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Population and Deforestation in Humid Tropics

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Introduction

Policy & Research Papers are primarily directed to policy makers at all levels. They should also be of interest to the educated public and to the academic community. The policy monographs give, in simple non-technical language, a synthetic overview of the main policy implications identified by the Committees and Working Groups. The contents are therefore strictly based on the papers and discussions of these seminars. For ease of reading no specific references to individual papers is given in the text. However the programme of the seminar and a listing of all the papers presented is given at the end of the monograph.

This policy monograph is based on the seminar on 'Population and Deforestation in the Humid Tropics' organized by the IUSSP Scientific Committee on Population and Environment and the Brazilian Association for the Study of Population (ABEP), held at the State University of Campinas from 30 November to 3 December 1992.

Summary of Main Points

1. Policy-making and programme formulation in regard to population, deforestation and other environmental problems in the humid tropics will have to be done in a context of uncertainty. Many facts are uncertain, even contradictory. There is a paucity of good indicators. Furthermore a large part of the existing indicators give ambiguous results. Finally the analytical relationship between demographic and other variables remains uncertain or unexplored and often lacks substantial theoretical underpinnings. Policy makers should take an active role in supporting programmes for the improvement of data and indicators on population and the ecology of the forest in the humid tropics.

2. Population and environment are two concepts which are too general to have real explanatory value by themselves. Population dynamics includes a whole range of dynamic behaviours and changing structures which are related in multiple ways to problems of deforestation. Likewise the dynamics and environmental problems of the humid tropics need to be specified in more detail. The policy maker must formulate recommendations which are based on a clear perception of which population dynamics and what aspects of the tropical environment come into play.

3. Environment-society-population relations are immensely intricate. Population normally is not the most important factor in this complex. There are situations where population growth plays an important role and others where population growth is only a partial or insignificant contributor to the problem. However the role of population dynamics can be quite significant and is often underestimated. However, no complete environmental solutions should be automatically expected from the mere manipulation of demographic variables.

4. Population dynamics, in interaction and in combination with other factors will cause environmental problems. Environmental problems in their turn can impact on population variables. Policy-makers therefore should look at both the demographic causes and consequences of environmental problems.

5. Policy makers should look carefully at the ways in which existing population and exploitation policies have contributed to the problems of deforestation in the humid tropics. This does not necessarily imply that all these policies are completely wrong. However, the neglect of measures to counter potential negative side effects of the policies has often resulted in extraordinarily negative consequences.

1. Policy-making and programme formulation in regard to population, deforestation and other environmental problems in the humid tropics will have to be done in a context of uncertainty. Many facts are uncertain, even contradictory. There is a paucity of good indicators. Furthermore a large part of the existing indicators give ambiguous results. Finally the analytical relationship between demographic and other variables remains uncertain or unexplored and often lack substantial theoretical underpinnings. Policy makers should take an active role in supporting programmes for the improvement of data and indicators on population and the ecology of the forest in the humid tropics.

The development of proper indicators to study population- environment relations as they relate to deforestation in the humid tropics and to other environmental problems is still in its infancy. There is no agreement on the causes of deforestation and on the relative contributions of activities such as firewood gathering, grazing, fodder collection and many others in different contexts. Systematic data on land use patterns, on claims on existing land, on land regulation, on the sources of energy used in the humid tropics and on forest management policies remain weak and, in their current form, are seldom suitable for comparative analysis. Little is also known about decision making of the small farmer regarding land use in frontier areas. One should be especially careful in assuming that there is a more-or-less uniform pattern of land use dictated by gradual soil nutrient depletion from the initial clearing or partial deforestation to annual cropping, perennial cropping and then pasture use. Multi-dimensional approaches to the study of land use in the humid tropics have shown that this common view has many shortcomings and that socio-economic characteristics and the policy environment act as filters which widen or further constrain the options open to farmers given their natural resource base.

Failure to fully consider the possible technological, socioeconomic and cultural processes that mediate the ecological effects of population dynamics characterize many analyses of population-environment interrelationships and thus limit their value in assessing the real impact of demographic variables. Much analysis makes it difficult to go beyond ill-informed aggregate assertions about demographic, political and economic factors underlying forest interventions. Much of the policy recommendations remain conjectural or, at best, are only sector specific because we usually remain ignorant of the totality of effects on the overall social and economic behaviour of the households.

Furthermore the hidden social relationships underlying economic transactions are often insufficiently explored. Existing statistics on international trade, for example, cannot cope with the energy dimension unless it is specifically labelled as energy. The figures for agricultural exports such as bananas from a tropical country, do not reveal that the agrosystem can become deprived of nutrients and fertilizer. In fact it is the hidden export of fertilizer and energy, which can reduce the sustainability of the local agrosystem. When heavily polluting or energy demanding industries are transferred to developing countries, the source of the costs imposed on the environment do not originate exclusively from the population of the country to which they were transferred. In the future, issues of foreign trade will be inextricably mixed with environmental issues, as shown by the discussions within the International Tropical Timber organization. This development will intensify the need for indicators which call attention to environmental problems as well as to the size and characteristics of the populations which affect or are affected by these problems either through their consumption or production patterns.

Some experts, in the face of so many uncertainties, confess agnosticism and have concluded that there are regions, such as the Himalayas, in which the geophysical features define an intrinsically unstable landscape against which attempts to measure the proportional impacts of human interventions are impossible. There are certainly conflicting estimations of the magnitude and devastation of the progression of deforestation.

Some of these conflicts follow from the fact that conceptualizations of deforestation vary between disciplines because of differences in emphasis. Some studies stress the loss of species and the destruction of their ecosystem, others pay attention to the loss of sizeable areas of tropical forest lands. The last perspective directs us immediately to the proper definitions of deforestation and of forest land. Deforestation is generally defined as a reduction in the forest area over time. Closed forest embraces natural and managed forest. Depending on the definition, forest land may or may not include closed forest, managed forest and other woody formations such as those used for agroforestry. This is important because different types of forest may experience different rates of deforestation in a variety of circumstances. For example, until recently closed forest in Nigeria suffered minimal disturbance.

Generally speaking, environmental degradation and deforestation in the humid tropics can be revealed through a multiplicity of indices: declining crop yields per unit of land, soil erosion, deterioration of the quality of the soil through the loss of soil nutrients, dwindling farm lands, greater subdivision and fragmentation of holdings, decreased per capita holdings of land, use of marginal lands for agriculture or cattle breeding, insufficient food production, decreased per capita production, appreciable increase in the number of communal disputes over land ownership, increase of travel time from dwelling to farm land, increase in time spent gathering firewood.

By themselves these indices can never show unambiguously whether, how and to what degree population dynamics play a role in socio-environmental problems of the humid tropics. Even changes in demographic indices such as an acceleration in the rate of population growth, an absolute increase in population density or substantial out-migration do not automatically prove that population is the culprit. These indices can only reveal the negative and positive impact of population dynamics when they are part of detailed socio-anthropological studies which trace the paths through which population dynamics affect the forests.

Box 3: Population and Forest Classification

Even those forest classifications which are quite complex may suffer through their neglect of demographic criteria. In Indonesia the Forestry Department classifies forest land in five categories using criteria of slope, erodability and rainfall intensity: Park and Reserve Forest; Protection Forest, mainly aimed at watershed protection; Limited Production Forest; Non-convertible Production Forest which along with the previous category is open to licensed commercial exploitation subject to regulations; and Convertible Production Forest which is open to more or less unrestricted cutting and subsequent conversion to other uses, mainly food and cash crops. Unfortunately this classification does not take population and land use patterns into consideration. This is an important oversight, especially since the classification was supposed to help identify land suitable for transmigration settlement. As a consequence, data collected from satellites was used to identify actual patterns of land use. This data showed that considerable areas with Forest Department boundaries were simply not forested and that this included many areas within protection and production forests which were, at least in theory supposed to be largely free of human habitation and other types of economic activity.

Even if population density is low, we cannot conclude an absence of population pressure on forest resources. Theoretically it can be hypothesized that, at least at current levels of technological practice, there is a threshold beyond which population density becomes an almost unsurmountable impediment to maintaining large areas of forest. However, sustainable systems of exploitation in many regions are relatively land extensive. Therefore population pressure on forest resources may exist, even in the face of low demographic density.

The Concept of Carrying Capacity

This is an important concept in studies concerning the impact of population and environmental degradation on deforestation and other ecological problems. Nevertheless, the concept of carrying capacity is still controversial. Although it is has been applied with relative success to preindustrial populations, provided their technological development is fully integrated in the analysis, its use in the modern context remains problematic. Carrying capacity implicitly includes the notion of sustainability. A particular carrying capacity may be possible at a specific moment in time but not sustainable forever. The term, carrying capacity, therefore refers to the number of individuals that can be supported indefinitely in a given area at a certain level of consumption. It incorporates the notion of a population density that can be sustained indefinitely. It has been suggested that sustainable carrying capacity should be operationally defined, not as an absolute concept, but in terms of probabilities of failure. The criteria of failure could be defined in a variety of ways. These might include measures of environmental degradation, levels of consumption and the failure of colonists to settle permanently in sustainable fashion. The stricter the criteria the greater the probability that carrying capacity will be reached. The criteria can also be formulated with socio-economic values in mind.

Box 4: Unrealistic Assumptions

The Food and Agriculture Organization (FAO) of the United Nations collaboration with United Nations Fund for Population Activities (UNFPA) and the International Institute for Applied Systems Analysis (IIASA) made an effort to estimate carrying capacities for developing countries. Their estimate for Brazil comes to 7.1 billion people based on the assumption that the Brazilian Amazon is capable of supporting five to ten people per hectare with high inputs (fertilizers, mechanization and an optimal mix of rain-fed crops). The assumption that Amazonia can be transformed into a major breadbasket is a pernicious one. The study does not recognize that unproductive and unsustainable cattle pasture is the dominant land use in Brazilian Amazonia. Even if the apparently assumed shifting cultivation was the technology of choice, many factors would still limit population densities to low levels. The assumptions in regard to length of growing season and the average temperature are too favourable. The assumption that farming and fallowing practices do not result in environmental degradation is also simplistic. One of the factors leading to the high population estimate is the mistaken assumption that land quality in uncultivated areas is equal to that in already cultivated ones. The study also implicitly recommends a land tenure system with an active anti-equity base.

Sustainable carrying capacity, therefore, is at the same time a dynamic, sociophysical and probabilistic concept which, operationally, very much depends on a series of assumptions which must, necessarily, be made. Some estimates may lead to unduly pessimistic results because reasonable and feasible technological and socio-economic change is not adequately integrated in the assumptions. On the other hand unreachable assumptions may lead to overly optimistic estimates as is shown in Box 4.

2. Population and environment are two concepts which are too general to have real explanatory value by themselves. Population dynamics includes a whole range of dynamic behaviours and changing structures which are related in multiple ways to problems of deforestation. Likewise the dynamics and environmental problems of the humid tropics need to be specified in more detail. The policy maker must formulate recommendations which are based on a clear perception of which population dynamics and what aspects of the tropical environment come into play.

Therefore population growth should not be emphasized exclusively as the more popular literature on the topic often tends to do. Sound population policy recommendations for the humid tropics can only grow out of full recognition of the extremely comprehensive and complex nature of population dynamics. It ranges from settlement patterns to the family dynamics of the settlers, from the mortality and morbidity patterns of the inhabitants to the role of children in the fertility decisions of settlers in the humid tropics.

Even the same aspect of population dynamics can be related in different ways to problems of deforestation, depending on the social, economic and other ecological conditions of the population under consideration. Same size populations may exhibit wide differences in the relative size of the urban and rural populations. The modes of production and the occupational distribution of the inhabitants can vary enormously. Quantitative measures without their qualitative context never give a clear picture of their impact on the humid tropics.

Even when the focus is narrowly on population growth, matters are far more complex than often imagined. Population growth can be broken down into its components: natural growth (the difference between natality and mortality) and net migration. The balance between natality and mortality, even if identical, can be the result of a variety of mortality and fertility patterns, each with quite different implications for the environment. Furthermore it is not sufficient to look exclusively at the natural growth of the inhabitants of the humid tropics. Natural growth patterns in other parts of the country may set migration streams in movement toward the humid tropics as a consequence of specific policies encouraging migration either directly (e.g. special subsidies to attract migrants) or indirectly (e.g. the construction of highways).

Nor is it sufficient to look exclusively at the volume of these migration streams. Qualitatively these migration streams may be quite different in their settlement characteristics and in their impact on the environment of the humid tropics. For example, in the Amazon region Indians, rubber tappers and traditional riverine dwellers live in stable and dispersed settlements in harmony with the environment. Old ranches and older types of colonization have also a more stable relationship. On the other hand settlers such as the small scale ore and tin miners and small ranchers who clear the forest clash with the forest environment. In Peru recent migration has created more

havoc with the environment of the humid tropics than the great estates which represented the dominant form of tenancy during the past and which due to serious problems of labour scarcity, do not appear to have caused massive deforestation.

The case of the recent, rapid growth of malaria in some tropical areas is another case in point. Migration to the tropical forest areas should not be simplistically viewed as the only culprit. In Amazon areas with sufficient infrastructure or where companies or official agencies provide sufficient protection against and control of malaria, it does not become a serious problem. But outbreaks are often severe among migrants who are on their own without access to suitable health infrastructure and insufficiently educated about the sanitary habits and protection against malaria. Insufficiency and instability of production in the rain forest environment, especially in the informal sector, provoke frequent temporary mobility which contributes to the incidence and spread of malaria. More efficient anti-malaria programmes will result if due consideration is given to the complex epidemiology of malaria in the humid tropics. For example, research shows that settler households can protect themselves to a certain degree when more attention is given to prevention of mosquito bites while out of doors in the neighbourhood of the dwelling and in the natural environment. House spraying should not be the mainstay of the strategy because there is now growing recognition of a significant degree of outdoor transmission in the Amazon.

When looking at fertility patterns, the analysis should not be limited to the calculation and comparison of quantitative indices of fertility, family formation and contraceptive use. Fertility patterns need to be seen as instruments of survival strategies and as means of adjustment to the complex environment of the humid tropics. The complex intertwining of the impact of fertility on and response to migration needs to be unravelled. Historically sharecropping in the Amazon region might have stimulated large families in response to reduction of costs and the maximization of benefits to both sharecroppers and landowners. Analysis of current fertility patterns should also recognize that these decisions are not frozen in time and that they can be overturned by new calculations of the couple in regard to the costs and benefits of reproduction and by acquaintance with new possibilities for the control of human fertility.

As we have seen for population concepts, deforestation in the humid tropics also cannot be reduced to a single unidimensional concept. It can occur through a variety of processes depending on the characteristics, functions and dynamics of the land's forest coverage. Furthermore the problem of deforestation in the humid tropics should not only be related to the local necessities of fuel, wood or open land, but also to the bigger regional, national or even global production and consumption systems.

3. Environment-society-population relations are immensely intricate. Population normally is not the most important factor in this complex. There are situations where population growth plays an important role and others where population growth is only a partial or insignificant contributor to the problem. However the role of population dynamics can be quite significant and is often underestimated. However, no complete environmental solution should be automatically expected from the mere manipulation of demographic variables.

Environmental problems in the humid tropics, therefore, can never be solved adequately by focusing unilaterally on population. The same demographic context can be linked with very different environmental outcomes, depending on other variables and depending on the types of interaction of these variables with demographic variables. Other variables can be present in many different forms and they can interact in a variety of combinations. Therefore, anyone interested in the policy and programmatic aspects of population dynamics in the humid tropics should give attention to matters such as the following: patterns of social and economic change in the humid tropics, institutional context of population settlement patterns in the humic tropics, explicit and implicit incentive systems which favour the location of certain economic activities in the humid tropics, social and economic policies which operate to the advantage or disadvantage of certain groups of the population who are living in the humid tropics or who are considering moving there. It may sound overly academic to advise that the interactions between population dynamics and the other variables need to be unravelled in order to develop wise policy and programme recommendations. However, it is impossible to over-emphasize the tremendous burden, both financial and consequential, of incorrect and hasty policy and programme decisions.

Patterns of Environmental Degradation and Social and Economic Change in the HumidTropics: Two Contrasting Pathways

Even a summary overview of the scientific literature and of actual policy debates surrounding deforestation and environmental degradation in the humid tropics will show that the proposed explanations can be put on a continuum between two poles. One pole represents those explanations which attribute all problems to disruption of the traditional exploitation patterns of the humid tropical forests. Disruption may occur because of the introduction of unsuitable modern exploitation methods or because new settlers simply rely on methods suitable for their agro-ecological areas of origin but not for the humid tropics. The other pole, on the contrary, finds that the fault lies in the traditional patterns of exploitation themselves. In actual reality, depending on regional and contextual factors, the explanation usually must encompass elements from both poles. Unfortunately many current discussions line up behind one of the two poles neglecting the 'fertile ground' which lies between.

It should be noted that at both extremes population dynamics may either be ignored or may be assigned an important role. The two poles and the role of population are summarized in the four cells of Table 1 which summarizes four 'ideal types' of explanations for the problems of deforestation of the humid tropics. In looking at these explanations one should avoid getting enmeshed in unproductive 'Blaming or not blaming the victim' type of discussions. An elitist paradigm depicting the poor as guilty of deforestation has no place in scientific analysis. At the same time, it cannot be denied that certain life styles and modes of production of the so-called victims may be part of the explanation. If this is the case, care should be exercised that judgements of fact are not transformed into judgements of morality.

Table 1: Methods of exploitation and population dynamics and their possible interactive impact on deforestation

Methods of exploitation	***Population dynamics***	
	Population pressure is not important factor	***Population pressure is important factor***
Disruption of traditional patterns of exploitation	***Deforestation***	***Deforestation***
Intensification of traditional agricultural methods	***Deforestation***	***Deforestation***

Another type of blaming strategy is that of blaming the benefactor and labelling any development project based on foreign investment as a manifestation of Western hegemony resulting inexorably in ecological damage. Certainly there are development projects which have had deplorable consequences for the environment either as a consequence of ignorance or misplaced self interest. However, scientific analysis, not emotional slogans, must form the basis for a correct diagnosis. And since, in most cases, there are many actors involved in the deforestation, a careful analysis will normally show that the causal pattern is extremely complex.

According to one group of observers the driving force behind extensive deforestation is the disruption of social, cultural, and productive institutions that provide an essential glue to those rural societies that carried on traditional methods of exploitation such as slash and burn, extractive utilization of the forest or others. In some cases population dynamics on the national or regional level along with other societal changes may contribute to the institutional disruptions. Rapid frontierward migration has often caused the breakdown of community institutions for managing the resource.

An Example from Northern Argentina

In Northern Argentina on the borderline between the Chaco and the Andes lies an intermediate area between a dry forest and a subtropical rain forest. Up to the fifties a system of forest cattle breeding maintained a quasi-stable relationship with the forest. Forest cattle modified the forests' characteristics, without deforestation. Since the fifties a new 'miner rationality' transformed the use of natural resources in this area. The combination of high economic returns and low land prices resulted in patterns where forests were exploited for short maximization of gains without any efforts to improve soil capacity or to avoid land degradation. This rationale led to a race for new

lands moving to the east and the north of the original areas. Behind these expansions lay exhausted and deforested lands. In ten years, between 1975 and 1984 more than one million hectares were deforested but the total amount under tillage was no more than 500,000 ha. The rest was either abandoned agricultural land or land that was being prepared for tillage. Larger regional, national and international companies, observing the success of the farmers, followed in their tracks and eventually replaced them with agribusiness accompanied by aggressive deforestation methods. The practical result of this type of agriculture was depopulation. In most of the areas of agricultural expansion there is now a smaller rural population than in 1970.

The Intensification of Traditional Agricultural Methods

In other areas it is traditional agricultural exploitation techniques which are responsible for deforestation. Traditional agricultural techniques can become a threat to the forest of the humid tropics because of their undue intensification under the pressure of certain factors. Among these factors population growth can play an important, if not key, role. The already existing population pressure can be aggravated by the return of previously employed urban migrants to the already crowded agricultural sector because of the sagging national and urban economy. Intensification of traditional exploitation techniques may be at the origin of shifts toward other traditional techniques of exploitation which then are directly responsible for deforestation problems.

The pressure of traditional exploitation techniques on the forest is not necessarily a modern phenomenon. For example there is sufficient evidence that deforestation pre-dates the colonial incursion in Southern Nigeria. The rate of deforestation was subsequently controlled by the colonial government through the issuing of concessions for selective logging.

An Example from Cameroon

Certain parts of Cameroon are characterized by population densities of 1200 per km² and high population growth rates. Population growth has resulted in the fracturing of family exploitation units and the disappearance of common lands on the tops of the hills. Population pressure causes pastoral land to be transformed into agricultural land. As a consequence cattle are moved to less accessible parts on the slopes of the hills. In a further phase of the displacement process the year-round presence of cattle impedes possibilities of plant regeneration on the hills.

- In actual reality both the explanations blaming the disruption of traditional methods and those targeting the intensification of traditional agriculture are often simultaneously present but need to be unravelled through a wider perspective.

An Example from Indonesia

In Indonesia about half of deforestation is estimated to be due to the practices of small-scale swidden cultivators. Another 25 to 30 percent is due to estate development and development projects which include transmigration settlement. Logging seems to have much less impact than often thought. However this pattern of forest use can hide the larger picture. Loggers will displace small land- holders to more marginal areas causing further encroachment on the forest. Also small land-owners participate in forest destruction as a consequence of economic incentives emanating from the modern sector.

- Even if strong population growth is present, the automatic conclusion should not be that population growth will cause deforestation.

An Example from a Nepalese Village

In a village surrounded by the hills of central Nepal it was found in 1990 that, despite an annual population growth rate of about 2.5 percent, the forests were in much better condition than in 1980. In fact, in 1980 the forests were in poor condition principally as a consequence of the grazing and fodder collection required by the large livestock population. In 1990 it was found that the total livestock population had remained constant over the 10 year period and consequently the amount of manure available for fertilizing had also remained constant. The number of grazing livestock was less than in 1980 because farmers kept fewer cattle. The average number of livestock per household thus was substantially lower in 1990. Firewood demands also remained constant during this period.

This was the consequence of two important developments in the village. First, there was a remarkable improvement in the infrastructure. A mountain road was built and thereby enlarged the market, accelerating the diffusion of new techniques and increased seasonal migration by opening opportunities for cash labour. Villagers

could now import fertilizer. These favourable developments permitted the maintenance of, and even increased, per capita agricultural production.

Secondly, there were successful conservation and forest management efforts thanks to direct involvement of the village community. The National Forestry Plan of 1976 provided a policy base for initiating village participation in managing forests. Village protection committees issued rules governing management of these resources and hired local farmers to thin out forests. Introduction of new tenure regime for forest lands and the provision of incentives for local people to divert resources to the management of forest lands encouraged farmers to assume responsibility for forest management. Once the forests were protected from grazing, native species quickly regenerated. The closure of the village's forest land forced villagers to stall- feed their animals leading to a change in the livestock composition with more buffaloes and fewer cattle. Villagers also increased the number of fodder trees on private land.

Population growth did not lead to further land degradation, nor did it confirm the thesis that population growth would lead to internal innovations for managing forests more efficiently. The disturbing aspect of these results is the suggestion that forest degradation must be fairly severe before perceived environmental risk causes forest management policies to be changed. It is therefore possible that it would be much more difficult to protect valuable forest lands in sparsely populated environments like Kalimantan or the Amazon. Also it needs to be pointed out that, in this case, outside pressure to change the tenure system of the village forests originating under the influence of external donors was very important.

Even in Cameroon where deforestation has taken on alarming characteristics, there are some areas where people have started to reforest as a consequence of a desire to bring wood to the market. Reforestation was facilitated by the integration of certain tree species originally introduced by European foresters into traditional production systems.

However, one should not expect that population increase automatically provides the seeds for its own solution. This is clearly shown by an example from southern Honduras where the concentration of landholdings, combined with continuing population increase is leading to a more intensive use of land resources, especially by small land-holders. There is a direct relationship between the size of landholdings and the amount of time fields lie fallow. The problem is that, although farmers are utilizing the land more frequently, they are not intensifying their operations. Data show that those individuals with the smallest amounts of land are least likely to engage in land-conserving practices. Those without resources have essentially concluded that further labour invested in intensification of land use is a losing proposition.

4. Population dynamics, in interaction and in combination with other factors will cause environmental problems. Environmental problems in their turn can impact on population variables. Policy-makers therefore should look at both the demographic causes and consequences of environmental problems.

Environmental Consequences of Demographic Problems

There is no doubt that in several cases demographic trends have played havoc with the environment of the humid tropics. In some cases the demographic impact might have been the main culprit. In many other cases it certainly was a contributory factor. It is possible to conceive that the problems caused by population might not have occurred if other ideal factors had been in place. For example, in circumstances of population pressure the natural resource base undoubtedly can act as a binding constraint on land-use options to the farmer. This is especially true when access to alternative forms of technology and a positive policy towards the environment do not exist. And even under optimal technological and policy conditions it is not always possible to remove these constraints in the short run. Furthermore, reduction of population pressure might accelerate the acceptance of alternative forms of technology and encourage positive policy toward the environment.

The Philippines is a country with serious population pressures on the resources of the highland forests. The average annual upland population growth rate is larger than the national average. The pressure is aggravated by cyclical and structural inequities such as the recent impact of the economic crisis on the urban economy and unequal land distribution patterns. In the past, upland migration was directed toward low density destinations. But the low land agricultural frontier has long since been closed. At the same time institutional and technological factors limit the expansion of the intensive margin in these lands. This situation has promoted demographic expansion into ecologically sensitive areas and has created additional stress on open access frontier lands. Government settlement schemes and poor regulation of logging activities contributed to the 'opening' of forest sites.

The current frontier movement in the Philippines is largely motivated by push factors of depressed urban wages which also have demographic aspects. These factors have led to a largely poverty-driven reversal of population movements. The dominant urbanward movements of the seventies have been reversed. As a consequence forests and marginal lands are now increasingly colonized by marginal populations. Even regions with high population density and declining forest cover receive an increasing number of migrants. There has been a large increase in the outflows from Manila to nearby upland areas. At the same time there has been a change in the characteristics of the upland migrants. In earlier periods upland migration was dominated by better-off migrants who moved primarily in search of homesteads. Later-period migrants, when rural-to-rural migration increased in importance, were either displaced rural workers who could not afford homesteads or discouraged rural-urban migrants who now left the urban environment and moved into the densely populated uplands. Rural-to-rural migrants initially sold their labour in return for use-rights to previously cleared forest lands.

The largest concentrations of upland populations were in logged-over timberlands where migrants provided ideal sources of inexpensive labour. There are now regions in steeply sloping lands with upland population densities of over 100 persons per km². In more accessible upland areas population densities of more than 500 persons per km², twice the national average, can be found. A substantial portion of deforestation in these regions comes from commercial logging and small scale timber cutting. The harvesting of non-timber forest products such as rattan, bamboo, certain leaves and gathering of fuel wood also contribute to the problem. But the most significant form of degradation occurred when forests were permanently transformed into cultivated areas. Long fallow rotations will be unable to support these populations while more frequent cropping results in greater soil loss with the same dire consequences for the populations cultivating these areas.

It should be noted that population increase did not stimulate a transition toward more intensive or productive cultivation. Cropland expansion, as just shown, moved heavily into fragile forested sites which are unable to support intensive cultivation. To compound the problems, inappropriate farming practices on the sloping lands have led to further reductions in land productivity and substantial soil loss and not to new or more efficient farming methods in either the lowlands or uplands.

In the absence of such intense population pressure migrants may have had the resources to try out new technologies or implement policy recommendations which could have led to greater productivity or reduced land degradation in the long run.

Demographic Consequences of Environmental Problems

There is evidence that deforestation in the humid tropics, partially the consequence of population pressure, is responsible for the renewed vigour and spread of certain tropical diseases such as filariasis, dengue haemorrhagic fever and especially malaria. Studies of deforestation have given ample attention to their ecological and economic consequences but have rarely concentrated on the impact of deforestation on health and disease transmission. In contrast to city dwellers, traditional forest dwellers acquired a certain degree of immunity against diseases which are common in wooded areas. In the past city dwellers in tropical areas of South East Asia, aware of this difference in immunity, avoided the forests as the abode of evil spirits who could inflict these diseases. Religious mythology thus functioned as protection against tropical disease and against the encroachment of outsiders on the forest.

Examples from both South East Asia and Brazil show that certain settlement patterns can break the traditional equilibrium. In Brazil, after a decrease from an estimated 6 million cases of malaria per year to about 52,000 in 1970, the number of reported cases has increased steadily every year to more than 550,000 in 1990. Most of these cases occur in the Amazon region. This phenomenon is linked to deforestation in the region which now amounts to about 8 percent of the Amazon forest cover. Deforestation is closely related to population movement and to natural growth which is higher in the Amazon than the average for the whole country. Much of the settlement in the forest margins is essentially migration of poverty from other parts of Brazil.

Malaria in the Amazon is spread by a mosquito which prefers breeding places that have deep, clean, partly sunlit water with aquatic plants but are free of decomposing organic matter. These mosquitos have multiplied rapidly thanks to man-made breeding places which form pools of stagnant water such as culverts, borrow pits, streams clogged by felled trees, and pits left by miners. In addition, forest clearing provides sunlight for pools of water that were previously too shaded. Malaria vectors have shown great capacity to adapt to the opportunities and challenges of the man-made environment. The malaria parasite has adapted well to the human and vector environment in the forest margins, reproducing in its vertebrate and invertebrate hosts without killing them.

It is especially in the initial phase of certain types of settlement in the Amazon that malaria, frontier malaria, has distinct characteristics which make it more difficult to control than stable malaria which is associated with more stable and traditional settlement patterns. Vector density is high and there is intense exposure to vectors. There is

a high level of transmission and immunity is low. Settlers have a limited knowledge of disease. Morbidity is high. Nevertheless, case fatality remains relatively low.

In Southeast Asia new techniques of logging such as commercial teak logging have attracted new forest dwellers. Traditional forest people built homes on stilts and cooked on a smoky fire inside the house while livestock remained under the house. New settlers built homes on the ground with no space for livestock under the house and cooked in a detached room. Agricultural techniques unsuitable for once forested areas further created problems. Deforestation and increased hunting reduced the number of animals preying on rodents. Urban rats followed migrants into the forests. Declining bird and bat populations facilitated the growth of insect populations. All these developments have promoted the renewed transmission of malaria and created widespread hyperendemic areas. The effects of deforestation on the spread of malaria do not remain limited to forest settlements but go beyond to populations living away from the forest settlements who will also become more susceptible to malaria.

High malaria prevalence in a given locality in turn affects population mobility and socio-economic conditions which in turn reinforce high transmission and weak control. The solution is not to limit migration, which is ethically impossible, but to discourage migration to those areas where malaria epidemics are certain to occur. What is needed is a polyvalent approach which makes possible decreased exposure of men to mosquitos using low cost technologies.

5. Policy makers should look carefully at the ways in which existing population and exploitation policies have contributed to the problems of deforestation in the humid tropics. This does not necessarily imply that all these policies are completely wrong. However, the neglect of measures to counter potential negative side effects of the policies has often resulted in extraordinarily negative consequences.

Peru: Road Construction Policies, Coca Cultivation and Deforestation

An active policy of road building toward and within the Peruvian Amazon region has created a pattern of migratory agriculture. Migratory agriculture has spread the agricultural practices of peasant Andean migrants to regions not suitable for this type of agricultural exploitation and has been directly responsible for the massive deforestation process in the Peruvian Amazon. The construction of major roads into the high forest through land inadequate for agriculture has therefore been one of the principal causes of the occupation of the so-called protected forest lands. This negative impact of road construction could probably have been avoided if it had been accompanied by other policies. However a major part of budget for the Special Development Projects of the Peruvian government went to road construction with inadequate consideration of investment in rational forest development and management. These government policies together with inappropriate regional political relations have favoured an extensive type of cultivation at great ecological and economic cost which has been extremely detrimental to the forest.

The productivity of the principal crops of the region, based on extensive agriculture, is well below the national average. The low productivity of legal crops in these regions has stimulated coca production which contributed substantially to the deforestation process. In one area, the Upper Huallaga, the amount dedicated to the cultivation of coca is five times the amount of land planted for corn, the largest legal crop in that region. Furthermore coca tends to be cultivated in locations far away from the main highways to avoid police, thereby further promoting the human encroachment on the forest. The competition created by coca production leads to a chronic labour shortage for the cultivation of legal agricultural crops. The relatively lower profitability of legal agricultural products makes better wages impossible in this sector. The scarcity of labour in legal agriculture is reflected in the fact that family labour is more important for non-coca farmers than for coca farmers. Furthermore the importance of coca has deterred the development of technology specifically related to legal crops to replace the extensive land management strategy resulting in continued deforestation. It should be recognized, however, that coca cultivation has a lower rate of deforestation compared to the cultivation of legal crops because legal producers practice a more extensive type of cultivation than coca farmers.

The tremendous amount of deforestation is not only a result of coca expansion but also of inadequate economic policies that promote the agricultural and demographic frontier through the construction and penetration of roads without altering the productive conditions of the impoverished colonists. It is an example of how a specific set of policies aimed at populating the low density tropical regions of Eastern Peru created many negative side effects because the policy focused too exclusively on the construction of a highway infrastructure and neglected the

wider human needs of the settlers. In general the effort to direct migration to the Amazon can be seen as a misplaced strategy to address rural poverty without confronting the need for agrarian reform in other parts of the country.

Indonesia: Transmigration Goals and Realities

Over time since the Dutch colonial period the goals of the transmigration policy have frequently changed in emphasis. However, in one way or the other, the various goals were always present in the minds of policy makers. They ranged from a desire to change the perceived imbalance in the population distribution between Java and the outer islands of the Indonesian archipelago to arguments of social welfare and the avoidance of population pressure from the destitute masses in Java. In certain periods the perceived need to address imbalances in rural labour supply, (surplus in Java, deficit in the outer islands) was predominant. In other periods there was an emphasis on the need to increase the supply of food through the expansion of food crop cultivation in the outer islands. Altogether transmigration was an explicit policy to expand human settlement to the frontier with landless or near landless peasants expected to play a major role.

However, frequently, the complexities of implementing these policies was underestimated and attention to potential side effects were minimized or totally neglected. Often the site selected was inappropriate for sustained food cultivation. The indiscriminate use of heavy technology to clear land was often responsible for the rapid deterioration of the soil, thus precluding sustainable exploitation patterns. The mistaken assumption that land was largely free of opposing claims by local inhabitants or the forestry sector resulted in wider dispersion of selected settlements, thus promoting wider deforestation than initially anticipated. Frequently it was difficult for new settlers to combine productive crop development and minimum sustainable management of the deforested area.

As a consequence of these problems and side effects there was a fundamental shift away from a programme oriented primarily toward demographic and welfare objectives to one oriented more toward supporting cash crops for export as well as for the domestic market. This fortunately implies a dilution of the direct effects of transmigration on patterns of deforestation, typified by the creation of distinct food or mixed crop settlements. Fortunately it has also been realized that transmigration is not a viable solution for reducing the population pressure in rural Java and that direct policies to reduce population growth and fertility of rural Java are necessary.

Costa Rica: Inappropriate Property Laws

Property laws which discourage the adoption of soil conservation and which encouraged speculation in place of stable occupation were the major cause of extensive exploitation of land in Costa Rica. Cattle ranching expanded rapidly through a combination of misplaced government incentives and lenient laws on land squatting. In addition, charges for timber cutting were very low. Cleared lands commanded substantially higher prices and thus created a strong incentive to cut and burn the squatted- on land for sale to cattle ranchers. The maintenance of land fertility fared badly in this process. When the economic crisis made ranching unprofitable, large tracts of spoiled pastures were abandoned and soils under these conditions deteriorated rapidly and damaged surrounding lands and waterways.

The roads left behind following this process of misplaced incentives attracted even more migrants. Initially attention went to semi-forested land, where clearing was easier. As these lands became occupied there was a significant redistribution of migrants towards denser forests.

Since frontier-ward migration in Costa Rica has been to marginal lands, conversion lands for crop cultivation has had little impact on increasing the domestic food supply. Instead most land conversion is to unsustainable grazing which contributes to the country's soil loss.

Policy Conclusions

The principles which have been discussed in this policy monograph demonstrate that formulation of effective population/environmental policy is an extremely complex process. Successful policies directed to alleviating the environmental problems of humid tropics cannot be reduced to a few single- minded slogans. They must contain a set of balanced and integrated measures giving due attention to direct population policy measures and wise land management policies. Such policies should provide wide support to the collection of high-quality, systematic data both on population dynamics and on the environment of the humid forests of the tropical areas. More support is needed for efforts to increase the analytical quality of scientific studies dealing with the interrelations between population dynamics and deforestation and other environmental problems of the humid tropics. While many other environmental problems cry for a need for data and better scientific analysis, these needs are most urgent for the topic discussed in this monograph.

Four components are needed for an integrated and balanced policy. They are:

1. Improvement in the Quality of Life

Focus on improvement in the quality of life will create a context where many of the negative effects of population dynamics on the tropical environment of the humid tropics can be reduced or even neutralized. Three aspects need to be especially singled out: better education, improved health services and promotion of woman's welfare. Improvement in these areas will greatly increase the efficiency of well designed population policies.

In some cases profound transformation of social and economic conditions may be necessary. For example in Honduras it is not the carrying capacity of the land that has failed to keep pace with population growth, nor is population growth the primary cause of the impoverishment of the Honduran ecology and its inhabitants. Rather it is the general trend toward resource oligopoly and patterns of exploitation and production that jeopardize future systemic sustainability.

2. Attention to Population Dynamics and Policies

Population dynamics are intertwined with ecological dynamics of the humid tropics in many ways. Where population growth contributes to the problems of deforestation the promotion of family planning needs to receive ample support. While there is no clear pattern toward higher fertility in most frontier areas in many parts of the humid tropics access to family planning is more limited than in other parts of the country. Attention to public policies aimed at reduction of fertility would have more decisive impacts than merely increasing availability of land for habitation.

The dynamics of migration should also receive ample attention from the policy makers. High population growth and fertility in other parts of the country may stimulate migration to the humid tropics. This has often been further aggravated by special migration policies which have failed to produce the expected benefits and caused additional problems instead. A major conclusion of many empirical findings is that if deforestation is to be limited, the most direct policy is to minimize new road construction in the humic tropics, particularly in areas where there are no roads. In some cases, though, as in the example from Nepal, improvements in infrastructure can create conditions which make it easier to control deforestation.

Promotion of better health for the populations of the humid tropics will create a favourable context for pursuing other policies of potential benefit to the humid tropics. The health conditions of these populations is sometimes precarious because of the spread of contagious tropical diseases. If these are not controlled in the humid tropics themselves they will spread to surrounding regions including the urban areas.

3. Good Forest and Land Management Policies

These include a variety of measures such as increasing land use efficiency at both the macro and micro-level, comprehensive afforestation policies, encouragement to plant fodder trees, shift from cattle population to smaller livestock. The short term management perspective characteristic of many timber concessions in the humid tropics and which results in underpricing land and timber resources, should be replaced by a long term perspective which emphasizes forest sustainability, conservation and regeneration. Many different policy instruments can be useful in executing these policies. For example, the Indonesian government requires a reforestation fee from the timber concessionaires which is supposed to be returned to them upon presentation of suitable evidence of replantation. Policies which encourage inefficient use of quality hardwood in manufacturing plywood, for example, should be eliminated. The importance of clearly defined land rights, particularly for smallholders, should be recognized and special programmes should be designed to secure these rights.

Management policies should be comprehensive and include the means to enforce them. For example the location of the Congo on the crossroads of important tropical ecosystems with relatively low population densities made it possible to declare many areas as protected. In reality these are often not protected and as a consequence a lot of informal settlement is occurring.

4. Attention to Measures at the Regional, National and International Level

Policies to control deforestation in the humid tropics can only be successful if they are applied within a national and international framework. Policies to improve the general welfare of the populations of the humid tropics are a proper part of national welfare policies. Often they exist but their implementation at the regional level is inadequate.

Problems of deforestation in the humid tropics must encompass not only the populations of the humid tropics but those in other parts of the country and even in neighbouring countries as well. Furthermore international consumption and production patterns may impinge on the environment of the humid tropics. Therefore these problems can only be adequately solved if they are framed within national and international perspectives.

Seminar on Population and Deforestation in the Humid Tropics

List of the papers presented at the Seminar on 'Population and Deforestation in the Humid Tropics' organized by the IUSSP Scientific Committee on Population and Environment and the Brazilian Association for the Study of Population (ABEP), held at the State University of Campinas from 30 November to 3 December 1992.

Session 1: Socio-economic Determinants of Carrying Capacity in Forest Regions

- 'Human Carrying Capacity Estimation in Brazil's Amazonian Settlements as a Guide to Development Policy' by Philip M. Fearnside
- 'Demographic and Technological Responses to Rapid Population Growth and Environmental Degradation. A Case Study of Arwa-Bijaypur Village, Nepal' by Keshari Kansakar
- 'Dynamique démographique, causes et conséquences de la déforestation dans les forêts tropicales humides en Afrique au sud du Sahara: le cas du Congo' by Joseph Gabriel Mokima
- 'Population Pressure, Economic Stagnation and Deforestation in Costa Rica and the Philippines' by Maria Concepcion J. Cruz

Session 2: Human Settlement and Transformation of Forest Regions I

- 'Population and Deforestation: Two Examples from Northwest Argentina' by Carlos Reboratti
- 'Inequality, Population and Forest Destruction in Honduras' by Billie R. DeWalt and Susan C. Stonich
- 'Land Tenure and Land Use Systems, Deforestation and Associated Factors in the Humid Tropics - Farm-Level Evidence from Ecuador' by Francisco Pichon and Richard Bilsborrow
- 'Croissance démographique et mise en culture des réserves forestières sur les Hautes Terres de l'Ouest Cameroun' by Jean-Marie Fotsing and Denis Gautier

Session 3: Human Settlement and Transformation of Forest Regions II

- 'Migration and Sustainable Management of Woods in Pinares de Mayari, Cuba' by Gilberto J. Cabrera Trimino and Mar¡a Herrera Ariel Guilar
- 'Migration, Transmigration and Regional Development: Frontier Settlement and Environment in Indonesia' by Peter Gardiner
- 'Coca Expansion and Environmental Destruction in the Peruvian Amazon Basin: The Case of Upper Huallaga' by Eduardo Bedoya and Lorien Klein
- 'Population Growth, Agricultural Activities and Deforestation in Southern Nigeria: An Analysis of Causal Factors' by Animam Beecroft Osirike

Session 4: Health and Family in the Humid Tropics

- 'Deforestation and Malaria in Rondonia' by Donald Sawyer
- 'Some Thoughts on the Impact of Deforestation on Health among Upland Populations in Mainland Southeast Asia' by Andhalee-Singhanetra-Renard
- 'Contraception in Frontier Regions: An Unexpected Picture' by John Marion Sydenstricker Neto

Session 5: Ecosystems, Socio-economic Systems and Population Dynamics

- 'Sustainability Assessment and the Fetishism of Indicators' by Fernando Tudela
- 'On the Management of Resources by Forest Dwellers: Towards a Sustainable Productive Rationality in the Humid Tropics Viewed from a Latin American Perspective' by Enrique Leff
- 'Ecocolonialism or Blaming the Victims: The Population and Environment Dilemma' by Maria Pilar Garcia
- 'Resources in a Nepali Village in 1980 and 1990: Toward a Theory of Agrarian Change' by Jeff Fox Forest

The International Union for the Scientific Study of Population (IUSSP) is the foremost international professional association dedicated to the scientific study of population. Its four basic objectives are:

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3. promotion of exchange between population specialists and those in related disciplines;

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