

Environmental Health in a Rural Economy

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PROGRESS in environmental health in rural areas has lagged behind improvements in urban living. Rural sanitation, though it has advanced considerably in recent years, has lagged behind other forms of material progress even in rural areas, and, in certain respects, the rural environment in the past 10 years has deteriorated. Such deterioration is observed not only in the lack of maintenance of originally satisfactory installations, it is found also in new installations in fringe urban areas where, for example, septic tanks have been employed under unsuitable conditions.

Public health in the city is affected by rural health. The food of the population as a whole depends on the productive efforts of a small rural minority (1). In view of its economic importance and in view of the tendency of rural youth to move to cities, the rural population's health should be at least as good as the health of urban dwellers. There is a prospect that the productive powers of the rural population must be increased by all means possible to feed a growing population (2). Moreover, in an age of automobiles and planes, the communication of disease between rural and urban areas is swift: it is folly to expose any part of

the population unnecessarily to channels of infection (3). The lack of rural sanitation imperils not only the country dweller but also the many millions from the city who visit rural recreational areas.

Sanitation as an Investment

The speed and direction of change in our times has not spared the rural economy. In older agrarian societies where the life cycle seemed to repeat itself from season to season, traditional customs and techniques were seldom questioned. But modern technology has stepped up the tempo of every isolated farm and quiet hamlet. Rural life has grown so much more complex that it becomes necessary not only to meet present sanitation needs but also to prepare to meet needs of the future. At present, we think of the rural dwellers who come to the city. For the future, we may think of the possibility of a dispersion from cities to rural areas as a technique of civil defense (4).

The emphasis on economic factors in environmental health is prompted by knowledge that vital statistics have so much to do with earning a living (3). We work to produce the essentials of life which make it possible for us to work. At the same time, improvements in health do not necessarily increase productivity; nor does every economic gain necessarily contribute to health. The relation between health and economics is not simple. While it may be assumed generally that every investment in health is returned many times over to the economy, it is practical to ask how to invest money in health

Assistant Surgeon General Hollis, chief engineer of the Public Health Service, used the data in this paper in July 1953 in discussions with the WHO Expert Committee on Environmental Sanitation, in Geneva. This paper deals with conditions in the United States only.

so as to secure the greatest return per dollar. The value of the return itself must be gauged not only by morbidity statistics but also by statistics indicating a change in levels of consumption, productivity, and social welfare. To determine whether the gain from rural sanitation is worth the cost in each area is not to question whether it pays to save a life. The question is how, with available resources, investment in rural sanitation can secure a satisfactory return in the abundance and richness of human life.

Rural Attitudes

About a third of the population is rural. A sixth of the Nation live on farms: these feed the lot of us and some abroad, too. About 30 million other rural Americans live in villages of less than 2,500 or in even more isolated circumstances. They include loggers, fishermen, trappers, miners, retired elders, and commuters. Half of the rural population lives in the south, where a fourth of the farm families are non-white. The total rural population exceeds 55 million.

Obviously, the needs of the rural population vary from house to house. Also, the operations to finance and administer sanitation programs for this population are bound to vary. The necessity for tailoring sanitation operations to peculiar local needs places the main responsibility upon local authorities, and often on the individual family.

Government is ordinarily held responsible for financing public health services in the city. This is not so in the country. Sanitation of food and premises is clearly a public problem in the village and in other rural centers such as the school, church, and grange or community hall. But in most rural areas in the United States, sanitation is ordinarily regarded as an individual or private concern, even though many individual rural families cannot finance sanitation by themselves. If there is the will to bring rural demands for environmental improvement into balance with the demand for cars and electricity, however, the economic devices that provide cars, telephones, and power are capable of financing pipes and drains as well.

In the city, the danger of contagion has created awareness of community responsibility. In rural areas, the danger of contagion is less apparent. It is recognized mainly in the enforcement of sanitation on dairy farms, in the effort to protect the safety of fluid milk produced for the urban market. Hygienic milk production is probably the heaviest single contribution of its kind to rural environmental health in the United States. Tests of village water supplies by State and county health departments may rank next.

Factors in the Lag

Three major factors in the lag in rural sanitation are the relatively high cost of water and sewerage systems for isolated structures, the usual necessity to finance each installation individually at relatively high rates, and the absence in many rural areas of a strong public health authority. These factors have less force in the village than on the farm.

Isolation, an important factor in protecting the health of the rural family, especially the farm family, also imposes penalties, especially penalties of a social nature. For example, among farm families with an annual income of more than \$10,000, it is found that 1 in 8 lives without running water in the house, and 1 in 30 lives in a dilapidated dwelling. Presumably, in an urban environment, these same families, stimulated by the example of their neighbors, would be much more likely to occupy homes reflecting their economic status.

The great majority of farm families, however, are not usually in a position to finance environmental improvements even at modest interest rates. To relieve their situation, there must be a narrowing of the gap between costs and capacity to pay, as a consequence of higher earnings, technological progress, or favorable financial devices. Most nonfarm rural families are only slightly better off. Environmental health services may be contributory to economic gains in rural areas, but first there must be economic devices to improve the rural environment.

Such devices have in fact contributed to rural improvements, including lighting, refrigeration, cleaning, smokeless cooking, and

milk sterilization. According to the United States Department of Agriculture index, American farm living improved 25 percent from 1940 to 1945. The improvement was 37 percent in the southeast. This index grades living levels on the farm according to the value of its products and the presence of an automobile, electricity, and a telephone. All these factors are important in the economy and welfare of the farm. The important factor of water does not figure directly in the index, although health levels are affected by the simple availability of water. Both the living level and the productivity of the farm family depend on easy access to water for such purposes as washing, bathing, irrigation, cooling facilities, and a water-carriage disposal system.

Health and Health Facilities

Much of the recent literature on rural health touches only lightly on the environment. There has been a tendency to assume that the books on rural sanitation were closed with the decline of interest in hookworm. Even malaria control in rural areas is regarded by a few as a closed chapter. It has been more fashionable to speak of rural health wholly in terms of clinics, physicians, and nurses. Important as personal health services are, however, they do not reduce the value to family health of running water in the house, safe shelter, proper waste disposal, and protection against vectors of disease. Such environmental factors, covered here in the comprehensive term "sanitation," can contribute directly to rural health and indirectly to rural personal health services. If rural areas gain in health and productivity through improved sanitation, they will be less in need of other health services, and they will also more readily obtain and afford the other services they should have—nurses, physicians, and clinics.

The more rural the area, the fewer the health personnel, services, and facilities are in proportion to the population. At present there are public health organizations in approximately 1,600 of the 3,071 counties in the Nation. Most of these provide some service to rural areas. The counties that are not organized for direct full-time health services hold less than a fourth of the national population, but these counties

are predominantly rural. They contain 30 percent of the national rural population.

Some explanation for the slow trend in farm sanitation may be found in the studies which determined that village residents suffer more enteric infections than farmers (5). These studies suggest that the need for sanitation is less urgent on the farm.

The negative trend in village sanitation is laid to the unplanned construction of new homes without regard to the needs for water or waste disposal. About 40 percent of the new homes built in recent years are served with septic tanks rather than with sewer lines (6). In addition to the burden of maintenance, such installations require a proper regard for the suitability of the soil, the water table, and the density of the population.

In the past, the rural environment has been considered more healthful than the city, an assumption which must be qualified today. Relative healthfulness of environment depends on what places and conditions are compared. Even on the fundamental issue of the quality of the atmosphere, many a rural dweller is more exposed to dust, fungi, or pollen than an urban dweller who works and sleeps in an atmosphere which is filtered, humidified, and cooled or warmed to order.

Although the romantic appeal of the rural environment is strong, it is tempered by epidemiology. In 1900, the registered death rate among farmers was only half the urban death rate (7). Since then, however, living conditions in the city have been improved, and there has been a strong movement of relatively healthy and vigorous young people from rural to urban residence. Consequently, the death rates registered in rural and urban areas today are about equal. Death rates for mothers and infants are higher in rural areas than in cities. As to the death rates from enteric diseases, these are associated with a lack of water-carriage sewage facilities, a lack that is common in rural areas. Recently, in one county, the death rate from dysentery and diarrhea was 169.3 per 100,000, in contrast with a national average of 5.9 (8). This range suggests how sanitation may affect rural health. Hookworm in certain rural areas is found in more than half the population. The simple availability of running water for

convenient washing of the person has a relation to health that is so obvious it is readily overlooked.

Sanitation in the broad sense applies to all facilities and practices that concern public health, and, for this reason, the records on accidental injury are pertinent. Opportunities for serious injury on farms seem greater than in cities; disabling conditions among farm workers are one and one-half times greater than among industrial workers. Accidents on farms kill 14,500 and injure an additional 1.3 million yearly (9). Although concern with accident prevention in rural areas has activated the United States Department of Agriculture, manufacturers of farm machinery, distributors of electrical power and equipment, farm youth organizations, the National Safety Council, and various rural educational leaders, the accident problem is not appreciably controlled. At the University of Michigan School of Public Health a comprehensive survey of accident experience among the population of Washtenaw County, conducted in 1951-52, revealed the home accident injury frequency of urban dwellers to be 5 per 100, as compared with 11 per 100 for rural dwellers.

Physical Sanitation Needs

It is difficult to appraise the educational and physical needs of rural sanitation. An inventory of health facilities prepared by the Public Health Service in 1947 estimated that rural physical sanitation needs included repairs to existing water supplies or development of new supplies, chiefly wells, for more than 6 million homes where facilities were either lacking or insanitary. More than 7 million homes required improved sewage disposal. In terms of the affected population, more than 27 million people in rural areas needed new or improved water supplies, and 33 million had unsatisfactory sewage disposal facilities. There was a measurable difference between rural and urban areas in the quality of the water supply.

In 1950, piped running water inside the home was available in 96.4 percent of urban dwellings and in 42.7 percent of farm dwellings. Piped water was running in 68 percent of the rural nonfarm dwellings. In round numbers,

Housing facilities

Condition	Percentages of occupied ¹ dwelling units		
	Urban	Rural non-farm	Farm
Dilapidated ²	6.5	13.4	19.5
No running water in or outside the home	1.7	28.6	54.6
Outside toilets	6.8	41.4	65.6
Structure more than 30 years old	46.4	39.0	53.4
Noncentral heat	35.9	67.9	80.7
Wood cookstove	2.4	15.4	38.7
Kerosene cookstove	4.8	11.6	8.9
No icebox or refrigerator	4.0	16.1	25.5
No kitchen sink	5.3	26.5	45.2

¹ 42.5 million occupied dwelling units.

² A dwelling unit is classified as dilapidated when it has serious deficiencies, is run down or neglected, or is of inadequate original construction, so that the dwelling unit does not provide adequate shelter or protection against the elements or it endangers the safety of the occupants. Dilapidated dwelling units are so classified because of deterioration, as evidenced by the presence of one or more critical deficiencies or a combination of minor deficiencies, or because of inadequate original construction, such that they should be torn down, extensively repaired, or rebuilt.

SOURCE: U. S. Department of Commerce Census of Housing, 1950.

piped water was lacking in 1.1 million urban dwellings, in 3.1 million rural nonfarm dwellings, and in 3.6 million farm dwellings.

Rural homes are more crowded than urban homes. In 1950, the percentage of dwellings with more than 1.5 persons per room was 10.2 on the farms, 8.6 in rural nonfarm dwellings, and 4.7 in urban dwellings. The relation of crowding to contact diseases, such as tuberculosis and pneumonia, has been revealed in many studies, including the National Health Survey of 1936.

Comparisons in housing facilities offer further grounds for reflection upon the differences between urban and rural health (see table). The heating and cooking facilities indicate the relative extent of fire hazards. Other hazards to safety are suggested by the degree of dilapidation and age. The icebox figures may have significance for nutrition and food poisoning.

And the nature of the water and toilet facilities may be indicators of the extent of enteric infections.

It seems apparent that rural health is poorer than it should be. Medical surveys have found the rural population relatively high in incidence of brucellosis, septic throat, enteric disorders, and insectborne disease (10).

The Rural Economy

Rural life is being transformed by population growth, by decentralization of industry, by modern communications, and by a broadening desire for the security that is attached to a piece of land. The farm economy also has been transformed by a series of strong markets, advances in agrobiological, electrified communication and mechanization, and a high degree of specialization suitable to given locations and markets.

According to the 1950 census of agriculture, there are more than 5 million farms. This number includes cattle ranches, groves, dairies, greenhouses, apiaries, mushroom cellars, and cranberry bogs. Nearly a third of these farms are part-time or residential farms whose occupants do not contribute materially to commercial agriculture. More than two-thirds of the operators had other income amounting to more than receipts from farm produce sales.

Of the commercial farms, more than a fourth specialize in field crops. Less than one-seventh of the commercial farms are classified as "general" farms.

Crop specialization influences the size of farms, although the wealth and enterprise of the owner, the dictates of geography and climate, and such legal provisions as those in the homestead or reclamation laws are also factors in determining farm size. A wheat farm, for example, takes more acreage than a pecan grove. Although the average size of an American farm is 215 acres, nearly 3 farms in 5 (56 percent) are smaller than 100 acres; 2 in 5 (36.5 percent) are under 50 acres. Only 5.7 percent have more than 500 acres, and most of these are in 17 western States.

The foregoing figures merely hint at variable situations to be met in a rural sanitation program. The following facts may indicate how

conditions of tenure, income, wealth, and social status influence the opportunities for sanitation.

The Virtue of Ownership

The amount of money invested in a farm, or its capital value, is bound to affect a banker's judgment as to the desirability of investing additional funds in sanitation. There is distinctly a heavier investment in farms operated by owners than in farms operated by tenants. According to the 1952 survey of consumer finances published by the Federal Reserve Board, 69 percent of the owner-operated farms were valued above \$10,000. The corresponding figure among farms operated by tenants, managers, or sharecroppers was 22 percent. At the other end of the scale, only 1 percent of the owner-operated farms but 59 percent of the non-owner-operated farms were valued below \$2,500. These valuations include land, buildings, machines, and inventory.

Although nearly 1.5 million farms in 1950 were operated by tenants or sharecroppers, the trend in American farming since 1930 has been away from tenancy and toward ownership. The percentage of farms operated by the owners has increased since 1930 from 56 to 72 in 1950. The percentage of dwellings occupied by owners in 1950 was 66 on farms and 63 in rural non-farm units. Quite a variety of farm credit programs have assisted tenants in becoming farm owners and have contributed to improvement of rural sanitation. However, the differences between sanitation facilities of owned and rented homes are less pronounced than differences related to farm value, income, location, or ethnic factors.

The relationship of tenure to dilapidation is obvious. Of 5,721,000 occupied rural farm dwellings reported in 1950, nearly 4 million were owner-occupied, and 2 million were rented. About a fourth of the tenant homes were dilapidated (see table). Most of these lacked running water. About 12 percent of the owner-occupied farm homes were dilapidated as compared with 17 percent for all occupied farm dwellings. Of the farm tenant homes in good condition, almost half were lacking in running water. Rented farm homes were more crowded than homes occupied by the owners.

Capacity to Pay

Farm income is probably the best indicator of the capacity to pay for sanitation. In 1949, by prewar standards a prosperous year, 3 out of 5 farm families reported net cash income of less than \$2,000. The median farm income of \$1,730 contrasts with \$2,560 for the rural nonfarm family and \$3,430 for the urban family in that year, even though it does not include any allowance for noncash income in the form of food and shelter provided on the farm. The maximum net cash income on nearly a third of American farms in 1946, also a prosperous year, was less than \$750.

Even when off-farm income is combined with farm income, including noncash income, it appears that in 1946 two-thirds of the farms accounted for about 92 percent of the farm family income from all sources. Ten percent of the farm families obtained 40 percent of the total income. The capacity to pay for sanitation on an individual basis was most restricted among that third of the farm families which share only 8 percent of the farm income.

Of the farm families with incomes of less than \$1,000, according to Census Bureau calculations of 1950, almost one-third lived in dilapidated homes. Two-thirds of the non-dilapidated homes in this income group lacked running water, and more than nine-tenths of the dilapidated homes occupied by this group lacked running water. Conditions were only a little better in the group, almost as large, with incomes from \$1,000 to \$2,000. These families with incomes below \$2,000 compose the majority of the farm population. Even if it is assumed that the extent of poverty in rural areas has been overstated, as it may have been, the maximum net cash income of the less prosperous farmers provides no great surplus to invest in the costs and charges described below for environmental facilities.

Ethnic Factors

Ethnic and social factors also have a bearing on the sanitation of rural dwellings. Such factors create particularly acute problems for a high proportion of nonwhite Americans, including native American tribes (11), and for

about a million migratory workers (12). The migrants' problem is particularly difficult because of their transient residence. They assume living expenses not ordinary in a settled community, and, because of temporary residence, they are unable to gain eligibility for local welfare and health services.

While housing generally has become less crowded in the period from 1940 to 1950, for the nonwhite farm population the number of persons per dwelling actually increased. More than 80 percent of the dwellings of the rural nonwhite population have outside toilets, and more than 40 percent lack running water. No toilets at all are found on the premises of 13.7 percent of the nonwhite farm population as compared to 6.4 percent for the white farm population. To report that sanitation in a given ethnic group is below average, however, does not suggest that the aspirations and potential achievements of this group may not be as high as any other.

Sanitation Costs

Costs of sanitation, in terms of out-of-pocket charges, must be recalculated for each separate project. The following figures give merely a rough idea of their probable magnitude.

In 1947, the Public Health Service estimated per-capita costs for provision of community water facilities in towns of less than 1,000 would range from \$35 to \$58, and sewage disposal systems would cost a bit more than \$60 in such areas. The cost of installing needed minimum individual rural sanitation facilities, such as a privy and a hand pump on a shallow well, was estimated to range from less than \$10 for each member of the population in New England and on the Pacific Coast to more than \$20 in parts of the south, where the needs were greater and where the degree of urbanization was less.

A 1948 estimate of the cost of constructing a house sewer, septic tank, distribution box, and 100 to 200 feet of absorption trench for a rural sewage disposal system gave figures which ranged from \$110 in the southern United States to \$525 in the north. The level of construction costs today is somewhat higher. Estimates for cleaning such a system range from \$14 for the simplest of operations to \$300 for operations

involving, for example, taking up and replacing the tile distribution system.

Fifteen years ago, the sanitary pit privy cost roughly from \$20 to \$40 each in prewar dollars, the equivalent of from 50 to 100 man-hours. The greater part of the cost was for materials.

At present, a shallow well with a hand pump costs \$75 or more to install. A privy usually costs a similar amount. Three-fourths of the cost is for labor. The cost of a pump alone today ranges from \$4 for a simple manual pump to more than \$500 for a heavy duty power pump. Construction cost index numbers are roughly twice as high today as in 1938.

Costs of vector control have been calculated for specific projects. Malaria control in our southern States uses $2\frac{1}{2}$ man-hours and more than a pound of insecticide per dwelling per season. Ordinarily, the cost of residual spraying works out to less than \$1 per capita in these States, with labor charges the major factor. Typhus control in urban or village areas uses two-thirds of a man-hour and about $2\frac{1}{2}$ pounds of DDT dust per dwelling. Because of the appearance of resistant strains of insects, health departments cannot rely completely on chemical controls. Rat and fly control are directly associated with refuse disposal, but sanitary disposal of refuse in rural areas is laggard.

The economical approach to hookworm disease appears to require concentration on afflicted families, rather than a mass approach. At the same time, since a high iron and protein diet supports resistance to hookworm disease, mass economic improvement appears to be a means as well as an end in the process of hookworm control (13).

Costs of accident prevention, an important phase of sanitation, are not calculable on the basis of common experience, at present.

Administrative Considerations

Education also must be counted in the cost of sanitation. The economies of rural sanitation cannot be separated from the desires, needs, and interests of the people affected. Time and effort invested in helping the rural community to understand the need, purpose, and use of environmental health services also contribute

to the installation and maintenance of the necessary facilities. Too many installations go out of operation for lack of maintenance and repairs. Similarly, an installation may be wasted unless there is a parallel investment in developing local understanding and participation in an enduring sanitation program. Education is a major factor in the conquest of many rural hazards, both biological and physical.

In theory, a logical, orderly, and economical development of rural sanitation would begin with individual surveys to determine the environmental health needs of each rural home. These needs would be weighed against capacity to finance construction and installation.

In practice, the task of determining needs is handled more often by equipment and supply salesmen and the consumer than by health departments.

About the best that can be done by responsible health authorities or community leaders in this situation is to try to bring about a mutual understanding among the many parties interested in sanitary installations and services on both the buying and selling ends and to help them secure the required financial assistance. More and more, the businessmen themselves may develop systematic packaging and marketing of complete sanitary units for the rural household to improve random marketing of pumps, screens, concrete tanks, pipe, sinks, and tubs. The technical advice of health officials would contribute materially to this development.

The rural credit program as a whole has given less emphasis to sanitation than meets the need. Although the bulk of farm credit is provided by private lending institutions, several Federal agencies provide guaranties and other facilities for obtaining credit at moderate interest rates.

Credit for farm development, including sanitation, has been supported by the Federal Government since 1916. Several thousand units of low-rent public housing in rural areas have been built under credit supports provided by the United States Public Housing Administration. Loans and grants to improve private rural housing were authorized to the extent of \$19 million for administration in 1952 by the United States Department of Agriculture through the Farmers Home Administra-

tion. The funds were all committed within a few months. The Farmers Home Administration also issues loans to assist farm tenants to become farm owners, and it assists owners to develop farm property.

While these loans are not necessarily profitable, similar credit operations of the Department, through the Farm Credit Administration and the Rural Electrification Administration, have been self-supporting. Loans have always been available from REA for financing rural plumbing. And home construction loans by the Farmers Home Administration are issued under sanitary standards consistent with those recommended by public health agencies. If rural credit programs are assisted to a greater extent by the advice and resources of health authorities, it may be expected that rural sanitation and welfare will advance the more rapidly.

The experience of the Rural Electrification Administration suggests a time schedule that might be applied to rural sanitation. Electric power from a central station is provided on 90 percent of the farms in the United States. In 1935, only 10.9 percent of farms were so electrified, only 0.9 percent in the least developed States, and only 53.9 percent in the best. The percentage of electrified farms in each State today ranges from as high as 98.9 to no lower than 65. Judging by the pace of rural electrification, it should be possible to satisfy the bulk of environmental health needs in rural areas within a generation.

NOTE. Unless otherwise indicated, the economic statistical data are taken from tables published by the United States Department of Commerce, the United States Department of Agriculture, and the Federal Reserve Board. An extensive list of references on the general subject of rural health is available from the United States Department of Agriculture Library (Rural Health; Annotated list of selected references; Library list No. 60, 1953).

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