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HEALTH AND RESETTLEMENT IN ETHIOPIA, WITH AN EMPHASIS ON THE 1984/85 RESETTLEMENT PROGRAMME: A REVIEW

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ABSTRACT. The major objective of this review of health implications of government-sponsored resettlement in Ethiopia is to indicate the health status of settlers and the health hazards of resettlement. The focus is on the 1984/85 resettlement programme, which resulted in the movement of about 600,000 drought victims from northern and central Ethiopia to the western part of the country. Malaria, trypanosomiasis, onchocerciasis, yellow fever, podoconiosis and sand-flea infestation are identified as immediate and greater hazards than in the areas of settler origin, based on the geographic distribution and ecology of the major communicable, nutritional and geochemical diseases in Ethiopia. More studies are needed on the epidemiology and ecology of bancroftian filariasis, cutaneous and visceral leishmaniasis, dracunculiasis, eye and skin infections, tuberculosis, meningitis, intestinal parasitims, diarrhoea and calorie/protein malnutrition before their public health and economic significance can be evaluated. Schistosomiasis appears to be less common, for the time being, in the resettlement areas than in the areas of settler origin. Research needs on constraints in resettlement planning, implementation and operation are identified, and some recommendations made for disease control programmes.

1. INTRODUCTION

As in many other African, and in South American and Asian countries, large-scale government-sponsored resettlement has been carried out in Ethiopia [12,21,50,62,64,88,90]. All these programmes share a common objective, namely that of obtaining a public good. However, although health risks have been recognized as potential barriers to achieving stated or implied economic and social goals of resettlement, theyhave seldom received the attention that they demand. The review by Roundy [79] of the literature on health impacts of resettlement identifies a wide range of health problems which vary in their magnitude among different projects.

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Health problems may or may not be considered by planners as major constraints to the success of resettlement. They may be even completely ignored in the planning and administration of projects. Where health problems are considered, they are usually given lower priority than problems of administration, provision of infrastructure and access of settlers to support agencies [79]. On balance, while disease is seldom nowadays the major constraint upon settlement and development, largely due to improvements in health services and living conditions of settlers, it may result in significant increases in the operational cost of settlement schemes, in low production and even in the departure of settlers.

The major health problems associated with resettlement in developing countries are nutritional and communicable diseases [25,40,79,89], but psychological impact on settlers may be equally severe [11,53,81]. Recent epidemiological studies indicate that all these and other health problems may be of considerable importance in Ehiopian settlement schemes.

Infectious diseases are commonly introduced and spread in new settlements in at least five different ways. First, disease-causing organisms and their vectors may be introduced by settlers from their home areas. Second, development activities in the settlements may create favourable conditions for the spread of insect and snail vectors and disease agents. Third, increases in population density in settlements facilitates the transmission of density-dependent diseases, including malaria, schistosomiasis, onchocerciasis, hookworm and ascaris. Fourth, the intrusion of man into uninhabited and sparsly inhabited areas with zoonotic disease complexes such as yellow fever, trypanosomiasis and leishmaniasis may expose him to new disease hazards. Fifth, the physical and psychological stress of the resettlement process, including adaptation to their new environment, tends to predispose migrants to ill health. Debilitating disease may result from build-up of high transmission levels in disease-enhancing environments, but also from lack of immunity in settlers from non-endemic areas, the synergistic effects of malnutrition and psychological stress, and deficiencies in health services, community organization and social services [25,40,79,89].

Malnutrition in resettlement projects is commonly associated with food production and consumption problems. While starvation is apparently rate because of government and international support structures, the common replacement of traditional production systems by mechanized monoculture and cash-cropping often results in imbalanced diets and nutritional disorders. When aggravated by breakdown in social organization and health-related cultural practices such as in child-rearing, nutritional disorders may be rife.

Infectious disease and malnutrition risks are not confined to settler populations but may spill over into nearby indigenous populations or, vice versa, spread from indigeness to settlers. Improved health status of settlers, on the other hand, must then also be expected to affect non-settlers favourably. This two-way diffusion of disease and health is increasingly receiving attention from planners and health officials [19,60], since the implications for disease control are obvious.

The objective of this paper is to review the health literature on Ethiopian government schemes, with an emphasis on those developed during the 1984/85 resettlement programme. This is the first, and by necessity a preliminary review. Areas requiring further studies are pointed out to facilitate the development of disease control programmes.

The migration of about 600,000 drought victims from northern to western Ethiopia as part of the 1984/85 resettlement programme exposed these settlers to some major vector-borne diseases for the first time [43]. Because of the emergency nature of this resettlement programme, it was not possible for government organizations to give adequate attention to health screening of settlers and landscape epidemiology in regard to the ecology, geographic distribution and spread of diseases [47]. Such data are essential for the evaluation of health risks prior to resettlement, for the purpose of minimizing adverse health impacts in the long term. Such studies may also facilitate the prioritization of different diseases for control and of health-related community development projects. Malaria, tuberculosis, diarrhoeal diseases, yellow fever, schistosomiasis, trypanosomiasis and leprosy have been identified by the Ministry of Health [60] as health problems of "prime importance" in settlements. Several other, less studied diseases, including podoconiosis (non-filarial elephantiasis), kala-azar, nutritional disorders and intestinal parasitism, may be equally important, judged by recent epidemiological studies [105].

North-south population movements for the purpose of agricultural settlement in the Ethiopian highlands have taken place for hundreds of years [51,103], but government-sponsored resettlement has become important only after the 1974 Revolution, culminating in the 1984/85 resettlement programme. Unlike the earlier, mostly spontaneous movements, which were characterized by short-distance movements within the same or to adjacent administrative regions, the government-sponsored resettlement programmes of the late 1970s and 1980s involved long-distance movements [43]. There were about 80 large and more than 200 small resettlement schemes in Ethiopia in 1985 (Fig. 1). Their history, the various types of settlers involved, and their performance have been described by Simpson [86] and Chole and Mulat [22]. The general down-slope and southwestward movements of these large populations have considerable health implications, largely because the ecology, including endemic diseases, varies altitudinally and geographically in Ethiopia [105].

2. COMMUNICABLE DISEASE

Numerous parasitic, bacterial, rickettsial, viral and fungal agents are involved in the long list of communicable diseases in Ethiopia [78], many of which have a discontinuous and localized distribution. The diseases studied here have been reported from settlement schemes or surrounding areas and appear to be of major public health and economic importance. Lack of data and the ubiquity of other common communicable diseases, do not permit their study here. They include pneumonia, infectious and chronic hepatitis, tuberculosis, gastroenteritis, tetanus and dysentery (all among the 10 major causes of hospital deaths in 1983/84, as well as skin and eye diseases (among the 4 leading causes of outpatient morbidity).

MALARIA. This is the most important parasitic disease in Ethiopia in terms of morbidity and mortality. Malaria is endemic in more than 75% of the area of the country, below about 2000 metres altitude, where about 45% of the popultion lives (Fig. 2) [44]. The Ethiopian population practicing seed/plow agriculture has traditionally preferred to live in the malaria-free highlands, contributing to overpopulation, land degradation and famine. Malaria transmission patterns within the endemic area are place- and altitude-specific. Most epidemics occur at altitudes between 1700-2000m; but spread occasionally into higher areas; seasonal transmission prevails in the semiarid lowlands, and continuous transmission around lakes and swamps, along streams and in irrigation schemes. Major epidemics, caused most by **Plasmodium falciparum,** occurred in 1958, 1965, 1973 and 1981/82. These periodic, regularly spaced epidemics indicate that declining immunity levels after each major outbreak are involved [63]. Most settlers in the 1984/85 resettlement programme came from the malaria-free highlands and unstable fringe areas in Wello, Shewa and Tigray [43], putting them at high morbidity and mortality risk in the more humid and altitudinally lower western parts of the country, where indigenous people have developed marked resistance to infection [63]. Particularly high mortality rates have been reported from the settlements in Gambela **Awraja** (District), where many swamps and seasonally flooded areas support large anopheline vector populations. Increased malaria risk from moving into new ecological zones is also demonstrated by the high morbidity rates among highland Ethiopian refugeees in Sudan [83]. The swampy Awash flood-plain near Gewani prevents permanent settlement even of the local Afar pastoralists, who continue to migrate seasonally to the surrounding uplands to escape the mosquitoes during inundation. Irrigation development in the Awash valley and elsewhere has contributed to increased transmission in settlement schemes [26]. Accelerated development of small, medium and large irrigation projects in all administrative regions, as part of the strategy to boost food production [59,98], may also increase the malaria risk. Agricultural projects aggravaing the malaria situation have been identified in many African countries [39].

In order to control malaria in settlement schemes, the Ministry of Health developed a surveillance programme similar to the one operating in urban areas. This involves monitoring and control activities by local health staff, with the assistance of settler communities. Specifically, microscopic diagnosis of fever cases, treatment of positives, house-to-house detection, identification and monitoring of mosquito-breeding sites and their elimination through weekly "health working day" activities are regularly carried out by communities. House-spraying with insecticides is carried out twice a year in settlements with high transmission levels. In Metekel resettlement scheme, where this programme has been implemented, monthly malaria prevalence in 1984/85 varied from 2.6% (dry season) to 5.8% (wet season) [31]. Malaria prevalence (and incidence) in the other settlements is not known.

Neither drug resistance in the **Plasmodium** parasite nor insecticide resistance in **Anopheles** mosquitoes have so far been reported from resettlement areas in Ethiopia. However, the appearance of chloroquine resistance in lowland areas along the Sudan and Kenya borders [9,63,96] and in the interior of Wellega [34], where about 300,000 settlers were settled in 1984/85, indicates that drug resistance may become a major control obstacle in the future. Since drug resistance typically develops in areas characterized by incomplete chemotherapy of malaria cases and high incidence of migration [10,72], judicious use of antimalarial drugs and close monitoring of population movements are essential preventive measures. The latter will be particularly difficult to accomplish, because of widespread uncontrolled migration in and out of settlements [43].

SCHISTOSOMIASIS. Both schistosomiasis mansoni and schistosomiasis haematobium are endemic in Ethiopia. The former is most common at altitudes between 1000 and 2000m in all administrative regions, and the latter is confined in its distribution to four lowland areas in the Awash and lower Wabe Shebelle valleys, and in Kurmuk town near the Sudan border (Fig. 2). Recent reviews of the literature on schistosomiasis in Ethiopia [46, 84] show that **S. mansoni** infection rates are significantly higher in most areas of settler origin, particularly in Wello and Tigray administrative regions, than in western and southern Ethiopia, where most settlements are located. This has been attributed to a combination of lower population density and fast-flowing perennial and shaded streams in western and southern Ethiopia (Fig. 2) [46].

Of 141 settlements and villages in Keffa, Wellega and Illubabor searched for schistosomiasis-transmitting snails, only 4 (Dimtu Kersa, Megelle and Anger Gutin No. 2, all in Wellega, and Didessa No. 5 in Keffa) yielded **Biomphalaria pfeifferi** snails (Fig. 2) [95]. Although this survey probably underreported snail occurrence, due to its timing shortly after the main rains (which swell the rivers and cause flushing-out of snails), the observed scarcity of host snails corroborates the findings of other malacological studies in western Ethiopa [24]. Similarly, epidemiological studies in the three settlements of Kishe, Gera and Didessa Limu in Keffa [1], and in Keto settlement in Wellega [3], revealed only one **S. mansoni** case among nearly 2800 settlers and indigenous peasants. These data suggest that these settlers either lost their schistosomiasis infection during the 3-4 years they spent in these schemes (the mean life span of schistosome worms in man is about 3-4 years), or they originated in highland communities where intestinal schistosomiasis is not endemic.

Variable schistosomiasis prevalence rates were found in other settlements. Afar pastoralist settlers in at least four settlements in the Awash valley (Halidebi, Galela Dora, Dubti and Assaita) had **S. haematobium** infection rates up to 54% [27,28,46]. Similarly high rates were reported from Somali settlers in the lower Wabe Shebelle valley [15]. Between 5% and 20% of indigenous Kereyu, Ittu and Arsi pastoralists in Metahara/Abadir and Nura Era settlements became infected with **S. mansoni** [46], and the indigenous Anuak contracted this infection around four settlements in the Gambela area in western Ethiopia [36]. On the other hand, migrant farm labourers from the highlands working for Afar pastoralist settlers in several Awash valley schemes became infected in nearby swamps. Irrigation has been a major factor in the spread of endemic schistosomiasis in Ethiopia [26,46]. The reported spread of schistosomiasis in water development projects, and the successes and failures of nearly one dozen control programmes in Ethiopia [46], will have to be considered in the development of strategies and control programmes in the resettlement schemes.

INTESTINAL PARASITISM AND DIARRHOEA. The prevalence of intestinal parasitic infections and diarrhoea in children is a good indicator of the level of environmental sanitation and type of water supply in rural communities. Studies in and around irrigated settlements in the Awash valley showed that settlers and migrant farm labourers had significantly higher infection rates for all common intestinal parasites than indigenous pastoralists. These differences were associated with higher population densities and poorer sanitation on these farms than in the temporary camps of the pastoralists [105]. In general settlements in lowland Illubabor, on the other hand, 75% of the indigenous Anuak, but only 4.3% of newly arrived settlers, had hookworm infection [37], indicating that the newcomers will in time acquire higher rates. Seventy-two per cent of settlers in Didessa settlement had hookworm, 43% **Trichuris trichiura** and 36% **Ascaris** [94]. In four settlements in Keffa and Wellega settlers had high rates similar to those of indigenous peasants after four years of settlement [1, 3]. The existence of more latrines and safe water supplies (wells) in the settler than in the non-settler communities suggests that these facilities are not properly or adequately used, and that health education programmes and community awareness are unsatisfactory.

Less information is available on the prevalence and incidence of diarrhoea in settler populations. Diarrhoeal diseases are a major cause of illness among children of settlers, not only in settlement schemes but also in relief and transit shelters in the areas of settler origin and along transit routes [60,85]. In addition to diarrhoea, the Relief and Rehabilitation Commission reported dysentery, infectious hepatitis and typhoid fever to be major health problems in several settlements [73-76].

ONCHOCERCIASIS. In onchocerciasis, as in malaria and schistosomiasis, man plays the central role in transmission, since animal reservoir hosts are unimportant. Onchocerciasis in Ethiopia is limited in its distribution to the western part of the country. The known endemic area covers nearly all of Keffa, Illubabor and Wellega, the western part of Gojam and the Angereb valley in Gonder, but additional lowland areas in Gonder and Gamo Gofa may be affected (Fig. 3). Fast-flowing, shaded streams in these areas support large populations of black flies (**Simulium** spp.), the vectors of the parasite **Onchocerca volvulus** in Ethiopia. The endemic areas extends into Sudan. Unlike the situation in Sudan and in central and west African countries, onchocerciasis has not been found to cause blindness in Ethiopia, but it has been associated with low-level vision loss [106] and in the Ethiopia-Sudan border area with medically and socially significant skin pathology [33].

Settlers from the northern and central parts of the country become exposed to onchocerciasis for the first time in the western settlement schemes. Onchocerciasis transmission levels vary considerably within the endemic area, with settlements in forests and along streams significantly more infected than those in dry open areas away from streams. Infection rates declined up to five fold, 2-3 km away from forests and suitable stream habitats in several settlements in Keffa and Illubabor [1, 17]. This distance relationship was also noted in Metekel scheme, where infection rates varied from 0-62% in 10 villages [29]. In two settlements in Keffa, onchocerciasis prevalence and intensity increased with duration of stay of settlers, confirming that this is a new disease for them [1]. The newly arrived, still non-infected settlers in several villages in Illubabor [38] must be expected to become infected eventually.

The concentration of transmission sites along favourable stream habitats has important control implications. Proper location of settlements in open grasslands, away from suspected transmission sites, would be a simple, effective measure to minimize exposure. Large-scale deforestation for the purpose of controlling black fly populations, however, would be undesirable, in view of observed accelerated erosion in the areas of resettlement.

TRYPANOSOMIASIS. Both human and animal trypanosomiasis are endemic in western Ethiopia. Human **Trypanosoma rhodesiense** infections have been reported mostly from Gambela **Awraja,** but case reports have also come from Mocha **Awraja** (Illubabor), Maji **Awraja** (Keffa), and settlement schemes in Didessa valley in Wellega and in the lower Omo valley (Gamo Gofa). Animal trypanosomiasis has been reported from a larger area, which extends from the southern Rift Valley of Ethiopia across most of the Omo valley to western Keffa, most of Illubabor, and the western lowlands of Wellega, Gojam and Shewa (Fig. 3). Most human cases were reported from areas along the Gilo, Akobo and Baro rivers in Illubabor, where epidemics occurred in the late 1960s and 1970s [42]. The endemic area is probably larger than the clinical reports from hospitals indicate, due to the lack of diagnostic facilities in health centres and health stations (clinics) and the failure of many patients to seek medical care [56].

At least seven species of tsetse flies are endemic in an area of about 100,000 square kilometres in the above-mentioned administrative regions and in Sidamo [48,56]. Riverine woodlands and thickets are the preferred habitat of tsetse flies, and most transmission to man and livestock takes place there; but they also occur in open grassland and tree savannah [56]. Several species of tsetse, including **Glossina tachinoides, G.** morsitans and **G. pallidipes,** have been found in the Metekel [30], Woito [99], Gambela [74] and lower

Didessa [38] settlement schemes. Entomological studies have not been carried out in most of the other settlements. In other endemic areas in Africa, tsetse flies and trypanosomiasis could be controled by vegetation clearance around settlements [49,104], but no information is available on the response of Ethiopian tsetse to such environmental control measures. Such studies are urgently needed, since RRC has carried out extensive brush and woodland clearance programmes, with the objective of eventually introducing plow oxen and dairy cattle into the settlements. Moreover, settlers themselves have caused major declines in woody vegetation through livestock grazing, tree cutting and burning for the purpose of cultivation, procurement of firewood and construction wood, and the control of animal pests and predators. Reports by local veterinary services and settlers of high cattle mortality rates in the Gojeb and Didessa valleys in Keffa and Illubabor [1] indicate that trypanosomiasis transmission continues in these partly cleared areas, although chemotherapy and chemoprophylaxis appear to have reduced livestock mortality in some settlements [1]. Considering the financial and manpower constraints of the settlement authorities, there is a need to develop epidemiological models to evaluate the relationship between land-use management systems, chemotherapy, chemoprophylaxis, the use of trypanosome-tolerant cattle and trypanosomiasis transmission. Such a model was developed by Habtemariam [35]. The major value of these models lies in their use in the selection of the most cost effective control measures.

VISCERAL LEISHMANIASIS (KALA-AZAR). Visceral leishmaniasis is endemic in Ethiopia, Sudan, Somalia and Kenya, mostly in lowland **Acacia-Balanites** woodlands and **Acacia** savannah [7,41]. **Leishmania donovani** is transmitted by several species of **Phlebotomus** sand flies in Ethiopia, although the transmission status of all vectors is not known. Even less is known about the role of animal reservoir hosts. The size of the endemic area has been estimated on the basis of clinical histories of patients and serological tests. Thus transmission is thought to take place in 20 **Awrajas** in Eritrea, Wello, Gonder, Tigray, Assab, Wellega, Illubabor, Keffa, Gamo Gofa, Sidamo and Bale (Fig. 4), but actual transmission sites have not been identified. Since kala-azar is also endemic in Djibouti Republic and in areas of Sudan, Somalia and Kenya adjacent to the Ethiopian border [7], it may be endemic in additional lowlands in the above administrative regions. This is also indicated by the recent discovery of additional kala-azar foci in northern and southern Ethiopia through increased research efforts [7, 41].

The public health importance of visceral leishmaniasis in Ethiopia is indicated by high annual incidence rates (up to 6/1000) [91] and high mortality rates [92]. Circumstantial evidence suggests that endemic kala-azar is confined in its distribution to altitudes below 1400m, which would put settlers in conventional settlements in lowland areas at greatest risk. The likelihood of man-to-man transmission inside rural communities, including towns in the Konso area of Gamo Gofa [92], may greatly increase the kala azar risk in resettlement schemes. Anthroponotic transmission of kala-azar has been described in Kenya [7].

YELLOW FEVER. Yellow fever, like trypanosomiasis and visceral leishmaniasis, exists in natural zoonotic systems in which man's involvement is often incidental rather than required. People may thus become infected when intruding into sparsely populated or unpopulated areas, a rather common situation in resettlement schemes world-wide. Yellow fever occurs periodically in epidemic form in Ethiopia, persisting silently in the interim in Cercopithecus and Cynocephalus monkey reservoir hosts. Dense riverine and other lowland forests inhabited by these monkeys and the **Aedes africanus** mosquito vector are involved in the sylvatic (forest type) transmission cycle. Settlers, as well as woodcutters, gold miners, hunters and gatherers, and other people living in or on the fringe of forests are high-risk groups. In farms cultivating taro and **enset (Ensete ventricosum),** a domestic transmission cycle is maintained by **Aedes simpsoni,** which breeds in these plants and bites nearby human populations around their homes, without the need for monkey hosts [58, 82].

Three epidemics occurred in Ethiopia between 1959 and 1965, all in the western part of the country. The 1960 epidemic resulted in an estimated 200,000 cases and more than 30,000 deaths in an estimated population of 1 million in Sidamo, Gamo Gofa, Illubabor and in the Didessa valley of Wellega. No transmission was reported from communities above 1600m altitude [58,82].

Although no yellow fever epidemics have occurred in Ethiopia since 1965, various serological studies showed a wide distribution of high antibody levels in humans and in infected wild animals.

This suggests that the virus is present in many communities where people have developed protective immunity without disease manifestations [58]. The presence in the endemic areas of large numbers of non-immune settlers, together with extensive population movements within western Ethiopia, require the continuation and expansion of the vaccination programme for settlers [61]. Another preventive measure that should be incorporated into the settlement programme is the location of settlements away from lowland forests and **enset**/taro farms. Moreover, since the absence of yellow fever epidemics in recent years has been attributed in part to insecticide spraying within the malaria control programme [58], continuation of this vector control programme is highly desirable.

3. NUTRITIONAL DISEASES

The relationship between malnutrition, decreased immunity and enhanced risk of disease from infection has been well established [80]. Four factors tend to predispose settlers from central and northern Ethiopia to nutritional diseases in the western settlements. First, western Ethiopia's agro-climates are different from those in highland Wello, Shewa and Tigray, limiting the production of the traditional staples of settlers, such as **teff (Eragrostis tef),** barley and various pulses [14], and contributing to unbalanced diets. Second, the 1984/85 famine experience in the home areas left settlers weak and susceptible to infectious diseases, especially measles, pneumonia, dysentery and gastroenteritis [66]. Third, the resettlement experience, together with environmental stress and the problem of achieving food-self-sufficiency in the settlements [21,22,66], contributed to malnutrition. Fourth, the presence of trypanosomiasis and consequent lack of milk cattle, together with maize monoculture and early weaning by some mothers, have been associated with protein/calorie malnutrition in settler children [1].

The most severe forms of malnutrition, particularly widespread starvation with high mortality rates, existed during the 1984/85 famine in the areas of settler origin. Many settlers in the worst-hit drought areas, in Wello and Tigray, passed through feeding camps on their way to the settlement schemes [43]. Several nutrition surveys reported that about 40% of the children in such camps were below the 70 percentile of the Harvard Standard weight/for/height [4].

Assessment of the nutritional status of children below age 5 in regard to weight/height has been carried out in Keto settlement in Wellega. No significant differences were found between settlers and indigenous people [2] and with the results of the national nutrition survey [107]. These results are not representative for settlements in Ethiopia, however, since Keto is one of the best performing settlements in terms of per capita crop production [66]. Preliminary results of studies in three settlements in Keffa show that kwashiorkor in children is still a problem [1]. While lack of milk in tsetse-infested areas may contribute to protein/calorie deficiency syndrome, absence of cattle has been associated with lower incidence of blinding trachoma in Ethiopia [15].

Widespread malnutrition has been reported by RRC [75] for adults and by Bedri et al. [1] for children under 5 years from several settlements in western Ethiopia. Inability of many settlers to attain food sufficiency in the first three to four years suggests that malnutrition may become rampant if RRC discontinues its food relief programme for settlers as planned.

4. OTHER HEALTH HAZARDS

Several additional health hazards have been associated with resettlement in western Ethiopia. Of these, non-filarial elephantiasis, recently named podoconiosis, appears to be the most serious one. This is a chronic, debilitating disease involving swelling of the feet and lower legs. It appears to be more common in Ethiopia than in any other country. Podoconiosis is endemic in the highlands above 1200-1500m with underlying basalt rock, and is absent from most of Eritrea and much of Tigray, where crystalline basement rocks predominate [69]. It has recently been confirmed that podoconiosis is a geochemical disease caused by the penetration of microscopic aluminium silicate of the basaltic clays through the intact or damaged skin of the feet of bare-footed people, with subsequent damage to the lymphatic tissues [71]. Oomen [65] reported a prevalence of 2.7% among 247,000 adults in 56 markets in western Ethiopia, where the disease is most common. Price [70] estimated the total number of cases in Ethiopia in 1974 at 200,000-350,000, suggesting that there were about 300,000-500,000 cases in 1988, due to population increase. The highest prevalence levels were reported by Mengistu et al. [32] in a community in Gamo Gofa (5.4%) and by Price [69] in communities in the vicinity of Damot volcano in Wolaiyta **Awraja** (6.9%). Rates generally decline with distance from volcanoes, which correlates with the distribution of clay soils.

The severe form of podoconiosis debilitates, causing a considerable economic burden for families and communities. In two settlement schemes in Keffa, advanced stages of podoconiosis left afflicted persons economically inactive or marginally active. Nearly all settlers in these two schemes were reportedly free of symptoms when they first arrived in western Ethiopia, but a substantial number developed swollen feet after about 2-3 years. Interviews with settlers revealed that persons regularly wearing shoes had significantly less podoconiosis than barefooted persons [1]. Local manufacture of shoes or boots through community-based enterprises may have to be considered as a prevention of podoconiosis, for which there is no cure.

Sand-flea infestation is widespread in several resettlement areas. Between 25-86% of 1037 settlers of all age groups examined in 10 villages in the Asossa area were found to be infected with the ectoparasite **Tunga penetrans** [57]. Rates increased with duration of stay of settlers on this scheme. Spraying of huts with DDT, lindane and malathion reduced infestation rates by about 40%, but behavioural changes, including the wearing of shoes, will also be necessary for control purposes. The urgency of these measures is indicated by the economic burden of sand-flea infestation; five cases, on the average, are being admitted to Asossa Hospital daily [57].

The spread of bancroftian filariasis, which appears to be endemic mostly in the lowlands of Illubabor [52], has been associated with deforestation in West Africa and with irrigated agriculture in East Africa [97]. Accelerated clearing of forests in settlement schemes in Ethiopia for cultivation, including irrigated agriculture, may thus result in increased **Wuchereria bancrofti** transmission. Similarly, in the Ethiopian highlands, increased transmission of cutaneous leishmaniasis along forest fringes and in incompletely cleared areas has been reported by Roundy [77], who also reviewed the literature for other health effects of vegetation changes in Ethiopia.

The significance of guinea worm infection (dracunculiasis), which appears to be endemic only in the western Ethiopian lowlands, cannot be established with the available data. Only one epidemiological study reported active transmission, in a community in lowland Eritrea near the Sudan border [93]. The high prevalence rates reported by Watts [100] for most administrative regions are unfortunately based on faulty statistical reporting by the local health services [67]. Thus extensive epidemiological studies are needed in lowland communities in western Ethiopia to evaluate the potential public health and economic importance of dracunculiasis, which is known to be considerable in West African countries where the infection is endemic [100].

A major meningitis epidemic occurred in late 1988/early 1989 in Gamo Gofa, northern Sidamo, southern Shewa and Hararge [5,6,55], areas from where meningitis had not been reported before [23]. The Ministry of Health reported 745 deaths from meningitis for the period September 1988 to February 1989 [68]. Although climatic factors may be responsible for this epidemic, it is also possible that the resettlement programme and particularly villagization, which resulted in more crowded conditions in many communities, may have been a contributing factor. Careful examination of climatic records and incidence rates in different types and sizes of communities may provide predictive information on this possible hazard for resettlement areas in the future.

5. CONCLUSION

The 1984/85 resettlement programme in Ethiopia illustrates the role of popultion movements, agricultural development, landscape modification, settlement changes and environmental factors in disease ecology. Unlike the situation in pre-revolutionary Ethiopia, when spontaneous and government-sponsored resettlement took place within the same or neighbouring administrative regions [77,103], the 1984/85 programme resulted in extensive geographical and altitudinal movements which brought settlers into new disease regions, ecological zones and culture areas. This scenario, reported also from settlement schemes in Latin America [20, 101] and elsewhere, complicated the adjustment of settlers, and resulted in a general increase in the prevalence and risk of several major communicable, non-communicable and nutritional diseases. Mortality rates, which exceed birth rates up to ten-fold, were highest during the first 6 months of settlement in Metekel scheme [87], reflecting the drastic adjustment experience of the highly susceptible settlers. This critical health situation was aggravated by the haste with which the 1984/85 resettlement programme was carried out, and associated lack of experience of the Ethiopian government with large-scale resettlement. Site selection for most schemes was based on the findings of high-level government reconnaissance teams from brief visits to western Ethiopia [18], rather than the more comprehensive multidisciplinary feasibility studies that had been undertaken in previous years [76]. Logistic and security problems in isolated schemes, and top-heavy planning and implementation with minimum settler particiption and incentives, were major constraints in the implementation of the programme [21]. While this emergency resettlement programme can be justified on the grounds of the severity of the famine, which represents one of the world's most severe famines in recent decades, based on mortality rates [8], this review shows that curative health services in settlement schemes need to be supplemented with more comprehensive, preventive health programmes. In addition to safe water supply and latrine construction programmes that have been developed by the settlement authorities, greater consideration needs to be given to locational, environmental and human behavioural factors, with the objective of improving health levels. Specifically, further epidemiological and linked socio-economic studies are needed to more accurately assess the public health and economic importance of the major diseases in and around settlements, and to evaluate the role of location of settlements and villages, changes in natural vegetation, land-use and dietary patterns, and vaccination and health screening of new settlers. Results may facilitate the development of cost-effective disease control programmes on an intersectorial basis. Persisting low production and dependency of settlers on government food relief need to be remedied, to improve the nutritional status of settlers, reduce the high settler defection rates [21,43] and facilitate community development. Failure of most NGOs in Ethiopia to actively support the resettlement programme increases the need for ecologically sound planning and efficient implementation with the scarce available resources. The magnitude of the task is indicated by the fact that most settlement projects in developing countries have a poor performance record [12,64], with only a few that have succeeded in improving the health status of settlers [31, 54].

NOTE

1. Between 1974 and 1983 meningococcal meningitis cases were reported from Wello, Wellega, Tigray, Gonder, Eritrea and Northwestern Shewa.

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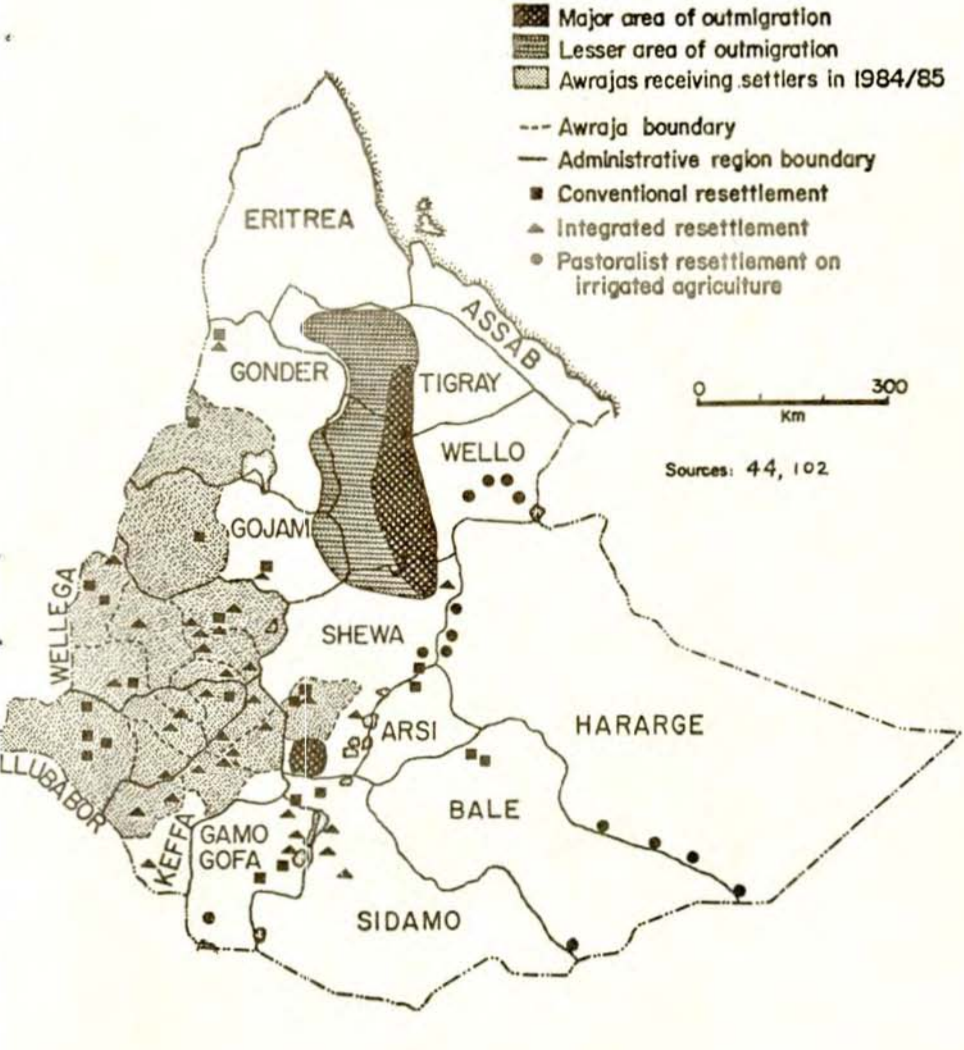

Fig. 1. Areas sending settlers and awrajas receiving settlers in 1984/85

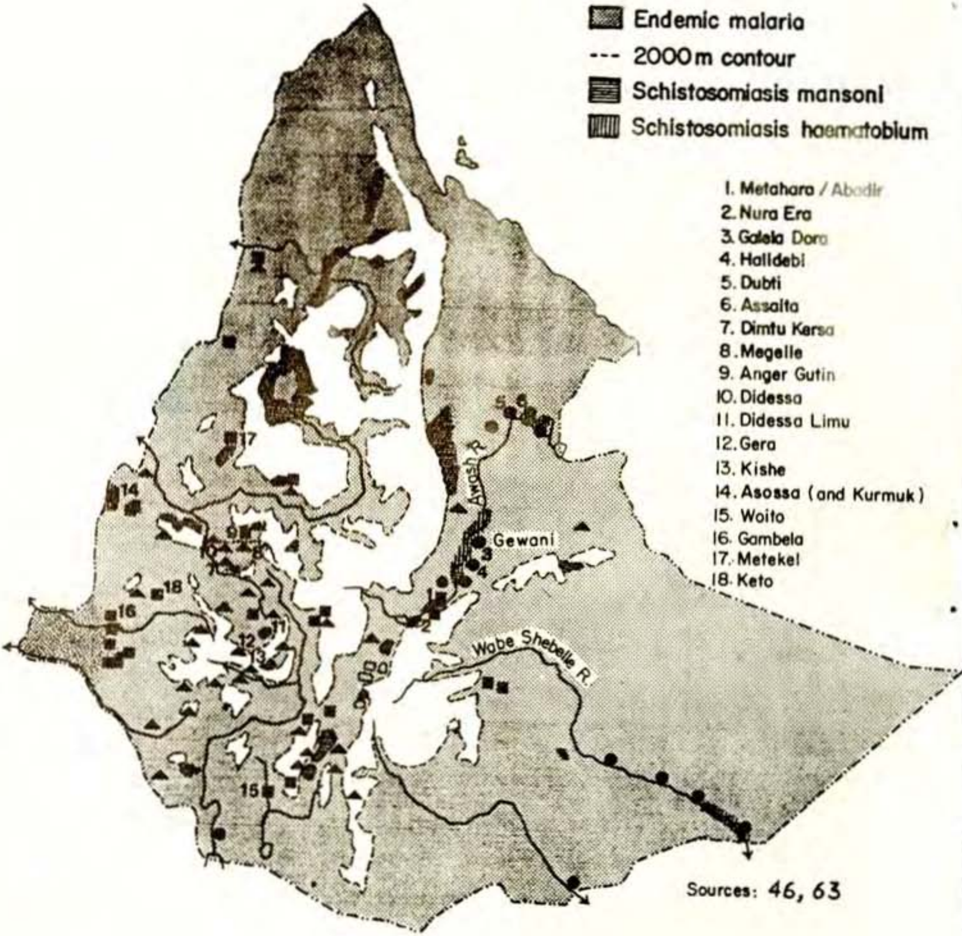

Fig. 2. Areas of endemic malaria and schistosomiasis in relation to resettlement schemes

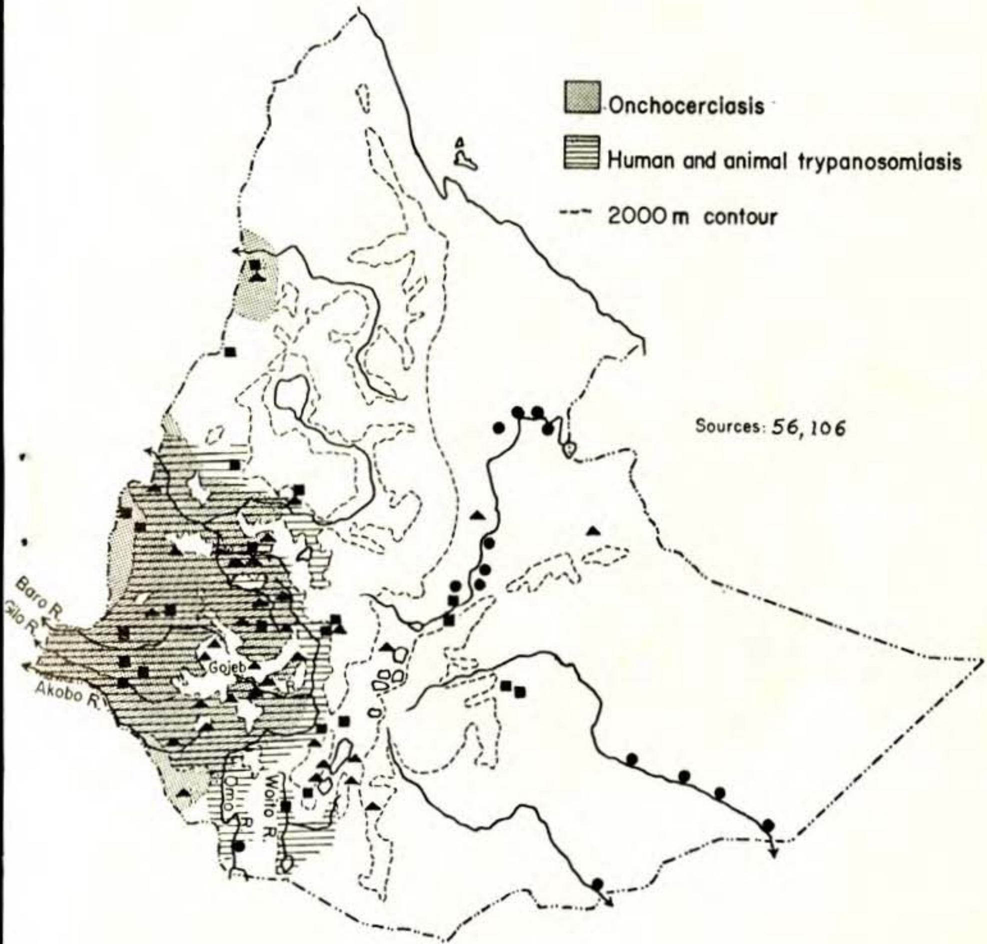

Fig. 3. Areas of endemic onchocerciasis and trypanosomiasis

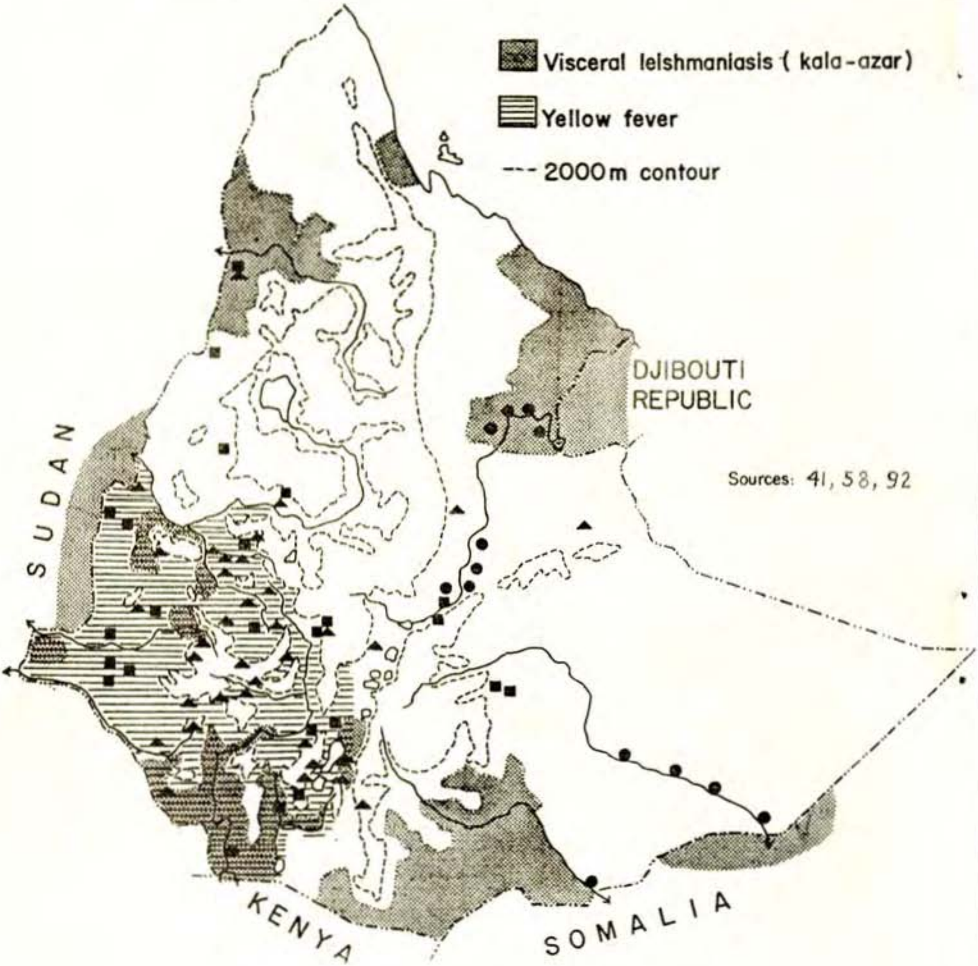

Fig. 4. Areas of endemic visceral leishmaniasis and yellow fever