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THE NUTRITIONAL IMPACT OF RESETTLEMENT, SETTLEMENT AND COLONIZATION

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> The literature...contains little systematic discussion and virtually no empirical research findings concerning the influence of government economic, agricultural, or social policies on the incidence of malnutrition in a country — even though the consequences of these policies on nutritional status may be considerably greater than any direct efforts to reduce malnutrition and, in addition, may seriously affect the results of such direct efforts.
>
> (Hakim and Solimano, 1976)

Many development specialists have learned that development programs and projects can either improve nutritional, and hence, the health status of affected populations or intensify and deepen problems of malnutrition, concommitant infectious disease rates, infant mortality rates and the capacities of human communities to efficiently marshall social, economic and political energies. The most common consequence of development efforts, however, is no change in the dietary conditions and nutritional status of human communities defined as beneficiaries of these projects.

Development projects are by definition intended to change the cultural traditions and patterns of life of human communities. Projects and programs which result in population displacement, either directly as when communities are picked up and moved or indirectly as when a new colony changes factor and commodity markets and drives out families that cannot compete, are perhaps

the most extreme or dramatic example of such change processes. Individuals, families and communities so affected face a difficult break with proven and familiar ways of life and a lengthy period, perhaps persisting into the new generation, of arduous, painful, expensive and relentless adjustment to new environmental, social and economic conditions. The nutritionally at-risk segments of these populations may or may not survive the adjustment.

While it might appear at first that we will be dealing only with "rural" development projects, this is not the case. The vast majority of population displacements examined here are in fact "urban" development projects. Their designers are urban technical specialists, their managers and administrators are urban professionals and their beneficiaries are urban consumers of food, fuel, electricity and other goods produced. Rural development in our view can be said to have taken place when rural people manage new enterprises, are able to utilize their indigenous skills to improve and fine-tune new enterprises and reap the benefits of new enterprises

This paper will synthesize what is known about the nutritional impacts of population displacement resulting from development projects, and will derive recommendations regarding anticipation of negative impacts and the creation of design strategies to lessen negative impacts. We will first outline types of projects that lead to population displacement, then outline the ways in which such displacement affects nutritional status, and then turn to a review of empirical findings regarding the incidence, magnitude, duration and distribution of negative impacts. We conclude with recommendations derived from the analysis for each of the major stages of a development assistance project or program.

I

THE NATURAL HISTORY OF POPULATIONS DISPLACEMENTS

> Practically all recorded colonization failures have been state-directed projects.
>
> (Nelson 1973)

Population displacement and the new communities which result are quite common phenomenon. They are the product of many forces and are born of several different goals or objectives. Population displacement occurs for some of the following reasons.

(1) Displacement of refugees from natural disasters, wars and political turmoil. Examples include the 1 million North Vietnames settled in the Mekong River area (Palmer 1979); the relocation to concentration camps of 100,00 Japanese-Americans in the US during World War II (Arensberg 1942; Kimball 1946; Leighton 1945); resettlement of suspected Mau-Mau rebels in Kenya (Korte 1969); relocation of Bikini Islanders by US nuclear bomb testing (Kiste 1967); settlement of 8 million European and Far East people displaced by World War II by the United Nations Relief Administration (Jackson 1970); and resettlement of earthquake refugees in Peru and elsewhere (Oliver-Smith 1977).

(2) Displacement to secure boundaries by peopling remote frontier regions. Examples include the National Resettlement and Rehabilitation Administration of the Phillipines project to people unoccupied forest areas (Fernandez 1972); the Brazilian effort to populate the Amazon Basin border areas with Colombia, Peru, Ecuador, Suriname and Venezuela (Moran 1976, 1979; Nelson 1973;

Goodland and Irwin 1975; Wilkening and Iutaka 1967); the Colombian effort to do the same on its border with Brazil, Peru and Venezuela (Crist and Guhl 1957; Tinnermeier 1964; Crist and Nissly 1973; Nelson 1973); and similar efforts by Ecuador, Peru, Bolivia and Venezuela (Crist and Nissly 1973; Nelson 1973).

(3) Displacement of nomads for the purpose of sedentarization. Sometimes this is done to prevent real or immaginary military problems associated with nomads crossing political boundaries, as in the case of the Iranian sedentarization of the Basseri (Fars) (Barth 1962) and the Skolt-Lapp sedentarization by Finland (Pelto 1971). At other times the same process is undertaken in order to open up land for colonization and to force intensification of meat and milk production for urban consumers, as in Senegal (Teitelbaum 1977) and Tanzania (Talbot 1972).

(4) Displacement for the purpose of intensifying agricultural production for export and foreign exchange. Examples include the Malay rubber, oil palm and sugar cane projects of the Federal Land Development Authority (Ho 1965; Meade 1974, 1976); the Jari scheme in Brazil (Partridge 1979); the Plan Chontalpa banana and sugar cane plantations of Mexico (Nelson 1973; Hernandez, et al 1973); and the "moving frontier" of coffee plantations into the forests of Brazil, to be followed by tropical cattle ranch settlements (Margolis 1973).

(5) Displacement for the purpose of securing land ownership and employment opportunities. Examples include most "spontaneous" settlement efforts and many "semi-spontaneous" or government assisted colonization efforts, as in the colonization of the lakeside of the Seven-Forks Hydroelectric Complex in Kenya (Odingo 1977); the Javanese settlers penetrating the jungles of Sumatra

(Utomo 1967); the voluntary sedentarization of Bedouin tribes in Saudia Arabia in response to water wells resulting from oil drilling (Heady 1972); and the continuous surge of settlers fleeing landlessness, uneconomic size holdings and unemployment in the interior of Colombia, Peru, Bolivia, etc. to the eastern lowlands (Crist and Nissly 1973).

(6) Displacement in order to confine, consolidate and/or protect racially and/or culturally distinct populations as part of the process of opening up access to their soil, mineral and forest resources. Example include the persistence of the Indian reservation system in the US (Jorgensen 1971; Officer 1971; Kimball 1946); the indigenous reserves of Brazil (Davis 1974; Goodland and Irwin 1975); and the "homelands" designated in undeveloped areas of South Africa for the Bushman and other black people expelled from white society.

(7) Displacement as a way of redistributing rights to land in agrarian reform programs. Examples include the Colombian Agrarian Reform Institute parcelas carved out of large estates expropriated for the purpose (ILO 1971; Partridge 1978; Escobar Sierra 1972); the famous Mexican ejido or communal land tenure experiment forged in the wake of revolutionary destruction of the hacienda system (Simpson 1937; Whetten 1948; Mejia Fernandez 1973); and the agrarian reform efforts of Bolivia (Carter 1965; Marschall 1973).

(8) Displacement for the purposes of harbor or dam building. Examples include the Tema Harbor project in Ghana where 6,000 were resettled (Butcher and Amarteifio, Whitham 1966); the Aswan High Dam in Egypt which entailed resettlement of 120,000 in Sudan and

Egypt (Fahim 1972; Raheja 1973; Fernea and Kennedy 196); the resettlement of 57,000 in Zambia and Rhodesia due to Kariba Dam (Colson 1971; Scudder and Colson 1972; Scudder 1966, 1968, 1969, 1972,1973); the Akosombo Dam of Ghana which displaced 82,000 (Chambers 1970; Kalitsi 1973; Taylor 1973); the Kainji Dam of Nigeria which displaced 44,000 (El-Zarka 1973; Zajac, Umolu and Grabik 1979); the Kossou Dam of the Ivory Coast that required resettlemtn of 75,000 (Zajac, Umolu and Grabik 1979); the Presidente Aleman Dam and the Cerro de Oro Dam of Mexico's Papaloapan River Basin which displaced 20,000 people in each case (Villa Rojas 1955; Barabas and Bartolome 1973; Camara 1955; Poleman 1964; Nugent, Partridge, Brown and Rees 1978); the Brokopondo Dam of Suriname which displaced 5,000 (Leentvaar 1973); the Yacyreta project of Argentina and Paraguay which is now resettling somewhere around 30,000 (Campbell 1980); in addition, feasibility studies are now completed by the National Electric Power Authority of Nigeria for the largest dam resettlement project ever undertaken, the relocation of over 250,000 as an element of the Lokoja Hydroelectric Project (Zajac, Umolu and Grabik 1979).

Even if the primary mission is to move people from here to there, most population displacements involve more than a single purpose. Although we will not examine cases of disaster refugees nor racial/cultural reservations in depth (since we are dealing here with development assistance impacts), it should be noted that even in these cases the primary mission is soon clouded by multiple additional objectives. Thus the detention of Mau-Mau rebels was transformed into an irrigation scheme with the twin with the further goal of a demonstration effect for local villagers (Korte 1969).

And the veritable mountain of studies on US Indian reservations bear mute testimony to a century of development experiments ranging from family planning to intensive land use, long since obscuring the primary goal of reducing resource amounts controlled by Indians (Jorgensen 1971).

In the cases which are primarily development projects, the same principal holds. At Akosombo the resettlement of 82,000 people was seen by the Agriculture Ministry as an excellent chance to experiment with intensive, mechanized agriculture on a bold scale in the effort to achieve goals of the national seven-year agriculture plan. Since funds for agricultural assistance had to come from the ministry, the Volta Resettlement Authority agreed (Chambers 1970). Similarly, the spontaneous influx of pioneers in the eastern plains of Colombia is seen by the government as a chance to stimulate palm oil, rubber and beef production through the provision of credit, land titling, extension, and other services (Crist and Nissly 1973).

In all examples we are dealing with a complex set of goals and objectives. For some types of development projects population displacement may be a major objective; for others it may be a minor event in a much longer, larger series. Therefore, in order to compare and evaluate the nutritional consequences of development projects, it is important that we first identify kinds of population displacements and trace them to development programs that induce them.

The terms resettlement, settlement, colonization, new lands development, internal population transfer, population displacement, internal migration, etc. are confused and entwined in the development literature. This is partly because terms have different meanings in different parts of the world. In the Phillipines "resettlement"

refers to opening up a frontier jungle region with government planning, administration and assistance programs (Fernandez 1972), whereas a quite similar project in Malaya is termed "settlement" (Ho 1965; Meade 1974). In Latin America "colonization" refers to the same process of public agencies dividing large regions, placing families on the plots thereby created, and supervising, assisting and managing the families in establishing commercially viable hamlets and market towns (Smith 1968). The need is apparent for some convention to systematize our language and discussion in this paper.

We will use resettlement to refer to forced or directed relocation of whole communities or integral segments (not a few selected families) of communities from one site to another. Such programs are always part of large-scale construction projects like dams or harbors or airports, administered and planned by public or private agents, and merely a minor component of some larger national or regional development plan. Resettlement is never a goal in and of itself. We can refer to the affected population as relocatees. The facts that whole communities are impacted, the move is forced, the mobilization and transfer administered by powerful central agencies, and the relocatees of relatively minor importance against the backdrop of assumed development benefits to nation or region, mean that the nature and magnitude of nutritional problems are distinct from other kinds of population displacements.

We will use the term settlement to mean the reverse case of resettlement: the voluntary, spontaneous shift of population from one site to another. Settlement never involves whole communities nor integral parts thereof, but instead involves self-selected

individual and families. Settlements may be large or only a handful of pioneers, may be connected to a larger development scheme or not, but they are always marked by the absence of administrative supervision or public services in the early stage. Settlements occur in areas of low population density, and are often sparked by improvements in transportation links to areas of higher density; in fact, the rumor of an all-weather road on the drawing board is enough to spark settlements along the proposed route as documented in the Papaloapan River Basin (Winnie 1956). We can refer to settlement populations as settlers. After an initial period of hardship and absence of government or private services, the settlers may become the objects of concerted government efforts to raise levels of health, productivity, education, etc. once the land is opened up for middle class immigration. Nutritional impacts of settlement are quite different from resettlement.

We will use the term colonization to refer to population shifts which are planned and administered by public or private agencies from the outset. Colonization schemes always involve selection of participants according to criteria set up by planners; colonists may be evaluated in terms of age, family size, previous experience, capital assets, credit history, or other variables felt to be indicators of potentiality for success by planners. Unlike resettlement such programs never entail whole communities, and unlike settlement such programs are always part of larger regional or national development schemes. The nutritional impacts facing colonists, then, are distinguished from those facing relocatees and settlers.

Summarizing, resettlement, settlement and colonization are

distinct processes with distinct origins, distinctive structures and distinctive consequences:

(1) each is the product of a different kind of development program or project,

(2) each displays a different natural history and evolves through a series of distinctive phases marked by different problems,

(3) and each affects dietary behavior and nutritional status in different ways and to different degrees.

Resettlement

The process of resettlement is the product of construction projects which alter the physical environment by creating reservoirs, borrow-pits, access roads, drainage channels, borders and dikes, spoil areas, straightened river courses and the like. Relocatees must be evacuated, following several years of planning studies which assess sociological characteristics of relocatees, the economic production and distribution system, values of property to be destroyed, as well as the environmental, economic and social conditions of the new sites. This first stage Scudder (1980) calls "recruitment." Relocation is compulsory, so all members of the community are made relocatees (wealthy and poor, at-risk, elderly, etc.), but recruitment is nevertheless an appropriate label because while the majority may accept government resettlement programs a substantial number elect to strike out on their own, thus becoming settlers (see below). In Africa experience shows that only about 10% choose to break away from their communities (Scudder 1973), whereas in Asia some 50% reject resettlement schemes; in Latin America the figure is over 50% (Partridge, Brown and Nugent 1980). The formation of government resettlement communities, then, is based on recruitment of some

portion of the displaced community. While a number of studies exist of relocatees in resettlement communities, nothing is known of those who reject resettlement to strike out on their own (the authors' current research, 1980-1981, addresses this data gap).

The second phase in the resettlement process is "transition" (Scudder 1973, 1980). It lasts from the time when rumors of the move first stir anxieties in affected communities, and ends when the majority of relocatees regain their former standard of living and self-sufficiency. Transition may last several years or several decades, depending upon how successful the government resettlement program is. At Kariba (Scudder and Colson 1972) the relocatees passed out of transition in three years; at Akosombo (Chambers 1970; Kalitsi 1973) where construction began in 1961 the relocatees had still not regained previous standards of living or even a subsistence level of living as of 1973.

Transition is characterized by multidimentional stress (sociological, psychological, physiological) which stems from social disintegration. Some leaders loose credibility by assisting the authorities; the rest loose it when their resistence proves impotent. People respond to the stress by drawing inward, adopting a security orientation, asserting traditional cultural goals, and resisting incentives for further change. Morbidity and mortality rates rise; conflicts ensue with host populations and immigrants drawn to the area; larger than normal social units evolve as people seek assistance and security; and the cultural inventory becomes simplified to basics and any normal tendency to innovate and experiment within that cultural inventory is avoided. The nutritional consequences of this period are related to problems

of food relief, unfamiliar foods, lack of knowledge of resources in the new environment, adequacy of savings, and the perception and understanding of the problem by planners.

Transition ends and the stage Scudder (1980) calls "potential development" begins when social integration returns and new leaders arise and have influence, health conditions improve to former levels, and normal socioeconomic activities guarantee a subsistence income. The end of high levels of stress means that once again relocatees can tolerate normal anxieties associated with the uncertainty that attends experimentation and innovation, forms of risk-taking that could not be tolerated during transition. Potential development begins when relocatees begin experimenting with new production enterprises intended to yield products for commercial distribution locally, regionally or nationally. At Aswan High Dam, while the majority of relocatees have not yet ended transition due to the failure of agencies to deliver promised irrigation water, the Aswan relocatees at New Halfa Agricultural Project after a a transition period of 10 years have innovated credit and supply cooperatives that have produced agricultural yields equal to those in former sites (Fahim 1972). Similarly, the relocatees in one of the five resettlement zones of the Papaloapan River Basin have passed out of transition and through the stage of potential development, marked by normal subsistence crop yields, commercial production of sugar cane and innovative investments in cattle, tractors and trucks (Partridge, Brown and Nugent 1980).

Unfortunately, few other examples of successful transtion can be cited; in most resettlement projects, as Scudder (1980 emphasizes, planners are ignorant of the natural history of the

resettlement process. Government budgets for extension, credit, infrastructure and other services are squandered during transition when the people will not accept further risks; government agents become discouraged due to uninformed expectations of rapid progress; and having lost interest, the government agents then miss the real opportunity to provide useful assistance as relocatees enter the stage of potential development. Examples include the calamitous mechanized agriculture scheme for bush-fallow cultivators at Akosombo, where 60% of the relocatees had to abandon government communities in order to earn a living (Chambers 1970) and the La Joya project in the Papaloapan where over 50% left following conflict between extension agents who insisted on relocatees planting high-value tree crops which took an average of seven years to mature and the relocatees insistence on planting subsistence crops mixed with small quantities of traditional cash crops (Ballesteros, Edel and Nelson 1970).

The final stage is labeled "handing over/incorporation" (Scudder 1980). It occurs when management of production activities and community affairs are transmitted to the second generation and the first generation retires. Scudder also believes that this stage entails the resettlement authority handing over management responsibility for community development to local institutions and relevant government agencies or departments. While we concur with the first proposition, the incorporation of the second generation, because we have seen it happen in the Papaloapan, we do not agree that the local community can accept responsibility for management and maintenance of many services upon which they have become dependant. In Latin American countries central

governments control between 90 and 95% of total public income, and municipal and state governments split what remains (exceptions include Brazil, Colombia and Ecuador where federal budgets range between 60 and 80% of totals). In this region of the world, at least, there is little chance local institutions can ever take responsibility for community development. Of course this not apply to private institutions. Therefore, we take as the indicator of passage into the incorporation stage the transmission of authority to market farm produce, to accept contracts, to make investmer decision, and to sign credit agreement from the older to the younger generation. In projects such as the Papaloapan Resettlement Zone I, this process is taking place now (Partridge, Brown and Nugent 1980), whereas in projects such as the Uxpanapa resettlment zone for the Cerro de Oro Dam of Mexico it will never take place because relocatees who were former free-holders have been transformed into wage laborers on huge government-managed rice plantations. The older generation has no power to incorporate the younger, for it has no authority to manage its own affairs.

Settlement

Spontaneous movement of settlers into a region results from the removal of factors which previously limited the capacities of human communities to survive in the area, or the creation of new tolerance factors in the region of origin which compells some people to leave. Both are the products of development decisions by public agencies, although once the process of settlement begins the agencies play no further role. Highway construction or improvement of a dirt road to all-weather condition removes the limiting factor of isolation from markets, as in the Caquetá

settlement process in eastern Colombia stemming from roads linking the densely populated highlands to the town of Florencia (Crist and Guhl 1957; Tinnermei er 1964; Nelson 1973). The Puyo-Tena settlement zone in eastern Ecuador is an example where several large tea plantations, about twenty sawmills, and four distilleries combined to provide significant employment opportunity in a remote area (Nelson 1973). In Kenya the Seven-Forks Hydro-electric Complex removed the serious limiting factor of tsetse fly in the area immediately adjacent to the Kamburu Dam, through construction related clearing of riverine brush for equipment access, worker housing, spoil and borrow areas, etc. Thus the more moist and fertile soils which had previously been avoided by the local population, which prefered the dry and less fertile uplands, was settled spontaneously and the resulting clearing of homesteads further reduced tsetse habitats (O dingo 1977).

Resettlement projects in remote areas can have the effect of removing limiting factors and sparking settlement, as in Sumatra where government planned resettlment communities failed but the infrastructure, employment opportunities, and the like have stimulated a substantial number of settlements (Utomo 1967). In the Papaloapan resettlement the zones called Nuevo Ixcatlan and Cihualtepec have opened up the entire La Lana-La Trinidad river basin area to settlers (Ballesteros, Edel and Nelson 1970).

When existing, albeit poor, roads are upgraded to all-weather conditions the existing tolerance factors change, thus compelling some portion of the existing population to become settlers elsewhere. This occured in the Papaloapan when roads to market towns were paved; factor markets for land, capital and labor escalated quickly

as cattle ranchers invaded highland valley floors settled earlier this century by indigenous subsistence farmers. No longer able to compete and being unable to reduce fallow time on land they retained, the farmers became settlers on higher altitude slopes (Nugent, Partridge, Brown and Rees 1978). Tolerance factors can also change in government resettlement communities so as to force out large numbers of relocatees who must then settle elsewhere, as in the Los Naranjos irrigation project in Mexico in which the resettlement authority decided that the costs were no longer justified and ceased expenditures to maintain roads and irrigation pumps only three years after recruiting several hundred families to the scheme. Having exhausted all savings, and being left with plots too small to cultivate using traditional technology, the relocatees left to settle elsewhere (Poleman 1964).

The settlement process is described by Nelson (1973) in three stages: pioneer, consolidation and growth. In the pioneer phase settlers are primarily engaged in land clearing and subsistence economies. Housing is poor, infrastructural links to markets still incomplete, the population is unstable as many fail and leave, capital is scarce, health conditions are bad, and settlers have little knowledge of soils, climate, crops or appropraite technology for the area (Nelson 1973). In particular, health conditions are poor because food supplies are uncertain and inadequate, making the population extremely vulnerable to infectious disease (Crist and Ghul 1957).

Consolidation may follow five to ten years after the pioneering phase. It is marked by large crop areas per family, consolidation of holdings (since some cleared areas have been abandoned), and

commercial crop production. Permanent housing, stores, credit, some minimal government services such as land titling, and some small-scale processing industries appear; increased capitalization of production is reflected in livestock purchases. Settlers form organizations, perhaps even municipal governments, which spur the arrival of rudimentary urban services like health care and education (Nelson 1973).

The growth phase may follow five to ten years later. The settlers' success has now stimulated the growth of urban nuclei and a major flow of private capital into the region in the form of commercial activity and industry, and the associated immigration provides a significant market for agricultural products of the settlement. Municipal government is firmly established, as are services such as potable water, electricity, education and health care.

Settlers are self-selected out of communities of origin, and are therefore frequently better off financially than those unable to invest in pioneering (Scudder 1980; Nelson 1973). During the pioneering phase land, capital and labor requirements of production derive entirely from the settlers themseleves, and this tends to select out the families unable to weather the first lean years of inadequate diet, infectious disease and isolation. The result is that by the consolidation phase the surviving settlers are those whose financial resources, health and stamina were greatest. Nelson (1973:285) concludes, "...cases studied indicate...spontaneous [settlement] in peripheral frontier areas can result in relatively low-cost settlement at subsistence levels higher than the lower strata in the more densely populated rural areas."

Moreover, Nelson (1973) demonstrates through a comparison of many settlement projects that timely government assistance at the consolidation phase can intensify the process of development and hasten arrival of the growth phases, as in the Valle de Upano of Ecuador and in the Tingo Maria-Tocache region of Peru. In these cases, government began delivery of critically important services such as feeder roads, extension service, education, land titling, and agricultural credit only after the pioneering phase was complete. The settlers had clearly achieved subsistence production and had developed a market orientation, and thus were highly receptive to government innovations in the area

Colonization

Colonization is a population shift that is planned, assisted and administered by public or private agencies. The development projects which entail the formation of colonies are those seeming to promise production of high value crops for urban or export markets: irrigation schemes devoted to rice, cotton, sugar, etc.; plantations devoted to rubber, oil palm, bananas, citrus, pineapple, sugar, coffee, etc.; and industrial complexes such as fruit packing plants, slaughterhouses and meat packing or processing plants, paper and pulp mills, sugar refineries, tanning plants, etc. which must be located close to their supply sources and therefore in rural areas In short, colonization projects usually involve high-technology, mechanized production, large capitalization, urban markets, and modern corporate and bureaucratic forms of production organization. The colony is generally built before colonists arrive, and they are placed in the uniform housing just as they are assigned places and roles in the production process.

The Federal Land Development Authority of Malaya (FELDA) is

a major successful example. In the 1950's FELDA efforts were directed towards creating "...prosperous farming communities with economically viable farms" (Ho 1965:1), including food crops for family consumption and cash crops. Felling and clearing the forest to create 6 acre lots devolved upon the colonists. But by the 1960's it was realized this process was too slow (4 years to clear and 6 to reach commercial production) and the abandonment and absentee rate too high. At that point FELDA redirected efforts in new colonies towards achieving commercial production as quickly as possible, meaning mechanized clear-cutting of forest, construction of houses, schools, clinics, roads and water systems, and then moving in families selected by a point system who maintain rubber or oil palm seedlings previously developed in nurseries. Commercial production is achieved after 3-5 years of crop maintenance, weeding and fertilizing (Meade 1974). Plot size increased to 10 acres and food crop lands were eliminated, thereby turning the colonists into plantation laborers working under direction of a manager, an assistant manager, a crew of field supervisors, and clerical workers who keep track of payments, loans and shop credits (Ho 1965; Meade 1974).

The National Resettlement and Rehabilitation Administration (NARRA) of the Phillipines has selected irrigation rice farmers from densely populated areas for a colony carved from tropical forest; the colony was to have been in irrigated rice production after 10 years. In fact, after 22 years the colony lands are only 10% irrigated, the remainder being still forested or reduced to grass-infested wasteland due to inexperienced administrators allowing plowing of the thin layer of top soil, cultivating for

two years, and then fallowing the plots only to have them invaded by grasses. More forest was then cut and the cycle continued until watersheds were destroyed to the point that irrigation possibilities remain only in a few areas. About 30% of the colonists abandonded the colony, and have been replaced by squatters (Fernandez 1972).

In Kenya the Mwea-Tebere Irrigation settlement is a colony originally created by the government to detain Mau-Mau rebels, as well as for the demonstration effect of modern rice agriculture in the area. A small pilot scheme tested soil suitability and technology with the result that each of the colonists were assigned 4-5 acres of irrigable soils for rice production and variable amounts of non-irrigable soils for subsistence. Colonists work the rice crop under close supervision of the scheme management, which markets the product and distributes earnings twice a year out of which colonists repay credit given during their first three years of residence. The colony is successful enough that 54% of colonists keep at least one full-time employee in their household, and as new land is opened there is no dearth of applications (Korte 1969).

In stark contrast is the project to create government colonies composed of sedentarized Masai pastoralists in Tanzania, in order to develop commercial beef production. Wells and other management improvements permitted massive build up of the herds until the drought of 1961, at which time the range was so disastrously overstocked as to induce a catastrophic famine taking three-fourths of the livestock and uncounted Masai lives (Talbot 1973). The Senegal government is now creating a similar crisis (Teitelbaum 1977) using almost exactly the same project design.

La Chontalpa in Mexico is a colonization effort to bring

72,000 hectares of tropical land under intensive agriculture. Land rights of resident farmers were dissolved in the 1950's and they were given the choice of joining the colony, designed as an urban center, or leaving the area with an indemnification. The lands were then subdivided into a plantation grid pattern and each colonist given rights to a parcel, which with the provision of credit, technical assistance and machines by the management the colonist must cultivate in either bananas, sugar cane, or other approved crops. Corporate organization results in all decisions over crop areas, sowing dates, labor inputs, fertilizer use, etc. being made by technical specialists. Implementation of policy depends on an agronomist in charge of sections; field supervisors record days worked by colonists who are then paid on the basis of their plot's cash yield. Inputs required by management are debeted to the colonist's account. Colonists also have common rights to pasture and corrals where they can run cattle purchased with their earnings or credit, although cattle production decisions are also made by the section agronomist (Nelson 1973; Hernandez, et al. 1976).

The process of colonization seems to be much more simple than those of resettlement and settlement. The first stage is planning and design by the public or private agency creating the colony. When intelligently executed, as at the Mwe-Tebere irrigation colony (Korte 1969), this stage include pilot experiments on the site before people are moved in. In most colonization efforts planners are not this intelligent; as Nelson (1973) points out, there is no colonization project in Latin America where the site was chosen on the basis of on-site soil studies, pilot experiments or crop testing. The second stage is the placement of colonists in the scheme table

of organization and the beginning of production activity. Few colonies, excepting certain religious sects not discussed here, have been studied beyond this phase probably because none have yet evolved beyond it. The FELDA scheme has as a policy objective the handing over of manangement and maintenance of the plantations to the colonists, but after several decades none of the over 100 colonies are deemed ready (Meade 1974).

II

RELATIONSHIP BETWEEN NUTRITION AND POPULATION DISPLACEMENT

> Development programs, being an intervention into the affairs of nature, will have both intended and unintended consequences; that is to say, they enter the scheme as elements in the ecological dialectic in which all life is enmeshed, and they must be examined as such.
>
> Change itself, creating a necessity for re-adaptation to a complex of conditions, is predispositional to disease, although not necessarily causitive of it.
>
> (Hughes and Hunter 1972)

The proposition underlying this section is that malnutrition should properly be a priority concern of development planners since its eradication and prevention will contribute to the success of development projects and programs. For example, high rates of absenteeism, abandonment and failure of relocatees, settlers and colonists to cooperate with project plans can in many cases be traced to the failure of planners to calculate the nutritional costs of plans which must be paid by affected populations. In support of this proposition this section examines some of the development ramifications of malnutrition in general, and provides an analytical framework for understanding the determinants of malnutrition associated with population displacements brought about by development projects and programs in particular.

The Consequences of Malnutrition for Development

Those advocating changes in nutrition policies have attempted to show that malnutrition is a major obstacle to development efforts.

The thrust of the arguments derives from an extrapolation to the national level of the effect of malnutrition on the individual. Malnutrition, by contributing to illness, impared physical and mental abilities, and a shorter life span, lowers the productive potential of the individual and consequently a country. Investments to improve nutritional standards are therefore justifiable not only on humanitarian grounds, but also as stimulants to economic growth (Berg 1973; Hakim and Solimano 1976).

Other social costs attributed to malnutrition are the added burden placed on already overtaxed health services (Bengoa 1970) and the reduced efficiency of educational systems due to the reduction of mental alertness and physical efficiency (Aylward and Jul 1975; Picass de Oyague 1972). There is substantial evidence that severe malnutrition in infants and very young children can result in retardation in the development of the brain and nervous system which interferes with later learning, particularly when malnutrition is accompanied by other deprivations as is usually the case. Similarly it has been shown that malnourished children demonstrate diminished resistence to infectious disease and are therefore greatly more subject to illness and require hospital treatment more often and for longer periods than well nourished children. It can therefore be concluded that reducing malnutrition would increase the efficiency and improve resource utilization in health and education.

Malnutrition is considered an important contributory cause of the high death rates among children in low-income countries. Several studies argue that malnutrition, by contributing to high rates of child and infant mortality, may be frustrating efforts

of countries to limit population growth (Austin and Levinson 1974; Berg 1973). In many countries a reduced birth rate has followed the achievement of lowered rates of infant mortality. One explanation of this phenomenon is that families are unlikely to restrict births voluntarily unless they are assured of the survival of a certain number of offspring. The conclusion can be drawn that investments in nutrition which lead to decreased infant mortality rates are also likely to result in reduced rates of population growth.

A final argument is that high infant and child mortality rates represent severe pregnancy wastage which results in a loss of energy, both in terms of food energy and human energy, to the country. The caloric costs of the developing fetus, of maternal lactation, and of early growth and development, are lost to the country with the death of the child. Similarly, the mother's care of the child and her reduced work output druing pregnancy represent opportunity costs wasted with the death of the child. Given high rates of infant and child mortality, often as high as 50%, the cost of each child is nearly double that which it could be with adequate nutrition.

Determinants of Malnutrition

Nutrition specialists have given considerable attention to identifying the determinants of individual and family nutritional status, generally concluding that they are complex and varied, and that malnutrition is a result of social, economic and environmental variables (Hakim and Solimano 1976). Several studies, focused on the income variable alone, have shown that increased family income is generally translated into improved family nutritional status; others have noted that modest additions to income may result in

changes detrimental to nutrition (Berg 1970). Other research has pointed to the effects of traditional beliefs and customs and of common behavioral adaptations to development.

For the purposes of this discussion of nutritional determinants, emphasis will be placed on the social and environmental variables, along with the economic exchanges that occur between the variables. Economic exchanges will be measured by the flow of work, of money and of food. The physical environment includes the soil, climate, water, animals and plants surrounding the individual. The social environment consists of the people (outside the individual's family) and human institutions surrounding the individual including voluntary associations, stores, schools and local government.

Human organisms meet their biological requirements for nutrients through a complex interaction with their physical and social environment, extracting nutrients and expending energy in a delicate balance. Changes in any one part of the interaction system will have consequences on other parts of the system. For example, increasing biological requirements for nutrients will create greater demands on the physical and social environments. Changes in more than one part of the system will have greater effects, resulting in more adaptations. The greater the intensity of the change, the more intense must be the resultant adaptations. Movement of people from one place to another has the potential for drastic change and dramatic disaster because it alters all three parts of the system, and thereby disturbs every interaction responsible for meeting human nutrient requirements.

The fragile interaction of the human organism and its physical and social environment as it attempts to meet its nutrient

requirements is largely an artifact of the transformations which nutrients undergo in the process of food acquisition, processing and distribution. Humans are unique among the animals in their propensity for cultural elaboration in matters of food. It is not enough for humans to dig a root out of the earth and eat it. We must first find the right soil, fertilize the earth, plant the carrot seed, weed from time to time, harvest at the right moment and then store the carrots until we want one. Then we must wash it, scrub it, peel it, cut it into pieces, cook it, season it, and share it with a number of friends and family. At other times we will sell the carrot and use the proceeds to buy artichokes, or perhaps trade the carrots for turnips, or give the carrot as a gift and hope for radishes in return.

Even with all this effort we may not meet our nutrient requirements because of biological demands imposed by hard work, extremes of climate, illness, growth, pregnancy or lactation. Because of the infinite number of transformations and interactions possible in different human communities, any change in the physical or social environment or in nutrient requirements presents the possibility of an infinte number of disruptions of the processes of filling nutrient requirements. The consequence of failing to meet those requirements is disease. Failure to adapt to the changes imposed on the system by population displacement results in a deficiency disease, most commonly protein-calorie malnutrition, less commonly a specific mineral or vitamin deficiency.

Attempts to diagram the interactions between the human being and its physical and social environment tend to disintegrate as three dimensions are flattened onto a flat sheet of paper. Still,

by organizing the discussion in a temporal sequence, while at the same time distinguishing between energy flow, food flow and money flow, the process of filling human nutrient demands can be traced and the potential effects of population displacement shown. (In this discussion, the emphasis will be on agricultural nutrient extraction systems, although much of the discussion will be phrased in general terms with application to gathering and hunting societies or to animal raising groups).

Acquisition Stage

At the acquisition stage of the nutrient extraction process, food is still part of the physical environment. Therefore energy and money flow into the physical environment as an investment designed to earn food in return. The physical environment can be seen as a bank or an investment house, in which the people have confidence and in which they are willing to invest on the basis of past history of the physical environment's ability to pay dividends. The social environment limits the kinds of investments that people can make by a set of regulations or conventions which determine how much land an individual has access to, the period of time during which the individual has access, and the limits of access to social resources such as labor from the social pool for heavy inputs such as clearing, weeding and harvesting or the maintenance of large-scale production inputs like irrigation and drainage systems. The investments can be made in terms of human energy input, the input of energy in the form of animal traction, animal manure or green manure, or in the form of monetary investments such as purchased fertilizer, insecticide, herbicide, purchased human labor and the use of fossil fuels to replace human energy. During acquisition

energy also flows from the individual to the social environment, as the individual's work or monetary contribution is often required for the maintenance of systems of irrigation and drainage or to meet reciprocal debt obligations to other individuals for assistance in the production processes such as clearing, weeding or harvesting.

The physical environment's role in the food acquisition stage is to place limits on the investments made by individuals and the social environment. The limiting factors are those which prevent the production of certain foods because of inadequacy of variables necessary for production, such as water, soil or long enough growing period. Limits are also placed on production by tolerance factors which by their presence prevent production, such as high soil saline content, cold or high altitude. These limits not only effect the nutrient production, but also affect the individual and social inputs. Energy inputs are limited by the health of individuals, which is related to aspects of the physical environment such as disease vectors, climate and past dividends of the physical environment reflected in the nutritonal status of individuals and their ability to perform work. Monetary inputs are limited by the physical environment's performance in the past to provide sufficient dividends which could be converted to cash to provide the monetary inputs.

The physical environment returns energy to the individual and the social environment in the form of food. Depending on the regulations of the social environment, the food may be considered the property of either the individual or the society, or a portion may accrue to both. In order for the individual to break even the net flow of food from the physcial environment must be adequate to supply nutrient requirements until the next harvest. In order for

the acquisition process to be truly successful, however, the food extracted from the physical environment must also equal all the inputs, both work and money which the individual invested.

Consumption Stage

For convenience the food storage, processing and distribution processes will be considered part of the consumption stage. During this stage the physical environment provides energy primarily in the form of fuel for food processing. The individual in return must invest energy in its acquisition.

Food is exchanged between the individual and the social environment. The analogy of the environment as an investment house can also be applied to the social environment. Food is invested in the social environment with the expectation of returns. Unlike the physical environment however, loans can be drawn on the social environment's reserves when the physical environment does not meet the individual's nutrient requirements. Just as with investments of labor or money during the acquisition stage, the success of the individual is achieved when the input of food or work is equal to the return from the social environment.

The form which the exchange takes varies from community to community and from individual to individual. Obviously social regulations determine much of the nature of food exchanges. Food sales, purchases, barter and gifts are all heavily regulated in the social environment. The physical environment also regulates the exchange by its productivity. Individuals who do not extract nutrients beyond those necessary to fill their own requirements may not be able to participate in food exchange, although they may still receive food from the social environment based on their past

history of social investments and expectations of future investment.

The potential changes for the nutrient extraction systme resulting from population displacement which might result in malnutrition, and the concomitant responses necessary to produce adequate nutrition are discussed below. Predictions on the likelihood of successful responses to changes are presented and will be tested against the empirical evidence in the third section.

Population displacement disrupts both the individual's physical and social environment, and consequently those exchanges which the individual makes are also disrupted. Furthermore, the individual's propensity to make investments in the physical and social environments are severely altered. Whether these changes will improve or worsen the nutritonal status of individuals cannot easily be predicted, although a few generalizations can be made based on the flows of energy.

With regard to acquisition, the new physical environment will not have exactly the same potentials for investments and returns that the former environment had. The most obvious changes which will affect nutrient extraction are in the nature of the limiting factors. Of these, inadequate land amounts, poor soil, inadequate water and short growing period are the most severe and the most difficult to overcome. The presence of tolerance factors can also change, introducing higher soil saline levels, diseases or extremes of temperature. All changes in limiting and tolerance factors will require adaptation which necessitates higher inputs of work and/or money from the individual and from the social environment. The increased production costs to be borne by the individual can only be met if the health and caloric intake of the individual permit the performance of additional work or if the individual has enough

money to buy the additional inputs of labor, fertilizer, pesticide, etc. Alternatively the individual could be assisted by investments of work and money from the social environment, but as seen above this is quite unlikely as other individuals operate under the same constraints and the social mechanisms for mobilizing energy of the social environment are disintegrated. Moreover, individual investment as well as social investment are limited by the confidence that individuals and society have in the physical environment's ability to pay returns, which is uncertain at best in a new environment.

Larger production costs required to overcome environmental limiting and tolerance factors, such as irrigation or drainage, terraces, or extensive ground cover clearance can only occur through the social environment's ability to generate investments by people. In the case of population displacement, the local community lacks this capacity.

The nature of population displacement is such that often neither the individual nor the social environment is able or willing to make the additional investments of work and money in the new physical environment which are necessary to reproduce or produce adequate nutritional status. Individuals selected for participation in colonization schemes are often chosen, at least in part, on the basis of their poverty reflected in poor nutritonal status and lack of monetary resources. The self-selected settler is more likely than colonists to have either resources of energy for work or money to invest in the new physical environment. The relocatee may also be in a better position since poverty is not a uniform characteristic of whole human communities resettled. Individual willingness to invest work or money, however, is limited in any displaced population

since there is no way to predict the return on investments in the unfamiliar physical environment.

The investments from the social environment will vary among the types of displaced populations. The colonists' social environment makes quite large investments in the form of irrigation and drainage systems, large-scale clearing of plantations, machines, fertilizers, herbicides, and food and money; the expectation in all cases is that colonist incomes will be high enough to return these investments at a later time. This applies of course only to the public or private corporation financing the colony, for the local community of colonists rarely achieves sufficient social integration apart from the production organization itself to permit confidence levels to rise to the point where repayment of investments is predictable. Exchanges among colonists are rare. This is so not only because the local social environment is unpredictable, due to absenteeism and abandonment rates in the main, but also because colonist incomes remain quite small in relation to high levels of productivity achieved and high values of the products.

The settlers' social environment is equally unable to invest in the physical environment. The voluntary settler is unlikely to invest in the social environment not necessarily because of poverty, but because of an unwillingness to invest in unpredictable social institutions which may or may not be able to drawn in further investments from outside the settlement. Investment from the larger social environment is, of course, absent in the early stages.

Resettlement community social environments are best able to invest in the social environment. Since individuals are most often resettled as a community or integral parts thereof, their old social environment

is likely to retain some degree of credibility and be best able to attract individual investments of work and money to apply to production. Given growing familiarity with the physical environment over time and the achievement of subsistence levels equal to the past, the relocatees may be in an excellent position to make large investments in the social environment. At the same time, the resettlement community may be in a good position to attract investments from outside the community, in that government agencies may have made large investments already in the physical environment and may have been negotiating with segments of the community regarding further investments for some time.

At the consumption stage energy in the form of fuel used for processing food flows from the physical environment in exchange for individual work or money. Changes in the availability of fuel in the new physical environment will alter the amount of work or money the individual must return to the physical environment.

The major exchanges in the consumption stage occur as food and money are exchanged between the individual and the social environment. In functioning, pre-move social environments individuals produce food or earn money to buy food, investing a portion in the social environment often in obligatory fashion with the expectation of being repayed either immediately or at a later time. Changes in the social environment accompanying displacment disturb these exchanges which serve to supply an individual's nutrient requirements throughout the year. Alterations in a social environment may reduce either the amounts of food or the amounts of money available for redistribution to an individual who is unable to produce enough food to meet requirements or earn enough money to buy it. Social institutions which cannot redistributed food suffer from a deficit

of food, an unwillingness to share food, or a lack of an avenue for redistribution. A food deficit can occur when individuals can or will not invest food in social institutions or when institutions cannot attract food investments from outside the community. The first case, of individual inability to invest food, is a production problem and was discussed above. The second case, unwillingness to invest, reprsents the individual's lack of confidence in the social environment to repay investments, and the social environment's lack of confidence in the individual to repay. This reciprocal mistrust is more commonly present in colonization and settlement communities. The third case, that of lacking an avenue for food redistribution, occurs more commonly in settlement communities where individuals lack an organized social environment which would include food redistribution associations.

Failure to attract food investments from outside can occur in displaced populations when the social environment is too remote to make sale from the outside profitable or when it cannot attract food investments due to lack of confidence. The first case, of remoteness from food markets, occurs often in resettlement and colonization schemes not provided with adequate roads. This isolation may be less common is settlements because settlers are attracted to a region because of proximity of roads. Outside food investment from government or international donors is intended for redistribution to individuals. Settlement communities are at a disadvantage since they lack a visable social environment which attracts these investments. Colonist and relocatee social environments are more likely to receive food investments from outside, just as they are better able to attract production investments.

The failure of a social environment to have money for

redistribution to individuals who do not produce or are unable to purchase adequate food nutrients can occur as a result of population displacement due to low incomes and high expenses associated with the move. There can be a deficit of money among individuals, an unwillingness to share money and a lack of avenues for monetary distribution. The unwillingness to share money and lack of avenues for distribution share characteristics with food redistribution failures covered above. The lack of money available for redistribution is a production problem indicating errors in investment strategies in the social or physical environments.

Failure to attract outside money investments is a less common problem for transferred populations. Settlement communities often locate themselves near roads which give them access to markets and outside employment. Resettlement communities and colonization schemes are often the recipients of large monetary investments from outside agencies in the form of loans, salaries and in the case of relocatees compensation for property lost.

III

EVIDENCE FOR NUTRITION IMPACTS

> Changes in traditions and cultural habits, especially those pertaining to agriculture, can be indicators of impending nutritional improvement or disaster. These factors are all-pervasive and range from the techniques people use to grow their food, to what they grow, how they harvest it, how they store it, how they market it, and how they prepare it for consumption.
>
> (May 1974)

The empirical evidence of nutrition impacts in resettlement, settlement and colonization projects is incomplete, rarely systematic and not always scientifically sound. Yet enough scientific work has been done to point the way to some of the serious consequences and some of the policy considerations.

Scientifically sound assessments of nutritional impacts of population displacement must encompass four linked elements: (1) change in nutritional status must be demonstrated either by comparison of current conditions to baseline conditions or in the absence of baseline data comparison of current conditions of affected populations with current conditions of unaffected; (2) dietary composition and its derivation from the production and distribution activities of the populations must be analyzed; (3) anthropometric data showing the physical changes in nutritional status indicators must be recorded; and (4) the distributional characteristics of dietary and nutritional status within the socioeconomic segments, sectors or classes of the population must be presented.

Unfortunately, most evaluations on the subject of human consequences of resettlement are unsophisticated in matters of human health, frequently gathering data only on infectious disease and failing to recognize that at base good health is not the absence of disease but the capacity to rally from disease (Audy 1971). That capacity is the product of fundamental health status which is in large part determined by adequate nutritional status. Failing scientific,sound data collection on nutrition, what we usually find in the literature are anecdotal observations or undocumented general statements about diet. In some cases, however, we have good data. We will present below what is known of nutritional impacts at each stage of the three types of population displacement processes.

Resettlement

Despite large budgets, no public or private resettlement authority has ever collected baseline data on nutritional status of the relocatees. During the recruitment stage it would seem that health of the relocatees would be a major consideration in project planning, but this has never been the case.

During transition dietary deprivation can be quite severe. With the exception of Kainiji Dam resettlement in which no food relief was provided to relocatees, all resettlement projects entail food relief for periods ranging from one season to nine years (Zajac, Umolu and Grabik 1979). In the Papaloapan resettlement relocatees were provided with enough grain to carry them to the initial harvest (Villa Rojas 1955), whereas at Kariba food relief continued for two planting seasons (Scudder and Colson 1972). At Aswan food relief continued for 5 years in Egypt and for 7 years in Sudan; at Kossou food relief was discontinued after 3 years; and at Akosombo food

relief lasted for 9 years (Zajac, Umolu and Grabik 1979). It is probably no coincidence that in the three projects involving relatively short or no periods of food relief, Kariba, Kainiji and Papaloapan, the majority of the relocatees were encouraged by resettlement authorities to perpetuate traditional subsistence technologies. In the cases of prolonged food relief, indicative of major failure of production systems and therefore major problems with meeting nutritional requirements, Aswan and Akosombo, the relocatees were compelled to innovate commercial production systems and depend upon cash income earned to satisfy nutritional needs as well as purchase expensive production inputs. The latter cases even in the absence of nutritional status data can only be considered as human health and nutrition disasters; we can only know for sure when the incidence, duration, magnitude and distribution of dietary deficits and nutritional diseases are measured.

To our knowledge, there have been no empirical studies of the potential development stage either. This is not only because field researchers have not been on site at the right times and planners have ignored the problem, but because in projects like Aswan and Akosombo the vast majority of resettlment communities have never left the transition stage.

Our knowledge of the handing over/incorporation stage is more complete. In the Papaloapan resettlement communities we have completed socioeconomic and nutritional impact assessments some 25 years after displacement. The Aleman Dam was completed in 1954, and between 1953 and 1954 five resettlement zones were established for approximately 20,000 Mazatec people (Villa Rojas 1955; Camara 1955; Poleman 1964; Nugent, Partridge, Brown and Rees 1978). Since no baseline data was collected, we constructed a controlled

comparison of two Mazatec communities: one located in a region unaffected by the dam and reservoir and one resettled to an area near the base of the dam called Resettlement Zone I.

The relocatees studied numbered 224 families of farmers and their client-day-laborers living in a hamlet named Las Margaritas. They passed through the stage of transition between 1954 and 1963, the latter data being the point at which presidential decrees were issued granting legal title to 166 household heads in the three ejidos which constitute the land base of the hamlet. Day laborers were not given plots, unless men on the ejido rosters already did not appear to claim their rights to plots, in which case the vacancy was filled by a day laborer. During transition they achieved subsistence security on the 10 hectare plots alotted, and utilized the traditional faena or collective work party to build a new church, an elementary school (with materials provided by the National Indian Institute) and local offices for ejido officers. The stage of potential development began after legal titles were secured. The relocatees innovated commercial sugar cane cultivation for a nearby refinery, acquired credit through the National Indian Institute for the purchase of a truck and a tractor, and secured credit from the Rural Credit Bank for purchase of cattle and pasture improvement. At present the handing over/incorporation stage is taking place, marked by the death and retirement of the first generation of relocatees. Younger men now occupy offices in the three ejido organizations.

The unaffected community is an ejido in the largely Mazatec municipality of San Felipe Jalapa de Diaz, located about 40 km from the dam and 20 km from the reservoir. Some 78 ejido families

farm 5 hectare plots, and 80 families of landless day-laborers sell their labor to the farmers. The community is typically Mazatec in that marriage is endogamous, few women are bilingual, and almost all farmers are commercially oriented. All farm produce is marketed either to the Rural Credit Bank in satisfaction of advanced-purchase credit contracts or to large-scale Mazatec and mestizo shopkeepers in Jalapa de Diaz. All farmers plant corn, and the entire crop is delivered to the Bank and none is withheld for household consumption. Food eaten is purchased from shopkeepers.

Comparison of production systems, in terms of technology, yields, costs and income, reveals differences in income distribution in the two communities. In the resettlement community sugar cane is grown on poorer soils using inputs supplied by the refinery; labor from the community is the only cost not deducted from profits paid at time of delivery of the crop. Corn is grown on alluvial soils, where yields range from 1500 to 2000 kilos per hectare, with little weeding and no chemical inputs. In the early years land was prepared by day laborers and farmers, but since the stage of potential development began tractors have been used. Corn is sold on the open market, with an amount withheld for household subsistence needs. Declining labor needs of ejidos has meant the landless must depend upon seasonal labor outside the community. In the unaffected community corn yields are a low average of 750 kilos per hectare. Poorer soils require a more traditional technology, a fallow period of 2 years, and intensive weeding to combat grasses. Upon comparing costs of production per hectare we discovered that relocatees spend 41% of total production inputs on labor whereas unaffected farmers spend 81% of total costs on labor. Therefore, we find greater disparity in distribution of incomes in the resettlement community.

Anthropometric measurements, weight, height, weight-for-height, were taken of a 1% sample of children in each community. Data were compared to the corresponding Boston standards (Vaughn 1975), and all children were assigned a Gomez classification based on their weight-for-age (Gomez, et al. 1955). The results show a larger percentage of adequately nourished children in the resettlement community (18.5%) than in the unaffected community (16.5). First degree malnutrition affects 50% of relocatee children and 67% of unaffected children; second degree malnutrition characterizes 31% of relocatee children and 16.5% of unaffected; and third degree malnutrition affects 0.5% of relocatees and no unaffected children. We conclude that a greater proportion of children are better nourished in the resettlement community, but that the severity of malnutrition is also greater in the resettlement community. More uniform incomes in the unaffected community and greater disparity of incomes among relocatees seem to fit the data on nutritional status. Dietary surveys revealed few significant differences in food habits, so we conclude that the differences can be explained only in terms of total caloric intake, which is the variable with high sensitivity to income levels (see Partridge, Brown and Nugent 1980 for fuller explication).

In summary, resettlement entails different nutritional problems at different phases. In the early phases food relief is needed to prevent disaster, and in poorly designed projects food relief must continue. In later phases of well designed projects some relocatees emerge as successful producers who innovate and raise levels of productivity, income levels, and nutritional levels for their families. There is a higher incidence of such cases as com-

pared to former conditions. For a large proportion (about 30% of other relocatees) however, the severity of malnutrition actually deepens. Out-migrants from resettlement communities to urban areas come from the families suffering low incomes and high incidence of nutritional disease, as revealed in follow-up studies of scheme abandonment (Partridge and Brown 1979).

Settlement

Settlers face a different set of problems than relocatees. They choose to pioneer remote lands, presumably calculating the chances for success against their current conditions. Since population movement in the pioneering phase is spontaneous, the literature is largely silent on the nutritional impacts; no observers are present to record baseline data or initial impacts. Crist and Guhl (1957) recorded anecdotes related by settlers who remained in the eastern plains of Colombia, which testify to the several years of hunger endured while land was being cleared and brought under cultivation. Utomo (1967) presents similar anecdotes of the deprivation suffered by Javanese settlers in Sumatra. But to our knowledge there is no empirical data in the nutritional costs of the pioneer phase of settlement.

During the consolidation phases, however, we have good research results from the Seven-Forks Hydroelectric Complex settlements in Kenya (Odingo 1979). The Kamburu Dam was completed in 1975, one of three projected in close proximity on the Tana River. The 1969 population census provides no population estimate for the area, but merely designates it "Tsetse Area", meaning no one lived there. A decade later, after construction-related clearing of riverine bushes for equipment access, worker housing, spoil and borrow areas, etc., the tsetse habitats were sufficiently reduced to encourage the

spontaneous settlement of 5,715 people, about 78% of whom live in two major market centers and the rest of whom are scattered in small hamlets of 15 to 80 families.

This is traditionally one of the "famine lands" of Kenya, and previous to the settlement the regional population was confined to the uplands away from the river and the tsetse. Soils in the upland are poor and moisture content too low to permit grain cultivation other than of millet cultivated in a bush fallow farming system. The settlers came largely from these upland hamlets in the immediate locale, only 24% coming from distant areas of Kenya. The construction-stage worker population is now largely dispersed and the settlers are predominantly subsistence agriculturalists, growing corn (accounting for 75% of cultivated land), Mexican pea beans, pigeon peas, castor, and cotton on an average of 1 hectare per family. Settlers aim to be self-sufficient in maize and beans, and invest cash crop earnings in livestock. Most families have about 4 cattle, sheep or goats, and the livestock herds are gradually building in the area where livestock were rare 10 years ago. As cultivation expands the cleared area, more tsetse habitats are destroyed, permitting further colonization. The major limiting factors preventing rapid growth now are moisture content of the soil, which is sufficient for corn only on the reservoir margin, and the availability of hardwood trees to make charcoal for cooking.

Dietary and nutritional assessments were carried out in 1974-1975; anthropometric measurements were taken three times over an 18-month period in order to capture seasonal variations. A control group was also studied which was composed of families in an upland hamlet 10 km from the shoreline. The results show that 28% of the children measured in the study group were malnourished in the first survey, compared to 34% of the control group. In the study group all four parameters measured showed a worsening after the first six

months; the month of May, when the second survey was made, represents the "hunger season" when harvest stores have been exhausted and rains just beginning. The measurements of the third period show an improvement in the study group. Height-for-age, arm circumference-for-age, and weight-for-height deteriorate during the hunger season but then improve to former levels. Only weight-for-age fails to show an improvement. That the study group was able to recover from the effects of the rainy season after the second six months indicates a better diet than the control group. In the control group, weight-for-age continues to worsen throughout the study, in the same pattern as in the study group. But weight-for-height and height-for-age also show no improvement in the control group; only in arm circumference-for-age is there improvement after the second six months in the study group.

The results indicate a consistently better nutritional status in the settler community compared to an older, established community of the same region. The effect of seasonal change is clear in both groups, but only the study group recovers adequately. That this is a viable settlement from the perspective of human health seems clear when comparison is made to other kinds of communities in the area. It should be noted, however, that in the consolidation stage families are still actively engaged in building their farming systems and males cannot be spared, whereas in the control community a high incidence of male out-migration in search of work is observed. There are also differences in the care of children, in that the study group mothers more often bottle feed, include animal protein in the weaning diet, and immunize their children.

We are not aware of empirical research on the growth stage of settlements.

In summary, the evidence from the few studies of nutrition

in settlements indicates that initial hardships may be severe, but settlers do achieve viable adaptations to the new lands settled. The evidence also indicates substantial improvement over previous health and nutrition conditions. The absence of studies of mature settlements prevents any generalizations about the distributional characteristics of settlement nutritional impacts. It should also be noted that the evidence permits us only to speak of cultivators, and that in the case of nomadic or seminomadic pastoralists the nutritional consequences may be quite the reverse (Teitelbaum 1977).

Colonization

While the processural structure of colonization schemes is not well understood, evidence of nutrition impacts is greater than for resettlement and settlement. The weight of the evidence is that nutritional costs are high in poorly designed colonization schemes, and that nutritional benefits are also high in well designed colonization schemes.

The Federal Land Development Authority (FELDA) projects in Malaya have been studied by Meade (1974, 1976) in terms of impacts on human health. The colony chosen for study was Gedangsa, a rubber tree colony, which was compared to Selisek, an administrative center composed of 12 villages not pertaining to FELDA. Schemes are usually developed in phases, so that on the Gedangsa scheme there were colonists already harvesting their rubber crop, colonists tending seedling lots, and houses under construction and forest being clear-cut for the next group of colonists. Until the crop is mature enough to harvest, a monthly allowance of Malaya $69 is provided and added to the development loan account of the colonist; after a commercial income is achieved, a prorated proportion is deducted monthly from the income for debt payment. Colonies are nucleated and constructed with houses, schools, clinics, access roads, and water systems; plots are

prepared and planted for the colonists; and for the first few years after their arrival management and field supervisors require only that the colonists maintain the rubber trees. When the crop matures, monthly income is quite high compared to non-scheme areas. However, even in bad years, the basic income of colonists is maintained through the continuing development loan. Colonists on the scheme display a wide variety of incomes reflecting the stage of maturity of their trees.

Health as measured in terms of morbidity due to infectious disease is superior to non-scheme communities, with the exception of enteric disorders, which despite sanitation facilities on FELDA schemes, remain about the same as in non-scheme communities. Most latrines are not used, and children from homes where they are used contract diseases in schools. Health as measured in terms of nutritional evidence is not well understood since no anthropometric surveys were done; one survey completed in the non-scheme community was uninformative except for the observation of "several cases of frank malnutrition." Colonists do not cultivate plots for their own subsistence as a rule, but buy food at colony stores and grow only tapioca on house lots, in ravines, and in adjacent vacant lots. Managers have pressed colonists to raise vegetables, with no success. The colony store stocks only dried foods and no fresh produce, meat or fish. This has attracted a merchant whose van visits periodically to supply several unofficial shops, but merchants are reluctant to deal in perishable goods and only one or two vegetable items and one kind of fish are carried. No fruit is available in the colony. With the passage of time it is expected that, as in other more mature schemes, an all-weather road will link the scheme to urban markets so that the availability of food will be better. Until that time, colonists will pay from 10-20% higher prices for their limited diet.

No empirical evidence is available regarding the severity, incidence, duration or distribution of nutritional disease.

Our data for the Plan Chontalpa, on the other hand, are quite good. This colonization scheme has achieved enormous increases in productivity in a hot and humid tropical zone of southern Mexico: production on the colony's banana plantations has risen over 17,000% between 1958 and 1971; sugar cane production is up 994%; cocoa production is increased 231%; and so on (Hernandez et al 1976). Indeed the project might be declared an economic success if the capital investment by the Mexican government had not made it one of the most expensive regional development projects in the country (Nelson 1973). From the perspective of the colonist, however, spectacular productivity increases and huge public investment in the region is of less importance; income has remained stable over the 13 year period, for the Plan Chontalpa is a classic example of urban development that happens to be situated in a rural setting. The colony is designed to produce cheap food for urban consumers (Hernandez et al 1976).

The colony is administered by the Grijalva Commission, a federal regional development agency, which initiated the project with a large drainage system to bring the rich alluvial soils of the Grijalva Basin under plantation crops. Land was expropriated from resident farmers who were given the choice between joining the colony or accepting indemnification to leave the area. Farmers were then relocated to an urban center, the lands were divided into a plantation grid system, and plots were assigned to each colonist. The Commission directs all agricultural activities, and the colonist draws a wage based on the productivity of his plot.

In 1958 Hernandez and colleagues (1976) carried out baseline studies in the urban center and in a rural hamlet. They returned

13 years later to measure changes. The data collected included food consumption records, food costs, nutrient content of foods eaten, and anthropometric measurements as well as basic demographic and socio-economic data. The results indicate that change in nutritional status has taken place. The rate of infant mortality, which is a good indicator of the avavilability to food, has been halved; but it was also noted that malaria was controlled during the same period, potable water supplies were introduced, and the urban center now has a hospital. Diet in general underwent little change. The urban center population has quadrupled due to the influx of colonists as well as urban employees of the Commission and commercial immigrants. These immigrants do not eat the traditional foods of the region, but the colonists continue to consume the same foods. Amounts of food consumed changed. Less corn is grown and eaten, more bananas are consumed, meat and milk consumption which was already quite high in 1958 are even higher on the average in 1971. Still, about 42% of families in 1958 consumed no milk; this fell to 35% in 1971. About 33% consumed less than 55 grams of protein per day in 1958, and this fell only to 31%. So about 30% of the population has not participated in improved average dietary conditions.

The anthropometric data reveal that 13% of preschool children received adequate diets in 1958, whereas 30.6% were classified as normal in 1971. Similarly, 60.9% of the children suffered first-degree malnutrition in 1958 compared to only 46.1% in 1971. Clearly, the immigrants' offspring, Commission employees and commercial elites, have pushed the percentage classified as normal upwards in 1971. Yet it is also true that some movement from first-degree malnutrition into normal probably occurred. The proportion of children with second and third-degree malnutrition remained substantially the same: 26.1% in 1958 and 22.5% in 1971,

a difference that is not statistically significant. The study concludes that explosive economic growth has favored only the managerial and commercial sectors of the colony, and agricultural change failed to improve the diets of those working in agriculture.

Nutritional studies on the Mwea-Tebere Irrigation Settlement provide a different interpretation of the nutritional impact of colonization. Korte (1969) shows that good project design and administration have led to improved diets for most colonists when compared to non-scheme villagers in the same area. The reasons are found in site selection on the basis of soils studies, a lengthy pilot project to test the suitability of soils for irrigated rice farming, and a project design which allows the colonists to independently farm on non-irrigated plots to which they have legal rights and to carefully supervise irrigated farming. Therefore, colonists produce maize and beans as a dietary staple on non-irrigated land, while rice is grown under colony management direction on irrigated land. Home produced food lasts throughout the year for 60% of the colonists, and in the lean times rice is substituted for corn and beans to fill the gap. In contrast, only 20% of the non-scheme villagers produce sufficient grain for the entire year, and no rice is grown. Anthropometric measurements were taken, but these are reported as "overall averages" and are therefore quite useless for our purposes.

Korte (1969) concludes that comparing the colonists with the non-scheme villagers, the economic and nutritional progress is good. Income is increased, luxury goods are present, 54% of the colonists have sufficient resources to house a permanent laborer in their home, more money is invested in education, mortality rate

is down, and there are no longer intermittant periods of famine. Caloric requirements are met throughout the year. It would of course be helpful to have anthropometric verification of these dietary observations in order to consider the severity, incidence, duration and distribution of nutritional diseases, if any. Still, we can conclude that the Mwea-Tebere colonization scheme appears to be successful in terms of nutritional improvement.

IV

RECOMMENDATIONS

There is often an association of malnutrition with population displacement, created by disruptions in the physcial and social environments, and compounded by higher individual caloric requirements due to heavy work loads, stress and disease. The traditional nutritional solutions — by direct intervention — generally give short-term effects, and have only a marginal impact. Sustained impact can only be achieved through mainsteam development efforts in which improved nutritional status is a project goal. At the moment, the resouces invested in development by government and international donors do not necessarily have a beneficial effect on the nutrition of displaced populations. More resource commitment and better use of these will both be needed to reduce malnutrition in displaced populations.

Opportunities for improving the nutritional design of projects occur at several stages in the temporal history of population displacement, and the number and kinds of opportunities will vary between resettlement, setttlement and colonization projects. The general project stages for nutrition improvement opportunities are:

(1) Design

(2) Survey

(3) Pre-move

(4) Move

(5) Food Relief

(6) Monitoring and Assessment

Specific recommendations for nutritional improvement in displaced populations and their expected effects follow.

(1) Design

Considerable effort has been devoted to formulating prescriptions for improving nutritional status in developing countries, some of which can be adapted for use in planning for population displacement (AID 1973; Berg 1973; FAO 1978; Joy 1973; Levinson and Call 1971). With some variation, the planning sequence generally includes the following steps: A. Problem Definition, B. Establishment of Plan Objective, C. Comparison of Alternative Measures, D. Final Selection and Integration of Measures (Hakim and Solimano 1976).

A. Problem Definition. The objective in population transfer should be to minimize the amount and severity of changes in the social and physical environment to which the displaced individual must adjust. Following that, changes that must be made should maximize the individual's resources of food, work and money which can be invested in new social and physical environments.

B. Establishment of Plan Objective. The first-stage level of analysis must define the target population and the likely impact of the project on nutrition of that group.

B.1. The definition of target group means those individuals whose food consumption could be expected to change within five years as a result of the project, and not people who secondarily may have access to the products of the project (FAO 1978).

B.2. Target groups should be defined by more than geographical area. Specifications should be made by subsistence base, resource endowment, etc. In some projects a number of distinct target groups may be defined; impacts on these should be considered separately.

B.3. After the target group has been considered, investigation should turn to the nutritional impact of population displacement on non-target groups. Negative impacts only are considered, since positive would be a bonus (FAO 1978).

B.4. Nutritional impact can be assessed on three factors at the household level: consumption of purchased food, subsistence food consumption, and nutritional requirements. The likely change in these three factors should be assessed. The effect on purchased food consumption is primarily one of available income to purchase an adequate diet and the availability of food. In some schemes the availability of food may be as much a limiting dietary factor as income available for food purchases. Subsistence food effects are a combination of the resources available for growing these crops, including time and land, as well as the probability that crops will be consumed rather than sold or bartered. Food requirements can be estimated as the likelihood of increased nutrient requirements due to increased workload, increased family/household size, of the effects of extreme temperature, altitude, disease and stress. A positive impact is indicated by an increase in either the income or the amount of subsistence food produced and consumed, provided that the other two factors remain constant. An increase in either income or subsistence food, with changes in the other two factors (e.g. nutrient requirement and subsistence food or nutrient requirement and purchased food) may not provide an adequate diet and may in fact be a cause of poorer diet. For a positive impact via increased consumption of purchased food, it is necessary to propose that incomes will rise faster than food prices. An increase in subsistence food consumption may be likely if the project increases farm food

crop productivity through intensification or increased land cultivated, and the farming family had previously experienced a substantial food deficit. In other circumstances the subsistence element may remain constant and the surplus sold. In either case a positive impact is expected, unless nutritional requirements rise concomitantly. A negative impact on nutritional status is indicated by a decrease in subsistence food or income, either by itself or with the worsening of the other factor. The main cases where subsistence foods may decrease areprojects involving a shift to cash crops or resettlement to a new habitat. The two possibilities of consequent risk in these cases are then whether food for purchase will be available without supply constraints causing price inflation and whether the agricultural products promoted by the project are as reliable as the previous products. Negative impacts on a non-target group may be the result of ecological impacts over a large area, economic impacts, or health impacts. Examples of ecological impacts affecting non-target groups could be deforestation, soil erosion or salination by irrigation projects. Water development schemes will affect present users such as those whose supply is tapped for irrigation; farms downstream of an irrigation project; fishing populations downstream from a dam; nomads where grazing land is enclosed. Target populations may also alter market and price factors within the region by raising food prices or lowering prices of food crops produced by non-target groups. This situation is likely in large-scale colonization and resettlement projects where income generation is substantial and a significant proportion of the target population benefits.

C. Comparison of Alternative Measures. The main purpose of comparison of alternative actions is to determine whether additions

and modifications to the project design could increase its positive impacts on nutrition of the target group. The output of this stage should be an improved project design having an optimum chance of producing nutritional benefits. For a comparison of the nutrition conditions of the proposed project target group with other groups who could become project targets, three types of data must be collected in a socioeconomic and nutritional survey. These are data derived from household budget survey (food expenditure, food intake), food consumption data as determined by weighting food as it is consumed by the household or by recall methods, and anthropometric data for evaluating nutritional status. Second-stage analysis of the project impacts on nutrition of alternative target groups is broken down into three factors: purchased food consumption, subsistence food consumption and nutrient requirements. This analysis require explicit hypotheses as to how the project will affect all three.

(2) Survey

If a socioeconomic and nutritional survey was not done before the second-stage analysis during the design phase, it should be performed at this point in order that the results can be used in detailed planning and execution of the displacement operations.

A. Appropriate staff should be recruited and trained in advance in the collection of dietary and anthropometric data.

B. Data concerning the number of family members and livestock should be confirmed by agency personnel and native authorities.

C. Data should be collected on household expenditure for food, household food consumption, subsistence yields, and food distribution within the household and between households of the community.

D. The nutritional status of children and adults, but in particular of children under the age of three years, should be measured through the collection of anthropometric data. This is necessary in order to assess the current nutritional status so as to highlight problems and to draw a baseline for later measurements of change. The assessment can be used to choose a healthy segment of a population, to diagnose individuals for treatment of deficiency disease, to identify at-risk segments of the population for future food relief programs, and to establish nutritional requirements for food relief and other programs. Baseline data can be used at a later stage to measure the socio-economic and agricultural impact of displacement on nutritional status and health, to measure the influence of particular project elements on nutrition and health, to measure the influence of changed patterns of endemic and epidemic diseases on nutritional status and health, to measure the flow of new food sources and their impacts on nutritional status, and to measure the adequacy of food relief and other direct intervention programs.

(3) Pre-move

Displaced persons encounter many dietary problems in their new environment which are related to their inability to purchase of produce traditional foods. In some cases this is compounded by religious beliefs which concern dietary behaviors. In order to overcome the social dietary problems development agencies should before the move:

A. Inform prospective relocatees and colonists of social and physical conditions in the new environment which may necessitate changes in food habits.

B. Analyze typical diets to determine inherent nutritional deficiences and incorporate the results into recommendations for possible dietary modification.

C. Encourage the domestic production of preferred foodstuffs, and suggest substitutes for unavailable foods.

D. Conduct nutrition education in the schools which is integrated with school feeding programs.

E. Provide nutrition education and child diet sheets in native languages for parents and incorporate mothercraft centers into infant and child welfare clinics (Freedman 1973).

(4) Move

In the cases of long journeys, temporary camps can be provided to distribute food and drink. Otherwise, transportion allowances should be paid the population before the move to permit them to purchase food for the move. Even if people are moved with crops harvested on their old farms, it would be desireable that at their arrival in the new areas there be a stock of provisions as well as firewood or fuel for cooking.

(5) Food Relief

Food relief can become one of the most expensive costs of resettlement, as at Akosombo where it continued for nine years. Given the high costs involved and the difficulty of ending it, careful planning must precede, and monitoring accompany, food relief programs.

A. After human and livestock censuses are completed, estimates of the amount of foodstuffs needed for relief can be made by dertermining the Recommended Daily Allowance of nutrients for each of several categories (infants, children under the age of

five, older children 5-12, adult males, adult females, pregnant and lactating females), multiplying those requirements by the number of people determined by the census in each category. The requirements are then converted into actual foodstuffs, providing estimates of food requirements which can be multiplied by the estimated period during which food relief will be needed.

B. The foods chosen for food relief should conform as much as possible both to the native diet and to the needs of the population. That is, acceptability, availabilty, transportability, storage capacity as well as ease of preparation.

C. When unfamiliar foods must be included, local people should be trained to prepare these in traditional acceptable dishes. They can then assist in the distribution so they can inform the people of food preparation methods.

D. Follow-up visits to the homes should be made to determine whether to food is actually being consumed, or whether it is being traded or sold in order to obtain more valued foodstuffs.

E. Anthropometric monitoring of children should continue during the relief period to assess the adequacy of the diet, as well as the distribution system in community and household.

F. Animal feed requirements can also be counted, multiplied by the numbers of animals determined from the census, and the number of days that food will have to be provided before the people are able to provide livestock feed themselves.

G. It should be made clear to the people that food relief is intended to be temporary. A predetermined date can be set at which time relief will cease, at which time it would be wise to conduct socioeconomic and nutritional surveys of samples to see if it can.

(6) Monitoring and Assessment

Monitoring of the nutritional status of small children should be continued on a regular basis past the initial food relief period. Periodic socioeconomic data on household food expenditures and food consumption should also be conducted. These data can be compared to baseline data for the same community to measure the agricultural and socioeconomic impact of the project, the measure the influence of changing disease patterns, and to measure the influence of new food sources as these become available in order to reconsider and alter project plans so as to maximize nutritional well-being.

At periodic intervals, a complete assessment of the project should be made. Results of these long-term assessments can be used to evaluate original goals, techniques of implementation, and program elements and to make adjustments which may improve the success of the project. Such assessments can also be used in the planning of other development projects and programs which entail population displacement so as to optimize the beneficial effects on the nutritional status of relocatees, settlers and colonists.

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