Services in a Colombian Shantytown: Speculations on the Limits of Collective Self-Help

Mark A. Ridgley
Department of Geography
University of Hawaii at Manoa
Honolulu, Hawaii 96822 USA

ABSTRACT
Given the gross deficiency of government-provided services in shantytowns, the potential for self-reliance and aided self-help approaches to alleviate the deficit is receiving ever greater attention. After reviewing reasons advanced for the success or failure of collective self-help, the paper describes water-supply and sanitation systems that have evolved through self-directed collective action in an illegal settlement in Cali, Colombia. Information from key informants indicates that considerable social discord accompanied the development of these systems. Redundancy in water transmission lines and the great variety of water-and-sanitation systems suggest that such conflict might be reflected in the physical systems themselves. The relationships among complexity, control, and stability, as advanced in cybernetics and systems ecology and interpreted in the context of the social and political relations within the settlement, suggest that self-organizing service systems in shanty environments might be limited to certain sizes and degrees of interaction.

INTRODUCTION
It was to be another example of community self-reliance: action at the grassroots level to create a day-care service within Comuneros II, a poor barrio on the periphery of Cali, Colombia. Single parents in the majority of the cases, the women faced the conflict of needing to work outside the barrio yet caring for their children at the same time. It was decided that they would take turns remaining at home and caring for the children, so that while a few were "on duty," the others were free to work elsewhere in the city. Their homes would rotate as the day-care center. This would provide everyone with an opportunity to work four days a week. The increased incomes would not only ease the financial burdens of each family, but a proportion of the earnings would also go to a fund to support a teacher for the school which the Ministry of Education had provided but not yet been able to staff.

The plan probably would have worked but for one seemingly technical detail. Small children have small bladders, and many small children in one place, together with the requisite number of adult chaperons, make significant demands on the plumbing of a private residence. But in Comuneros II, lacking municipal services like so many other barrios comprising Latin America's urban fringe, "plumbing" is a hand-dug latrine doomed by poor drainage to fill in within a year. With new latrine sites limited by small lot sizes, the solution would be short-lived at best. So while private homes were ruled out, the need for daycare persisted, and thinking later focussed on using the rudimentary chapel and constructing several latrines on the vacant lot adjacent to it. The problem with the high water table remained, however, and while some potential solutions were advanced, each had its drawbacks.

The number of people living in the world's shantytowns and squatter settlements is doubling every four to five years (CIUL 1982), with such settlements already encompassing half or more of the residents of many metropolitan areas (Lakshhmanan and Chatterjee 1977). As Third World governments have proven unable to provide baasic goods and services to a large segment of the urban population, urban self-reliance is being promoted with growing vigor as a generic, if partial, remedy to these deficiencies (Turner 1976; ·C. Sachs 1986; I. Sachs 1986; EI-Shakhs 1986; UNU/IFDA 1985). Not only is collective self-help being advocated for similar problems (e.g. shelter) in a wide variety of contexts, but successes in one domain are suggesting application of the concept in others which might prove to be significantly different. Thus, positive experiences utilizing self-help and community participation in housing programs (Turner 1972 and 1976) have been cited in suggesting such approaches for the provision of other basic services as well, such as water supply and sanitation (Campbell 1987).

Yet before we set self-help, whether individual or collective, as the cornerstone of plans and policies aimed at the provision of basic services in low-income settlements, we need to know more **[end p. 59]** about how it works in the absence of "official" help from the outside. How do shanty residents service their communities? How do they decide which services they need most, and how do they organize themselves to carry out the variety of tasks necessary to supply the services? How do they plan, design, construct, operate, and maintain the services they require? When one considers the sheer numbers of people engaged in these activities, and that many governmental programs aimed at shanty upgrading include a self-help or community-participation component, it is surprissing that, in contrast to self-help housing, so little has been written about self-provision of services.

This paper examines the experience of Comuneros II, an illegal settlement in Cali, Colombia, in using collective self-help in the development of water-supply and sewage-disposal systems. The paper consists of three main parts. First, factors which

might promote, hinder, or limit community cooperation and self-help are reviewed. Then, the founding of the barrio and some of the early attempts by settlers to construct water-supply and sanitation systems are described. The third part analyzes the case study, drawing on concepts from cybernetics and systems ecology to raise the question of possible limits to the scale of service systems developed through collective self-help.

COMMUNITY SELF-HELP: INCENTIVES AND OBSTACLES

Why should residents want to work together, rather than individually, to meet their needs? Where the desire to work collectively does indeed exist, what are some of the obstacles to effective cooperation? Answers to these questions are needed before the role of self-help in service provision can be adequately evaluated. Conceptual stances and empirical studies alike, however, indicate relatively little consensus on the answers.

In examining the supposed benefits from workking together, one must first distinguish the case where collective action has arisen as a result of internal impetus, from that where it has been promoted by outside parties, e.g. the state. In the latter case, the context is often one of project development, even though the true reasons for state involvement are frequently complex and disguised (Gilbert and Ward 1985; Ward 1986). Collective self-help in these situations is purported to demonstrate the community's desire for help, reeduce government's cost, increase user acceptance of the project, and facilitate the realization of other development projects (Feachem et al. 1978). Community participation is also seen as a way to improve maintenance of project infrastructure once it is built (van der Linden 1986), as it allegedly familiarizes the users with the technologies employed and promotes a feeling of responsibility for the continued functioning of the system (Glennie 1982).

As logical as these benefits might seem, examples where they have failed to appear are not uncommon. Feachem et al. (1978,47,61) working in Lesotho villages, have come to believe that "in the long term, voluntary contributions for the upkeep of a public service do not work," that cash contributions do not increase villagers' readiness to maintain water supplies once built, and that "voluntary work on a sustained basis is usually too much to ask of village organization."

Collective action promoted from within a community is usually associated with different motivations. Reasons might include the need to acquire land by invasion, to resist threats of eviction, to petition government for services and legal status, and generally to defend the settlement (Ward 1986). However, success does not ensure long-term communal activity, as Moser (1982) has shown with regard to self-help groups that became dormant when politicians no longer needed their votes.

A large body of literature on Latin American shanties implies a natural tendency to work collectively (Lloyd 1980). This account by Turner (1972, 137) of a squatter settlement in Arequipa, Peru, exemplifies this view:

> The settlements were all planned by the squattter associations, with or without the assistance of the district municipality. Most of the twenty associations in the urban area of Areequipa had also built their own meeting halls and at least one school. Several had already installed electric light services and a few had started to install water-supply systems. The associations, all active, were quite strongly supported for the most part by their local resident populations, as well as by many members and plot owners who were still living in the city.

But there are many reasons why community self-help might not occur on a sustained basis (Lloyd 1979; Gilbert and Ward 1985). Among these are (1) the differences between home owners and renters in their inclinations to invest in the community; (2) the absence of effective leadership (Ward and Chant 1987); (3) cooptation of local leaders by elements of the state; (4) factionalism resulting from competition among local leaders; (5) lack of time, money, and information on the part of many shanty residents; (6) differences in expected benefits resulting from spatial variations within the **[end p. 60]** community; (7) conflicts between the community's goals and existing systems of domination (Skinner 1982); and (8) changes in residents' socioeconomic status leading to changing aspirations and the promotion of individual goals. More extreme is the concept of a "natural individualism that resists collectivization," a view Green and Isely (1988, 160) cite in a discussion of rural community participation in Africa.

Reflecting such motivations are accounts which paint quite a different picture from Turner's. Roberts (1973), for example, working in Guatemala City, noted the difference in stimulating collective action when residents came from different places. Lloyd (1980), describing the case of Medalla Milagrosa, a shantytown in Lima that evolved by gradual accretion rather than being born overnight as an invasion, notes "a lack of will to work together" and a "lack of communal activity" (p. 87). In fact, he challenges the notion of residents' "general propensity to act collectively" (p. 94), maintaining that far from being a monolithic body, they have different interests and objectives which result in any given project's delivering differential benefits. "Thus it is not that the most felt needs become more individual than collective, but that the attitudes taken towards all needs become infused with an individualism which inhibits collective activity" (p. 94). As Lloyd himself observes, where these traits are common they quite obviously carry serious implications for policies that depend on communal activity to develop social infrastructure.

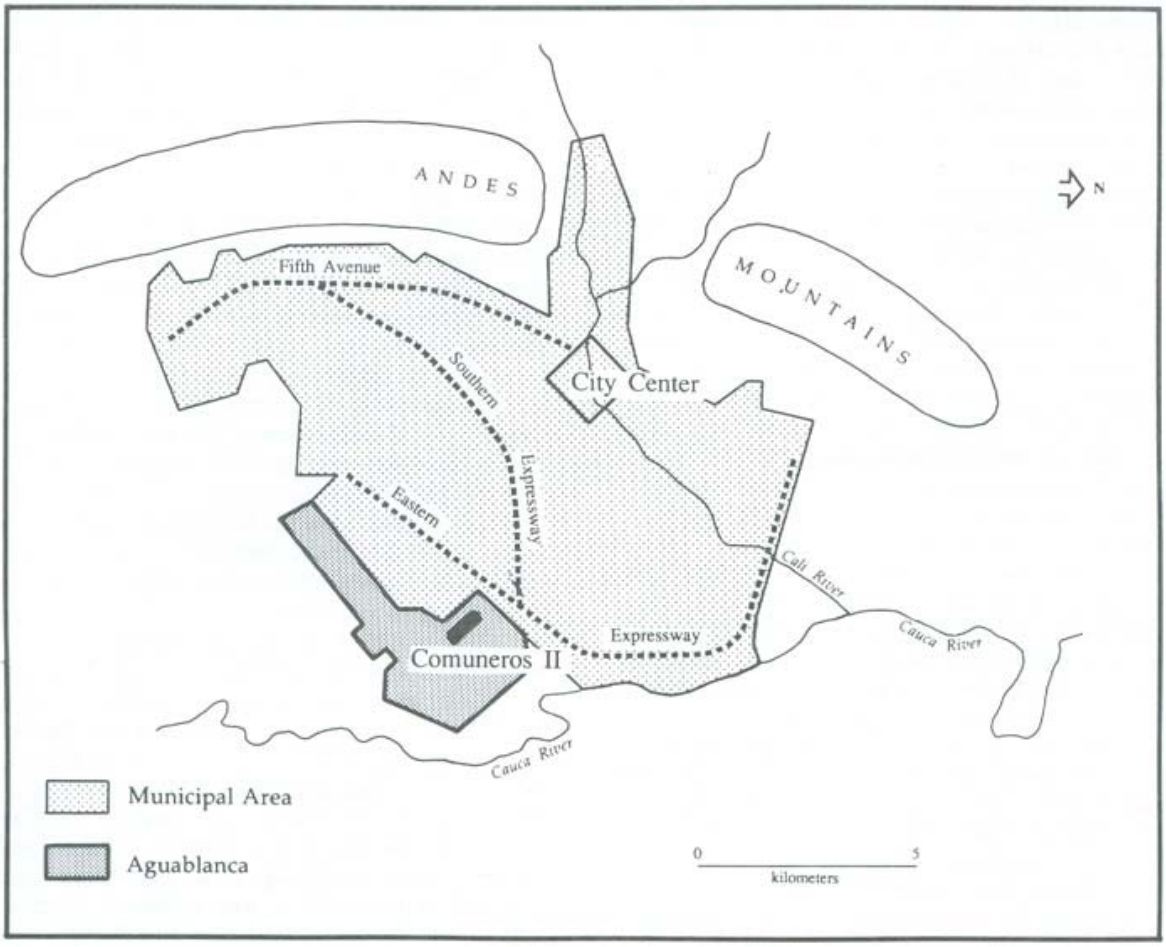
Lack of leadership and conflictive interpersonal relations are two closely-related barriers to communal self-reliance which have received relaatively little empirical study (Ward and Chant 1987). While these factors are frequently mentioned in discussions of the organization required to carry out successful land invasions, and to some degree this attention has carried over to the resulting settlements, far less has been written with regard to settlements formed in other ways. Where future residents of a community need not be organized to gain possession of the land itself, the nature of subsequent community organization might be expected to be quite different. Insightful in this regard is the case of Comuneros II, an illegal subdivision in which deficient leadership and interrpersonal relations prove to be significant obstacles.

THE CASE OF COMUNEROS II

For people who cannot or choose not to buy or rent existing dwellings, the alternative is to construct their own. For this they need land, and in Latin America there are two principal mechanisms outside the formal market by which land is acquired (Gilbert 1981). One means is through invasions, whereby a group of individuals targets a parcel of vacant land and settles upon it, dividing it into lots and erecting shelters. Such actions, commonly executed in a single night and extremely well-organized, resemble military maneuvers and can involve tens of thousands of participants (Lloyd 1980). The other mechanism, the illegal or quasi-legal settlement, involves the acquisition of a large tract of land, its subdivision into small lots, and their subsequent sale to new settlers. Although the initial acquisition is usually legal, its developpment violates subdivision regulations, zoning laws, service standards, or other requirements (Carroll 1980). As a consequence, the new settlers are apt to lack full title to their property. Which mechanism is employed in any given case depends on many factors, from the financial position of the individual settler, to national politics and the nature of the state (Gilbert 1981; Moser 1982; Gilbert and Ward 1982; Ward 1986).

Comuneros II is of the second type of settlement, known in Colombia as an *urbanizacion* (or *barrio pirata*, or "pirate development.") It is one of the many barrios located in the District of Aguablanca, a poorly drained area of 3,000 hectares (ha) lying on the floodplain of the Cauca River, along the southeastern margin of Cali (Figure 1). By the end of 1980 several invasions and barrios piratas had sprung up in Aguablanca, and although in mid-1983 it was estimated to cover 200 ha and house a population of 250,000, with more than 500,000 projected for "the near future" (EMCALI 1983), a detailed census of the District in late 1984 indicated 145,000 people inhabiting 1,000 ha. (EMCALI 1984; EMCALI 1985a).

Comuneros II (Figures 1 and 2) was officially founded on April 5, 1981, when pirate developers, calling themselves the Corporación de Adjudicatarios del Valle (the "Corporación"), began selling off lots from a much larger tract formerly used for pasture and occasional soya cultivation. There were 1,400 lots available, measuring 7 m by 15 m and costing COL$15,000 (pesos) for interior locations, COL$19,800 for comer units (approximately US$270 and US$356, respectively). Considered very low, these prices reflected the lots' relatively inaccessible location, poor site qualities, and total lack of services; bulldozing of streets and the platting itself were the only improvements made to the pasture. People learned of the offering through word of mouth, radio, and the newspaper, and transactions were effectuated in an office located in a nearby barrio. From the roughly 100 households that purchased lots on that occasion, Comuneros II had grown by the end of 1984 to encompass **[end p. 61]** a population of about 6,513 occupying 1,163 dwellings (EMCALI 1985a).



Since Aguablanca lay outside Cali's municiipal boundaries until only recently. Comuneros II, like the other barrios, was not provided services by Empresas Municipales de Cali (EMCALI),the city's public utilities agency. This left the residents to fend for themselves. In contrast to most invasions, however, barrios piratas tend to be settled gradually and by people usually unacquainted with each other. As a consequence, they lack the existing organization that invasions tend to exhibit and which might be harnessed to facilitate service provision. Nevertheless, water supply and sewage disposal were two immediate needs. How some of the settlers met them provides not only an understanding of how these services can be organized, but gives an insight into the nature of community organization as well.

The following descriptions of the evolution of selected water-and-sanitation systems in Coomuneros II are based on informal discussions with eight key informants (whose names have been changed to maintain anonymity) and a systematic survey of 28 households. With one exception--a priest who had been working in the barrio almost since its inception--all the informants were longtime residents of Comuneros II, and some were among the first settlers. The actions. designs, and organizations reported here do not pretend to cover the full range of such in the settlement, nor should they be construed as typical or representative; indeed, at this juncture typicality is not an issue (Mitchell 1983; Peattie 1983). Rather, the importance of this isolated case lies in its illumination of the possible links between certain social phenomena that can arise in shanty environments, their effects on collective action, and the influence such effects may have on the development of watersanitation systems through self-help.

Water Supply

For the first settlers, water was obtained through haulage from other barrios, by digging an *aljibe* **[end p. 62]** EMCALI even distributed water from a tank truck without charge, but that did not last long. Well water was generally used for laundry and household cleaning, but most residents did not consider it potable. However, one of Comuneros' first settlers, Santiago, as well as some others, chose not to haul water at all, preferring to boil whatever water they needed for drinking and cooking. Another initial solution was to pipe water from the aljibe straight into the house.

Sooner or later, aljibes and haulage gave way to piped supplies. On one of the blocks, eight households joined together to run a hose from a water main in the barrio "12 de Octubre," a kilometer distant, down through the center of their street. Each household paid COL$I,OOO (US$18) toward the purchase of the hose, and they all worked together to install it, although it

was a moonlighting EMCALI employee who actually tapped illegally into the water main. Each household then made its individual connection (its *pega*). This "group of eight," still organized in mid-1985, did not allow others on the street to tap into the hose, although it is unclear why. One member of the group, Mirta, claimed that it was because those who wanted to join were unwilling to contribute labor or money to the maintenance of the system. But Santiago, also a member, explained that it was due to the diameter of the hose; at three quarters of an inch it was too small to supply more people reliably. He added, though, that when water was not in short supply the group would "donate" it to the others. This practice went on until things started to disappear from the home of one of the members giving it away, whereupon the group decided not to share with anyone.

Problems may continue to arise even after an individual or group has successfully "pirated" water and conveyed it to individual households. Dishonesty within a group, or merely distrust and suspicion, have been known to lead to conflict on several occasions. The "group of eight" is a case in point. Whereas Mirta portrayed the relations within it as completely harmonious, where all members contributed money and labor equally, and where receipts were neither needed nor kept, Santiago told of numerous squabbles--concerning accounting for money collected and disbursed, verifying who did and who did not contribute, and book-keeping in general-that actually led to the temporary disbanding of the group.

Sabotage is another example of what can threaten a system after piracy has occurred. While on one end of the network EMCALI would sever any illegal connections to the municipal distribution system that it found, on the other hand *pegas* would be sliced through by angry residents of the barrio itself. Sometimes this occurred in response to being denied access to a hose, and sometimes it occurred due to a squabble not related to water at all. Then, too, it was not unusual for the hose itself to be the object of unauthorized pegas. When detected, these clandestine tie-ins often were, with one slice of a machete, summarily cut, but since the hole left in the line resulted in even greater pressure loss, they were just as often left in place until repair could be made immediately upon severance. All the while the culprits would be hounded, pressured to pay, and generally ostracized. Vigilance, then, was a constant necessity. Either a watchman was hired by the group and paid for out of the fees collected from its members, as was the case with the 72nd Street Committee, another community group which had established a clandestine line, or the members themselves would assume the responsibility.

Denial of service, and the conflict and surerptitious connections resulting from it, were also symptomatic of a more general situation, that of whether and how to accommodate new residents. As settlement did not proceed from lot to lot in a contiguous fashion, newer arrivals, finding themselves on streets many of which had been developed for some time, quite naturally wanted to hook up to the water line already serving that street. But even where system capacity was deemed adequate, there was much disagreement over what would constitute appropriate contributions by the new "subscribers," since these would be benefitting from the labor and capital expenditures of the earlier settlers. At least in one case, failure to resolve the conflict led to the installation of a separate water hose adjacent to the first (Figure 2).

Suspicion and uncertainty regarding future actions by fellow residents were also factors which may have influenced the spatial organization of the water supply. Almost without exception, committtees and groups organized to ensure water supply and sewage disposal were focused on the street rather than the block (*manzana*); members of the same committee shared a common street. The primary reason for this, it was explained, rests with the juridical concept of right-of-way (*servidumbre de paso*). Were a water hose to be stretched across lot A, whether vacant or not, in order to serve lot B behind it, a right-of-way would be created along the narrow corridor marked by the hose. This right-of-way would belong to lot B and would, with time, probably come to be treated as public property. The owner of lot A is thus reluctant to allow the creation of such a right-of-way in the first place. Whether such rights would in fact have **[end p. 63]** legal backing is moot; what is important is the local interpretation of servidumbre and the response it engenders. Fear of servidumbre was also given as motivation for the fencing of lots at the earliest opportunity.

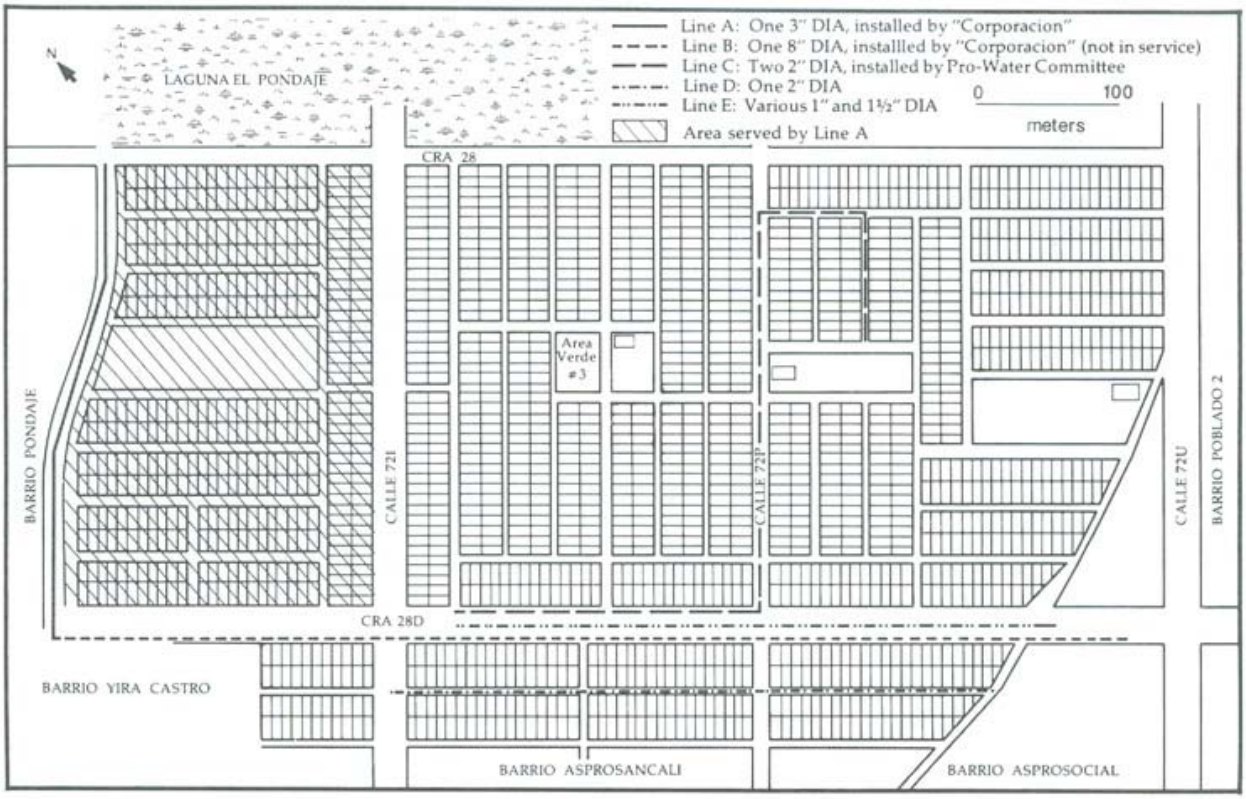


Fig. 2. Selected Water-Supply Lines in Comuneros II. (Source: selected informants and author's reconnaissance.)

Technical problems associated with piping the water plagued the barrio as well. Difficulties in joining different pipe or hose segments were especially common, and leaks, both into and out of the conduit, required continuous attention. The experience of the 72nd Street Committee, as recounted by Beatríz, its organizer, is instructive in this regard. About 50 people united and paid COL$1,000 (US$18) each for the purchase of a hose. The first installation was poor and the splicings kept bursting, so the hose was then replaced with segments of polyvinyl chloride (PVC). Requests were made for another COL$1,000 per head, although the original members-the group by this time having grown-could contribute labor instead. Still, not everyone contributed, and Beatriz claimed she not only worked, digging trenches with pick and shovel and carrying the hoses, but contributed more than COL$2,000 (US$36), since she paid a lot of kids to work as well. When the problems continued with the PVC, the group resorted to hoses once again, splicing them with galvanized tube and covering the junctions with hot tar. This solution has proven fairly effective.

Not all water lines serving the barrio had to be installed by the residents themselves, and some of the later settlers have had neither to haul water nor to dig an a/jibe. The "Corporación" laid a three-inch-diameter hose, supplying the area adjacent to the barrio of "Pondaje", and an eight-inch-diameter PVC pipe, never put into use, perpendicular to the first one and running along Carrera 28D (Figure 2). From this three-inch hose, though, residents had to lay smaller distribution hoses to serve individual streets. Mercedes and Francisco were two who used this system immediately upon arrival, Franncisco paying COL$450 (US$8) to join. When demand on the line rose, another pega was required and a second hose laid; the users gave money for this but refused to work. Mercedes connected her line to an old refrigerator converted by her husband into a large storage tank. Francisco, using a slightly different approach, connected his line to a drum which he had placed underground. In contrast to the others on the "Corporación" line, who had left their drums above ground, he benefitted from the increased hydraulic head and was able to fill **[end p. 64]** his drum easuy even when his neighbors were complaining of low pressure. For a long time Francisco kept his solution a secret. When he finally told the others, some were angry that he had concealed it. No one adopted it, however, and Francisco attributed this to their unwillingness to dig the hole required to bury the drum; they are too lazy, he said. Some time later, a committee put in a new hose and failed to tell him. When he found out and wanted to link up, the others refused, saying the line could not supply any more households. He tapped in anyway.

Two other problems regarding water supply provoked recurrent complaint. First, even when a network is well-maintained, water pressure is rarely considered adequate, and there are frequent periods when supply is cut altogether, two- to four-day outages being not uncommon. One response to this unreliability is the use of storage containers. Beatriz, for instance, told of

how water would often not arrive until 3:00 a.m., forcing her and her family to fill the containers at that time. The second problem is pollution of the piped water by infiltration of contaminants through cracks and loose joints. Although the hoses in some cases were originally attached to the facades or suspended above ground on stakes, most of them now lie on the ground adjacent to the sewage ditches running in front of the houses. Many snake in and out of the trenches themselves. With the occurrence of a heavy shower, and throughout the rainy season, these ditches overflow and bathe the hoses in sewage and runoff.

Responses to the danger of sewage infiltration varied. Mirta, having examined cross-sections of cut hoses and seen a greasy, paste-like substance built-up on the interior, would rarely let her children drink from the hose. Another woman, Amalia, noted that there were several families whose kids seemed forever sick, and she attributed their chronic illness to the infiltration problem. Ester, on the other hand, agreed that infiltration was a problem but blamed the children's illness on poor nutrition. Noting that the doctor always prescribed lots of liquids to those with diarrhea, she concluded that not drinking enough was partly to blame as well.

With the exception of the early and short-lived tank truck service offered by EMCALI, for two and a half years after its official founding no governmental agency approached Comuneros II for the purpose of improving its water suppply. In October 1983, however, residents began receiving monthly bills for COL$200 (US$2.25), COL$75 of which were for water and the rest for electricity. This amount was equivalent to that charged the lowest socioeconomic "stratum"in Cali for public services, and was a reason of EMCALI's view that, first, "pirated" services were nonetheless services, and second, that the poorly executed tie-ins caused disproportionately large losses to the whole municipal system. However, as noted by all interviewed, the day the bills arrived the electricity went out for three months. In September 1984 the bills jumped to COL$I,I13 (US$1O.50) per month (some said COL$I,205). The increment, it was explained, was to go toward the construction of a "formal" water-supply system, finally approved and programmed as a result of new financing"obtained through the Inter-American Development Bank and the Japanese government (EMCALI 1985b). Promised for December of the same year, by August 1985 the new system had yet to materialize.

Sewage Disposal

Disposal of sewage and greywater, or sullage, was another immediate problem faced by new arrivals to Comuneros II. The pit latrine was the solution adopted by all those settling within the first few months of the barrio's founding. In most cases the pit consisted merely of a large hole, hurriedly dug and lacking lining or structural support, a wooden platform served as a seat, and a rudimentary superstructure was erected for privacy. Since there was neither toilet nor squatting plate, flushwater was not required. This initial latrine usually was meant to be temporary, to be used while the settler was building his or her home and to be improved or replaced later with a more substantial one. Together with the aljibe and the *mejora*, a one-room hastily constructed shelter, the latrine provided the services necessary for the new residents to consolidate their presence in the settlement. An exception to this general pattern occurred when purchasers of lots did not move to the barrio immediately, but rather resided elsewhere while gradually preparing the lot for later occupation. In these cases, the latrine was usually more substantial, having a sturdier superstructure and often a squatting plate or toilet bowl; in one case this first solution was an indoor, cistern-flush toilet connected to a septic tank. Since the aljibe was dug before the latrine, water was available and commonly used to wash away excreta. Thus, both pour-flush and dry latrines were common in this situation.

By March 1985, more than four years after the founding of the settlement, the prevalence of latrines remained essentially unchanged, despite continual problems with their functioning. Proper sewage disposal was agreed by all to be the top priority of the barrio. One reason for this was the perennially high water table, causing most hand- **[end p. 65]** dug latrines to fill up within a year and sometimes within a mere three months. Since these had to be covered over and relocated, and patios rarely exceeded three-by-five meters in area, space was quickly exhausted.

Despite this general pattern, some latrine users did not experience these problems. Francisco expressed perfect contentment with a very shallow (50 cm), wide latrine that he constructed and lined with bricks. He explained that the shallowwness prevented its being reached by groundwater.! Further, he had no desire to use sewage ditches since they overflowed so frequently. Beatriz's husband developed a slightly different sort of privy, covering his old well (aljibe) with a concrete floor and placing a latrine superstructure atop it. A screened orifice allowed liquid waste to flow into a sewage trench while the solids were retained in the well.

Localized sewerage had also been attempted. Mercedes' father, after having the pour-flush latrine fill up within the first year, installed his own sewer, buying from EMCALI used pipes that it was replacing in the barrio of "Siloe" on the western slopes of the city. For a fee, her father connected others to the sewer, which emptied into the Laguna EI Pondaje, and he continued to oversee its maintenance, organizing the replacement of clogged sections whenever necessary. The 72nd Street Committee, the only group organized to deal with both water supply and sanitation, installed a hose emptying sewage into the park called Area Verde #3. At the other end of the park was another hose, also leading to Laguna EI Pondaje, and as of August 1985 it was still the committee's desire to link the two and thus discharge the sewage into the Laguna.

These exceptions and problems notwithstanding, a stratified random survey of 28 households indicated that by mid-1985 the pit latrine continued to form the core of the vast majority of excreta-disposal systems in Comuneros II (Table 1). Of those households, only two had on-lot cistern-flush toilets, three utilized septic tanks, and five channelled toilet wastes into ditches bordering their lots. No sewers were used for excreta disposal. Of the latrines, 18 used water while ten were dry, and 20 were placed outside the house. Drainage problems ensured that sullage was never emptied into latrine pits, however, unless it was used as flushwater. Rather, it was channelled into ditches, onto streets, or, in three cases, into sewers.

Table 1. Water and sanitation systems in a sample of 28 households.

Water Supply (source/tap)	Sanitation (toilet/nightsoil/greywater)
mcpl-net / G	PF / NS => ditch / grey => ditch
mcpl-net / G	PF / NS => septic / grey => septic
mcpl-net / G	PF / NS => pit / grey => street
mcpl-net / G	dry / NS => pit / grey => street
mcpl-net / G	PF / NS => pit / grey => ditch
mcpl-net / G	dry / NS => pit / grey => ditch
mcpl-net / G	CF / NS => septic / grey => ditch
mcpl-net / L+B+T	PF / NS => ditch / grey => ditch
mcpl-net / L	PF / NS => ditch / grey => ditch
mcpl-net / L	dry / NS => pit / grey => ditch
mcpl-net / L	dry / NS => pit / grey => street
mcpl-net / L	dry / NS => pit / grey => ditch & street
mcpl-net / L	PF / NS => ditch / grey => ditch & street
mcpl-net / L	CF / NS => septic / grey => sewer
mcpl-net / B	dry / NS => pit / grey => ditch & street
mcpl-net / lot	PF / NS => pit / grey => sewer
mcpl-net / lot	PF / NS => pit / grey => ditch
mcpl-net / lot	dry / NS => pit / grey => ditch & street
mcpl-net / lot	neighbor CF / NS => pit / grey => street
neighbor / —	
neighbor / —	PF / NS => ditch / grey => ditch & street
mcpl-net / L	dry / NS => pit / grey => sewer
mcpl-net / B+G	PF / NS => pit / grey => ditch

mcpl-net = muncipal network

Tap locations: L = laundry basin, G = garden, B = bathing area, T = toilet/latrine area

Toilet type: PF = pour-flush, dry = water-less, CF = cistern-flush; NS = nightsoil; grey = greywater

=> "goes to"

EMPIRICAL FINDINGS

These chronicles identify several important features in the residents' activities with regard to water and sanitaiton. First, the settlers weny through a learning process, experimenting with a number of different technical systems and contending with failures of various types, before finally adopting a particular solution. Indeed, as the current efforts to install a sewerage system indicate, in many cases the final solution has yet to be discovered and implemented.

Second, activities were largely individual in character or carried out in separate small groups, with a significant degree of social discord within and between groups. Groups resisted entry by new arrivals and took steps to reduce future claims to the services they had organized. In turn, they were targets of sabotage and spiteful actions. Within groups themselves, comments suggest dishonesty, distrust, suspicion, and laziness to be more commmon than the obverse. Raising monev and recruit- **[end p. 66]** ing labor were especially problematic.

Third, at the barrio level, the water sanitation system which has evolved is fragmented into many smaller disconnected subsystems. Spatially, the water and sanitation committees are highly localized, sub-barrio in extent, and tend to be organized around a single street. Technical solutions also tend to be highly varied. Although it is true that some of the distinctions are subtle--e.g., sullage flows onto the street instead of into a ditch, or one household has its only water tap in the garden while another has its located at the laundry basin--it is equally true that apparently minute differences can affect people in different and significant ways and may respond to different needs. For example, a household's single water tap perhaps was installed at the front of the lot to save expense, the laundry basin subsequently built in the patio area at the back of the house to ensure privacy, and lack of funds has prevented the household from installing a second tap at the basin. Or, one household may opt to divert its sullage onto the street to minimize overflow of the sewage ditch, while another, on a corner lot with its laundry facility at the back, might do the same, but merely because the street at the side is closer than the ditch in front. Since such systems were designed-that is, they were the product of conscious decisions in the face of alternatives and constraints, real or imagined-there must be, or have been in the past, some significance ascribed to the characteristics distinguishing them.

COMPLEXITY AND VIABILITY OF SELF-HELP SYSTEMS

Why have localized, diverse, and, in the case of water hoses, redundant water-supply and sanitation systems evolved under collective self-help in Comuneros II? Although no definitive answer can be given, we can speculate on theoretical grounds that this type of organization is more viable than would be a single large system composed of a more tightly interconnected assemblage of subsystems. By "viability" we mean the capacity of a system to remain stable or under control in the face of a changing environment. To understand the reasons for this conjecture, we need to understand how stability and control relate to complexity.

The first relationship is that between complexxity and control. The complexity of a system is commonly measured by its "variety," defined as the number of its possible states (Beer 1974). Two factors determining system complexity are thus the number of components comprising it, i.e. its "size," and the degree to which these components are interconnected. In cybernetics, Ashby's law of requisite variety (Ashby 1964; Beer 1974; 1975) states that any governing system must be able to match the variety of the system it wishes to control. Thus, other things being equal, the greater the number of people comprising a given water-supply system, the larger will be its potential number of states and, hence, the greater will be the complexity required of the management system overseeing it.

The second relationship, that between complexity and stability, has been the subject of recent research in systems ecology. Theoretical studies suggest that as the number of components in an ecosystem rises, or as the interaction among them increases, or both, the greater will be the likelihood of the system's becoming unstable. This likelihood not only increases exponentially with system size, it also grows quickly once a certain threshold of connectivity is crossed (Gardner and Ashby 1970; May 1972). However, how the interaction is arranged also appears to be important. The studies indicate that systems with "blocks" of highly interconnected components, with few interactions between the blocks themselves, tend to be more stable than systems without such structured interconnection, even though the overall degree of connectivity remains constant.

These principles suggest one possible explanation for the localized and fragmentary character of Comuneros II's water-and-sanitation systems. As these systems expand to include more households and a larger array of physical infrastructure, an ever greater range of governing actions is required to coordinate and make effective the larger and more interconnected assemblages of decision makers and resources that result Thus the complexity of the management system must also increase. It is reasonable to suggest, however, that the same barriers purported to impede self-help and which are present in Comuneros II--lack of resources, deficient leadership, inherent individualism, and factionalism--also limit the complexity of these management systems. Under such conditions, effective control would diminish, and we might expect water-and-sanitation services to become less reliable. Although a larger, highly articulated sysstem might be more efficient, it could well lack the robustness of the smaller, relatively disconnected systems we find there.

Chadwick (1977), considering settlement plannning in general, has used such arguments to suggest that there might be "limits of the plannable." If he is correct, there must also be limits to the complexity of self-organizing infrastructural systems within irregular settlements. Where the sorts of barriers to self-help enunciated above are present, the limits are apt to be tighter. In those situations, large-scale service systems are unlikely to develop via self- **[end p. 67]** help; where they are forced, we can expect them to be unstable and short-lived.

These observations suggest two elements which ought to be part of strategies of service provision based on self-reliance. First, shanty dwellers should be introduced to solutions requiring the involvement of only a few people, as these are less affected by obstacles to collective enterprise. Further, the adoption of such solutions should be facilitated. In the area of sewage disposal, for example, many sound, decentralized technologies exist which are rarely considered by municipal agencies yet are simple to build and afford significant economic savings (Kalbermatten et al. 1982; Ridgley 1989). Secondly, where there are clear advantages to large-scale systems, incentives adequate to overcome barriers, and to prevent them from arising anew, need to be identified and provided. The failure to ensure that incentives are on-going is a key reason why maintenance problems continue to plague infrastructure developed through communal action.

Although collective self-help may well be the only realistic approach to servicing the populous shanties and squatter settlements of Third World cities, we know very little about how user-developed service systems evolve in these environments. We do know that very real barriers to communal action are common, and that these limit the solutions which can be developed. Greater understanding and observance of these constraints will spare much disappointment and promote more effective self-help solutions.

ACKNOWLEDGMENTS
I would like to thank Michael Douglass, Tom Koch, two anonymous referees, and the editors for constructive comments leading to the revision of earlier versions of this paper. The maps were prepared by staff of the Cartography Lab of the University of Hawaii's Department of Geography. I would also like to acknowledge financial support from Fulbright-Hays and a National Science Foundation doctoral dissertation research grants which enabled the field work upon which this paper is based.

NOTE
1. This is somewhat difficult to believe, since in most parts of Comuneros II, and in Aguablanca in general, the water table rarely falls below one meter from the surface, and, especially in the rainy season, often breaks the surface altogether.

REFERENCES CITED
Ashby, W. R 1964. *An introduction to cybernetics.* London: Methuen.

Beer, S. 1974. *Designing freedom.* Massey Lectures, Thirteenth Series. Toronto: Canadian Broadcasting Corporation.

Beer, S. 1975. *Platform for change.* London: Wiley.

Campbell, T. 1987. Applying lessons from housing to meeting the challenge of water and sanitation for the urban poor. *Journal of the American Planning Association* 53(2): 186-192.

Carroll, A 1980. *Pirate subdivisions and the market for residential lots in Bogota.* World Bank Working Paper No. 435. Washington, DC: The World Bank.

Chadwick, G. 1977. The limits of the plannable: Stability and complexity in planning and planned systems. *Environment and Planning* A 9:118991192.

CIUL (Council for International Urban Liaison). 1982. Urbanización: Políticas y posibilidades. *The Urban Edge-Hechos e Ideas* 6(11): 1-4.

El-Shakhs, S. 1986. Urban self-reliance: Limits and possibilities in the Middle East. *Development: Seeds of Change* 4: 17-18.

EMCALI (Empresas Municipales de Cali). 1983. Distrito de Aguablanca. Programa de servicios publicos. Documento GPDOO6-83, Agosto. Cali: EMCALI.

EMCALI (Empresas Municipales de Cali). 1984. Plan de desarrollo de Aguablanca: Diagnostico y plan general. Documento No.1, Febrero. Cali: EMCALI.

EMCALI (Empresas Municipales de Cali). 1985a. Asentamientos subnormales en Cali. Cali: EMMCALI.

EMCALI (Empresas Municipales de Cali). 1985b. Aguablanca project. Cali: EMCALI.

Feachem, R, E. Bums, S. Cairncross, A Cronin, P. Cross, D. Curtis, M. Khalid Khan, D. Lamb and H. Southall, eds. 1978. *Water, health and development.* London: Tri-Med Books.

Gardner, M. R and W. R. Ashby. 1970. Connnectance of large dynamic (cybernetic) systems. Critical values for stability. *Nature* 228: 784

Gilbert, A 1981. Pirates and invaders: Land acquisition in urban Colombia and Venezuela. *World Development* 9:657-678.

Gilbert, A., L.Hardoy, and R Ramírez, eds. 1982. *Urbanization in contemporary Latin America,* Chichester: John Wiley.

Gilbert, A and P. Ward. 1982. Low-income housing and the state. In *Urbanization in conntemporary Latin America,* eds. A Gilbert, J. Hardoy, and R Ramirez, 79-127. Chichester: John Wiley. **[end p. 68]**

Gilbert, A. and P. Ward. 1985. *Housing, the state, and the poor.* Cambridge: Cambridge University Press.

Glennie, C. 1982. *A model for the development of a self-help water supply program.* Technology Advisory Group Working Paper No.1. (World Bank Technical Paper No.2). Washington, DC: The World Bank.

Green, E. C. and R. B. Isely. 1988. The significance of settlement pattern for community participation in health: Lessons from Africa. *Human Organization* 47(2): 158-166.

Kalbermatten, J. M., D. S. Julius and C. G. Gunnnerson. 1982. *Appropriate sanitation alterrnatives. A technical and economic appraisal.* World Bank Studies in Water Supply and Sanitation 1. Baltimore, MD: Johns Hopkins Uniiversity Press.

Lakshmanan, T. and L. Chatterjee. 1977. *Urbanization and environmental quality.* Resource Paper for College Geography No. 77-1. Washhington, DC: Association of American Geograaphers.

Lloyd, P. 1980. *The 'Young Towns' of Lima: Aspects of urbanization in Peru.* New York, NY: Cambridge University Press.

Lloyd, P. 1979. *Slums of hope?* New York, NY: St. Martin's.

May, R. M. 1972. Will a large complex system be stable? *Nature 238: 413-414.*

Mitchell, J. C. 1983. Case and situation analysis. Sociological Review 31(2): 187-211.

Moser, C. 1982. A home of one's own: Squatter housing strategies in Guayaquil, Ecuador. In Urbanization in contemporary Latin America, Gilbert, J. Hardoy, and R. Ramirez, eds., 799127. Chichester: John Wiley.

Peattie , L. R. 1983. Realistic planning and quallitative research. Habitat International 7(5/6): 227-234.

Ridgley, M. A. 1989. Evaluation of water-supply and sanitation options in third world cities: An example from Cali, Colombia. GeoJournal 18(2): 199-211.

Roberts, B. R. 1973. Organising strangers: Poor families in Guatemala City. Austin, TX: Uniiversity of Texas Press.

Sachs, C. 1986. Mutirao in Brazil, initiatives for self-reliance. Development: Seeds of Change 4:65-69.

Sachs, 1. 1986. Work, food, and energy in urban ecodevelopment. Development: Seeds of Change 4:2-11.

Skinner, R. 1982. Self help, community organnization and politics: Villa EI Salvador, Lima. In Self-Help housing: A critique, P. Ward, ed. London: Mansell.

Turner, J. F. C. 1972. The re-education of a proofessional. In Freedom to build, J. F. C. Turner and R. Fichter, eds., 122-147. New York: Macmillan.

Turner, J. F. C. 1976. Housing by people: Towards autonomy in building environments./i> London: Marion Boyar.

Turner, J. F. C. and R. Fichter, eds. 1972. Freeedom to build. New York, NY: Macmillan.

UNU/IFDA (United Nations University/International Foundation for Development Alternatives). 1985. Urban self-reliance. A directory of institutions and projects. Paris: UNU.

Van der Linden, J. 1986. The sites and services approach reviewed. Aldershot: Gower.

Ward, P. 1986. Welfare politics in Mexico: Papering over the cracks. London: Allen and Unwin.

Ward, P., ed. 1982. Self-help housing: A critique. London: Mansell.

Ward, P. and S. Chant. 1987. Community leadership and self-help housing. Progress in Planning 27:69-136.

RESUMEN

En vista de la marcada deficiencia de 105 servicios municipales en poblaciones marginales, se esta prestando cada vez mas atencion a estrategias de autoayuda y autoabastecimiento que puedan potenncialmente reducir el deficiL Tras resefiar varias razones que han sido propuestas para explicar 105 exitos y fracasos de la autoayuda comunal, el artfculo describe sistemas de agua potable y saneamiento desarrollados par 105 residentes de una urbanizaci6n ilegal en Cali, Colombia. Relatos personales proporcionados por inforrnantes del barrio muestran que la evoluci6n de estos sistemas fue acompafiada par un considerable grado de conflictos sociales. La presencia excesiva de conductos de agua, asl como la variedad de soluciones individuales respecto al abastecimiento del mismo y a la disposici6n de aguas servidas, sugiere que dicho conflicto tal vez se refleje en la infraestructura flsica. Hecha esta observaci6n, se discuten las relaciones entre los conceptos de complejidad, control, y estabilidad, tal y como estos estan desarrollados en la cibemetica y la ecologla de sistemas. Estas relaciones, junto con 105 fen6menos sociales y de infraestructura observados en la poblaci6n, sugieren que 10s sistemas de servicios desarrollados por medios propios de 105 pobladores pueden ser limitados a ciertos tamailos y grados de interacci6n. ***[end p. 69]***