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Environmental Health Education in Micronesia

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Abstract

Water supply and sanitation programmes in Micronesia require substantial capital investments. In the past, many of these projects have failed to achieve their maximum impact on preventing water-related diseases. Cases of cholera and the continuation of frequently occurring gastro-intestinal diseases undermine the expectations that new and planned water and sanitation systems will result in disease prevention. This report indicates that knowledge of water-related diseases and the understanding of the benefits of safe water supply and sanitation are limited as programmes in Micronesia that would educate the different sectors of the community have never been institutionalised. We have developed the first comprehensive system for teaching about water supply, sanitation and health in a Micronesian environment. The educational materials will be used as curricula in public education and as information resources for appropriate individuals in these remote and scattered communities of the Pacific.

Keywords: Environmental health, Health education, Micronesia.

Background

A recurrent problem in maximising the benefits and cost effectiveness of water supply and sanitation (i.e. environmental health) investments in developing countries has been the lack of appropriate community knowledge and education at the community level. It is all too common to hear about water supply and sanitation project failures (inadequate maintenance, equipment failure, continued high disease rates, etc) attributed to a poor understanding of the operation or even the benefits of the project by the members of the beneficiary community. Health professionals blame engineers and engineers, in turn, blame health professionals, often health educators, who are frequently not consulted in advance. In part, this is because health educators are perceived as not having a "proper background" in or little exposure to environmental health technology. The current emphasis on oral rehydration and family planning often consumes the time of the few health educators that are available in developing countries.

These "educational or knowledge" failures in rural communities result in a loss of a portion of the overall investment in these projects. In the worst case examples, environmental health hazards have actually increased, even though a well-designed project was put into place.

Clearly, there are many rural communities in developing countries that could initiate environmental health improvements with a minimum of outside assistance and maintain or upgrade available facilities, but have not done so due to insufficient incentive, knowledge and/or basic skills. Such is the case in Micronesia in the tropical north Pacific (**Figure 1**).

Micronesia includes the Commonwealth of the Northern Mariana Islands, the Republic of the Marshall Islands, Federated States of Micronesia and Republic of Palau. The Federated States of Micronesia include the States of Truk, Yap, Pohnpei and Kosrae. It consists of approximately 3,000 islands, some of which are uninhabited, totaling 834 square kilometers in land area scattered over 7.8 million square kilometers of ocean.

These islands are not all of a single type — some are classified as "high islands" and some as "low islands". The high islands are volcanic in origin, often large, sometimes steep, and may rise to several thousand feet in elevation. The low islands or coral atolls, are the

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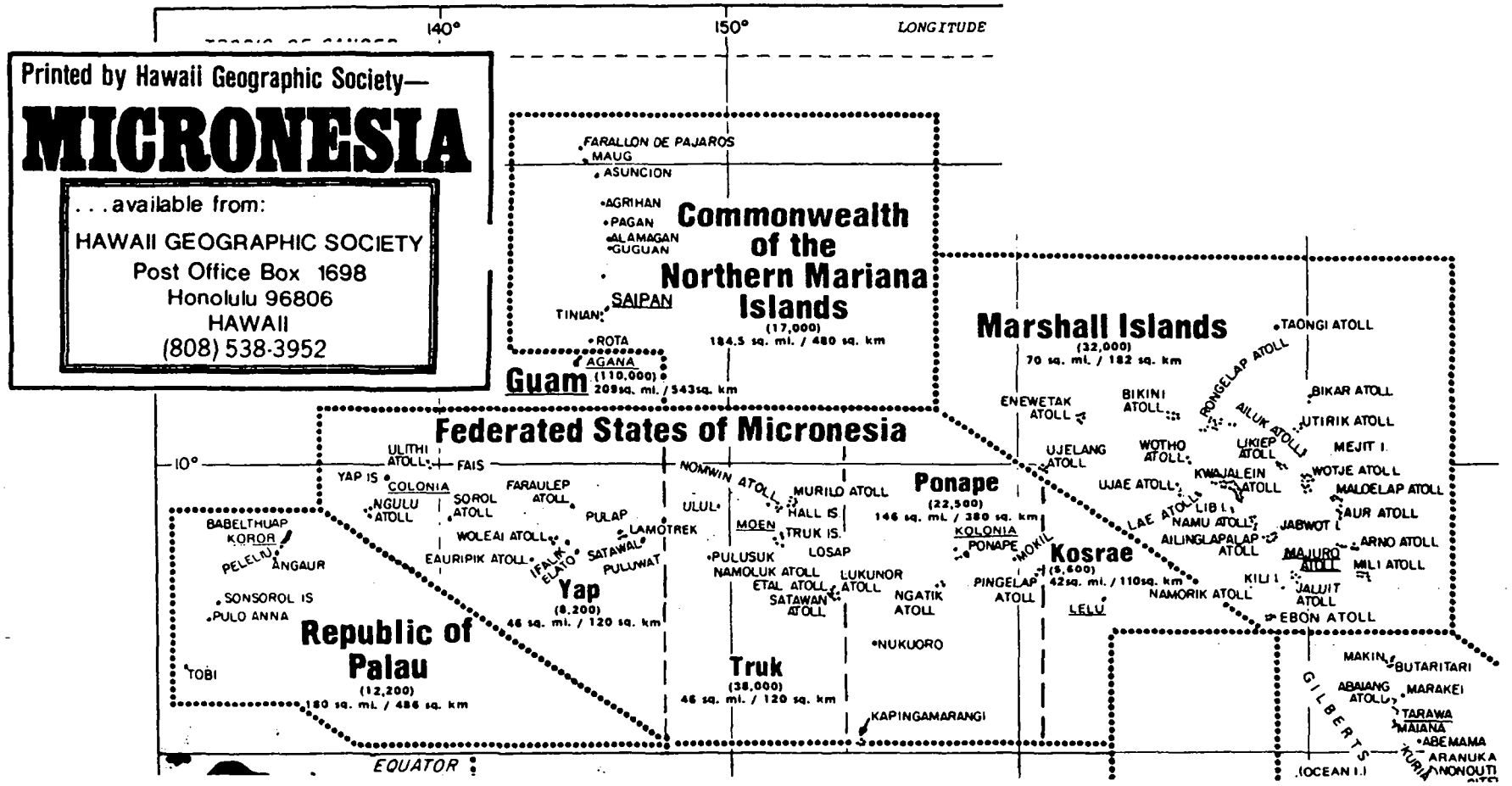

Fig 1. — A map of the western Pacific, 0°-20° north of the Equator.

Table 1. — Distribution of Population and Water Supply in Micronesia Excluding Yap and the Northern Marianas.

	Federated States of Micronesia									
	Republic of Marshall Islands		Pohnpei		Kosrae		Truk		Republic of Palau	
	No.	%	No.	%	No.	%	No.	%	No.	%
Population (1980 Estimates)	30,873		22,081		5,491		37,488		12,116	
Total houses surveyed	4,163		3,613		615		5,428		2,265	
Number of homes using public systems	1,444	35	1,119	31	549	89	738	14	1,493	66
Number of homes using wells	412	10	666	18			835	15	90	4
Number of homes using rain catchment	2,123	51	671	44	44	7	2,563	47	560	25
Number of homes using public standpipes	23	1	51	1			218	20		
Untreated Surface Waters or other sources	111	3	1,106	31	22	4	1,074	20	102	5

result of continued coral growth around or on an eroded volcanic base. Few of the coral atolls have altitudes of over 30 feet. This topography is significant in the availability of water on each of these islands. High islands generate more rainfall and have more surface water supplies. The low coral atolls are more susceptible to drought conditions.

Although the total populations of most Pacific basin communities are small in comparison to the large populations of Asia or Africa, these communities are uniquely isolated. Like many developing nations, there has been an explosive growth in the Micronesian populations and in some island states, crowded conditions and the concomitant lack of safe or potable water and limited land space can be as intense as in any similar developing country community. Analogous conditions have been reported in the South Pacific Islands.[1]

A wide variety of water supply and sanitation systems exists in Micronesia ranging from semi-urban systems that serve district centres to isolated rural settings where there may not be access to safe drinking water and no sanitary facilities. A rough distribution of water supply systems of Micronesia is shown in **Table 1**. Overrepresentation of district centre dwellings tends to overstate the numbers receiving public systems. Although this report does not include the Marianas, we continue to use Micronesia as a term for convenience.

Water supply systems in Micronesia, both public and individual systems, do not consistently meet US minimum public health criteria, and the potential for widespread transmission of water-related disease exists. Public systems suffer from sporadic maintenance, shortage of replacement parts and inadequate training and certification of operators. Distribution system loss and drought require the enforcing of restricted water hours. Sometimes this is limited to only one hour in the

Fig 2. — An "over-water" benjo with children playing nearby.

morning and evening. Water supplies for primary schools and rural health dispensaries may be in disrepair or non-existent. The largest sector of the Micronesian population, the scattered isolated rural communities, has to depend on individual systems, the most common of which catches rainwater from the roof of the village dwelling. Shallow unprotected wells and, in some places, small surface water streams provide alternative but questionable water sources. Fortunately, there are a number of locally funded rainwater catchment projects for the rural communities now underway in the area.

The problem of water conservation has been difficult to promote. In Kosrae, for example, taps are left running even when no one is drawing water. There are two schools of thought behind this practice. One is the belief that water will flow forever if it is not turned off, the other is that the water in the tap continues to flow just like a river or stream. Because of this belief, people do not conserve public water supplies and do not have the concept that water conservation is important.

Sanitation systems in Micronesia vary greatly. A common system is the over-water toilet or benjo. This is a single latrine house built out over the water, usually the lagoon. **Figure 2** shows a typical over-water benjo. There are also simple pit latrines, pit latrines with a water-seal toilet installed, conventional flush toilets connected to septic tanks and tiles fields and the "umbrella latrine" (i.e., the bush, the lagoon at low tide or the ocean-side at night).

Rural sanitation projects have increased the number of water-seal latrines and discouraged the use of over-water benjos and the "umbrella" approach. Major problems remain however. For example, in some areas, such as the Republic of the Marshall Islands, it is not acceptable for a woman to be seen nearby or even walking in the vicinity of a latrine or benjo. This custom forces the women to postpone urination and/or defecation until after dark, usually at the ocean-side.

Young children are often the most affected by this habit and can be seen swimming and playing near the over-water benjos as seen in **Figure 2**. Water-seal pit latrines may contaminate the shallow and limited ground water found in the ground water lens on these islands (**Figure 3**). They are frequently in disuse, however, because the water seal is broken/absent or blocked by coconut husks.

The traditional cooking and eating habits throughout Micronesia also contribute to infectious disease transmission. It is very common for people in Micronesia to eat with their hands. Most of the cooking is done over

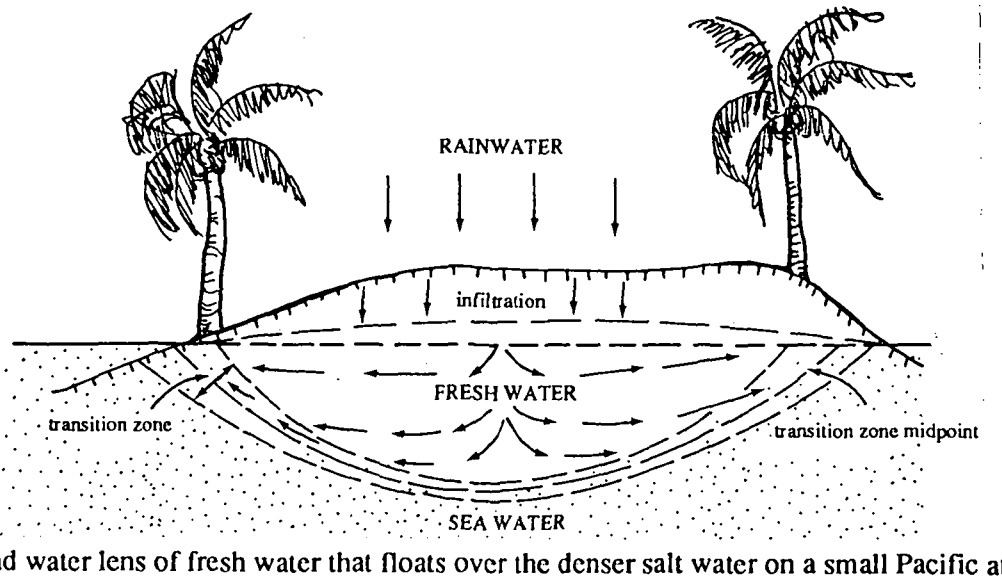

Fig 3. — Ground water lens of fresh water that floats over the denser salt water on a small Pacific atoll.

Table 2. — Presence or Absence of Environmental Health Educational Infrastructure in Micronesia.

	Marshalls	Pohnpei	Kosrae	Truk	Yap	Palau
Public health educators	Y(2)*	No	Y(1)	Y(1)	Y(1)	N
radio programme	Y				N	N
Peace Corps related projects	N	Y	N	Y	N	N
Primary school environmental health curriculum	N	Y	Y	Y	Y	Y
Secondary school environmental health curriculum	Y	Y	Y	Y	Y	Y
Environmental health services: health education programmes**	N	N	N	N	N	N
Rural sanitation programme	N	Y	N	Y	Y	N
Rural water supply programme	Y	Y	N	Y	Y	N
Environmental health survey data	Y	Y	N	Y	Y	Y
Related epidemiological data	Y	Y	Y	Y	Y	Y
Community action groups health education	N	Y	N	Y	N	N
Primary health care: environmental health education	N	N	N	N	N	N

* Number present

** All services provide some health education on demand. Some programmes or outreach activities were organised (Y) others were not (N).

fires close to the ground. Cooking utensils may not be adequately cleaned due to scarce water supplies and proximity of domestic animals (dogs, cats, chickens and sometimes pigs) who are often allowed to roam freely in the food storage and preparation area.

Shellfish collected from the lagoons are eaten raw. As noted previously, lagoon waters are often polluted by over-water benjos or the umbrella approach. The filter feeding shellfish bioconcentrate microorganisms from the lagoon including microbial pathogens. An outbreak of cholera in Truk has been attributed in part to this mode of transmission.

Not surprisingly, water- and sanitation-related diseases are presently transmitted in Micronesia. Cholera is the most dramatic example.[2] In 1982 to 1983, there were 2,217 confirmed cases of cholera in Truk and 17 deaths due to this infection. The following year, control measures reduced the number of new confirmed cases to 209 with three deaths. The 1982 to 1983 experience, of course, was a major epidemic and precipitated considerable interest in environmental health improvements. Less dramatic indicators suggest that water-related diseases remain common and widespread in Micronesia. In Kosrae, for example, the most frequent discharge diagnosis in the district centre hospital in 1985 was dysentery, which comprised 32% of the total discharges. In Palau, in July and August of 1985, there was an epidemic of infectious hepatitis. In a survey of primary school children in Yap, over 80% were found infested with one or more protozoan or helminthic parasite. The infant mortality rate in Truk, 30 per 1,000 live births, is the highest in the tropical Pacific with the exception of Papua New Guinea. This is a reflection of the commonly seen infant and childhood diarrhoeal

disease cases. Similar data are available for the other Micronesian states.

Water Supply Initiative

The preceding description is not a comprehensive assessment of environmental health problems in Micronesia but rather serves to illustrate that the full benefits of previous investments in water supply and sanitation have yet to be realised. In recognition of this and in observance with the United Nations declaration of the 1980s as the International Drinking Water Supply and Sanitation Decade (IDWSSD), the United States Environmental Protection Agency (USEPA) has recently begun a project in Micronesia entitled the Water Supply Initiative (WSI).

The underlying goal of the WSI is to develop and make available to the governments of Micronesia a series of model programmes. When fully implemented, these programmes will correct water supply problems which, in turn, will improve the environment and prevent or limit the spread of enteric diseases.

This effort alone is not intended to remedy the existing water supply problems, however, but aims to result in some demonstrable advances and give governments the necessary information to continue making improvements.

The initiative is divided into the following five programme areas:

(i) Public health education
(ii) Technical assistance for operations and maintenance of public systems
(iii) Training of water supply treatment operators
(iv) Improved analytical capabilities in water quality monitoring
(v) Water supply regulation improvements

Current Data

Our part of the initiative is:

(i) to review on site the major public health educational needs regarding water supply and sanitation. More specifically, it is to assess current programmes in health education including primary and secondary school curricula
(ii) to make an inventory of the major water-related diseases in Micronesia and the associated environmental health problems
(iii) to identify and assess feasible routes of information dissemination for environmental health education
(iv) to develop a model or prototype environmental health education programme that would provide the stimulus and basis for initiative action by local Micronesian administrations.

Field visits to each of the Micronesian states were made to obtain information related to the first four objectives stated above. **Table 2** shows a summary of the data collected and, taken as a whole, suggests that certain infrastructures that would be necessary for an environmental health education initiative are present in Micronesia. Health educators were present in the majority of the States and there was evidence that environmental health education was provided by the environmental health or community services in Pohnpei and Palau where there was no health educator. The health educators had not been providing any information on environmental health, nor did they have anything but the most general materials available to do so. None were aware of the IDWSSD or the USEPA WSI. Primary health care and environmental health services resources were consistently underutilised.

Rural water supply and sanitation projects were not present in every State and varied greatly from one location to the next in their design and extent of coverage. Only a limited amount of environmental health educational materials were present in the Marshalls and distribution was limited and required a literate user. As pointed out earlier, survey data on environmental health conditions could usually be found locally. There were published technical reports prepared by outside agencies such as *UNICEF, WHO and the University of Guam.*[5,8,9] The remaining reports were usually interdepartmental, had limited readership, were not being used fully in decision making but were nevertheless informative. For example, **Table 3** shows the results of a survey of water supply and sanitation in Yap conducted in 1984 by the Environmental Health Office.

Yap proper is a large high island where most of the population resides. The public water supply system is limited to only 3.5% of the homes in Colonia, the district centre town. Metal drums, 55 gallons in size, provide water to 71.4% of the homes and serve as roof rainwater catchments and storage. Large capacity community water catchment tanks, usually >5,000 gallons capacity, were most common on the outer island atolls. Such large capacity systems were not as frequent on outer islands elsewhere. In the Marshalls, discarded aviation fuel tanks that had washed ashore, were often seen guttered to roofs. It is interesting that the rainwater catchment systems provide reasonably safe water. Dillaha and Zolan, in 1983, showed that coliform concentrations were acceptably low (≤5 per 100 ml) in concrete rainwater catchments surveyed in Kosrae, Yap, Pohnpei, and Palau.[5] They found that the more common metal 55 gallon drums had higher mean

Table 3. — Percent Distribution of Water Supply and Sanitation in Yap, FSM (courtesy of YAP Environmental Health Services).

	Yap Proper	Yap Outer islands
Drinking water supply:	n=840 homes	n=328 homes
55 gallon drums	71.4	4.0
Concrete catchment	14.2	81.7
Well	5.0	1.8
Spring	3.8	—
Stream	1.4	—
Colonia public system	3.5	—
Other	0.7	12.5
Sanitation:		
Water seal	3.2	14.9
Pit latrine	27.1	16.5
Over-water benjo	11.9	8.5
Septic tank system	1.1	6.5
Colonia sewer system	4.6	—
No sanitation	52.1	53.7

coliform counts and that the larger covered and better maintained concrete catchments had lower and more acceptable counts.

Related epidemiological data were most often found in the five-year comprehensive health plans, available in each of the district centre hospital administrative offices. Although the data in these documents strongly indicated that diarrhoeal diseases were common, the severity of disease and related mortality could not be assessed except for cholera in Truk.[2] Moreover, the available data would not be useful for evaluating the effect of the Initiative due to a lack of individual specific information for both disease and environmental health conditions.

Only in Yap and Kosrae was there a health education curriculum:

(i) specifically designed for the local school system
(ii) with teachers trained in its use
(iii) here the curriculum had been reproduced in sufficient numbers for teacher and student use.

The curriculum was called *Island Health Series*.[6]

The Truk Department of Education (DOE) also had a curriculum for health education which had been prepared some years earlier and forwarded to the DOE by an action committee established during the cholera epidemic in 1983. Copies were limited and the curriculum had not been implemented. A similar situation existed in Pohnpei. In the Marshalls, a curriculum had been developed in 1984 by a local science teacher with outside consultation provided by UNICEF for their secondary school. Palau had purchased textbooks on health, safety and biological sciences from US publishers. With the exception of the *Island Health Series* series and the Marshall Island text, a detailed review of the available related materials and curricula revealed that environmental health education was either totally lacking or if present, inappropriate. The environmental health content of the *Island Health Series* in the Marshall Island text was limited but appropriate. The contents of the US published texts were either inappropriate for Micronesian students or deficient in content on water supply and sanitation. Germ theory and personal hygiene was adequate in the *Island Health Series* and Marshalls Islands materials.

No formally collected data was found on the current status of knowledge, attitudes and practices of Micronesians relating to water and sanitation. Although personal hygiene was overtly low, even to the transient observer, the extent of knowledge regarding the importance of personal hygiene is not known. There were numerous anecdotal reports that the relationship between water, sanitation and related pathogens and disease was poorly understood, if at all, by rural Micronesians.

Development of Environmental Health Educational Materials and Initiative Measures

Based on our review of the information cited above, a prototype programme for public health education for environmental health was developed. Two major target groups were delineated, i.e. adults in rural communities and children attending primary and secondary schools.

Community Level Health Education

A theme for the environmental health education initiative was developed in the field as the result of interaction with administrators and professionals from the Health Services and Education agencies throughout Micronesia. The theme was "Bad Water and Bad Sanitation Causes Disease." The negative connotation was chosen so that Micronesians could recognise the relationship between the environment and disease and initiate the question, "What can I do about this?" and seek solutions.

Public health educators were given or sent material regarding IDWSSD and WSI and given directions on how to use IDWSSD resources, for example, the series produced by the World Bank Technology Advisory Group on Sanitation.[7] Prototype radio scripts were prepared that stressed the project's theme and the relationship between water supply, sanitation and disease and who to contact for assistance for initiating improvements. The same resources were provided to Peace Corps offices, environmental health services, public works, community action agencies and primary health care directors.

Rainwater catchments were identified as an appropriate method for improving water supplies for all Micronesian communities. This water supply resource was used as indicated in an evaluation of water supply practices in Micronesia by Stephenson in 1984.[8,9] Resources for rainwater catchment tank design, construction and maintenance were provided to the individuals and agencies mentioned above. Because ground and surface waters were also being used in certain communities, resources for shallow ground water withdrawal and spring protection were provided. This was especially important for those atolls whose rainfall was subject to repeated droughts, such as the northern atolls of the Marshalls.

Although it was stressed that primary health care workers, at least administratively, be integrated into the overall Initiative, we are not certain that this was done. To do so would require additional purchase or printing of the resources materials provided to each rural health dispensary and a minimum of training in the understanding and use of these materials among primary health care workers. The Initiative was designed to stimulate community action that would precipitate this type of integration.

Educational System Level Health Education

From the onset of the project the public education system seemed to have the best potential for sustaining the Initiative over the long term. The field data available suggested that there was a poor understanding of water, sanitation and disease relationships among the general population. The fundamentals of this relationship should be learned early in life; the lack understanding results in poorly received educational messages in adulthood regarding this issue, especially since approximately 60% of the population in Micronesia is under 16 years of age.

An environmental health curriculum was developed for primary and secondary school students in Micronesia. The completed curriculum entitled, "Water Supply, Sanitation and Health for Micronesia," was put in loose-leaf binders to facilitate local reproduction. It consisted of 422 pages, including 81 full-page illustrations. All illustrations were consistent with Micronesian customs and features and reviewed by Micronesians and specialists in Micronesian culture for appropriateness before being included. Curriculum modules were grouped into four levels (grades 1, 2, 3 — level I, grades 4, 5, 6 — level II, grades 7, 8 — level III and grades 9, 10, 11, 12 — level IV). The format of the teacher modules was designed to provide the following for each lesson:

1. Purpose of the lesson
2. Explanatory teacher notes to provide supplemental background information on each topic
3. A list of materials including illustrations needed for the lesson
4. Procedures for lesson activity (i.e. draw, make, do, etc)
5. Any worksheets, activities or teacher keys
6. Student feedback/assessment: question and answer session

Each level includes one or more lessons on:

- Physical and chemical nature of water
- Water sources and conservation
- Safe and unsafe domestic water supply
- Water systems and improvements (levels III and IV)
- Personal hygiene
- Home and food hygiene and solid wastes disposal
- Sanitation and human waste disposal
- Environmental pollution

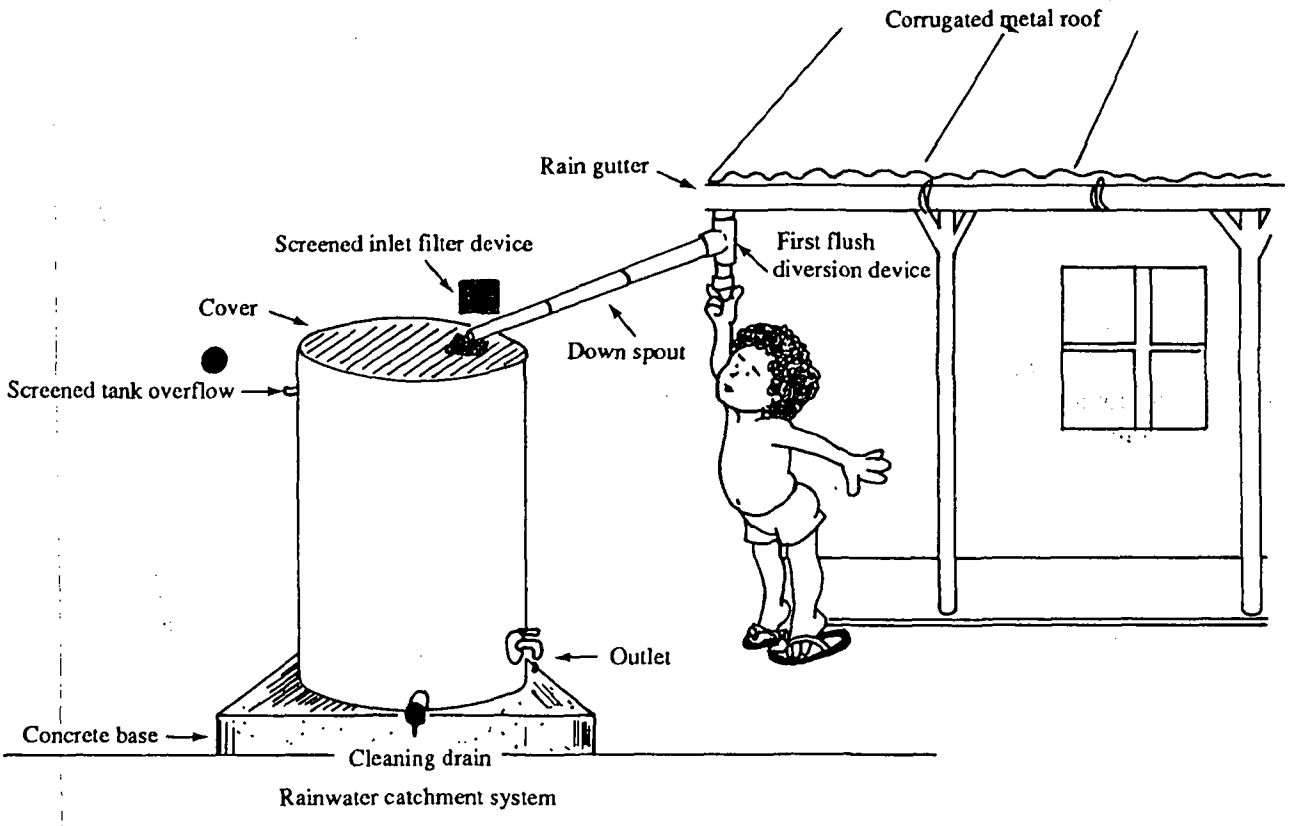

Fig 4. — Illustration of rainwater catchment system taken for the environmental health education curriculum.

- Sanitation systems and improvements (levels III and IV)
- Germ theory
- Water-related diseases
- Basic microbiology and parasitology (levels III and IV)
- Prevention concepts

Figure 4 is an illustration from the curriculum — level III, of a rainwater catchment system. Similar illustrations of catchment systems are used in every level, including a manual provided with the curriculum for catchment construction for 11th and 12th graders. How a water supply, whether catchment, groundwater, public water supply or water in the home, becomes unsafe or polluted and how pollution can be prevented is also repeated in different lessons throughout the curriculum. Illustrations and student activities for teaching sanitation and the relationship between these environmental factors and the spread of disease are emphasised in the lessons. For example, a lesson shows how chalk dust can be used to demonstrate the transmission of pathogens from the fingers of one individual to another. The concept of having enough water readily available for washing hands and for personal hygiene in general is conveyed by this exercise.

Overall, the curriculum is a practical guide for solutions to water supply and sanitation problems that can be achieved with a minimum of imported materials and village level operation and maintenance (VLOM). VLOM is a concept promoted by IDWSSD. Communities' needs for water supply and sanitation could, in great part, be met by a high school graduate who had mastered at least level IV materials. The curriculum is designed to served as a resource and a manual that the local teachers or other community leaders could refer to for identifying problems and initiating action. The delineation of the curriculum into discrete lessons facilitates adapting it or using the material outside the classroom, for example, various community meetings for informational or planning purposes. Therefore, distribution of the finished curriculum was distributed to all appropriate state agencies in addition to the education offices.

Evaluation

Although, we may be justified in assuming that the new environmental health educational materials, and especially the new curriculum, will increase awareness and promote improvements given the virtual absence of this information, evaluation of the WSI in health education

is needed. This requires measuring outcomes related to the project. The most readily quantifiable outcome is to determine, in coming academic years, the extent of distribution of the new curriculum in the educational systems of Micronesia, i.e. how many copies have been reproduced and distributed to primary and secondary schools, Peace Corps volunteers, environmental health services, primary health care services, community action agencies and so on. Alternatively, a survey of primary and secondary school teachers during the annual in-service training at district centres would indicate the extent that the curriculum is used and would also provide useful feedback from teachers for formulating revisions.

Testing and retesting school children on their knowledge of environmental health and carrying out a knowledge, attitudes and practices survey in the communities would indicate that health education inputs had made an impact. It would be difficult technically to link directly the two in a causal fashion, however. This level of evaluation would require more money than was committed to the development of the project and is not consistent with the objectives of the Initiative.

It is desirable that health education, carried out because of the Initiative, would lead to improvements in water supply and sanitation that in turn would maximise the benefits of good water and sanitation. The most profound benefit would be the reduction of water-related diseases and eventually their prevention. Presently, there are no tools of evaluation that are not very expensive and can produce unequivocal findings.[3] A quote by Dr David J. Bradley: "It should be sufficient to accept the universally recognised fact that the provision of an adequate quantity of safe water is a basic necessity for the maintenance of good health and productivity,"[4] is a widely held perspective. Nevertheless, a limited evaluation is being carried out. The most immediate assessment will be to determine the extent to which teachers can use the materials in the new curriculum without in-service training.

Acknowledgement

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