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THE ECONOMIC IMPACT OF MALARIA ERADICATION
WITH SPECIAL EMPHASIS ON THE HAWASH VALLEY IN ETHIOPIA

by

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The introduction of health services and the control or
eradication of communicable diseases in an area or a country must
be considered from two points of view. One is the humanitarian,
the concept that a maximum level of health is a human right.
The other is the economic, whether an improvement of the
general health of a people will pave the way for a higher
standard of living or whether, as predicted by Malthus, it will
lead to unrestrained population growth and consequent poverty.
In this paper we will not be concerned primarily with the
humanitarian point of view, however reasonable and convincing
this might prove to be. Instead, our aim will be to study the
impact of health measures, and more particularly of malaria
eradication, on economic development. In addition, in order that
we can be quite specific in some of our conclusions, we will
concentrate on the problem as it pertains to a certain area of
Ethiopia known as the Hawash Valley.

A number of economists have expressed the fear that too
effective public health measures, in the early stages of economic
development of a country, may cause an explosive population
growth without a commensurate rise in gross national product
and/or per capita income (1) (2).

That effective health measures are followed by population
growth is a fact. For example, a post-war campaign to eradicate
malaria and other infectious diseases in Ceylon was accompanied
by an increase in the annual rate of population growth from a
yearly average of 1.6% during the period 1901 to 1950 to a yearly
average of more than 3% for the period 1946 to 1950. This
explosive population growth was mainly caused by a rapid decline
in mortality. For example, in Ceylon, the death rate dropped in
three years from 21.5 per thousand in 1945 to 12.8 in 1958.
In Puerto Rico, following the development of much improved
generalized health services, the mortality rate was halved in
the decade from 1940 to 1950 (3). Unfortunately, in both instances
there was no tendency for the birth rate to decline at the same
time. Fertility, in fact, is socially rather than medically
determined.

An increased rate of population growth must, therefore, be
accepted as one of the consequences of effective disease control
measures. The question is, how large an increase in population
can be expected ? Professor Leibenstein (4) has worked out a
"typical" or representative population based upon a known age-and-sex
distribution in several countries where the life expectancy at
birth is less than forty years.

According to Professor Leibenstein's model one can postulate a
certain rate of population growth if one can make certain assumptions
as follows: Assuming (1) high and constant fertility rate, equivalent
to birth rate of forty per thousand, (2) rapid decline in mortality
resulting in a twelve-year increase in life expectancy at birth
during the first ten years and a two-year increase in life expectancy
each ten years thereafter, then the new rate of population growth
will be 2.74% per annum. However, in this example, the average
rate of population growth would be 1.7% per annum even if mortality
is assumed constant at its initial high rate. The additional
growth is thus only 1% per year and not all this growth is necessar-
ily due to decrease in mortality but also to famine control, flood
prevention, etc.

It is obvious that there may be serious disadvantages connected
with a sudden population growth. If, for example, a population
increases at the rate of 2.7% per year, then gross national product
must grow by more than this percentage in order to achieve an
improvement in living standards. If this does not occur, then the
results of development programmes are likely to be "swallowed up
by extra mouths".

The assumption leading to the Malthusian view is that the
elements of production, like capital, natural resources, and land
will not increase proportionately with the increase in the labour
force. This is, however, by no means always the case. In Ethiopia,
for example, many of the natural resources have not yet been
touched and there is plenty of arable land in the big river valleys,
provided that these valleys are made suitable for human habitation.

One of the main factors in achieving this latter desirable result
would be the elimination of malaria.

As to capital, which primarily is expressed in terms of man-made
equipment or the financial resources to purchase such equipment,
modern economic experience indicates that this is potentially
the most expansible of all resources. For example, it may be
borrowed from abroad or may be created within the country by utiliz-
ing the surplus labour force for capital-producing industrial
projects.

One of the results of health improvement might be an increase
in the proportion of the working-age population as compared with
the total population. However, experience in various countries
has shown that this is not certain if the fertility rate stays
high. The reason for this is that the high birth rate will constant-
ly add more young (non-productive) members to the population than
the reduced death rate is adding to the working-age groups.

As a result of the aforementioned reasoning, increasing
attention has recently been directed (1,2) to other kinds of popula-
tion changes which might result from health programmes. In brief,
these consist in a change in the age structure of a population and
an improvement of the working capacity of each member of the popula-
tion in the working-age group. For example, the age structure of
an unhealthy population may yield as much as twice the number of
mouths to feed as it does hands to work. In the United States
only 14% of individuals lived through the productive years of life
to reach the age of 65 four or five decades ago; today, 50% reach
that age.

The economic loss, through death, of productive members of
a population only represents a minor part of the total loss. As
C.E.A. Winslow (5) points out, the loss from disability and debility
is much greater. Thus, since malaria is one of these incapacitating
and debilitating diseases, it may, in many areas, be most damaging
to productivity. In addition, as in Ethiopia, the fact that
malaria quite frequently reaches its greatest incidence during the
harvest time further accentuates this undesirable effect on the
productivity of the working-age population.

Finally the fact that ill health reduces enterprise and
initiative may be a less tangible effect but, none the less, a
most important one. For example, it is a well-known postulate
that people who are ill and debilitated will not very readily
accept changes in working conditions. Therefore, the raising of
levels of health may be a sine qua non for a social climate
hospitable to economic growth and a betterment of the standard
of living.

Before leaving this subject of the general effects of health
improvement on productive potential, it should be pointed out
that such health improvement will only be of economic benefit

if it results in actually increased production. Such a result
cannot be achieved without investment in other areas besides
health. It is therefore necessary to strike a reasonable
balance between efforts in the field of health and in other
fields, such as, social services, productive services, agriculture,
education, etc. Furthermore, it should be pointed out that planning
for the development of these various services should be geared to
the rate at which their effect will be felt upon the population
and the economy. For example, as has already been indicated, the
effect of malaria eradication can produce an explosive increase
in population. Consequently, if the maximum beneficial effect of
such a programme is to be achieved, the development of the other
services which need to go along with it should be started prior
to the actual malaria eradication programme because their effects
will take longer to produce than will those of the malaria
programme itself.

If all these considerations are observed, the productive
effect of investment in health may be enormous. According to
Collings (6), Dr. Choncha Venegas has estimated the cost of a
four-year malaria eradication programme for his country at U.S.
$ 13 million. On the other hand he estimates savings to the
country, due to reduction in work-loss, deaths and public
assistance, at U.S. $ 23 million per year. This represents a
return on investment of slightly under 100% per year while the
programme is in effect and, of course, there will be continued
benefits once the disease is eradicated. Thus, large initial
expenditures for widespread diseases like malaria may well prove
self-liquidating, in the long run, for once eradication has been
achieved, only relatively minor expenditures are required to
maintain the benefits of the eradication programme. However, one
should bear in mind that there is an "all or nothing" quality
about expenditures for this type of programme. If too little
is spent the whole may be wasted.

Malaria is still the greatest single menace to the health
of man and his economic development. A decade ago three million
people died every year of malaria while 300 million suffered its
weakening effects, the latter fact, from an economic point of
view, being the main importance of malaria. The disease produces
a chronic invalidism in endemic areas and, from time to time,
epidemics in the non-endemic areas. Ethiopia is, primarily, a
country which belongs in the latter category. For example, the
great malaria epidemic which occurred throughout Ethiopia during
the fall of 1958 apparently caused at least 100,000 deaths and
an untold number of additional deaths due to starvation as
well as great monetary losses. The Ethiopians, because they have
been aware of this hazard for many years, have neglected many
of the fertile parts of their country which are in danger of
periodic malaria epidemics. It is therefore correct when Senator
Humphrey says that "malaria, poverty, low population density and
lack of development are inseparable in the rural tropics".

In Ethiopia, this is particularly true in the fertile large river valleys, not only in the lowlands but at elevations as high as 2,000 metres.

Of the world's total population of 2,737 million, approximately 42% live in malarious areas. Much has been done in the way of control and eradication during the last decade and, consequently, the figures mentioned previously in this paper have practically been halved. The number of cases of malaria has thus decreased from 300 million to about 150 million per year with 1.5 million deaths. Complete eradication of malaria has been achieved in British and French Guiana, Italy, United States, Argentina, Ceylon, Thailand, Venezuela, Cyprus, Madagascar and Greece.

As an example of what could be achieved in the way of economic gains here in Ethiopia if malaria were eradicated, we have had the good fortune to study the "Report on the Development of the Hawash Valley" by Messrs. Bolton and Hennessey, (7). As indicated in our opening remarks, we shall now, in the light of what has already been pointed out concerning the relation between health services and economic development, try to draw a picture of the results which may be expected from a malaria eradication programme in a specific portion of Ethiopia, namely, the Hawash Valley. In our discussion we shall try and point out how the proposed malaria eradication programme in this location may be specifically tied in with the development plan for all available resources in the area rather than treating it as an isolated and unrelated entity.

The whole area of the Hawash River Basin covers approximately 130,000 square kilometres and can be divided into three parts: (1) the head-waters area with Hawash town as a centre, (2) the middle area with Gawani and Batia as centres and (3) the low area with Aisaile as centre.

The Hawash River is a perennial river which, in its course, is fed by six main tributaries from the eastern escarpment. Geologically, the region is of volcanic origin with much undecomposed lava and cinder composition. The available arable land constitutes about 400,000 hectares (approx. 1 million acres) while there are also some 200,000 to 300,000 hectars (500,000 to 750,000 acres) of pasture land. Broadly speaking, the region, notably the lower portion, is rather dry. At the head-waters of the Cassem River, which flows into the Hawash in its middle part, there is as much as 400 mm of rain during each of the months of July and August, while the total yield of rainfall amounts to about 1,000 mm. The temperature, in the lower regions, goes up to 120°F. In general, there is a great difference in temperature above and below the altitude of 1,000 metres.

The estimated population of the Hawash Valley is 450,000, largely concentrated in the crests of the escarpment, on the watersheds and around head-waters. The remainder of the middle

and lower areas is sparsely populated, probably with an overall
density below three per square kilometer.   Most of these latter people
are nomads.

Messrs. Bolton and Hennessey mentioned, as reasons for the
present economic backwardness of the area, low crop yields because
of outmoded methods of cultivation, improperly developed water and
land resources because of inadequate population and inadequate
capital investment, inefficient transport facilities even in
fertile regions, isolation caused by geographic factors, and
health problems.

In our opinion, the health problems, and particularly malaria,
are the basic reasons for defective development of this apparently
fertile area. Surveys carried out in the upper part of the Hawash
Basin have shown that this part of the basin was highly malarious,
and the present WHO pilot project in this area involving over
4,000 square kilometers with a population of about 130,000, has
indicated that transmission of malaria can be interrupted by
adequate spraying of all human and animal habitation with DDT.
There is little doubt that malaria plays a devastating role throughout
the whole basin, and the eradication of malaria is therefore in
our opinion a prerequisite to any investment for further development
of the area.

The Hawash River Basin would seem to us to be one of the best
places to demonstrate the economic result of a well-conducted
malaria eradication programme, mainly because of the perennial
water supply from the river, for irrigation purposes and because
of its strategic location for future development of the whole
country by reason of its actual and potential transportation
facilities. Once the area is habitable there will be rich
possibilities to grow cash crops for export in order to diversify
the Ethiopian export market, to establish meat and hide and other
processing centres, and to develop existing markets abroad i.e.
maize and pulses for Asia, oil seeds for North America and animal
protein for Europe and the Middle East.

In more details, Messrs. Bolton and Hennessey, in their report,
have made some rough calculations of the costs of development and
the returns which may be expected in this geographical area of
Ethiopia. The projected development costs include: (1) expenditures
for irrigation of the arable area of 400,000 hectars during a
period of thirty-five years, Ethiopian Dollars 280 million, or
Ethiopian Dollars eight million per year; (2) expenditures for
public works e.g. roads, bridges, electric power, etc., during
six years, Ethiopian Dollars 120 million, or Ethiopian Dollars
twenty million per year; (3) expenditures for improvement of
pastures, for animal breeding, etc., during six years, Ethiopian
Dollars nineteen million, or Ethiopian Dollars 3.3 million
per year; (4) expenditures for land development, no figures are
quoted for this item. It is presumed that the cost will be
carried by the developers.

To these four items we should like to add the cost of malaria eradication. Assuming that spraying of all habitations will be necessary during four years, to be certain that transmission of the disease has been interrupted and that the reservoir of infective cases has been eliminated, and assuming that the cost per person per year will be Ethiopian Dollars 1.25 [*], then we may estimate the total eradication costs at 450,000 X $1.25 X 4 = Ethiopian Dollars 2,250,000 or Ethiopian Dollars 562,500 per year for four years.

The total cost for developing the Hawash River Basin will then amount to Ethiopian Dollars 421,250,000 over a period of thirty-five years. This amount will be defrayed at the rate of Ethiopian Dollars 31,862,500 per year during the first four years, Ethiopian Dollars 31,300,000 per year during the next two years, and Ethiopian Dollars 8,000,000 yearly during the following twenty-nine years if the Bolton and Hennessey plan is followed.

This is the debit side. What could be expected on the credit side ? The main output of the area will derive from crops and from animal products. Assuming that the average yield of crops per hectar is three tons and that two thirds of the irrigated area is under cultivation at any one time, the total tonnage which could be produced per year will be 2/3 X 400,000 X 3 = 810,000 tons. If we assume that the value of the produced crops will be Ethiopian Dollars 200 per ton, then the annual value could be as high as Ethiopian Dollars 160,000,000 per year. In addition, some 450,000 domestic animals could be supported on the 200,000 to 300,000 hectars of pasture land. With an average price of Ethiopian Dollars 400 per head of improved good cattle and a sale of some 60,000 heads per year an additional income of Ethiopian Dollars 24,000,000 could be expected. This makes a total annual income of Ethiopian Dollars 184,000,000 after thirty-five years. However, no income should be expected during the first five years of the project and it is estimated that it will take about ten years before a favourable balance between income and outgo can be reached. However, after that time there should be an increasing return per year until the maximum annual income of Ethiopian Dollars 184,000,000, as indicated above, is achieved.

The question now is, will this development of the Hawash Valley bring a higher standard of living to the population ? If we assume that the whole population of the area is 450,000 and that after

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[*] As established in similar projects elsewhere and in our own pilot projects.

five years, when malaria is cradicated and reasonable health
services have been introduced, it will start to grow at a rate of
approximately 2.7% per annum, it will then, in thirty years, have
grown to well over a million. If we furthermore assume that the
average family will consist of four people, then this will mean
an average yearly income of Ethiopian Dollars 736 per family, an
amount which is certainly far above that which presently holds
in the valley. We have no figures on this, but, in general, the
impression seems to be that the average annual income, today, of
families in the Hawash Valley is not much more than Ethiopian
Dollars 200 at best.

To summarize our discussion, as Collings says (8) "the
Malthusian emphasis on the difficulty in raising output at a rate
commensurate with population growth derives from an assumption
not always sufficiently explicit. The assumption is that the
useful amounts of other factors of production (land, capital,
natural resources), also the skills and techniques by which man
uses these things for productive ends, are effectively fixed;
or at least will not improve proportionately with the growth of
the labour force. The increasing population, therefore, has
progressively fewer resources to work with, according to the
theory, and diminishing returns to labour must ensue".

"In actuality, the extent to which these resources are
capable of expansion varies widely between countries and regions,
but they can very seldom be regarded as fixed". In this paper,
we have attempted to show how the application of this philosophy
within a certain geographical portion of Ethiopia, logically
suited to such development, leads to the almost inescapable
conclusions that a malaria eradication programme in this area
would, in time, be one of the main factors and an absolutely
essential part of any significant economic development. In other
parts of Ethiopia, notably in the Kobo-Chercher Plain, where a
pilot project has been in operation for the past three years, it
would also appear that a similar degree of economic development
might be envisaged if the overall approach of the Bolton and
Hennessey plan referred to above (7) were utilized. For example,
in the Kobo-Chercher Plain, the influx of population from
surrounding marginal farm land in the hills has increased the
population in the plain by almost 30% in the past three years.
The excellent arable land in the plain is now being extensively
cultivated whereas before, due to the inroads of malaria, the
population was totally inadequate for even minimal use of this
land. However, certain crops which could, perhaps, be grown in
the Kobo-Chercher Plain, such as cotton, cannot now be developed
there because of inadequate water resources. Thus, the population
on the plain may well be increasing more rapidly than its
productive capacity.

It is our feeling that similar difficulties may be encountered
in other parts of Ethiopia and have probably been encountered in

other countries where the importance of this overall approach
has been neglected. Furthermore, it is also probable that in
certain portions of this country, because of geographical and
other difficulties, productivity can never be increased as rapidly
as the population may increase following a malaria eradication
programme. Normally, this might result in the movement of
excess population from these relatively unsatisfactory areas to
those which are more readily subject to development. If the
latter areas are free of malaria and have been developed according
to the logical steps outlined above, we will indeed be able to
accept and may even require larger populations than would result
simply from the decrease in malaria mortality and morbidity
resulting from the eradication programme. Thus, the overall
impact of a malaria programme in a country like Ethiopia could
well be envisioned as being most salutary assuming, however, that all
these factors are given adequate consideration in the country's
development plan.

Indeed, as <u>Ross Jenney</u> so cogently says (9) "The economic
effect is at the root. The writings of mature economists who have
more than an arm chair experience with underdevelopment reveal a
viewpoint somewhere between reticence and downright pessimism as
to the greener meadow over the underdeveloped hill. The capital
investment requirements are far beyond local means, and capital
is seldom generated in a population of low productivity increasing
at more than 2% a year. Private foreign capital is helpful but
is insufficient and not always welcomed. Foreign government loans
and grants cannot suffice while military expenditures continue
and, in any event, are governed by the limited absorptive capacity.
Each investment, however wise, leads to new requirements".

"In short, the 20th century has no ready solution for the
problems of disparity it has created by leaving so much of the world
in the 18th century. As a result, economists ask us to accept the
fact that much of the world's population must remain at a subsistence
level for a long time to come, and even this is threatened by the
population explosion". However, no one, as indicated by Dr. Jenney,
much less the public health worker, can be content with such a
philosophy. There must be progress and if progress involves the
development of a completely inter-disciplinary approach and the
utilization of all kinds of skills and resources in order to
achieve success, then so be it. It should indeed be a stimulating
experience to work more closely and more effectively with all of
our colleagues in the various professions and disciplines interested
in the creation of a better world for all mankind.

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