes. A larger number of water sealed toilets were reported and a higher number of residents washed hands routinely before meals. The survey showed that all the residents believed the filtered water to be clean and safe, more accessible, and less expensive to secure than other sources.

C. Operation of the Unit at San Juan, Magarao

1. Efficiency of Filter

Although few residents utilized the filtered water, the BRBDP personnel ran the filter 1 to 2 hrs per day for test purposes. Figure 8 shows that the filtered water can compete with the traditional pumped shallow well water in terms of clarity. Turbidities were almost identical for both waters averaging about 5 TU. The turbidity of the surface stream varied from 30 to 150 TU throughout the test period.

Figure 9 shows that the iron level of the filtered water was superior to that of the traditional water source. The iron level is Magarao well water varies from 0.3 to over 1.0 mg/1. The effluent from the filter was consistently zero to 0.2 mg/1 (with one exception).

Bacteriological removals through the filter, as shown in Table 1 for the three sample points, averaged 90 percent removal and effluent coliform levels prior to chlorination and were somewhat higher than those in the shallow well samples. Pesticide removals, as shown in Table 2, were 40 to 60 percent removed for two samples with no removal for a third sample. The pesticide levels in the shallow well water were comparable to those in the stream but in general fewer pesticides were found at San Juan than in the water sources of the other barrios.

2. Baranguy Participation

Participation by the baranguy residents was minimal; only 5 respondents in 48 households took any interest in the project. The negative interest was believed due mainly to the availability of good ground water, to the fact that most households had shallow wells with hand pumps, the inaccessability of the project (which was placed outside the barrio at the site planned for the future market place), and the fear that the surface waters might be poisoned with pesticides.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Operation and Acceptance of the Filters

The evaluation of operation efficiency and baranguy participation shows that in those baranguys where clean water is in short supply or is expensive there is a genuine demand for improved water, at least for drinking and cooking. The residents of Balagbag, and to a lesser degree San Francisco, demonstrated that the Frankel filter system can be maintained and operated efficiently and inexpensively by the baranguy residents. Water quality was greatly improved by use of the filters in all three barrios. Also, the residents accepted chlorination of the filtered water as a needed step to insure "potability".

The unit at Balagbag was turned over to the baranguy and is being operated successfully by the baranguy captain. Payments of one peso (₱ 1.00) per family per month were sufficient to pay for gasoline costs to run the pump and pay for pump repairs. The unit at San Francisco was not as yet turned over to the baranguy at the time of this report. It is recommended that prior to terminating project support this baranguy be assisted by (1) increasing the raw water supply by interconnecting two additional hand dug wells with the one existing well; (2) lowering the level of the gasoline pump to reduce suction head; (3) increasing the depth of the burnt rice husks to 80 cm; and (4) changing the level of the effluent piping from the second filter tank to the storage tank to insure immersion of the burnt rice husks. These changes would improve the present design. It is believed that once the project is turned over to the San Francisco baranguy that the leaders will be able to operate and maintain the project themselves.

The unit at San Juan will probably not be used by the baranguy residents until the filter is connected to the municipal offices and the market place because it lies outside the barrio. Operating funds will be required from either BRBDP or the municipality to start this unit.

Acceptance and interest by the baranguy residents in the project was a function of providing a trouble-free system. When there were few operational problems, shutdowns or water stoppages, villager participation increased. The gas-operated pump remains the sole malfunctioning item in the filter project system. The key to minimize problems appears to be in utilizing a hand operated

pump at the start of the project. The sizeable savings in both capital and operational costs associated with a hand pump more than offset the added administrative burden of organizing the barrio participants to share in the pumping load. By starting with smaller filter units and using hand pumps to serve barrios in the population range of 200 to 300 persons per project, capital costs can be further reduced to an estimated ₱ 15 per person. As the barrio residents become dependent upon the project for their water supply, their increase in water wants will foster greater participation, improved financial support, and awareness of water quality needs. At that stage, expansion of the distribution system and the addition of a gasoline or electric operated pump would be feasible.

B. Monitoring Program

The training and assistance given to the baranguy leaders to operate and maintain the filter projects were successfully carried out by BRBDP. Some delays in organizing baranguy particiation and in getting materials or supplies to the baranguys limited the data and feedback obtainable in the six month monitoring period. Sanitary Inspectors collected water samples and carried these to the Regional Health Office in Legaspi for chemical and bacteriological analyses. However, due to numerous delays in equipment repairs at the Public Health Laboratory no samples were analysed during most of the six months of bacteriological data collection. As a recourse, BRBDP personnel used portable bacteriological and chemical field test kits to collect meaningful and reliable data. It is recommended that BRBDP continue to use the field kits to carry out physical, chemical and bacteriological testing of water samples. Such work is valuable to the training of BRBDP personnel, the Sanitary Inspectors, and the baranguy leaders involved in these projects.

The monitoring program showed problems of communication between distant barrios and BRBDP. Baranguy leaders did not send messages requesting assistance and instead waited for BRBDP personnel visits which were often irregular. A central core of full time water supply/sanitation personnel will be needed if BRBDP intends to successfully expand its role in planning, construction, and supervision of rural water supply and sanitation projects. The BRBDP personnel are adequately trained and capable of running such a program, but more time should be spent by BRBDP in training the Sanitary Inspectors and baranguy leaders

to understand and anticipate the problems of operation and maintenance associated with community water projects. These projects can not be "walked away from" after completion if BRBDP intends to develop the awareness and interest of the baranguy residents for clean water and improved sanitation. This awareness will take considerable time and BRBDP should anticipate that the majority of baranguys will not be able to operate and maintain such projects without a follow up program of maintenance assistance over several years. It is most important that a long term maintenance and training program be developed as part of the BRBDP commitment to rural water supply and sanitation development. The failure of planning agencies in other countries to provide for such assistance after completion of construction of water/sanitation projects has been the chief reason for failure of rural communities to sustain their own projects and become self reliant.

ACKNOWLEDGEMENTS

The BRBDP monitoring program was organized and supervised under the direction of Pedro B. Olaño, Senior Development Project Coordinator, with assistance by Venerando B. Revilla, Project Coordinator. The consultant is indebted to both these individuals for their sustained interest and time inputs into this project. The initiative of Mr. Olaño in carrying out many of the water quality analyses himself and in having BRBDP personnel responsible for water quality monitoring was invaluable in obtaining reliable water quality data. Special thanks also go to Mr. Perfecto J. Bragais, Jr. for organizing and summarizing the results of the final field evaluation survey.

TABLE 1. BACTERIOLOGICAL ANALYSES OF WATER SAMPLES, FILTER PROJECTS, BRBDP

Location	Date of Sample	No. of Coliforms/100 ml.[1] Raw[2]	Treated[3]	Alternate[4]	% Removal
Balagbag, Milaor	12-27-76	8,000*	600	1,000	90
	1-3-77	11,200	1,700	2,240	85
	1-6-77	3,040	1,655	1,835	46
	1-10-77	7,000*	150	110	98
	1-12-77	9,000*	640	30	93
	1-17-77	5,320	160	170	97
San Juan, Magarao	12-27-76	8,000*	600	200	93
	1-3-77	10,000*	672	1,650	93
	1-19-77	12,000*	1,810	30	85
				Average	87%
				Median	93%

* Estimated total number of coliforms.

1/ Total coliforms as obtained from Millipore Portable Water Analysis Kit using bacteriological field monitors. Samples incubated 24 hrs. at 35°C prior to counting.

2/ Raw water from surface streams at both Balagbag and San Juan.

3/ Total coliform count from filter prior to chlorination. Chlorination in the filtered water storage tank practised when chlorine available in the baranguys.

4/ Alternative water source from shallow well water pumped by hand pumps in both baranguys.

TABLE 2. RESULTS OF PESTICIDE ANALYSES OF WATER SAMPLES AS REPORTED BY THE NATIONAL POLLUTION CONTROL COMMISSION, MANILA 1/

Pesticide \ Sample No. 4/	Concentration in µg/l (ppb) 2/												US EPA 3/ Recommended Limits
	Raw Water Source				Filtered Water				Alternative Water Supply				
	1	2	3	4	1	2	3	4	1	2	3	4	
A. BALAGBAG, MILAOR													
Dieldrin	trace	-	-	trace	-	-	-	trace	SAMPLE NOT MADE AVAILABLE FOR ANALYSES	-	-	.097	1.0
Heptachlor epoxide	-	-	trace	-	-	-	trace	-		-	.037	trace	.1
Endosulfan	-	1,193	-	-	-	0.795	-	-		1.234	-	-	N.A.
Alpha BHC	-	trace	trace	-	-	trace	trace	-		-	trace	-	N.A.
Gamma BHC	-	trace	-	-	-	trace	-	-		trace	-	trace	N.A.
Aldrin	.319	-	.349	.263	.092	-	.376	.164		-	.288	.544	1.0
B. SAN FRANCISCO, CANAMAN													
Dieldrin	-	-	-	-	-	-	-	-		.146	-	.083	
Heptachlor epoxide	-	-	-	-	-	-	trace	-		-	trace	trace	
Endosulfan	-	2.701	-	-	-	2.736	-	-		2.78	-	-	
Alpha BHC	-	trace	.037	-	-	-	trace	.021		trace	trace	-	
Gamma BHC	-	-	-	-	-	-	-	.019		-	-	trace	
Aldrin	.006	-	.329	-	trace	-	.338	.173		-	.315	.833	
C. SAN JUAN, MAGARAO													
Dieldrin	trace	NEGATIVE								NEGATIVE			
Heptachlor epoxide	-	-	-	-	.041	-	-	-		-	trace	-	
Endosulfan	NEGATIVE									NEGATIVE			
Alpha BHC	-	-	trace	trace	-	-	trace	trace		trace	-	trace	
Gamma BHC	-	.042	trace	.044	-	.0475	trace	.06		-	-	trace	
Aldrin	.320	-	.274	.073	.113	-	.170	.133		-	.359	.107	

1/ Data reported by Ms. Clarita Centeno, Science Research Supervisor, Chief of Division of Research & Development, National Pollution Control Commission, NSDB, Manila.

2/ Results of full gas chromatograph analysis of chlorinated hydrocarbons. Only those pesticides that appeared are shown as measured above. All others were at zero levels.

3/ Reference: US Environmental Protection Agency, Water Quality Criteria, 1972, Washington, D.C.

4/ Dates of sample numbers: No. 1 = 6 July 1976; No. 2 = 27 September 1976; No. 3 = 25 October 1976; and No. 4 = 10 January 1977.

FIGURE 1. PHOTOGRAPH OF FILTER PROJECT IN BARRIO BALAGBAG, MILAOR

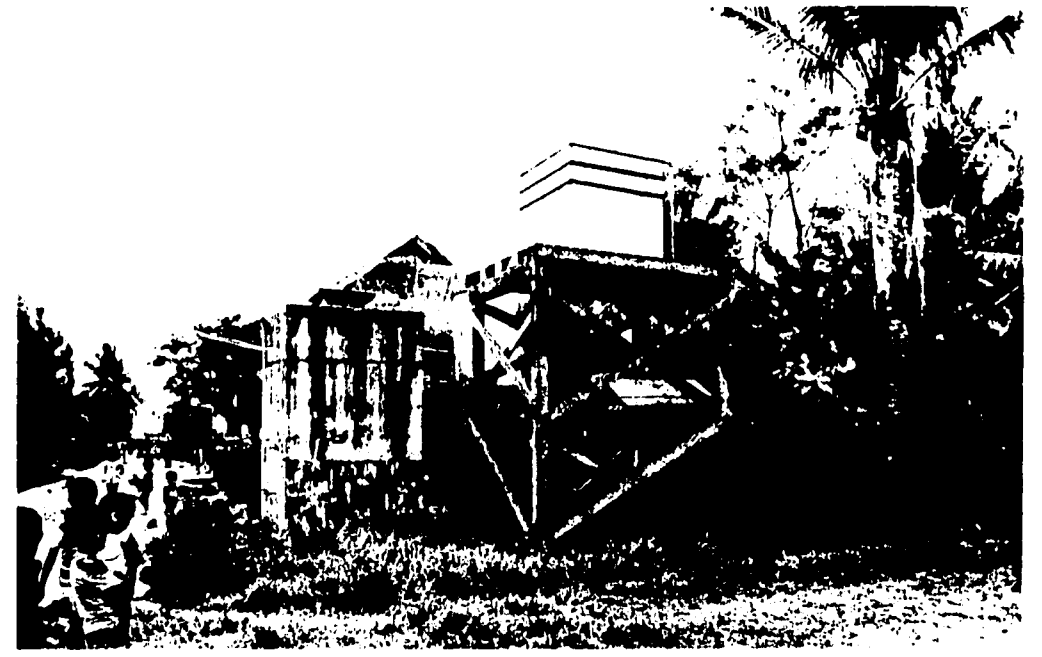


FIGURE 2. PHOTOGRAPH OF FILTER PROJECT IN SAN FRANCISCO, CANAMAN

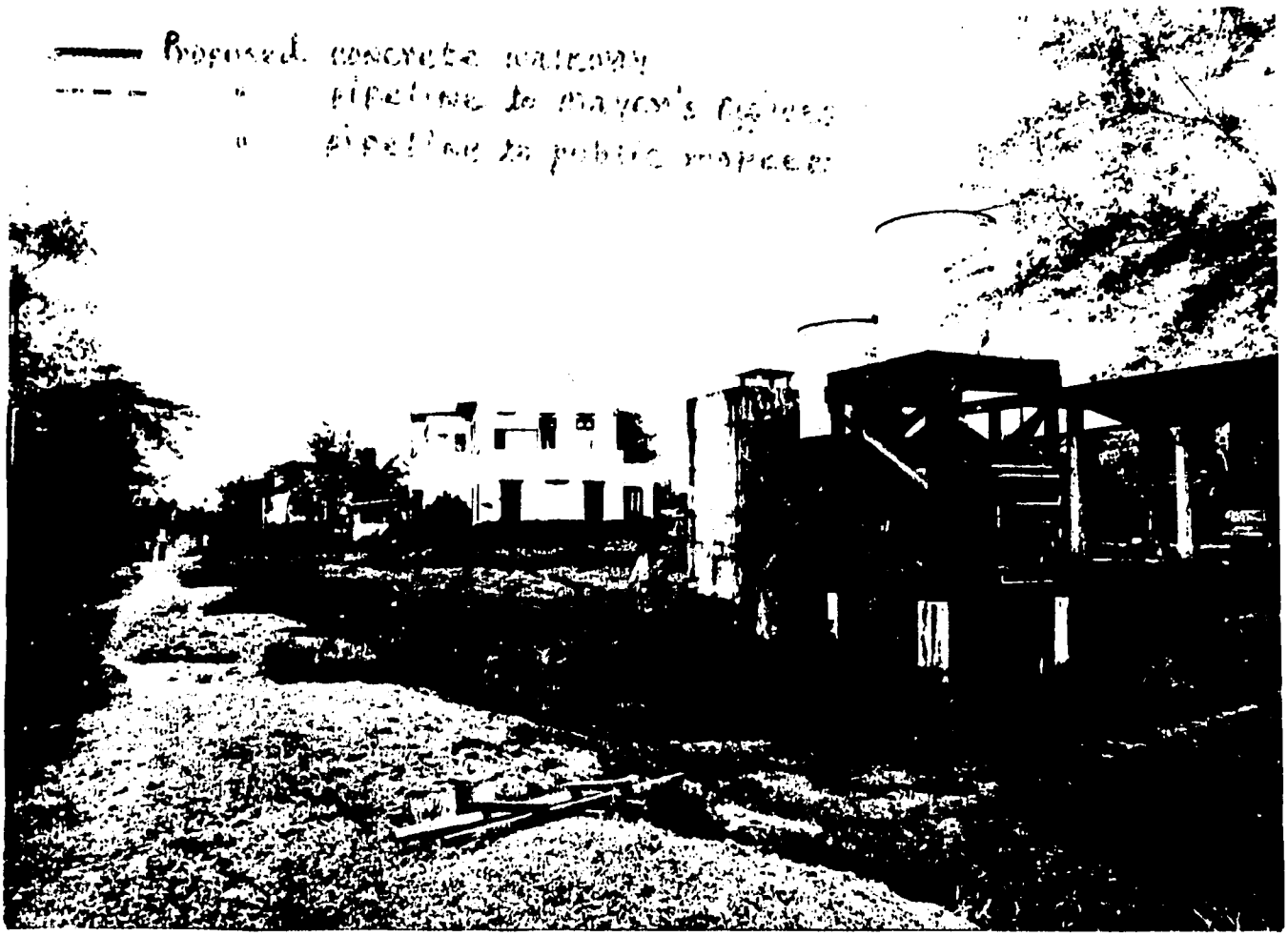
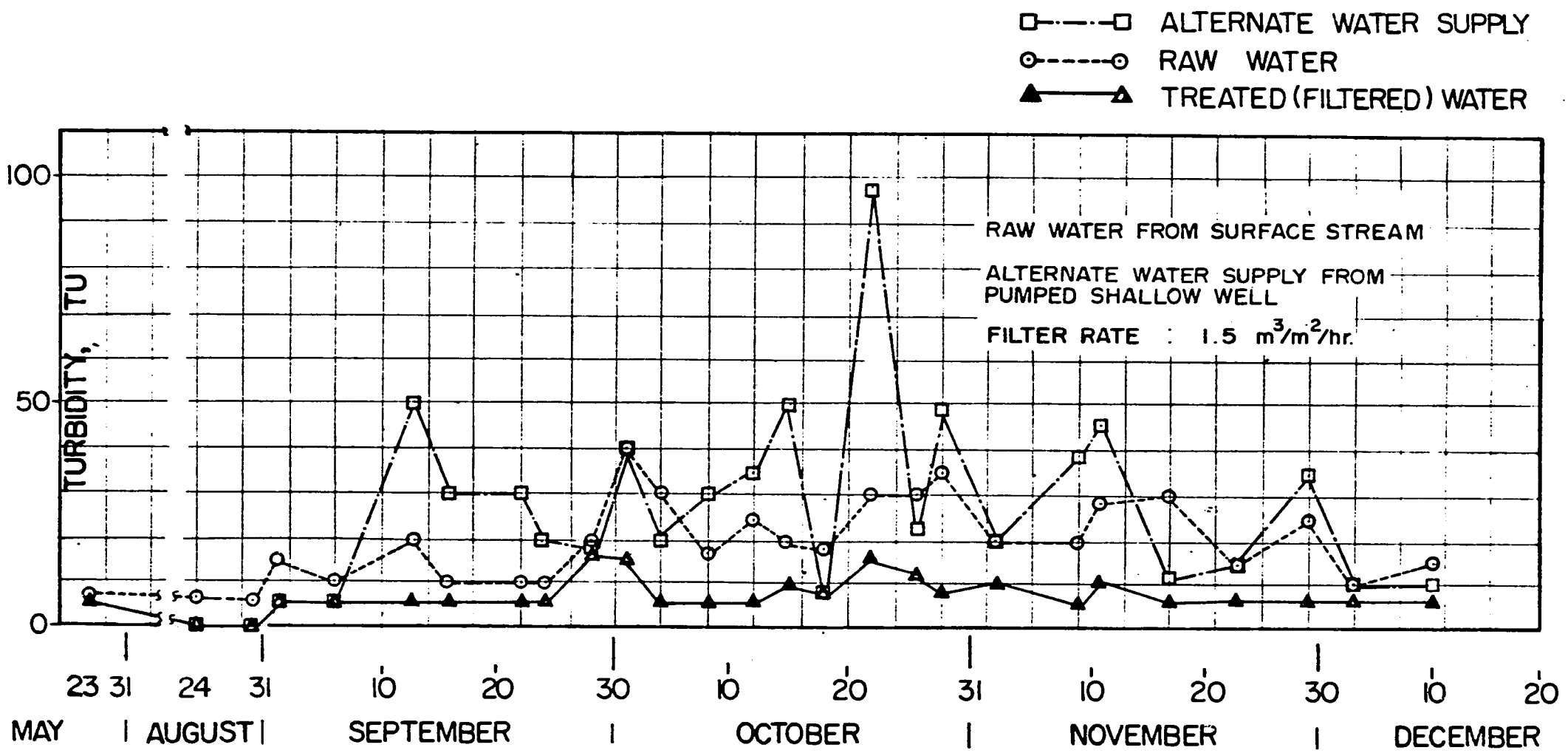


FIGURE 3. PHOTOGRAPH OF FILTER PROJECT IN SAN JUAN, MAGARAO

FIGURE 4 : REMOVAL OF TURBIDITY BY FRANKEL FILTER PROJECT

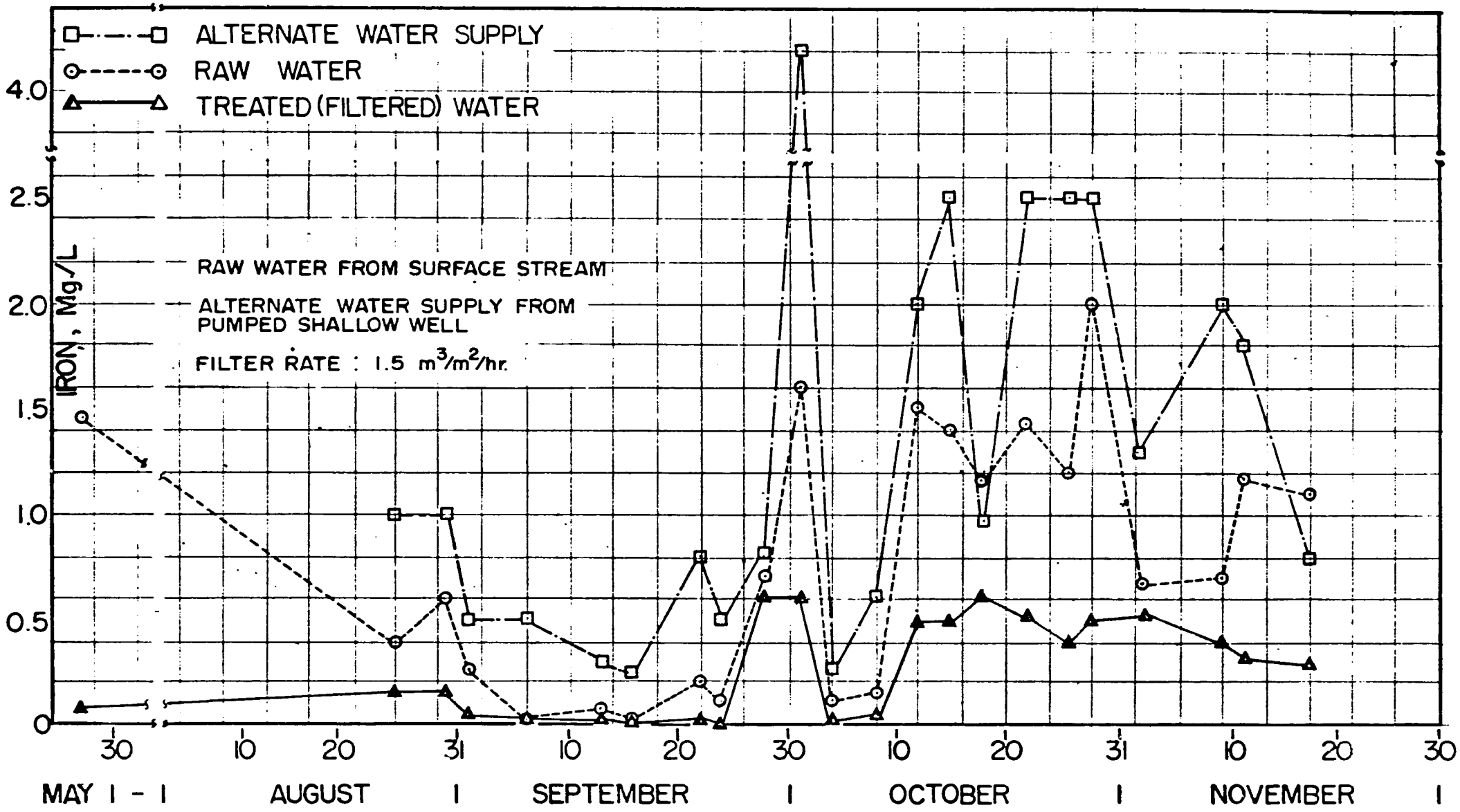
BALAGBAG , MILAOR , CAMARINES SUR



TIME SINCE OPERATION BEGAN

FIGURE 5 : REMOVAL OF IRON BY FRANKEL FILTER PROJECT

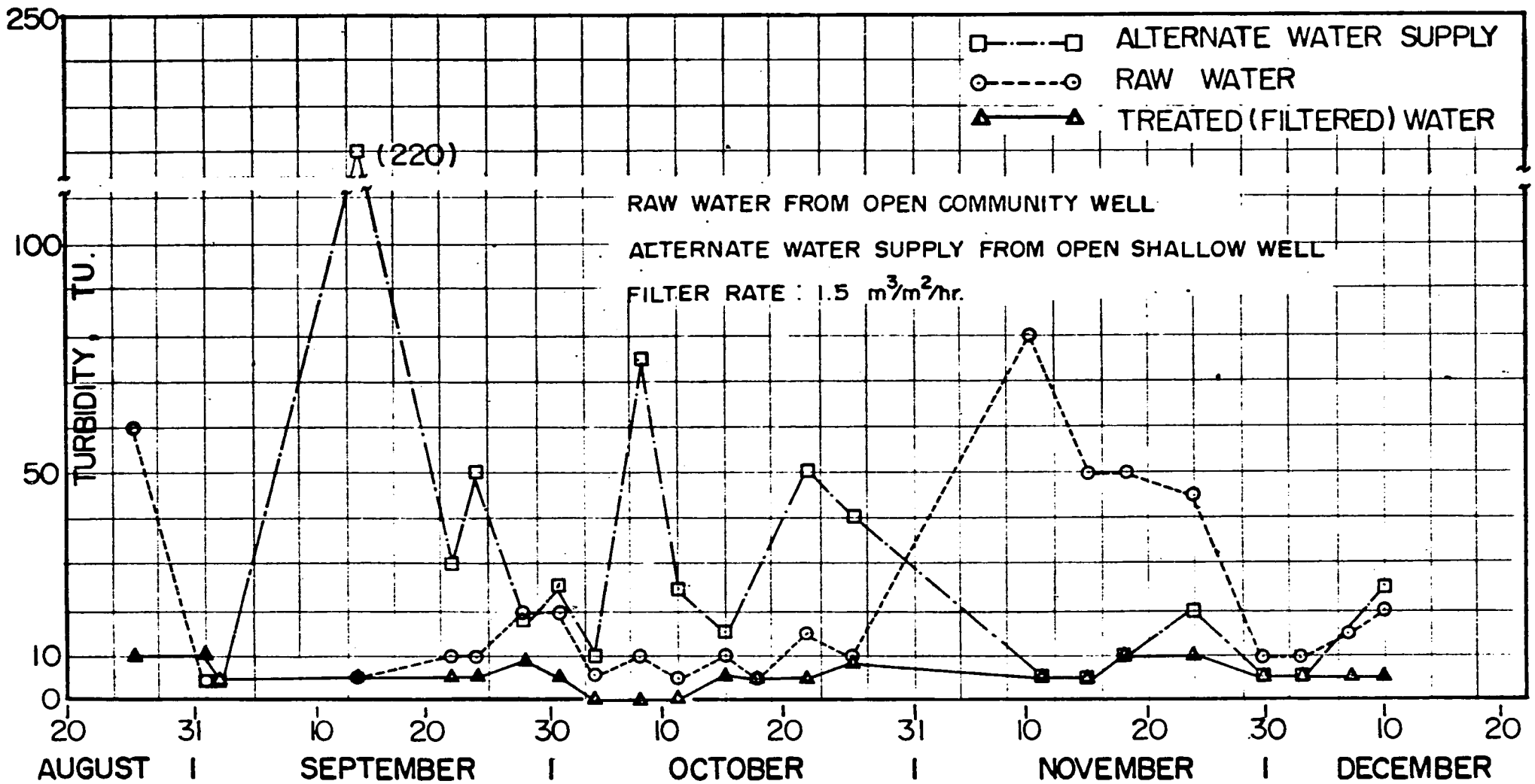
BALAGBAG , MILAOR , CAMARINES SUR



TIME SINCE OPERATION BEGAN

FIGURE 6 : REMOVAL OF TURBIDITY BY FRANKEL FILTER PROJECT

BAWA, CANAMAN, CAMARINES SUR



TIME SINCE OPERATION BEGAN

FIGURE 7 : REMOVAL OF IRON BY FRANKEL FILTER PROJECT

BAWA, CANAMAN, CAMARINES SUR

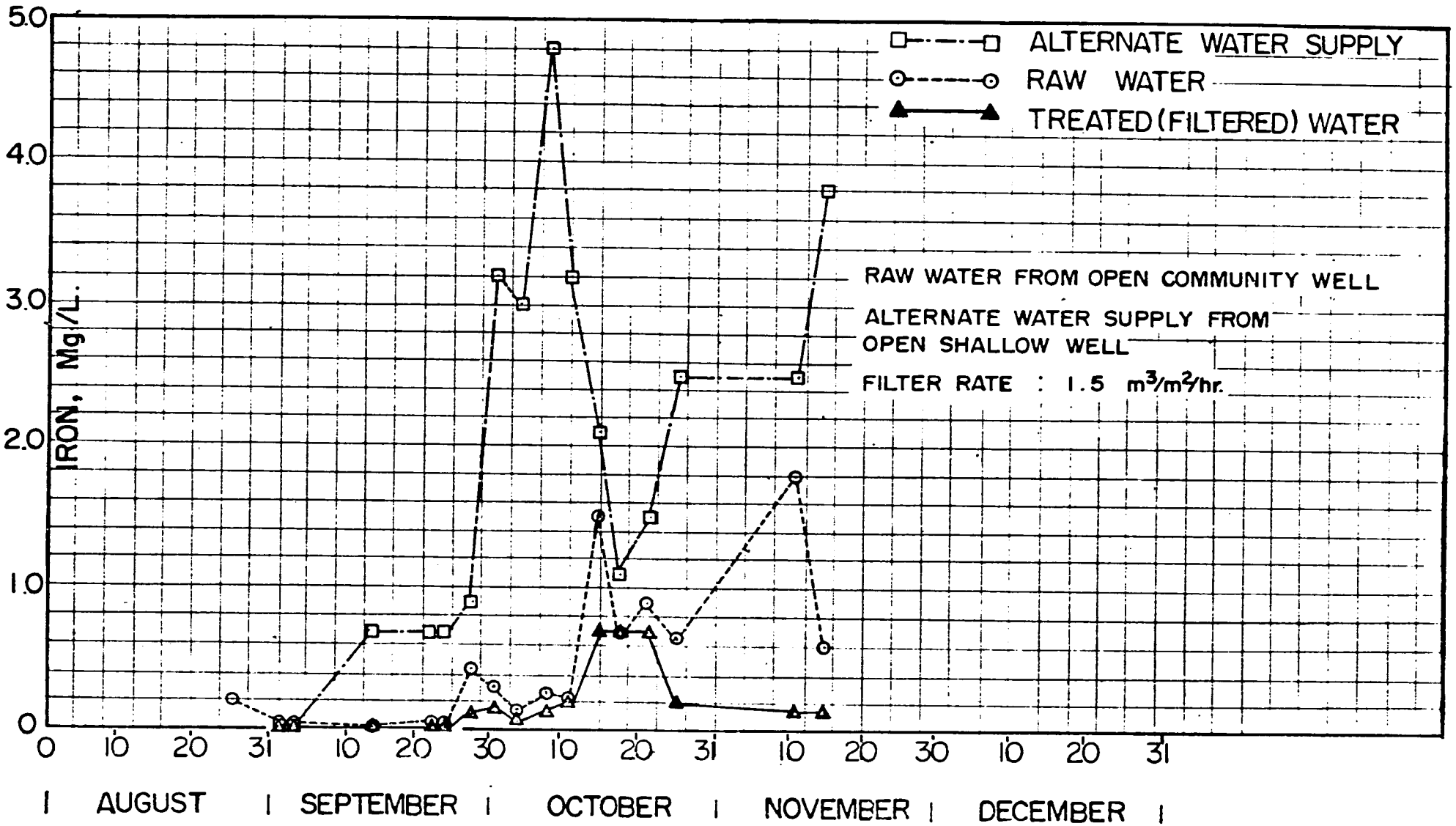


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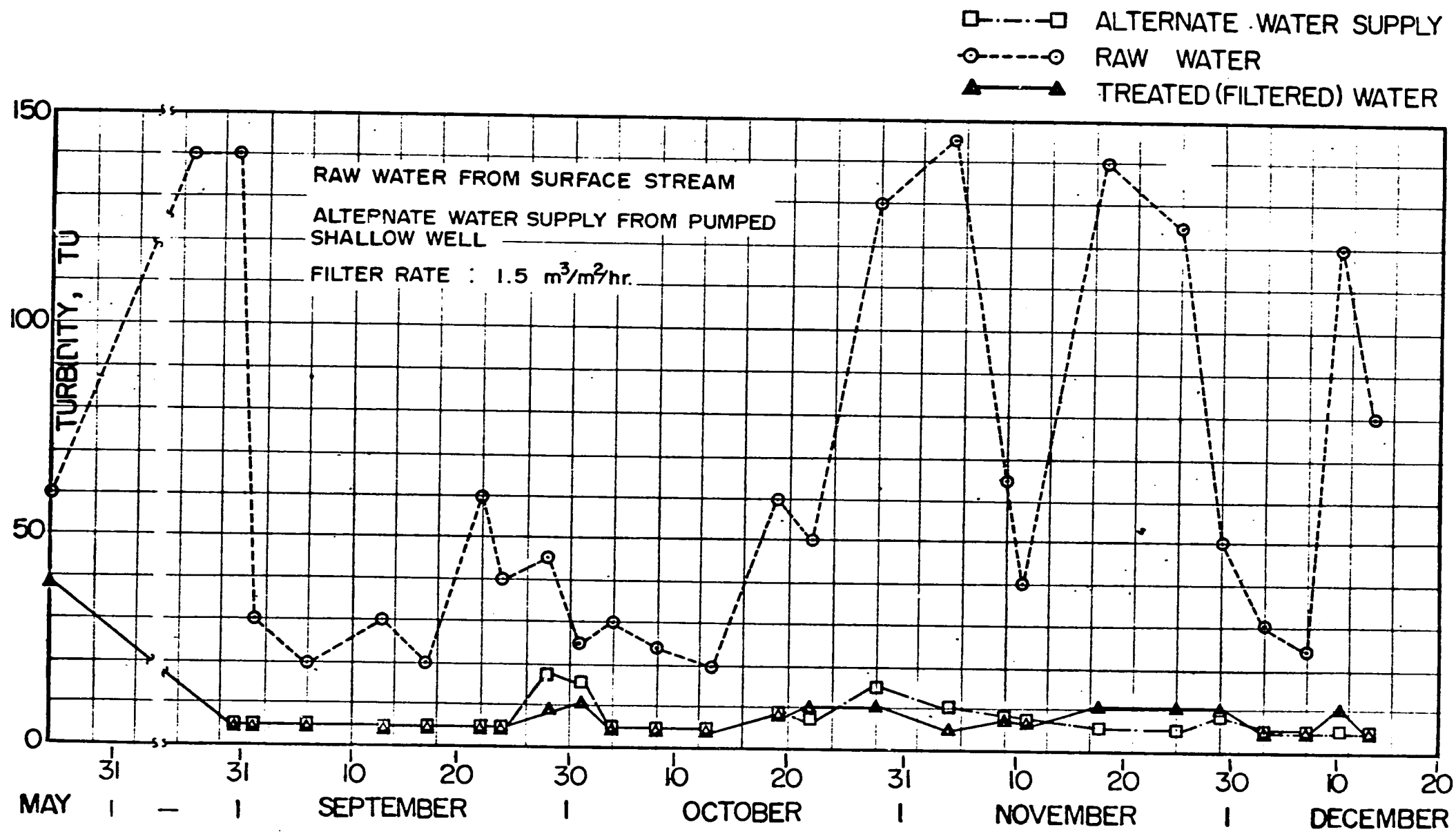
FIGURE 8 : REMOVAL OF TURBIDITY BY FRANKEL FILTER PROJECT

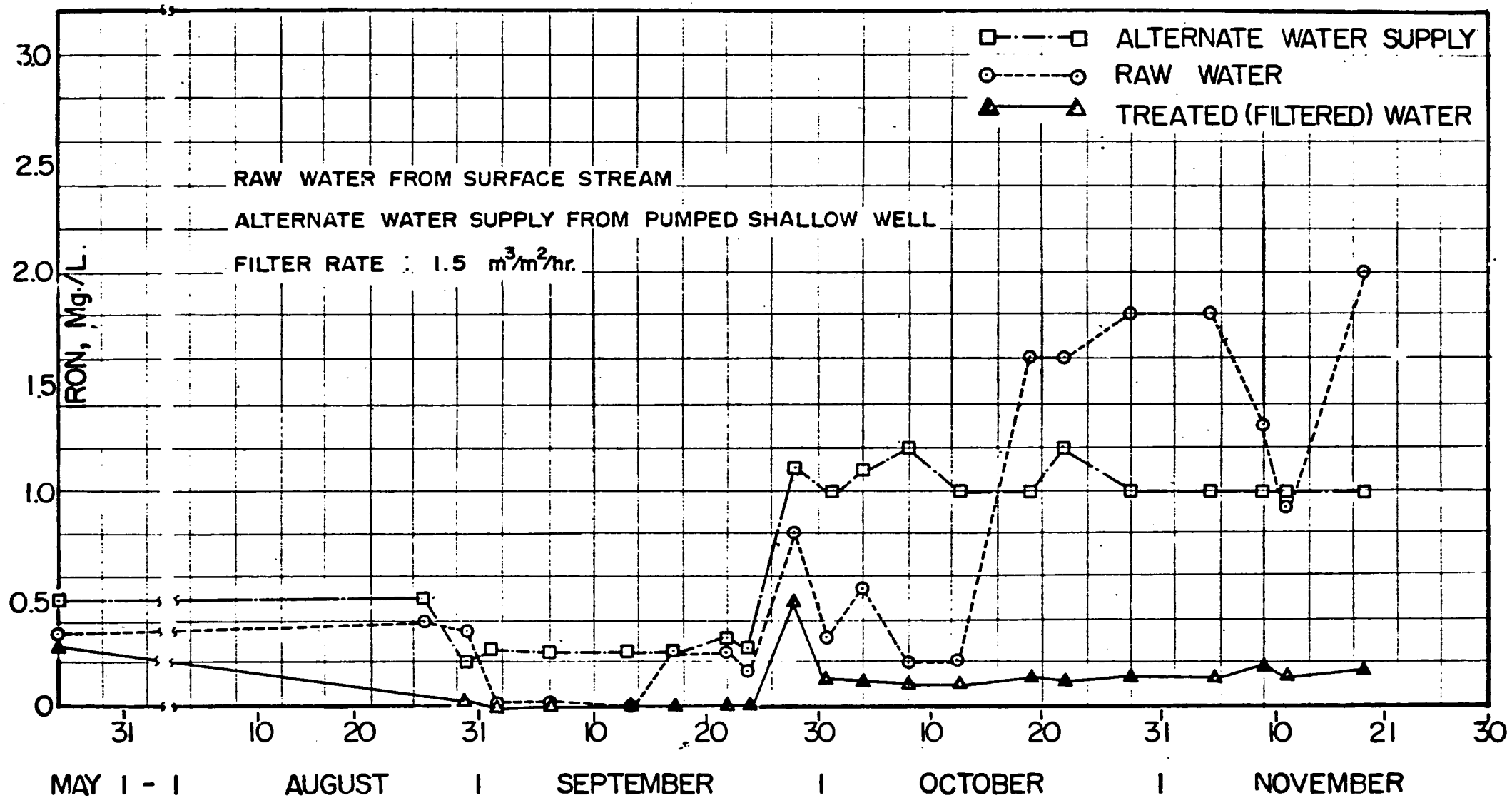
SAN JUAN, MAGARAO, CAMARINES SUR



TIME SINCE OPERATION BEGAN

FIGURE 9 : REMOVAL OF IRON BY FRANKEL FILTER PROJECT

SAN JUAN, MAGARAO, CAMARINES SUR



TIME SINCE OPERATION BEGAN

SEATEC INTERNATIONAL

SUMMARY OF QUESTIONNAIRE RESPONSES ON INDIVIDUAL WATER USE & HEALTH HABITS IN BARANGUYS OF THE BICOL RIVER BASIN, PHILIPPINES 1/ NOVEMBER-DECEMBER 1976

		BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
		Percent of households		
		%	%	%
I. PERSONAL BACKGROUND:				
(1) Status of person interviewed in the household				
1) Head of household		100	38.6	79.3
2) Wife of head of household		-	61.4	18.4
3) Other		-	-	2.3
(2) Age of person interviewed	Mean	= 44.2 yrs	39.2	= 45.2 yrs
	Std dev.	= ±11.1	±15.0	= ±14.3
(3) Number of children (including those who have left in the household	Mean	= 4.5	4.0	= 5.3
	Std dev.	= ±2.7	± 2.7	= ±3.0
(4) Total number of persons in the household	Mean	= 6.4	6.7	= 6.9
	Std dev.	= ±2.6	± 2.7	= ±3.1
(5) Age of members of household				
0-1		2.6	4.5	2.0
1-5		14.7	15.1	12.8
6-10		15.4	17.0	15.4
11-15		11.8	11.8	14.7
16-20		12.0	9.2	13.4
21-25		9.7	10.6	8.3
26-30		6.3	6.6	8.5
31-35		7.6	6.1	3.7
36-40		5.5	5.6	2.6
41-50		5.8	7.1	8.8
51-60		4.7	3.8	5.6
61-70		1.8	1.6	3.7
Above 70		2.1	1.0	.5
		100.0	100.0	100.0
(6) Level of education of head of household				
1) Illiterate		8.3	6.0	-
2) Below Grade 4 (primary grade)		30.0	29.0	18.4
3) Elementary School		41.7	37.0	41.4
4) High School		13.3	24.0	26.4
5) Collegiate		6.7	4.0	13.8
		100.0	100.0	100.0

1/ Survey by Bicol Regional Health Office No. 5, Department of Health, Philippines, November-December 1975. Analysis of data by SEATEC International.

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, HAGAPAO
	Percent of households		
	%	%	%
(7) Total number of members of household who are over 15 years old of age and illiterate	2.7	8.0	5.9
(8) Educational attainment of other household members			
1) None	25.5	26.0	2.6
2) Less than or up to Grade 4 (primary school)	24.8	22.0	29.4
3) Less than or up to Grade 6 (elementary school)	32.6	27.0	25.6
4) High school	13.1	12.0	23.8
5) College or trade school	3.7	4.0	18.6
6) Other	.3	1.0	-
	100.0	100.0	100.0
(9) Religion			
1) Catholic	98.3	94.3	96.6
2) Protestant	1.7	3.0	1.1
3) Other	-	2.7	2.3
	100.0	100.0	100.0
II. HEALTH HABITS			
A. Medical Attitude			
1) When a member of your household gets sick, what do you do during the initial period of illness?			
1) Do nothing	-	-	-
2) Buy some medicine from drug store	54.1	14.0	31.0
3) Prepare own medication	18.0	30.0	20.7
4) See some medico	3.3	1.0	8.0
5) See nurse or midwife at health center	-	17.0	14.9
6) Go to a hospital or see private doctor	24.6	37.0	25.4
	100.0	100.0	100.0

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
2) What do you think one should do or have in order to be healthy and free of sickness? (choose three answers)			
1) Do not know	-	1.0	-
2) Eat plenty of food	1.1	1.0	10.3
3) Eat clean and properly prepared food	33.4	28.0	27.6
4) Drink clean water	33.4	26.0	28.0
5) Wear clean clothes	3.3	10.0	4.6
6) Have a clean house	22.2	27.0	3.4
7) Good and fresh air	1.1	2.0	22.6
8) Exercise	2.2	3.0	3.1
9) Vaccinate every time when informed by the government authority	3.3	2.0	.4
	100.0	100.0	100.0
3) Cleanliness of items listed (by observation of interview)			
1) Clothes			
a) Very clean	5.0	6.0	18.4
b) Clean	81.7	59.0	73.6
c) Rather dirty	13.3	17.0	6.9
d) Dirty	-	19.0	1.1
	100.0	100.0	100.0
2) Body			
a) Very clean	3.3	4.0	18.4
b) Clean	83.3	62.0	80.4
c) Rather dirty	13.4	21.0	1.2
d) Dirty	-	13.0	-
	100.0	100.0	100.0
3) House			
a) Very clean	3.3	3.0	11.5
b) Clean	31.7	43.0	70.1
c) Rather dirty	53.3	33.0	13.8
d) Dirty	11.7	20.0	4.6
	100.0	100.0	100.0

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
4) House compound			
a) Very clean	-	3.0	4.6
b) Clean	6.7	27.0	56.3
c) Rather dirty	31.7	41.0	39.1
d) Dirty	61.6	29.0	-
	100.0	100.0	100.0
5) Kitchen			
a) Very clean	-	3.0	1.1
b) Clean	8.3	36.0	66.7
c) Rather dirty	78.3	34.0	32.2
d) Dirty	13.4	27.0	-
	100.0	100.0	100.0
6) Privy			
a) Very clean	-	1.0	1.1
b) Clean	8.3	30.0	72.4
c) Rather dirty	76.7	39.0	26.5
d) Dirty	15.0	30.0	-
	100.0	100.0	100.0
B. Eating Habits			
1) How do you prepare meat for your meal?			
1) Eat raw			
a) All times	-	-	-
b) Often	-	-	-
c) Seldom	-	-	-
d) Don't	100.0	100.0	100.0
2) Eat slightly cooked			
a) All times	-	-	-
b) Often	1.7	4.0	27.6
c) Seldom	-	7.0	72.4
d) Don't	98.3	89.0	-
	100.0	100.0	100.0

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
3) Eat well-cooked meat			
a) All times	98.3	97.0	72.4
b) Often	1.7	2.0	27.6
c) Seldom	-	1.0	-
d) Don't	-	-	-
	100.0	100.0	100.0
2) If you eat fresh vegetables and fruits, do you usually clean them before eating?			
1) Never	-	-	-
2) Once in a long while	-	-	-
3) Sometimes	10.0	9.0	5.7
4) Frequently	1.7	2.0	4.6
5) Every time	88.3	89.0	89.7
	100.0	100.0	100.0
3) How do you eat your meal?			
1) With hands	65.0	39.0	46.0
2) With spoon	25.0	29.0	4.6
3) With fork and spoon	10.0	32.0	49.4
	100.0	100.0	100.0
4) Do you wash your hands before having meals?			
1) Never	-	-	-
2) Seldom	-	1.0	-
3) Sometimes	13.3	36.0	4.6
4) Every time	86.7	63.0	95.4
	100.0	100.0	100.0
C. Personal Hygiene			
1) What kind of privy do you have?			
1) None	-	-	-
2) A privy (antipolo type) within the house	18.3	7.0	-
3) A privy outside the house	38.3	22.0	3.4
4) Septic tank	13.4	3.0	16.0
5) Bucket privy	3.3	-	-
6) Water sealed toilet	26.7	68.0	80.6
	100.0	100.0	100.0

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
2) How often do you use your privy?			
1) Every time	85.0	N.A.*	97.7
2) Seldom	1.7		-
3) Sometimes	13.3		2.3
4) Never	-		-
	100.0		100.0
3) Do you wash your hands after going to the privy?			
1) Never	-	N.A.	-
2) Sometimes	18.3		21.8
3) Every time	81.7		78.2
	100.0		100.0
4) When washing your hands, do you use soap?			
1) Always	16.7	54.0	51.7
2) Sometimes	83.3	43.0	48.3
3) Never	-	1.0	-
4) Don't wash hands	-	1.0	-
	100.0	100.0	100.0
5) How often do you bathe?			
1) Less than once daily	78.3	63.0	80.5
2) Daily	15.0	37.0**	13.8
3) Twice a day	6.7	-	5.7
	100.0	100.0	100.0
6) What kind of water do you use for washing and cleaning?			
1) Dry season			
a) Rain water	-	1.0	1.1
b) Water from open wells	31.9	63.0	9.2
c) Water from ponds, lakes, rice paddies	1.4	11.0	-

* Data not available
** Located near the river; bathing done there.

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
d) Water from streams, rivers	40.3	22.0	-
e) Water after settled in containers	1.4	-	-
f) Water from artesian wells, springs	25.0	2.0	5.7
g) Pumped shallow well water	-	1.0	84.0
	100.0	100.0	100.0
2) Wet season			
a) Rain water	54.7	39.0	3.5
b) Water from open wells	17.8	36.0	5.7
c) Water from ponds, lakes, rice paddies	1.4	4.0	-
d) Water from streams, rivers	19.2	18.0	-
e) Water after settled in containers	1.4	-	-
f) Water from artesian wells, springs	5.5	2.0	5.7
g) Pumped shallow well water	-	-	85.1
	100.0	100.0	100.0
7) What kind of water do you use for drinking?			
1) Rain water	40.0	38.0	6.9
2) Water from dug wells with pump	8.3	-	85.1
3) Water purchased from Naga City	60.0	7.0	6.9
4) Water from ponds, lakes, rice paddies	-	21.0	-
5) Water from river, stream	-	-	1.1
6) Open shallow dug well (no pump)	-	34.0	-
	100.0	100.0	100.0
8) Do you treat your water before drinking?			
1) No	46.7	60.0	40.2
2) Some filtration or settling	31.7	30.0	32.2
3) Boiling sometimes	20.0	3.0	27.6
4) Boiling every time	1.6	7.0	-
	100.0	100.0	100.0

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
9) How much water do your use each day?			
1) For drinking	17.3 l/family (2.7 l/person)	15.0 l/family (2.5 l/person)	10.4 l/family (1.5 l/person)
2) For cooking	39.6 l/family (6.2 l/person)	42.0 l/family (6.9 l/person)	57.3 l/family (8.2 l/person)
3) For washing, bathing	83.5 l/family (13.1 l/person)	67.7 l/family (11.2 l/person)	153.2 l/family (22.2 l/person)
4) For vegetable gardening	63.9 l/family (10.0 l/person)	15.1 l/family (2.5 l/person)	79.3 l/family (11.5 l/person)
5) Other	3.1 l/family (.5 l/person)	-	-
Roughly	32.5 lpcd	23.1 lpcd	43.4 lpcd
10) Do you store water?			
1) Dry season	100.0	N.A.	64.8
2) Wet season	86.6		33.9
11) In case there is no water system,			
1) Who is responsible to fetch water?			
a) Daughter	25.0	14.0	15.0
Times per week	3.1 trips	7.9 trips	.4 trips
Time consumed, hrs/week	8.6 hrs	N.A.	-
b) Son	36.0	17.0	43.9
Times per week	4.3 trips	8.9 trips	1.9 trips
Times consumed, hrs/week	13.3 hrs	N.A.	.8 hrs

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
c) Wife	11.0	25.0	41.1
Times per week	4.8 trips	10.0 trips	2.3 trips
Time consumed, hrs/week	10.6 hrs	N.A.	2.0 hrs
d) Water vendor	-	4.0	-
e) Husband	28.0	39.0	-
Times per week	3.4 trips	7.2 trips	-
Time consumed, hrs/week	7.9 hrs	N.A.	-

III. DATA ON INCOME AND EXPENDITURE

1) Observe the economic status of the house in comparison with local conditions?			
1) Very rich	-	N.A.	-
2) Rich	-		6.9
3) Average	48.3		51.7
4) Poor	51.7		39.1
5) Very poor	-		2.3
	100.0		100.0
2) Are you satisfied with your present economic condition?			
1) Do not know	-	N.A.	2.3
2) Satisfied	11.7		2.3
3) Want improvement, but do not know what to do	50.0		35.6
4) Want some improvement and have already done something	38.3		59.8
	100.0		100.0
3) Do you think your economic status has changed during the past year?			
1) About the same as before	20.0	N.A.	33.3
2) A little better	60.0		52.9
3) Much better	6.7		-
4) A little worse	11.7		9.3

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, MAGARAO
	Percent of households		
	%	%	%
5) Much worse	1.6		3.4
6) Other	-		1.1
	100.0		100.0
4) Last year, your income was derived from which of the following items (whole household?)			
1) From selling rice	43.9	N.A.	24.3
2) From selling vegetables, fruits, and other farm products	8.2		8.7
3) From selling livestock, fish	27.4		6.8
4) From land and labor animal lease	4.1		9.7
5) From cottage industrial products	-		-
6) From trading	4.1		1.9
7) From salary	12.3		48.6
	100.0		100.0
5) What livestock do you have available?			
1) Cattle		N.A.	
a) No. presently available	23		-
b) Sold last year	8		-
2) Carabao			
a) No. presently available	12		7
b) Sold last year			-
3) Swine			
a) No. presently available	52		84
b) Sold last year	7		-
4) Duck			
a) No. presently available	37		43
b) Sold last year	-		-
5) Chicken			
a) No. presently available	229		204
b) Sold last year	13		-

	BARRIO BALAGBAG, MILAOR	BARRIO BAWA, CANAMAN	BARRIO SAN JUAN, NAGARAO
	Percent of households		
	%	%	%
6) Goose			
a) No. presently available	4		-
b) Sold last year	-		-
7) Other	-		-
6) What were your three largest expenditures paid last year?			
1) Food	29.1	60.2	33.9
2) Clothes	14.6	17.2	25.2
3) Education	12.8	7.2	19.0
4) Medicine	11.0	8.5	10.0
5) Agricultural supply (not including land)	18.0	-	9.1
6) Cottage industrial materials	-	5.5	-
7) Land and other investments	5.8	-	.8
8) Wage payment	-	-	-
9) Debt and interest payments	8.1	.2	1.2
10) Gold and jewelry	-	-	-
11) Other	.6	1.1	.8
	100.0	100.0	100.0
7) When you borrow money, livestock, equipment or tools, you pay an interest rate of			
1) Do not know because never borrowed anything	45.0	N.A.	75.9
2) Interest per month, average	5.6		6.8

FRANKEL FILTRATION PROJECT EVALUATION SURVEY

December 1976

by

Planning Research Division[1/]

I. INTRODUCTION

The basic problem of lack of potable water in some areas have plagued some low lying areas of the Bicol River Basin. For several decades these areas have persistently remained without water. To meet the local demand for water, residents in these areas resorted to questionable ways of acquiring their water for drinking, which have frequently caused an increase in the incidence of various diseases. The rate of population increase has also aggravated this situation.

Recognizing the grave problem of no waterworks system and its repercussions, the Bicol River Basin Development Program, assisted by SEATEC INTERNATIONAL CO. LTD., Consulting Engineers headquartered in Bangkok, Thailand, embarked on a pilot water filter project using a new low-cost technology called the Frankel Filtration System. The system is a two-stage filtration process using local materials available in the tropics. The primary filter uses coconut husk which is shredded to form a fibrous mat type medium. The coconut fiber behaves like the coagulation/sedimentation portion of conventional water treatment plants and serves to remove much of the gross turbidity and suspended solids in the raw water.

The secondary filter uses burnt rice husks which are the charred (black) rice hulls made of mostly porous silica. The husks have an effective particle size of 0.55 mm diameter and a large surface area per unit volume. The burnt rice husks behave much like fine filter sand but exhibit absorption properties available for removal of unpleasant tastes, odor or color. The secondary filter acts as a polishing filter to remove residual turbidity, iron and 75-85% of the incoming bacteria. With these materials, the system offers an attractive alternative to solve the problems of treating surface waters inexpensively (or groundwaters containing high iron levels) and distinctly improves the quality of water.

Most often chemicals are not required and the filter utilizes a much smaller surface area per unit volume of water treated than other conventional water systems. Disinfection using chlorine should be introduced as a second step towards achieving a safe potable water supply.

1/ Researchers who conducted the field evaluation survey were Miss Vicenta Gunay, Miss Lorna Obias, Miss Lualhati Eguia, Mr. Renato Deuda, Mr. Manuel Habana, Mr. Francisco Ojeda under the supervision of Mr. Perfecto Bragais, Jr., all of the Planning Research Division, BRBDP.

Frankel Filtration Project Evaluation Survey (Cont'd)

The study aimed to provide additional informations to determine the sociological acceptability of the Frankel Filtration System and its use in three selected barrios. It also aims to determine factors affecting the use of the system. This study will test the hypotheses that (1) the use of improved quality water leads to better and healthful living (2) the Frankel Filtration System constructed a year ago is being utilized efficiently.

II. METHODOLOGY

In order to gain the desired information, this study was conducted in three barrios of selected municipalities of the Bicol River Basin, namely:

1. Barrio San Juan, Magarao
2. Barrio Balagbag, Milaor
3. Barrio San Francisco, Canaman

These areas were chosen during the first survey conducted a year ago as pilot areas reflecting typical areas of no potable water in the Bicol River Basin Area.

To collect the data, a total household enumeration was conducted. A total of 166 household heads or perceived heads were personally interviewed. The analysis was based on 48, 47, and 71 household respondents for San Juan, Magarao; Balagbag, Milaor; and San Francisco, Canaman respectively, and used tabular presentation and statistical techniques whenever appropriate.

III. RESULTS AND DISCUSSIONS

A. Household Background

Table 1 shows the characteristics of household respondents in the three barrios. The average age of the respondents is 39 years mostly female. The respondents were mostly married and had spent an average of 6 years in school. The average number of children as shown in Table 2 is 4 with age ranged of about 6.5 years. Two sources of income are distinguished as shown in the major occupation of household respondents (Table 3). Farming is still the major occupation with 59% of the total respondents dependent on farming and 48% to non farming activities.

B. Health Habits and Attitude

Health habits and attitudes of the people in the study area are shown in Tables 4 to 8, Table 4 shows the manner of eating of respondents. The study reveals that 71 respondents (43%) used either hands and spoon for eating followed by with hands alone and fork and spoons with 35% and 22%, respectively.

Frankel Filtration Project Evaluation Survey (Cont'd)

Results in the frequency of washing hands before eating were encouraging, Table 5 shows that 81% of the total respondents washed their hands before eating and 69% always used soap in washing their hands as shown in Table 6.

The frequency of bathing (Table 7) reveals that most of the respondents have it every other day, followed by the once a week frequency. The household members follow almost the same pattern as the respondents (Table 8).

Eighty one percent of the households in the study area generally have the water sealed toilet (with covered/uncovered, lined/unlined pit type) Table 9. The water sealed bowl with concrete linedpit or septic tank constitutes 7% and only 4% have the antipolo type that is a toilet outside the house. Only 8% of the household have no toilet particularly in San Francisco, Canaman.

C. Water System and Uses

There are two common water system in the study area, namely pitcher pump and dug well. Table 10 indicates that out of 166 respondents in the study area, 109 have their own sources of water. Respondents in San Juan, Magarao and Balagbag, Milaor have pitcher pumps while in San Francisco, Canaman, the common source of water is the dug well.

The sources of water used for washing and cleaning are shown in Table 11. In Barrio San Francisco, Canaman, 63% of the total respondents used water from canals, stream and rivers, 41% used water from open wells while 7% get water from rain water, ponds, rice paddies and others. Barrio San Juan, Magarao had 58% using water from shallow pump wells followed by water from open wells. In Balagbag, Milaor, 40% used water from canals, streams and rivers.

The study, however, reveals a very encouraging result as to the source of drinking water is concerned. Table 11 shows that in the Barrio Balagbag in Milaor, 83 percent of the respondent families used water from the Frankel Filtration System and in San Francisco, Canaman, 66 percent of the families used the filtered water. Respondents in San Juan, Magarao, on the other hand, demonstrated a negative acceptance of the project with only 2% utilizing the system. This is mainly due to the availability of shallow pumps in almost all households in the area and the inaccessibility of the filter project which was placed outside the Barangay at a site planned for the future market place. The project is still not connected by pipeline to the Mayor's office, the Rural Health Center or the Barangay as originally planned. Once the market place is completed and the pipe connections made, it is believed that the project will be integrated into the social fiber of the Barangay.

Frankel Filtration Project Evaluation Survey (Cont'd)

In Table 12, the source of water used when the Frankel Filtration System is not in operation is presented. A total of 46 respondents (28%) got their water in Naga City, about 20% in private pumps and open wells followed by rain water. In addition, the kind of water treatment employed for this water other than that of Naga City is shown in Table 13. The most common method used was simple storage, simply by placing the water in an earthen jar and left alone for a number of days to let some of the physical materials settle down. But almost the same number of respondents did not treat their water before drinking. The other treatment methods used were filtering, boiling and chemical disinfectation. Filtering the water of impurities using a piece of cotton cloth was also common, while very few employed boiling and chemical disinfection. The respondents however, claimed that the water they used for drinking were clean and safe as shown in Table 14.

D. , Amount of Water Used

The amount of water used daily is shown in Table 15. Bathing consumes the highest amount of water, followed by washing, then cooking and for drinking. Average per capita consumption for drinking and cooking was almost identical for all three barangays of about 2.5 and 5.7 liters per capita respectively. For washing and bathing, however, San Francisco showed significantly less water consumption than in San Juan, Magarao, or Balagbag. It is believed that this difference is due to the fact that many residents of San Francisco wash and bath in the nearby Bicol River. This water consumption would not show up in the figures of amounts of water used per household.

E. Community/Social Interactions

The construction and completion of the farm-to-market roads are the prime concern of the people as far as their community is concerned. In San Juan, Magarao as well as in San Francisco, Canaman the second priority of change is the putting up of street lights, cleanliness and irrigation facilities. Respondents in Balagbag, Milaor on the other hand, showed much interest in the Frankel Filtration System. They said that they want to have connecting pipelines from the system to their houses. Interest on the project is also manifested in the barrio of San Francisco, Canaman. One hundred percent of the total respondents of these two barrios thinks the system helps the community because the water is clean and safe, and secondly it is more accessible and less expensive to secure clean water for drinking and for other uses. However, in San Juan, Magarao, 31 out of 48 respondents thinks that the system does not help nor benefit the community. Some of the reasons given were proximity, that the system is not always in operation, fear of poisoning and that almost all of the households have their own pumps.

In the barrios of San Francisco and Balagbag, respondents generally believe that they could operate and maintain the system and provide the leadership and are contributing one peso per family per month for its maintenance.

Frankel Filtration Project Evaluation Survey (Cont'd)

IV. SUMMARY

The evaluation survey was conducted to provide informations regarding the sociological acceptability of the Frankel Filtration System and its use in the three selected barrios.

The results indicated that the residents of Balagbag, Milaor and San Francisco, Canaman were the project is centrally located enthusiastically accepted the system. The use of water coming from the system helped the household residents. However, residents of San Juan, Magarao did not benefit from the system. This was due mainly to the availability of shallow pumps in most of the household residents and the inconvenience in obtaining the water from the filter which was located of the proposed future market place on the outskirts of the Baranguy.

The hypotheses that the use of safe water leads to better and healthful living and that the system constructed a year ago is being utilized efficiently were also tested. The results indicated that residents of these areas are better-off as far as their health habits are concerned and that the Frankel Filtration System is being utilized efficiently, as manifested in the community interactions regarding the system.

The Frankel Filtration project undeniably realized the importance of good and safe water supply to areas that are persistently without safe water. The conveyed interest of the beneficiaries to the project concluded a success of the system.

TABLE 3 - Major Occupation of Household Respondents

Occupation	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Farming								
Crops[a/]	17		22		29		68	
Fishing	1		25		4		30	
Total For Farming	18		47		3		98	
Non-Farming								
Government Employee	5		1				6	
Housekeeper	8		7		30		45	
Dressmaker	3						3	
Businessman	4		2		4		10	
Others [b/]	10		2		4		16	
Total for Non-Farming	30		12		38		80	

a/ Crops include rice, corn, vegetables, coconut

b/ Others include carpenter, radio technician, latero, driver, lavandero, beautician.

TABLE 4 - Manner of Eating

Manner	San Juan, Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
With Hands	14	29	17	36	28	40	59	35
With Fork and Spoons	16	33	10	21	10	14	36	22
With Hand and Spoon	18	38	20	43	33	46	71	43

TABLE 5 - Frequency of Washing Hands Before Eating

Frequency	San Juan, Magarao		Balagbag Milaor		San Francisco Canaman		T O t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No 166	% 100
Never	0		0		0		0	
Seldom	0		2	04	3	04	5	03
Sometines	10	20	2	04	14	20	26	16
Always	38	80	43	92	54	76	135	81

TABLE 6 - Frequency Of Using Soap When Washing Hands

Frequency	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Always	33	69	39	83	42	59	144	69
Sometimes	15	31	8	17	29	41	52	31
Never	0		0		0		0	

TABLE 7 - Frequency Of Bathing Of Respondents

Frequency	San Juan, Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Once a week	9	19	8	17	21	30	38	23
Daily	17	35	6	13	7	10	30	18
Every other day	20	42	20	43	39	55	79	48
Less than a week	2	04	3	06	4	06	9	05
Twice a week	0		10	21	0		10	06

TABLE 6 - Frequency Of Using Soap When Washing Hands

Frequency	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Always	33	69	39	83	42	59	144	69
Sometimes	15	31	8	17	29	41	52	31
Never	0		0		0		0	

TABLE 7 - Frequency Of Bathing Of Respondents

Frequency	San Juan, Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Once a week	9	19	8	17	21	30	38	23
Daily	17	35	6	13	7	10	30	18
Every other day	20	42	20	43	39	55	79	48
Less than a week	2	04	3	06	4	06	9	05
Twice a week	0		10	21	0		10	06

TABLE 8 - Frequency Of Bathing By The Members Of Family

Frequency	San Juan, Magarao				Balagbag Milaor				San Francisco Canaman				Total			
No. of Respondents	48				47				71				166			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Once a Week	4	3	2	5	4	0	1	1	21	2	0	1	29	5	3	7
Daily	14	13	16	1	7	13	17	4	1	12	13	1	22	38	46	6
Every other day	20	19	18	6	23	20	19	9	32	36	32	9	75	75	69	24
Less than once a week	0	0	0	0	1	0	0	1	1	0	0	1	2	0	0	1
Twice a week	0	0	0	0	9	3	3	4	0	0	0	0	9	3	3	4

A/ Husband/Wife
B/ Son
C/ Daughter
D/ Others

TABLE 9 - Type Of Toilet

Type	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. Of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
None	1	02	3	06	10	14	14	08
Antipolo Type a/	3	06	2	04	2	03	7	04
Water Sealed Bowl b/	39	82	38	81	58	82	136	81
Water Sealed Bowl c/	5	10	4	09	1	01	10	07
Others	0		0		0		0	

a/ a toilet within/out side the house with/without pit
b/ with covered/uncovered, line/unlined pit
c/ with concrete-lined pit or septic tank

TABLE 10 - Ownership Of Water System

Ownership	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Pitcher Pump	23	48	17	36	2	03	42	25
Dug Well	9	19	9	19	49	69	67	41
None	16	33	21	45	20	28	57	34

TABLE 11 - Ownership Of Water System

Ownership	San Juan, Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 43	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Pitcher Pump	23	47.92	17	36.17	2	2.82	42	25.30
Dug Well	9	18.75	9	19.15	49	69.01	67	40.36

TABLE 12 - Source Of Water Used For Drinking And Washing

Source	San Juan Magarao		Balagbag Milaor		San Francisco, Canaman		Total	
	Washing Cleaning	Drinking	Washing Cleaning	Drinking	Washing Cleaning	Drinking	Washing Cleaning	Drinking
No. of Respondents	48		47		71		166	
Rain Water	1	0	0	3	2	27	3	30
Open Wells	16	0	12	0	29	15	57	15
Ponds, Rice Paddies	0	0	0	0	3	0	3	0
Canals, Stream Rivers	1	0	14	0	45	0	60	0
Public Artesian Wells	1	2	3	1	0	0	4	2
Private Shallow Pump Wells	28	44	0	0	0	0	28	44
Spring	0	0	0	0	0	0	0	0
Frankel Filter System	1	1	5	39	0	47	6	87
Naga City Water works	0	1	0	4	0	16	0	21
Others	0	0	0	0	0	0	0	0

TABLE 13 - Kind Of Water Used When FFS Was Not In Operation

Water Used	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Private Pump	18	3	15	33	0	-	33	20
Naga City Waterworks	0	-	23	48	23	32	46	28
Rain Water	0	-	1	02	17	24	18	11
Open Well	2	04	1	02	31	44	34	20
Others	28	58	7	15	0	-	35	21

TABLE 14 - Treatment Employed On Water Not From FFS Before Drinking

Treatment	San Juan Magarao		Balagbag Milaor		San Fracisco Canaman		T o t a l	
No. Of Respondents	no. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Boiling	5	10	0		6	09	11	07
Sinple Storage	18	38	27	57	23	32	68	41
Chemical Disinfection	2	04	0	-	0	-	2	01
No Treatment at All	23	48	13	28	30	42	66	40
Filtering	0		26	55	12	17	38	23

TABLE 15 - Reasons For Not Treating The Water Not From FFS Drinking

Reasons	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l	
No. of Respondents	No. 48	% 100	No. 47	% 100	No. 71	% 100	No. 166	% 100
Clean	8	17	8	17	20	28	36	22
Safe	15	31	3	06	10	14	28	18
Good	0	-	1	02	0	-	1	-
Clear	0	-	1	02	0	-	1	-
No Reason	25	52	34	73	41	58	100	60

TABLE 16 - Amount of Water Used By User, in liters and in liters per capita (l/p)

Use of Water	San Juan Magarao		Balagbag Milaor		San Francisco Canaman		T o t a l
No. of Respondents	No. 48		No. 47		No. 71		No. 166
	l	l/p	l	l/p	l	l/p	l
For Drinking	900	2.9	719	2.3	1,112	2.3	2,731
For Cooking	1,794	5.8	1,860	5.9	2,599	5.3	6,253
For Washing	5,236	17.1	3,841	12.2	3,304	6.7	12,381
For Bathing	6,723	21.9	6,834	21.7	5,289	10.8	18,846
For Gardening	536	1.7	1,037	3.3	38	.1	1,611
Others	1,048	3.4	0	-	0	-	1,048
TOTAL . . .	16,237	52.9	13,291	42.2	12,342	25.2	41,870

Republic of the Philippines
Bicol River Basin Development Program Office
Baras, Canaman, Camarines Sur

_____
(Date)

Researcher: _____ No. _____

Barrio: _____ Municipality _____

EVALUATION QUESTIONNAIRE
(Frankel Filter System Project)

I. Personal Background:

1. Name _____ 2. Age: _____
3. Sex: Male Female
4. Civil Status: singles married widow
   widower separated
5. Highest Educational Attainment _____
6. Religious Affiliation: _____
7. Major Occupation: _____

Farming	Non-Farming
Type:	Type:
_____Rice	_____Carpenter
_____Corn	_____Gov't. Employee
_____Vegetable	_____Others (Specify)
_____Others (Specify)	_____
_____	

8. Number of children in household: _____
   age ranges from _____ TO _____
9. Other members of household:

Relation to Respondent	AGE
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

II. Health Habits & Attitudes:

1. How do you usually eat your meals?

_____ with hands?

_____ with fork & spoon?

_____ with hand and spoon?

2. Do you wash your hands before eating meals?

_____ never _____ sometimes

_____ Seldom _____ Always

3. What kind of toilet do you have?

_____ None

_____ A toilet (antipolo type) within/out side the house with/without pit

_____ Water-sealed bowl with covered/uncovered, lined/unlined pit

_____ Water-sealed bowl with concrete-lined pit or septic tank.

_____ Others (specify) _____

4. When washing your hands, do you use soap?

_____ Always _____ Don't wash hands

_____ Sometimes Remarks: _____

_____ Never _____

5. How often do you bathe?

_____ once a week

_____ daily

_____ every other day

_____ less than once a week

6. How often do members of your family bath?

	Once a week	Every other day	Daily	Less than once a week
Husband/Wife				
Son				
Daughter				
Others				

7. Do you have your own pitcher pump? _____

Dug Well? _____

If answer is none of these, where do you get your water?

8. What kind of water do you use?

For Washing and Cleaning	For Drinking	Kind of Water
_____	_____	Rain Water
_____	_____	Water from Open wells
_____	_____	Water from ponds, rice paddies
_____	_____	Water from canals, streams, river
_____	_____	Water from public artesian wells
_____	_____	Water from private shallow pump wells
_____	_____	Water from Springs
_____	_____	Water from the Frankel Filter System
_____	_____	Water from Naga City Waterworks
_____	_____	Others (specify) _____

9. If you use the filtered water for drinking/cooking and when the Frankel Filter System is not in operation, what kind of water do you use for drinking?

_____.

10. a. If your water is not from the "Frankel Filter System", do you treat it before drinking?

Yes: _____ No: _____

b. If yes, how?

_____ (a) Boiling

_____ (b) Simple Storage

_____ (c) Chemical Disinfection

_____ (d) No treatment at all

c. If no, why? _____

11. How much water do you use each day? (in liters? can?)

For drinking: _____

For cooking: _____

For washing: _____

For bathing: _____

For gardening: _____

Others: _____

TOTAL ==========

III. Community/Social Interactions:

1. What community changes would you like to happen here?

_____

2. (a) At present what are the problems within the community?

_____

(b) How do you think should be solved? _____

_____

3. Did the "Frankel Filter" System project recently put-up by the BRBDP help the community? _____

_____

4. (a) The "Frankel Filter" System will be turned-over to the barrio after this evaluation. Do you honestly think that the barrio is capable of operating and maintaining the system? ___ Yes ___ No
If not, give the reason why: _____

_____

(b) If yes, who among your barrio mates do you think should and could provide the leadership in operating and maintaining the system?

_____

5. Would you be willing to participate in the operation and maintenance of this system? _____

_____

6. How much are you willing to pay each month for clean water? _____

_____