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Housing and Health:
An Analysis for Use in the Planning, Design, and Evaluation of Low-income Housing Programs

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OFFICE OF HOUSING
AND URBAN DEVELOPMENT

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FOREWORD

This study was undertaken by the Office of Housing and Urban Development (formerly the Office of Housing) to determine the effects of improved housing on health, as revealed in the existing literature, in developing countries. The study further examines the housing-health linkages in the A.I.D. Housing Guaranty Program and recommends a strategy to evaluate these relationships in specific Housing Guaranty projects.

Housing and Health was conducted for the Office of Housing and Urban Development by John F. Mason, Cooperative Housing Foundation Development Anthropoligist and Betsy Stephens, Health Planner, International Science and Technology Institute. Ms. Stephens participated as a member of A.I.D.'s Water and Sanitation for Health Project (WASH).

It is hoped that this study which establishes a relationship between housing conditions and health will generate further discussion and review of housing-health issues. It should be noted that the findings and recommendations of this study should not be considered as the official position of the Agency for International Development.

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HIGHLIGHTS OF REPORT

- It is almost impossible to attribute a specific health condition to housing alone (See Section I.)

- Some specialists contend that enough is known about the housing-health relationship to curtail new research in that area (I)

- Some paradoxes are found in the evidence on the housing-health association: e.g., new housing can actually be associated to a decline in health conditions (III)

- Examination of the links between specific planning and design criteria and the diseases and pathological conditions with which they are most closely associated, lead to a few preliminary conclusions (III)

  - Health authorities consider that no single factor approaches the significance of a safe, adequate water supply in reducing disease (IV-A)

  - However, the reduction of disease is primarily associated with access to adequate quantities of water, with less importance attached to its purity (IV-A)

  - Most evidence does not isolate the effects of sanitary excreta removal from other water and sanitation measures (IV-B)

  - The only clear linkages found between standard (vs. substandard) housing are psychological well-being and the reduction of accidents (IV-C)

  - Although crowding is associated with disease, there is relatively little that housing planners can do to reduce crowding (IV-C-1)

  - Contamination of foodstuffs and of water receptacles has been implicated in cases where good water quality did not result in reduced rates of gastroenteritis (IV-D)

  - Nutritional deficiencies are often associated with urbanization and moving from rural to urban housing as migrants are cut off from customary food sources (IV-F)

- The clearest housing-health associations--except accidents--are categories of diarrheal and respiratory and other infectious diseases (V)

- The AID Housing Guaranty Program has clearly addressed the housing-health linkage in its numerous sites and services and squatter upgrading projects around the world (VI)

- Most of the interventions that have a greater correlation with health improvements are planning--not design features (VI)

- An inexpensive assessment of health outcomes should be integrated into HG evaluations, examples of which are provided (VII)

  - The role of the beneficiary in the assessment of a HG project for its housing-health linkages is a key to the overall success (VIII)

- It is recommended that an experimental home gardening component be introduced to HG projects, first to sites and services, then upgrading projects (VIII)

  - Preliminary guidelines for planning a home gardening experiment are provided (VIII-A)

- The study has established a framework for monitoring the effects of the HG Program on Health (IX)

  - The AID Offices of Housing and Health should continue the cooperative relationship in both planning and evaluating the health impact of shelter projects (IX)

TABLE OF CONTENTS

Page

I. INTRODUCTION. 1

II. DEFINITIONS AND A NOTE ON METHODS. 4

A. Housing. 4

B. Health. 5

C. Methods 5

III. GENERALIZATIONS ON THE EFFECTS OF HOUSING ON HEALTH. 6

IV. RELATIONSHIP BETWEEN SHELTER PLANNING AND DESIGN FEATURES AND HEALTH CONDITIONS. 10

A. Water Supply and Storage/Washing and Bathing Facilities. . . .11

B. Excreta Removal. 15

C. General Housing Standards and Rehousing. 17

1. Space. 20

2. Temperature 21

3. Ventilation 22

4. Color and Illumination 22

D. Food Preparation and Household Storage 23

E. Construction Materials: Roofing, Flooring, Screening 24

F. Home Gardens and Livestock Raising. 26

G. Physical Planning of Immediate Surroundings. 28

H. General Land-Use Planning 28

V. PRIORITY LINKAGES IN THE HOUSING-HEALTH DOMAIN. 30

VI. HOUSING-HEALTH PRIORITIES IN THE CONTEXT OF THE AID HOUSING GUARANTY PROGRAM. 34

VII. A RECOMMENDED STRATEGY FOR EVALUATING THE HOUSING-HEALTH RELATIONSHIP IN AID HOUSING GUARANTY PROJECTS. 39

VIII. AN ILLUSTRATIVE CASE OF AN INNOVATIVE INTERVENTION: THE HOME GARDEN. 46

A. Preliminary Guidelines for Home Gardening Component. 47

1. Goal. 47

2. Organizational Options. 48

3. Program Inputs. 49

4. Evaluation 49

5. Issues. 49

IX. CONCLUSION. 50

REFERENCES 53

LIST OF TABLES

Page

Table 1 Classification of Variables Involved in Residential Environmental Impact on Health. 7

Table 2 Priority of General Residential Environment Impact on Health and its Relation to Planning and Design Functions. . .31

Table 3 Planning/Design Criteria and their Strength of Association with Specific Diseases and Illnesses. 33

Table 4 Planning and Design Interventions for Health in the Context of the AID Housing Guaranty Program. 34

LIST OF FIGURES

Figure 1 A Model Showing Residential Environment Impact on Health. 9

I. INTRODUCTION

Many efforts have been made over the last several decades to examine the specific relationship between housing and health. (e.g., WHO Technical Report Series (TRS) No. 224, 1961; No. 225, 1961; No. 353, 1967; No. 544, 1974; Hinkle & Loring 1977) Most have attacked the problem from the health rather than the housing side of the equation. Nevertheless, considerable headway has been made in unraveling the complexities of the linkage between the residential environment and health conditions.

The purpose of this report is to examine the effects of improved housing on health as revealed in the existing literature. Since AID's Housing Guaranty program is directed at low income shelter solutions in the developing countries, and because much of the recent housing-health research has been done in those countries, they will be the focus of this report. Where relevant, studies derived from the so-called developed nations will also be cited since conditions in the developing countries today resemble those that existed a half century or more ago in the industrialized nations.

Overcrowding, poverty, malnutrition, inadequate education, and poor medical and public services characterize much of the developing world. In such conditions communicable diseases flourish. Because of the complex weave of socio-economic and environmental factors found in the developing countries, in addition to the lack of adequate and reliable health records, the study of the direct housing-health link is very difficult. Housing--albeit an important ingredient--is just one of the multiplicity of socio-economic factors. Because of this mix of probable causative factors it is almost impossible to attribute a specific health condition to housing alone.

Many of the studies done both in western and third world countries suggest that an "additive mix" of physical and social factors account for changes in

the prevalence of most diseases. (Hinkle & Loring 1977) This mix is based on the influence of three types of environmental factors: (1) nutrition, (2) man-made settlements, and (3) social-behavioral. Each of these is mediated by the other, making direct causation difficult to pin down no matter how exact the measure. Furthermore, only recently has the social environment been analyzed jointly by health specialists, including epidemiologists, applied sociologists and psychologists, and architect-engineers. Already increasing numbers of both health specialists and social scientists are of the firm opinion that factors in the social environment constitute an essential link in the housing-health relationship. (Hinkle & Loring 1977)

When so much weight in the housing-health debate is given to influences not directly linkable to the physical environment, one cannot help but conclude that health conditions are as much a result of the human use of the built environment as they are of the architect's or builder's design. This finding, corroborated in several health-housing studies, is perhaps best summarized in the important work, The Effect of the Man-Made Environment on Health and Behavior (Hinkle & Loring 1977):

> ...poor housing, however measured, is so closely correlated with other environmental and personal variables that it is difficult if not impossible to determine whether it was the quality of the housing *per se* that was responsible for the relationship or the cluster of the correlated variables.

If health conditions, as measured by mortality and morbidity, are strongly related to social factors such as class, occupational status, unemployment, poverty, or to physical variables such as infectious agents, toxic substances, diet, and injury-producing hazards, then certain explicit conclusions emerge. One of the tentative conclusions arising from the present study is that, with the exception of safety hazards, one should not expect

general health conditions to be greatly affected by physical planning and design of shelter alone. Modification of the physical environment will have the maximum effect on health only if accompanied by other socio-economic and environmental improvements.

While improved housing by itself will not ameliorate health, nonetheless poor housing conditions are associated with certain diseases and therefore changes in housing are a necessary element in the reduction of those diseases. A general confirmation of those housing-health links derives from practical field experience in international low-income shelter programs. It is maintained by several housing specialists working on site with squatter upgrading (e.g., McVoy, p.c.*) that outside of the provision of health service facilities, the supply of water and the removal of waste are the two major elements in a housing project, over which one has significant control, and which can dramatically affect health status. However, control can be exerted over several important features that are not directly health-related, such as land tenure. That feature, along with water supply and waste disposal systems, seems most clearly to affect the overall success of a project--including improved health conditions. There is a common pattern associated with security of ownership--a personal investment in improvement, minimal water delivery and waste disposal systems are introduced, and a public health campaign may be launched. This pattern leads to overall improvement in life conditions that can be readily observed. The pattern is basic to programs developed by the AID Office of Housing. The programs are usually delivered on a pilot basis and are incremental, i.e., the fine-tuned improvements are left for the beneficiaries to make as their situations permit. The

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*p.c. = personal communication

end result is usually an improved environment, including the elements important for health.

Although research on the residential environment-health relationship is useful as a conceptual support for the program, some contend that no new research should be carried out. (Warford, p.c. 1981) Arguing from a cost-benefit point of view, these persons favor a more common sense approach. They assume that enough scientific information is presently available to warrant expenditures on action.

The above conclusions do not mean that certain areas of shelter planning and design directed at better health--beyond water supply and waste removal systems--are not effective or should not be improved and tested. In fact, the present study, as a result of a review of the literature and extensive discussion with specialists and housing field personnel, has produced several tentative conclusions about planning and design features that are thought to have a positive effect on health status and should be extended and evaluated, and others that are recommended for introduction.

II. DEFINITIONS AND A NOTE ON METHODS

A. Housing

'Housing' will be defined according to its use by a WHO committee, in Public Health Aspects of Housing, (TRS 224, 1961), as:

> ...the residential environment, neighborhood, micro-district or the physical structure that mankind uses for shelter and the environs of that structure including all necessary services, facilities, equipment and devices needed for the physical health and social well being of the family and the individual.

Though somewhat lengthy, this definition is comprehensive. It includes the elements of services and infrastructure, planning area, health conditions,

and social bonds, among others, which are all integral parts of this analysis. Following the above definition, much of the very poor housing in developing countries would clearly not qualify as 'good' much less 'healthful' housing in terms of international policies, standards and codes of housing, building, and planning.

B. Health

The World Health Organization definition of health is:

> ...the state of...physical, mental, and social well-being, not merely the absence of disease or infirmity.

This broad definition is refined later in the report through the examples presented. The first priority in improving a population's health should be the reduction, and where possible, elimination of disease and infirmity. Once a "reasonable" level of health is achieved, the objective of "good" health can be pursued. (Pineo 1981)

Statistical reporting of the general health status of a community, nation or world region is often stated in terms of death rates within certain age groups (mortality) or of rates of sickness of a given population (morbidity). More specifically, these measures are defined as follows:

1. Mortality - the relative frequency of death, or death rate, as in a country, district, or community or age group.
2. Morbidity - the proportion of sickness or of a specific disease in a geographic locality or age group.

C. Methods

An extensive bibliographical search was made using the Agency for International Development (AID), Cooperative Housing Foundation (CHF), Housing and Urban Development (HUD), Water and Sanitation for Health Project (WASH), the National Library of Medicine, and World Bank collections, as well as others,

including private and personal collections. The perennial problem of evaluating sources is more than ever present in this study, given the sometimes ambiguous, often contradictory information uncovered. Only sources judged as 'valid' and 'reliable' are given prominence here. However, the only studies examined in detail were those in which the findings were unique or contradicted a familiar pattern. Otherwise, they were used mainly as corroborative evidence.

It should be emphasized that the literature which describes and analyzes the direct relationship between housing conditions and health in a detailed, measurable fashion is very limited. This fact has meant that a considerable amount of inference has been required in making the present analysis. To the extent that some of the associations are inferential, they must be considered as only preliminary or suggestive.

III. GENERALIZATIONS ON THE EFFECTS OF HOUSING ON HEALTH

Changes in the health status of a given population through better health service, higher income, improved diet, and a generally higher living standard have themselves created new problems, including overpopulation, rapid urbanization, squatter development, uncontrolled settlement, and overcrowding. (WHO TRS No. 544, 1974) Poor housing and poor health are generally associated with these problems in urban areas. However, one must be cautious in attributing deteriorating health status to housing alone. Housing is only one factor in the cycle.

Detailed documentation of some of the effects of housing on health--both positive and negative--is presented in later sections of the report. Below a few, short examples of ambivalent evidence that underscore the care which must be taken in assessing the effects of housing on health are presented.

Table 1

CLASSIFICATION OF VARIABLES INVOLVED IN RESIDENTIAL ENVIRONMENTAL IMPACT ON HEALTH

I — INITIAL CONDITIONS

A. Physical Environment
1. Geographic
2. Seasonal and climatic
3. Water supply

B. Resource Base
1. Soil fertility
2. Productive capacity
3. Resource accessibility

II — CONDITIONING VARIABLES

A. Population Attributes
Demographic
1. Age
2. Sex ratio
3. Ethnic
4. Stage of life cycle

B. Socio-psychological Environment
Perceptions, attitudes e.g. crowding, privacy convenience to facilities, pollution, etc.

(Some overlap occurs here with III, A,B,&C)

III — ADAPTIVE PROCESSES

A. Biological
1. Reproduction
2. Development-Growth
3. Disease Vectors

B. Psychological
Personality
1. Habit patterns
2. Coping styles
3. Ego strength

C. Social
1. Family structure
2. Employment
3. Economic status-income
4. Education
5. Differentiation by sex or ethnic status

D. Technical
Built environment
1. Housing-characteristic of dwelling unit, neighborhood
2. Distance to facilities
3. Water supply
4. Sanitation facilities
5. Energy systems
6. Safety systems

E. Institutional
Health services
1. Health history
2. Perceived health level
3. Available health services
4. Health services utilization

IV — OUTCOME: HEALTH INDICES

A. Mortality
1. General
2. Infant/Child age specific
3. Disease-specific
4. Accidental
5. Traumatic
6. Suicide and homicide

B. Morbidity
1. Sickness occurrence
2. Sickness aggravation
3. Prevalence

C. Fitness or Performance
1. Accident occurrence
2. Household performance
3. Work performance
4. School performance

(Some variables adapted from WHO TRS No. 544, 1974 and Hinkle and Loring, 1977)

Conventional wisdom suggests that crowded or overcrowded housing has a negative effect on health, yet evidence from Hong Kong (WHO TRS No. 544, 1974) shows a reasonable tolerance by the inhabitants of a density of 100,000 persons per km2. That same kind of wisdom has led planners to accept the thinking that re-housing a population almost by definition means an improvement in its health. Studies reviewed later in the report show, however, that re-housing may lead to a decline in health conditions. Poor planning and design may enhance physical and mental stresses which in turn induce latent disease. Equally, the higher costs of new housing can skew a family's budget, resulting in unintended effects such as a poorer diet and less adequate health care.

The residential environment, which is more inclusive than the physical structure of a house, plays an influential part in the determination of general health conditions. For example, the adequacy of sanitation facilities is known to be a significant factor in the occurrence of some kinds of parasitic infections while overcrowding, inadequate ventilation, and air pollution predispose residents to respiratory infections. The way a residence is used in shaping interpersonal contacts may influence the transmission of communicable disease. However, infectious disease is a function not simply of housing by itself but of a simultaneous combination of factors, such as poor nutrition and personal hygiene, and inadequate sanitation facilities.

Poor housing is also linked to poor nutrition and a lack of hygiene in causing a group of diseases known as airborne infections. These conditions are known to predispose an inhabitant to such conditions as tuberculosis, cerebrospinal meningitis and, it is suspected, hepatitis.* (Ghipponi 1971)

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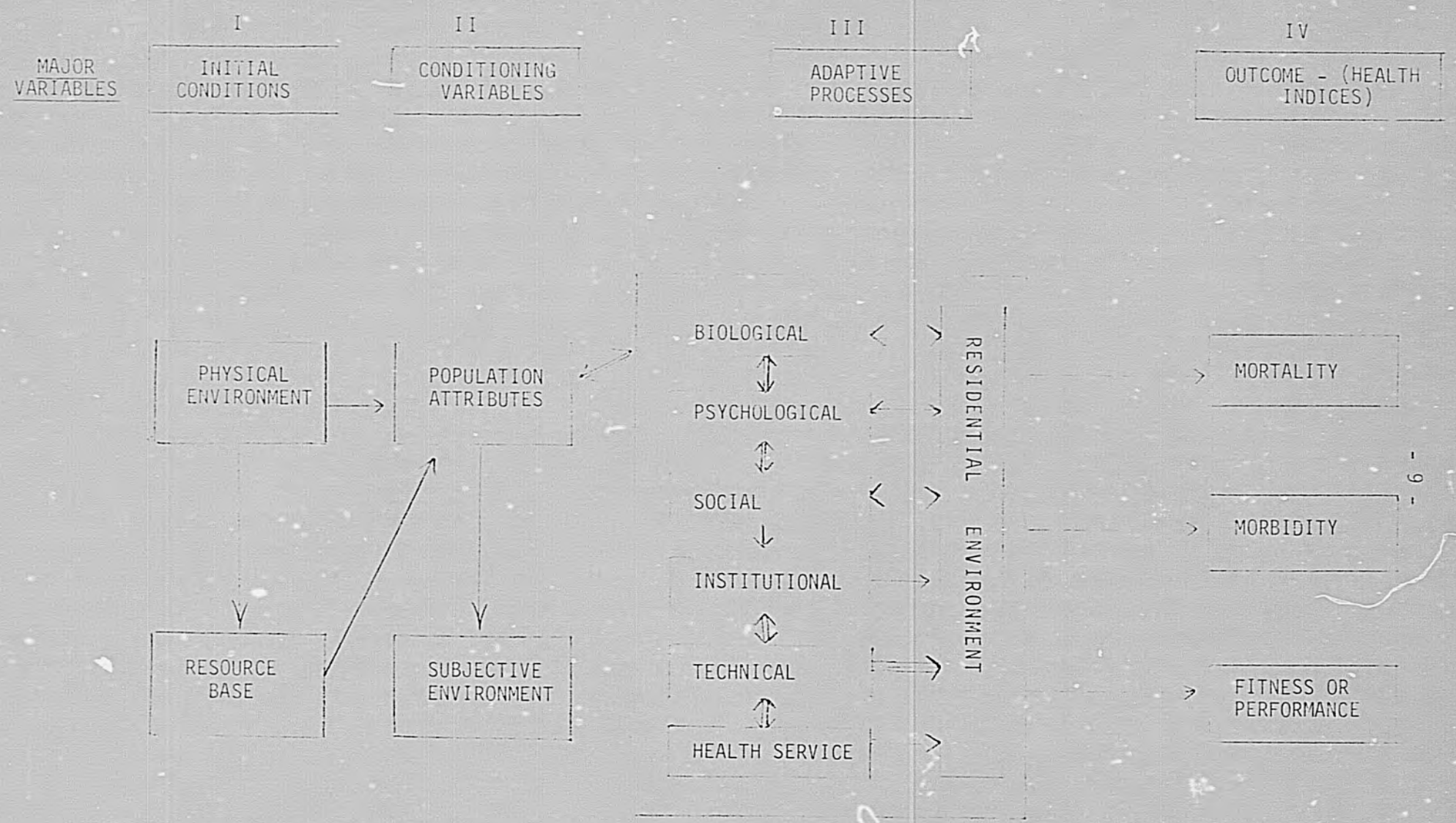
*Also: bronchopneumonia, pertussis, streptococcal infections such as rheumatic fever.

Figure 1

A MODEL SHOWING RESIDENTIAL ENVIRONMENT IMPACT ON HEALTH



(See 'Classification of Variables' table for categories used here)

Key

→ = one-way influence

⟷ = two-way influence

⟹ = strong relationship

> = indirectly related

Some housing-linked diseases are tied not only to the presence or quality of sanitary facilities but also to personal behavior and the socio-cultural environment. These factors influence the spread of such food and water-borne infections as cholera, typhoid, hepatitis, poliomyelitis, enterovirus and respiratory infections, among others.* (WHO TRS No. 544, 1971) The presence of good facilities alone is insufficient to reduce the incidence of these infections. Control of the so-called "diseases of dirty hands" can only be affected through the promotion of personal hygiene in conjunction with improved housing and sanitation.

The association between housing and other specific diseases and conditions, such as animal-and vector-borne diseases, chronic respiratory diseases, and domestic accidents, are detailed in a subsequent section. Also to be considered are the effects on health conditions of such factors as water pollution, sewage disposal, and air and dust pollution.

IV. RELATIONSHIP BETWEEN SHELTER PLANNING AND DESIGN FEATURES AND HEALTH CONDITIONS

The procedure followed in clarifying housing-health relationships was to examine specific planning and design characteristics and to link these to the equally specific diseases and pathological conditions with which they are most closely associated. The discussion commences with water and sanitation and excreta removal, followed by general housing standards and the internal structure of the house itself, and concludes with settlement planning and site selection. Some of the linkages discussed here are well established in the literature, while others are not. For the latter, the authors have postulated

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*Including amoebic dysentery, E. Coli diarrhea, bacillary dysentary, salmonellosis.

ties or suggested the possibility of links which, in several cases, have not been considered heretofore.

A. Water Supply and Storage/Washing and Bathing Facilities

Much of the research indicates that water-related diseases decrease as socio-economic conditions improve and few studies show a direct relationship between the "water factor" and disease rates. Nevertheless, health authorities still consider that no single factor approaches the significance of a safe, adequate water supply in reducing disease. (Kourany & Vasquez 1969; Wolff & Van Zijl 1969; White et al. 1972; Wolman 1969; Nerl, et al. 1974)

Unquestionably, unsafe water is a causal factor of typhoid, cholera, trachoma, skin infections, gastroenteric and other diseases. (PAHO, No. 390, 1979) Although dramatic reductions in these diseases in many countries followed the improvement of water supplies, (Dietrich & Henderson 1963) the following paragraphs cite some of the research that points to their reduction being primarily associated with access to adequate quantities of water, with less importance attached to the purity of the water.

The presence of a pathogen or toxin is an essential but not necessarily sufficient condition for causing a disease. (Krishnaswami 1971) Research in three villages in India found that while wells in all three were contaminated to the highest measurable level, studies of the populations showed significant differences in the rates of parasitic infection. The village with the greatest annual rainfall and greatest number of wells had the least infection and the village with the least rainfall and least number of wells had the greatest infection rates. (U.S. AID 1980(2)) In Lesotho, no difference was found in the incidence of water-related diseases between villages with and without piped water, despite the better quality of water in the former. (Feachem 1978)

Another study in East Bengal found that while children living near tube wells with safe water had a much lower rate of infection of the classical cholera strain than children living farther away, there was no difference in the attack rates of the El Tor type. (Sommer and Woodward 1972) A controlled prospective trial in the Gambia comparing the use of bacterially contaminated well water and clean water for oral glucose electrolyte solution, found no significant differences in the effects of either composition. (Watkinson et al. 1980) On the other hand, in Bangladesh, while attack rates of cholera in families drinking from a positive source were no different than among those drinking from a negative source, families using a positive source for washing, bathing or cooking were significantly more likely to be infected. This outcome is thought to be a result of the thorough bathing which is common in Islamic societies. Thus, in this case, pollution of the water evidently was significant. (Hughes et al. 1977)

Research in the United States found that convenient access to adequate quantities of water for personal hygiene was related to the reduction of Shigellosis and that other measured environmental variables were not significant. (Hollister et al. 1955; Rubenstein, Boyle et al. 1969; Schliessman 1959; Steward, McCabe et al. 1955; Wolman 1969) In Costa Rica reduction in the incidence of diarrhea was related to a good level of sanitation but water pollution could not be shown to have a direct effect upon diarrhea morbidity. A bathing facility was needed to obtain the best effect from piped water. (Moore et al. 1965) Analysis of data collected in two villages in Guatemala indicates that a significant reduction in skin diseases was related to convenient access to water at individual family patios. The amount of water used by those families was three times greater than families in the comparison group.

(University of North Carolina et al., 1978) Research in the Ryukyu Islands found trachoma prevalence significantly greater in communities without a piped water supply, a finding thought to be more related to different patterns of water utilization in water-scarce and water-rich areas than to purity of water. (Marshall 1968)

Hygienic habits and accessibility both play important parts in the water-disease equation. Handwashing is thought to be the principal intervention in preventing the spread of diarrhea, and clothes washing and bathing in the reduction of trachoma, conjunctivitis and other infections. (U.S. AID 1981; World Bank 1980) Therefore, the quantity of water and convenience to it are important factors. Research has shown that personal washing is directly related to water availability and that having water inside the home is preferable to having water outside. Furthermore, given several choices, including traditional and improved sources, it has been found that the closest source is almost always chosen. (Stewart, McCabe et al. 1955; USAID 1980(2); Hughes 1981; Warner and Dajani 1975; White 1971) A reduction in schistosomiasis was achieved in St. Lucia by providing piped water to public standpipes for a population that had previously been dependent for water on infective streams and rivers. (Jordan et al. 1975) The most significant reduction, however, came after alternative swimming and bathing facilities were introduced.

In refugee camp situations, specific problems are known to occur if adequate quantities are not supplied. There is a direct correlation between the quantity of water received by refugees and their health status. Fifteen to twenty liters of water per day (lpd) are considered the minimum for refugees in a camp. With various reductions in this quantity, certain routines or activities will not be possible. With the first reduction, (to 12 lpd's)

clothes will not be washed. With the next reduction (9 lpd's), bathing will be greatly reduced. With the next reduction (6 lpd's), cooking utensils will not be properly cleaned. Next, food cannot be adequately prepared, contributing to malnutrition. Next, water will be inadequate to support strenuous activities, and at the lowest minimal level water will be insufficient to provide normal drinking requirements. With the first level of reduction, skin diseases (scabies) and fungus will become a problem. At the point where the washing of cooking utensils is reduced, diarrheal diseases will become a problem. (Cuny 1981)

Water collected from a good source may become as contaminated as water from a polluted one if drawn into a contaminated receptacle or not protected during storage. A layer of slime often coats the bottom of the bucket in which water is carried and the container used for storage likewise becomes bacteria laden. (UNICEF 1979) Data from Lesotho show significant pollution between the times of collection and use of water--often the storage containers are not washed out nor the scoops and buckets used to collect and carry the water. (Feachem 1978) A striking example of how easily pollution takes place is the observation of a woman in Ghana filling her dirty pail with clean water from a bore well. The water was further contaminated by a village dog drinking from it, her child washing his hands in it, and a man scooping a drink from the pail with his hands. (USAID 1980(2)) A problem experienced in tropical more than in other developing areas, is the return of waste water to fresh sources. (U.N. HABITAT, 1979) The best method to guaranty pure water in refugee camps is to control both the source and the distribution of the water. The best system is the use of closed containers for storage, transport, and distribution, and the use of chlorine compounds to purify the water prior to distribution to the refugees. (Cuny 1981)

Piped water can have a negative effect on disease prevalence. If a community is using a common polluted water source (river, tank etc.), a hygienic benefit might be expected if that same water were piped to houses. However, if many separate sources are being used, the introduction of a single unprotected piped supply might produce explosive disease episodes. (Moore et al. 1965) Mild pollution of a widely used source can have more serious epidemiological effects than greater pollution of a source used by a few people. (Bradley & Emuron 1968) Under certain conditions neighborhood wells probably would prevent widespread cholera and typhoid epidemics that are spread by unified town water supplies. (Cairncross et al. 1980)

In recent years there have been suggestions that drinking water should be enriched to meet mineral deficiencies. However, the quantitative requirements or hazards of minerals are not well known, nor the relative role of minerals in water compared to other sources. (Krishnaswami 1971)

B. Excreta Removal

Most of the evidence relating sanitation with health does not isolate the effects of excreta disposal from other water and sanitation measures. Moreover, some research has shown a negative relationship between privies and health due to poor use. At best, water and sanitation improvements are not likely to eliminate all water-related diseases, especially in the absence of other socio-economic improvements. On the other hand, these diseases are not likely to diminish without the sanitary improvements. (Thomson 1981)

In some tropical countries it is estimated that more than one-half the food grown and consumed by the rural poor nourishes intestinal parasites. Eggs leave the body in excreta and subsequently infect others. (Pacey 1968; WHO 1974) Effective excreta disposal can interrupt this cycle of infection

and reinfection. Research in the United States and in Venezuela found that protected latrines inhibiting access by flies is more effective in reducing Shigella transmission than attempting to eliminate flies. (McCabe and Haines 1957; Wolff and Van Zijl 1979) One study found a significant difference in the typhoid case rate in the southern United States between populations with and without private toilets. (DallaValle 1937) Another found a significantly higher prevalence of diarrhea with outside, in contrast to inside, privies in rural Kentucky. (Schliessman et al. 1958) Rehoused families in Singapore experienced a pronounced reduction of Ascaris and Trichuris which appeared to be due principally to better sanitary facilities (WHO Bibl. #205). In a USAID squatter upgrading program in Seoul, Korea pit latrines were vacuumed weekly by a pumping truck, reducing water use (compared with sewerage) and thus efficiently removing excreta. Although health benefits were presumed to derive from this method of excreta removal, measurements of its impact were not made. (McVoy, p.c. 1981)

In contrast to the above, research in Cost Rica found no evidence that the use of pit privies had a positive effect on reducing intestinal parasitism. The reduction of hookworm was associated with the existence of durable floors, not privies. (Moore et al. 1965) Latrines can become the focus for the spread of fecal-oral diseases if proper hygiene and latrine maintenance are not observed. A higher incidence of Ascaris among urban latrine users than rural non-users in South Africa was attributed to unsanitary latrines. (World Bank 1980; Pacey 1978) A project in Guatemalan villages found that education in sanitary practices, combined with a program to build latrines, was successful in changing attitudes and behavior but apparently had little or no effect on rates of diarrhea. (U.S. AID 1980(1))

Combined water and sanitation measures tend to show more of an effect. One research investigation in the Philippines found that the provision of sanitary facilities for human waste disposal reduced the incidence of cholera by 68 , the provision of safe water by 73 , and both by 76 . (Azurin and Alvero 1974) Significant differences in the prevalence of fecal-oral transmitted diseases were found among Hong Kong children, having virtually no socio-economic or genetic differences, when those with access to clean water and a concrete-structured environment were compared with those living with an unprotected water supply and grossly contaminated soil. (Worth 1963) In U.S. Indian communities in Arizona a reduction in skin and enteric diseases occurred as facilities increased--indoor water sources and sanitary privies. (Thomson 1981)

C. General Housing Standards and Rehousing

Many studies have shown a relationship between poor housing and poor health. However, very few of these controlled for other socio-economic variables while at the same time identifying housing as the key variable. Some of the research found other determinants to be more important than housing *per se*. The only clear linkages found in the literature between health and standard, in contrast to substandard, housing, are psychological well-being and the reduction of accidents.

In Panama, enterobacterial pathogens were found in 6-10 of children living in substandard dwellings but none were found in children living in high standard housing. However, no significant variation in prevelance was found among children living in different grades of substandard housing. (Kourany and Basquez 1969) A study in Guatemala found the habits of people and the density of population more important than housing type. (Bruch 1963)

In Maharashtra State, India, extraordinarily high rates of mortality were found in a population living in crowded damp huts with bamboo walls, thatched roofs and mud floors which were often shared with goats and cattle. (WHO Bibl. #229) A study in Sierra Leone, comparing a population in a mining town with a sample from three nearby villages, found better health status in town, attributable to better housing and sanitation, wages, and medical care. (WHO Bibl. #278) An unusually high prevalence of tuberculosis in an isolated Eskimo community was attributed to low standards of housing and crowding. (WHO Bibl. #63) On the other hand, a survey in Malaya found no significant difference in weight and health of infants among three classifications of housing type. (WHO Bibl. #51) In Ibadan, Nigeria there was a strong association between poor environment and prevalence of intestinal parasites and malaria. However, the author was unable to separate the effects of housing from other factors. (Oduntan 1973)

Research in the U.S., the U.K. and Europe also show mixed results. Slum dwelling has been shown to create a "slum mentality," which has the psychological effect of lowering expectations. Lack of play areas for children is found to affect their social well-being. (WHO Bibl. #419, #128) Conversely, good mental health is related to good housing, privacy, and opportunities for free social circulation. (WHO Bibl. #67) Slum children in the U.S. were found to have lower weights for age. (DallaValle 1937) In Dallas, Shigellosis was associated with families in which there was adequate water supply and sewage but poor interpersonal hygiene, crowded living conditions, and less than optimal diet. (WHO Bibl. #290) On the other hand, research in Providence, Rhode Island found that infant mortality had more to do with biological than with socio-economic factors, including housing.

(WHO Bibl. #384) Research in Boston and in the Solomon Islands led to the general conclusion that the effect of the built environment on health and behavior (and such effects are still to be demonstrated) result largely from people's perceptions and attitudes. Mortality and morbidity are thought to be more related to social variables and therefore, excepting for safety hazards, health is believed by many environmental health specialists not to be greatly influenced by the design and construction features of shelter. (Hinkle and Loring 1977)

The experience with rehousing has also been contradictory. A study of relocated miners in Korea found that the rehoused population made only 50% as many clinical visits, thus introducing a significant cost savings through improved housing by increasing worker output. (Grimes 1976) In Port Said, Egypt, there was a greater decline in infant mortality in the rehoused population than in the remainder of Port Said. Rehousing was thought to have affected barefootedness and the increased use of soap and other hygienic practices. (WHO Bibl. #350) Significant delcines in morbidity occurred in California when people were moved from substandard wooden frame houses to improved accommodations. (WHO Bibl. #416) A longitudinal study in Baltimore of families living in a slum who moved to a new housing project, found an improved psychological state in the rehoused area and an improvement in health in the under 35 population. (WHO Bibl. #423) However, rehoused populations sometimes have poor diets because of the greater portion of income necessary for the new investment in housing. (Hinkle and Loring 1977) Research conducted in a northern English mining town found an increase in infant mortality among the rehoused population which was thought to be related to the fact that rents in the rehoused area were much higher and therefore the diet poorer. (WHO Bibl. #248)

A final measure of the paradox of rehousing suggests yet another reversal of common-sense understanding. In a study of resettlement from a village setting to a Hong Kong squatter community a reduction in gastrointestinal infectious disease was found. However, the move was also accompanied by an increase in respiratory disease. (Wolf 1963, cited in Martin 1976)

1. Space

As long ago as the 17th century John Gaunt related density and other aspects of urbanization with 50 higher rates of mortality in London than in the English counties. In more recent years, the findings have been mixed. Numerous studies in the U.K., Hong Kong, Japan, the U.S., Greenland, and Holland have found an apparent relationship between crowding and significantly higher rates of respiratory diseases overall, and of tuberculosis, rheumatic heart disease, venereal disease, tension, meningitis, pneumonia and the common cold. (Martin 1967: WHO Bibl. #'s 168, 377, 208, 315, 252, 46, 25, 27; DaliaVaile 1937; Worth 1963) Other studies indicate that overcrowding was associated with higher disease rates but that crowding cannot be disaggregated from other contributory factors, and other social status indicators. (WHO Bibl.#'s 221, 430, 239, 46, 253; Ghipponi et al. 1971)

One particular study, carried out by an anthropologist-physician team among tribal societies in the Solomon Islands, helpfully differentiates 'micro-crowding.' (Damon 1974) Micro-crowding within dwellings was found to be more important than settlement density. The number of residents inhabiting an area showed little effect, but when the number of square meters per person per shelter fell below a certain threshold value (8-10m2), the prevalence of social and physical pathological conditions doubled. It is suggested from the Solomon Islands study that the major effect of crowding may be social disorganization and a resulting stress on the individual.

The factors that have been associated with density of habitation are all declining in importance in most of the countries in which these studies have been done. Families that were more likely to suffer from overcrowding also were more exposed to communicable diseases, and had less access to medical and other social services. Crowding has less of an effect on health when other aspects of the social and physical environment are improved. (Martin 1967)

Considering the minimal availability of health services to the urban poor in most developing countries at the present time, and their exposure to disease, the effects of overcrowding on health are likely to be significant. However, there is relatively little that housing planners can do to reduce crowding short of infusing impossibly massive investments into universal shelter. Even then, experience has shown that more living space on a compound results over time in more people, including renters and kinsmen, inhabiting that space. (Stephens 1976)

2. Temperature

A 'zone of thermal comfort,' the range over which human energy expenditure is minimal, was found to be between about 15 and 25 degrees centigrade. Research in the Soviet Union indicated that a superheated microclimate, especially in the evening and at night, was associated with disturbances of the body's thermoregulatory mechanism. However, more research is needed to identify the effects of indoor climate on health. (Goromosov 1968; WHO Bibl. #5)

Factors that need to be considered in planning dwellings in hot climates are: protection from solar radiation by the orientation of the dwelling, awnings and shutters, insulation, colors that minimize heat absorption, appro-

priate roofing materials and style; vegetation around the dwelling; orientation to prevailing winds and ventilation. (Goromosov 1968; APHA 1968; Woodhouse 1966)

3. Ventilation

Cooking fuels and devices release carbon dioxide, carbon monoxide, and sulphur dioxide which, if not properly ventilated adversely affect respiration, circulation, and higher nervous activity. (Goromosov 1968) In Lagos, Nigeria a study found higher death rates from bronchial diseases in residences in which there was poor ventilation on woodburning stoves and during the rainy season when people cooked indoors. (Sofoluwe 1969) Studies in India, Barbados and England found linkages between house dust and asthma. (WHO Bibl. #'s223, 269, 301) Dust from desert sandstorms has been found to influence bronchial conditions, including asthma, in the arid climatic setting of the Libyan Sahara Desert. (Mason 1977)

The recommended standard 'air cube' per person is 25-30cm^3 or 10ft^3 with one change of air per hour. More fresh air is needed if there are heavy odors in the room, or tobacco or other smoke. Cooking areas should be located away from living areas and apertures placed on more than one wall. (Goromosov 1968; APHA 1968) A 1.3% maximum concentration of noxious gases, such as carbon monoxide, is a standard established in some countries. (United Nations-UNESOC-April 1979)

4. Color and Illumination

The "color climate" is thought to have an effect on mental health and prolonged deprivation of sunlight "light starvation" to result in physiological disequilibrium. Illumination is important to visual comfort and acuity and to minimizing accidents in the home. Moreover, ultra-violet rays from the sun have a bactericidal effect. (Goromosov 1968) Studies in the

U.S. found a correlation between the prevalence of rickets and inadequate natural lighting in slum dwellings. (DallaValle 1937) In many tropical climates shelter is most important as a protection from sunlight and heat. Nonetheless, there still must be adequate illumination to minimize accidents and maximize safety in the home. Colors must be acceptable in the socio-cultural milieu and pleasing to the inhabitants.

D. Food Preparation and Household Storage

Research among African children in the Republic of South Africa found that good water quality did not result in reduced rates of gastroenteritis and that the contamination of foodstuffs might be implicated. (Feachem et al. 1978) Dirty hands, contaminated water storage receptacles, soiled dishes, inadequate cooking of contaminated raw foods, and exposure of cooked foods to flies and other vectors contribute to unwarranted exposure to disease. (UNICEF 1979)

A study in Honduras found that most of the staple foods are prepared ahead, stored without adequate protection, and served cold or after minimal reheating that does not destroy the bacteria. Handwashing was observed, especially during the preparation of tortillas, but the water was often contaminated by women interspersing the cooking with dirty chores. (Booth et al. 1980)

Indoor cooking fires are related to respiratory infection, while wood-piles in indoor cooking areas were found to be habitats for the Chagas' vector. (Steven Ault p.c. 1981) Accidents, especially burns, are associated with open fires that are particularly hazardous for young children. On the other hand, cooking with bottled gas or kerosene also creates potential health hazards, including noxious fumes that can be deadly, and the possibility

of fires and explosions. If cooking is to be done over an open fire, a well-protected and well ventilated space must be provided. If possible, the cooking area should be separated from other living space.

Food should be stored and prepared in a sanitary environment. Storage must also be secure against rodents and other pests. Poisonous substances that are kept in the household must be inaccessible to children. Such items as cooking utensils and kerosene, that could cause accidents, should be safely stored.

E. Construction Materials: Roofing, Flooring, Screening

Thatched roofs and cracked mud walls provide a breeding site for the vector of Chagas' disease. (UNDP 1979) Thatched roofs are also a fire hazard. Cresote, which is used to fireproof and seal thatch, is poisonous There are examples of cresote dripping onto food and causing serious illness. (Cuny p.c. 1981) Plastering mud walls and the use of modern roofing materials will reduce Chagas' disease and minimize fire hazards. On the other hand, there are advantages to thatched roofs which are well adapted to tropical climates, providing good insulation against heat in the summer and also against cold, in countries where the temperature drops in the winter. A project in Venezuela for the control of Chagas' disease used tin roofs but raised them well above the tops of the walls, thus creating a good breeze that cooled the houses more than those constructed with thatch. (Steven Ault p.c. 1981)

Durable floors were associated with the reduction of Ascaris in Costa Rica. (Moore et al. 1965) Cement or other finished floors are more easily kept free of filth and dust than traditional mud floors. They are generally associated with cleaner living habits and a reduced prevalence of tetanus

and hookworm. One study found the number of bacteria suspended in the air in cement floor huts lower than in earth floor huts. However, the difference could have been due to factors other than the state of the floor. (Ghipponi 1971)

A finding from India shows that when the Government designed housing with concrete floors for the lower caste population, certain unexpected results occurred. Because they were barefooted, the recipients ended up experiencing stress in their backs. (Cuny p.c. 1981) One possible way around this problem is, in localities where disease-carrying insects enter the skin from the soil, to place plastic sheeting about one-half foot below the surface of a mud floor to prevent the entry of such insects. (Cuny p.c. 1981)

Screens in houses and outdoor privies are a protection against mosquitoes, vectors of malaria and other diseases. U.S. studies found that a lack of screens correlated with malaria in the southern part of the country. (DallaValle 1973)

An association has been found between health and some traditional and modern building materials. Some plastics are less susceptible to contamination and dust, have low thermal conductivity, and good sound insulation. Some additives to plastics are toxic. (Goromosov 1968) One study found brass handles on water closet doors to carry fewer organisms than other materials. (WHO Bibl. #154) Construction materials and building design are both crucial ingredients in housing located in seismic activity zones. (PADCO 1981) Another important consideration is the design of solar energy producing structures which, because of hot surfaces, must be safety-proofed. (Shaw p.c. 1981)

F. Home Gardens and Livestock Raising

Nutritional deficiencies are frequently associated with urbanization and moving from traditional to new housing as people are cut off from customary food sources. Poverty, ignorance, change of occupation, including new roles for women, and lack of facilities for producing food result in inadequate diet. (WHO Bibl. #359) In Botswana, significantly higher rates of malnutrition were found among urban migrants than among comparable rural populations. (Stephens 1976) Several studies found that the family food budget suffers when rehousing is more expensive for residents. (Hinkle and Loring 1977; WHO Bibl. #248)

A study of health and nutrition in the third world shows profound differences in health and nutrition status between different income groups in urban centers. In squatter settlements of third world cities, the prevalence of most diseases is 50 higher than for the city as a whole. For example, in Madras, the average death rate from dysentery is three times lower than that in the squatter areas. In Manila, tuberculosis is ten times higher in squatter settlements than in the city as a whole. (Basta 1977)

Concerning nutrition, food energy intake in squatter settlements is often 50-65 of the urban average, anemia two times more frequent, and vitamin A status one-third to one-half. The incidence of so-called 'third degree malnutrition' is three times greater for squatters than average urban inhabitants. Perhaps even more telling than the above picture is the infant mortality rate: for squatters it is as much as six times greater than the city average. (Basta 1977)

Provisions for home gardening and animal rearing can help to counteract nutritional deficiencies by providing food to participating families and also the possibility of added income if some of the food can be sold.

Even a small plot, if specifically planned to meet the nutritional needs of the area, can contribute significantly to family dietary requirements. (Yang 1981) The planning should include a local caloric staple (e.g. a cereal) and a legume to supply protein. (Wray p.c. 1981) Livestock, vital to supplying protein, also supply manure for home gardening. (APHA 1968; UN 1978) They are, however, disease carriers. A study in Guyana found that animals kept in or near the house attracted malaria-carrying mosquitoes. Other research in East Africa found that tick borne relapsing fever was correlated with keeping cattle inside the house at night. (Stephen Ault p.c. 1981) Provision for livestock shelter should minimize resident's exposure to disease.

Some existing activities demonstrate that home gardens can be highly productive. The Mennonite Central Committee has promoted them in refugee camps in Bangladesh, for example, where they have achieved 50 food self-sufficiency. (Cuny p.c. 1981) While not very urban in their distribution, these gardens serve as a good example to urbanites, with vegetables, cereals, and fruits growing on rooftops, in windowboxes, and on vines. In some cases rooftop gardens serve the secondary function of helping break the lift in windstorms. Depending on the spatial and social contexts, gardens may take the form of 'home', 'communal' or 'community' endeavors.

Although water is necessary for home gardening, research in Lesotho has shown that the success of home gardens was more related to communal attitudes than to a piped water supply. Therefore community education, in addition to technical assistance and access to the necessary materials, including tools, is essential to a home gardening project. (White et al. 1972; Feachem et al. 1978; Yang 1981)

G. Physical Planning of Immediate Surroundings

Many studies have found a correlation between mental health and the overall housing environment, especially general attractiveness, the provision of opportunities for social intercourse and privacy, and recreational facilities. (Goromosov 1968; APHA 1968; WHO Bibl. #448) Provisions for vehicular and pedestrian circulation and area lighting are related to accidents and personal safety. (APHA 1968) Contours of the land can be used as a windblock, influencing internal household temperatures and stabilizing top soil which reduces windblown dust. (Shaw p.c. 1981)

Spacing of houses has an impact on environmental health conditions which should not be overlooked. In the absence of water-borne sewage, there must be adequate space to build pit latrines and move them when they fill up. In warm humid climates, buildings should be well spaced in order to reduce the opportunity for disease transmission. In colder climates, too, air movement is desirable. However, generalizations in this area must be treated gingerly, since the same structures may have competing uses in climates with contrasting seasons. For example, adequately spaced houses in a cold season setting may be ill-adapted to the summer season, in which close spacing, mutual shading and wind protective designs are more appropriate. A greater analysis of building spacing and its relationship to health conditions needs to be carried out.

H. General Land-Use Planning

Water-related criteria must be taken into consideration in siting a housing development. Adequate storm and waste drainage are necessary to avoid the buildup of stagnant pools and sullage that provide a breeding ground for mosquitoes that transmit malaria and/or forms of filariasis.

(International Institute for Environment and Development 1979) Therefore, the terrain of the land may have to be altered, and/or sewers added. Housing must be located a good distance from existing pools in which most mosquitoes breed, and from rivers near which tsetse flies and black flies, that carry trypanosomiasis and onchocerciasis respectively, breed. (International Institute for Environment and Development 1979; WHO 1974; APHA 1968; WHO 1972) Research in Egypt has shown that the prevalence of schistomiasis can be reduced by siting residential areas away from canals in which the snails breed. (Steven Ault p.c. 1981)

Numerous studies have shown that undue noise is related to cardiovascular, hearing, nervous, and psychic disorders. (Goromosov 1968; WHO Bibl. #133; WHO TRS 1965) However, levels of noise tolerance are difficult to quantify. (WHO Bibl. #'s 22, 106) Nonetheless, housing should be located so as to minimize the amount of noise to which inhabitants are exposed, including road, industrial plant, and airport noise. (WHO Bibl. #134; Goromosov 1968; WHO Bibl. #181)

Access to health care services has direct bearing on health status. Convenience to work and to educational, cultural and commercial facilities, while not as directly related to health, are important to general well-being. (Goromosov 1968; WHO 1972)

Planned refugee camps offer good case studies of shelter impact on health. Results of studies show that properly laid out camps, organized from the outset, can reduce problems and, especially in high exposure, tropical environments, save lives. (Cuny 1977) Camps designed to facilitate sanitation, for example, greatly reduce disease incidence.

A comparison of two camps in Managua, Nicaragua following the 1972 earthquake show significant differences in their impact on health. One, an Inter-

tect-Oxfam camp, was planned and organized in advance, while the second, under the U.S. Army, was simply set up in a grid layout with no prior planning or sequencing of its development. Provisions for group cooking, washing, and recreational activities were made for communities living in the first camp, fire breaks were built throughout and drainage ditches planned. Sanitation was provided by bore-hole latrines placed nearby and water was supplied daily by truck.

In the first camp, no major health problems occurred, while in the army camps several outbreaks of various waterborne diseases and minor contagious disease afflicted the refugees. On the community organization side of the coin, the planned camp was a model of harmony and industrious activity, while in the army camp a high degree of disorganization set in. (Cuny 1977)

V. PRIORITY LINKAGES IN THE HOUSING-HEALTH DOMAIN

This review of housing-health linkages through a literature search and discussions with a variety of specialists points to some fairly clear associations. The clearest--excepting the area of accidents--are the categories of respiratory diseases* and diarrheal and other infectious diseases. (WHO TRS 1974)

A general ranking of environmental health conditions (see Table 2) would undoubtedly place water and sanitation at the forefront. (Martin 1976) These conditions, as has been demonstrated, account for a broad range of health effects. After water and sanitation, crowding shows a marked effect on communicable disease rates as well as on stress. The latter, of course,

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*including both infectious and non-infectious diseases.

Table 2

PRIORITY OF GENERAL RESIDENTIAL ENVIRONMENT IMPACT ON HEALTH AND ITS RELATION TO PLANNING AND DESIGN FUNCTIONS

Rank Order	Residential Environmental	(Effect on) →	Health Condition	(As a Function of) →	Planning/Design Level
1	WATER (supply and storage)		Typhoid, cholera trachoma, skin infections, gastro-enteric diseases		General Infrastructure (Source - removal) Site Planning Design (of interior for water storage)
2	SANITATION (Excreta disposal, bathing)		Gastro-enteric diseases		General Infrastructure (Source - removal) Site Planning Design (of interior for bathing/washing)
3	CROWDING (interior)		Communicable, including respiratory, diseases, stress, mental health		Design (adapted culturally according to patterns of space use)
4	AIR POLLUTION		Respiratory disease (specific/nonspecific)		Site Selection Environmental Safety and Protection
(Physical House Structure 5-9:)					
5	CONSTRUCTION MATERIALS		Air/Soil/Water vector diseases		Design-Materials Selection
6	QUALITY OF STRUCTURE		Accidents		Materials Selection Maintenance and Improvement Replaceability
7	VENTILATION-ENCLOSURE		Air vector diseases, communicable and non-communicable		Site Planning Design
8	LIGHTING, SPACE ENCLOSURE		Allergies		Site Planning Design
9	SPACING OF STRUCTURES (external)		Communicable, respiratory diseases		Site Selection (space) Design

is measured in physical as well as mental health terms. Air pollution, especially as a function of industrial activity, is perhaps next in the order of priority.

Also, the following conditions of the house itself, in ranked order, are important in the housing-health association: construction materials--in that they harbor and encourage vectors of disease; house structure--since it may be the cause of accidents; ventilation and enclosure--because these affect the degree of protection from excessive heat, damp, or cold; lighting, space, and degree of enclosure--for these influence allergies caused by molds and dust; and, last, the spacing (agglomeration) of houses--since that affects disease transmission as well as moisture and temperature levels.

The tabular presentation of this ranking and its relationship to residential environment design and planning functions is provided in Table 2.

In the case of programmed low-income housing, such as sites and services projects, the general infrastructure referred to in Table 2 usually includes a minimal level of provisions. Called 'basic provisions', these include water supplies, waste disposal, and access ways both for residents and public service authorities (fire, police, refuse collection). (World Bank 1974) Although it is difficult to provide cost benefit measures of improved housing, including the micro- and macro-benefits of improved physical health and nutrition, (e.g., Burns 1966) many low-income programs (AID, UN, World Bank, etc.) have established comparable 'minimal' standards of services. These are by no means absolute, since uniform standards are almost impossible to formulate, given differences in local conditions, income levels, and customs that affect both the demand for the services and the cost of supplying them. (World Bank 1974, Mason 1979, 1981)

Table 3

PLANNING/DESIGN CRITERIA AND THEIR STRENGTH OF ASSOCIATION WITH SPECIFIC DISEASES AND ILLNESSES

Strength	Physical Planning/Design Criteria	Specific Disease or Illness Affected
High	Adequate supply of water	Trachoma, skin infections, gastro-enteric diseases
	Sanitary excreta disposal	Gastro-enteric infections, including intestinal parasites
(I)	Safe water supply	Typhoid, cholera
	Bathing and washing facilities	Schistosomiasis, trachoma, gastro-enteric and skin diseases
	Appropriate density of habitation	Respiratory diseases, including tuberculosis, rheumatic heart disease
	Control of urbanization	Nutritional status
	Control of air pollution	Acute and chronic respiratory diseases, respiratory malignancies
Medium High	Ventilation of houses (in which there is smoke from indoor fires)	Acute and chronic respiratory diseases
	Control of house dust	Asthma
(II)	Siting of housing away from vector breeding areas (including stagnant water)	Malaria, schistosomiasis, filariasis, trypanosomiasis
	Control of open fires, protection of kerosene or bottled gas	Burns
	Finished floors	Hookworms
	Screening	Malaria
Medium	Control of use of thatch material	Chagas' disease
	Rehabilitated housing	Psychological status
(III)	Control of heat inside the shelter	The body's thermoregulatory mechanism
	Adequate food storage	Nutritional status
	Refuse collection	Gastro-enteric infections

The provision of water supply, sanitation, roads and storm drainage, and electricity and street lighting comprise on average about 50% of total low-income housing project costs. (Shah 1980) However high that percentage might be or appear to be, there is a great opportunity for significantly affecting health conditions by three of these services (water, sanitation, drainage) and thus they can be justified in cost-effective terms.

Table 3 presents a more specific ranking of the housing-health associations than Table 2. The residential planning and design interventions are presented in terms of their positive role in affecting health. Health conditions are presented according to diseases and illnesses affected by the specific planning and design interventions.

VI. HOUSING-HEALTH PRIORITIES IN THE CONTEXT OF THE AID HOUSING GUARANTY PROGRAM

The AID Housing Guaranty (HG) Program has clearly addressed the housing-health linkage in its numerous sites and services and squatter upgrading projects around the world. That Program has positively affected the health conditions of well over a half million people. This result has been achieved through the inclusion in its projects of the 'basic provisions' package referred to earlier. These services are now a standard part of the HG program.*

Table 4 depicts the housing-health linkage in relation to the HG program. The planning/design criteria are defined as 'interventions' because they have been introduced programatically to the HG Program. For the associated health condition addressed by the intervention, the reader is referred to Table 3. As this table suggests, the HG Program has addressed most of the housing-health associations. That is especially the case for the sites and services projects, for which site planning, certain public services, minimal house

*The HG Program is a financial package used in a variety of ways by different government borrowers to support low-income shelter; basic planning and design standards are usually included in HG-sponsored projects.

Table 4

PLANNING AND DESIGN INTERVENTIONS FOR HEALTH IN THE CONTEXT OF THE AID HOUSING GUARANTY PROGRAM*

Strength	Planning and Design Interventions	Status in Housing Guaranty Program: PRESENT	ABSENT	NEED TESTING
HIGH (I)	Adequate supply of water	✓		
	Sanitary excreta disposal	✓		
	Safe water supply	✓		
	Bathing and washing facilities		✓	
	Appropriate density of habitation	NO EFFECTIVE CONTROL OF THIS FACTOR		
	Control of urbanization (in relation to nutrition)		✓	✓ Home gardens for Sites & Services and Upgrading Projects
	Control of pollution	✓		
MEDIUM HIGH (II)	Ventilation of houses	✓	✓ **	
	Control of house dust	✓	✓ **	
	Siting of housing away from vector breeding areas	✓	✓ ***	

*The HG Program is comprised predominantly of sites and services projects, on the one hand, and squatter upgrading projects, on the other.

**Because new, core-type houses are not systematically introduced in squatter upgrading projects, design criteria affecting health are difficult to influence.

***Squatter upgrading does not affect site location and therefore cannot control proximity to vector breeding areas; such areas, if present, however, can be controlled for health purposes.

Table 4 - Cont'd.

Strength	Planning and Design Interventions	Status in Housing Guaranty Program: PRESENT	ABSENT	NEED TESTING
MEDIUM HIGH (II)	Control of open fires		✓	
	Finished floors	✓		
	Screening		✓****	
MEDIUM (III)	Control of use of thatch	✓		
	Rehabilitated housing	✓		
	Control of interior temperature	✓		
	Adequate food storage	✓		
	Refuse collection	✓		

****Screening is very difficult to control in behavioral terms and equally difficult to maintain.

designs, in addition to technical assistance in the house construction activity, are provided. For squatter upgrading, a minimal degree of site planning is introduced through the reduction of high densities, the provision of basic infrastructure and service, home improvement loans for recipients. In general, however, less control is exerted on either site planning or design criteria in an upgrading project. Thus, the effect on the housing-health association is probably less for squatter upgrading than for sites and services projects.*

*Since squatter upgrading projects may receive a high standard of service infrastructure, their impact on health could be equal to that of sites and services projects.

The interventions referred to in Table 4 are part of the 'residential environment' in the stri ter sense of the term, exclusive of community health care services, such as clinics or health campaigns. Many of the interventions that relate to housing design and construction are very difficult to control, as they are affected by culture and behavior. For example, the shape and use of the house, including any additions made to it, are ultimately in the hands of the occupant. Thus, the provision of a space for a specific use, such as bathing or washing, does not mean the occupant will use it for its intended purpose. That is not to say, however, that it will not necessarily be used in an appropriate manner. That is very much a question of custom, personal sanitary habits and, by way of an intervention, training.

Most of the interventions that have a greater correlation with health improvement are planning, not design features. All of the "high" strength associations cited in Table 4, for example, are planning rather than design interventions. While it is not suggested that the design criteria discussed earlier are not important, they are clearly less influential in the housing-health association than those labelled as 'planning.' Furthermore, as discussed above, they are less amenable to control.

While only one intervention from Table 4 has been selected as requiring testing, the home garden concept, some of the other design and planning features necessitate further comment:

1. Adequate water supply: Given the argument for increasing the quantity of water, provision of improved access to the prescribed 15-20 liters per day per capita is urged. Evidence has shown that the closer the source of water is to a user, the greater the quantity likely to be used (up to a maximum) and the greater the probability of higher frequency of use (especially in

hand washing). Moreover, there is a possibility of maintaining the purity level of the water if it is used directly from the source. While the cost of individual standpipes or house connections is prohibitive for many developing countries' urban poor, the provision of greater access to water should continue as a goal of the HG program, especially given the critical role of water in the health of people.

2. Sanitary excreta disposal: One of the most important features of any excreta disposal system, assuming that technically appropriate and cost-effective solutions are available to a given population, is the role of training in the maintenance as well as the personal hygienic habits of its users.

3. Bathing and washing facilities: While not usually provided in HG projects, clothes washing, utensil washing, convenient hand washing and bathing facilities might be considered for possible introduction. Clothes washing facilities and perhaps shower blocks could be introduced on a communal basis, so long as these are socially acceptable. A private bathing area in the house also might be considered. Important is the need to train in hand washing and the use of soap, especially in connection with food preparation. A specifically designed space for a water container, soap, and water disposal might favorably influence the adoption of hygienic habits.

4. Ventilation of house/Control of dust, temperature, and open fires: These depend on both the orientation and design of the structure. Particular attention must be paid to existing cooking and heating practices so as to account for them in the house design or, accordingly, to provide for training in new practices.

5. Screens: As it has been shown that a lack of screening correlates with higher rates of malaria in endemic areas, it is suggested that, in such areas, screens be offered as an option in the package of materials available to sites and services and even upgrading project beneficiaries. The availability of screening should be accompanied by education in the value of its use.

6. Adequate food storage: Consideration should be given to incorporating into shelter design a means of protecting stored food from rodents and of keeping prepared food free of contamination.

VII. A RECOMMENDED STRATEGY FOR EVALUATING THE HOUSING-HEALTH RELATIONSHIP AID HOUSING GUARANTY PROJECTS

This report is essentially in agreement with the point of view cited in the introduction of the paper, that enough is known about the effects of basic features of housing programs on health to justify action without further research. Therefore, expensive, original studies of the housing-health relationship are not recommended. However, as improved health status is intrinsically one of the major objectives of the program, it is believed that an assessment of health outcomes should be integrated into HG evaluations. The assessments should seek to recommend adjustments in existing or planned projects that would increase health benefits, as well as provide evidence of success which reinforces the current HG approach.

Measuring health status is usually an expensive process which diverts resources from other aspects of evaluation. It is recommended, therefore, that a few indicators of health changes be selected which provide reliable information but can be measured inexpensively with reasonable accuracy. Each evaluation will have to utilize indicators that are consonant with

the design of the individual project. Indicators for which there is already strong evidence of a causal relationship with housing should be used because of the difficulties of disaggregating housing and other socio-economic variables.

Following are a few illustrative examples* of measures which could be integrated in HG evaluations. The measures suggested, while they are relatively simple, still require significant resources. In order to ensure a degree of validity and reliability, sampling techniques must be used. Furthermore, the monitoring and review of the methodology and results should be done by medical and public health specialists.

The role of the beneficary in the assessment fo a HG project for its housing-health linkages is a key to the overall success. The beneficiaries of a project being studied must feel confident that the sole aim of the research is to find ways of improving their health conditions. To the extent possible, local staff should be used in the research and local health authorities involved. So-called "participant research" (WHO TRS 544 1974) by the project beneficiaries can be an invaluable tool in gathering data, but especially where the data are of a simple nature. For example, if a water quantity measurement were to be made, in connection with the incidence of gastro-enteric disease, residents could be trained to report numbers of trips per day to the shared standpipe, amounts of water carried, and different uses of the water. Spot checks on a sample of participants would have to be made to verify counts. Obvious care must be taken in such research, in order to eliminate as much bias and other error as possible.

*See pp. 41-45; in each of the examples, details such as controls for intervening factors, sample size, etc. are not provided since these are intended to be illustrative.

EXAMPLE I

Objective: To determine the effect of a housing scheme on the reduction of diarrhea among the 1 to 5 population.

Populations from which samples will be drawn:

(1) the population prior to rehousing

(2) the same population at least two years after being rehoused.

Alternative:

(1) the group that has been living for a minimum of two years in the new housing scheme

(2) a comparable population living in substandard housing similar to that from which the rehoused population had moved.*

Target Group: Children 1 to 5 years of age. (This group has the highest pathology.)

Measurement: Height for weight. (Proxy indicator of diarrhea.)

Source: Field Study

Controlled indicators: Family income. (Proxy indicator for nutrition.)

Justification: Diarrhea among the 1 to 5 year old population is a sensitive indicator of health status. Height for weight is a practical measure, relatively easy to obtain in the field with reasonable accuracy. (Recall, an alternative approach, is not sufficiently reliable. Stool sampling is technically more complex and significantly more expensive.)

*As the rehoused population is a self-selected group, the comparison population may differ in motivation and life-style. (Associacion Demografica Salvadorena 1979)

EXAMPLE II

Objective: To determine the effect of sanitary facilities and finished floors on the reduction of hookworm.

Populations from which samples will be drawn:

(1) a group that has access to privies and/or finished floors

(2) a comparable group without access to privies and/or finished floors

Target Group: Children 2 to 5 years of age

Measurement: Hemoglobin counts

Source: Field Study

Controlled Indicators: wearing of shoes (determined by observation and inquiry)

EXAMPLE III

Objective: To determine the effect of screening on the reduction of malaria.

Populations from which samples will be drawn:

(1) a group living in screened housing

(2) a comparable group living in an area with comparable malarial prevalence but not having screened housing

Target Group: Under 5 year old population

Measurement: Hemoglobin counts

Source: Field Study

Controlled indicators: Malarial prophylaxis

EXAMPLE IV

Objective: To determine the effect of protecting cooking and warming facilities on the reduction of accidents.

Populations from which samples will be drawn:

(1) a group living in housing with protected cooking and/or warming fires or alternative cooking and warming facilities

(2) a comparable group using open fires

Target Group: Under 2 year old population

Measurement: Burns

Source: Health center statistics and/or observation and inquiry

Controlled indicators: none

EXAMPLE V

Objective: To determine the effect of washing and bathing facilities on the reduction of schistosomiasis (in endemic areas).

Populations from which samples will be drawn:

(1) a group that has access to washing and bathing facilities in or near the home

(2) a comparable group that continues to be dependent upon snail infested water for washing and bathing

Target Group: Five to 14 year old children

Measurement: Egg counts

Source: Field Study

EXAMPLE VI

Objective: To determine the effect of improved access to an adequate supply of water on the reduction of skin infections

Population from which samples will be drawn:

(1) a group living within a designated distance from standpipes, or having running water inside the house

(2) a comparable group without comparable access to running water

Target Group: Children under 5 years of age

Measurement: Skin infections - physical observation

Source: Field Study

Controlled indicators: None

ON-SITE INSPECTION AND SAMPLE INTERVIEWS TO ACCOMPANY FIELD STUDIES

All field studies should be accompanied by on-site inspection and sample interviews with the purpose of:

1. Determining the satisfaction of residents. Satisfaction is a reasonable proxy indicator of the effects of the housing scheme on the psychological well-being, or mental health, of residents.

2. Determining the degree to which health-related design features are being appropriately maintained and used (e.g. the cleanliness of finished floors, privies, and water storage containers, the quantity and purpose of water used in the household, the ventilation of indoor smoke and fumes, etc.)

3. Identifying customs that either lend themselves to improved health or that need to be modified through education in order to achieve health-related benefits.

4. Identifying practices that can be associated with people moving into new housing that have health-related benefits (e.g. higher standards of cleanliness, shoe-wearing, use of clotheslines, etc.)

Taken one step further, the participatory approach can be used to organize beneficiaries into health committees for both research and work groups that would carry out neighborhood improvements. An example of the latter comes from south-central Cameroon (Isely et.al. 1977), where the participatory approach was used effectively to organize village health committees which worked on latrine construction and water source protection, among other activities. While the rural-urban difference is noted, there is no convincing reason which would preclude work groups in urban projects from contributing to similar health-related efforts.

The community development function, though often overlooked in sites and services and squatter upgrading projects, is vital to overall 'development' success. At the same time, its impact on project success is often difficult to measure (Goodson p.c. 1981). What is usually felt is its absence, after something has gone wrong and all of the technical questions have been satisfactorily answered.

VIII. AN ILLUSTRATIVE CASE OF AN INNOVATIVE INTERVENTION: THE HOME GARDEN

There is a consensus regarding the importance of good nutrition to the maintenance of good health and, based on the literature search and consultations with specialists, nutritional deficiency was ranked very high on the scale of housing-health associations. Nutritional deficiency is part of a large complex of factors tied to the quickening pace of urbanization in the developing countries and to the increasing prevalence of disease (Golladay 1980).

The need to buy food is cited as one of the more important factors responsible for high rates of disease and mortality among the urban poor. (CIUL 1981) That need could effectively be reduced through the introduction of home gardening schemes. It is hypothesized that even a small ground space or roof space, window boxes or trellises--can enhance the prospect for reducing dependency of the urban poor on the cash food market. When it is considered that a carefully planned primary health care system can be operated at a cost as low as from $1 to $10 annually per person (CIUL 1981), the savings on food purchases would be significant. The value of increased nutritional intake for individual health, and also productivity, would also be important.

It is recommended that the introduction of an experimental gardening component be introduced first into sites and services projects and then, if successful, into squatter upgrading projects. The limitations on land are usually even more severe in squatter areas and therefore the planning and organization that much more difficult. Moreover, the necessary technological and material support more closely parallels sites and services programmatic inputs and therefore would be more efficiently integrated. However, the need for a home gardening program is great, perhaps even greater, among residents in squatter settlements. Therefore, subsequent testing of home gardening in squatter upgrading projects is a high priority.

A. Preliminary Guidelines for Home Gardening Component

Following are some very preliminary guidelines for planning an experimental home gardening component for HG projects.

1. Goal: The goal of a home garden scheme in a HG project would be to improve the nutritional status of project residents.

Food produced in the home gardens would either be consumed or sold. Either way, the food would provide an economic supplement to the producer which would enable participants to increase their food consumption.

2. Organizational Options

(a) Home gardens within individual plots

Advantages: The responsibility for production would be clear and the benefits of production would be reaped directly by those responsible. The garden would be conveniently located for the workers. Household organic waste could be used to enrich the soil.

Disadvantages: There is a tendency for open land on a compound to be used for building additional housing units (which is likely to be more profitable than the use of that land for gardening). Water may not be piped into the compound, resulting in considerable inconvenience. Technical support would be less efficient.

(b) Individual gardens in a communal area

Advantages: A communal gardening area could be preserved for gardening in perpetuity and would ensure green space within the project. The plots could be efficiently serviced with water and other inputs (such as protection from animals). A communal spirit might develop if the plots were contiguous, leading to sharing of implements and techniques.

Disadvantages: Individual family incentives might wane due to inconvenience, the necessity to pay monthly rentals, etc. The area might be subject to abuse or vandalism.

(c) Communal plots

Advantages: There would be economies of scale. A community project might be a good stimulus to other kinds of community development efforts.

Disadvantages: It might be difficult to organize and sustain clear responsibilities for production and maintenance. There might be less incentive for participation.

3. Program Inputs

(a) Technical assistance: Some guidance should be provided, at least during the initial stage of the project, on soil preparation, fertilizers. "crop" selection, cultivation, storage, and, where appropriate, marketing, etc. The technical assistance should, if possible, be provided by a trained local person, preferably a project resident.

(b) Tools, seeds, fertilizer etc: These items should be provided at cost, preferably through the same mechanisms as building materials and other similar project inputs.

(c) Water: Water must be available in adequate quantities.

4. Evaluation

Although the goal of the home garden program is nutritional improvement, changes in nutritional status are difficult to measure and more difficult to attribute to a single cause. Improvement in economic status, a program objective, is also hard to measure and attribute. Therefore, it is recommended that food production be used as the measure of project achievement.

Evaluation should continue for at least three years to ensure that changes in attitudes and practices are studied after the initial impetus of program effort has subsided.

5. Issues

While there is considerable evidence of poor nutrition among the urban poor in developing countries and reasonable assurance that a successful home

gardening program would improve their nutritional status, home gardening has not been systematically tested as a component of HG projects. The introduction of a home gardening program would have to be assessed in terms of its social and cultural acceptability. Community interest and participation in the planning would be a mandatory prerequisite. Other considerations include: environmental soundness (e.g. is there potential for cultivation given the soil and the climate?); economic viability (e.g. will be the benefits, including improved health resulting in increased labor productivity, justify the costs?); land availability and cost (e.g. can the community afford to reserve valuable urban land?); and crop choice (e.g. to what extent can the project encourage the production of cereals and vegetables that would help to compensate for caloric and protein deficiencies in the local diet?).

Training, production problems, and marketing constraints would have to be examined in the planning stage of a home gardening scheme. (see Colfer 1981) Questions should be asked such as who will make and keep the gardens? Will home gardening fit the work pattern of a given community? How will such items as tools, pesticides, and fertilizers be paid for? Is there a market for surplus produce and, if so, how much should be produced? These and other questions like them should be answered at the planning stages of a HG project for which a home garden scheme seems appropriate.

IX. CONCLUSION

While not explicitly designed as a programmatic evaluation of the health effects of the AID Housing Guaranty Program, this study has established the framework for monitoring these effects. The Office of Housing, in cooperation with the Office of Health of AID, can use the health-housing relationships cited in this report as a checklist for evaluating on-going HG projects. This colla-

boration should also help to ensure that new projects incorporate planning and design features that are identified with improved health status.

The study of the housing-health relationship in general terms, and specifically in the context of the AID Housing Guaranty Program, has underscored the complexity of that relationship. It has also shown that in the absence of other improvements in the socio-economic status of residents, housing by itself may not significantly affect health status. Conversely, without improved shelter, "good" health cannot be achieved.

An important point emerging from this analysis concerns the degree of 'advancement' of the shelter program concept in terms of its effect on health status. The concept, as promoted by the Housing Guaranty Program (and other international agencies), and realized in the implementation of its shelter projects, has quite adequately dealt with the objective of providing better life conditions, which result in health improvements. What has not been so heavily stressed in this report is the fact that it is in spheres other than housing that there has been a lag--many of the developing countries simply have not kept up the earlier pace in controlling disease.

Several reasons exist as to why these countries have not kept up with earlier advances. (e.g. Golladay 1980) First, the success met in controlling parasitic diseases, using insecticides, has declined because of program breakdowns. Secondly, economic developments, and the quickening pace of urbanization in the developing countries, have only served to compound the existing threat of disease. Thirdly, in recent times health care services have not adequately promoted disease prevention strategies. Lastly, it is estimated that in many developing countries, as much as 90 of the urban and rural poor have no access to modern health services.

The final point concerns the involvement of health professionals in the Housing Guaranty Program. The authors recommend that in both the planning and monitoring/assessment stages, systematic consultations should be held with public health officials in the host country. Their assistance should be elicited and programmed into the process for purposes of ensuring that, minimally, each of the planning/design criteria defined here is included in a project at the initial design stage. Furthermore, discussions on how to improve on the minimal standards and test improvements should be conducted.

In order to enhance the possibility of achieving ever-improved shelter for health in the above context, the collaboration of AID's Office of Health (OH) is suggested. The health specialist attached to a mission, if that position is present, could contribute towards the coordination of the cooperative effort of housing and health officials both in AID and the host country. It might even be efficacious, though perhaps too ambitious, if an Office of Health public health specialist could participate in Housing Guaranty project paper formulations--as a general principle. Without any reservations, such participation is recommended at the housing-health monitoring/assessment phase outlined earlier.

Lastly, in light of the goals set forth for the International Drinking Water Supply and Sanitation Decade and, given the critical role of water and sanitation in the housing-health relationship, it is advocated that the present high level of interest in the relationship be maintained. Collaboration between the AID Offices of Housing and Health in planning and monitoring Housing Guaranty projects, will ensure that maximum benefits will accrue to the beneficiaries from health-related features of HG projects.

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