

Paper technology and the Third World: global restrictions and technical alternatives

By Jörg Becker

"There is good evidence that small-scale paper mills based on indigenous fibres can be viable in Third World countries". In his article Jörg Becker examines some of the problems and possibilities facing developing countries that try to establish a national paper industry.

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Introduction

The triteness of the statement that a fish cannot swim without water stands in crass contradiction to the public and scholarly interests of communications and media researchers and book specialists in the use of, and research on, paper as the raw material for the technological basis of all printed matter (books, newspapers, comics, magazines, computer print-outs on paper etc). The general disinterest regarding this question demonstrates a general bias on the part of the Western media and book researchers, who with their idealistic and nonmaterialistic tradition,¹ would sooner involve themselves in disputes over the content transmitted by the print media than to reflect upon the economic, political and technological conditions that make possible the production, distribution and delivery of the contents communicated by the medium of paper.

If one differentiates the mass media by the basic production techniques employed by the print media on the one side and the electronic media on the other, then the raw material, paper, is for the print media the equivalent of the raw material radio frequencies, for the electronic media. Paper is a product of fossil energy resources which has a common qualitative characteristic with radio frequencies in that neither fossil energy resources nor the number of utilizable frequencies of electromagnetic waves can be increased. The worldwide energy crisis recognized since the start of the seventies, had as one result that the problem of paper supply as the basis for the provisioning of a print medium in many aspects came to resemble the battle for access to, and distribution of, other raw materials of finite resource availability very closely.

In the following, the assumption is made that it would be more practical if in a discussion of the democratic aspect of the international press and book system (bias, literacy campaigns, free flow of information etc) the interna-

tional battle for distribution of cultural paper be examined and considered.

All discussions of the international struggle involving the distribution of raw materials must nowadays be carried out within a multi-factor framework. Also the question of the supply of cultural paper to various nations and groups would soon become defined, since partial diagnosis and therapy would lead the whole problem into a cul-de-sac, since economic, political, technological, ecological and social causes and effects must be weighed all together.

In conflict with, and complementary to, other debates on raw materials — e.g. minerals — the debate over the provisioning of cultural paper has an additional dimension. As far as cultural paper is concerned, it is not only a question of seeing the materials from an economic but also from an ideological point of view. It is on this double characteristic of economy and ideology that the whole debate depends. Man's right to inform and to receive information that is socially relevant, is directly linked with the type and quality of cultural paper supply to a nation or group (as far as the print media sector is concerned).

The Third World, and in particular Black Africa, is especially disadvantaged as regards cultural paper supply. In discussions of the most varied dimensions concerning the supply of cultural paper, the figures show greater disadvantages for the Third World when compared with the disadvantages which are also experienced by regions within the industrial countries. The situation in the Third World is only comprehensible within the framework of a wider international analytic concept insofar that in principle it is only to be altered within the framework of a discussion over a *New International Economic Order* (NIEO) and a *New International Information Order* (NIIO).

Sure, a fish can swim if there is water; but the very presence of water does not

specify which, and how many, fish may swim in it — in which direction they can swim — nor for how long they can survive. In order to ensure a just and equal distribution of cultural paper to all nations and groups, certain fringe conditions must be fulfilled in order to give the water a "democratic" dimension.

Global aspects: the triangle of economics, politics and ecology

In his 1979 contribution: *Education about the Third World and its Development Problems*, Upper Volta's renowned social scientist Joseph Ki-Zerbo made the following points:

"What can be in interest of the masses? Surely the gratifying of basic needs. This is fundamental to all development concepts. One should take care, however, not to reduce basic needs to the absolute minimum necessary to stay alive. The basic human rights like freedom of opinion are a part of them, which does not mean, however, defining the basic human rights necessarily in accordance with Western concepts of law and morality (. . .). This leads me to a further principal characteristic of development: Cultural identity."²

If one concurs with such conclusions, it becomes clear, that the successful search for identity and the establishment of communication must be regarded as essential parts of a basic needs strategy. To avoid misunderstanding it needs to be stressed that there can be no abstract basic need for paper, books, TV broadcasting or microchips, but only for such that can adequately guarantee the historically grown need for communication. In this historically qualified sense there is a basic need for cultural paper in many Third World countries and in many regions within these countries. The current shortage of paper in the Third World increases foreign book penetration, and leads to conflicts of

identity, and weakens the education system, undermines the plurality of press opinion, makes political censorship easier and puts a strain on the foreign trade balance.

The reasons for the Third World paper shortage are manifold. In essence they are a function of the globally, externally originated conditions of the paper market. The five most important conditions will now be dealt with.

Development of energy costs

From 1973 till 1980 the world pulp and paper industries were burdened by ever-increasing energy costs, especially for oil and related products. Pulp, but especially paper production requires an enormous quantity of energy. According to a World Bank study pulp and paper production are counted among the energy-intensive branches of industry;³ it is one of the branches in which the energy costs account for between 15 and 50 per cent of the total costs per production unit. Even if the paper branch is less energy intensive than, for example, the metallurgic industries, still, on an average, to produce

one ton of paper 1—2 tons of black coal or 0.7 to 1.4 tons of natural gas are required.

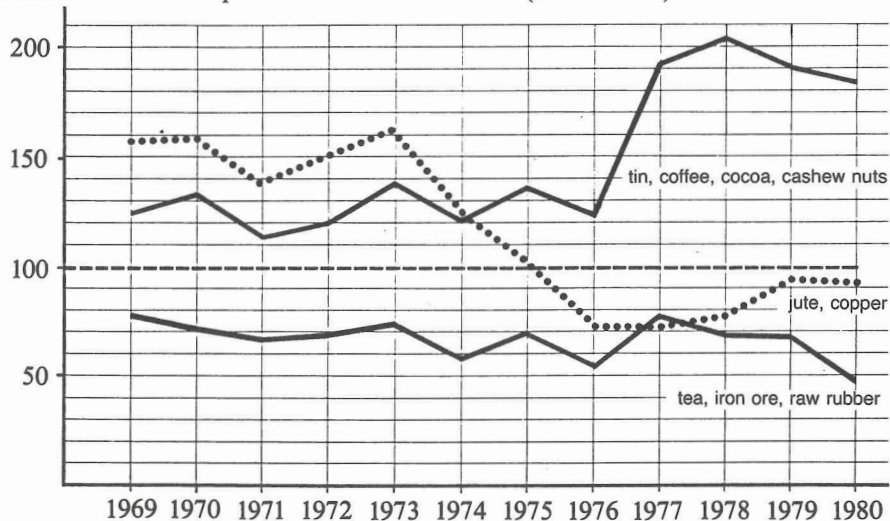
Drastic reduction of energy should be the first necessary consequence for the Third World. Another World Bank study assumes that smaller paper mills can save up to 11 per cent and bigger ones 12—15 per cent in energy costs in Third World countries.⁴ Smaller mills can save energy through better insulation and heat exploitation. Bigger mills should use their waste heat better, introduce simpler changes in the production process and use more energy-efficient equipment.

Development of paper prices

In the 1960s and 70s the prices of cellulose, pulp and paper increased at the same rate as other industrial goods in the developed world. The prices for pulp and paper increased to a lesser degree in the US, whereas cellulose was an exception since its price went up by 60 per cent in real terms as compared to the producers' price index for industrial products. This high level has been more or less maintained. This differentiated

Fig 1

"Terms of Trade" (commodity terms of trade) for selected raw materials from the Third World in comparison with U S cellulose (1960 = 100)



Source:

United States Department of Commerce; Statistical Abstract of the United States, Washington, DC; United States Department of Commerce 1975-; Estimates by the author.

development of paper and pulp prices on the one hand and cellulose on the other can also be applied to other industrial countries which possess a national manufacturing capability for cellulose paper and pulp.⁵

The Third World's "Commodity Terms of Trade", e.g. the relationship between the cost of raw materials and that of the cellulose produced in the US developed in a rather different manner in the years between 1969 and 1980. In an analysis the prices for 10 raw materials supplied to the industrial countries by the Third World were compared to the price for the US "special alpha and dissolving grades" cellulose; these were based on *fas* prices (= free alongside ship). Iron ore, tea, rubber, jute, copper, coffee, tin, cacao and cashew nuts were able to maintain their "terms of trade" in relation to cellulose from 1969 to the mid-70s. From 1975 on the prices for coffee, tin, cacao and cashew nuts increased so significantly that the resulting "terms of trade" net profits could not be ignored. Over the same period of time the conditions for tea, iron ore and rubber worsened. Already from 1973 onwards the barter relationship concerning the export commodities copper and jute deteriorated drastically.

The world economic crisis of 1980 which still continues in most developing countries has on the whole changed the "terms of trade" relationship between the above mentioned Third World export products and US-cellulose to the disadvantage of the former. The statistics for 1981 and 1982 which are the most recent available, show that almost all Third World export goods suffered "terms of trade" losses. Only iron ore and jute could be seen to have achieved a slight improvement. As opposed to this the barter value of such Third World export products as copper, tin, cacao, cashew nuts, coffee and rubber, suffered a considerable and at times even a catastrophic decline.

If the Third World intends to buy the

same quantities of US-cellulose as before, it will therefore have to export higher quantities of raw materials. Even if the Third World countries will be able to do so, they will most probably not have markets for large quantities of these products. The demand for raw materials remains weak.

Hence we may proceed on the assumption that the industrial countries' capacity of absorbing raw materials has now been reached, especially so since their markets are saturated and since there is a tendency to replace raw materials by synthetic products. And even if higher quantities of raw materials could be exported from third world countries, it is unlikely that any surplus from exports could be used in order to import more cellulose. Nowadays most developing countries need their foreign exchange to lower their debts to industrial countries.

Concentration in the paper industry

The pulp and paper markets are to a very large extent controlled by Western industrial countries. First and foremost among them is the twin economic system of North America (USA and Canada), Finland, Sweden and, to some extent, Japan, which, as far as production and trade with the end products of the paper industry are concerned, control more than 80—85 per cent of the world market. Diverse anti-trust suits against the paper industry are among the many indications of the extraordinarily high degree of concentration in this branch of industry.

With a regional concentration to Scandinavia and the USA the 100 largest pulp and paper companies controlled about 46 per cent of the world production of paper and cardboard in 1975. In 1980 their share had increased to approximately 51 per cent. Their share of market pulp was around 70 per cent in 1980. Whereas pulp production seems more concentrated than total production of paper and cardboard, it can generally be said that if one were to split

up market domination and world-wide control according to the enormous diversity of various end products from paper and pulp, the degree of concentration would increase many times over. For some qualities total world production is in the hands of a few concerns only.

Even if the Third World has at no time produced more than 6 per cent of all chemical pulp, some countries, especially Brazil, India, the People's Republic of China, the Philippines and South Korea, were able to increase their production considerably in the last few years. Whether this form of economic growth benefited the Third World generally or even the population of the actual country is doubtful. The beneficiaries were on the whole the North American — Scandinavian producers, who are building up the pulp and paper industry in some Third World countries by means of their capital and know-how, their technology and their advisory capacity. The recently constructed pulp mill CELLUCAM in Edea, Cameroon, for example, in important points shows a model of technology transfer which one can designate "pseudotransfer" in the words of Ignacy Sachs.⁶ Although more than 50 per cent of CELLUCAM shares are in the hands of the Cameroon government, a Swedish pulp and paper company, which is only minimally involved financially in CELLUCAM, gained the marketing rights for the paper meant for export. In this way transnational paper concerns have a considerable influence on the marketing and world-wide distribution of pulp produced in the Third World. Even if in some cases growth can be ascertained, it is doubtful whether one can speak of *A Third World* paper or pulp production.

Wood resources in the industrial nations

Expenditure for wood forms the biggest single cost item in the production of paper and pulp. Proportionally and

globally wood accounts for about a third of total variable costs of pulp production — they vary from 50 per cent of costs in Sweden to 25 per cent in Brazil. So it is plain as day that changes in world-wide forestation very soon have an effect on the price calculations of paper products. As approximately 80 per cent of the world's pulp production presently takes place in the Western industrial nations, the destruction of forests in the Third World will only peripherally influence world paper prices.

More interesting is therefore a glance at the ecological economic stability of northern forest areas. Conspicuous in this context is the fact that nearly all global models of recent years — from the "Club of Rome" to "Global 2000" take a stability of these forests for granted. In view of the damages to forests in North America and Europe caused by the complex disease — acid rain —, one cannot share this optimism any more. Despite the difficulties to list all the damages of acid rain in concrete form, the following approximations are nevertheless of interest.

The OECD has made calculations on the basis that approximately 3 to 5 per cent of a GNP must be included in any estimate for "repairs" of dying forests. In the USA an amount ranging from 6 to 35 G USD would thus be necessary to avert the economic damages of acid rain, and an additional amount of between 2 and 12 G USD would have to be spent by power stations to convert their present plants.

The effects of acid rain and of diminishing forests on global paper prices is difficult to estimate as a complex series of factors have to be considered. The West German trade paper *Das Papier Magazin*, however, warns against the effects of acid rain:

"For technological reasons only green wood is used in the production of wood pulp. We get it in the form of the so-called inferior wood when forests are thinned

out, a forestry necessity to encourage the healthy development of hard and valuable timber. If young trees succumb, our supply of green wood is in danger. For diseased trees that have reached a certain level of disease can no longer be utilized by us."⁷

This development will have the following consequences for the Third World: The damages caused in the forests by acid rain as well as increased expenditure for anti-pollution measures will push up paper prices world-wide with serious consequences for the Third World. Only recently one further effect was drawn into the public's awareness by West Germany's largest forest proprietor, Johannes, Prince Thurn and Taxis: Price pressure on northern forests will lead to an increased destruction of tropical rain forests in the Third World⁸.

Future market developments in industrial nations

The global consumption of cultural paper clearly demonstrates the gap between the Third World and the industrial nations well-known also from other problem areas. As far as the consumption of cultural paper is concerned the Western industrial nations show themselves as glaring surplus societies, whereas the consumption of cultural paper in the Third World (and many socialist countries of Eastern Europe) shows the typical characteristics of a deficiency economy.

One can drastically illustrate this relation between deficiency economy and surplus society in the following way: Whereas in 1980 Black Africa aimed for a book production of 120 pages per person per year (and did not achieve this aim), a Scandinavian household gets more than 200 pages of advertising material in four colour printing delivered to the door free and unasked for during two weeks. Although the theoretic and empirical mutual relations between deficiency economies and surplus societies

are multicausal, and a solution to the conflict potential between the two economies can't be found simply by the surplus societies passing a "little" of their "more" onto the deficiency economies, the question should be looked into here whether a reduction of paper consumption in industrial countries could lead to more favourable wholesale prices for the Third World.

According to all available prognostic studies the demand for cultural paper for books, press and magazines in the industrial nations will continue to grow, even though not as fast any more as in the sixties and seventies. The following prognosis by the consulting company of Arthur D Little concerning the late eighties can pass as an example of such studies:

"Printing and writing papers in general will continue to be the fastest growing products in the pulp and paper side of the forest products industry. We expect the demand for coated groundwood papers to continue to increase at about 5 per cent/year through the 1980's. Demand for this product is rising because of shifts in advertising expenditures from television toward the printed media. Not only has the amount of prime-time television available for advertising decreased, but also the spread in the cost of advertising between broadcast media and print media is steadily widening. We expect some continued cyclicity in the demand for coated groundwood papers as a function of advertising lineage demand swings during business cycles, but we expect the magazine expenditure revival of the past four years to continue into the 1980's."⁹

If considerations about the future development of the cultural paper market in Western industrial countries also include changes in the technological

field, we get the following picture: Although magnetic data carriers are cheaper and can absorb many more data than paper, they can hardly begin to make up for the functional advantages of the conventional print media. Other technological innovations will increase paper consumption even more: Photocopying and computer technology increase demand for paper. Whereas in 1970 1.5 billion normal photocopies and 1.2 billion photocopies on coated paper were made in the FRG, in 1977 the numbers have increased to 10 billion normal photocopies and 1.5 billion on coated paper. These changes amount to an annual increase of approximately 23 per cent. A further component which will ensure an increase in paper consumption, is connected to the increase in the number of computers, electronic printers and word processors. Interestingly enough, an increase in paper consumption corresponds to an increase in electronic printers.

Expressions such as the "paperless office" or even the "paperless society" thus turn out to be superficial slogans which are being propagated in the interest of suppliers of electronic services, which have very little in common with empirically verifiable reality, especially since, as a result of the world-wide economic crisis, the automation of offices is taking place at a much slower rate than feared by some and hoped for by others. Most prognoses predict a rate of increase of 2 to 3 per cent a year for cultural paper in Western industrial nations up to the year 2000. The result is that one cannot assume that the Third World may profit from a saturation of northern markets.

The five most important influences of the world paper market on the Third World may then, from a development policy point of view, be summarized in the following five propositions:

1. Only paper industries with the lowest possible demand for imported technology, energy and raw materials

can bring out real aid for the Third World, since no further burdening of the foreign trade balance of these countries can be allowed.

2. Of the three cost factors — technology, energy and raw materials — the one offering the least chance of saving is the primary energy needed in the production of pulp and of paper.

3. For many Third World countries the terms of trade for paper import have rapidly deteriorated in recent years, this is especially true of countries exporting tea, raw rubber and iron ore. Yet, even in case of a more favourable development of terms of trade, one cannot assume that broad masses of consumers within a Third World country will be able to buy imported paper more cheaply than at present.

4. The continuing tendency worldwide towards concentration and oligopolization of the pulp and paper manufacturing industry in North America, Scandinavia and the Common Market brings no hope for positive trickle-down effects from a national paper industry boost in Third World countries.

5. The economic consequences of damages in forests in northern hemisphere countries, the increasing costs of anti-pollution measures plus the still growing (though somewhat more slowly) demand for cultural paper in industrial nations (photocopies and computer printouts) will further increase the world market prices for paper to the detriment of the Third World.

Based on these five propositions one can draw two distinct conclusions:

1. An improvement of the paper situation in the Third World is possible only if there are simultaneous structural changes in international technology and raw material policies, in other words changes in the direction of a New Order in dealing with economic and information problems as demanded at the beginning of this paper.

2. Although theoretically and politically there are many reasons for the

desirability of such changes only a very limited cognizance awareness of the importance of the demands for a New Order can be deduced. That is why a different conclusion should be drawn from the analysis of global conditions: Since the international energy and raw material policy structures cannot be changed in essence — at least there are no political forces for such processes visible in the near future, it seems sensible if the Third World — far more than is the case at present — was to have second thoughts about its own potential and own raw materials for the production of pulp and paper.

Technological alternatives for the Third World

Large transnational paper companies do not invest in production of pulp and paper in Third World countries since access to natural resources and other conditions inhibit large-scale development. It is more profitable to export to these regions and more secure. Some of the larger machinery manufacturers in conjunction with international consultants or general contractors are able and willing to supply new mills on credit terms to Third World countries who can provide financial guarantees and have sizable resources of fibre.

But almost by definition only a few oil-rich countries can satisfy these conditions and the record of such installations has not been wholly encouraging. The costs of building such plants are higher than normal as the need for import and the costs of freight are raising capital costs over viability level. The efficiency of such mills seldom reaches the level attained in the industrialized world as the limitations in human resources necessitate operations to be supported by expensive expatriates and imports of materials making also the direct production costs higher than normal. As a result it is usually necessary to increase prices by tariff protection and paper is not, as it should be, cheap.

Large scale production is inappropriate

ate for Third World countries for other reasons than the sheer magnitude of cost. The most concentrated source of fibre, wood, upon which the whole philosophy of scale has been founded, is seldom available in sufficient quantity of suitable species and requires enormous infrastructural development when it is available, much beyond the financing capability even of government sponsors. Wood is necessary to support maximum scale in pulp or paper manufacture but it is no longer economic to cut down trees for paper alone; an economic mill today has to be integrated with timber production calling for even greater capital investment.

Apart from wood, which can almost be disregarded for most Third World countries, non-wood fibre resources, predominantly agricultural wastes, offer the best prospects but they are seldom available in sufficient concentration to support scale as it is currently understood. Straw, bagasse and bamboo are the most readily available fibre sources; there are others in particular areas such as reeds.

It is possible to attain large to medium scale from these materials but there are restricting factors which can make scale impossible or inappropriate. Merely non-wood fibres such as bagasse, straw or reeds are not sufficient for paper production because of the inherent weakness of the fibre which is shorter than that from coniferous wood. Long-fibre support, from 15 per cent to 40 per cent of total fibre is needed according to paper substance and quality and is unlikely to be available in the quantity required to support scale within economic range. It may, even for a small mill, have to be collected from scattered sources over quite wide area or imported. Among non-wood fibres bamboo alone is of sufficient strength to be used as the only fibre raw material in paper making but readily available resources have almost everywhere been used up for this reason.

The size of the market is also a lim-

iting factor to scale. Even where the total market is sufficient to support large scale, the distances involved for distribution and the inadequacy of road or rail services can make sales prices too high and a number of small mills, strategically sited may be more viable.

Natural resources other than that of fibre also have a bearing on scale. The manufacture of paper can require up to 80 tons of water per ton of paper produced and have a correspondingly large effluent treatment and disposal problem. Sites where water in sufficient quantity to satisfy scale are available are very difficult to find in most Third World countries.

Fuel to produce process steam is required for cooking the fibre and drying the finished paper. The quantity is significant, around 1.5 tons of oil or the equivalent as coal per ton of paper produced from a fully integrated mill. It is unlikely to be available in the quantity required to satisfy a large mill except in oil-rich Third World countries, and it is even more unlikely that the sources of fibre, water and fuel will jointly be so situated as to make collection and transportation remunerative.

A reliable source of electric power is also required, as much as 1 MWh per ton of paper produced depending on fibre and paper quality. It is almost by definition unlikely to be available in a Third World country, in quantities sufficient to support large scale production. With higher costs of capital and fuel consumption a mill can be self-sufficient in electric power and the large mill is usually equipped for total or partial independence in this respect. By current general standards the wood-based mill has natural advantages in terms of fuel consumption and as a consequence also in the use of electric power. There is usually wood waste and bark available as supplementary fuel particularly when a lumber operation is associated. Efficient chemical recovery producing high-pressure steam is also practical and can thermally satisfy pulp production

requirements with a margin for paper. It can also provide steam with a power generating potential above its own strict requirements.

These advantages are termed natural, because they are, and have been, exploited for wood. It was not always so; the pulp and paper industry of today was built on sulphite pulping without chemical recovery and this continued up to the last war. The effects of this on lakes and rivers are still being experienced in Canada and Scandinavia. Mountains of bark in Canada and Scandinavia also still exist as a memorial to the wastefulness of an industry which developed on the principle that fossil fuels would always be cheaply available. Changing standards and value inspired by popular pressures forced the developments in chemical recovery and fuel conservation which now apply to the wood-based pulp and paper industry. The costs in the research and development were high, but could be afforded by an expanding and profitable industry; they were essential for its survival. The non-wood pulp and paper industry has similar natural advantages, but these have not yet been exploited to the same degree for lack of funds and application.

Broadly speaking, wood is not likely to contribute significantly to the need of Third World countries, except in such favourable areas as exist in the climatically suitable regions. Africa and South America are perhaps the most probable locations. Even in these areas, although long-term prospects can be seen to exist in re-forestation with suitable species, short-term prospects are not good unless they can be realized economically on a small scale. The costs for large scale development are intrinsically and in total too high to be afforded and the market is too small to absorb the output. Export is no solution as has already been recognized. The world is already saturated with high quality pulp sold at prices below production costs.

The immediate future for the Third

World therefore lies mainly in the exploitation of existing non-wood materials. In general terms these are straw from wheat, rice or maize, bagasse, from the sugar industry, and bamboo.

Taking the last first, where *bamboo* exists within economic range it is already fully exploited. It is a self-sufficient source of fibre, very versatile and not requiring long fibre support. It can indeed carry a proportion of short fibre material. The paper industry in India has largely been based on the utilization of bamboo. However, it is not planted by man but grows naturally in tropical forests and its utilization depends on low cost labour for collection. Its use is only likely to be extended when presently inaccessible forest areas are opened up but enormous infrastructure costs are involved in this. Consideration has been given to plantations of bamboo but the cold truth today is that no raw material, even wood, can primarily be grown solely for paper; the costs are too high. The fibre must be available as a by-product from other industries and this narrows the choice.

Straw is the most commonly available fibre and it is an agricultural by-product. The total quantity available would very considerably contribute to the paper-making requirements in Third World countries but it is estimated that scarcely more than one tenth of the overall quantity produced is normally surplus to other uses, varying from cattle bedding to fuel for cooking. It is ironic that in some industrialized countries with little paper-making fibre resources, vast quantities of straw are wastefully burnt annually creating nuisance because other uses are limited, and current technical limitations are considered to make its use for paper uneconomic. Where collection is organized rationally straw-based mills can achieve scale, up to 100 kt per year of paper but mills of much smaller capacity can be economic in suitable circumstances, to the mutual benefit of paper mill and farmer.

Bagasse is also an agricultural by-product wherever sugar is produced from sugar cane and it is an excellent and versatile source of fibre. If the paper mill can be located adjacent to the sugar mill the cost of delivered fibre compares favourably with that of almost any other material. However, bagasse is also the traditional fuel for the cane sugar industry. Efficiently burnt, even unprocessed bagasse with about 50 per cent moist, there could be a bagasse surplus at all sugar mills varying from about 20 per cent at fully refined sugar mills to more than 50 per cent from sugar mills producing unrefined sugar. The efficient burning of bagasse, however, implies efficient boilers which are not always present; in addition, storage and handling arrangements must be made for the surplus, with further costs involved. Many sugar mills in consequence use their boilers to provide such steam as is necessary and as incinerators for the bagasse which remains. Properly organized, the duties of collection and storage can be undertaken by the paper mill. If the bagasse could be wholly or partially dried before burning and the sugar mill or paper mill is equipped to burn the pith which must be removed, the thermal effectiveness would be greatly improved. Under these circumstances it is not an impossible concept to imagine a combined industry requiring no supplementary fuel for the sugar mill and a viable paper mill alongside with reduced fuel requirements, but although this is a very real possibility, much development and research will be necessary to achieve it.

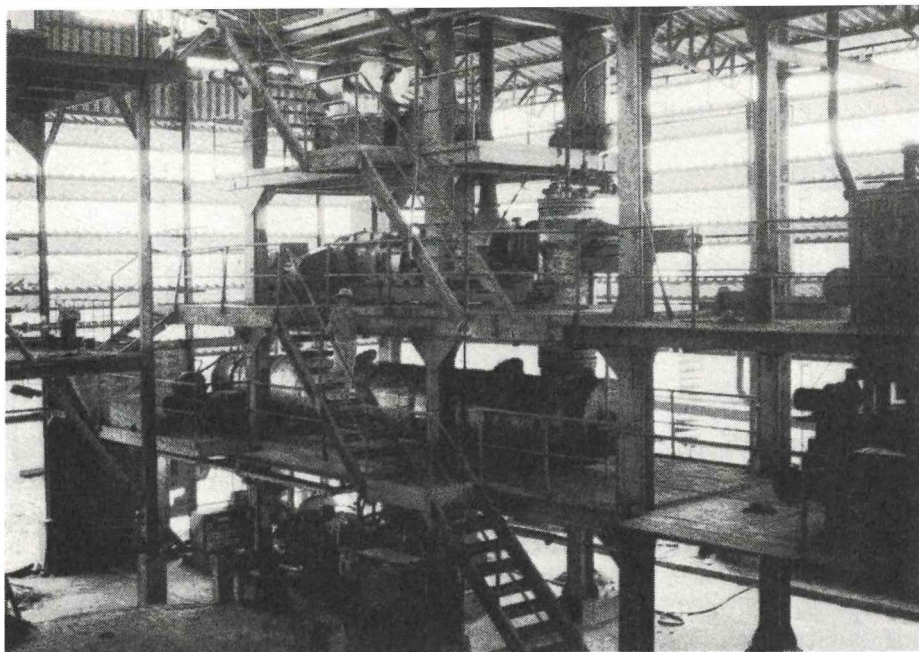
Where replacement fuel (which may also mean new boilers) is available, bagasse mills can achieve considerable scale and there are a number with paper production exceeding of 100 kt/year. Mills of this scale are becoming more frequent as a result of the development of newsprint production from bagasse in recent years. Newsprint is vital for the press and therefore is imported at high cost even by the poorest of countries.

Technical limitations to paper production from non-wood fibres

Non-wood fibres, as indicated above, are already supplying about 60 per cent of the paper consumption in Asia and China, and the proportion is estimated to increase, but since consumption rates in these countries are low, the amount produced is also low, much less than that needed. There are technical limitations to efficient production of quality paper from non-wood fibres which have discouraged investors and sponsors. It should be added here that very similar limitations once applied to the international wood-based paper industry in its formative years, but they have been overcome by applied effort and research.

- The first is *inefficient chemical recovery*. Wood-based mills today use a highly effective and economic process, conserving about 95 per cent of the cooking chemicals and in consequence reducing not only production costs but also achieving acceptable effluent standards. In addition, the process provides steam at pressures which can generate electric power, considerably reducing energy costs.

Non-wood fibre pulping produces cooking liquors which contain silica. Its presence increases the viscosity of the liquor when it is evaporated so that it cannot be concentrated to the same degree as the liquor from wood, and hence it is less effective in combustion. In addition, silica can produce scale which is almost impossible to remove and this limits operating temperatures. There is great need for an effective and economic process for removing silica from cooking liquors. One has been developed and is operating in the Rakhta Mill in Egypt. It is said to be very effective, but being the first off, it is obviously, at this stage, a production prototype needing continuing improvement and refinement. A reliable and effective plant would not only raise evaporation and combustion



A factory in Thailand using bagasse, a by-product from the sugar cane industry (top).

Thai workers with harvested kenaf, a jute-like fibre plant, to be used in a pulp mill.

Straw is used as raw material in a new paper mill in Foggia, Italy (bottom).

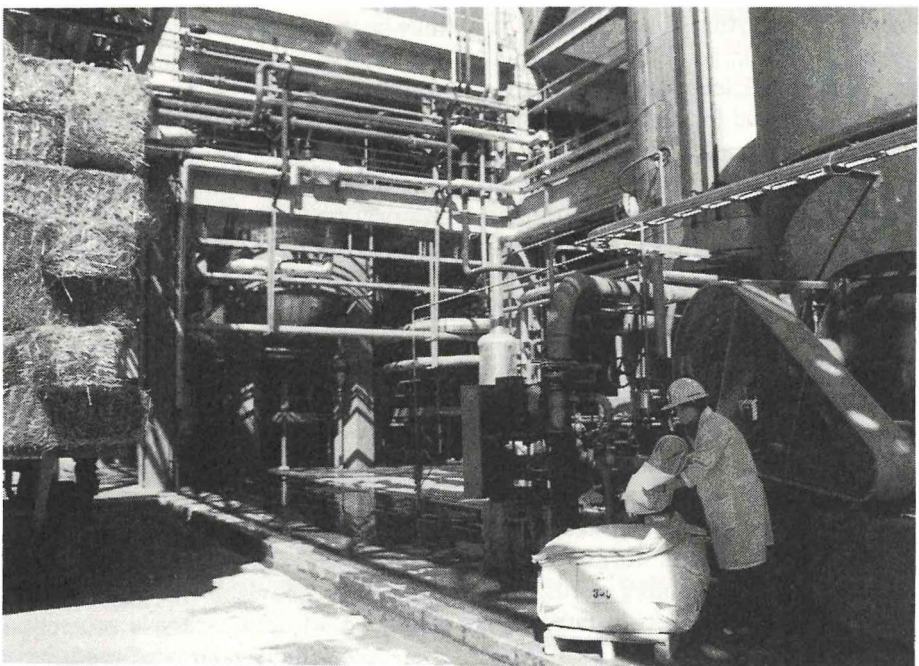


still requires long fibre support. If imported kraft can be afforded, the straw or bagasse based mill can produce an excellent range of papers, competitive in quality with the best, but this situation applies only to the oil-rich Third World countries. For the rest, which is by far the greatest in proportion, it is necessary to find cheap local materials which can be used as substitutes. Cotton waste is excellent but in very short supply, localized to specific areas where cotton is grown. Other textile fibre wastes can be used such as jute, sabai grass or sisal, but again supplies are limited.

The most promising source of long fibre for Third World countries is kenaf. Its value as long fibre is such that it is one of the few materials which can be grown in suitable areas solely for use in paper. A comprehensive study on the potential of kenaf carried out in recent years in USA suggest that it can actually be grown for newsprint production in that country and could achieve greater yield from a given area at lower cost than wood. For Third World countries its growth, for cattle fodder and long fibre pulp in combination, is seriously under consideration and seems the most promising route to follow.

The combination of long fibre shortage and the limited availability within economic range of the main fibres source plus the scarcity of fuel and power limits the scale of operations in all but a selected few situations. It is also limited by transport distances for the finished product. To many authorities, accepting without question the belief that scale is essential for viability, this is enough to inhibit investment. In reality it is only in one respect that the small, non-wood based mill suffers and that is in chemical recovery.

The modern recovery boiler is a very efficient and sophisticated unit capable of handling the liquors from pulp mills with a capacity up to 1 kt per day as unbleached pulp. It is less efficient at levels below 400 tons per day and almost impossible to build in its known form



efficiencies, but would also permit recausticising lime recovery, reducing production costs and the costs of effluent disposal.

• The second limitation, which does not apply to bamboo, is *the need for long fibre reinforcement*. In this respect, bagasse has advantages over straw but

much below 150 tons per day. Taking into account additives and moisture contents, this indicates that a paper mill should be producing as much as 60 kt per day to include an effective chemical recovery which contributes steam in excess of its own and pulp mill needs.

A more reasonable scale, taking into account size of the market and other limitations referred to above for Third World countries, would be around 10 kt per year and this was the level set by the Indian government in their plan to encourage paper mills to use indigenous fibres. Chemical recovery is available and economic in terms of chemical costs at levels down to 15 tons per day as pulp, but these units are consumers and not generators of steam and the efficiency of chemical recovery is also less, from 15 to 25 per cent. There is need for effective small scale recovery, but it is unlikely that attempts to scale down the traditional wood-based recovery units will be undertaken. There have been encouraging developments though, The Babcock Krauss Maffei kiln approach and the Sulzer, France, separated combustion approach, but the latter has now been delayed for lack of funds, and financial limitations are undoubtedly restricting progress in what is probably the most significant field.

Non-wood paper making does have some advantages which compensate to a degree for the disadvantages. Fibre preparation is more simple, less capital intensive, cooking is quicker and chemical consumption, ignoring recovery, is normally less. Adequate bleaching can be achieved by a simple 3-stage process whereas wood requires 5 stages costing more in capital investment and chemical preparation and consumption. Refining power for non-wood fibres is also considerably less than that required for wood and this is a significant factor in overall energy requirements.

• Apart from chemical recovery, contrary to general belief, *scale has virtually no advantages to offer Third World countries*. It is inappropriate for the

reasons which have been given and socio-economically less rewarding. Capital costs are higher, intrinsically, and the total financial burden one which is beyond reach for most private enterprises and unattractive to governments. Scale can offer a reduction in manpower which is its greatest attraction for industrialized countries with their high wages, but in Third World countries labour costs will be higher in large scale production, because of the expatriate component which will be required plus the need for greater levels of skill and experience in all departments.

For Third World countries the need is for efficient paper mills based on indigenous fibres which can offer viability to investors from first commissioning, something which the modern giants cannot achieve even in industrial countries. It is possible at an appropriate scale. Capital costs can be lower per unit of production at scale around 10 kt per year, because sophistication and expensive materials of construction are not necessary to anything like the extent required for the large units. Quality and production efficiency can be achieved without the need for highly trained personnel or expatriates. Energy costs per unit of production can be lower, naturally because of the fibre characteristics and also because of lower speed, an essential component of scale which is energy intensive in terms of electric power and energy used in the process of drying. Pressing efficiencies are improved as speed is reduced, because water removal is a function of time.

The enormous potential market for paper in Third World countries offers prospects for standardization of design which can still further reduce capital costs and training needs. This opportunity is not open to large scale production.

The level of paper consumption achieved in the Western world around the year 1900 would be, for want of a better definition, a reasonable target for Third World countries, still many times great-

er than present standards. It is interesting to look back at the machines of that era. They were virtually standard, around 2 to 3 m in width running at speeds around 100 m per minute. They were cheap and easy to operate, becoming the foundation on which the present industry has been based.

The Third World needs something similar as a basis for their industry and could have it in improved form taking advantage of the genuine advances in technology which have been achieved. They must use indigenous fibres, and in the short-term at least this means non-wood fibre sources for the majority of installations. The two major problems restricting progress are effective chemical recovery at small-scale production, and a reliable source of long fibre support. There is evidence that the former problem is possible to solve. The need for long fibre can be reduced by suitable machine design and economic speed, but the overall situation will still need substantial improvement. Kenaf may be the answer, this and many other possibilities should be thoroughly investigated on an industry basis.

The paper problem for developing countries will not go away or disappear. The need will remain as long as communications and education persist; the ultimate decline in the use of plastics as oil supplies are exhausted is likely to increase the demand for paper culturally, commercially and industrially. No Third World country can hope to improve its press and publishing system without an improvement in paper availability, but it can only come from the exploitation of its own potential.

There is good evidence that small-scale paper mills based on indigenous fibres can be viable in Third World countries without excessive protection even when the standards of productive efficiency are lower than would be considered acceptable by Western standards. There is no fundamental reason why standards should be lower, but it will need effort beyond that which can

be provided by the industry in its present state to bring about the improvements which are attainable.

Notes:

The preceding paper is a summary of an extensive research project which the author conducted on behalf of the German Agency for Economic Co-Operation (GTZ) in Eschborn, FRG. Apart from the author the following collaborators took part in this project: Frank-Michael Bahr, Dept of Political Sciences at Marburg University (North-American paper market), Dr Lutz Meyer, Dept of Sociology at Erlangen University (global paper market), and Arthur W Western, Intermediate Technology Consultants Ltd, London (technology). The project results were published in all details by Jörg Becker: *Papiertechnologie und Dritte Welt. Ökonomische Rahmenbedingungen und technische Alternativen für die Produktion von Kulturpapier*, Brunswick: Vieweg Verlag 1986. An English edition of this monograph will be published by the same publisher during 1987.

A second research project, also funded by the GTZ, deals with the evaluation of small paper mills using non-wood fibres in the following countries: India, People's Republic of China, Peru and Thailand. The collaborators of this second project are again Jörg Becker and Arthur W Western, and Aroon Auansakul and Paitoon Purasuwat (Thailand), Jaime Gianella and Guillermo Izquierdo (Peru) and P K Kauppi, Canada. The results of this second research project will be available by the end of 1987.

¹ Cf Heikki Hellmann, Kaarle Nordenstreng and Tapio Varis: *Idealism, Aggression, Apology, and Criticism: The Four Traditions of Research on International Communication*. Paper presented to the XII Congress of the IAMCR, Caracas, 1980-08-26/29.

² Joseph Ki-Zerbo: "Unterricht über die Dritte Welt und die Probleme ihrer Entwicklung" in: *Die Dritte Welt in Schule und Jugendarbeit*, ed by Jörg Becker, Frankfurt: Haag & Herchen 1980, p 20.

³ Cf Beak Consultants Ltd: *Environmental Considerations in the Pulp and Paper Industry*, Washington, DC: The World Bank 1980.

⁴ Cf *The Energy Transition in Developing Countries*, Washington, DC: The World Bank 1983.

⁵ Cf George H Boyd III: "Production Costs and Competitiveness in Industry, in: *European Pulp and Paper in the 80's*, ed by the Financial Times, London: Financial Times conference Organisation 1982, pp 59—65.

⁶ Calculated after: US Department of Commerce: *Statistical Abstract of the United States*, Washington, DC: United States Department of Commerce 1984, table 806.

⁷ Quoted in: Carlos Contreras: *The Transfer of Technology to Developing Countries*, Caracas: Instituto Latinoamericano de Investigaciones Sociales 1978, p 28.

⁸ Hans Wolfgang Jäger: "Die saure Quit-tung", in: *Das Papier Magazin* 7/1983.

⁹ Quoted in: "Waldsterben: Dem Überfluss folgt Mangel", in: *Süddeutsche Zeitung* 1984-01-17, p 11.

¹⁰ Fred D Iannazzi and Louise M Firth: *Outlook for the Forest Products Industry 1978—1988*, Cambridge, Mass: Arthur Little, Inc 1979 (mimeo), p 11.

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