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ENVIRONMENTAL PLANNING AND APPLIED GEOGRAPHY IN PAPUA NEW GUINEA

With 3 figures

MARJORIE E. SULLIVAN and PHILIP J. HUGHES

Zusammenfassung: Umweltplanung und angewandte Geographie in Papua-Neuguinea

Die traditionelle Bedeutung der Umwelt und ihrer Ressourcen für die Gesellschaften Melanesiens wurde in der Verfassung von Papua-Neuguinea besonders berücksichtigt. Die wichtigste Gesetzesgrundlage für den Umweltschutz ist der Environmental Planning Act von 1978, der die Erstellung eines Umweltplanes für jedes Entwicklungsvorhaben fordert, das eine nachhaltige Auswirkung auf die Umwelt haben könnte. Dabei ist der Begriff „Umwelt" weit gefaßt: er umschließt sowohl die soziale und kulturelle als auch die biophysische Umwelt. Bis heute wurde diese Gesetzgebung bei Projektplanungen allgemein berücksichtigt, ohne jedoch in einem regionalen Maßstab angewandt worden zu sein.

Der Erlaß weitreichender Gesetzesvorschriften zur Umweltplanung hatte in Papua-Neuguinea ähnliche Auswirkungen auf die Nutzung von Ressourcen wie z. B. vergleichbare Gesetze in Australien. In beiden Fällen wurden die bereits existierenden Gesetzesgrundlagen, denen nur mit Schwierigkeiten Geltung verschafft werden konnte, gestärkt, insofern die Entwicklungsgesellschaften verpflichtet wurden, während der Projektplanung die voraussichtlichen Wirkungen auf die natürlichen und kulturellen Ressourcen zu berücksichtigen.

In Papua-Neuguinea haben Geographen bisher schon eine große Rolle im Bereich der Umweltplanung gespielt. Es ist zu erwarten, daß sich deren Einfluß noch verstärken wird, wenn bei den Verwaltungen das Bewußtsein der Notwendigkeit von regionalen Umweltplänen wächst.

The physical and social setting

Papua New Guinea, an equatorial country, consists of the eastern part of the island of New Guinea and also several island groups (Fig. 1). It has a total land area of about 463,000 square kilometres and is environmentally remarkably diverse (see e. g. LÖFFLER 1977, PAIJMANS 1976). The interiors of all the main islands are mountainous, with the highest peak, Mount Wilhelm, rising to 4,500 metres. There are a large number of volcanoes (some of which are still active), especially in the seismically more active northern part of the country. The largest areas of lowlands occur along the south coast; within these are extensive areas of freshwater swampland.

Most of Papua New Guinea experiences a hot and wet climate with temperatures generally between 22 and 31 degrees C and an annual rainfall of more than 2,500 mm. Such areas support tropical rainforest. Other parts of the country, especially along the south coast, are also hot but have a much lower rainfall and a pronouced dry season; these areas support savanna and grassland vegetation. The highland areas, above about 1,200 metres, are cooler and experience a larger daily temperature range.

The people of Papua New Guinea are generally regarded as Melenesians but there is in fact a great deal of diversity in their ethnic structure. This diver-

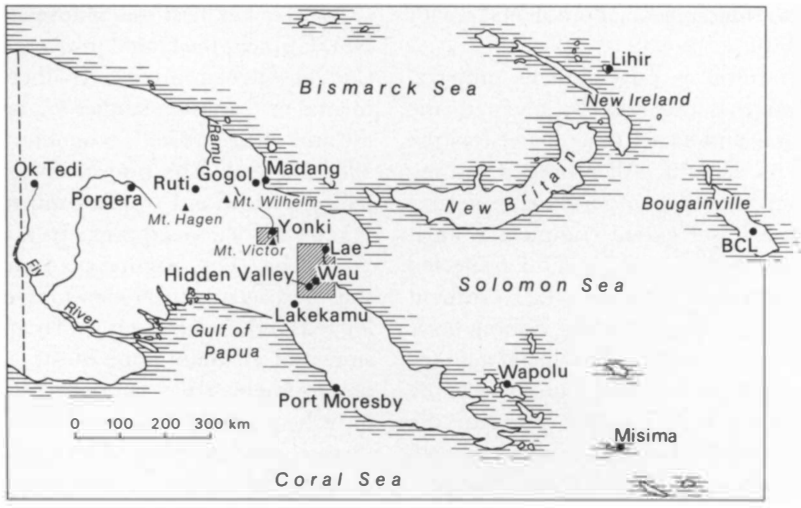

Fig. 1: Papua New Guinea: Locations of developments referred to in the text
Papua-Neuguinea: Lage der im Text erwähnten Entwicklungsprojekte

sity is reflected in, for example, the very large number of languages or dialects, estimated at about 700 (EATON 1984, 2). Much of the population lives from subsistence agriculture and most of the land (97%) is held under customary tenure systems whereby ownership is vested in the group, clan or village, not the individual (EATON 1984,2-3).

The present population of about 3.6 million is small compared with most other countries in the Asia-Pacific regeion. It is however growing at a moderately high rate of between 2.5 and 3.0% anually, and if this rate continues the population will double in the next 20-30 years. The average density of population, about 7 per square kilometre, is low compared with neighbouring countries, but the population is unevenly spread with the highlands regions having the highest concentrations of people.

The economic setting

Since Papua New Guinea gained independence in 1975, its population growth has kept pace with or outstripped economic growth, and commodity prices have generally been low. Because of the still relatively small population there are no major land shortages at present and the country has abundant natural and agricultural resources. In planning for Papua New Guinea's future economic development the government has placed a high priority on economic growth, especially in the agricultural sector, and actively encourages foreign investment.

The major exports are agricultural products, mainly coffee, tea, palm-oil, coca and copra; minerals, especially copper and gold; and timber, mainly in the form of unprocessed logs. The potential for expanding production and local processing in these and other industries such as fishing and oil and gas production is very promising. Although the long term future of the country rests on its agricultural potential, there are excellent short and medium term prospects for minerals. Papua New Guinea is rich in mineral resources, including gold, copper and probably oil and gas. Exploitation of these resources, especially gold, over the next decade is likely to provide a major boost to the nation's economy and it is predicted that by early next century Papua New Guinea could become the largest gold producer after the USSR and South Africa.

Benefits and costs of development

Like development projects in other developing countries, those in Papua New Guinea have attendant environmental and social impacts or costs as well as benefits. The brunt of such impacts is invariably felt most keenly by the local communities whose land will be alienated and whose traditional resources will be destroyed or degraded while the benefits are spread more widely throughout the country (HUGHES a. SULLIVAN, in press). In addition associated processes such as in-migration, either to project camps and towns or to adjacent villages and squatter

settlements, brings attendant social problems (see for example IASER 1986).

In planning for resource development projects, detailed consideration is theoretically given to the likely environmental and social costs as well as the economic and social benefits. All proposed mining projects are now subject to a comparatively rigorous analysis, as are to a lesser extent commercial agricultural projects. The major benefits of the projected mining boom will accrue to the national government and will take the form of company and income taxes and profits from equity holdings. Provincial governments will benefit mainly from their high share of the royalties (95% of the 1.25% royalties levied on the value of gold extracted). Local communities will benefit from their share of the royalties, compensation payments for loss of or damage to land and other resources, from wages and from increased business opportunities. As pointed out above, these communities will also bear the brunt of the negative impacts these projects inevitably have. A detailed account of the likely benefits and costs of one such mining project, the Ok Tedi copper and gold mine, is given by JACKSON (n. d.).

No environmental impact studies were carried out for Papua New Guinea's first mining project, the massive Bougainville Copper Ltd (BCL) open cut mine (Fig. 1), which began operation in 1971. While this mine has undoubtedly brought major economic benefits, the environmental costs have been considerable (CHAMBERS 1985,179–81). In the 10 year period from 1975 BCL contributed about $US 660 million to the State, more than 20% of the country's internally-generated revenue. Between 1973 and 1983 about 760 million tons of ore and waste were processed. About half of this was deposited in rock waste dumps adjacent to the mine. The remainder, mostly tailings from ore processing, was discharged into the Jaba River valley. The coarser fraction of the tailings covered the floor of the 35 km long valley up to 60 m deep and 1 km wide. A delta about 700 ha in area accumulated at the mouth of the river. The fine fraction was carried in suspension to the sea and has accumulated on the floor of Empress Augusta Bay. These tailings were rich in copper (800–1000 ppm) and other chemicals. All aquatic life in the Jaba Valley has been destroyed as a result of this physical and chemical pollution. As CHAMBERS (1985,181) pointed out, the project was commissioned with no regard for its impact on the environment, especially aquatic life, and it is unlikely that such a project would gain approval in Papua New Guinea today.

In 1973 the first major forestry scheme in Papua New Guinea, the Gogol project in Madang Province (Fig. 1), was commissioned without any prior environmental or feasibility studies to assess the suitability of the area or the project's economic viability (CHAMBERS 1985,183–84). The project involves large-scale clear felling of lowland tropical mixed hardwood forest, mainly for woodchipping, in a lease area covering 68,000 ha. The original plan envisages reafforestation and agricultural development of much of the logged land. In fact the rate of reafforestation has been slow and virtually none of the planned agricultural developments (rice, rubber, cattle and agroforestry) have been implemented. CHAMBERS concluded that there is no doubt that the Gogol project has been a disaster, at least for the local villagers. They have seen much of their natural environment destroyed, along with a great deal of their traditional way of life. Few of the expected benefits from employment, financial compensation for loss ofland and resources, and reafforestation and agricultural schemes have eventuated and this has left the residents angry and bitter.

Unlike the good record the mining industry currently has for environmental and social planning, as well as economic performance, the forestry industry has been plagued with accusations of corruption and economic and environmental mismanagement. The industry is currently the subject of a Commission of Enquiry. Numerous forestry projects have been permitted since the environmental legislation described below was enacted in 1978, but with very few exceptions development approval has been given by the Department of Forests without regard to the requirements of the environmental legislation. Most of these projects have been approved under the *Forestry (Private Dealings) Act* 1972 & 1974 which, as outlined below, does not specifically require environmental impact studies to be carried out. Where Environmental Plans have been prepared they have in most cases not fully addressed the likely environmental impacts.

The environmental legislation

The Fourth Goal and Directive Principle of the Papua New Guinea Constitution (1975) states; "We declare our fourth goal to be for Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of us all, and to be replenished for the benefit of future generations."

The *Environmental Planning Act* 1978 was enacted to give effect to the Fourth Goal and to protect the country's natural resources and environment, defined

(Sect. 2) as "the total stock of physical, biological and social resources available to man and other species and the ecosystems of which they form a part." The Guidelines to the Act (Sect. 5) recognise that environmental planning involves the consideration of eleven matters, including "any permanent change in the physical, biological, social or cultural characteristics of the affected environment or in the possible future use of the environment" (Department of Environment a. Conservation 1985).

Briefly, this Act requires a proponent of any development: (a) to liaise with the Department of Environment and Conservation to determine if there is a need to prepare an Environmental Plan, and if necessary, (b) to produce an Environmental Plan, which must be assessed before any decision concerning the development is finalised.

The Plan must outline all aspects of the development project, including any changes in the social, cultural, physical or biological characteristics; the use and discharge of contaminants; the costs and advantages of the project; the long and short term objectives; and any other matters considered necessary by the Secretary of the Department (BARGH n. d.,2).

Both the assessment and decision-making processes require consultation with local communities as well as the national and provincial governments. In addition to preparing a detailed Plan the proponent must provide an Executive Summary of the proposal including its major benefits and disadvantages, and that summary must be produced in both English and either Tok Pisin or Motu, the country's two other major languages, as appropriate.

All government departments and authorities, as well as private developers, are bound by the Act. Certain projects have been exempted from this Act and are instead covered by specific Acts. To date these are: The *Mining (Bougainville Copper Agreement) Act* 1967, the *Mining (Ok Tedi Agreement) Act* 1976 and subsequent Supplemental Agreements, and the *Petroleum (Gulf of Papua Agreements) Act* 1976. Under the *Environmental Planning Act* 1978 fines of up to K 500 are specified for several potential ommissions or failures to respond appropriately to its requirements (K 1 = approximately US$ 1). A fine of up to K 40,000 is payable for failure to observe the development conditions imposed under the Act, or for undertaking a project without government permission.

In terms of the physical, biological and social environment, a number of other Acts are also important to the planning of resource development projects and associated infrastructure. These include the *Environmental Contaminants Act* 1978, the *Water Resources Act* 1982, as well as Acts relating to town planning, public health, forestry and mining (EATON 1984).

Forestry development is governed by two separate Acts, the *Forestry Act (Amalgamated)* 1973 & 1975 and the *Forestry (Private Dealings) Act* 1972 & 1974. The former includes a provision that the requirements of the *Environmental Planning Act* 1978 be adhered to. The Private Dealings Act, which was enacted to facilitate forestry agreements between villagers and prospective developers with minimal bureaucratic process, does not specifically refer to a need for environmental investigations.

Another relevant Act is the *Conservation Areas Act* 1978, which was enacted to conserve and manage sites and areas having particular biological, topographical, geological, historic, scientific or social importance. This Act could theoretically be applied to the protection and management of elements of the cultural environment, and especially be applied to the management of any archeological sites or places of traditional significance, however it is not likely to be so in the foreseeable future given financial and staffing restrictions (SWADLING 1983 a,91). In Papua New Guinea the links between contemporaty ethnographic and broader social issues (and likely impacts on both) are close. As a result there is frequently an overlap or commonality of interest between social and cultural impact assessment, an overlap which is beneficial to the interests of cultural resource management.

Commenting on Papua New Guinea's environmental legislation soon after it had begun to be implemented, SPENCELEY (1980) noted that newly-emerging independent nations such as Papua New Guinea were likely to be at an advantage over industrialised nations with regard to environmental legislation, since they could observe and avoid some of the problems which these nations had faced. After outlining the environmental legislation which Papua New Guinea had adopted, he pointed out that most of the country's population was still unaware of this legislation and that it would become effective only if people were educated to be aware of their own responsibilities, as well as those of large scale developers. To a considerable extent the publicity surrounding environmental management problems such as those which beset the Ok Tedi and Bougainville mining projects and the Gogol timber project (CHAMBERS 1985) served to make the general Papua New Guinean population much more aware of the legislation than was the case in 1980, without the formal educative process which SPENCELEY saw as necessary.

The enactment of wide ranging environmental planning legislation has had similar effects on natural

and cultural resource management in Papua New Guinea as, for instance, the *Environmental Planning and Assessment Act* 1979 had in New South Wales. In both cases it strengthened existing legislation, which was difficult to enforce, by obliging developers to consider during the planning process likely impacts on natural and cultural resources (SULLIVAN a. HUGHES 1987).

Because of bureaucratic awareness that the Papua New Guinean population is generally poorly educated, government agencies have attempted to produce documents containing clear, simple advice to developers, made readily available through those agencies, provincial governments and development authorities. These documents not only set out the practical requirements of the Acts, but also advise consultation with all relevant government authorities.

Implementation of environmental planning legislation

Numerous Environmental Plans have been prepared in compliance with the *Environmental Planning Act* 1978. These include goldmining proposals (Fig. 1) for Misima Island, Milne Bay Province (Natural Systems Research [NSR] 1987 a), Porgera in Enga Province (NSR 1987 b), Lihir Island in New Ireland Province (NSR, in prep. a), Mt. Victor in the Eastern Highlands Province (NSR 1987 c), Hidden Valley in Morobe Province (NSR, in prep. b), Lakekamu in Gulf Province (Beca Gure, in prep.) and for Wapolu on Fergusson Island in Milne Bay Province (NSR, in prep. c).

Environmental Plans have also been prepared for agricultural developments, especially oil palm and cocoa, for forestry, and for industry and infrastructure. Industrial and infrastructure Environmental Plans include those for a meat cannery at Madang, the Lae City garbage disposal site, the Joyce Bay sewerage scheme in Port Moresby and stage 2 of the Ramu hydroelectric power generation scheme at Yonki in the Eastern Highlands. The Joyce Bay (Water Board of PNG 1987) and Yonki (Cameron McNamara Kramer 1985, 1986) reports especially give comprehensive accounts of a wide range of potential environmental problems and of measures that will be implemented to mitigate them.

Most Plans for major agricultural development projects have been prepared by the proponents themselves, and they generally give very superficial accounts of the biophysical impacts and even less consideration to impacts on the cultural or social environment, especially the living conditions of the settlers brought in to service these developments and the adjacent local communities (see for example, Cox, in press). Nevertheless the projects have generally obtained government approval with few if any additional conditions being imposed.

Whereas biophysical aspects are always addressed in Environmental Plans, cultural and social resources are frequently not given proper consideration; recent draft Environmental Plans for some large-scale developments, particularly forestry, give at best a cursory consideration of impact on cultural resources, for example. This has prompted the PNG National Museum and other concerned groups and individuals to comment forcefully on the lack of proper consideration of such impact. For instance, the Ok Tedi mining project environmental study report (Maunsell & Partners 1982) does not consider the likely impact that the project might have on archaeological sites. The results of a regional survey subsequently carried out by the PNG National Museum of the Ok Tedi impact area und its surroundings (Fig. 1), demonstrated that in fact it contains a diverse range of archaeological, traditional and material cultural resources (SWADLING 1983).

Despite financial, manpower and other constraints, Papua New Guinea is legislatively well placed to ensure that biophysical, cultural and social resources are properly considered in the environmental planning process. As has happened in Australia, as developers come to see that resource assessment and appropriate management planning need not cause considerable time delays or additional costs to development projects, there will be more co-operative working relationships established between developers, researchers, managers and villagers whose land or heritage is being affected.

Project and regional environmental planning

In many developed countries with effective environmental planning legislation project environmental planning is simply one element of a more extensive and highly integrated planning process. In New South Wales, for example, the *Environmental Planning and Assessment Act* 1979 provides for the preparation and execution of Local, Regional and State Environmental Plans, as well as project environmental impact assessments. These broader scale Plans are designed to establish frameworks within which individual development projects may proceed.

The existing environmental planning process in Papua New Guinea is likely to cope succesfully with

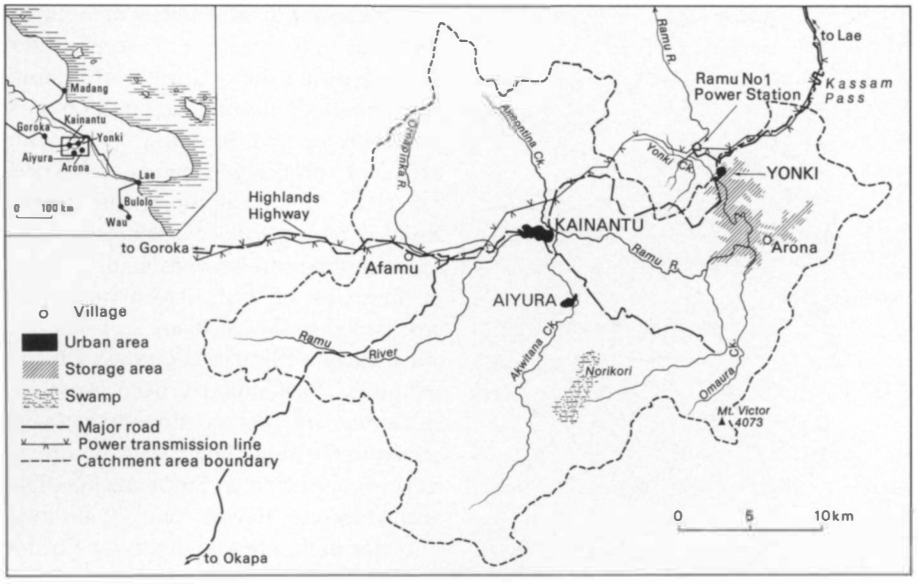

Fig. 2: The upper Ramu River catchment area
Source: Cameron McNamara Kramer, 1986
Das Einzugsgebiet des oberen Ramu

future development projects, including the current mining boom, on a project-by-project basis, however there is already an urgent need in some areas to begin applying environmental planning concepts on a regional basis. Examples of this need include, for instance, the upper Ramu River catchment (Fig. 2) and the Wau-Bulolo region (Fig. 3).

The upper Ramu River catchment is the site of Yonki hydroelectric power generation scheme. When the original power station was commissioned in 1971, plans were already underway to upgrade the scheme by increasing both the water storage and power generation capacity. Environmental impact work commissioned by the Papua New Guinea Electricity Commission included bio-physical, social, cultural and engineering feasibility studies (HEYLIGERS a. MCALPINE 1971, SWALDING 1971, YOUNG 1973, Cameron McNamara Kramer 1985, 1986). A large water storage dam is presently being constructed and its catchment, about 850 sq km in area, supports a diversity of land uses.

The projected life of the dam is 100 years but clearly any changes in land use in the catchment which increase the sediment load entering the dam via tributary streams will have adverse effects. Furthermore, suspended sediments passing through the turbines appreciably shorten their effective life, and result in additional costs to electricity consumers (Cameron McNamara Kramer 1986).

Planning for the new dam involves planting of a protective forestry area immediately above the water line, to inhibit local sedimentation into the reservoir. While the Electricity Commission can control land use on its own land, it has little control over land use practices throughout the catchment. The three major likely causes of increased sedimentation are increased rates of erosion resulting from intensification of subsistence and cash cropping land use, mining and forestry.

Intensified land use will be an inevitable consequence of population growth. Electricity Commission staff have already commenced extension work to encourage the co-operation of local landowners in implementing appropriate land conservation strategies. Their work needs to be integrated with the extension programmes of the numerous other national, provincial, institutional and private agencies involved in agricultural development in the region.

Already one small scale gold mine in the catchment, at Mt. Victor (Fig. 3), has recently been approved. The initial method of waste disposal involved discharging the tailings into the river system but this was rejected at an early stage of planning because of the effect it would have had on the Yonki power scheme. An alternative disposal method, discharge of the tailings into a grouted limestone sinkhole adjacent to the mine, was found to be environmentally more acceptable. (NSR 1987 c). It is highly likely that other

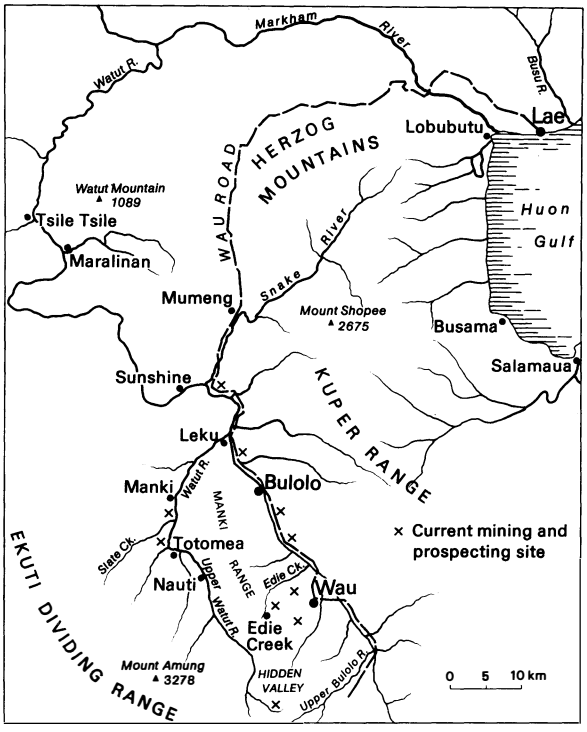

Fig. 3: The Wau-Bulolo area
Source: Natural Systems Research (in prep. c)
Das Gebiet von Wau-Bulolo

gold deposits will be found in the catchment and again waste disposal methods will have to be devised to prevent or minimise discharge of sediment into the stream system.

This is an area for which a regional environmental plan would now be relevant. In this instance an appropriate Act under which the land might be managed, and any future development projects controlled, is the *Water Resources Act* 1982, which allows for the declaration of catchment protection zones.

The Wau-Bulolo area also exemplifies the need for regional environmental planning. The Morobe Goldfield was discovered in 1922 and by 1926 there were more than 2500 men employed in sluice mining, with gold production at a rate of about 3000 kg per year. Mining peaked in 1938 when nearly 7000 men were employed in dredge and sluice mining, and gold was produced at a rate of about 8700 kg per year (Bowers 1985, Nelson 1976). By the early 1960s mining was confined to extensive small scale sluicing by Papua New Guineans, producing less than 500 kg of gold per year, and underground mining of the orebody at Wau producing about 500 kg per year.

The environmental impact of mining in the Morobe goldfield has been very severe. Bowers (1985) estimated that the quantities of ground moved have been: orebody mining, 2.5 million tons; sluicing, 63 million tons; and dredging, 254 million tons. Large areas of productive land have been destroyed, especially by dredging of the river flats around Bulolo, and the land surface has been converted to a boulder-strewn wasteland. The Bulolo River downstream of Wau has carried continuously high suspended sediment loads and has remained turbid since the late 1920s (NSR 1985). Edie Creek, a major tributary, has similarly been permanently polluted since that time, as occasionally have other rivers and creeks in the area. The effects of mining waste extend downriver at least as far as the junction of the Watut and Markham Rivers some 70 km away (Fig. 3).

It was in the context of this long history of environmental impact that NGG Holdings Ltd submitted a proposal to upgrade their Wau mine (NSR 1985). The proposal involved installing a cyanide treatment plant for ore processing, and a trebling of sedimentary waste disposal into the already polluted Bulolo River. It was estimated that the average annual discharge of waste over the 10 years project life would be about 56% of the long term annual average discharge, and that adverse environmental impact would remain similar to the previous Wau mining operations.

The degree of increased pollution was deemed acceptable by the government, and approval to upgrade the mine was given. At that time public discussion had centred around the question of what might be the government's response should another orebody of similar or even greater size be located, and the proponent seek approval to discharge mining waste into the already heavily polluted Bulolo-Watut River system.

Just such an orebody is now being prospected at Hidden Valley at the headwaters of the Watut River (Fig. 3). The proposed mill throughput and waste production is between 3.5 and 8.5 times as great as for the Wau mine, and the mine will operate for 10–15 years. Disposal of waste to either the Watut or Bulolo Rivers is being proposed (NSR, in prep. b). Other prospecting companies are also searching for orebodies in the area.

This presents a planning dilemma. The Wau mine upgrading was approved in the expectation that it would modestly increase pollution levels for a relatively short period. It was anticipated, furthermore, that small-scale alluvial mining, with its high levels of pollution, would continue at present levels for another 10–15 years (Bowers 1985). At some

future date, when the orebody and alluvial deposits were exhausted, the water quality in the Watut-Bulolo system might have returned to levels similar to those prevailing in the 1920's, and again be suitable for use by the local communities.

It is now unlikely that this will be the case. If the Hidden Valley mine proceeds (and there are strong socio-economic reasons why it should go ahead) then levels of river pollution will increase not decrease in the next two decades. Pollution will continue even longer, and may intensify if more mines come into production.

Regional growth will inevitably be affected by the continued pollution of this major river system. If growth in economic sectors other than mining is to proceed, then long-term regional environmental planning to determine appropriate land uses, and to ensure, for example, the provision of water supplies for domestic and commercial use, needs to be implemented.

Geographers and environmental planning in Papua New Guinea

Equitable social and economic development in Papua New Guinea will be contingent upon a proper balance being struck between sustained subsistence production and the commercial exploitation of the country's natural and agricultural resources. In this context there is clearly a need for planners and land managers to understand landscape, land use, socio-economic and demographic problems and the inter-relationships between them. Geographers are perhaps better trained than most professionals to do this and they have played an important role in the environmental planning process in Papua New Guinea.

Geography has been taught at the University of Papua New Guinea since the University was established in 1966, and has continued to grow steadily as its practitioners have been seen to be relevant to meeting the country's needs, especially in planning. Because educational planning policy in Papua New Guinea is based on assessed manpower needs, many courses at the University of Papua New Guinea tend to be applied, and geographic theory is taught largely through application and practice.

As was pointed out by PENNING-ROWSELL (1981) for Britain, consultancy and contract research were then doing more for the subject of Geography than were any of the more traditional academic pursuits. In addition Geographers were beeing seen as relevant, and it was realised that the skills brought by them to assessment and management consultancies were more professional than had hitherto been perceived.

Papua New Guinea is now in a similar position. After a slower start (University of Papua New Guinea geographers were in fact involved in the Ok Tedi and Bougainville environmental planning processes) there has been a recent upsurge of increasingly local geographical input into the environmental and socio-economic planning process associated with recent mining developments in Papua New Guinea - Misima, Mt. Victor, Porgera, Lihir, Wapolu, Hidden Valley, Lakekamu - as well as in industrial and infrastructural developments - Yonki hydro-electric power generation and the Mt. Hagen-Baiyer River-Ruti road development.

In addition the recent publication in Papua New Guinea of a country-wide geographic information system, the Papua New Guinea Resources Information System (Division of Water and Land Resources CSIRO and Land Utilization Branch DPI, 1987) has meant that integrated map-based geographic information is widely available. This system resulted from a co-operative research project which began in 1981 between CSIRO (which in the 1960s and 1970s had carried out numerous land systems surveys in Papua New Guinea) and DPI (BELLAMY 1986). It has resulted in the production of a resource base which is an excellent starting point with common terms of reference for any natural, social and cultural resource evaluation, and for land management planning.

Along with project Environmental Plans, for many mining projects separate, more comprehensive socio-economic impact studies have been commissioned under the auspices of the Department of Minerals and Energy. Such separate studies, which are not mandatory under the environmental legislation, now appear to have become an accepted phase of the environmental planning process associated with mining development. Because mining generally renders useful land unavailable to the traditional owners for the duration of the mine, and because mining brings immediate financial returns into communities often otherwise isolated from the country's cash economy, it is perceived to have enormous local social and economic impacts. The environmental and socio-economic impact studies have been integrated wherever possible.

Geographers, with their ability to integrate social, cultural, economic and land use variables, have been involved successfully in the production of many such socio-economic plans. In the case of Misima both the Environmental Plan (NSR 1987a) and the socio-

economic impact study (IASER 1986) have been completed and approved and development of the mine is likely to commence in early 1988. At Porgera both the draft Environmental Plan (NSR 1987b) and the socio-economic impact report (Pacific Agribusiness 1987) have been submitted for consideration by government but even if approved, development is unlikely to begin for several years. At Lihir the socio-economic impact study report (FILER a. JACKSON 1986) has been completed but the environmental plan is still being prepared by NSR PTY Ltd.

As in other developed countries, research participants in environmental impact assessments in Papua New Guinea are keen to ensure that strong links are maintained between the applied and more purely academic strands of their disciplines. In this respect it is pleasing to report that several geographic research projects have already arisen directly or indirectly out of the applied investigations referred to above.

When the need for regional environmental planning is more widely perceived by planning authorities in Papua New Guinea, geographers will undoubtedly assume an important role in the environmental planning process. Regional environmental planning will require the appreciation of the complex interactions between, social, cultural and economic factors and geographers are well qualified to undertake the necessary studies upon which such plans will be based.

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NOTES ON CHINESE AGRICULTURAL COLONIZATION IN SOUTHEAST ASIA

With 1 figure

RON D. HILL

Zusammenfassung: Zur chinesischen Agrarkolonisation in Südost-Asien

Unter allen Einwanderer-Gruppen in Südost-Asien sind die Chinesen die bedeutendste, insbesondere was ihre Rolle als Vermittler zwischen der Agrarproduktion und dem weltweiten Handelssystem betrifft. Neben dieser traditionellen Funktion spielten die Chinesen zusätzlich eine Rolle bei der landwirtschaftlichen Kolonisation. Obwohl die Beteiligung an der landwirtschaftlichen Produktion in der Vergangenheit stärker war als heute, so existieren doch noch einige bemerkenswerte Überreste früherer chinesischer Agrarkolonisation. Diese Überreste stammen vornehmlich aus dem Beginn dieses Jahrhunderts, als die Formen landwirtschaftlicher „Raubwirtschaft" von einer mehr permanenten Landbewirtschaftung in Betrieben abgelöst wurde, von denen sich noch zahlreiche in chinesischer Hand befinden. Neben diesen bis in die Gegenwart fortdauernden Beispielen chinesischer Agrarkolonisation gibt es auch solche, bei denen die Kontinuität unterbrochen wurde, bei denen chinesische Betriebe und die chinesische Bevölkerung wenige oder gar keine Spuren hinterlassen haben.

Mit der Ausnahme von Vietnam waren die landwirtschaftlichen Kolonien der Chinesen in Südost-Asien niemals Kolonien Chinas. Sie waren vielmehr relativ kleine Regionen, die Ländereien, Dörfer und Städte umfaßten, in vielen Fällen unabhängig oder halb-unabhängig waren oder zuweilen von Chinesen unter der Oberherrschaft eines autochthonen Landesherrn regiert wurden. In den meisten Fällen wurde die chinesische Bevölkerung in diesen Kolonien von einer einzigen Dialektgruppe gestellt. Jede Kolonie war hinsichtlich der grundlegenden Nahrungsmittel und Lebensbedürfnisse autark und produzierte darüber hinaus einige Güter für den Export.

Frühe Berichte zur chinesischen Siedlungstätigkeit sind vage. Obwohl Chinesen mindestens seit dem 4. Jh. n. Chr. in der Region reisten, erscheint der erste Hinweis auf eine Kolonisationstätigkeit (in Java) nicht vor dem 10. Jh. Ein Hauptteil des Aufsatzes untersucht die Hinweise auf Kolonien vor der Mitte des 19. Jhs. Zu den Beispielen zählen die Kolonien von Bantey Mas, Ayodhya (später Ayuthia), Java, Terengganu (malayische Halbinsel), die Fälle der christlichen Chinesen-Siedlungen auf Luzon oder auch die Kolonien in Sulu, Brunei sowie im nördlichen und westlichen Borneo. Seit etwa der Mitte des 19. Jahrhunderts wurde die politische Landkarte der Region nachhaltig verändert, da der von den westlichen Kolonialmächten kontrollierte Bereich von den ursprünglich isolierten Stützpunkten aus expandierte. Konfrontiert mit häufig dünn besiedelten Territorien und unter dem Druck, aus diesen Einkünfte ziehen zu müssen, bedienten sich die Kolonialverwaltungen häufig chinesischer Siedler, um mit deren