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ECOLOGICAL INDICATIONS OF THE NEED FOR A NEW APPROACH TO TROPICAL LAND USE

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Una serie dedicada a la difusión, con un enfoque interdisciplinario, de ideas básicas relacionadas con los problemas de tipo general que afectan el desarrollo de la agricultura y la vida rural en las Américas. La correspondencia debe ser enviada, al moderador: Armando Samper, Instituto Interamericano de Ciencias Agrícolas de la OEA, Turrialba, Costa Rica. Distribuye esta publicación el Servicio de Intercambio Científico.

A series devoted to the diffusion, on an interdisciplinary basis, of basic ideas pertaining to the broad problems affecting the development of agriculture and rural life in the Americas. Correspondence should be addressed to the moderator: Armando Samper, Inter-American Institute of Agricultural Sciences of the OAS, Turrialba, Costa Rica. Distributed by the Scientific Communications Service.

COMMENTS

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One who broadly surveys the history of agriculture is impressed by its conservatism, the slowness of its advance, the absence of the bold inventiveness which has characterized certain other branches of human endeavor. All the major crop plants, on which mankind depends for food, were domesticated in prehistoric times, in a manner which modern students gropingly strive to reconstruct. It is natural for us to think of the cultivation of plants as an invention, the fruit of some active mind's flash of insight, like the wheeled vehicle and the wind-propelled boat. But I believe that we shall gain a sounder understanding of the development of agriculture, its slowness and unpremeditated character, if we class it, not with inventions, but with biological or evolutionary processes, like the mutual adaptation of two symbionts. The adjustment of man's habits of living, working, and eating to his domesticated plants, and of these to his methods of culture, might profitably be compared to the rise of symbiosis between certain ants and the peculiar plants they inhabit (of which the widespread guarumo or Cecropia of tropical America is a good example), or of that between the leaf-cutting Atta ants and the fungi they cultivate on comminuted leaves. Especially in the case of maize, which closely resembles no known wild plant and would vanish from the earth without man's care, this method of viewing domestication seems appropriate.

We do not know by what steps men were led to sow and attend useful plants, but two theories merit attention. The first claims that seeds of edible wild plants, thrown by prehistoric men upon the middens or heaps of refuse at their more permanent settlements, grew and flourished in the rich, decaying organic matter, thereby suggesting deliberate efforts to reproduce the same result. The other theory, developed in some detail by Grant Allen in The Evolution of the Idea of God (Chapter XIII), is that agriculture arose in connection with the ancient cult of the dead. Early man nearly everywhere believed that departed spirits required nourishment; and filial piety, or fear of incurring the displeasure of the ghost, led him to make sacrifices and place offerings of food on the grave. Grains or other seeds included in these offerings would grow well in the recently stirred soil of the burial mound, enriched by the blood of the sacrificed victims and other organic remains; and by observing this, men were led to undertake more deliverate plantings. This theory explains why many peoples, scattered over the earth, sprinkled their seeds, or else the land that had been prepared for them, with the blood of a sacrificial victim, man or animal, thereby simulating the situation at the grave, which their primitive mentality could not easily dissociate from the act of sowing. Doubtless a practice so widespread as the cultivation of plants, which evidently began independently in the Old World and the New, had more than one mode of origin, and both of these theories are true. Both, it will be noted, emphasize the accidental character of the beginning of cultivation.

But whatever were the steps by which our forgotten ancestors, before the dawn of written history, developed agriculture, they established it so firmly that their literate descendants have succeeded in altering it relatively little. If we compare agriculture to a many-roomed house, I think it fair to say that prehistoric man laid its foundations, and raised its walls practically to their present height. Subsequent generations have ornamented the façade, added a small room here and there, and above all installed labor-saving machinery; but the plan of the edifice is still much the same as prehistoric man left it. Compare this conservatism with the daring originality that modern man has shown in certain other fields, such as transportation and communication. Agriculture has great need of imaginative vision, along with the courage to examine everything and to break away from practices and prejudices that have little more than hoary age to recommend them.

An important factor in the conservatism of agriculture is man's stubborn and irrational adherence to dietary habits, even when to change them would bring great advantages. Wheat-eaters insist on wheaten bread, potato-eaters on potatoes, no matter to what part of the world they go, and what excellent substitutes their new environment offers. Many people, I doubt not, would feel mistreated if forced to change their present food and drink for Olympian nectar and ambrosia. One gains the impression that at various times men were forced by scarcity to adopt new and unpromising foods, and having once fallen into the habit of eating them, they were never afterward able to give up these inappropriate articles of diet. Certainly small grains are more suitable for the nourishment of little birds than of men who, until the recent development of agricultural machinery, subsisted on them only at the price of gruelling labor in sowing, harvesting, and preparing them for consumption. And it appears that domesticated animals were first kept as pets, or perhaps for their supernatural or religious significance, that men were driven by hunger to devour these companions, and thenceforth had not the strength of mind to abandon the practice.

This background must be kept in mind by anyone who contemplates making radical changes in agricultural practices, which imply radical changes in diet, rather than merely increasing yields, or controlling plagues, in agricultural systems which adhere stubbornly to ancient patterns. That far-reaching changes are imperative, above all in tropical regions where rain-forest is the natural vegetation, is abundantly evident to anyone familiar with conditions there.

Dr. Holdridge's plea for a new approach to tropical land use, especially in humid regions, stirs an immediate response in me, because I have long lived in such a region, and seen the great evils of the present system. Almost a quarter of a century ago, I came as a wandering naturalist into the valley of El General in southern Costa Rica, which was then an isolated, sparsely populated area, largely unspoiled by human occupation. Over the years, I have watched its magnificent forests give way to inferior farmlands, from which a rapidly increasing population struggles to wrest an inadequate living. As a means of carrying on my studies, I have myself cultivated, on

a small scale, lands so broken and rocky that they can be prepared for sowing, at a reasonable expense, only by cutting and burning, and which after each harvest require years of rest, lest they lose their fertility and become infested by aggressive, sun-loving weeds.

By this ancient system, my neighbors and I grow maize, beans, and pumpkins, much, I imagine, as was earlier done by the Indians whose graves, so numerous in the valley, provide ornaments of gold to augment the meager incomes of some of the present inhabitants. But we labor under a heavy disadvantage unknown to the aborigines. Old World grasses (especially calinguero, Melinis minutiflora, and Guinea, Panicum maximum) introduced by the recent settlers to support their cattle, relentlessly overgrow the croplands, greatly diminishing their productivity or even rendering them unworkable by available means. Their introduction is just one more example of the lamentable lack of foresight and co-ordination which characterizes our agricultural operations.

While with much labor we raise annual crops like maize and beans, our woody perennial plants yield abundantly with scarcely any effort. For fifteen years a cluster of pejibaye palms, sprung from a single seed, gave us for several months each year as many of its nourishing fruits as we could eat, without ever requiring the least attention. By the time the older stems grew so tall that we could not reach their fruit clusters with a long pole from the top of a nearby thornless tree, other palms, that sprang up untended from seeds scattered by animals, had begun to bear. One avocado tree, which likewise needed no attention, gave us year after year enough fruit for the six or eight people on the farm and even for giving away. Similarly with the orange, the cashew and, in years when rain does not spoil the flowering, the mango. The local sweet orange reproduces so well from seeds which chance to fall in the pastures and plantations that we no longer propagate it; quite the contrary, we are obliged to remove excess trees. Bananas and plantains demand more attention, with replanting every five or six years; but they give a far greater return of food for one's labor than do the annual crops.

This experience should convince anyone that, in a region where temperature and rainfall permit vegetation to grow through most or all of the year, agriculture should be based on perennial plants, which make fullest use of these favorable conditions, and that to sow annual crops is wasteful of time, effort, and the soil's fertility. Indeed, this was a priori evident to me when I began to give attention to the problem long ago, and the passing years have strengthened this conviction.

Why, then, the reader will ask, do you not cease to bother with your troublesome annual crops, and live on the products of your generous trees? Aside from the fact that one must humor the dietary prejudices of his employes, the answer is that our trees, with the exception of the oranges, do not yield throughout the year. Here, after a usually short dry season, the rains begin in March, April, or at latest the beginning of May. From May until July or August, there is such variety and abundance of fruits that we might subsist on them alone, with possibly a small addition of proteins.

But in August or September begins a long season of scarcity, lasting until the following May, during which we depend on our stored grains, along with root crops like cassava and tiquisqui, the almost constantly yielding bananas, plantains and oranges, along with some bought food. Although grains can be kept, our fruits are not of kinds appropriate for storage or preserving -- at least, we have not learned how to store them. To add to the irony of the situation, we have been successful in growing some of the common garden vegetables only when they are planted early in the rainy season, so that they are ready for the table at the very time when we have the greatest abundance of fruits and need them least.

Greatly to reduce or even to eliminate areas devoted to annual food crops in the humid tropics is most desirable; but in many regions it seems impossible to do this without a good deal of preliminary development. From my experience in this valley, which is fairly typical of large areas in tropical America, I would suggest the following long-term project for agricultural improvement: Search the tropics of both hemispheres for perennial plants, preferably arborescent, which when brought together in any particular area would provide a satisfactory diet throughout the year. Pay attention likewise to the possibility of extending the productive period of valuable species by the selection of suitable strains; for, as is well known, different varieties may vary considerably in their season of flowering and fruiting, even in the same locality. Experiment with methods of storing the more nourishing products of these plants, especially the nuts which are richest in proteins. The ideal, however, is to provide each community, preferably each farm, with a galaxy of plants that would yield sufficient freshly gathered fruits and nuts at all seasons, for these are the most healthful and economical.

Dr. Holdridge has pointed out some of the ecological advantages of a mixed planting of trees and other plants, which simulates the variety found in tropical woodland: its stability, its capacity to maintain high productivity without commercial fertilizers, its resistance to injurious insects and fungi, as contrasted to the great vulnerability of pure stands to plagues of all sorts. To these advantages might be added the role of such mixed plantations in conserving the native fauna of the region, particularly the birds. Intermediate in character between the original forest and open country, they attract and provide nesting sites for many species from both of these habitats, although perhaps not the more extremely specialized forms. They are embellished by the vivid colors of plumage, and in the season of reproduction they resound with song.

By a careful selection of food plants, it should be possible to eliminate the need for domestic animals, such as chickens, pigs, and cattle. There are many reasons why it is preferable to dispense with them. If confined, their care is troublesome; if permitted to roam at large, they scratch and root out the young plants, or else browse on their foliage. One who attempts to produce his food yet preserve time for other pursuits prefers plants to animals; and of plants he prefers perennials to annuals. More important, the driving, confinement, mutilation, and killing which seen to be inseparable from animal husbandry become distasteful to us in proportion to the refinement of our sentiments and the elevation of our ideals. Long ago, in India, China, and Greece, it was recognized that the exploitation of animals retarded man's spiritual growth.

The effect of agricultural practices on the character of those who engage in them deserves at least as much attention as the quantity of food they produce. It is not mere men that we wish to keep alive, but excellent men. Because, in nearly every country and throughout the course of history, the lords of the land have been indifferent to the character of the people who produced their food, the name applied to the tiller of the soil has often become a term of disparagement and contempt-rustic, boor, yokel, villain, concho. Not the least of the tasks of agricultural science is to give the actual workers on the land a dignity compatible with their importance to society. In the measure that they base agriculture on trees, they should succeed in this high aim. To plant and prune fruit trees was not beneath the dignity of the proud aristocrats of Rome or England of past centuries; but it is hard to imagine them sowing corn or digging turnips. If agriculture could be made largely arboriculture, we might in time produce nations of aristocrats.

In an organism well adapted to its environment, all the aspects of its life form a coherent pattern. In birds, for example, the breeding season is adjusted to seasonal differences in the abundance of food; the number of eggs in a set is adjusted to the parents' ability to nourish the young; the number of broods is adjusted to the annual mortality of the species; the incubation and nestling periods are adjusted to the safety that the nest affords; the mating habits are adjusted to the ratio between the sexes; and so forth. Similarly, if men are ever to achieve good societies, far more attention must be paid to the integration of their several aspects than is commonly done. It is not wise to alter one department of life while leaving everything else just as it was; no matter how beneficent a change may be in itself, it may produce more harm than good unless certain correlative changes are made. Agriculture, diet, housing, economic practices, education, even religion, should fit into a coherent pattern, each part of which supports every other. The plight of the world today is largely due to the fact that men imagined that it was possible to decrease human mortality, by medicine and hygiene, without making compensatory alterations in certain other aspects of life, yet avoid eventual disaster.

Agriculture cannot profitably be changed unless our diet is correspondingly altered. As David Fairchild discovered, it is not enough to introduce strange plants from far places; the public must likewise be persuaded to eat them. A project such as we are now considering must give careful attention to the people whom it includes. It must bring together in its working area men and women whose idealism and vision of the future will help them to overcome their dietary prejudices and accustom themselves, perhaps at the price of the exercise of a good deal of self-control, to the new regimen. Their children, brought up on this regimen, would doubtless be healthier than their parents and prefer it to any other.

The vision of the advantages which the new system will bring is bright enough to arouse the enthusiasm of anyone who yearns for a better life for himself, his descendants, and mankind as a whole. In the first place, an abundance of food will be produced with a fraction of the labor

now expended on feeding one's family in all those parts of the world which lack the most modern machinery. As soon as the plantation of fruit trees is well started, its maintenance will be very easy, involving a little pruning, and occasional cutting down of the soft weeds that grow in its shade. Gone will be the heavy labor of guiding the plow, the anxious business of burning off a new clearing, the back-breaking hand cultivation beneath a burning sun. Not only will the production of food involve far less effort; since a large proportion of it can be eaten uncooked, there will be a corresponding reduction in the work of the kitchen. Gone will be the drudgery of the metate or hand corn mill and the tedious patting out of tortillas, which in Middle America claims so much of the rural housewife's strength and time. The problem of fuel, which in all non-industrial communities looms so big, will be readily solved: the small quantity of firewood needed by each household will be provided by branches pruned from the fruit trees and by old, dying trees.

The people who make up our tree-growing community will need, in addition to food, a variety of other things, including clothing, household furnishings, books and musical instruments to embellish their leisure, and tools, although those needed for arboriculture are few and simple. They must either make these things themselves or produce something for sale or exchange. Since it is hardly possible for any community to grow or manufacture everything it needs, some source of income will certainly be necessary; but each household or each community should, as far as possible, create what it requires. In this matter, America can well take a hint from Gandhi's encouragement of home industries in India.

Relieved of much of the drudgery of the kitchen, the women will have time for weaving, sewing, and other handicrafts; the men, with their agricultural labors greatly lightened, for woodwork and a variety of other creative occupations. Thereby they will know the joy which, I believe, every well-endowed man and woman derives from creating beautiful or useful things with his own mind and hands, so long as he is not forced to continue after he is weary; and their homes, as were those of many of the aboriginal inhabitants of this hemisphere, will be filled with beautiful objects fashioned by themselves and their neighbors, instead of with cheap, mass-produced goods, the price of which is largely made up of the costs of transportation and distribution, along with dealers' often excessive profits. Doubtless the householders could derive an income from their handicrafts, no less than from the excess produce of their farms. It is desirable that they make substantial articles of real use, rather than gewgaws for the tourist trade.

If suitable clay is available, the community should have its own pottery, operated by the fruit-growers themselves, for making tiles of several types, as well as a variety of vessels. It is distressing to see in this country, as doubtless in many others in tropical America, flimshy constructions of wood, with imported metal roofs, replacing the more attractive and substantial structures which in the past were built largely

of materials locally available: adobe or, where earthquakes occur, the bonded adobe called bahareque for the walls; tiles for the roofs and often likewise the floors. Although improvements might be made in the traditional white-walled, red-roofed home of Latin America, it is basically an excellent type of construction, durable, sanitary, cool beneath a hot sun, and under beating tropical rains far less noisy than a house roofed with corrugated sheet metal.

Of the material supports of a good and happy life, none, in my opinion, is more important than a beautiful home, which provides ample space for the various activities of those who dwell in it. Where good taste rules, such beauty is compatible with great simplicity. Adequate housing is far more necessary than fine clothing, or than food beyond the minimum essential for health and strength. With the saving in time and effort that will be given by an agricultural system well adjusted to the environment, every thrifty family should before long own such a home, to be carefully preserved and passed on to its descendants.

Each home will be situated on a plot of ground large enough to provide abundant food for the family that occupies it and perhaps also fibers for their clothes, as well as sources of cash. Dr. Holdridge's estimate of nine acres as the size of the homestead appears ample for a family of about eight on moderately productive land, although the actual area would need to be determined by experience in each region. If nine acres is the average size of the homestead, there would be about seventy in a square mile. Assuming a fairly uniform terrain, each family would live within an easy walk - one mile - of more than two hundred other families. This is a population density intermediate between that of agricultural regions which produce quantities of grain and cattle for distant cities and that of the cities themselves. It avoids oppressive isolation no less than unwholesome crowding. With such a distribution of homes, the people could develop communal activities and enjoy many of the cultural advantages of cities, without their nerve-racking tension, noise, and confusion. Those who believe in small schools, with close association between the pupils and an excellent teacher, would place the schoolhouses no more than a mile apart. Every child will live within walking distance of his school.

Although these people who dwell comfortably amid the fruit trees which support them may not have a large cash income, they will hardly need it in order to create for themselves a life well above the level that we call "subsistence". If they have the requisite qualities of mind, as they will have the leisure, they can in time make their lives far more satisfying and rewarding than those of the majority of wealthy people today. As rural life becomes more attractive, the more enterprising young people will not be lured away to the cities, to continue the well known pattern wherein the cities impoverish the country by draining off its best human stock, only to exhaust it in a few generations. With the most intelligent people staying steadfastly in their rural community, its cultural level will rapidly rise. The moral and social advantages which Arthur E. Morgan, in a number of thought-provoking books, has claimed for the small community will be realized by its inhabitants, set enduringly upon a solid foundation.

After one or a few communities, established on this pattern, begin to demonstrate its manifold benefits, there will doubtless be a widespread movement to extend it, without the necessity of propaganda. If we have faith in the old dictum of Socrates, that all men seek the good, although most mistake its nature, it seems only necessary to demonstrate in the clearest possible manner what a good life is, in order to have it widely imitated. Not only in those very wet tropical regions which support rainforest does the plan of producing all or most of our food from trees seem feasible; I suspect that it would be even easier to accomplish in somewhat drier regions, where more open types of woodland are the natural vegetation, because of the considerable variety of fruitful trees that thrive in such regions but are adversely affected by excessive rainfall. One of the world's important food-bearing trees, the date palm, is at home in the most arid deserts, where oases provide abundant ground water.

Even in the temperate zones it should be possible greatly to increase the proportion of human food produced by perennial plants, with consequent economy of effort. A large part of the North Temperate Zone has only recently, in geological terms, recovered its forests after the devastation wrought by the last continental glaciers; and with the present tendency toward the mitigation of its climate, an increasingly large variety of trees should flourish there. The people who live where nature is kindest to them, the somewhat elevated regions between the tropics, should set mankind the example of a good life based upon a good agriculture, which those in less favored areas should copy as closely as their circumstances permit.

To make rural life more attractive and satisfying would doubtless cause the cities to shrink. There would be a diminution in the number of people engaged in transportation, trading, book-keeping, money-lending, and other non-productive activities, all of whom are supported by the at present steadily declining number of producers. But in the measure that each community and each homestead supplied a larger proportion of its own requirements, there would be less need for all the complicated machinery of distribution, with the hordes of non-producers it engages. To those statistics-worshippers who measure the greatness of a country by the volume of its trade, the sum of its pay-rolls, the amount of its bank-clearances, this would appear a calamity. But it is a lamentable error to measure the greatness of nations in this superficial fashion. Their greatness or goodness is determined by the character of the people whom they comprise, and by this alone. A country whose people are intelligent, creative, kindly, honest, contented, good neighbors, and grateful custodians of the earth that supports them, with all the other living things that share it with them, is a great and admirable country, whether it has banks and railroads or lacks them. And people who dwell amid the trees which sustain them, creating as far as possible what they need with their own minds and hands, are more likely to acquire this character than those who, creating nothing for themselves, fling themselves into the competitive scramble for wealth that others have produced.

These are some of the benefits which, with wise guidance, should in time follow from Dr. Holdridge's project for developing the agriculture best adapted to a tropical environment, which is necessarily an agriculture based primarily on perennial plants. They will not be fully attained by a five- or a ten-year plan, but only in the course of generations. Neither plants nor the people whom they support are molded to our specifications as rapidly as metals and plastics; and men who cannot in the course of a lifetime bring their schemes to fruition commonly become discouraged and abandon them as impracticable -- which is why I suggested at the beginning of this paper that the domestication of plants should be regarded as a biological or evolutionary process, which moves almost imperceptibly toward an unforeseen end, rather than as an invention, which must develop far more rapidly in order to sustain men's interest in it. Thus there is need for great patience if we are to give agriculture, not a few superficial changes, but the radical reconstruction that it needs. Doubtless in this paper we have considered matters beyond the competence of the agricultural scientists in his professional capacity. But the vision of the blessings which his devoted efforts may in time bring to mankind, and indeed to all terrestrial life, and the conviction that as agriculture is the foundation of civilized society, so a good and stable agriculture is the indispensable foundation of a good and stable society, should strengthen his will to persevere in great undertakings.

San Isidro del General, Costa Rica
June 11, 1959

NO

SUPPLEMENTARY COMMENTS

L. R. Holdridge

Needless to say, I was pleased extremely to read over the several excellent and thought-provoking contributions which came in as a response to receiving the paper which I had prepared in haste for a conference at Turrialba. They all merit thoughtful reading and need no further comments on my part since the specific aim of my paper was to provoke thought and comments. The important indication from all these is that there does exist already considerable thought on the general problems of tropical agriculture. If my interpretations of these are correct, there is no general agreement on a specific future policy, while there is a mutual appreciation of the need of early progress towards a more rational land use in tropical regions.

Since the comments indicate that apparently I ventured on to "soft ground" with the subject of early agricultural development, I do want to explain that I had made no attempt at anthropological research or study of the literature in that field. Thus I appreciate the constructive contributions on that topic.

However, from an ecologist's point of view, the potential evapotranspiration rate line of unity, where potential evapotranspiration equals precipitation has seemed to work always as a powerful magnet for man's settlement and development. Nineteen of the capitals of the 21 American republics are located in the adjacent life-zones on both the subhumid and humid sides of this line. Lima, Peru and Santiago, Chile are the exceptions to this rule, but Cuzco, the original capital of Peru was near the line while the Araucarian Indians in Chile were strong enough to prevent the early Spaniards from reaching the area to the south closer to the unity line.

This line corresponds with the steppe-prairie division in the cool temperate region or in montane belts, which I used in my paper as a simpler expression than that of a unity potential evapotranspiration rate line. Such a line crosses the Guatemalan Peten from east to west and passes next to the prairies and savannas in highland Mexico, Guatemala, Colombia and Peru. I believe it should be taken into account in all anthropological studies.

However the above is really a side-issue relative to present-day tropical agriculture. We definitely must learn to be more productive and more importantly to attain a permanent equilibrium with the environment. I would like in closing these comments to express my appreciation for the time the commentators have put into their responses as well as the hope that our efforts will help somehow to stimulate further research and study on the general subject of tropical land-use.

August 6, 1959